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Report of the Planning Group for Herring Surveys

International Council for the Exploration of the Sea

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Executive Summary

1. **Terms of Reference** According to C. Res. 2005/2G02 the **Planning Group for Herring Surveys** [PGHERS] (Chair: B. Couperus, Netherlands) will meet in Flødevigen, Norway, from 24–28 January 2006 to:

a. combine the 2004 survey data to provide indices of abundance for the population within the area;

b. coordinate the timing, area and effort allocation, and methodologies for acoustic and larvae surveys for herring and sprat in the North Sea, Divisions VIa and IIIa and Western Baltic in 2005;

c. review and update the PGHERS manual for acoustic surveys to address standardization of all sampling tools and survey gears;

d. review the results of an exchange exercise on herring maturity staging, and comment on the implications of the conclusions of the sprat age reading exchange and Workshop for the Acoustic Surveys;

e. evaluate the results of the investigations of survey overlaps between vessels in the North Sea acoustic survey;

f. to conduct an Echogram Scrutiny Workshop aiming at further harmonisation of scrutiny procedures.

2. **Review of larvae surveys in 2004/2005.** At the time of writing two of the seven surveys in the North Sea remained to be carried out in January 2005. Results will be ready for the Herring Assessment Working Group (HAWG) meeting in March 2005.

3. **Co-ordination of larvae surveys for 2005/2006.** In the 2005/2006 period, the Netherlands and Germany will undertake 6 larvae surveys in the North Sea from 1 September 2004 to 31 January 2005. The Baltic Sea Fisheries Institute will continue with the larvae survey in the Greifswalder Bodden area in 2005.

4. **North Sea acoustic surveys in 2005.** Six acoustic surveys were carried out during late June and July 2004 covering the North Sea and west of Scotland. The provisional total combined estimate of North Sea spawning stock biomass (SSB) is 2.6 million t, a decrease from 3.1 million t in 2003. The survey again shows two well-above average year classes of herring (1998 and 2000). Growth of the 2000 year class seems still to be slower than average. The west of Scotland SSB estimate is 400,000 t (739,000 t in 2003). The surveys are reported individually in Annex 2.

5. **Western Baltic acoustic survey in 2004.** A joint German-Danish acoustic survey was carried out with RV "Solea" from 29 September to 18 October in the Western Baltic. The estimate of Western Baltic spring spawning herring SSB is 192,100 t, an increase since 2003 (106,000 t). A full survey report is given in Annex 3.

6. **Survey overlap between FRV "Scotia", FRV "G.O. Sars".** During the 2004 surveys two areas were selected for overlap, involving FRV Scotia and FV Enterprise in one area and "Johan Hjort", "Walther Herwig III" and "Dana" in another area. No significant differences have been found. However, this is not just confirmation of similar performance, but also illustrates the difficulty of obtaining sufficient precision to establish significant differences.

7. **Manuals for acoustic and herring larvae surveys.** The manual for herring acoustic surveys in ICES Divisions III, IV, and VIA has been reviewed and updated according to TOR (c) The new version 3.2 is provided in Annex 4. There was no need for an update of the IHLS manual.

8. **Exchange exercise on herring maturity staging.** A selection of digital images was prepared from a collection of Dutch, Irish, Norwegian and Scottish pictures, and distributed digitally to all the participating laboratories. The overall CV was high (16.4%) and it is recommended that the national laboratories put some effort into improving the confidence in maturity classifications of herring. An exchange exercise should be carried out every three year, beginning in 2007.

9. **Status and future of the HERSUR database.** The upload of data at least for one year has been done with the exception of Norwegian data and Dutch SMALKs. A higher-level database holding national aggregated data with survey results is currently set up by DIFRES, based on the consistency-checked data available from previous North Sea hydro acoustic surveys, kept at Aberdeen. This database is then used to further develop an automated system for delivering the outputs needed for the combined survey report and HAWG.
10. **Sprat.** Data on sprat were only available from RV "Walther Herwig III", RV "Tridens" and RV "Dana". The total sprat biomass estimated was 360,000 t in the North Sea (up from 270,000 t in 2003) and 15,000 t in the Kattegat (up from 13,000 t in 2003). The present data suggest that sprat abundance is decreasing to the south and the distribution limit might therefore have been reached.
11. **Co-ordination of acoustic surveys in 2005.** Six acoustic surveys will be carried out in the North Sea and west of Scotland in 2004 between 28 June and 27 July. Participants are referred to Figure 4 for indications of survey boundaries. "Tridens" and "Walther Herwig" will cover the area between 52º and 57º together with interlaced transects. A survey of the western Baltic and southern part of Kattegat, will be carried out by a German research vessel from 4 to 24 October.
12. **Scrutiny workshop.** A scrutiny was held workshop on 25 and 26 January. Five teams scrutinized six data sets (3 BI500 sets and 3 echoview sets) of which one BI500 set was later excluded, because time and position data were lost in the post logging process. Preliminary results show reasonable agreement between the teams. The data will be analysed and presented in a paper before the next PGHERS meeting.

1 Terms of reference

The **Planning Group for Herring Surveys** [PGHERS] (Chair: B. Couperus, The Netherlands) will meet in Bergen, Norway, from 24–28 January 2005 to:

a. combine the 2004 survey data to provide indices of abundance for the population within the area;
b. coordinate the timing, area and effort allocation, and methodologies for acoustic and larvae surveys for herring and sprat in the North Sea, Divisions VIa and IIIa and Western Baltic in 2005;
c. review and update the PGHERS manual for acoustic surveys to address standardization of all sampling tools and survey gears;
d. review the results of an exchange exercise on herring maturity staging, and comment on the implications of the conclusions of the sprat age reading exchange and Workshop for the Acoustic Surveys;
e. evaluate the results of the investigations of survey overlaps between vessels in the North Sea acoustic survey;
f. to conduct an Echogram Scrutiny Workshop aiming at further harmonisation of scrutiny procedures.

PGHERS will report by 7 February 2005 for the attention of the Living Resources and Resource Management Committees, and to HAWG.

1.1 Participants

Bram Couperus (Chair)	The Netherlands
Eric Armstrong	UK
Eckhard Bethke (part-time)*	Germany
Micheal Drenkow (part-time)*	Germany
Torben Filt Jensen (part-time)*	Denmark
Eberhard Götze	Germany
Birgitt Klenz (part-time)	Germany
Bo Lundgren	Denmark
Ciaran O'Donnell (part-time)	Ireland
Norbert Rohlf (part-time)	Germany
John Simmonds	UK
Else Torstensen (Host)	Norway
Sytse Ybema	The Netherlands
Christopher Zimmermann	Germany

Participant with an * attended for the scrutiny workshop only. Full contact details for each participant are given in Annex 1.

2 Herring larvae surveys

2.1 Review of larvae surveys 2004/2005

2.1.1 Review of the western Baltic larvae survey

Several fishery independent estimates of year-class strength are necessary for the assessment and the management of the total fish stock. An index for year-class strength and for stock forecast of the spring spawning herring in the western Baltic Sea (ICES-Division IIIa and

Subdivisions 22-24) is estimated on a weekly basis. Repeated larvae surveys are carried out in the main spawning ground and hatching area of larvae during the spawning season. The German effort to monitor this area started in 1977. Since then the same sampling strategy, the same sampling method and the same station grid have been used. The material and methods for the estimation of the year-class index N30 are presented in Klenz (2004).

The German Institute for Baltic Sea Fisheries Rostock continued with these larvae surveys in 2004. The estimated numbers of larvae for the period 1992 to 2004 are summarised in table 1. Compared to the previous years of high estimates, the 2004 estimate of the larvae index (number of larvae which will grow up to the total length of 30 mm) is at the same level as the good year-class 1994.

2.1.2 Review of the North Sea larvae survey

In the reporting period the Netherlands and Germany participated in the larvae surveys. In total six units and time periods out of ten were covered in the North Sea. They are listed below.

Areas and time periods covered during the 2004/2005 herring larvae surveys:

AREA / PERIOD	1–15 SEPTEMBER	16–30 SEPTEMBER	1–15 OCTOBER
Orkney / Shetland	--	Germany	
Buchan	--	Netherlands	
Central North Sea	--	Netherlands	--
	16–31 December	**1–15 January**	**16–31 January**
Southern North Sea	Netherlands	Germany	Netherlands

The recent herring larvae sampling period was finished just prior to the PGHERS meeting. Surveys in September suffered from bad weather conditions due to the after-effects of tropical storms and hurricanes from the US (Karl, Ivan, Jeannie etc.), but area coverage was still adequate. Also the surveys in January were influenced by very high wind speeds and rough weather conditions.

For most of the larvae surveys in the North Sea, sample examination and larvae measurements have not yet been completed; therefore it is not yet possible to give an overview on the larvae survey results. A distribution map of larval abundance from an individual survey in September (Orkney/Shetlands) is shown in Figure 1. All surveys give an account of relatively high numbers of larvae caught. Therefore it is very likely that abundance estimates will be at least comparable to last year's estimates.

However, as in previous years, the information necessary for the larvae abundance index calculation will be ready for and presented at the Herring Assessment Working Group (HAWG) meeting in March 2005.

2.2 Co-ordination of larvae surveys for 2005/2006

The contribution of at least three nations is needed to perform a complete coverage of the main herring spawning grounds and time periods in the North Sea. At present only the participation of the Netherlands and Germany is confirmed in the 2005/06 period. Thus, as in previous years, only a limited number of areas can be surveyed in the upcoming phase. A preliminary survey schedule is presented in the following table:

Areas and time periods for the 2005/06 herring larvae surveys:

AREA / PERIOD	1–15 SEPTEMBER	16–30 SEPTEMBER	1–15 OCTOBER
Orkney / Shetland	Germany *	Germany *	
Buchan	Germany *	Netherlands	
Central North Sea	--	Netherlands	--
	16–31 December	**1–15 January**	**16–31 January**
Southern North Sea	Netherlands	Germany	Netherlands

*** Preliminary cruise plan. The vessel days are not fixed yet. Germany will either cover the Orkney/Shetland area in the first or second half of September.**

Survey results should be sent, in the standard format, to Norbert Rohlf, IfM-Geomar in Kiel, for inclusion into the IHLS database. IfM-Geomar will report the summarised results and the updated series of MLAI-values to the HAWG.

3 Acoustic surveys

3.1 Review of acoustic surveys in 2004

3.1.1 North Sea and west of Scotland acoustic survey

Six surveys were carried out during late June and July covering most of the continental shelf north of 51.5°N in the North Sea and to the west of Scotland to a northern limit of 62°N. The eastern edge of the survey area was bounded by the Norwegian and Danish, Swedish and German coasts, and to the west by the shelf edge between 200 and 400 m depth. The area was covered by national research vessels as presented in the following table:

VESSEL	PERIOD	AREA
Charter west Scotland	05 July – 25 July	56°- 60°N, 3° - 9°30 W
Johan Hjort	08 July – 30 July	56°- 62° N, 2° - 6° E
Scotia	01 July – 22 July	58°30 - 62° N, 2/4° W - 2° E
Tridens	28 June – 23 July	54°30 – 58° N, west of 3° E
Walther Herwig III	28 June – 19 July	52° - 57° N, east of Engl./ 3° E / 6° E
Dana	29 June – 12 July	Kattegat north of 56°+ Skagerrak and North Sea north of 56°N, east of 6° E

The surveys are reported individually in the appendices of this report (the Planning Group for Herring Surveys report), 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 statistical rectangle; and distributions of mean weight and fraction mature at age.

The estimates of North Sea autumn spawning herring SSB are reasonably consistent with previous years, at 2.6 million tonnes and 14,000 millions herring individuals. The survey again shows two well-above average year classes of herring (1998 and 2000). Growth of the 2000 year class seems still to be slower than average, individuals of this year class are 1.4 cm smaller and 33g lighter than the 1998 year class at the same age. Only 65% are mature at age 3 compared to 97% and 93% for the 1998 and 1999 year classes.

The estimates of Western Baltic spring spawning herring SSB are 143,000 tonnes and 1,038 million herring which is a moderate increase following last years reduction. The Western Baltic survey produces a rather noisy signal but the indications are still that the stock is higher now than between 1996 and 2000.

The West of Scotland estimates of SSB are 400,000 tonnes and 2,260 million herring. Again, the 1998 year class appears to be strong. Total adult mortality estimated from the survey is

rather variable. The mean mortality over the last 6 years has been approximately 0.4, this is a little higher than the assessment indicated but is still consistent with the 2004 assessment that the stock is relatively lightly exploited (ICES 2003). The survey still indicates a slightly rising stock over the last seven years.

The combined report is prepared for the HAWG (Annex 5).

3.1.2 Western Baltic

A joint German-Danish acoustic survey was carried out with RV "Solea" from 29 September to 18 October 2004 in the Western Baltic. This survey is traditionally coordinated within the framework of the Baltic International Acoustic Survey. As in previous years, the survey was carried out during the night. An EK60 echosounder with a hull mounted ES38B transducer and EchoView3 integrator software were used to collect and process acoustic data. The cruise track was 1,268 nautical miles and related to an area coverage of 13,850 n.mi.^{2} and covered the ICES Subdivisions 21, 22, 23 and 24. To identify the target species and determine length and weight of fish 51 trawl hauls were carried out. Samples of herring and sprat were frozen for additional investigations in the lab. After each trawl haul the hydrographic condition was recorded by a CTD probe. The Western Baltic spring spawning herring stock was estimated to be 5,400 million fish or about 192,100 t in Subdivisions 22-24. This is comparable to the last year's result. The estimated total sprat stock was 7,180 million fish or 78,700 t. This is about 55% lower than the last years estimate. The portion of young sprat was low. A survey report is provided in Annex 3.

3.2 Survey overlap areas

During the 2004 surveys two areas were selected for overlap. FRV Scotia and FV Enterprise surveyed the area bounded by 58º30 to 60ºN and 3º to 4ºW between 20 and 25 July 2004 (Western Area). An elementary sampling distance unit (ESDU) of 2.5N.mi. intervals were used to analyse the data in this area. "Johan Hjort", "Walther Herwig III" and "Dana" surveyed the area bounded by 56º to 57ºN and 6º to 8ºE during the 10 and 11 July 2004 (Eastern Area). An ESDU of 5.0N.mi. was used to analyse the data for this area. All participating vessels followed standard survey procedures as described in the manual (see Annex 4).

The spread of NASC values attributed to herring are tabulated for each area as percentiles in Tables 2 and 3 for the eastern and western areas respectively. The precision of the mean values observed by the participating vessel is given in Tables 4 and 5 for eastern and western areas respectively.

There is substantial overlap in the spread of observed NASC values for both areas. Similarly for the 95% intervals on the estimate of mean NASC for the area by each vessel this interval substantially overlaps in all cases. Thus no significant differences have been found. However, this is not just confirmation of similar performance, but also illustrates the difficulty of obtaining sufficient precision to establish significant differences. The western area was affected by the presence of one single, very large value, which affects the mean, but not the main body of the distribution of the data. The different analysis methods used in the eastern area resulted in rather different distributions of values, but no significant differences in the mean.

3.3 Sprat

Sprat data were available from RV "Walther Herwig III", RV "Tridens" and RV "Dana". No sprat was reported in the northern areas by RV "Scotia" and RV "Johan Hjort". The distribution of sprat by numbers in millions and biomass in the North Sea is shown in Figure 3. The 2004 survey was extended 0.5 º to the south; however, the rectangle which contained most of the sprat in the south in the 2003 survey (33F1) was not covered. The present data suggest that sprat abundance is decreasing to the south and the distribution limit might therefore have been

reached. However, this question can't be answered without information from rectangle 33F1. This year, there are indications that an area with higher density was encountered further north than in 2003.

In the area covered by RV "Walther Herwig III", small 0-group sprat (<5-6 cm) accounted for 34% of this years total abundance. Abundance of 0-group sprat was last recorded from the 1998 summer survey. It is, however, not clear whether the component of 0-group is recruiting from autumn spawning sprat or from an early spring spawning component (ICES 2004). The length distribution indicates that only the largest of this age group have been sampled and the abundance of 0-group sprat is thus considered an underestimate.

In Division IIIa, sprat was only observed in the south eastern Kattegat. No sprat has been reported from the survey of Skagerrak in the last three years. In the North Sea, the highest concentrations of abundance and biomass were estimated in the German Bight and off East Anglia. The estimated number of sprat increased by nearly 80% compared to 2003. The total sprat biomass estimated for the North Sea, was 360,000 tonnes (Table 6). In Kattegat, the abundance and total biomass were estimated to be 1,090 million individuals, equivalent to 15,000 tonnes.

3.4 Co-ordination of acoustic surveys in 2004

3.4.1 North Sea

Following the reviews of the 2004 surveys, the 2005 scrutiny workshop (and the extensive plans for a re-allocation of survey effort in the near future (see Sec 5 of 2003 PGHERS report), the group considered it necessary to conduct the survey with an intermediate structure for a third year. Scrutiny procedures appear to be reasonably similar for NED, SCO and GER, and also fishing and interpretation of trawl haul information is comparable between these nations. Secondly, while the southern distribution boundary for sprat may have been reached in 2004 (Section 4.3 and Annex 2f), the wide distribution of sprat should be confirmed in a third survey extending southwards to 52°N. In principle, it was agreed that the survey could deliver a useful (1+) index for any in-year management of sprat, as most of the fishery (3/4) have recently taken place in the third and fourth quarter, and catch mostly 1- and 2 year old fish. The survey structure for 2005 will therefore be unchanged in the northern part, but interlacing starts in the southern part. Survey effort will again be high in areas with high variability and/or herring abundance and lower in all other areas, overlapping areas (surveyed by different vessels ideally at the same time) will be reduced to 3 (between Charter/Scotia; Scotia/Johan Hjort and Johan Hjort/Dana, see Figure 4).

The group considered that interlacing survey transects would have benefits for the overall quality of the survey, but would require a higher level of coordination than in the past. To facilitate this, it was decided that tentative cruise tracks should be exchanged prior to the survey for further harmonisation. Plans should be sent to Christopher Zimmermann, Hamburg, not later than 30 May 2005; he will then contact individual cruise leaders if amendments are required.

Additionally, vessels should send position and cruise track information as well as survey results (position, catch depth, species composition, length frequency distributions) in regular intervals during the cruise to a land-base coordinator (preferably by email). This would be required immediately if deviations from the originally submitted cruise track need to be implemented, to enable the coordinator to adapt other nations cruise tracks and to avoid gaps. Christopher Zimmermann (czimmermann@clupea.de) agreed to act as coordinator for the 2005 survey.

Acoustic surveys in the North Sea and west of Scotland in 2005 will be carried out in the periods and areas given in the following Table and Figure 4.

VESSEL	PERIOD	AREA	RECTANGLES
Charter west Scotland (SCO)	28 June – 18 July	56°- 60°30'N, 3° - 10° W	41E0-E3, 42E0-E3, 43E0-E3, 44E0-E3, 45E0-E4, 46E1-E5, 47E2-E7, 48E3-E7, 49E4-E8, 50E5-E6
Johan Hjort (NOR)	04 July – 27 July	56°30'- 62° N, 2° - 6° E	42F2-F7, 43F2-F5, 44F2-F5, 45F2-F5, 46F2-F4, 47F2-F4, 48F2-F4, 49F2-F4, 50F2-F4, 51F2-F4, 52F2-F4, plus overlap area A
Scotia (SCO)	28 June – 18 July	57° - 62° N, 2/4° W - 2° E	43E8-F1, 44E6-F1, 46E6-F1, 47E6-F1, 48E6-F1, 49E6-F1, 50E6-F1, 51E7-F1, 52E8-F1, 52E9-F1
Tridens (NED)	28 June – 23 July	53°30' – 58°30' N, Eng/ Sco to Den/Ger coasts	36F0-F3, 38F2-F7, 40E8-F7, 41E7-F3, 42E7-F1, 45E6-F1
Solea (GER)	28 June – 19 July	52° - 56°30' N, Eng to Den/Ger coasts	33F1-F3, 34F2-F3, 35F2-F4, 36F4-F7, 37E9-F8, 38E9-F1, 39E8-F7, 41F4-F7
Dana (DEN)	29 June – 12 July	Kattegat north of 56° + Skagerrak and North Sea north of 56°30' N, east of 6° E	41G1-G3, 42F6-F7, 42G0-G3, 43F6-G2, 44F6-G1, 45F8-G1, 46F9-G0

Borders of survey areas between the west of Scotland charter vessel and RV Scotia can be moved if required. Overlapping areas will be surveyed by (A) RV "Scotia" and RV "Johan Hjort" (mid of July, Rectangles 49E9-F0, 50E9-F0), (B) the charter vessel and RV "Scotia" (at dates to be defined, in Rectangles 47E6-E7, 48E6-E7. 49E6-E8), (C) RV "Johan Hjort" and RV "Dana" (around 10 July, Rectangles 42F6-7).

An **intercalibration** is planned between the new RV "Solea" and RV "Walther Herwig III" around 13 July, likely in the German Bight. The new vessel, which is significantly noise reduced (according to *ICES Cooperative Research Report, 209*: Mitson, 1995) entered into service in July 2004 and has so far not intercalibrated with any other vessel conducting the North Sea Acoustic survey.

The results from the national acoustic surveys in June-July 2005 will be collected and the result of the entire survey will be combined prior to the next PGHERS. Survey results for sprat should be sent to Else Torstensen (Norway). Survey results for herring should be sent to John Simmonds, UK (Scotland) in the format specified in the manual for the International Acoustic Survey in the North Sea and west of Scotland (Annex 4). In the light of the database development expected for 2005 (see Section 7), participants should be prepared to additionally deliver aggregated data to the new database in any specified format. Data for both sprat and herring should be with the coordinators (and uploaded to the new database) by **30 November 2005**. The group agreed that if one or more parties deliver their *validated* data later than 15 December 2004, the most delayed institute will be given the responsibility for producing the combined survey data and report in 2006.

3.4.2 Western Baltic

In the Western Baltic and the Kattegat, the following German-Danish acoustic survey will be carried out in 2005.

VESSEL	PERIOD	AREA
Solea	04. – 24 October	Subdivision 21 to 24

3.5 Hydrographic data

According to the recommendation of the last PGHERS meeting the hydrographic data from the participants of the acoustic survey in June/July were collected and stored in a common format. The result is a data set from 320 hydrographic stations conducted during the 2004

acoustic survey in the North Sea. Due to the limitations of the charter-vessel used, no data from the area west of Scotland are present. It was intended to produce a small set of standard outputs from the existing data and present these results on the 2005 meeting. This presentation aims to examine the use of hydrographic information for the improvement of acoustic surveys. Some of these results are represented in Annex 6. As a result of the presentation it was found that the extent of the data is sufficient to supply a good overview of the hydrographic situation during the survey. It is of special advantage that the hydrographic data are synoptic to the acoustic measurements. It should be noted however that the data of an individual year are not sufficient, to show a connection with the spatial distribution of fish. It is therefore recommended that further data be collected from the surveys and additionally to exchange the data of past years (back to the year 2000). The cooperation of hydrographers in the collection and processing of the data is highly appreciated.

4 Review and update of the PGHERS manuals

4.1 PGHERS manual for herring acoustic surveys

In 2005 the manual was updated to take into account those using Echoview post processing software (Annex 4). It is proposed that in 2006 the manual be updated to include settings for the EK60.

The current survey design is in line with the developing recommendations of the workshop on survey design in Aberdeen, June 2004. PGHERS needs to review further recommendations from this group in 2006. We consider that it would be preferable for an interlaced survey design, however there is a need to provide a framework for data exchange among the five countries involved.

Data exchange practices are to be reviewed and updated where necessary. Spreadsheet and database refinements are to be made to facilitate the ease of data transfer. This was highlighted as a dynamic process in light of the planned interlacing of survey tracks and output data.

Equipment presently used for the North Sea/western herring acoustic surveys:

	SCOTLAND	DENMARK	NETHERLANDS	GERMANY	NORWAY	IRELAND
Hardware						
EK500	X			X	X	
EK60		X	X	X		X
Post processing software						
Echoview	X	X	X	X		X
BI500				X	X	
EchoAnn		X				

4.2 IHLS manual

In 2004 the herring larvae surveys were not subject to any changes in methodology or index calculation. Hence there was no need for an update of the manual. Version 1.0 is available from the PGHERS Report 2004 (Appendix V).

5 Measurement of biological parameters

5.1 Maturity classification in herring - results of an exchange of digital images

Doubts and difficulties in the maturity staging of herring have been discussed in PGHERS since the end of the 1990s and different measures have been discussed to improve the confidence in the classification. In 2004 PGHERS (ICES, 2004b) agreed that an exchange of digital images should be carried out before the start of the acoustic surveys at the end of June.

A selection of 72 digital images was prepared from a collection of Dutch, Irish, Norwegian and Scottish pictures, and distributed digitally to all the participating laboratories (Table 7). The exchange series covered a whole spectrum of maturity stages. The participants in the acoustic survey for the North Sea herring use either an 8-point or a 4-point scale for maturity classification (ICES 2004b) and were asked to use the scale they normally use.

The main purpose of the exchange was to:

a. study the usefulness of digital photos as a tool for classifications of maturity stages;
b. analyse the agreement of maturity classifications between the participants.

Three analyses were made, based on a) classification according to the 8-point scale, b) classification according to the 4-point scale and those from the 8-point scale merged into 4-point stages and c) all merged into immature and mature. A spreadsheet for a standardised analysis of the age reading comparisons, found on the EFAN website (www.efan.no under "Guidelines"), was used for the analysis. The overall results from the three sets are presented in Table (8). The results were generated by experienced readers from laboratories taking part in annual North Sea surveys.

Improvements in the precision were noted going from an 8-point classification to a 2-point classification, as reported from the surveys. However, the overall CV was still high (16.4%) and it is recommended that the national laboratories put some effort into improving the confidence in maturity classifications of herring. An exchange exercise should be carried out every three year, beginning in 2007.

5.2 Sprat age reading exchange and Workshop

The age reading workshop was organised by Norway in December 2004 (ICES, 2003). Prior to the meeting an otolith exchange was organised to detect the problems in age reading. The exchange indicated that an improvement in the precision level of age reading was required. It also indicated that difficulties in the interpretation of the annual rings increased from younger to older the fish. This seemed to be due to a misinterpretation of the annual zones after age 1.

Misinterpretations of the annual zones after age 1, seemed to underestimate the ages of the older fish. This indicates that a reduction in the age reading bias is required.

Based on the results of the exchange it appeared to be possible to achieve reliable age readings for North Sea/Skagerrak sprat in future, if it can be proven that sprat always produces an opaque growth zone in the year it is born and that by age reading the otoliths of sprat can be assigned to a certain year class.

After discussion of the results, the WS re-read a sub-sample of the otoliths. Most readers still demonstrated difficulties in determining annual ring of age group 1 (highest CV). The CV is lowest for age group2 and increases again for age group 3. This indicates that readers are uncertain in determining the first annual and again become uncertain at the time the annual growth increment becomes narrow at age 3.

It was recommended that:

- all laboratories perform age-validation in order to confirm the validity of the ageing method used (confirm the periodicity of deposition of the translucent ring) and to investigate the time of deposition of the translucent ring for each age-class.
- daily increment count should be attempted in order to validate the deposition of the first hyaline ring and to determine the time of its formation and to determine the spawning time.
- a CD with photographs of all otoliths of which the ages were agreed at the workshop to be prepared as a reference collection and distributed to all age readers that participated in the exchange and workshop.
- all age readers calibrate their age reading method using this digital reference collection.

6 Status and future of the HERSUR database

A presentation on the status of the **HERSUR database** and developments on a database producing global estimates along with standard outputs from aggregated data (see discussion in last year's report) was given on behalf of Teunis Jansen, DIFRES Charlottenlund. The HERSUR database was developed in Hirtshals within the framework of the EU-funded projects "Herrings Surveys in the North Sea and West of Scotland" I and II, and has been online since 2001. It is intended to hold all primary acoustic and trawl data from the North Sea Herring Acoustic Survey (including West of Scotland and Kattegat/Skagerrak) and to provide primary outputs (tables and figures).

At the PGHERS 2004 meeting, it was agreed that, while obvious bugs should be permanently corrected, the HERSUR database should not be developed further until data is uploaded at least for one year. This has been done with the exception of Norwegian data (there is information that the data has been sent off and will be incorporated in due time), and SMALKs for the Netherlands, for the year 2000. Table 9 gives an overview over data uploaded by Jan 2005. Problems reported for the HERSUR database in 2004 included:

- missing codes for ships, gears (have been added)
- upload does not support unicode characters
- HL.Gear is stated to be Optional in the exchange format description, it is Mandatory in the validation
- HH.HaulDuration is stated to be Optional in the exchange format description, it is Mandatory in the validation.
- when no HLs are present, the error report is giving no useful info. HE.GroundSpeed is stated in the exchange format to be a float within the range of 2.0-6.0 (1 decimal). In the system it is still an integer within the range of 20-60 (implied decimal point).

Last year, the group discussed the various options for future developments. It was recognised that with the current method of estimation of population indices that it would not be possible to use the HERSUR database to derive standard outputs to be delivered to HAWG. There is no common procedure available to raise primary acoustic and biological data to derive total figures for the whole survey. Use of the HERSUR database, as it currently stands, requires an implementation of a flexible combination of biological and acoustic data that matches current national procedures. In spite of this, the storage of primary data is considered to be important by PGHERS. The group therefore agreed to follow a two-track approach: The HERSUR database should be maintained and missing data uploaded as soon as possible. In parallel, **a higher-level database holding national aggregated data** with survey results will be set up by Teunis Jansen (DIFRES), based on the consistency-checked data available from John

Simmonds (MarLab). This database is then used to further develop an automated system for delivering the outputs needed for the combined survey report and HAWG, using part of the routines already developed within the HERSUR database (Figure 5).

Simmonds and Jansen met in March 2004 to discuss the user specifications for such database routines in detail. The further development of the database and output routines was delayed, due to internal problems within DIFRES. As result it was not possible to collate and process data from the 2004 survey as anticipated. However, the development work has continued after September 2004 and an early draft of the database is visible at http://NorthSeaAcoustics.FishFrame.org (a username and password is required and is available from DIFRES). This system is based on FishFrame 3.1, basic modules are finished, and some specific modules are ready for demonstration (a tree-based browser, pivot reports and analyses, and the calculation of global stock estimates for weight and abundance.

The developer will meet John Simmonds at the HAWG 2005 meeting in March to receive additional information, and to finalise work on data upload and consistency check/data screening modules. According to the developer, a release candidate should be finished in May, and tested and debugged in the following months. Historic (national aggregated) data is due to be uploaded in August, followed by an in-depth comparison of the results obtained from the spreadsheet system used so far and the new database. When this final testing is complete, the database could be used in December to process data from the 2005 survey. According to DIFRES, sufficient funding is available for the development and debugging of that database.

Once this part of the database is finalised and in use, the missing link between primary acoustic and biological data and national meta-data (numbers by age and rectangle, mean weights) will be developed, following the harmonisation of national raising procedures in the course of the restructuring of the acoustic survey (see PGHERS' 2003 report).

In the light of emerging discussions within the ICES community on **data policies and data access**, the group supports the view that easy access to data is important for the scientific community. Open access facilitates a wider use, which adds value to data collected by public funding, and increases the quality of the data if a scheme for reporting errors is properly implemented. PGHERS decided that all aggregated data from the acoustic survey should be available to the public, without restrictions, after a certain period needed for checking. The group considered that data is final after the ACFM spring meeting, so the public should have access 10 months after the survey ends. Users should be encouraged to use the data according to good scientific practice, i.e. acknowledge the source of the data, report errors to the source, and to contact the source for additional information to avoid misinterpretation. Raw data stored in the HERSUR database should be kept password protected for the near future.

7 Scrutiny workshop

On 25 and 26 January 2005 a scrutiny workshop was held.

Echogram scrutiny is a computer-aided manual estimation procedure to determine which part of the recorded acoustic backscattering data corresponds to fish echoes, especially the two target species, herring and sprat, in order to extract them for the following biomass estimation procedures.

Participants were teams from Netherlands, Norway, Germany, Denmark, Scotland and Ireland (see participants list in Section 1).

The workshop took place from 25th of January 13:00h to 26th of January 20:00h in the Electronic Instrument Division of the Institute of Marine Research. For this purpose the group members had been asked to prepare a number of datasets, preferably 1 set of data from each of the participating survey ships covering approximately 1 selected day of the 2004 cruises, a

raw dataset for ships, where Echoview is the main scrutinizing tool, and a Bergen Integrator data set for ships, where BI500 is mainly used.

The Electronic Instrument Division and the Information Technology Divisions of the Institute of Marine Research guided by Kaare Hansen had set up a suitable workshop environment in the institute and kindly provided assistance with technical support during the sessions. The setup consisted of three workstations to run three parallel sessions for scrutinizing BI500 data sets and a switched local network including a printer to which the participants could connect their laptops for the Echoview scrutinity sessions.





Three BI500 datasets, a Dutch set from RV “Tridens”, a Norwegian set from RV “Johan Hjort” and a German set from RV “Walter Herwig”, were available as well as three echo-sounder (EK500 or EK60) raw datasets to be scrutinized by Echoview procedures, a Scottish set from RV “Scotia”, a Scottish set from the vessel Enterprise and a Dutch set from the vessel RV “Tridens”.

The datasets were scrutinized by several of the participating teams with the scrutiny tools they were most experienced with, using supplementary information like data about the nearest fishing stations and CTD-stations in space and time provided by the data-originating teams, who also re-scrutinized their own data sets. Preliminary results are presented in table 10 and in figure 6. The scrutiny results of the Dutch BI500 dataset has been excluded, because time -, and position stamps were lost when the raw EK60 data were post-logged by the BEI500.

An immediate impression is that there is reasonable agreement between the Echoview estimates and larger variations between the BI500 estimates. The data will be analysed and presented in a paper before the next PGHERS meeting.

8 Recommendations

The Planning Group for Herring Surveys recommends that:

PGHERS will meet at the Institute for Baltic Sea Fisheries in Rostock, Germany, from 24 to 27 January 2006 (Chair: B. Couperus, The Netherlands) to:

a. combine the 2005 survey data to provide indices of abundance for the population within the area;
b. coordinate the timing, area and effort allocation and methodologies for acoustic and larvae surveys for herring and sprat in the North Sea, Division VIa and IIIa and Western Baltic in 2006;
c. review and update the PGHERS manual for acoustic surveys to address standardization of all sampling tools and survey gears;

d. assess the status and future of the HERSUR database and an intermediate database, containing aggregated data
e. comment on the implications of the conclusions of the herring age reading exchange and workshop (Finland Turku) for the North Sea acoustic surveys

PGHERS will report by 6 February 2006 for the attention of the Resource Management and Living Resources Committees, and to HAWG.

Supporting Information:

Priority	The International Acoustic and Larvae surveys provide essential data for the assessment of pelagic stocks in and around the North Sea (Divisions IV, VIa, IIIa, and Western Baltic).
Scientific Justification and relation to Action Plan:	Term of reference a) and b) Surveys for herring are currently carried out by five different countries, covering the whole of the North Sea, Western Baltic and the west coast of Scotland. Effective co-ordination and quality control for these surveys is essential and while data combination can be managed by mail, a meeting is required to ensure that the larvae database is being used correctly and that the acoustic surveys are being carried out and analysed on a consistent basis. Term of reference c) The issue of standardisation of procedures and survey protocols is becoming increasingly important in the light of concerns of the quality assurance of data that are used for the assessment of commercial fish stocks. ICES is particularly concerned about the issue with regard to survey data as a result of adverse experiences in North America in recent years. Fortunately, PGHERS has always attempted to document their procedures through the production of a manual for the surveys conducted. This manual has been reviewed periodically from time to time on an ad hoc basis. In 2006 the updating will be continued. Term of reference d) The HERSUR database was developed in Hirtshals within the framework of the EU-funded projects “Herrings Surveys in the North Sea and West of Scotland” I and II, and has been online since 2001. It is intended to hold all primary acoustic and trawl data from the North Sea Herring Acoustic Survey (including West of Scotland and Kattegat/Skagerrak) and to provide primary outputs (tables and figures). Use of the HERSUR database, as it currently stands, requires an implementation of a flexible combination of biological and acoustic data that matches current national procedures. In spite of this, the storage of primary data is considered to be important by PGHERS. The group therefore agreed to follow a two-track approach: The HERSUR database should be maintained and missing data uploaded as soon as possible. In parallel, a higher-level database holding national aggregated data with survey results is in development. This database should be used to provide an automated system for delivering the outputs needed for the combined survey report for 2005. The group felt that this is an urgent requirement given the analysis of acoustic data from an interlaced transects survey design. PGHERS will perform the final testing during

	the 2006 meeting. Term of reference e) A consistent age determination is crucial for the use of survey results for the herring assessment, which is using an age-structured model. The results of the herring age reading workshop in Turku, organised by a different ICES specialist group (PGCCDBS), is therefore of special interest for PGHERS. The latter group will analyse the implications of the workshop's results with regard to the precision and variance of the acoustic survey's results.
Relation to Strategic Plan:	Directly relevant – it allows ICES to respond to requested advice on herring and sprat fisheries.
Resource Requirements:	No specific resource requirements beyond the need for members to prepare for and participate in the meeting
Participants	At least one scientist (preferably the cruise leader) from each survey; hence a minimum of 6 members.
Secretariat Facilities	None
Financial:	None
Linkages to Advisory Committees:	The survey data are prime inputs to the assessments which provide ACFM with information required for responding to requests for advice/information from NEAFC and EC DGXIV.
Linkages to other Committees or Groups:	Survey results are conveyed directly to the Herring Assessment Working Group for the Area South of 62°N (HAWG). HAWG to see this report
Linkages to other Organisations:	None
Cost Share:	ICES 100%

9 References

ICES. 2003. Planning group on commercial catch, discards and biological sampling. ICES 2003 ACFM:25.

ICES. 2004a. Report of the Herring Assessment Working Group for the Area South of 62 N. ICES C.M. 2004/ACFM:18.

ICES. 2004b. Report of the Planning Group for herring surveys. 2004/G:05.

Klenz, B. (2004): The German Herring Larvae Programme - a method for estimating a fishery independent recruitment index for the herring stock in the western Baltic Sea. In: ICES Living Resources Committee, ICES CM 2004/G: 05, Ref. D, Appendix V, 14 pp.

Mitson, R. B. 1995. “Underwater noise of research vessels: Review and recommendations.” ICES Coop. Res. Rep. 209: 61 pp.

Table 1. Results of the German herring larvae surveys in the Greifswalder Bodden and adjacent waters, 1992 to 2004.

N30 = year-class index, estimated number of herring larvae which will grow up to the total length >= 30mm; S = total survival rate; S1 = survival rate of the youngest larvae.

YEAR	NUMBER OF LARVAE = YEAR-CLASS INDEX N30 [MILLIONS]	MEAN SURVIVAL RATE PER DAY S S1 [%]	MEAN GROWTH RATE PER DAY [MM D^{-1}]
1992	18	80 / 71	0.48
1993	199	79 / 75	0.53
1994	788	92 / 92	0.47
1995	171	90 / 64	0.53
1996	31	81 / 77	0.44
1997	54	76 / 73	0.43
1998	2,553	92 / 96	0.63
1999	1,945	91 / 95	0.59
2000	151	87 / 91	0.68
2001	421	92 / 98	0.53
2002	2,051	94../..94	0.48
2003	2,005	97../100	0.51
2004	860	91 / 95	0.60

Table 2. Percentiles on the distribution of NASC values observed by the three vessels, Johan Hjort, Walther Herwig III and Dana, in the Eastern area bounded by 56 to 57N and 6 to 8E between 10 and 11 July 2004.

PERCENTILE	JOHAN HJORT	WALTHER HERWIG III	DANA
2.5%	0.0	0.0	11.4
25%	0.0	0.0	21.5
50%	0.0	5.2	32.8
75%	22.8	38.3	61.1
97.5%	267.0	410.5	177.5

Table 3. Percentles on the distribution of NASC values observed by the three vessels Scota and Enterprise area bounded by 58 30 to 60N 3 to 4W between 20 to 25 July.

PECENTILE	ENTERPRISE	SCOTIA
2.5%	0.0	0.0
25%	0.0	0.0
50%	31.5	74.5
75%	282.5	296.7
97.5%	2892.3	2307.8

Table 4. Mean and interval expressed as ± 2 standard errors of NASC values observed by the three vessels, Johan Hjort, Walther Herwig III and Dana, in the Eastern area bounded by 56° to 57°N and 6° to 8°E between 10 and 11 July 2004.

PERCENTILE	JOHAN HJORT	WALTHER HERWIG III	DANA
lower	13.1	15.5	37.9
mean	29.6	59.8	49.9
upper	46.2	104.0	61.9

Table 5. Mean and interval expressed as ± 2 standard errors of NASC values observed by the three vessels Scota and Enterprise area bounded by 58° 30 to 60°N 3 to 4W between 20 to 25 July.

PECENTILE	ENTERPRISE	SCOTIA
lower	-2086.0	171.2
Mean	2720.4	296.6
Upper	7526.8	422.0

Table 6. Estimates of sprat in the North Sea from the acoustic surveys, 2001–2004. Total number (million), total biomass (thousands of tonnes) and Spawning Stock Biomass (SSB, thousands of tonnes).

YEAR	TOTAL NUMBER (MILL.)	TOTAL BIOMASS (1000 TONNES)	SSB (1000 TONNES)
2001	21.300	200	157
2002	21.900	240	165
2003	29.800	270	160
2004	52.800	360	175

Table 7. Participants in the exchange of digital images of herring gonads for maturity classification, May-June 2004.

	Total readers	Experienced readers
Denmark	4	2
Germany	3	1
Netherlands	4	2
Norway	5	5
UK-scotland	5	4
Total	21	14

Table 8. The CV and % agreement from the analyses of the maturity classification by expert readers.

a) Classification using an 8-point scale

COEFFICIENT OF VARIATION (CV)

MODAL	NO-1	NL-2	NL-4	NO-5	NO-2	NO-4	NO-3	DK-4	DK-1	SC-3	SC-4	SC-5	SC-2	ALL
MATURITY	0	0	0	0	0	0	0	0	0	0	0	0	0	Readers
0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2	20%	11%	33%	0%	0%	19%	11%	101%	36%	12%	24%	26%	21%	**30,5%**
3	26%	20%	23%	47%	41%	49%	48%	54%	21%	34%	12%	48%	29%	**27,4%**
4	6%	8%	10%	9%	9%	13%	18%	11%	15%	10%	9%	13%	10%	**13,7%**
5	10%	0%	17%	19%	9%	9%	0%	9%	0%	12%	12%	12%	12%	**10,7%**
6	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8	-	-	-	-	-	-	-	-	-	-	-	-	-	-
0-15	**18,3%**	**12,8%**	**21,4%**	**22,3%**	**19,2%**	**28,5%**	**26,3%**	**51,5%**	**21,8%**	**20,0%**	**13,4%**	**29,9%**	**20,6%**	**23,7%**
RANKING	**3**	**1**	**7**	**9**	**4**	**11**	**10**	**13**	**8**	**5**	**2**	**12**	**6**	

PERCENTAGE AGREEMENT

MODAL	NO-1	NL-2	NL-4	NO-5	NO-2	NO-4	NO-3	DK-4	DK-1	SC-3	SC-4	SC-5	SC-2	
MATURITY	0	0	0	0	0	0	0	0	0	0	0	0	0	ALL
0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2	47%	95%	63%	100%	100%	79%	95%	37%	32%	95%	17%	74%	58%	**70%**
3	28%	52%	45%	83%	59%	79%	86%	50%	55%	79%	81%	45%	83%	**63%**
4	0%	18%	76%	88%	82%	71%	53%	71%	59%	82%	87%	76%	82%	**65%**
5	60%	100%	40%	20%	80%	80%	100%	80%	100%	40%	60%	60%	40%	**66%**
6	100%	0%	100%	100%	100%	100%	100%	100%	0%	0%	100%	100%	0%	**69%**
7	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8	0%	0%	0%	0%	0%	0%	100%	0%	0%	100%	100%	100%	100%	**38%**
0-15	**29,2%**	**56,9%**	**56,9%**	**83,3%**	**76,4%**	**76,4%**	**81,9%**	**53,5%**	**51,4%**	**80,6%**	**68,9%**	**62,5%**	**72,2%**	**65,4%**
RANKING	**13**	**9**	**9**	**1**	**4**	**4**	**2**	**11**	**12**	**3**	**7**	**8**	**6**	

b) Classifications using a 4-point scale and an 8-point scale merged into 4-points.

COEFFICIENT OF VARIATION (CV)

MODAL	NO-1	NL-2	NL-4	NO-5	NO-2	NO-4	NO-3	DK-4	DK-1	SC-3	SC-4	SC-2	D-3	SC-5	ALL
mat	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Readers
0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1	34%	22%	29%	0%	0%	35%	22%	72%	0%	0%	32%	36%	72%	32%	**28,5%**
2	15%	7%	12%	20%	22%	23%	19%	30%	23%	21%	0%	14%	30%	13%	**13,1%**
3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	0%	0%	0%	0%	16%	0%	0%	58%	43%	43%	43%	43%	0%	43%	**35,3%**
0-4	**18,8%**	**10,7%**	**15,9%**	**13,6%**	**15,7%**	**25,0%**	**18,8%**	**41,6%**	**17,2%**	**15,9%**	**9,6%**	**20,8%**	**39,4%**	**19,4%**	**18,1%**
RANKING	**8**	**2**	**6**	**3**	**4**	**13**	**9**	**15**	**7**	**5**	**1**	**11**	**14**	**10**	

PERCENTAGE AGREEMENT

MODAL	NO-1	NL-2	NL-4	NO-5	NO-2	NO-4	NO-3	DK-4	DK-1	SC-3	SC-4	SC-2	D-3	SC-5	
mat	0	0	0	0	0	0	0	0	0	0	0	0	0	0	ALL
0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1	47%	95%	89%	100%	100%	79%	95%	89%	100%	100%	41%	58%	89%	84%	**85%**
2	90%	98%	94%	94%	88%	92%	96%	80%	80%	90%	100%	98%	58%	92%	**89%**
3	100%	0%	100%	100%	100%	100%	100%	100%	0%	0%	100%	0%	100%	100%	**73%**
4	100%	0%	0%	100%	67%	100%	100%	67%	0%	33%	33%	33%	100%	33%	**56%**
0-4	**79,2%**	**91,7%**	**88,9%**	**95,8%**	**90,3%**	**88,9%**	**95,8%**	**81,9%**	**80,6%**	**88,9%**	**82,9%**	**83,3%**	**69,0%**	**87,5%**	**86,3%**
RANKING	**14**	**3**	**5**	**1**	**4**	**5**	**1**	**12**	**13**	**5**	**11**	**10**	**15**	**9**	

c) Classifications merged into immature and mature (2-point scale)

COEFFICIENT OF VARIATION (CV)

MODAL	NO-1	NL-2	NL-4	NO-5	NO-2	NO-4	NO-3	DK-4	DK-1	SC-3	SC-4	SC-2	D-3*	SC-5	ALL
maturity	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Readers
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
im-mat	50 %	42 %	52 %	0 %	0 %	59 %	42 %	52 %	0 %	0 %	47 %	55 %	52 %	0 %	41,2%
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
mat	0 %	9 %	9 %	0 %	21 %	0 %	0 %	28 %	33 %	19 %	0 %	0 %	19 %	16 %	7,5%
	13,2%	**17,8%**	**20,6%**	**0,0%**	**15,5%**	**15,6%**	**11,0%**	**34,7%**	**24,4%**	**13,8%**	**11,3%**	**14,5%**	**27,8%**	**11,9%**	**16,4%**
RANKING	**5**	**10**	**11**	**1**	**8**	**9**	**2**	**14**	**12**	**6**	**3**	**7**	**13**	**4**	

PERCENTAGE AGREEMENT

MODAL	NO-1	NL-2	NL-4	NO-5	NO-2	NO-4	NO-3	DK-4	DK-1	SC-3	SC-4	SC-2	D-3*	SC-5	
maturity	0	0	0	0	0	0	0	0	0	0	0	0	0	0	ALL
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
im-mat	47 %	95 %	89 %	100 %	100 %	79 %	95 %	89 %	100 %	100 %	41 %	58 %	89 %	100 %	85 %
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
mat	100 %	98 %	98 %	100 %	91 %	100 %	100 %	83 %	77 %	92 %	100 %	100 %	92 %	94 %	95 %
	86,1%	**97,2%**	**95,8%**	**100,0%**	**93,1%**	**94,4%**	**98,6%**	**84,7%**	**83,3%**	**94,4%**	**85,7%**	**88,9%**	**91,5%**	**95,8%**	**92,1%**
RANKING	**11**	**3**	**4**	**1**	**8**	**6**	**2**	**13**	**14**	**6**	**12**	**10**	**9**	**4**	

Table 9. Status of the HERSUR database as per 15.January 2005 (number of records uploaded).

COUNTRY	YEAR		ACOUSTIC	HH	HE	HL	SMALK
GFR	1994	WH149	1276	0	0	0	365
	1995	WH162	2205	44	44	2568	1433
	1996	SO392	1029	25	25	714	1030
	1997	WH186	0	78	78	5955	2802
	1998	WH196	1791	43	43	1289	1596
	1999	SO444	650	10	10	371	1120
	2000	WH218	1822	39	39	2278	2734
	2001	SO478	1625	31	31	787	2435
	2002	WH240	1752	37	37	1470	2905
	2003	WH253	1992	27	27	1152	2275
NED	2000	TRI2 6	3688	22	22	305	0
NOR	2000		0	0	0	0	0
SCO	1999	CSO2 1	976	38	38	339	1556
	1999	SCO2 11	1101	39	39	0	1988
	2000	CSO2 4	1039	50	50	562	2391
	2000	SCO2 10	975	45	45	593	2194
	2001	SCO 11	0	42	42	681	0
	2002	EXP	938	0	39	486	0
	2002	SCO2	1028	45	45	654	0
DEN	1992	DAN2 7	12066	45	45	70	0
	1993	DAN2 6	32997	36	36	447	556
	1994	DAN2 7	14007	43	43	357	0
	1995	DAN2 7	6698	0	0	0	0
	1996	DAN2 10	11835	36	36	545	1843
	1997	DAN2 10	9659	37	37	2646	1610
	1998	DAN2 8	11831	53	53	3257	1743
	2000	DAN2 6	5922	32	32	1912	2778
	2001	DAN2 6	6192	0	0	0	0
	2002	DAN2 5	5876	31	31	2003	1397
	2003	DAN2 4	6984	0	0	0	0

Table 10. Total summed acoustic backscatter in NASCs for each of the datasets as judged by the different teams.

SCRUTINIZING TEAM	BI500		ECHOVIEW		
	NO Johan Hjort	DE W Herwig	SC Scotia	SC Enterprise *	NL Tridens
NL	1917	9436	15210	182880 + 22058	5287
DE1	1251**	8360	13073	182888 + 19339	5125
DE2	1684	8088			
NO	2209	10500			
SC	1844	8881	14212	182904 + 20917	4830
Interval nm	5	5	2.5	2.5	5
Intervals	24	30	52	80	22

*** This set is shown as 1 big school + the rest of the data.**

**** This team has missed one school estimated by other teams to have a NASC between 600 and 700, which would raise the total to between 1850 and 1950.**

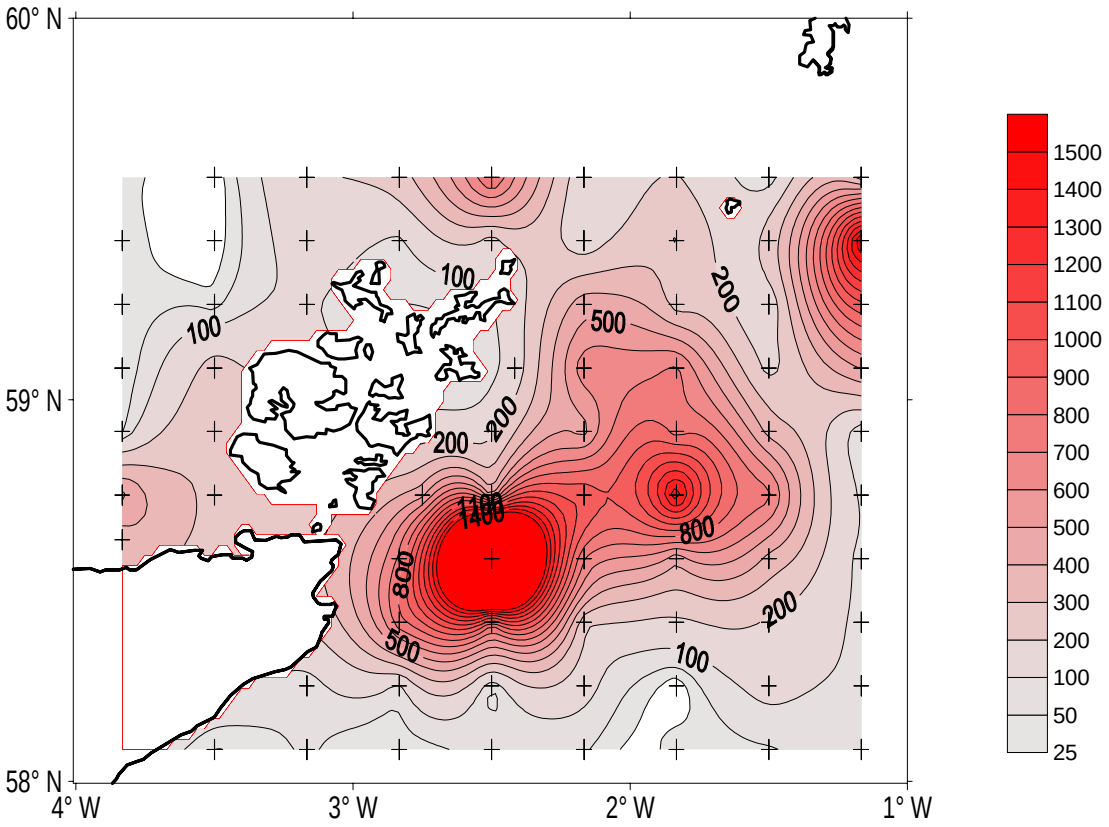


Figure 1. Larvae distribution map of an individual survey in the Orkney/Shetland area, (16.09. – 30.09.04). Abundance is shown for larvae < 24 mm TL (n/m²))

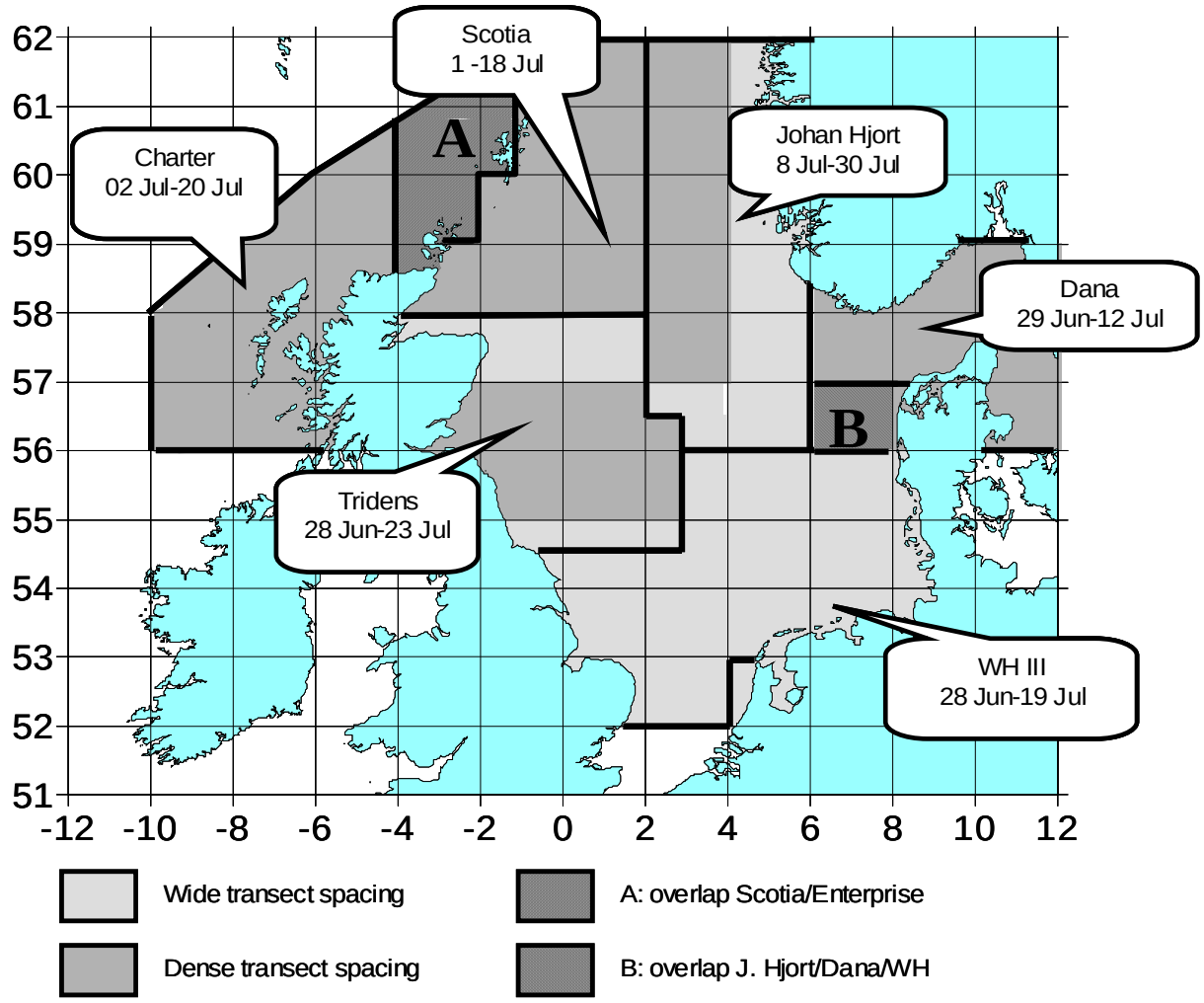


Figure 2. Survey area layouts and dates for all participating vessel in the 2004 acoustic survey of the North Sea and adjacent area's. Area's A an B indicate areas of overlap.

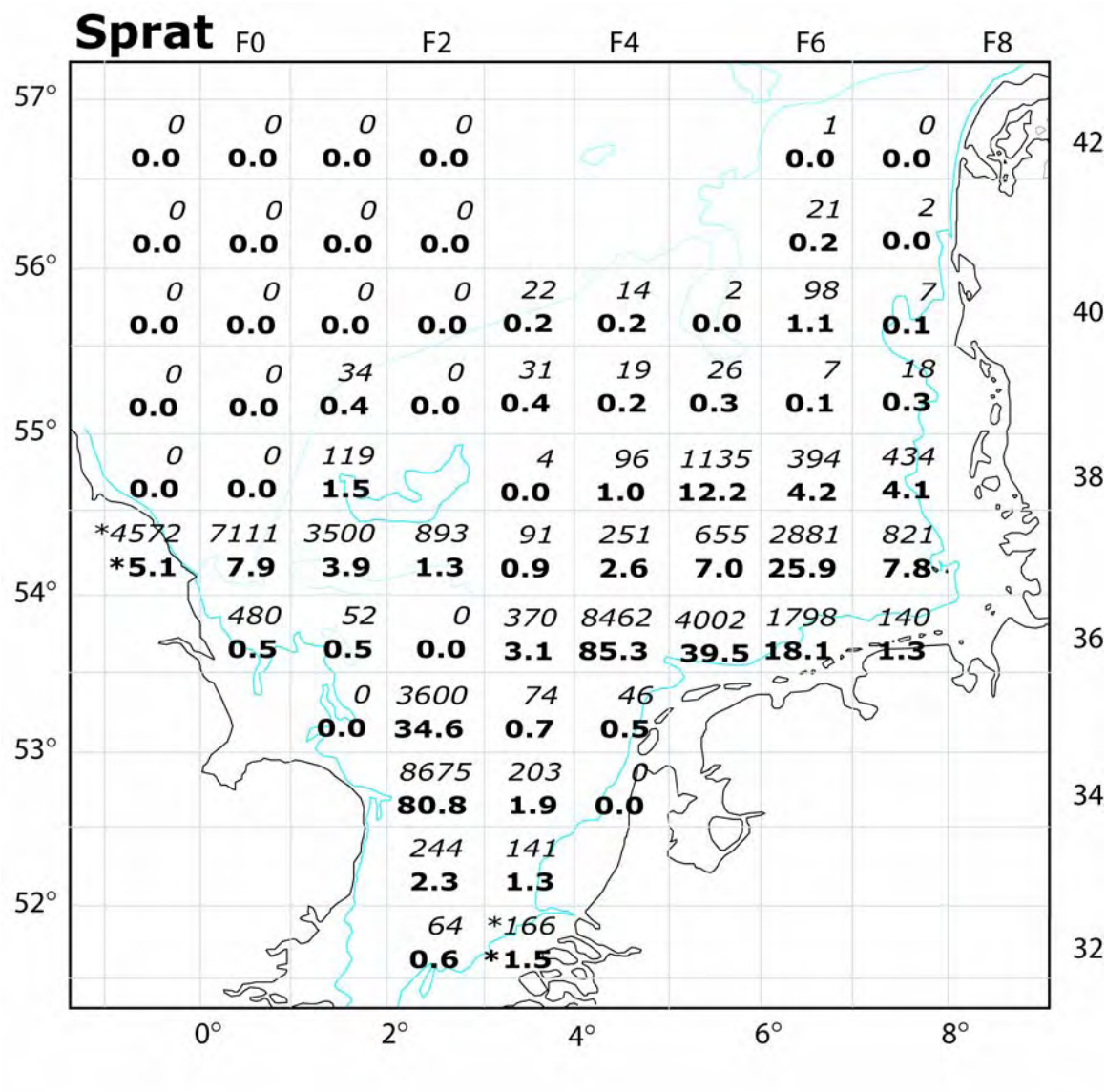


Figure 3. International hydro acoustic survey in The North Sea, 2004: Abundance (Million individuals, upper value in italics) and biomass (thousand tonnes, lower value in bold) of Sprat per statistical rectangle. * indicates unreliable estimates which were raised using distant catch information.

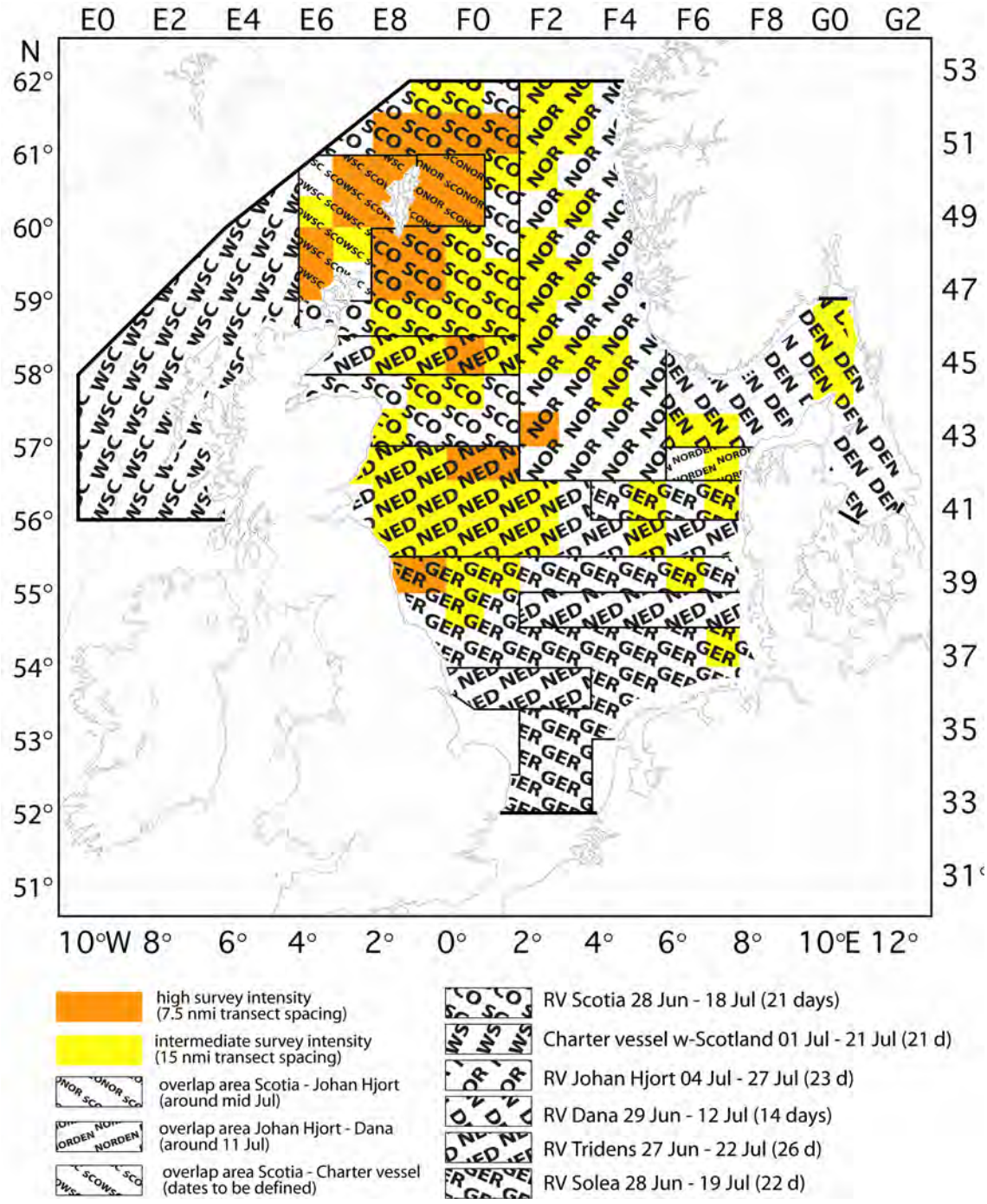


Figure 4. Layout of the herring acoustic survey in the North Sea, Divs. IIIa and VIaN in 2005. Suggested effort distribution is indicated per rectangle, based on an analysis of the contribution to the herring assessment and advice (Simmonds *et al.* 2004). *Map source: GEBCO, 200 m depth contour drawn.*

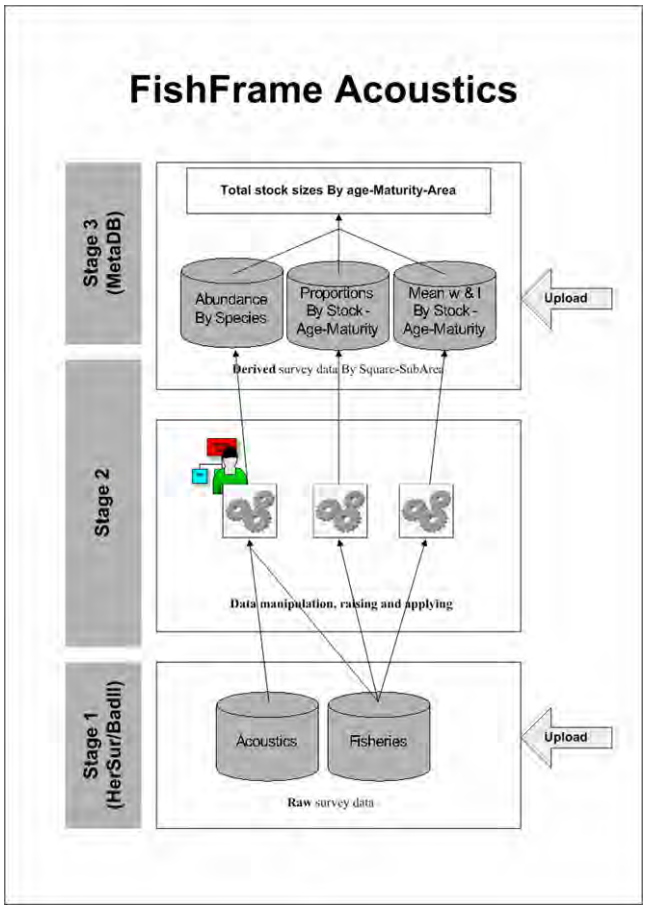


Figure 5. FishFrame Acoustics. Stage 1: Basic, disaggregated fisheries and acoustics data (the current HERSUR database); stage 2: data manipulation and aggregation tools – to be implemented in a later stage; stage 3: Aggregated database and tools to derive global estimates from national, aggregated data.

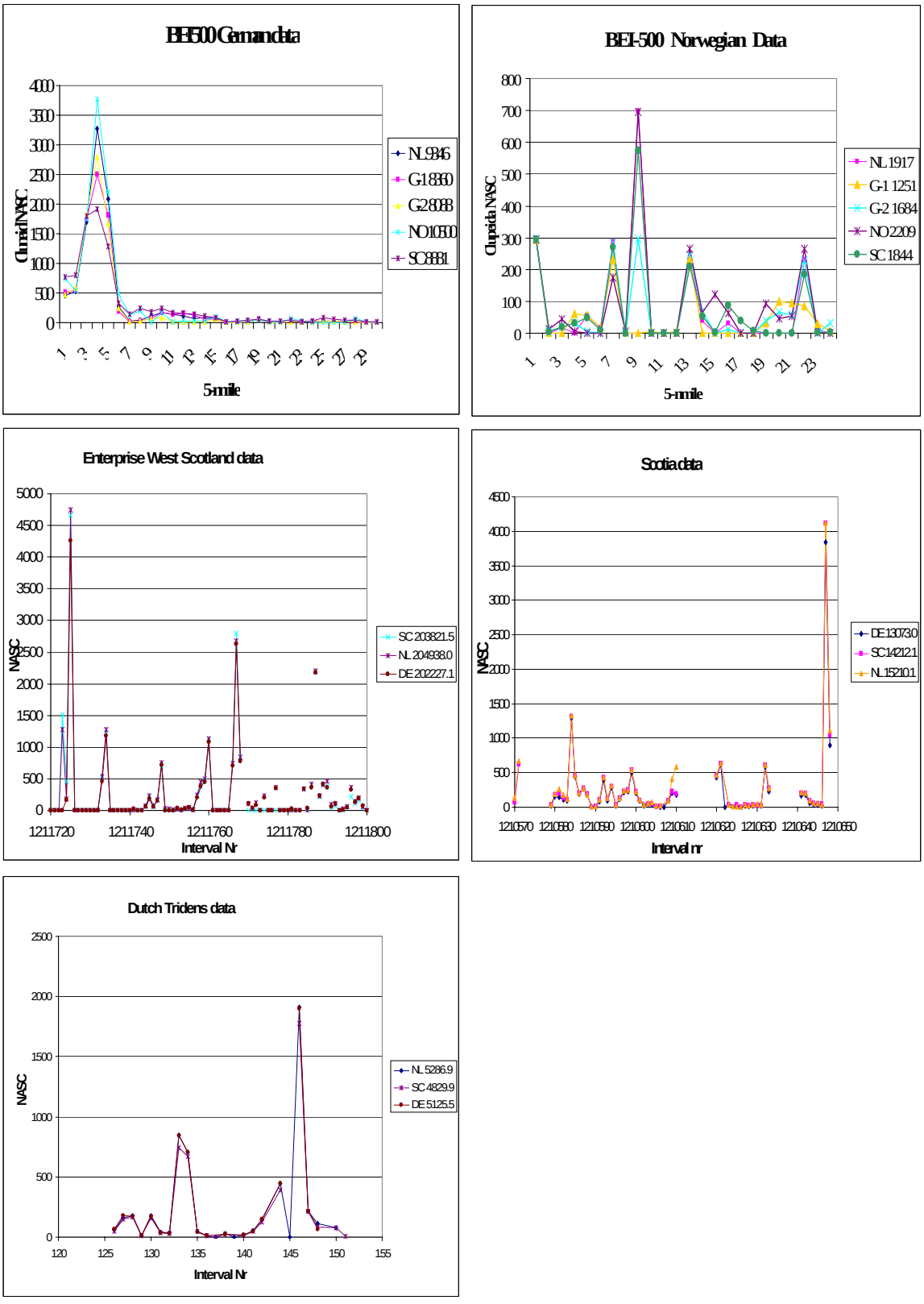


Figure 6. Estimated NASC-values corresponding to clupeids for various teams for the national datasets.

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Annex 2: 2004 Acoustic survey reports

Annex 2A: West of Scotland

Survey report for MFV *Enterprise*

6–25 July 2004

Paul Fernandes, FRS Marine Laboratory, Aberdeen

1. Introduction

An acoustic survey for herring was carried out by the Marine Laboratory on the west coast of Scotland (ICES Div VIa(N)) from the 6 to the 25 July 2004. The survey was conducted on the chartered fishing vessel MFV *Enterprise*. The main objective of the survey was to provide an abundance estimate for herring in this area and to map the distribution of this species.

The survey was carried out as a part of the ICES coordinated herring acoustic survey of the North Sea and adjacent waters. The data from this survey were combined with other surveys in the North Sea to provide an age disaggregated abundance index for use in the assessment process. The assessment will be carried out by the ICES Herring Assessment Working Group (HAWG) to be held in March 2005.

This survey has been carried out every year, at this time, by the Marine Laboratory since 1992. With the exception of 1997 the survey has always been conducted using chartered commercial fishing vessels.

2. Survey description and methods

2.1 Personnel

Paul Fernandes	Cruise Leader
Eric Armstrong	
Emma Hatfield	
Doug Beare	(6-16 July)
Owen Goudie	(6-16 July)
Finlay Burns	(16-25 July)
Colin Millar	(16-25 July)
Claire Embling	Visitor (U. of St Andrews)

2.2 Narrative

Loading of the vessel and installation of a wet lab container and equipment was carried out on the 5 July. The vessel left Fraserburgh at 0300hrs on the 6 July and proceeded to Loch Eriboll for a calibration. Survey work began at Cape Wrath at 0200hrs on the morning of 7 July. The survey continued in generally good weather until 15 July when the vessel steamed to Loch Broom. A second calibration was performed on the morning of the 16 prior to landing in Ullapool for a rest day and crew change. The survey continued from the 17 in good weather covering the full survey area up to 60^{o}N 3^{o}W. This was successfully completed by the morning of the 25th. On the last day, the ship returned to the location of an extremely dense school which had been detected on the previous day. A number of transects were completed over the area to confirm that the mark was indeed a fish shoal. The vessel then steamed to Fraserburgh for off

loading of personnel at 1030 on the 25th. Equipment and gear was off-loaded on Monday the 26th. No time was lost due to weather or mechanical breakdown and no damage occurred to net gear or acoustic equipment.

2.3 Survey design

The survey design (Figure. 2A.1) was selected to cover the area in three levels of sampling intensity based on herring densities found in 1991-2003. Areas with highest intensity sampling had a transect spacing of 3.75 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. Between track data, were discarded at the end of all transects. The survey area was within an area defined by 56° and 60° N, and the shelf break in the west to approx. 450m depth and the Scottish coast or the 3° W line in the east.

2.4 Calibration

Two good calibrations were carried out, at the beginning (6 July) in Loch Erribol and in the middle (16 July) in Loch Broom. All calibrations were carried out in ideal conditions, and the constants for the 38 kHz integrating frequency agreed well (Table 2A.1). All procedures were according to those defined in the survey manual.

2.5 Acoustic data collection

The survey was carried out using a Simrad EK500 38 kHz sounder echo-integrator, the system settings are given in Table 2A.1. Further data analysis was carried out using SonarData Echoview and Marine Laboratory Analysis systems. Data from the echo integrator were summed over fifteen minute periods (2.5 n.mi. at 10 knots). The survey was generally restricted to hours of daylight between 0300h and 2300h UTC. A total of 2600 nautical miles of track were recorded. Echo integrator data were collected from 10 metres below the surface (transducer at 5.5 m depth) to 0.5 m above the seabed. Data were processed on a daily basis, then archived as Echoview files (*.ek5,*.evi) and stored on DVD.

2.6 Biological data - fishing trawls

42 trawl hauls (Figure 2A.1 and Tables 2A.2 and 2A.3) were carried out opportunistically during the survey on the denser echo traces. All trawls were carried out using a PT160 pelagic trawl with a 20 mm cod end liner. A scanning netsonde was mounted on the headline. Each haul was sampled for length, age, maturity and weight of individual herring. Up to 707 fish were measured at 0.5 cm intervals from each haul. Otoliths were collected with 1 per 0.5 cm class below 23 cm, 3 per 0.5 cm class from 23 to 27 cm and 10 per 0.5 cm class for 27.5 cm and above. Fish weights were collected at sea for all fish aged. An eight stage maturity scale was used. Immature fish were defined as stages 1 and 2.

2.7 Hydrographic data

No hydrographic data were collected

2.7 Data analysis

EDSUs were defined by 15 minute intervals which represented 2.5 n.mi. per EDSU, assuming a survey speed of 10 knots. The data were divided into five categories: “herring traces”; “probably herring traces”; “surface herring” and “possibly herring traces” (which were identified with enough uncertainty as to not be included in the estimate); and “herring in a mixture”. Data were analysed using rectangles of 15’ by 30’.

Target strength to length relationships used were those recommended by the acoustic survey planning group (ICES, 1994).

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

For mackerel: $TS = 20\log_{10}L-84.9$ dB per individual

For gadoids: $TS = 20\log_{10}L-67.5$ dB per individual

For sprat: $TS = 20\log_{10}L-71.2$ dB per individual

The herring data from the trawl hauls were used to divide the area into five strata based on length distributions and geographic criteria. The five regions (Figure 2A.4) were:

I. Shelf break north
II. Shelf break south
III. Inshore areas west of islands and north Scotland
IV. Southern area
V. Minch and north Lewis

Trawling in the Minch area was again very difficult except in the most northerly and southerly parts. The length frequencies are presented in Table 2A.4. The overall age length key is presented in Table 2A.5.

3. Results

3.1 Acoustic data

The geographical distribution of the NASC values assigned to herring are presented in Figure 2A.2. Large quantities of herring were detected to the south and north of the area in the middle of the shelf . The main areas of concentration were North of 58° 45', and around 57° 00'N. There were also some good marks recorded at the Butt of Lewis. There were no major concentrations NW of Lewis at Gallan Head; little herring in the main part of the Minch; and no evidence of large quantities sometimes found at Barra Head. An unusual extremely dense mark was detected at 59° 37'N 3° 24' W. This mark had a NASC of just over 180,000 m^2.n.mi.$^{-2}$ and a maximum Sv of –9.51 dB (Figure 2A.6). The nature of the slope where this school was located did not allow a fishing sample to be taken, however, the area was surveyed at 1410hrs the following day (24 July) to confirm that the mark was fish rather than some property of the seabed (Figure 2A.7). Three passes were made: one going west, one east and one going south; in all cases no fish schools were detected.

3.2 Biological data

A total of 42 trawl hauls were carried out. Table 2A.2 gives the positions and characteristics of these trawl hauls and Table 2A.3 gives their species composition. 36 hauls contained sufficient herring to define the 5 survey sub areas (Figure 2A.4). Herring were present in 38 hauls and there was a good coverage of herring trawl hauls across the area with the exception of the south Minch. All major concentrations were adequately characterised from these trawls. Other hauls were dominated by sprat (haul 3), blue whiting (haul 14), mackerel (2 and 22) and pearlsides (38). Mackerel were ubiquitous throughout the area although rarely in great numbers.

The weight of herring at length was determined from length stratified samples of each trawl haul. Lengths were measured from a random sample in 0.5 cm intervals to the nearest 0.5 cm below. The resulting weight-length relationship for herring was:

$$W = 0.00412.L^{3.22} \qquad \text{L measured in cm}$$

Samples of fish were aged in the laboratory by counting winter rings. These were then used to compile an age length key (Table 2A.5) to determine the proportion at age for each length class.

3.3 Biomass estimates

The total biomass estimates for the survey were:

Definitely herring	357,300 tonnes	25%
Probably herring	1,035,000 tonnes	73%
Herring at surface	19,020 tonnes	1%
Herring in mixture	2,033 tonnes	<1%
Total herring	**1,413,353 tonnes**	
Spawning stock biomass	1,359,450 tonnes	96%
Immature	53,620 tonnes	4%

Total abundance (numbers of fish) were:

Total herring	8,159 million	
Spawning stock numbers	7,440 million	91%
Immature numbers	718 million	9%

A breakdown of the estimates by age class is given in Table 2A.6. The survey included all of ICES Subdivision VIa(N) plus some of the area between 3° and 4°W in Subdivision IV. The estimates given here are for the whole survey.

The results for ICES Subdivision VIa(N) alone were:

Total herring biomass	**438,100 tonnes**
Total herring numbers	2,894 million

4. Discussion

The stock estimate for VIa(N) is down substantially by approximately 50% from 2003 (from 889,200 to 438,100 tonnes). Given the known difficulties of quantifying young fish on this survey, the SSB estimate is likely to give a better index of change. This is also down significantly, by 46% (745,070 to 400,000 tonnes) from 2003 to 2004. This rather large fluctuation may have something to do with the distribution of fish. The distributions were slightly different to previous years, with a large proportion of fish being detected towards the north and south of the area, and less in the middle reaches west of the Hebrides. The high densities of smaller fish detected at Barra Head in previous years were absent this year. Last year more of the fish were located in the centre for the area, well west of 4 degrees. This year there were large quantities of fish close to 4 degrees: there is a possibility, therefore, that some west coast fish could be present on the North Sea side of the division and, therefore, taken as North Sea fish. Although this line has been shown, on average, to be the best separator of the west of Scotland herring stock from that of the North Sea (Anon 1998), its definition may have implications for estimates of both stocks in any one year.

The abundance by year class is consistent with previous years. The 1998 year class was still very strong (26% of numbers) and there were also a very large number of 3 and 4 ring fish detected on the survey (29 and 19% respectively by number).

References

Anon. 1998. Report of the Herring Assessment Working Group for the Area South of 62°N. ICES CM 1998/ACFM:14

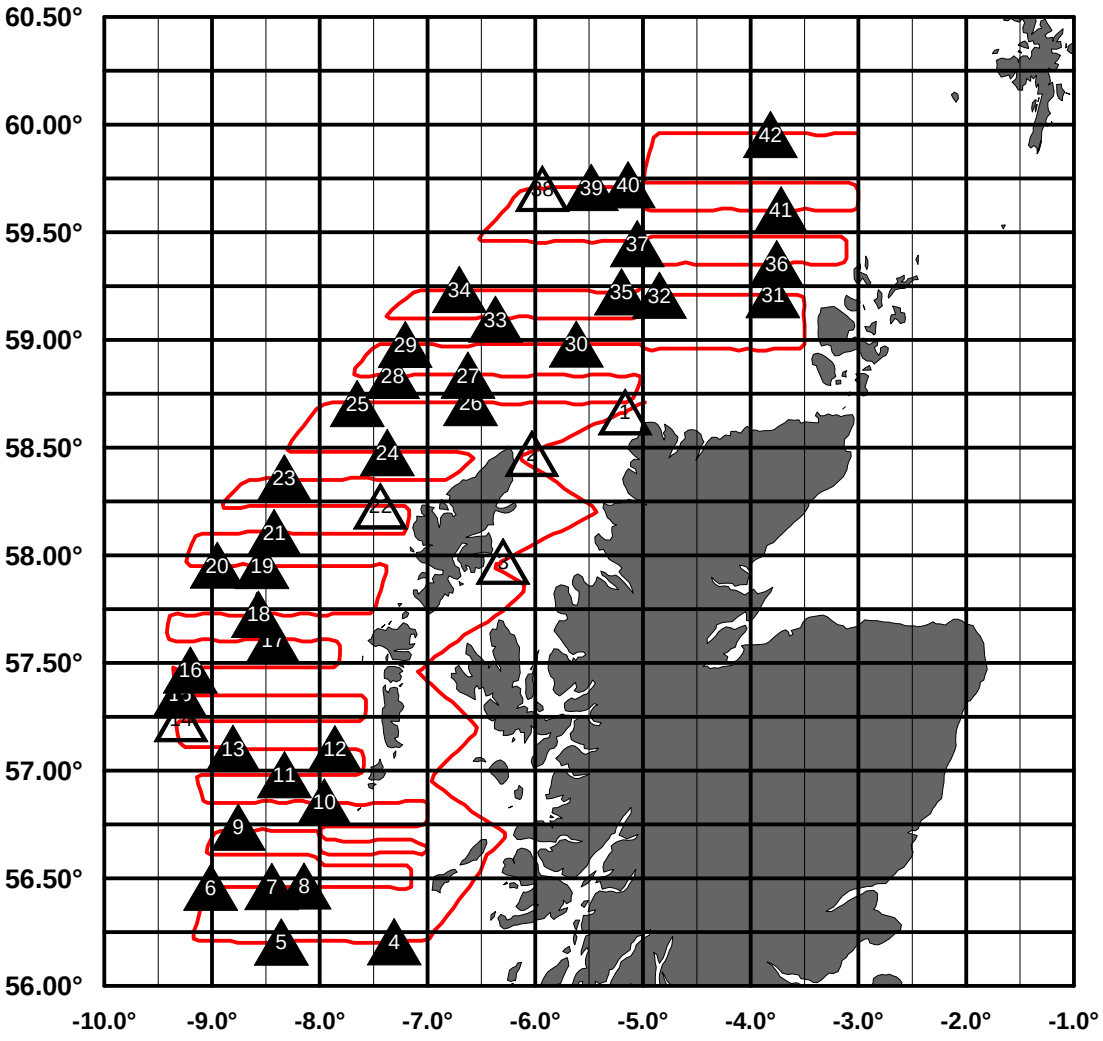


Figure 2A.1. Map of the west of Scotland showing cruise track (red) and positions of fishing trawls undertaken during the July 2004 west coast acoustic survey on MFV *Enterprise*. Filled triangles indicate trawls in which significant numbers of herring were caught, whilst open triangles indicate trawls with few or no herring.

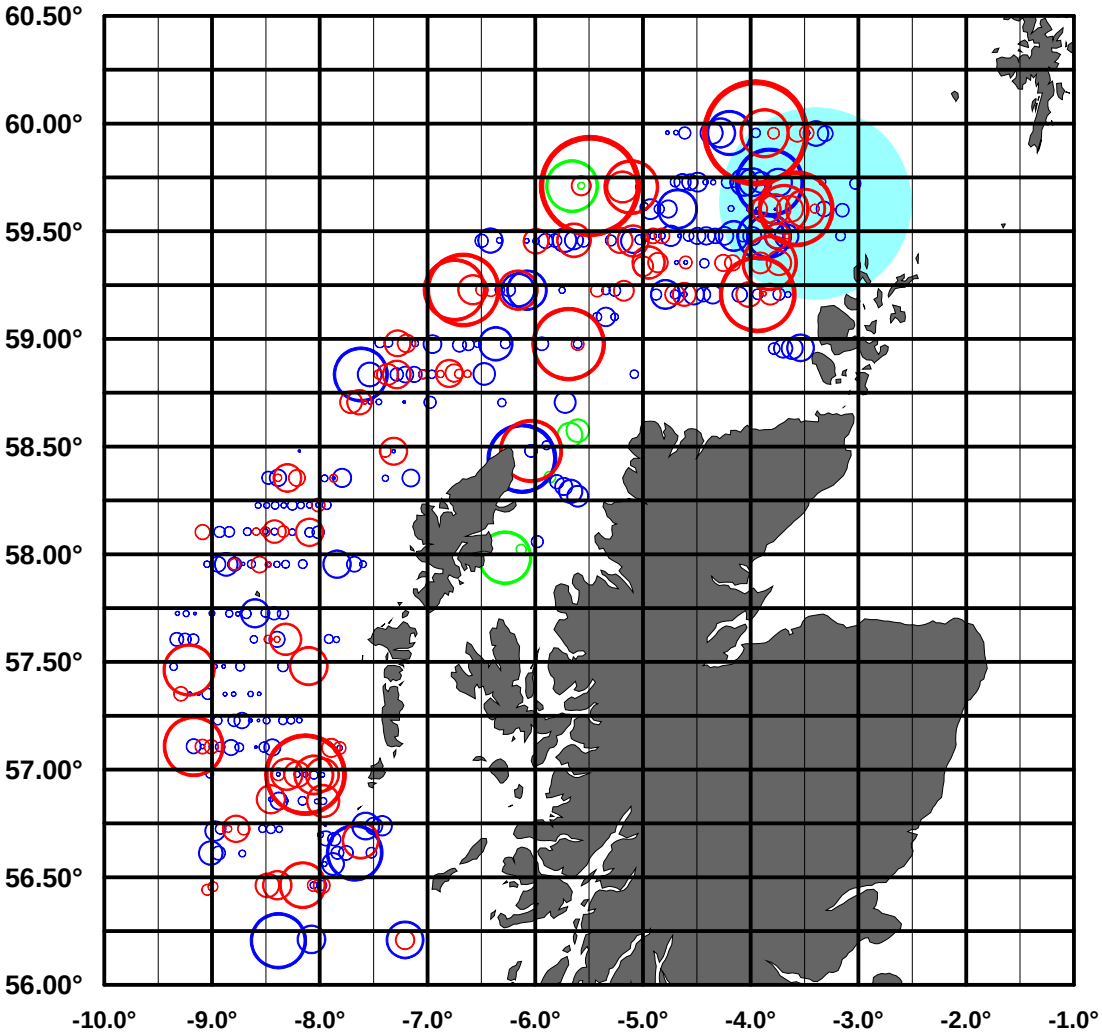


Figure 2A.2. Map of the west of Scotland with a post plot showing the distribution of herring NASC values (on a proportional square root scale relative to a value of 5000) obtained during the July 2004 west coast acoustic survey on MFV *Enterprise*. Red indicate definitely herring, blue probably herring and green, herring at the surface. The large pale blue filled circle at approx. 59.55°N, 3.5°W is an extremely dense herring school (see Figure 2A.6) which is on a different scale to the other symbols by virtue of its size: the 2.5 n.mi. NASC value for the school was 181,000 m^2.n.mi.$^{-2}$.

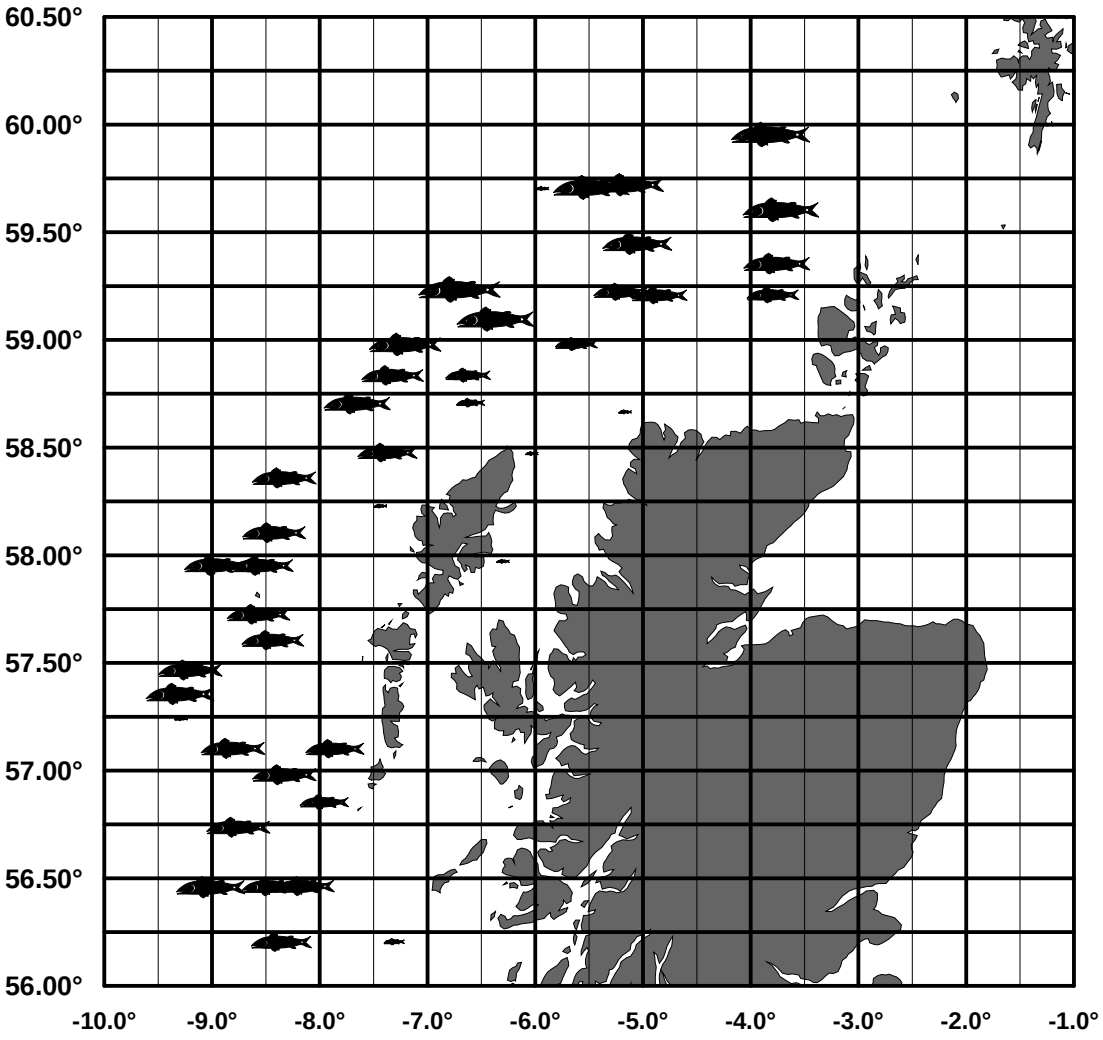


Figure 2A.3. Map of the west of Scotland with a post plot showing the mean length of herring caught in the trawl hauls carried out during the July 2004 west coast acoustic survey on MFV *Enterprise*.

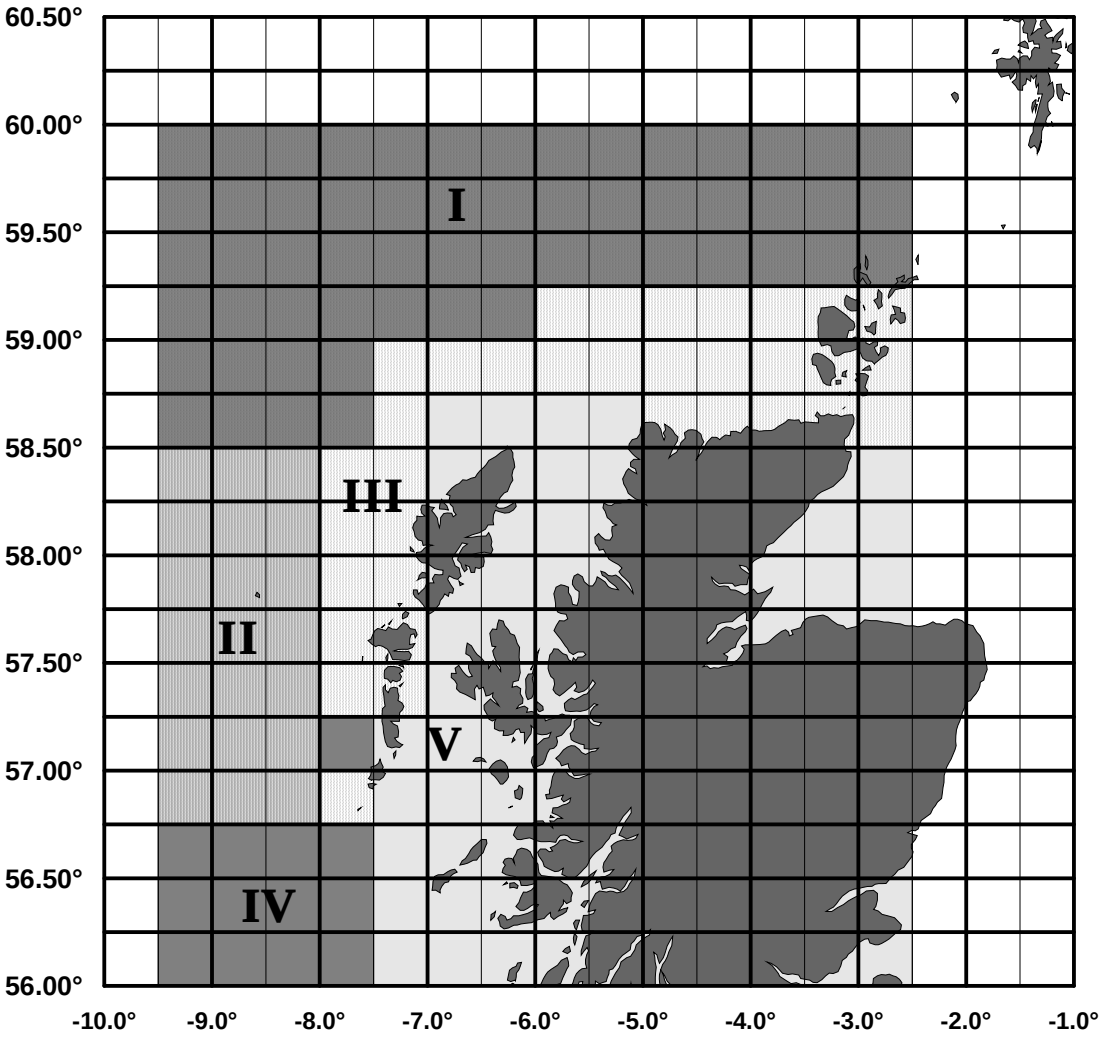


Figure 2A.4. Map of the west of Scotland showing the area strata (indicated by shaded areas with roman numerals I-V) used for combining data from the trawl hauls.

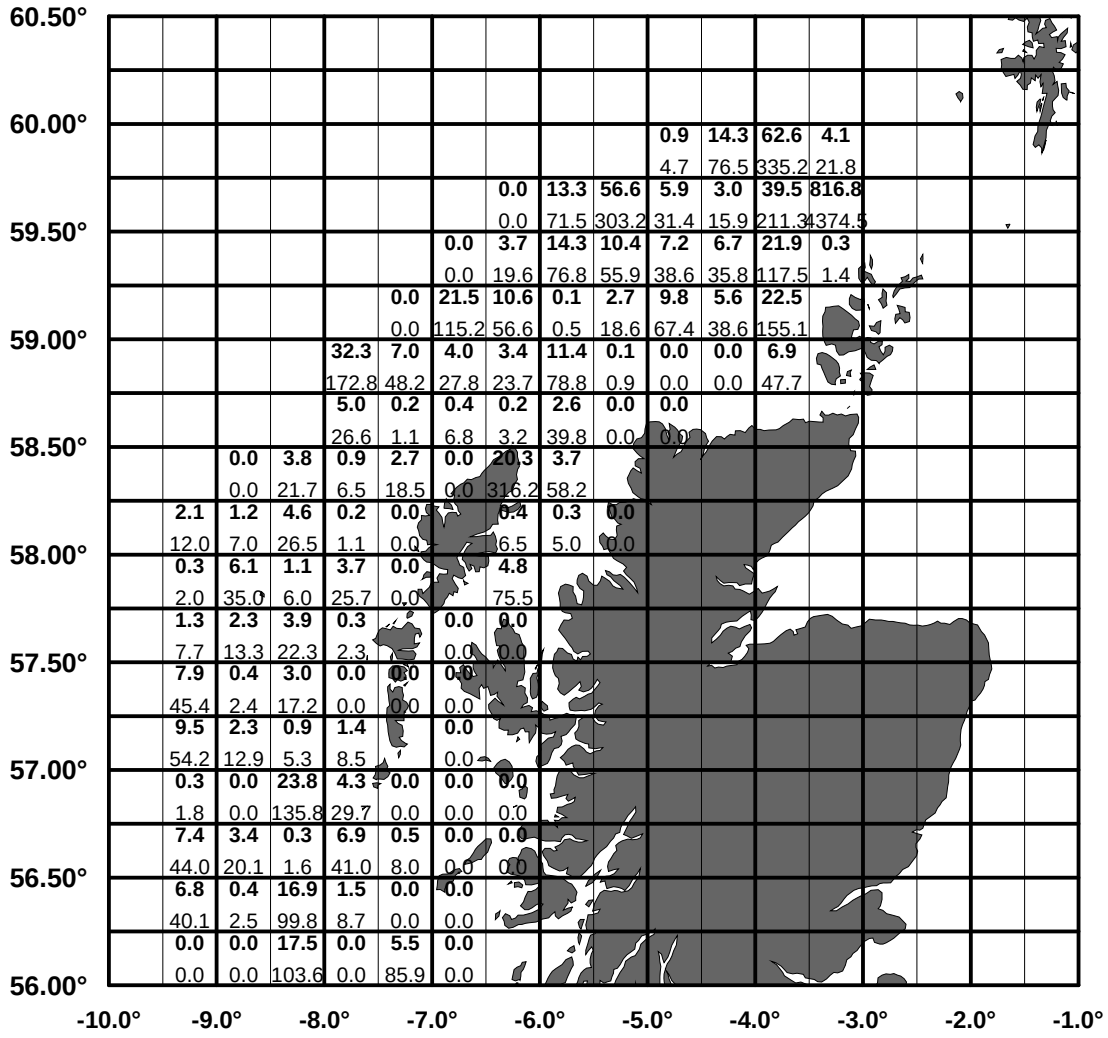


Figure 2A.5. Map of the west of Scotland with a post plot showing the herring numbers in millions (bottom) and biomass in thousands of tonnes (top) by quarter ICES rectangle obtained during the July 2004 west coast acoustic survey on MFV *Enterprise*.

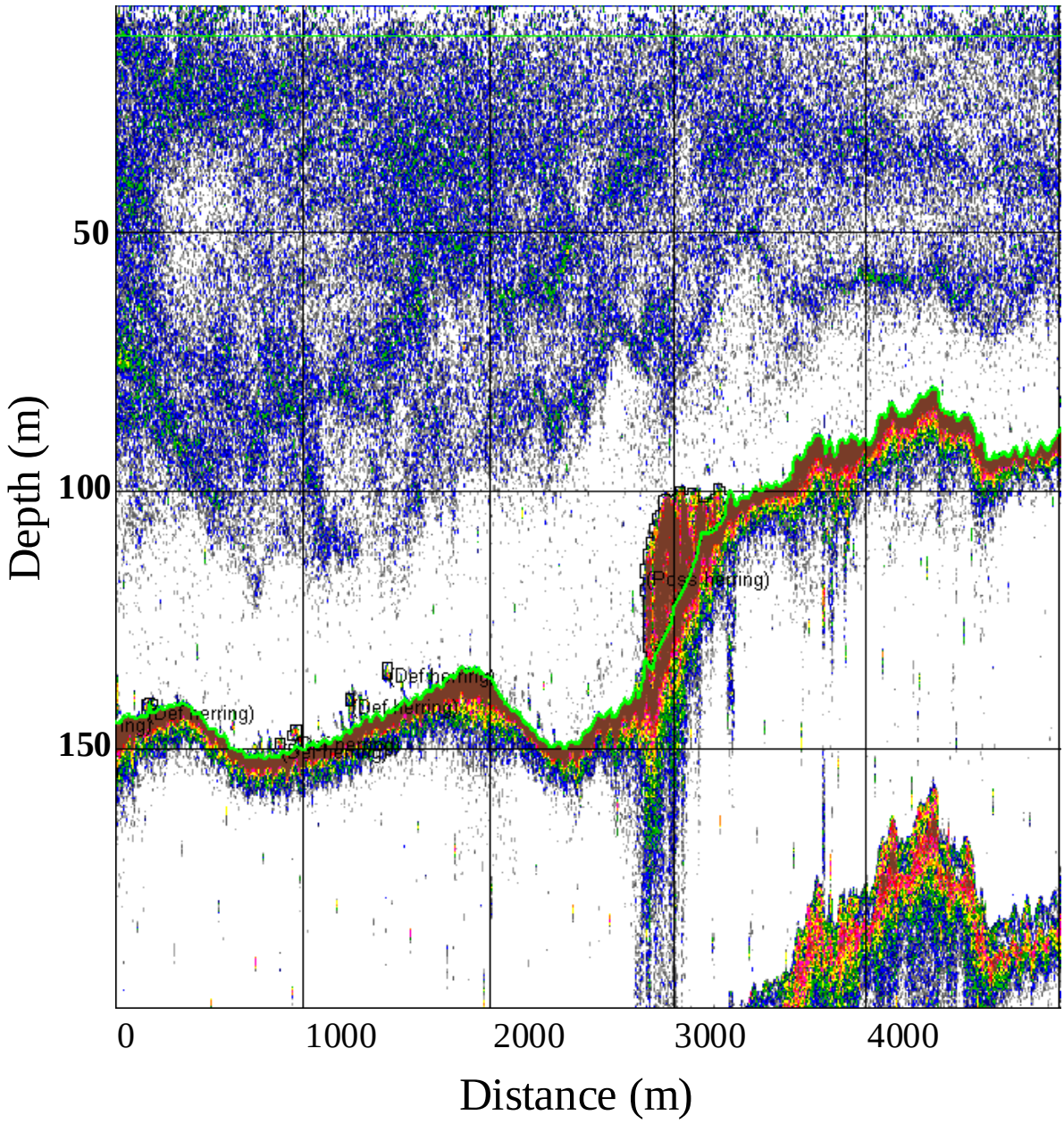


Figure 2A.6. Echogram from the west of Scotland at approximately 59°37'N, 003°24'W, at 14:00 on 23 July 2004, showing the extremely dense school detected on the slope (at about 3000 m distance).

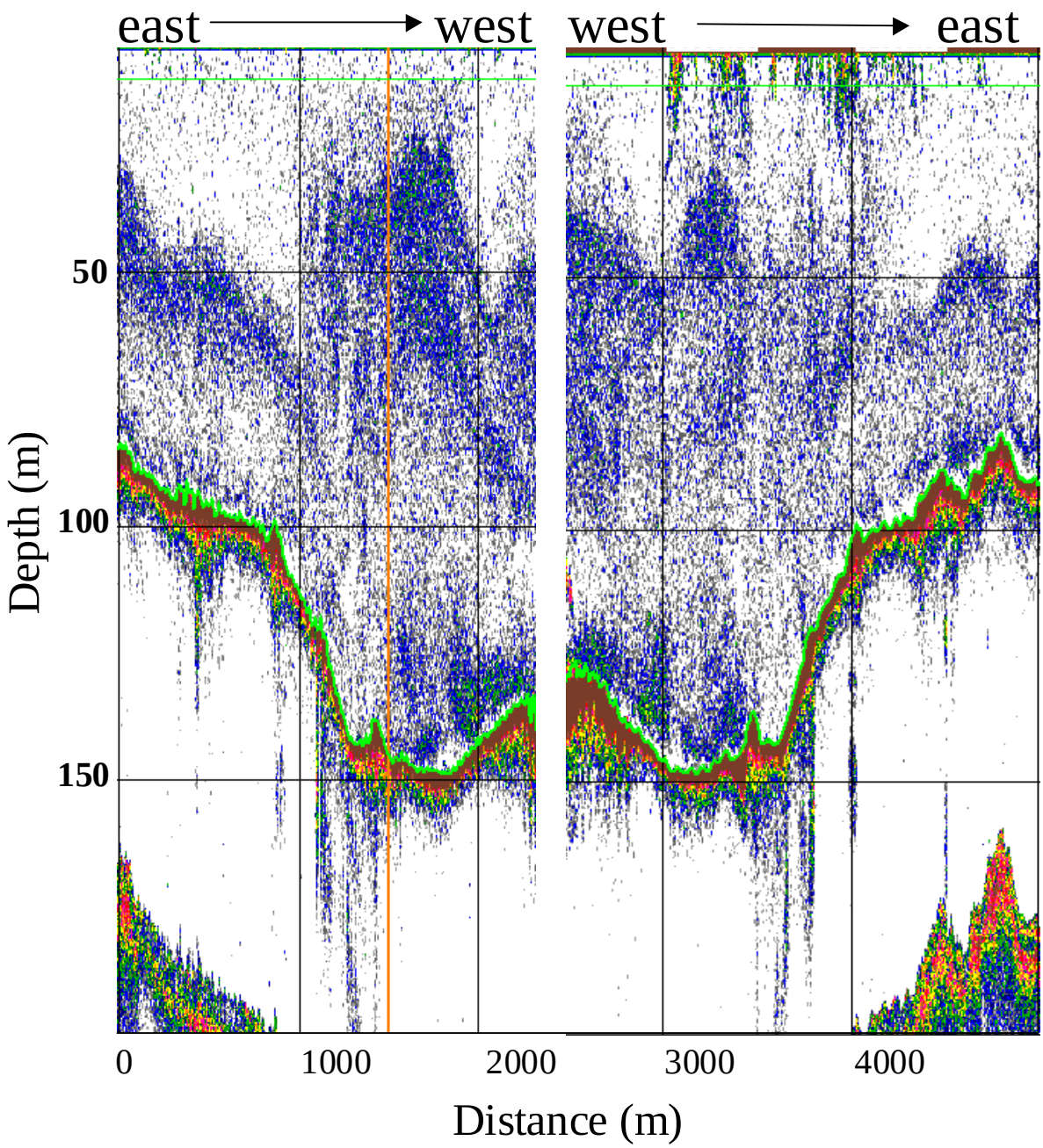


Figure 2A.7. Echogram from the west of Scotland at approximately 59°37'N, 003°24'W, at 16:10 on 24 July 2004, showing two passes (east to west, and west to east) of the slope where the dense school (shown in Figure 2A.6) had previously been detected (at about 1000 m and 3600 distance on this figure).

Table 2A.1. Simrad EK500 and analysis settings used on the July 2004 west coast of Scotland herring acoustic survey on MFV *Enterprise*. Calibrations a) Loch Erribol 6 July; and b) Loch Broom 16 July. *Milap factor based on a Simrad factor of 1 because calibration settings were incorporated into the Echoview post processing package.

Transceiver Menu	
Frequency	38 kHz
Sound speed	1503[a],1498[b] $m.s^{-1}$
Max. Power	2000 W
Equivalent two-way beam angle	-20.6 dB
Default Transducer Sv gain	26.5 dB
3 dB Beamwidth	7.1°
Calibration details	
TS of sphere	-42.4 dB
Range to sphere in calibration	9.7[a], 9.8[b]
Measured NASC value for calibration	3017[a], 3146[b]
Calibration factor for NASCs	0.79[a], 0.82[b]
Calibration constant for MILAP (optional)*	1.1005 at -35 dB
Log Menu	
Integration performed in Echoview post processing based on 15 minute EDSUs	
Operation Menu	
Ping interval	1 s at 100 m range 1.5 s at 250 m range 2.5 at 500 m range
Analysis settings	
Bottom margin (backstep)	0.5 m
Integration start (absolute) depth	11 m
Sv gain threshold	-70 dB

Table 2A.2. Details of the fishing trawls taken during the West Coast acoustic survey, July 2004; Trawl depth = depth (m) of headrope; Gear type P=pelagic; Duration of trawl (minutes); Total catch (number); Use H=used to qualify herring acoustic data, s= used to qualify sprat acoustic data (blank if neither).

Haul	Date	Latitude	Longitude	Time	Water Depth	Trawl Depth	Gear Type	Dura-tion	Use	Baskets
1	7/7	58° 40 N	5° 13 W	03:21	59	24	P	56		0
2	7/7	58° 28 N	6° 0 W	08:32	86	63	P	29	H	9
3	7/7	57° 58 N	6° 20 W	15:47	138	6	P	31	H	0.25
4	8/7	56° 12 N	7° 20 W	14:34	107	84	P	23	H	40
5	8/7	56° 12 N	8° 21 W	21:13	145	7	P	25	H	20
6	9/7	56° 27 N	8° 57 W	06:48	150	141	P	1.01	H	5
7	9/7	56° 28 N	8° 25 W	10:17	146	132	P	28	H	25
8	9/7	56° 28 N	8° 7 W	12:59	145	124	P	28	H	40
9	10/7	56° 45 N	8° 48 W	07:06	116	98	P	50	H	15
10	11/7	56° 51 N	7° 56 W	06:02	100	74	P	19	H	10
11	11/7	56° 59 N	8° 18 W	14:16	128	116	P	38	H	25
12	11/7	57° 6 N	7° 54 W	19:52	96	74	P	37	H	10
13	12/7	57° 6 N	8° 51 W	04:33	135	120	P	38	H	8
14	12/7	57° 14 N	9° 14 W	08:20	300	284	P	72		1
15	12/7	57° 21 N	9° 15 W	22:14	170	153	P	30	H	2
16	13/7	57° 29 N	9° 12 W	03:05	150	124	P	49	H	20
17	13/7	57° 36 N	8° 28 W	11:34	165	133	P	28	H	15
18	13/7	57° 43 N	8° 32 W	19:03	152	132	P	33	H	8
19	14/7	57° 57 N	8° 36 W	08:45	135	111	P	56	H	0.75
20	14/7	57° 57 N	9° 0 W	11:46	163	143	P	NA	H	3
21	14/7	58° 6 N	8° 23 W	17:27	151	124	P	37	H	15
22	15/7	58° 14 N	7° 28 W	04:27	60	50	P	29	H	0.5
23	15/7	58° 21 N	8° 18 W	12:25	165	143	P	47	H	2.5
24	17/7	58° 29 N	7° 25 W	20:39	109	81	P	46	H	10
25	18/7	58° 42 N	7° 37 W	07:44	124	128	P	37	H	30
26	18/7	58° 43 N	6° 32 W	12:26	123	111	P	59	H	5
27	19/7	58° 50 N	6° 41 W	04:48	140	120	P	56	H	6
28	19/7	58° 50 N	7° 23 W	08:41	102	91	P	53	H	15
29	19/7	58° 59 N	7° 9 W	13:27	190	146	P	49	H	10
30	19/7	58° 59 N	5° 35 W	19:41	95	84	P	41	H	4
31	20/7	59° 13 N	3° 50 W	09:57	135	114	P	40	H	20
32	20/7	59° 12 N	4° 55 W	14:25	105	101	P	61	H	0
33	20/7	59° 6 N	6° 25 W	21:29	104	75	P	50	H	2.5
34	21/7	59° 14 N	6° 38 W	07:54	180	104	P	76	H	7
35	21/7	59° 13 N	5° 8 W	14:30	105	91	P	58	H	7
36	21/7	59° 21 N	3° 43 W	21:08	149	135	P	41	H	14
37	22/7	59° 28 N	5° 7 W	11:10	138	128	P	69	H	6
38	22/7	59° 42 N	5° 53 W	19:55	247	128	P	39		0
39	23/7	59° 43 N	5° 27 W	03:28	142	129	P	30	H	10
40	23/7	59° 42 N	5° 6 W	05:33	128	120	P	53	H	4
41	23/7	59° 36 N	3° 41 W	12:12	120	114	P	41	H	9
42	24/7	59° 57 N	3° 46 W	08:11	130	126	P	49	H	1.5

Table 2A.3 Catch composition by trawl haul on the west coast herring acoustic survey. MFV *Enterprise* (6 - 25 July 2004)

	Haul	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
Herring	*Clupea harengus*		17	7	18760	5686	972	4186	8960	2340	2810	4437
Sprat	*Sprattus sprattus*			91								
Mackerel	*Scomber scombrus*		1755		560	12	2	380	360	308	35	750
Raitt's Sandeel	*Ammodytes marinus*			7								
Haddock	*Melanogrammus aeglefinus*				2			10	410			
Whiting	*Merlangius merlangus*											
Cod	*Gadus morhua*											
Saithe	*Pollachius virens*						2					
Norway Pout	*Trisopterus esmarki*		160									
Poor Cod	*Trisopterus minutus*											
Blue Whiting	*Micromesistius poutassou*					48		30				
Lesser Argentine	*Argentina sphyraena*											
Greater Argentine	*Argentina silus*											
Grey Gurnard	*Eutrigla gurnardus*											24
Hake	*Merluccius merluccius*											
Horse Mackerel (Scad)	*Trachurus trachurus*											
Blue-mouth	*Helicolenus dactylopterus*											1
Snake Pipefish	*Entelurus aequoreus*		4	1	1	12	40					12

Table 2A.3 (cont.) Catch composition by trawl haul on the west coast herring acoustic survey. MFV *Enterprise* (6 - 25 July 2004).

	Haul	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**
Herring	*Clupea harengus*	2160	1712		273	3760	3330	1208	91	1489	3525	24
Sprat	*Sprattus sprattus*											
Mackerel	*Scomber scombrus*	30	104		11	400	90	56	5	6	120	80
Raitt's Sandeel	*Ammodytes marinus*											
Haddock	*Melanogrammus aeglefinus*			1	2		15	24	4	2		1
Whiting	*Merlangius merlangus*				1			40	2			
Cod	*Gadus morhua*											
Saithe	*Pollachius virens*									1		
Norway Pout	*Trisopterus esmarki*							320				
Poor Cod	*Trisopterus minutus*											
Blue Whiting	*Micromesistius poutassou*			446				248				
Lesser Argentine	*Argentina sphyraena*							16				
Greater Argentine	*Argentina silus*											
Grey Gurnard	*Eutrigla gurnardus*								1	2		3
Hake	*Merluccius merluccius*											
Horse Mackerel (Scad)	*Trachurus trachurus*				1							
Blue-mouth	*Helicolenus dactylopterus*			1								
Snake Pipefish	*Entelurus aequoreus*			2	2					1		

Table 2A.3(cont.) Catch composition by trawl haul on the west coast herring acoustic survey. MFV Enterprise (6 - 25 July 2004).

	Haul	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**	**33**
Herring	*Clupea harengus*	370	2045	6030	1298	1347	3161	1901	884	3903	1564	401
Sprat	*Sprattus sprattus*											
Mackerel	*Scomber scombrus*	32	70		459	72			2	606		
Raitt's Sandeel	*Ammodytes marinus*											
Haddock	*Melanogrammus aeglefinus*	3				3				4	12	
Whiting	*Merlangius merlangus*					3		8				
Cod	*Gadus morhua*											
Saithe	*Pollachius virens*											
Norway Pout	*Trisopterus esmarki*	36										
Poor Cod	*Trisopterus minutus*											
Blue Whiting	*Micromesistius poutassou*	3						19				
Lesser Argentine	*Argentina sphyraena*	1										
Greater Argentine	*Argentina silus*											
Grey Gurnard	*Eutrigla gurnardus*	1							16	8		
Hake	*Merluccius merluccius*	1								8		
Horse Mackerel (Scad)	*Trachurus trachurus*											
Blue-mouth	*Helicolenus dactylopterus*											
Snake Pipefish	*Entelurus aequoreus*	2										

Table 2A.3(cont.) Catch composition by trawl haul on the west coast herring acoustic survey. MFV *Enterprise* (6 - 25 July 2004).

	Haul	**34**	**35**	**36**	**37**	**38**	**39**	**40**	**41**	**42**
Herring	*Clupea harengus*	1287	1513	2156	1149		1608	812	1273	274
Sprat	*Sprattus sprattus*			12						
Mackerel	*Scomber scombrus*		91	281	22		6	4	51	1
Raitt's Sandeel	*Ammodytes marinus*									
Haddock	*Melanogrammus aeglefinus*				36		2	1		
Whiting	*Merlangius merlangus*			6	5					
Cod	*Gadus morhua*				2					
Saithe	*Pollachius virens*							1		
Norway Pout	*Trisopterus esmarki*	7		690	1			12		
Poor Cod	*Trisopterus minutus*							42		
Blue Whiting	*Micromesistius poutassou*	17		12	36		54			
Lesser Argentine	*Argentina sphyraena*				73					
Greater Argentine	*Argentina silus*						22			
Grey Gurnard	*Eutrigla gurnardus*			77	1			3	2	2
Hake	*Merluccius merluccius*			3	1		2			
Horse Mackerel (Scad)	*Trachurus trachurus*	1		3	2					
Blue-mouth	*Helicolenus dactylopterus*									
Snake Pipefish	*Entelurus aequoreus*									

Table 2A.4. Herring length frequency proportion by trawl haul by sub- area for west coast acoustic survey MFV *Enterprise* (6 - 25 July 2004). Length in cm, weight in g, TS=target strength in dB.

	I											II	
L (cm)	25	29	33	34	36	37	39	40	41	42	mean	9	11
16.5													
17													
17.5													
18													
18.5													
19													
19.5													
20													
20.5													
21													
21.5													
22													
22.5									0.1		0.0		
23					0.3	0.3					0.1		
23.5					1.3	2.2		0.2	0.1		0.4		
24		0.3		0.3	3.6	4.4			2.0		1.1		
24.5			0.5		5.2	8.5		0.7	1.6		1.7	0.9	0.9
25	0.7	0.3	2.2	0.5	9.1	11.6		1.7	4.1	1.8	3.2	1.3	2.5
25.5	2.5	2.1	2.5	1.9	10.7	13.9	0.6	4.1	4.0	5.8	4.8	5.1	4.8
26	8.5	6.6	8.5	6.8	20.3	19.8	3.7	13.6	5.7	13.1	10.7	12.5	13.3
26.5	13.9	10.8	11.7	6.5	12.7	13.1	7.5	14.8	4.4	10.2	10.6	25.0	20.3
27	21.6	23.1	20.9	16.1	12.7	12.9	15.9	23.0	7.9	18.2	17.2	27.6	26.8
27.5	23.4	21.0	14.7	14.1	8.1	6.8	19.3	13.1	8.5	13.9	14.3	17.0	19.2
28	17.4	21.3	17.5	16.3	8.1	3.5	19.6	13.1	11.5	8.4	13.7	8.6	8.2
28.5	7.0	7.9	7.5	13.6	4.2	0.9	12.1	4.1	10.6	4.0	7.2	1.6	3.4
29	3.2	4.2	5.0	8.5	2.3	1.0	9.0	3.6	13.2	5.8	5.6		0.6
29.5	1.7	1.3	3.7	5.4	0.8	0.3	5.6	3.4	8.1	4.0	3.4		0.3
30		0.8	2.5	4.9	0.4	0.7	2.9	3.1	7.5	5.1	2.8	0.3	
30.5			1.7	2.7	0.2	0.2	1.4	0.7	5.8	4.7	1.8		
31		0.2	0.5	0.9	0.1		0.9	0.5	2.5	2.2	0.8		
31.5				0.5			0.6		1.1	0.7	0.3		
32				0.3		0.1	0.2	0.2	0.6	1.5	0.3		
32.5		0.2		0.2			0.1		0.3		0.1		
33				0.1		0.1	0.5		0.3		0.1		
33.5			0.2	0.1			0.1		0.3	0.4	0.1		
34				0.1							0.0		
34.5			0.2								0.0		
Number	6030	1901	401	1287	2156	1149	1608	413	707	274		2340	4437
mean length	27.8	27.9	28	28.4	26.9	26.5	28.5	27.7	28.6	28.2	27.9	27.33	27.4
mean weight	184	187	190	199	166	159	200	184	204	194	187	174.4	175
TS/individual	-42.3	-42.3	-42.2	-42.1	-42.6	-42.7	-42.1	-42.3	-42.1	-42.2	-42.3	-42.5	-42.5
TS/kilogramme	-35	-35	-35	-35.1	-34.8	-34.7	-35.1	-35	-35.2	-35.1	-35	-34.9	-34.9

Table 2A.4. (cont.) length frequency proportion by trawl haul by sub- area for west coast acoustic survey MFV *Enterprise* (6 - 25 July 2004). Length in cm, weight in g, TS=target strength in dB.

	II (cont.)										III		
L (cm)	13	15	16	17	18	19	20	21	23	mean	10	22	24
16.5													
17											0.2		
17.5													
18											0.2		
18.5									0.3	0.0	0.4		
19											0.2		
19.5											0.5		
20											1.4		
20.5											0.5		
21											0.7		
21.5											2.0		
22											0.5	2.9	
22.5											1.8	2.9	
23											3.4	2.9	
23.5	0.5			0.5	0.7	1.1	0.6		0.3	0.3	7.5	11.4	
24			1.1	0.9		1.1		0.4	1.1	0.4	18.0	20.0	2.2
24.5	0.5		0.5	3.2	3.3	4.4	1.2	3.8	2.2	1.9	16.5	22.9	7.1
25	1.4	0.4		5.4	6.6	2.2	1.8	5.5	2.4	2.7	15.8	5.7	12.5
25.5	6.1	0.7	7.4	9.9	4.0	1.1	9.8	7.7	3.2	5.4	7.7	11.4	12.7
26	14.0	2.9	12.8	10.8	13.9	19.8	12.9	5.1	11.9	11.8	8.0	8.6	18.3
26.5	20.6	8.8	23.9	18.0	12.6	22.0	25.8	17.0	17.6	19.2	4.4	8.6	15.6
27	22.9	24.2	26.6	25.7	27.8	25.3	25.8	28.5	21.1	25.6	5.7	2.9	14.7
27.5	19.2	29.3	15.4	17.1	19.9	8.8	16.6	16.6	23.2	18.4	2.5		7.6
28	12.1	20.5	8.5	5.9	7.9	8.8	3.1	12.8	11.4	9.8	0.9		5.4
28.5	2.8	9.2	2.1	1.4	2.0	4.4	2.5	2.1	3.8	3.2	1.2		3.2
29		2.9	1.6	1.4	1.3				1.4	0.8			0.5
29.5		1.1						0.4	0.3	0.2			0.2
30						1.1				0.1			
30.5													
31													
31.5													
32													
32.5													
33													
33.5													
34													
34.5													
Number	1712	273	3760	3330	1208	91	489	3525	370		2810	35	2045
mean length	27.4	28.0	27.3	27.1	27.2	27.2	27.2	27.3	27.4	27.3	25.1	25.1	26.7
mean weight	175.3	188.2	174.4	170.4	172.8	171.8	171.0	173.8	176.2	174.9	135.1	133.8	162.6
TS/individual	-42.5	-42.3	-42.5	-42.5	-42.5	-42.5	-42.5	-42.5	-42.4	-42.5	-43.2	-43.2	-42.7
TS/kilogramme	-34.9	-35.0	-34.9	-34.8	-34.9	-34.9	-34.8	-34.9	-34.9	-34.9	-34.5	-34.5	-34.8

Table 2A.4. (cont.). Length frequency proportion by trawl haul by sub- area for west coast acoustic survey MFV *Enterprise* (6 - 25 July 2004). Length in cm, weight in g, TS=target strength in dB.

	III (cont.)					IV						V		
L (cm)	30	31	32	35	mean	5	6	7	8	12	mean	4	26	mean
16.5													1.2	0.6
17					0.0								9.9	4.9
17.5					0.1							0.4	19.7	10.1
18	0.5	0.3			0.1							3.2	37.0	20.1
18.5	0.3				0.2							8.7	13.6	11.2
19	0.8				0.2							9.2	9.2	9.2
19.5	0.6			0.2	0.2							12.8	4.9	8.9
20	0.7	0.2			0.3					0.5	0.1	19.2	1.2	10.2
20.5	0.5	0.4		0.2	0.2							13.9	0.6	7.2
21	0.1	0.7	0.3		0.2							8.7	1.2	5.0
21.5		0.3			0.3							6.2		3.1
22		0.3			0.4							2.6		1.3
22.5		0.4	0.3	0.1	0.6					0.9	0.2	1.9		1.0
23	0.9	2.4	0.5	0.5	1.3				0.4		0.1	3.0		1.5
23.5	6.1	6.4	4.9	4.4	4.9	0.4		0.3	1.8	1.9	0.9	3.0	0.1	1.5
24	17.2	17.9	10.2	17.1	13.2	0.4		0.9	2.2	3.2	1.4	3.4	0.1	1.7
24.5	16.1	16.5	8.7	16.2	13.3	3.1		6.3	8.5	8.3	5.2	2.3	0.2	1.2
25	19.5	14.1	13.8	21.1	15.1	11.0	0.2	11.0	3.6	13.4	7.8	0.4	0.4	0.4
25.5	10.9	10.6	14.1	14.6	12.8	15.4	2.1	12.5	9.4	11.6	10.2		0.2	0.1
26	14.5	13.7	17.1	13.9	14.6	17.8	2.3	16.4	17.0	13.0	13.3	0.9	0.2	0.5
26.5	5.2	8.3	8.7	5.8	8.6	18.9	12.9	17.0	13.8	10.2	14.6	0.2	0.1	0.1
27	2.5	4.5	10.2	3.5	7.0	12.3	19.0	19.7	23.2	18.1	18.5			
27.5	3.2	1.4	5.4	0.7	3.4	12.5	21.6	11.3	8.0	8.8	12.5		0.1	0.0
28	0.2	1.2	3.6	0.7	1.9	5.3	21.6	2.4	5.4	8.3	8.6		0.1	0.0
28.5	0.5	0.2	1.3	0.7	1.0	2.2	11.5	1.5	4.0		3.8			
29			1.0	0.3	0.2	0.4	7.4	0.6	1.8	1.9	2.4			
29.5		0.1		0.1	0.0	0.2	1.2		0.9		0.5			
30														
30.5														
31		0.1			0.0		0.2				0.0			
31.5														
32														
32.5														
33														
33.5														
34														
34.5														
Number	884	3903	1564	1513		5686	972	4186	8960	2160		18760	1298	
mean length	25.4	25.5	26.2	25.6	25.8	26.8	28.1	26.8	26.9	26.6	27.0	21.0	18.7	19.9
mean weight	138.6	140.1	152.4	141.7	145.2	164.8	190.0	163.4	166.6	160.8	169.1	76.4	52.0	64.2
TS/individual	-43.1	-43.1	-42.8	-43.0	-43.0	-42.6	-42.2	-42.6	-42.6	-42.7	-42.6	-44.7	-45.7	-45.2
TS/kilogramme	-34.5	-34.5	-34.7	-34.5	-34.6	-34.8	-35.0	-34.8	-34.8	-34.8	-34.8	-33.6	-32.9	-33.3

Table 2A.5. Age/maturity-length key for herring (numbers of fish sampled MFV *Enterprise,* 6 - 25 July 2004)

	Number at age / maturity												
Length (cm)	0	1	2I	2M	3I	3M	4	5	6	7	8	9+	Grand Total
16.5		1											1
17		3											3
17.5		4											4
18		17											17
18.5		14											14
19		7											7
19.5		11											11
20		12											12
20.5		9											9
21		7											7
21.5		4											4
22		2	2										4
22.5		2	2	1	1	2							8
23		1	3	6	7	7							24
23.5			5	24	8	17							54
24			3	32	8	22	2					1	68
24.5			12	40	5	25	5	2				1	90
25			8	31		54	6	1					100
25.5			4	19	1	72	17	6				2	121
26			2	9		74	25	11				1	122
26.5			1	7		62	27	26				2	125
27				2		34	42	51	4		3	4	140
27.5						49	79	151	15	12	19	9	334
28				3		20	75	121	15	33	31	9	307
28.5				1		19	31	79	17	37	34	25	243
29				1		11	25	41	10	19	24	25	156
29.5						4	18	35	7	7	16	14	101
30						1	13	34	7	11	5	7	78
30.5						1	5	20	2	7	12	8	55
31						1	1	6	3	6	13	7	37
31.5						1		3	2	2	5	8	21
32										4	5	6	15
32.5									1		1	5	7
33								1	1		1	3	6
33.5							1		1			4	6
34											1	2	3
34.5								1					1
Grand Total	0	94	42	176	30	476	372	589	85	138	170	143	2315

Table 2A.6. Mean length, mean weight, biomass (thousands of tonnes) and numbers (millions) break-down by age and maturity obtained during the MFV *Enterprise* 2004 herring acoustic survey.

Total area						
Age (ring)	Mean Length (cm)	Mean Weight (g)	Number$x10^6$	%	Biomass$x10^3$ T	%
1	18.98	59.37	568	7	33.73	2
2I	24.58	132.90	95	1	13.16	1
2M	25.00	140.18	452	6	66.55	5
3I	24.00	122.62	55	1	6.73	0
3M	26.08	160.03	2382	29	390.41	28
4	27.15	181.67	1532	19	284.88	20
5	27.58	190.66	2095	26	405.15	29
6	28.16	204.02	184	2	38.19	3
7	28.68	215.88	216	3	47.73	3
8	28.69	216.24	308	4	68.17	5
9+	28.27	208.26	272	3	58.37	4
Mean	25.62	157.76				
Total			8159	100	1413.07	100
Immature			718	9	53.62	4
Mature			7440	91	1359.45	96

Annex 2B: Denmark

Acoustic Herring Survey report for RV "DANA"

29 June2004 – July 2004

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1. Introduction

Since 1991 the Danish institute for Fisheries Research (DIFRES) has participated in the ICES co-ordinated herring acoustic survey of the North Sea and adjacent waters with the responsibility for the surveying the Skagerrak and Kattegat area.

The actual 2004-survey with RV "DANA", covering the Skagerrak and Kattegat, was conducted in the period 1 July to 12 July 2004, while calibration was done during 29 June – 1 July.

2. SURVEY

2.1 Personnel

During calibration 29/6 – 1/7-2004

Bo Lundgren (cruise leader)	HFI
Torben Filt Jensen(assisting cruise leader)	ITT
Teunis Jansen	HFI
Tommy Nielsen	ITT
Bo Tegen Nielsen	ITT
Claus Halle	ADM

During acoustic monitoring 1/7-12/7-2004

Bo Lundgren (cruise leader)	HFI
Torben Filt Jensen (assisting cruise leader)	ITT
Teunis Jansen	ITT
Lise Sindahl	HFI
Helle Rasmussen	HFI
Tommy Kristensen	HFI
Rasmus F. Jensen	HFI
Bo Tegen Nielsen	ITT

HFI = Dept for Marine Fisheries, DIFRES, Denmark
ITT = Dept. of IT and Technical Support, DIFRES, Denmark
ADM = Administration Dept, DIFRES, Denmark

2.2 Narrative

RV "Dana" left Hirtshals on June 29th 2003 at 12.00 for the calibration site in the Gullmar Fjord in Sweden. Some tests of the echosounder equipment and some preparations for the calibration next day were carried underway.

RV "Dana" went to harbour in Frederikshavn on July 1 2004 at 13.00 for exchange of scientific personnel and left again at 18.00 (Danish local time, 16.00 UTC) with a southerly course to start the survey. The survey work (acoustic integration) started at 16.36 UTC on the position 57º 23.20´ N 10º 37.60´ E in the north-western part of the Kattegat. The Kattegat area was covered during July 2 – 3, eastern Skagerrak during July 4 – 6, western Skagerrak during July 7 – 9 and morning of July 12 and the overlap area during July 10 – 11. Short stops just outside Hirtshals on July 5 and just outside Hanstholm on July 7 was done to change personel. Totally the survey covered about 1700 nautical miles mainly using the 38 kHz paravane transducer running at depths of 4 – 6 m depending on the sea state and sailing direction relative to the waves. Simultaneously data from the 120 kHz and 18 kHz echosounders using the hull-mounted transducers were also recorded, but unfortunately the quality of these data were strongly dependent on the weather conditions. During trawling hull-mounted transducers were used for all three frequencies. The acoustic integration ended near the Danish coast in mid-Skagerrak at 06.27 UTC on the position 57º 39.40´ N 09º 44.40´ E. The survey ended in Hirtshals on 10 July 2003 at 11.00 hour.

2.3 Survey design

The survey was carried out in the Kattegat and in the Skagerrak, east of 6° E and north of 56° N (Figure 2B.1). The area is split into 7 sub-areas surveyed by Dana and one overlap area to be surveyed also by the Norwegian and German survey partners. This year the survey was started in the eastern Kattegat and ended in the western Skagerrak in order to reach the overlap area on June 10th at the same time as the other partners. In principal the survey is designed with parallel survey tracks at right angles to the depth lines with a spacing of 10-15 nm in the area west of 10°E. Due to limited time periods and places for fishing (late morning, early afternoon and immediately before and after midnight; limited amount of fishable positions for bottom trawl hauls) this structure cannot not be kept strictly. Along the Swedish coast, the transects are planned as east-west transects with a spacing of 10 nm approximately at right angles to the coastline. In Kattegat the survey track was made in a zigzag way adapted to the depth curves and the relatively heavy ship traffic.

2.4 Calibration

The echo sounders were calibrated at the Bornö Island site in the Gullmar Fjord, Sweden 29 June – 1 July 2004. This year the calibration procedures were different from earlier years because the echosounder equipment had been upgraded to EK60 with three frequencies (18, 38 and 120 kHz) earlier in the year. The modified procedures were introduced during a previous cruise to the North Atlantic with guidance from colleagues at IMR in Bergen, Norway. Calibration of the paravane split-beam transducer at 38 kHz was done with a 60 mm copper sphere. Calibration of the three hull-mounted split-beam transducers at 18, 38 and 120 kHz were carried out with 63mm, 60 mm and 23 mm copper spheres, respectively. As a backup in case of failures in the new system calibration was also carried out with the 60 mm Cu-sphere on the paravane mounted 38 kHz transducer with the previously used EY500 echo sounder. The results were similar to the previous calibration earlier in the year, and for 38 kHz close to results from previous years. The calibration setup of the EK60 38 kHz used to produce the survey data is shown in Table 2B.1.

2.5 Acoustic data collection

Acoustic data were collected using mainly the Simrad EK60 38kHz echosounder with the transducer (Type ES 38 7x7 degrees main lobe) in a towed body. The towed body runs running at approx. 3 m depth in good weather and down to about 6 -7 m as needed depending on the weather conditions. The speed of the vessel during acoustic sampling was 8 – 10 knots. Also EK60 18 kHz

and 120 kHz data were collected, but has not been used for the survey estimate since the data quality is very weather dependent due to the position of the transducers on the hull. Acoustic data were recorded as raw data on hard disk all 24 hours also during fishing operations, but data taken during fishing periods (usually two daytime hauls and two night time hauls (the latter immediately before and after local midnight)) are not used for the biomass estimate. The sampling unit (ESDU) was one nautical mile (nm). For the survey purpose raw data is pre-integrated into 1 m meter samples for each ping and stored as files on hard disk for each 1 nm interval. Integration is conducted from 3 m below the transducer to 1 m above the bottom or usually max 300 m depth. During trawl hauls the towed body is taken aboard and the EK60 38 kHz echosounder run on the hull transducer.

2.6 Biological data - fishing trawls

Trawl hauls were carried out during the survey for species identification. Pelagic hauls were carried out using a FOTÖ trawl (16 mm in the codend) while demersal hauls (Figure 2B.2) were carried out using an EXPO trawl (16 mm in the codend). Trawling was carried out in the time intervals 1000 to 1800h and 2200 to 0300h UTC (Table 2B.2). The trawling strategy was made in a way that most depth zones were covered with in each geographical stratum (see Figure 2B.2). In the deeper areas mid water hauls were made to identify until which depth herring will be found. 1 hour hauls were used as a standard during the survey, but sometimes shortened if the catch indicators indicated very large catches.

The fish caught were sorted into species groups and length groups within each species. Numbers and weight for each length group for each species was recorded with emphasis on pelagic species. The clupeid fish were measured to the nearest 0.5 cm total length below other fish to 1 cm and the weight to nearest 0.1g wet weight. In each trawl haul 10 (if available) herring per 0.5 cm length class were sampled for determination of age, race (North Sea autumn spawners or Baltic Sea spring spawners) and maturity. Micro-structure formed during the larval period were used for the discrimination of herring race. Maturity was determined according to an 8-stage scale as also used by Scotland (see Survey Manual Annex 4.

2.7 Hydrographic data

CTD profiles with a Seabird 911 were made immediately before or after each trawl haul. Salinity and temperature were measured continuously during the cruise at an intake at about 5 m depth. Data is stored together with position and weather data in the vessel's general information system The distribution of CTD stations is shown in Figure 2B.4.

2.8 Data analysis

The raw data is pre-integrated into 1m samples for each ping and divided into 1 mile datasets and stored on hard disk as files. Scrutiny of the acoustic data is done for a fixed set of layers (3–6 m, 6-10, 10 – 20 and so on) for each mile, using special judging software. It allows deleting layers and/or intervals with interference from wave- or ship wake-bubbles or rarely with bottom-integration. In areas with heavy abundance of jellyfish or zooplankton, usually krill, manually adjustable thresholds is applied separately to each layer to suppress background echoes

For each sub area the mean back scattering cross section was estimated for herring, sprat, gadoids and mackerel based on the TS relationships given in the Manual for Herring Acoustic Surveys in ICES Division III, IV, and IVa (ICES 2000):

$$\text{Herring TS} = 20 \log L - 71.2 \text{ dB}$$
$$\text{Sprat TS} = 20 \log L - 71.2 \text{ dB}$$
$$\text{Gadoids TS} = 20 \log L - 67.5 \text{ dB}$$
$$\text{Mackerel TS} = 20 \log L - 84.9 \text{ dB}$$

where L is the total length in cm. The number of fish per species is assumed to be in proportion to the contribution of the given species in the trawl hauls. Therefore, the relative density of a given species is estimated by Subarea using the species composition in the trawl hauls. The nearest trawl hauls are allocated to Subareas with uniform depth strata. The length-race and length-age distributions for herring are assumed to be in accordance with the length-race and length-age distributions in the allocated trawl hauls.

Length-weight relationships by race for the herring were made based on the single fish sampled in each haul and frozen for later for micro-structure analysis of the otolith after the cruise.

3. Results and discussion

3.1 Acoustic data

The total number of acoustic sample units of 1 nm (ESDUs) used in the stock size calculation is about 1300. Herring and sprat was not observed in mid-water trawl hauls at depths below 150 meters. Therefore, layers below 150 meter were excluded from the estimation.

3.2 Biological data

35 hauls were conducted (18 surface hauls, 3 mid water hauls and 14 bottom hauls, two of which were unsuccessful (Figure IIB.2 and Tables 2B2 and 2B.3.). The total catch was 14 tons of which about on third was jellyfish and one third clupeids. Herring was present in 30 of the hauls and was the dominant catch in the fishery with a total catch at 4602 kg. No herring was present in hauls below 150 m depths. Blue whiting, mackerel, invertebrates (krill, shrimp, Norway lobster) and saithe, were the most common among the remaining species with a total catch of 1,515 kg, 428 kg, 679 kg and 241 kg respectively. They were mainly taken in the bottom and pelagic hauls, while mackerel and garfish were taken in surface hauls. Jellyfish were sometimes present in high quantities in the catches totally almost 5 tonnes. In the southern Kattegat totally 127 kg of sprat was taken. For herring the total catch was 4.6 tons which is somewhat higher than last year.

Based on maturity analysis of frozen single fish samples from each haul, where micro-structure analysis of the otoliths was used to differentiate between North Sea herring and Western Baltic herring, the maturity by age key was made for both races is given in the text table below. In accordance with the survey manual both North Sea autumn spawners and Baltic spring-spawners at maturity state 3 and up have been considered as mature. The following constants have been used to split the catch.

North Sea autumn spawners:

WR	0im	1im	1ma	2im	2ma	3im	3ma	4	5
%	100	99	1	58	42	61	39	100	100

Western Baltic spring spawners:

WR	0im	1im	1ma	2im	2ma	3im	3ma	4	5	6	7	8	9+
%	100	100	0	96	4	90	10	100	100	100	100	100	100

Figure **2B.4.a** shows the length-weight relations for various age groups an the average for the two races based on the single fish data. The trendline estimates are based on the points of the average relations. Figure **2B.4.b** shows the length-weight relations for sprat.

Table **2B.4.a** shows the size distribution and total number of herring in each trawl haul based on the total catch for small catches or on subsamples raised to total catch for large samples. Table **2B.4.b** shows the corresponding total catches.

3.3 Biomass estimates

The total herring biomass estimate for the survey is 274,000 tonnes of which 28% or 78,000 tonnes is North Sea autumn spawning herring and 72% or 196,000 tonnes is Western Baltic spring spawning herring.

The estimated total number of herring, mean weight and mean length per age and maturity group in each of the surveyed strata for the two herring stock components in the are given in Table **2B.5.a**, **b, and c.** Stratum 560E06 is the overlap area and the others together is the standard Danish survey area.

Figures **2B.5.a and b** shows plots of the estimated number of herring per stratum and the total with and without the overlap area.

Stratum overview Acoustic Herring Survey RV "Dana" Cruise 07/04 July 2004

Stratum Nr	Stratum ID	Area Nm^2	Number of logs	Hauls in stratum	Hauls from neighbour strata	Total hauls used	Mean Sa	Mean TS
3	570E08	3406	266	7	4	11	272.5319	-42.40
4	570E06	3600	319	7	4	11	155.0617	-44.16
5	580E08	1822	142	2	5	7	57.68696	-42.28
6	580E06	209	11	1	2	3	201.8364	-42.62
7	C	988	97	2	3	5	198.3685	-44.36
8	D	1837	178	2	8	10	469.1892	-42.66
9	E	5228	385	9	-1	8	152.638	-46.86
Overlap	560E06	3980	270	4	4	8	86.06304	-44.49

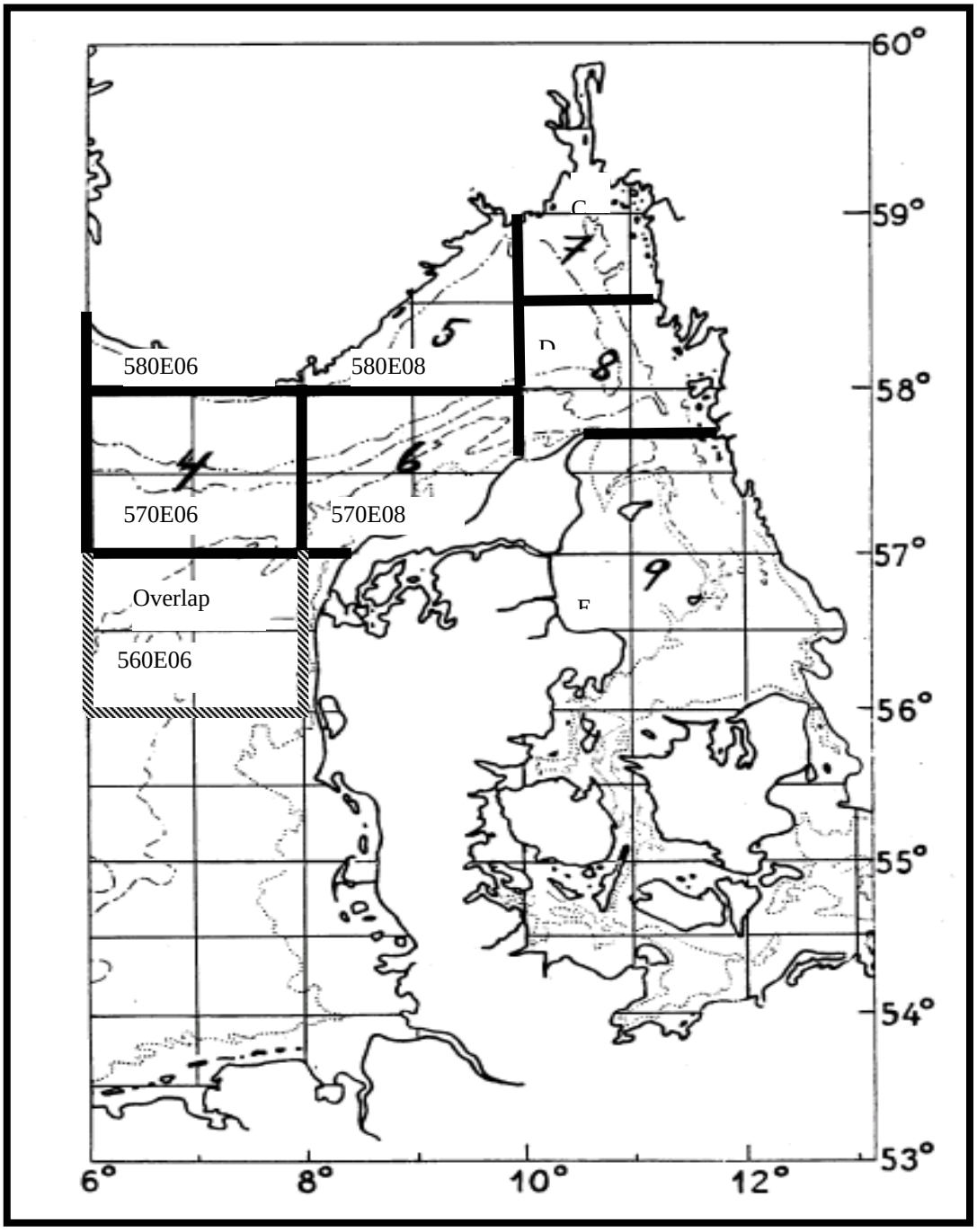


Figure 2B.1. Map of the eastern North Sea, Skagerrak and Kattegat showing the sub areas used in the estimation during the July Danish acoustic survey of RV "Dana" 2004.

Cruise track and stations during the Acoustic Herring Survey RV "Dana" Cruise 07/04 July 2004

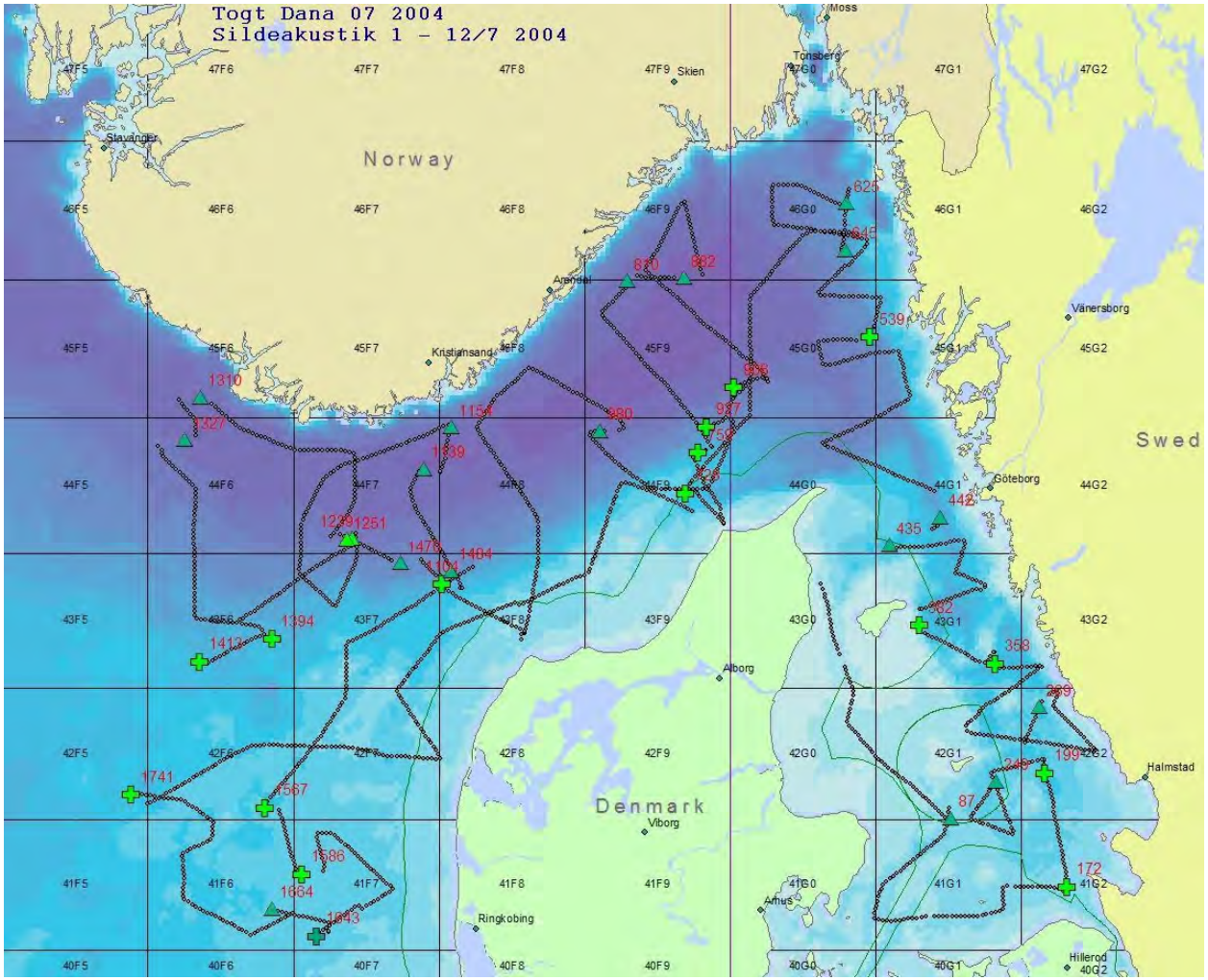


Figure 2B.2. Map of the eastern North Sea, Skagerrak and Kattegat showing cruise track, the location of stations (trawl hauls and CTD stations) during the July 2004 Danish acoustic survey (Fotö hauls ▲ are pelagic and Expo hauls ╬ are demersal, Red numbers are haul IDs cumulative sailed distance along the track in nm). Bathymetry from: The MAST project DYNOCS MAST II contract No MAS2-CT94-0088.

Density in numbers of herring during the Acoustic Herring Survey RV "Dana" Cruise July 2004

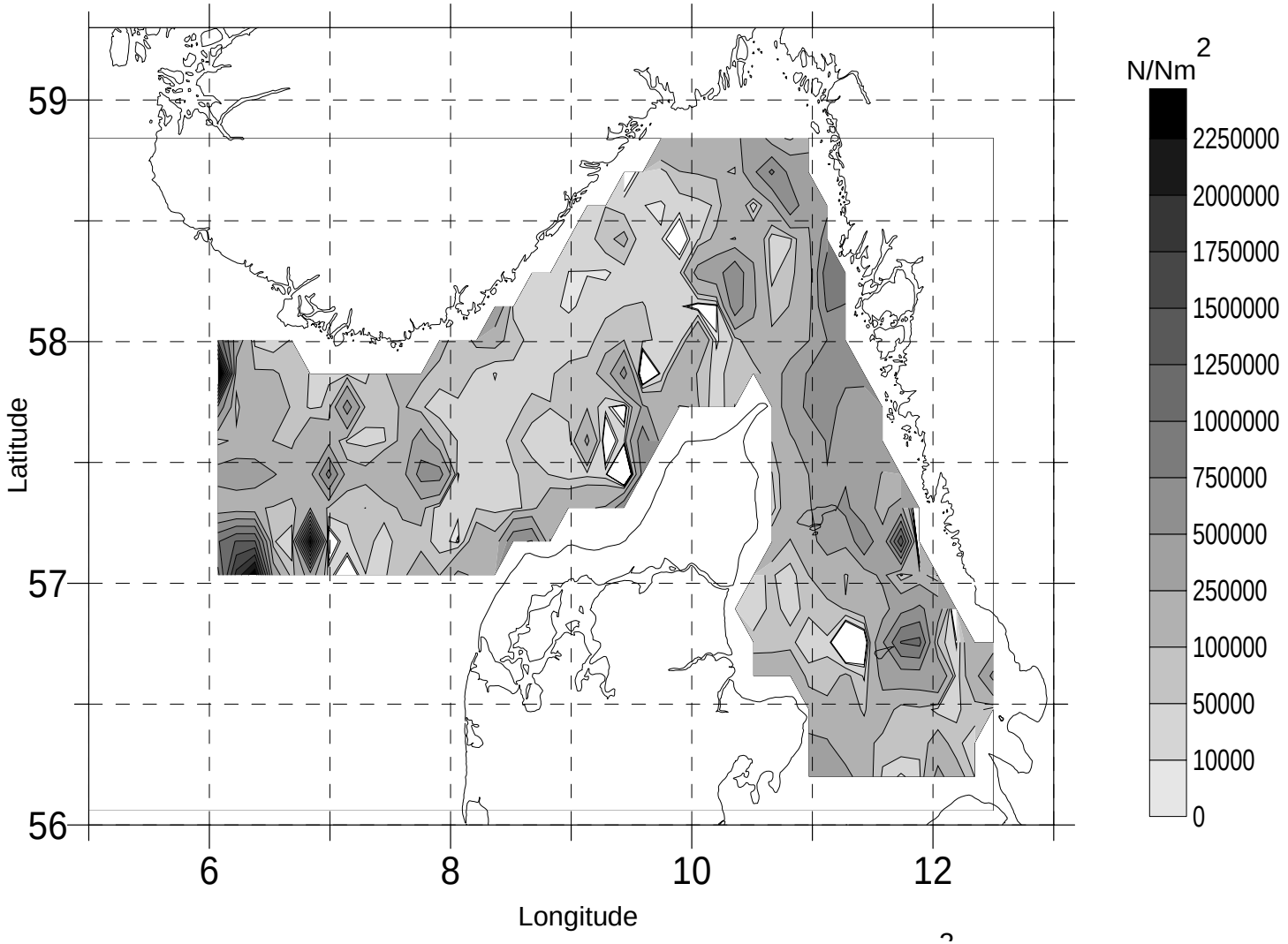


Figure 2B.3.a Contoured density (N/nm²) of herring from the July 2004 Danish acoustic survey in the eastern North Sea, Skagerrak and Kattegat.

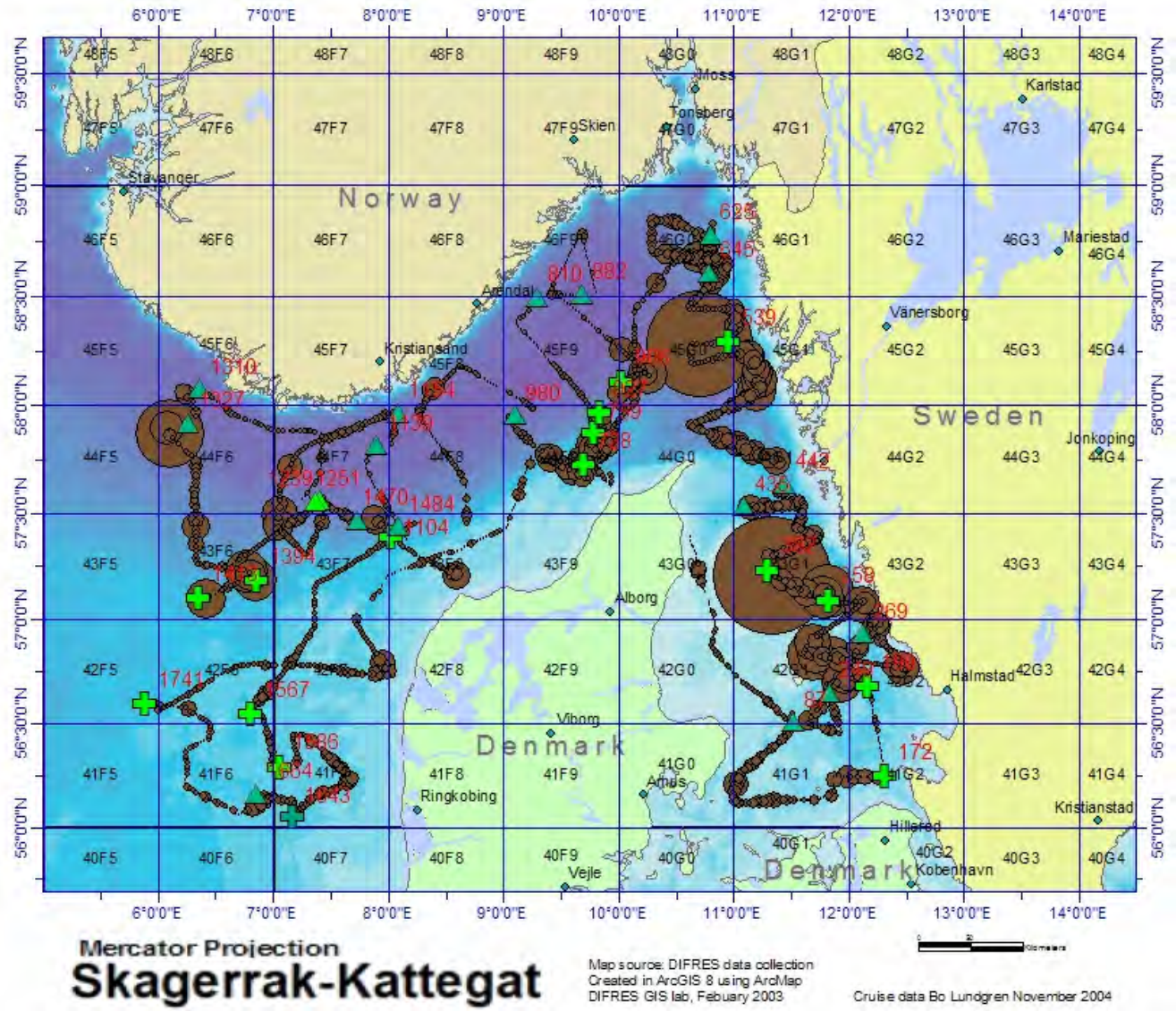
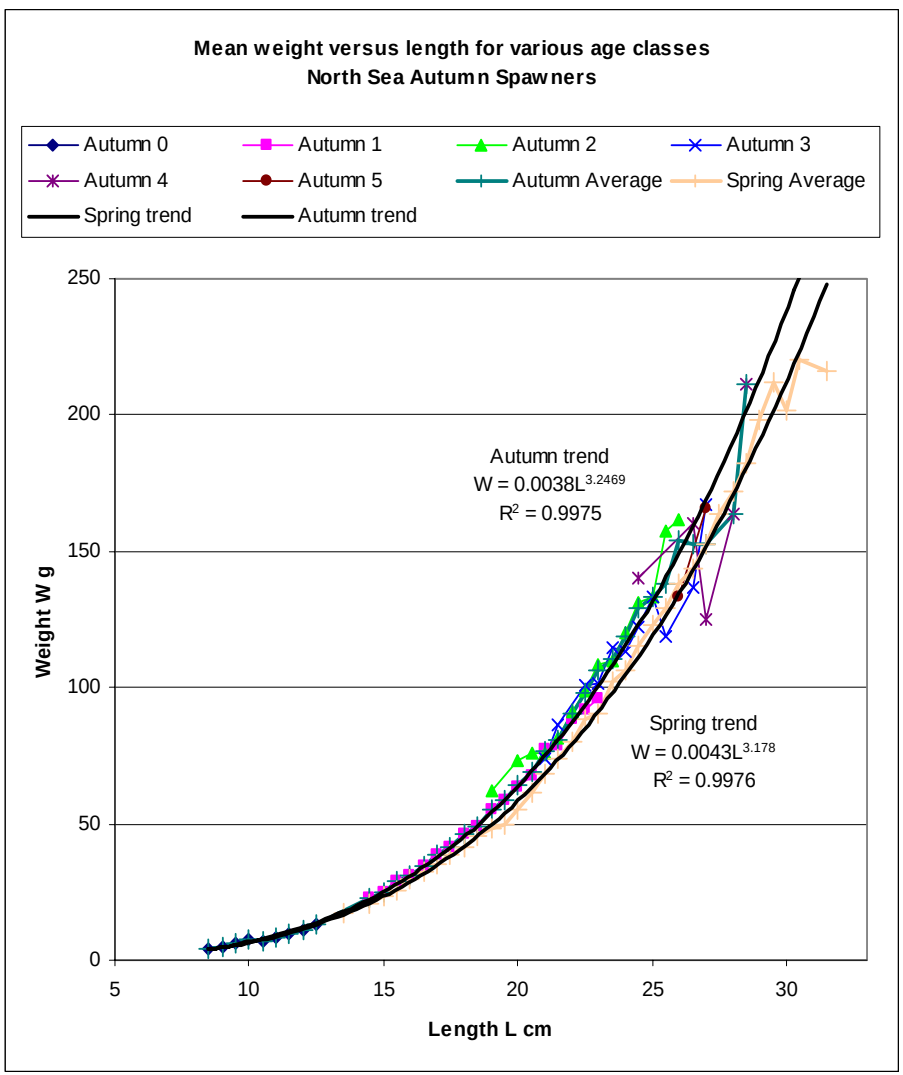


Figure 2B.3.b Relative herring density (in numbers per nm²) along the track of the July 2004 Danish acoustic survey in the eastern North Sea, Skagerrak and Kattegat. Brown circles indicate relative density of herring per ESDU (1 nm).



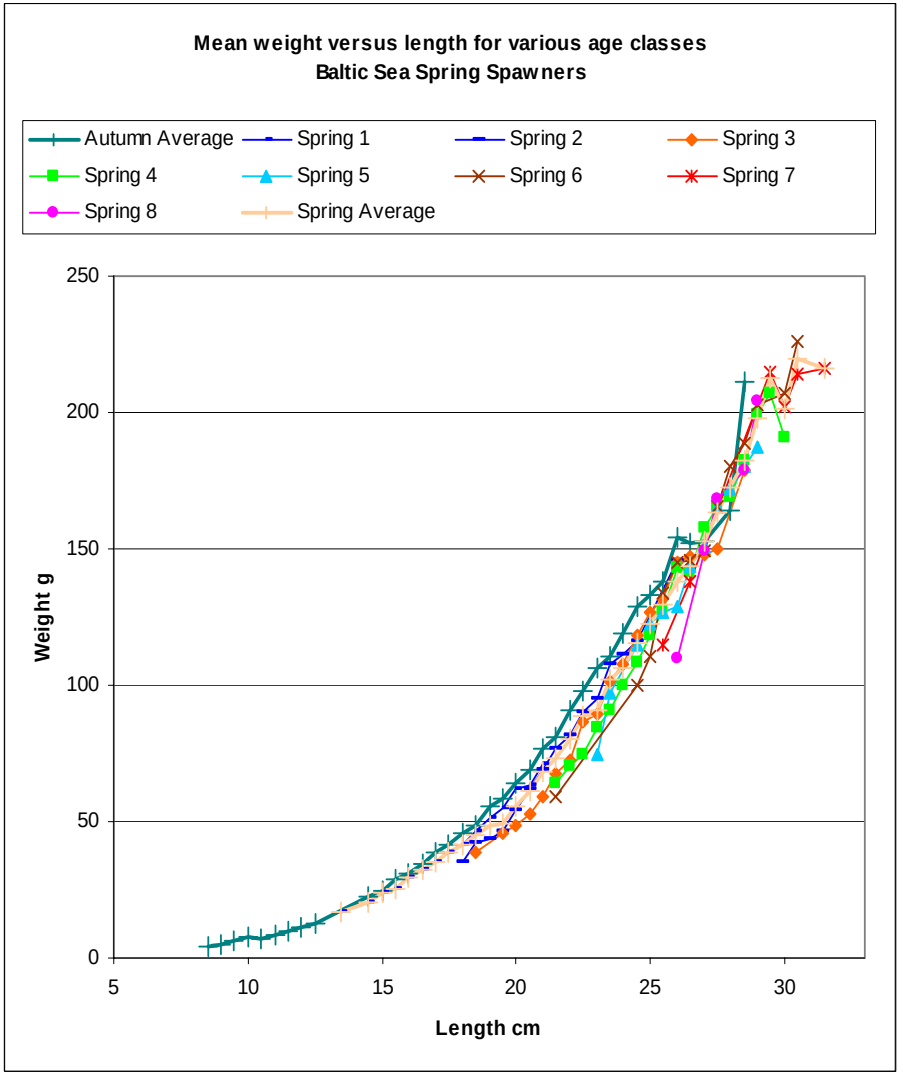


Figure 2B.4.a Length weight relationship by winter ring numbers for herring from the July 2004 Danish acoustic survey.

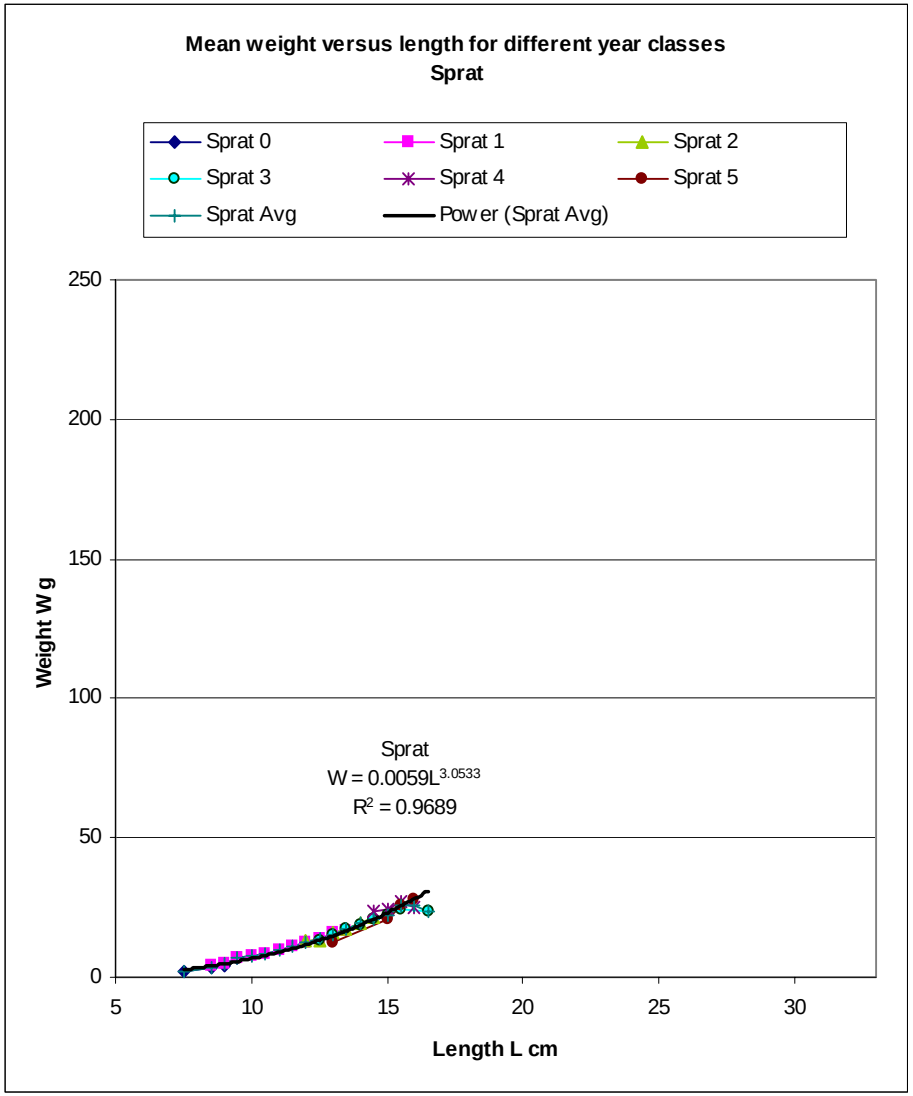


Figure 2B.4.b Length weight relationship by winter ring numbers for sprat from the July 2004 Danish acoustic survey.

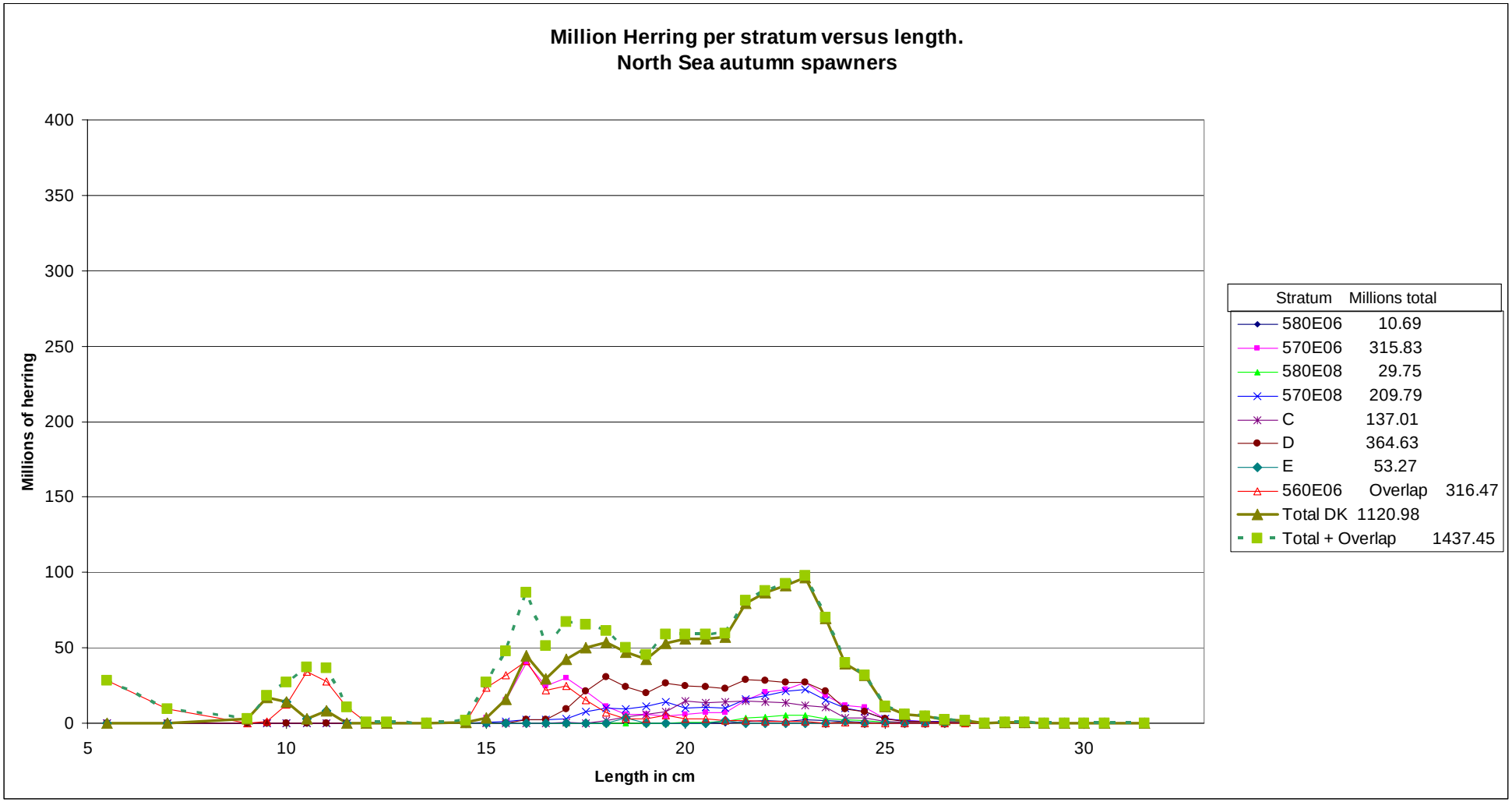


Figure 2B.5.a Estimated number of herring per length group in various strata from the July 2004 Danish acoustic survey.

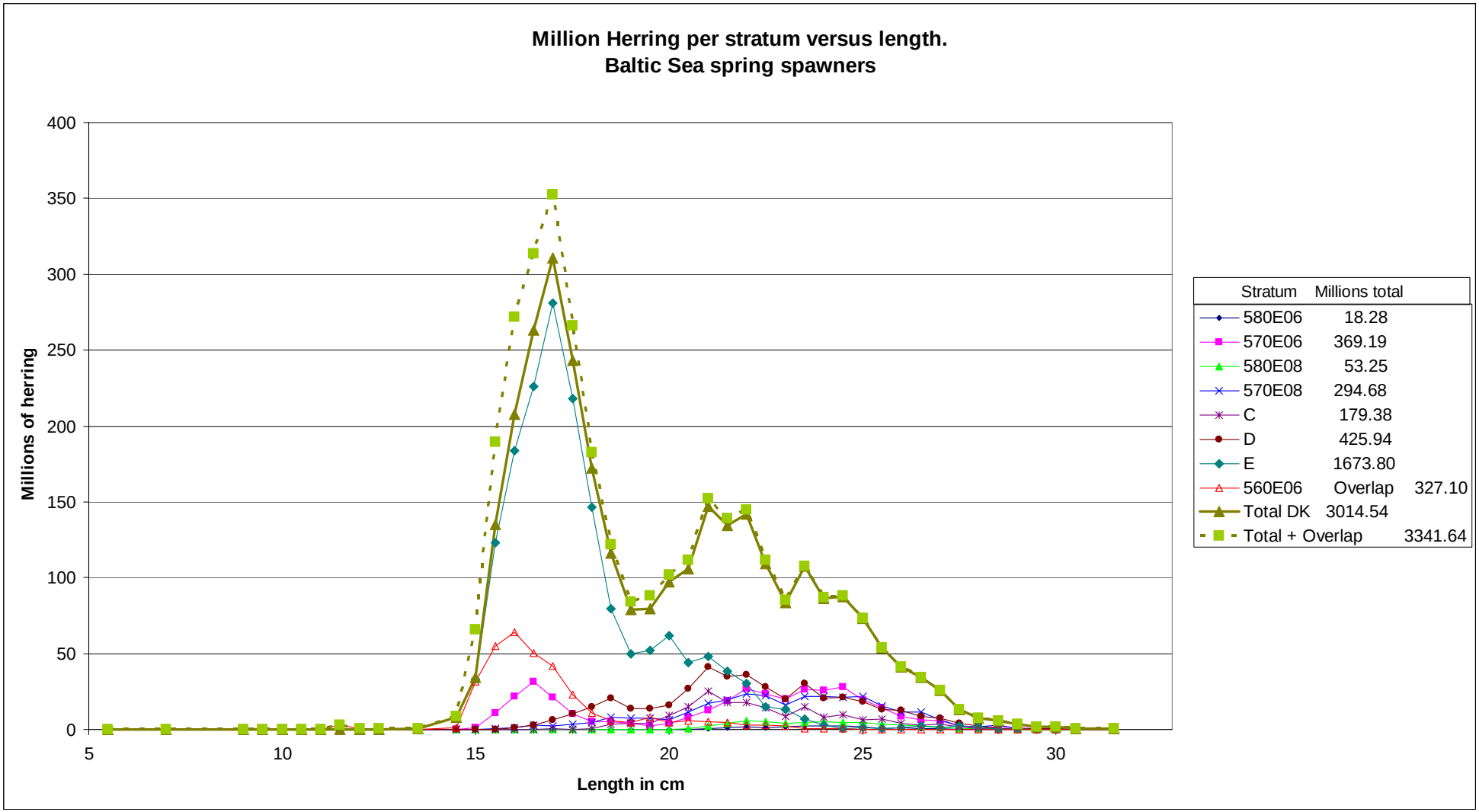


Figure 2B.5.b Estimated number of herring per length group in various strata from the July 2004 Danish acoustic survey.

Table 2B.1. Simrad EK60 and analysis settings used during the Acoustic Herring Survey RV "Dana" Cruise July 2004.

Transceiver Menu	
Frequency	38 kHz
Sound speed	1491 $m.s^{-1}$
Max. Power	2000 W
Equivalent two-way beam angle	-20.5 dB
Default Transducer Sv gain	24.59 dB
3 dB Beam width	6.9°
Calibration details	
TS of sphere	-33.6 dB
Range to sphere in calibration	9.17 m
Measured NASC value for calibration	23100 m^2/nmi^2
Calibration factor for NASCs	1.00
Log Menu	
Distance	1,0 n.mi. using GPS-speed
Operation Menu	
Ping interval	1 s external trig
Analysis settings	
Bottom margin (backstep)	1.0 m
Integration start (absolute) depth	7 - 9 m
Range of thresholds used	-70 dB

Table 2B.2. Trawl hauls during the Acoustic Herring Survey RV "Dana" Cruise July 2004.

Haul ID	Date Time UTC	Sun time	ICES square	Lat N	Long E	Trawl	Catch Depth	Mean BDepth	Wire length	Door span m	Trawling duration	Catch kg	Main Species	Speed kn	Course deg	Wind m/s	Wind deg	Sea Bead
87	02-07-04 01:30	02:16	42G1	56.30.400	011.31.555	fotø	surface	27.3	300	70	48	2000	Jellyfish, Sprat, Herring, Mackerel, Common Weaver	4.1	345	9	251	2
172	02-07-04 10:33	11:22	41G2	56.14.778	012.19.143	expo	bottom	26	250	68	30	650	Jellyfish, Whiting, Sprat, Herring, Anchovy	3	346	8	247	3
199	02-07-04 14:05	14:53	42G2	56.40.754	012.10.034	expo	bottom	42.8	300	72	60	208	Jellyfish, Herring, Cod, Whiting, Plaice, Sprat	2.9	319	8	242	3
249	02-07-04 21:28	22:15	42G1	56.38.824	011.50.098	fotø	surface	36	300	70	30	220	Jellyfish, Herring, Sprat, Common Weaver	3.7	220	7	220	2
269	03-07-04 00:12	01:00	42G2	56.55.647	012.07.740	fotø	surface	49	300	75	30	1400	Jellyfish, Herring, Sprat, Garfish, Mackerel	4	26	4	227	2
358	03-07-04 10:30	11:17	43G1	57.05.432	011.49.516	expo	X	58.4	350	77	59		Trawl torn	3		5	146	2
382	03-07-04 14:17	15:02	43G1	57.14.090	011.18.180	expo	bottom	30.2	270	63	60	296	Common Weaver, Sprat, Jellyfish, Dab, Whiting, Herring	3.2	221	5	209	1
435	03-07-04 21:19	22:03	44G1	57.31.860	011.05.959	fotø	surface	40.7	330	70	60	380	Jellyfish, Herring, Mackerel, Garfish	3.7	55	5	286	2
442	04-07-04 00:22	01:07	44G1	57.38.072	011.27.034	fotø	surface	86.1	330	74	60	903	Jellyfish, Herring, Mackerel, Horse Mackerel	3.9	349	4	243	2
539	04-07-04 11:57	12:40	45G0	58.17.661	010.57.882	expo	bottom	111.8	500	82	22	425	Krill, Saithe, Cod, Dogfish, Whiting, Blue Whiting, Norway Pout, Herring, (Common Weaver), Pearlside	2.9	43	5	237	2
625	04-07-04 21:20	22:03	46G0	58.46.571	010.48.308	fotø	surface	79.2	375	82	60	450	Jellyfish, Herring, Mackerel, Garfish	3.7	92	9	219	3
645	05-07-04 00:44	01:27	46G0	58.36.453	010.47.710	fotø	surface	84.6	375	70	60	465	Jellyfish, Herring, Mackerel, Lumpsucker	4.2	47	7	229	3
728	05-07-04 10:15	10:53	44F9	57.43.485	009.41.900	expo	bottom	35.9	300	72	30	75	Dab, Whiting, Jellyfish, Herring, Cod, Gurnards, Horse Mackerel	3.5	54	11	256	4
759	05-07-04 14:33	15:12	44F9	57.52.366	009.47.218	expo	bottom	60	400	77	45	990	Herring, Haddock, Saithe, Cod, Flatfish	3.4	75	9	263	4
810	05-07-04 21:37	22:14	46F9	58.29.788	009.17.814	fotø	surface	452.1	390	80	60	312	Herring, Jellyfish, Mackerel, Garfish	2.4	60	5	262	2
882	06-07-04 00:23	01:01	46F9	58.30.504	009.41.260	fotø	surface	592.9	425	80	60	200	Herring, Jellyfish and Krill, Garfish, Lumpsucker, Saithe, Mackerel	3.7	92	7	297	3
906	06-07-04 10:44	11:24	45G0	58.06.719	010.01.744	expo	bottom	201	860	89	60	1407	Blue Whiting, Shrimps, Saithe, Vahls Eelpout, Lumpsucker, Cod, Haddock	2.7	69	7	268	4
927	06-07-04 14:32	15:11	44F9	57.58.040	009.50.590	expo	bottom	100.8	640	78	60	322	Jellyfish, Herring, Saithe, Norway Pout, Haddock, Lumpsucker, Hake	3.3	69	12	261	5
980	06-07-04 23:34	00:10	44F9	57.57.151	009.06.796	fotø	surface	459.8	420	86	61	290	Blue Whiting, Herring, Jellyfish, Lumpsucker, Saithe, Mackerel	3.7	88	12	283	5
1104	07-07-04 14:52	15:24	43F8	57.23.220	008.01.259	expo	X	71.4	500	91	60		Trawl torn	3		11	301	5
1139	07-07-04 21:25	21:56	44F7	57.48.736	007.53.955	fotø	surface	513.2	350	89	61	680	Herring, Mackerel, Jellyfish, Saithe, Lumpsucker, Blue Whiting, Garfish	3	104	6	301	4
1154	08-07-04 00:23	00:55	44F8	57.57.902	008.05.575	fotø	surface	520.7	400	78	66	265	Herring, Mackerel, Jellyfish, Garfish, Lumpsucker	1.7	101	2	295	3

Table 2B.2. Continued. Trawl hauls during the Acoustic Herring Survey RV "Dana" Cruise July 2004.

Haul ID	Date Time UTC	Sun time	ICES square	Lat N	Long E	Trawl	Catch Depth	Mean BDepth	Wire length	Door span m	Trawling duration	Catch kg	Main Species	Speed kn	Course deg	Wind m/s	Wind deg	Sea Bead
1239	08-07-04 10:37	11:06	44F7	57.33.442	007.24.534	fotø	230-250	263.4	1140	112	60	75	Jellyfish, Saithe, Blue Whiting, Shrimp, Lumpsucker, Krill, Pearlside	3.6	285	8	76	2
1251	08-07-04 13:09	13:38	44F7	57.33.112	007.22.143	fotø	138-158	259	915	109	60	115	Saithe, Pearlside, Krill, Lumpsucker	3.5	281	10	57	3
1310	08-07-04 21:28	21:53	45F6	58.04.506	006.22.160	fotø	surface	343	470	80	60	430	Herring, Krill and Jellyfish, Blue Whiting, Lumpsucker, Mackerel, Dogfish	4.2	276	9	52	4
1327	09-07-04 00:29	00:54	44F6	57.55.109	006.15.591	fotø	surface	309.1	415	83	60	480	Herring, Krill and Jellyfish,Blue Whiting, Garfish, Mackerel	4.5	259	13	85	4
1394	09-07-04 10:24	10:51	43F6	57.11.008	006.51.306	expo	bottom	66.1	400	80	30	260	Herring, Haddock, Jellyfish, Whiting	3.1	313	4	76	3
1413	09-07-04 13:47	14:12	43F6	57.05.987	006.21.396	expo	bottom	61.2	400	86	61	295	Herring, Dab, Haddock, Cod, Jellyfish, Gurnard, Flatfish	3.1	311	2	130	2
1470	09-07-04 21:39	22:09	43F7	57.27.995	007.44.353	fotø	surface	157	375	72	62	380	Herring, Blue Whiting, Krill and Jellyfish, Mackerel, Lumpsucker, Garfish	3.8	81	1	351	2
1484	10-07-04 00:23	00:55	43F8	57.26.143	008.05.567	fotø	surface	91.5	375	72	60	240	Herring, Jellyfish, Mackerel, Garfish, Lumpsucker	4.6	78	4	59	2
1567	10-07-04 10:38	11:05	42F6	56.32.859	006.48.374	expo	bottom	41.8	360	77	50	73	Gurnards, Jellyfish, Whiting, Dab, Hake, Horse Mackerel, Cod	3.6	84	8	293	4
1586	10-07-04 13:56	14:24	41F7	56.17.625	007.03.584	expo	pelagic	34	290	67	60	10	Jellyfish, Gurnards, Herring, Sprat (small catch)	4.2	79	11	290	4
1643	10-07-04 21:38	22:06	41F7	56.03.347	007.09.925	expo	surface	29.1	300	68	31	8	Jellyfish, Mackerel, Garfish, Herring (very small catch)	4.1	64	12	268	5
1664	11-07-04 00:34	01:01	41F6	56.09.636	006.51.611	fotø	surface	37.4	320	72	60	83	Mackerel, Horse mackerel, Garfish, Jellyfish, Herring, Gurnards,	4.2	111	9	271	5
1741	11-07-04 10:34	10:57	42F5	56.35.829	005.53.206	expo	bottom	51.1	400	83	60	230	Herring, Dab, Jellyfish, Flatfish, Whiting, Gurnards	3.3	118	10	316	5

Table 2B.3. Trawl haul species composition in kg during the Acoustic Herring Survey RV "Dana" Cruise July 2004.

Weight Total Kg	Station	87	172	199	249	269	382	435	442	539	625	645	728	759	810	882	906
	Fishing depth	surface	bottom	bottom	surface	surface	bottom	surface	surface	bottom	surface	surface	Bottom	bottom	surface	surface	bottom
	Gear Type	Fotø	Expo	Expo	Fotø	Fotø	Expo	Fotø	Fotø	Expo	Fotø	Fotø	Expo	Expo	Fotø	Fotø	Expo
	Area	E	E	E	E	E	E	E	E	D	C	C	570E08	570E08	580E08	580E08	D
Species	ICES Sq	42G1	41G2	42G2	42G1	42G2	43G1	44G1	44G1	45G0	46G0	46G0	44F9	44F9	46F9	46F9	45G0
Scyphozoa		1962.400	547.976	153.556	153.154	1308.232	21.708	257.502	537.206		320.660	217.610					
Clupea harengus		16.352	18.280	27.694	49.694	84.223	12.938	112.803	320.135	5.530	106.692	211.202	3.160	945.685	263.558	141.691	
Micromesistius poutassou										7.035							1196.952
Scomber scombrus		2.787			0.254	0.999		4.574	42.207	0.158	16.900	30.500			20.223	1.140	
Invertebrata													5.626		22.229	34.330	
Euphausiidae										299.393							
Pollachius virens										49.500				9.700		6.480	36.600
Trachinus draco		1.481	5.296	0.068	2.052	0.704	154.844			4.400		0.202	0.664				
Limanda limanda			4.342	0.630	0.050		20.859						33.298	4.050			
Sprattus sprattus		16.356	29.567	0.856	14.030	4.714	61.262	0.162	0.304								
Cyclopterus lumpus			1.022		0.160					0.804		4.800				7.940	12.600
Merlangius merlangus		0.050	32.631	5.096	0.210	0.091	17.656	0.476	0.428	10.900	0.406	0.132	23.250		0.096		
Pandalus borealis																	101.628
Gadus morhua			1.094	17.800			0.318			23.900			3.152	7.100			11.100
Belone belone					0.178	1.101		4.244		0.052	3.774	0.570			5.850	8.410	
Melanogrammus aeglefinus				0.154	0.010			0.010		0.968			0.690	18.295	0.012		6.907
Maurolicus muelleri										3.505					0.018		0.113
Trachurus trachurus							0.859	0.190	2.052				1.532				
Lycodes vahlii																	36.097
Eutrigla gurnardus		0.057		0.034			0.492						1.646				
Trisopterus esmarkii				0.220						5.860							0.301
Squalus acanthias										11.900							
Hippoglossoides platesso				0.200									0.246	3.042			0.151

Table 2B.3. Continued. Trawl haul species composition in kg during the Acoustic Herring Survey RV "Dana" Cruise July 2004.

Species	ICES Sq	42G1	41G2	42G2	42G1	42G2	43G1	44G1	44G1	45G0	46G0	46G0	44F9	44F9	46F9	46F9	45G0
Engraulis encrasicolus		0.039	9.808		0.200		0.087	0.042	0.113				0.028				
Pleuronectes platessa			0.124	1.414			3.193						0.482	1.172			
Merluccius merluccius										0.032			0.478	0.200			
Pasiphaea sp.																	
Hyperoplus lanceolatus		0.061															
Microstomus kitt				0.272						0.184			0.664	0.794			
Sardina pilchardus																	
Myxine glutinosa																	1.769
Salmo trutta											1.560						
Cephalopoda																	0.412
Scophthalmus rhombus							1.224										
Glyptocephalus cynogloss																	0.910
Enchelyopus cimbrius																	0.866
Raja radiata										0.794							
Trigla lucerna									0.552								
Solea vulgaris							0.531										
Nephrops norvegicus										0.066							0.404
Notoscopelus kroeyeri																	
Zeugopterus punctatus																	0.169
Buglossidium luteum																	
Ammodytidae																	
Grand Total		1999.582	650.141	207.994	219.992	1400.064	295.972	380.003	902.998	424.981	449.992	465.016	74.916	990.038	311.986	199.991	1406.978

Table 2B.3. continued. Trawl haul species composition in kg during the Acoustic Herring Survey RV "Dana" Cruise July 2004.

Weight Total Kg	Station	927	980	1139	1154	1239	1251	1310	1327	1394	1413	1470	1484	1567	1586	1643	1664	1741	Total	Max
	Fishing depth	bottom	surface	surface	surface	230-250	138-158	surface	surface	bottom	bottom	surface	surface	bottom	Pelagic	surface	surface	bottom	Survey	Survey
	Gear Type	Expo	Fotø	Fotø	Fotø	Fotø	Fotø	Fotø	Fotø	Expo	Expo	Fotø	Fotø	Expo	Expo	Expo	Fotø	Expo		
	Area	570E08	570E08	570E06	570E08	570E06	570E06	580E06	570E06	570E06	570E06	570E06	570E08	560E06	560E06	560E06	560E06	560E04		
Species	ICES Sq	44F9	44F9	44F7	44F8	44F7	44F7	45F6	44F6	43F6	43F6	43F7	43F8	42F6	41F7	41F7	41F6	42F5		
Scyphozoa		176.576		22.048	73.044	33.354							88.015		5.084	4.840	3.802		5886.768	1962.400
Clupea harengus		66.294	93.974	546.369	92.400			274.072	329.340	241.447	211.312	127.614	126.294	0.318	2.118	0.102	0.522	170.849	4602.662	945.685
Micromesistius poutassou			115.623	5.631	0.428	10.816		52.391	34.331			91.947							1515.154	1196.952
Scomber scombrus			2.662	88.847	84.200			2.430	6.520			64.403	18.428	0.668		1.664	38.480		428.043	88.847
Invertebrata			15.397					96.584	97.065	3.747	5.671	70.448		18.424				7.854	377.375	97.065
Euphausiidae						3.916	16.879												320.187	299.393
Pollachius virens		36.730	28.600	7.600		12.200	54.500												241.910	54.500
Trachinus draco																			169.711	154.844
Limanda limanda										0.304	33.348			5.460				38.226	140.567	38.226
Sprattus sprattus															0.097				127.349	61.262
Cyclopterus lumpus		6.500	33.700	6.500	1.020	5.300	5.154	3.214				22.500	1.924						113.138	33.700
Merlangius merlangus		1.710	0.061	0.141	0.308	0.014		0.285	0.224	1.706	1.600	0.356	0.656	10.098	0.026		0.006	3.404	112.018	32.631
Pandalus borealis																			101.628	101.628
Gadus morhua		0.462								0.144	17.700			3.788				0.072	86.630	23.900
Belone belone				2.854	13.600			0.214	11.840			2.756	2.824	0.468		0.998	6.555		66.288	13.600
Melanogrammus aeglefinus		11.910				0.006			0.032	12.486	11.778		0.036	0.184				0.322	63.800	18.295
Maurolicus muelleri		0.008	0.009			0.298	38.467												42.418	38.467
Trachurus trachurus														3.850		0.434	33.431		42.348	33.431

Table 2B.3. Continued. Trawl haul species composition in kg during the Acoustic Herring Survey RV "Dana" Cruise July 2004.

Species	ICES Sq	44F9	44F9	44F7	44F8	44F7	44F7	45F6	44F6	43F6	43F6	43F7	43F8	42F6	41F7	41F7	41F6	42F5		
Lycodes vahlii																			36.097	36.097
Eutrigla gurnardus											2.474			19.510	2.960		0.296	2.371	29.840	19.510
Trisopterus esmarkii		18.102				0.076					0.279								24.838	18.102
Squalus acanthias								0.644											12.544	11.900
Hippoglossoides platesso											0.512			0.120				6.516	10.786	6.516
Engraulis encrasicolus																			10.316	9.808
Pleuronectes platessa											2.242			1.362					9.989	3.193
Merluccius merluccius		2.958												4.900				0.372	8.940	4.900
Pasiphaea sp.						8.777													8.777	8.777
Hyperoplus lanceolatus										0.090	6.137			1.260					7.548	6.137
Microstomus kitt		0.462								0.080	1.928								4.384	1.928
Sardina pilchardus													1.828				0.152		1.980	1.828
Myxine glutinosa																			1.769	1.769
Salmo trutta																			1.560	1.560
Cephalopoda		0.184						0.162	0.721										1.479	0.721
Scophthalmus rhombus																			1.224	1.224
Glyptocephalus cynogloss																			0.910	0.910
Enchelyopus cimbrius																			0.866	0.866
Raja radiata																			0.794	0.794
Trigla lucerna																			0.552	0.552
Solea vulgaris																			0.531	0.531
Nephrops norvegicus																			0.470	0.404
Notoscopelus kroeyeri						0.230													0.230	0.230

Table 2B.3. Continued. Trawl haul species composition in kg during the Acoustic Herring Survey RV "Dana" Cruise July 2004

Species	ICES Sq	44F9	44F9	44F7	44F8	44F7	44F7	45F6	44F6	43F6	43F6	43F7	43F8	42F6	41F7	41F7	41F6	42F5		
Zeugopterus punctatus																			0.169	0.169
Buglossidium luteum																0.006			0.006	0.006
Ammodytidae																	0.004		0.004	0.004
Grand Total		321.896	290.025	679.989	265.000	74.988	115.000	429.996	480.074	260.004	294.982	380.024	240.006	70.410	10.285	8.044	83.248	229.986	14614.600	1999.582

Table 2B.4.a Raised length frequency composition by stratum and trawl station for the Acoustic Herring Survey RV "Dana" Cruise July 2004.

	560E04	560E06				570E06					570E08							580E06	580E08		C		D	E								
	42F5	41F6	41F7		42F6	43F6		43F7	44F6	44F7	43F8	44F8	44F9					45F6	46F9		46G0		45G0	41G2	42G1		42G2		43G1	44G1		
	1741	1664	1586	1643	1567	1394	1413	1470	1327	1139	1484	1154	728	759	927	980	1310	810	882	625	645	539	172	87	249	199	269	382	435	442		
Length	EXPO	FOTØ	EXPO	EXPO	EXPO	EXPO	EXPO	FOTØ	FOTØ	FOTØ	FOTØ	FOTØ	EXPO	EXPO	EXPO	FOTØ	FOTØ	FOTØ	FOTØ	FOTØ	FOTØ	EXPO	EXPO	FOTØ	FOTØ	EXPO	FOTØ	EXPO	FOTØ	FOTØ	Total
5.5				3																											3
7				1																											1
9																												5			5
9.5			5																									29			34
10			62																									24			86
10.5			126		2																							5			133
11			70	1	1																							14			86
11.5			6	1																											7
12			3																												3
12.5			2																												2
13.5																								2							2
14.5	44		2																				4	5	4	2		5			66
15	148	10				5	96				8												32	37	26	2					365
15.5	1022	8			3	57	439				23												105	91	218	9	11	10			1995
16	1940	2			3	277	1002				39		1										84	102	473	75	24	10	51	14	4095
16.5	1333				2	288	1167	4			42		2								4		77	77	417	158	73	48	42	14	3747
17	622				1	307	1359	4			52		1								8	21	61	55	332	194	184	63	295	139	3700
17.5	178					155	906	17			73		4	41		4					8		28	46	59	94	211	39	464	474	2800
18	15					60	439	37			52		8	81							33	64	16	14	22	21	91	34	489	752	2230

Table 2B.4.a Continued …. Raised length frequency composition by stratum and trawl station for the Acoustic Herring Survey RV "Dana" Cruise July 2004.

Length	EXPO	FOTØ	EXPO	EXPO	EXPO	EXPO	EXPO	FOTØ	FOTØ	FOTØ	FOTØ	FOTØ	EXPO	EXPO	EXPO	FOTØ	FOTØ	FOTØ	FOTØ	FOTØ	FOTØ	EXPO	EXPO	FOTØ	FOTØ	EXPO	FOTØ	EXPO	FOTØ	FOTØ	Total
18.5	30					33	233	54			26		11	122						62	213	1	6	4	7	15	24	29	270	571	1709
19						22	55	50			47	1	10	284					5	123	245		20	18	4	4	15	5	110	348	1364
19.5					1		41	25	9	16	52		12	609						123	351		19	20	11	9	15	10	118	251	1690
20						8	14	33		63	60	2	4	731		4	4		30	287	532	1	18	9	4	15	29	14	110	432	2403
20.5						5		50	28	47	83	7	4	1055	2	4	4	53	61	238	543	4	19	2	4	9	13	5	127	334	2700
21								33	75	173	81	12		2070	6	29	25	80	142	332	585	6	12	4	18	17	11	10	101	418	4240
21.5						5		50	224	425	62	27	1	1827	15	46	68	320	188	189	351	2	12	7	4	2	2	5	93	418	4342
22								66	373	709	42	34		1908	13	67	121	386	274	82	202	3	2	4	4	11	7	5	34	376	4723
22.5								91	233	756	42	36		1543	28	67	107	440	228	74	106	2	4			11	4		8	195	3974
23								91	457	583	34	22		812	63	83	153	280	208	21	11	3	4	2	4	6			8	181	3025
23.5								137	467	410	5	23		487	72	92	143	173	117	8	21	13	2	2		4	4			70	2249
24								95	280	504	16	18		41	80	63	135	160	91	8		3		2		2	2		17	14	1530
24.5								141	336	441	8	18			63	46	110	213	46			5				2					1429
25								70	168	142	3	19	1	41	57	79	75	120	41	4		2		2		2				14	839
25.5								70	112	189		13			25	58	25	40	41			4		2							579
26								17	121	189		1			49	46	29	93	10	4		1				2				14	576
26.5								21	28	95		7			27	63	18	40	15	4		1								56	373
27								8	47	110		6			15	17	14	27	15			2				2	2			14	279
27.5								4	9	63		1			4	8	4	13	10			1				4				28	150
28								8	9	16					8	8		13												42	104
28.5								12	19	32		1			6	13															82
29								4	9	16						4	4	13												14	64

Table 2B.4.a Continued. Raised length frequency composition by stratum and trawl station for the Acoustic Herring Survey RV "Dana" Cruise July 2004.

Length	EXPO	FOTØ	EXPO	EXPO	EXPO	EXPO	EXPO	FOTØ	FOTØ	FOTØ	FOTØ	FOTØ	EXPO	EXPO	EXPO	FOTØ	FOTØ	FOTØ	FOTØ	FOTØ	FOTØ	FOTØ	EXPO	EXPO	FOTØ	FOTØ	EXPO	FOTØ	EXPO	FOTØ	FOTØ	Total
29.5								4		16					2																	22
30								4	9						2		4															19
30.5								4	9																							13
31.5																4																4
Total	5332	20	276	6	13	1224	5751	1206	3024	4994	849	248	59	11651	536	805	1041	2464	1520	1612	3245	54	523	505	1610	671	720	367	2337	5184	57843

Table 2B.4.b Raised catch weights of herring by trawl station for the Acoustic Herring Survey RV "Dana" Cruise July 2004.

	560E04	560E06				570E06					570E08							580E06	580E08		C		D	E							
	42F5	41F6	41F7		42F6	43F6		43F7	44F6	44F7	43F8	44F8	44F9					45F6	46F9		46G0		45G0	41G2	42G1		42G2		43G1	44G1		
	1741	1664	1586	1643	1567	1394	1413	1470	1327	1139	1484	1154	728	759	927	980	1310	810	882	625	645	539	172	87	249	199	269	382	435	442	
Total	EXPO	FOTØ	EXPO	EXPO	EXPO	EXPO	EXPO	FOTØ	FOTØ	FOTØ	FOTØ	FOTØ	EXPO	EXPO	EXPO	FOTØ	FOTØ	FOTØ	FOTØ	FOTØ	FOTØ	EXPO	EXPO	FOTØ	FOTØ	EXPO	FOTØ	EXPO	FOTØ	FOTØ	Total
Catch	170.8	0.52	2.11	0.10	0.32	241	211	127	329	546	126	92.4	3.16	945	66.3	94.0	274	264	142	107	211	5.53	18.3	16.4	49.7	27.7	84.2	12.9	113	320	3

Table 2B.5a Numbers of herring by age, maturity, stock and sub area for the Acoustic Herring Survey RV "Dana" Cruise July 2004

	North Sea Autumn spawners Abundance (Millions).....												
Stratum	**0**	**1i**	**1m**	**2i**	**2m**	**3i**	**3m**	**4**	**5**	**6**	**7**	**8**	**9+**
580E06	0.00	1.33	0.01	4.55	3.32	0.83	0.53	0.10	0.02	0.00	0.00	0.00	0.00
570E06	0.00	192.25	1.54	59.37	43.36	10.63	6.88	1.56	0.23	0.00	0.00	0.00	0.00
580E08	0.00	5.13	0.04	11.88	8.68	2.14	1.38	0.41	0.08	0.00	0.00	0.00	0.00
570E08	0.00	98.06	0.79	53.70	39.22	9.60	6.21	1.88	0.32	0.00	0.00	0.00	0.00
C	0.00	63.69	0.51	36.51	26.66	5.46	3.53	0.55	0.10	0.00	0.00	0.00	0.00
D	0.00	213.01	1.71	74.51	54.42	11.55	7.47	1.61	0.35	0.00	0.00	0.00	0.00
E	45.45	3.28	0.03	2.26	1.65	0.00	0.00	0.00	0.60	0.00	0.00	0.00	0.00
560E06	113.37	194.78	1.56	3.48	2.54	0.43	0.28	0.01	0.00	0.00	0.00	0.00	0.00

	Baltic Sea Spring spawners Abundance (Millions).....												
Stratum	**0**	**1i**	**1m**	**2i**	**2m**	**3i**	**3m**	**4**	**5**	**6**	**7**	**8**	**9+**
580E06	0.00	0.06	0.00	6.28	0.23	5.77	0.64	3.34	1.26	0.54	0.10	0.06	0.00
570E06	0.00	116.82	0.00	100.62	3.69	71.74	7.97	41.59	17.02	7.27	1.70	0.76	0.00
580E08	0.00	0.38	0.00	19.57	0.72	14.58	1.62	9.29	4.63	1.88	0.38	0.20	0.00
570E08	0.00	42.71	0.00	102.59	3.76	65.40	7.27	41.22	20.23	8.55	2.08	0.89	0.00
C	0.00	18.94	0.00	93.87	3.44	30.81	3.42	17.74	7.76	2.71	0.43	0.26	0.00
D	0.00	93.74	0.00	176.18	6.46	69.57	7.73	42.55	20.26	7.49	1.20	0.76	0.00
E	0.00	1286.61	0.00	287.64	10.55	53.62	5.96	16.55	6.30	5.71	0.00	0.88	0.00
560E06	0.00	300.05	0.00	22.02	0.81	2.77	0.31	1.06	0.07	0.02	0.00	0.00	0.00

Table 2B.5b Mean weight of herring by age, maturity, stock and Subarea for the Acoustic Herring Survey RV "Dana" Cruise July 2004

	North Sea Autumn spawners.												
	Mean weights (g)												
Stratum	**0**	**1i**	**1m**	**2i**	**2m**	**3i**	**3m**	**4**	**5**	**6**	**7**	**8**	**9+**
580E06	0.000	81.883	81.883	97.068	97.068	104.867	104.867	135.916	140.606	0.000	0.000	0.000	0.000
570E06	0.000	42.965	42.965	94.993	94.993	104.003	104.003	141.627	140.606	0.000	0.000	0.000	0.000
580E08	0.000	78.362	78.362	94.923	94.923	104.168	104.168	148.818	140.606	0.000	0.000	0.000	0.000
570E08	0.000	57.386	57.386	93.939	93.939	104.017	104.017	149.878	140.606	0.000	0.000	0.000	0.000
C	0.000	64.931	64.931	89.720	89.720	98.623	98.623	137.925	140.606	0.000	0.000	0.000	0.000
D	0.000	56.261	56.261	90.889	90.889	100.196	100.196	146.575	140.606	0.000	0.000	0.000	0.000
E	7.183	48.708	48.708	94.457	94.457	0.000	0.000	0.000	158.147	0.000	0.000	0.000	0.000
560E06	6.226	33.755	33.755	83.988	83.988	90.073	90.073	116.846	0.000	0.000	0.000	0.000	0.000

	Baltic Sea Spring spawners												
	Mean weights (g)												
Stratum	**0**	**1i**	**1m**	**2i**	**2m**	**3i**	**3m**	**4**	**5**	**6**	**7**	**8**	**9+**
580E06		66.463		89.474	89.474	111.410	111.410	119.495	137.942	153.338	177.725	165.294	0.000
570E06		37.116		85.435	85.435	111.946	111.946	121.162	141.237	151.587	173.053	168.508	0.000
580E08		64.369		86.395	86.395	113.224	113.224	124.426	144.974	147.363	173.750	163.838	0.000
570E08		48.917		83.160	83.160	113.545	113.545	124.464	144.811	149.352	179.591	166.021	0.000
C		56.566		79.004	79.004	109.610	109.610	119.740	141.388	144.334	135.303	159.797	0.000
D		49.592		79.970	79.970	110.801	110.801	121.920	143.888	147.097	154.441	159.531	0.000
E	0.000	36.872		64.776	64.776	76.972	76.972	94.693	137.347	133.478	0.000	0.166	0.000
560E06	0.000	0.034		0.075	0.075	0.096	0.096	0.098	0.114	0.120	0.000	0.000	0.000

Table 2B.5c Mean length of herring by age, maturity, stock and Subarea for the Acoustic Herring Survey RV "Dana" Cruise July 2004.

	North Sea Autumn spawners.												
	Mean lengths (cm)												
Stratum	0	1i	1m	2i	2m	3i	3m	4	5	6	7	8	9+
580E06	0.00	21.82	21.82	23.04	23.04	23.61	23.61	25.63	26.00	0.00	0.00	0.00	0.00
570E06	0.00	17.54	17.54	22.88	22.88	23.54	23.54	25.97	26.00	0.00	0.00	0.00	0.00
580E08	0.00	21.51	21.51	22.87	22.87	23.55	23.55	26.40	26.00	0.00	0.00	0.00	0.00
570E08	0.00	19.35	19.35	22.78	22.78	23.53	23.53	26.45	26.00	0.00	0.00	0.00	0.00
C	0.00	20.22	20.22	22.45	22.45	23.12	23.12	25.78	26.00	0.00	0.00	0.00	0.00
D	0.00	19.26	19.26	22.54	22.54	23.24	23.24	26.27	26.00	0.00	0.00	0.00	0.00
E	9.97	18.50	18.50	22.75	22.75	0.00	0.00	0.00	27.00	0.00	0.00	0.00	0.00
560E06	9.03	16.25	16.25	21.98	21.98	22.48	22.48	24.50	0.00	0.00	0.00	0.00	0.00

	Baltic Sea Spring spawners												
	Mean lengths (cm)												
Stratum	0	1i	1m	2i	2m	3i	3m	4	5	6	7	8	9+
580E06		20.42		22.44	22.44	24.09	24.09	24.60	25.77	26.60	27.83	27.32	0.00
570E06		16.88		22.10	22.10	24.11	24.11	24.70	25.96	26.53	27.61	27.50	0.00
580E08		20.19		22.19	22.19	24.19	24.19	24.91	26.19	26.34	27.60	27.25	0.00
570E08		18.44		21.91	21.91	24.22	24.22	24.91	26.18	26.44	27.91	27.37	0.00
C		19.37		21.56	21.56	23.94	23.94	24.60	25.98	26.17	25.68	27.04	0.00
D		18.54		21.64	21.64	24.02	24.02	24.74	26.13	26.32	26.68	27.02	0.00
E	0.00	16.86		20.19	20.19	21.35	21.35	22.77	25.68	25.22	0.00	27.44	0.00
560E06	0.00	16.38		21.17	21.17	23.00	23.00	23.13	24.30	24.68	0.00	0.00	0.00

ANNEX 2C: NORWAY

Survey report for RV "Johan Hjort",

8–30 July 2004

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1. Introduction

The Institute of Marine Research carried out an acoustic survey for herring and sprat in the North Sea from the 8 – 30 of July 2004. The survey was part of the ICES coordinated herring acoustic survey for the North Sea and adjacent areas planned and coordinated by the Planning Group for Herring Surveys (ICES 2004). Data from this survey will be combined with the other surveys to provide a combined age disaggregated abundance index for use in the assessment carried out by the ICES Herring Assessment Working Group (HAWG) to be held in March 2005.

This survey has been carried out annually (June-July) since the late 1970s and standardized since 1984, to provide estimates of adult herring in the North Sea.

Objectives

a. To conduct an acoustic survey to estimate the abundance and distribution of herring and sprat in the eastern part of the North Sea, between 56°- 62° N, 2°- 6° E.
b. To obtain samples of herring for biological analysis: including length, weight, age, sex, maturity, and Ichthyophonus infection.
c. To map the general hydrographical regime and monitor the standard profiles: Oksøy – Hanstholm, Hanstholm – Aberdeen, Utsira - Start Point, and Feie – Shetland.
d. To obtain samples of sediments, seawater and biota for monitoring of radioisotopes.

2. Survey description and methods

2.1 Personnel

Else Torstensen	(Cruise leader)
Bjarte Kvinge	(Acoustic expert)
Penny Alvstad	(Chem.lab)
Knut Hansen (16 – 30 July)	(Fish lab Technician)
Karen Gjertsen	(Fish lab Technician)
Anne-Liv Johnsen	(Fish lab Technician)
Jan de Lange (8 – 16 July)	(Fish lab Technician)
Bente Lundin (8 – 16 July)	(Fish lab Technician)
Andreas Nieuwejaar	(Acoustic Technician)
Bjørn Vidar Svendsen	(Fish lab Technician)

No exchange of staff with other vessels was made.

2.2 Narrative

The RV "Johan Hjort" left Bergen at 1210 UTC on 8 July 2004 and made passage to Uggedalseide/Tysnes for a calibration of the acoustic instruments. Conditions were unfavourable for calibration and vessel continued south to Rossfjord, 58°03'96"N 7°00'4"E where we arrived the next day at noon. Again the conditions were unfavourable for calibrating. The same was found in the Kristiansand area. The survey commenced with the Oksøy-Shetland transect (58° 3'N and 8°5' E) at1750 UTC without an updated calibration. Later in the survey areas north and south of Lerwick, Shetland, potential calibration conditions were explored, but without success.

RV "Johan Hjort" met RV "Walther Herwig" and RV "Dana" in the morning 10 July to begin surveying the "overlapping" area (41F6-F7 42F6-F7), see Figure 1. The three vessels started in the north-easterly part of 42F7 and continued in east - west transects southwards. The eastern part of the Hanstholm-Aberdeen transect defined the northern transect of the Norwegian coverage of the area. After five transects in an E-W direction, "Johan Hjort" returned north to 57° N and 05° 40' E (CTD-677), and continued the Hanstholm-Aberdeen transect. The survey continued with east-west transects from south to north. The cruise track is given in Figure 1. We broke off the survey on 15 July at 0430 UTC (57°31'N 5°55'E) for exchange of maritime crew in Stavanger. On the way to Stavanger, a call was made in Egersund at noontime to receive onboard 54 frozen samples of 20 kg each of commercially fished herring. "Johan Hjort" left Stavanger on 16 July at 1600 and was back on track on 17 July at 0700. In general, the weather conditions were good, but early in the survey we had some days with rough weather and lots of noise on the transducer, even with the drop keel in use. The planned coverage of the southern rectangles 41F3-F5 and 42F2-F5 was not realised, due to time constraints.

A call was made in Lerwick, Shetland on 27 July for a break. "Johan Hjort" sailed again at 1000 UTC on 28 July and recommenced the survey at 60°32'N 0°40'W at 1335 UTC. We finished the survey area at 60°45'N 4°37'E on 30 July at 0630 UTC and proceeded to Bergen where "Johan Hjort" docked at 0900 UTC. A total of 3,512 n.mi. were sailed, 75 trawl hauls and 156 CTD-stations were taken. Figure 2 gives the cruise track and locations of trawl hauls and Figure 3 the locations of CTD- and grab-stations.

The sampling of sediments, seawater and biota for monitoring of radioisotopes, will not be covered by the present report.

2.3 Survey design

The survey was carried out in systematically parallel east-west transects with about 15n.mi spacing between 2° and 4° E and a spacing of about 30n.mi between 4° and 6°E progressing northwards. Dense spacing (13–15 nm) was used in the overlapping area 41F6-F7- 42F6-F7.

2.4 Calibration

The acoustic sounders, SIMRAD EK500 38 kHz and 120 kHz, could not be calibrated for this survey, as no areas with favourable calibration conditions were found; neither in the beginning or at the end of the survey. The sounders were calibrated in March 2004, with only minor changes. The calibration history indicates, however, stable behaviour of the sounders. The main settings for the 38 kHz and 120 kHz transceivers are given in Table 1.

2.5 Acoustic data collection

Acoustic data were collected 24 hours per day using a SIMRAD EK500 38 kHz echo sounder with an ES38B SK transducer mounted on the drop keel. Additional data was collected at 120 kHz (ES120–7 transducer) but was not used in the present analysis. The mean volume back scattering values (Sv) were integrated over 1 nm intervals from 10-13m (depending on weather conditions and the use of keel) below the surface to 0,5m above the seabed. The speed

of the vessel during the acoustic sampling was 10–11 knots. The acoustic data were archived to tape. The acoustic recordings were scrutinized twice per day using the IMR BEI/SIMRAD BI500 Scientific Post Processing System (The Bergen Echo Integrator) (Foote *et al.* 1991). Paper records were kept of acoustic data from the 38 kHz sounder.

2.6 Biological data - fishing trawls

Trawling was carried out for supporting the species identifications of acoustic scatters and for biological sampling. For pelagic trawling a Fotö trawl was used in the first part of the survey, but due to damage, it was replaced by an Åkra-trawl (16 x 20 m). A Harstad-trawl was used occasionally. A Campelen 1800 equipped with a Rock hopper gear, was used for bottom trawling. The pelagic trawl had an 11 mm cod end liner. The bottom trawl hauls were monitored using Scanmar TS150 and the pelagic trawl hauls monitored by Scanmar TE40 and depth sensor D1200.

The catches were sampled for species composition by weights, and biological samples (length, weight) of the most important species were taken according to the IMR fish-sampling manual (Fotland et.al. 2002). Herring were examined for age, sex, maturity (8 point scale), fat, stomach contents, vertebrae counts (east of 2°00'E) and macroscopic evidence of *Ichthyophonus* infection.

If the catch of a target species contained less than 100 specimens, the total catch was sampled. If the catch contained more than 100 specimens, representative samples of about 100 specimens were randomly chosen.

2.7 Hydrographic data

CTD-stations were taken regularly in addition to the four standard hydrographical profiles: Oksøy-Hanstholm, Hanstholm-Aberdeen, Utsira - Start Point, and Feie – Shetland.

2.8 Data analysis

Echogram scrutiny was made per n.mi. intervals and presented as average per 5 n.mi. Total NASC-values were allocated to the following categories: herring, sprat, pelagic fish, demersal fish, plankton and other. To calculate integrator conversion factors the target strength of clupeids in the mixture were estimated using the following TS/length relationship:

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

Herring were separated from other recordings by using catch information and characteristics of the recordings. The abundance estimation (Toresen *et al*., 1998) was made by ICES rectangles and summed up for the whole area.

North Sea autumn spawners and Western Baltic spring spawners (WBSS) are mixed during summer in the area covered by RV "Johan Hjort". No system for workable stock discrimination on individual herring during the survey is available. The proportion of Baltic spring spawners and North Sea autumn spawners by age was calculated by applying the formula

WBSS= ((56.5-VS (sample))/(56.5–55.8)) (ICES, 1999). All samples were worked up on board. The length-at age and weight-at age were assumed to be the same in the two stocks. The measured proportions of mature fish were applied equally to calculate the maturing part of each age group in both stocks.

3 Results and discussion

3.1 Acoustic data

3.1. 1 Herring

The geographical distribution of the NASC values assigned to herring by 5 n.mi intervals along the cruise track, are presented in Figure 3. More herring schools were observed than in the last years and single schools were observed scattered throughout the area, often close to the surface. Trawling targeting some of the larger single schools failed, as we were not able to detect them again. Highest mean densities were measured in the ICES rectangles 43F5, 47F2 and 47F3. Random trawling positions were regularly chosen for trawling at the surface, i.e., not based on echo registration. In the "Norwegian" areas herring tend to keep close to the surface during daytime and may thus be underestimated. Best herring catches were taken in the surface area, during day and night time.

3.2.2 Sprat

No sprat was observed in the target area of the Norwegian survey.

3.3 Biological data

The total number of valid trawl hauls taken during the survey was 73: 62 pelagic and 11 bottom trawl hauls (Figure 1, Table 2), of which 8 pelagic hauls were taken in the overlapping area west of Jutland. Of the pelagic hauls, 10 were midwater hauls and 52 were carried out with large buoys for fishing at the surface. In general 30 min hauls were made. Catch composition per haul is given in Table 3. Herring were present in 44 hauls of which 27 had sample size >20 herring. The length distributions of herring are presented in Table 4. A total of 2,302 fish were measured and 1,943 fish were aged (otoliths). Ten herring were observed with Ichthyophonus infection, all north of 59º.

3.4 Abundance and Biomass estimates

3.4.1 Herring

The bulk of the herring were in general found in the north and central region of the area (Figure 3). Highest concentration was found in the ICES rectangle 43F5(mean NASC = 336). Here two schools in one n.mi gave a NASC value of 22,115. High concentrations were also recorded in the ICES rectangles 47F2 and 47F3 (mean NASC = 155-166). Few good acoustic marks of herring schools were observed and the majority of the trawling positions were, however, regularly chosen for trawling at surface, i.e. not based on echo registration. Due to the tendency of staying near the surface during daytime, herring may have been underestimated.

Total number of herring was 1,917 million of which 60% was North Sea Autumn Spawners (NSAS) and 40% Western Baltic Spring Spawners (WBSS). The relation between the total numbers of the two stocks was nearly the same as last year (63 vs. 37%). Total biomass of NSAS was estimated to 162,000 tonnes and the spawning stock biomass as 153,000 tonnes. Herring of the 2000-year-class (3-winter ringers) made 54% of both the total biomass and the spawning stock biomass. The 1998-year class (5-ringers) made about 9% of the number and 11% of the biomass. The total biomass of WBSS was 106,100 tonnes.

Table 6 gives the mean length, mean weight, total numbers (millions) and biomass (thousands of tonnes) by age and maturity stage for the North Sea autumn spawners and the Western Baltic spring spawners in the Norwegian target area in July 2004.

3.4.2 Overlap area

Nine pelagic trawl hauls were taken randomly at surface, PT340-PT348. Herring were caught in the three hauls PT342-343-347 and were all juvenile 0-2 ringers (Table 4). The estimated abundance (mill) by rectangle was as follows:

ICES RECT.	NUMBER (MILL)
41F6	29.10
41F7	54.67
42F6	27.11
42F7	23.79

3.5 Hydrography

A total of 156 CTD-stations were sampled (Figure 2). The horizontal distributions of temperature at 5m, 50m and at seabed, are shown in Figures 4a-c. The temperature at surface (5m depth) ranged from 12–13°C in the west to 14–15°C along the Norwegian west coast. The temperature was in general 2–3°C lower than measured during the survey in 2003 (Torstensen 2003), when high temperatures were recorded (17-18ºC). The temperature regimes at 50m depth and at the bottom were about the same as last year, with higher temperatures in west (up to 10–12°C) and in south east (up to 10–14°C) than in the central area (7–8°C).

The hydrographical data are part of a general monitoring program in IMR and will be analysed and published separately.

3.6 Radioisotopes in sediments, seawater and biota

Results from the radioisotope analysis will be published separately as part of a monitoring program.

4. References

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Table 1. RV "Johan Hjort", survey 2004209. International acoustic survey on herring in the North Sea, 8 - 30 July 2004, Simrad EK500 and analysis settings used.

Transceiver 1 Menu (38 kHz)	
Absorption coefficient	10 dB.km^{-1}
Pulse length	Medium
Bandwidth	Wide
Max. Power	2000 W
Equivalent two-way beam angle	-21.0 dB
Default Transducer S_v gain	27.53 dB
TS-transducergain	27.73 dB
3 dB Beam width	7.0/6.7 deg
Alongship offset	-0.08 deg
Althw.Ship Offset	-0.03 deg
Calibration details (18 March 2004)	
TS of sphere	-33.60 dB (cupper 60 mm diameter, CU60)
Range to sphere in calibration	45.25
Selected NASC (sA) value for calibration	1138
Log Menu	
Mode NM+	
Operation Menu	
Ping interval	0.0 (all ranges)
Analysis settings	
Bottom margin (backstep)	0.5 m
Integration start (absolute) depth	9.5 m
Display	
TVG	20 log R
Integration line	1000
TS colour min.	-60 dB
Sv colour min.	-70 dB
Printer	
TS colour min.	-60 dB
Sv colour min	-70 dB

Table 1. Cont.

Transceiver 1 Menu (120 kHz)	
Absorption coefficient	38 $dB.km^{-1}$
Pulse length	Long
Bandwidth	Narrow
Max. Power	1000 W
Equivalent two-way beam angle	-20.6 dB
Default Transducer S_v gain	25.44 dB
TS transducer gain	25.30 dB
3 dB Beam width	7.6/7.5 deg
Alongship offset	0.07 deg
Althw.Ship Offset	-0.20 deg
Calibration details (1 December 2003)	
TS of sphere	-39.4 dB (tungsten 38.1 (mm) diameter)
Range to sphere in calibration	21.9
Selected NASC (sA) value for calibration	1181
Log Menu	
GPS	
Operation Menu	
Ping interval	0.0 (all ranges)

Table 2. RV "Johan Hjort" 8–30 July 2004. Details of trawl stations during the acoustic survey on herring and sprat in the North Sea. PT = Pelagic Trawl, BT = Bottom Trawl, h=herring sample used.

Trawl haul no	Date	Lat	Lon	Time UTC	Water depth (m)	Trawl depth (m)	Duration (min)		Total catch (kg)
PT339	09.jul	57°43'	8°19' E	2224	124	0	35	h	146,31
PT340	10.jul	57°02'	7°57' E	0626	33	0	34		14,73
PT341	10.jul	56°45'	6°16' E	1751	40	0	36		60,24
PT342	10.jul	56°45'	7°37' E	2320	29	0	31	h	54,49
PT343	11.jul	56°31'	5°19' E	0300	29	0	31	h	325,20
PT344	11.jul	56°30'	7°19' E	0622	31	0	36		18,67
PT345	11.jul	56°14'	7°11' E	1614	?	0	35		21,91
PT346	11.jul	56°13'	7°51' E	1925	23	0	30		10,85
PT347	11.jul	56°02'	7°21' E	2356	27	0	28	h	259,24
PT348	12.jul	56°01'	6°47' E	0318	37	0	26		68,22
PT349	13.jul	57°00'	3°29' E	0123	67	0	39		48,85
BT350	13.jul	57°00'	2°22' E	0658	80	80	34		183,36
PT351	13.jul	57°00'	1°23' E	1236	101	0	10		not valid
BT352	14.jul	57°16'	2°37' E	1329	81	81	36		213,26
BT353	14.jul	57°17'	3°26' E	1710	62	62	40		1136,20
PT354	14.jul	57°16'	4°57' E	2241	56	32	33		93,34
PT355	15.jul	57°16'	5°31' E	0131	58	0	31		20,36
BT356	17.jul	57°30'	5°55' E	0926	77	77	34	h	84,82
BT357	17.jul	57°45'	5°53' E	1332	157	157	26		499,33
BT358	17.jul	57°45'	5°27' E	1521	120	117	22		310,45
PT359	17.jul	57°45'	4°23' E	2047	81	30	61		24,80
PT360	18.jul	57°38'	4°00' E	0102	73	0	30		96,76
BT361	18.jul	57°30'	3°42' E	0350	68	68	33		395,13
PT362	18.jul	57°30'	2°52' E	0817	66	29	38		31,89
PT363	18.jul	58°02'	3°43' E	2217	93	0	34		9,16
PT364	19.jul	58°02'	2°56' E	0159	74	0	24		22,77
BT365	19.jul	58°05'	2°05' E	0640	80	80	36		103,96
PT366	19.jul	58°15'	2°56' E	1101	77	50	33		1,01
PT367	19.jul	58°15'	4°20' E	1734	159	40	7		5,72
PT368	19.jul	58°16'	5°23' E	2149	316	0	27		32,02
PT369	20.jul	58°15'	5°50' E	0032	337	0	30	h	201,33
PT370	20.jul	58°44'	5°20' E	0634	213	170	30		58,39
PT371	20.jul	58°40'	2°05' E	2035	97	0	29	h	7,16
PT372	20.jul	58°41'	2°04' E	2158	98	0	34	h	643,20
PT373	21.jul	58°45'	3°03' E	0300	101	0	29		14,73
PT374	21.jul	58°46'	3°54' E	0654	270	0	31		38,72
PT375	21.jul	59°01'	3°55' E	0919	285	0	36		9,30
PT376	21.jul	59°02'	3°16' E	1256	165	150	35		1,25
BT377	21.jul	59°01'	3°20' E	1429	162	162	60		591,67
PT378	21.jul	59°02'	3°06' E	1654	149	120	29		2,03
PT379	21.jul	59°02'	2°51' E	1928	134	120	41	h	56,28
PT380	22.jul	59°03'	1°41' E	0042	116	0	39	h	411,22
PT381	23.jul	59°17'	1°03 E	0122	107	0	30	h	82,13
PT382	23.jul	59°17'	2°19' E	1012	127	0	30	h	34,36
PT383	23.jul	59°17'	3°24' E	1540	194	0	35	h	1618,50
PT384	23.jul	59°17'	4°22' E	2102	259	0	30	h	174,58
PT385	24.jul	59°33'	4°48' E	0231	213	0	49		23,12
PT386	24.jul	59°47'	4°37' E	0548	265	0	30		22,77
PT387	24.jul	59°33'	2°58' E	1428	123	0	35		not valid
PT388	24.jul	59°33'	3°02' E	1839	120	0	30	h	96,41
PT389	24.jul	59°47'	2°48' E	2347	115	0	31	h	736,03

Table 2. Cont.

Trawl haul no	Date	Lat	Lon	Time UTC	Water depth (m)	Trawl depth (m)	Duration (min)		Total catch (kg)
PT390	25.jul	59°47'	3°|13' E	0233	170	0	29	h	420,19
PT391	25.jul	60°03'	3°52' E	0726	283	0	31		19,51
PT392	25.jul	60°04'	2°06' E	1523	100	0	30	h	37,34
PT393	25.jul	60°17'	2°23' E	1854	109	0	31	h	118,16
PT394	25.jul	60°17'	3°03' E	2159	122	0	30	h	113,24
PT395	26.jul	60°17'	3°49' E	0114	295	0	30		172,90
PT396	26.jul	60°29'	4°39' E	0631	350	0	30	h	306,79
PT397	26.jul	60°32'	2°45' E	1412	106	0	31		27,66
BT398	26.jul	60°32'	2°06' E	1717	123	123	30	h	128,89
PT399	26.jul	60°32'	1°55' E	1917	106	25	65		15,93
PT400	26.jul	60°33'	1°12' E	2256	135	0	35	h	86,49
PT401	27.jul	60°33'	0°11' E	0201	142	0	30	h	45,14
PT402	28.jul	60°32'	0°16' W	1519	96	0	29	h	25,66
BT403	28.jul	60°57'	0°06'W	1929	171	0	21	h	693,58
PT404	28.jul	61°00'	0°44' E	2244	118	0	30	h	572,84
PT405	29.jul	60°45'	0°22' W	0342	133	25	25		7,54
PT406	29.jul	60°45'	2°45' E	1620	125	0	30		20,06
PT407	29.jul	60°44'	3°21' E	2003	331	0	30		166,197
PT408	29.jul	60°45'	3°46' E	2245	331	0	29		772,75
PT409	30.jul	60°45'	4°10' E	0211	320	0	28		52,612

Table 3. RV "Johan Hjort" 8 - 30 July 2004. Catch compositions in the trawl hauls (kg).

Trawl station		**339**	**340**	**341**	**342**	**343**	**344**	**345**	**346**	**347**	**348**	**349**	**350**	**351**	**352**	**353**	**354**	**355**	**356**	**357**	**358**	**359**
Total catch (kg)		**146.31**	**14.73**	**59.93**	**54.49**	**325.20**	**18.67**	**21.91**	**10.85**	**259.24**	**68.22**	**48.85**	**183.36**	**0.00**	**213.26**	**1136.20**		**20.36**	**75.31**	**499.33**	**310.45**	**24.80**
Herring	Clupea harengus	48,82			11,06	268,00	0,03		0,05	6,48			0,09					0,10	23,93	1,56		
Sprat	Sprattus sprattus																					
Pilchard	Sardina pilchardus																					
Anchovy	Engraulis encrasicolus																					
Mackerel	Scombrus scombrus	61,24	9,34	50,13	21,14	34,60	1,91		1,23	139,60	55,10	47,80						2,25		9,48		
Horse mackerel	Tracurus tracurus				2,18					108,72												
Norway pout	Trisopterus esmarkii	0,172																		184,80	13,40	
Haddock	Melanogrammus aeglefinus												95,28		110,16	247,50			29,46		9,75	6,59
Whiting	Merlangius merlangus		0,061	0,02	0,33		0,03	0,00					13,90		46,44	497,40			0,18	0,15	0,05	1,57
Blue-whiting	Micromesistius poutassou	4,64																		26,73		1,20
Saithe	Pollachius virens																		7,33	245,14	235,55	
Hake	Merluccius merluccius																			2,34	5,35	
Pollack	Pollachius pollachius																				13,25	
Torsk	Brosme brosme																					
Cod	Gadus morhua												1,56		1,47				12,13	3,89		
Poor cod	Trisopterus minutus																					
Ling	Molva molva																				5,25	
Argentine	Argentina sphyraena																		0,20			
Sandeels	Ammodytidae spp																		0,54			
Gurnard	Trigla spp		0,318	0,49			3,69			4,32	0,17		0,97		0,47	15,93		0,47				14,84
Dab	Limanda limanda									0,12			59,24		48,42	350,80			0,93			
Plaice	Pleuronectes platessa												0,26									
Witch	Glyptocephalus cynoglossus												0,62									
Lemon sole	Microstomus kitt												2,23									
Long rough dab	Hippoglossoides platessoides												5,43		6,30	22,20			0,42	0,35		
Wolffish	Anarhichas lupus																					
Lumpsucker	Cyclopterus lumpus																			0,91		
Monkfish	Lophius piscatorius																					
Garpike	Belona belona							20,83	2,56		2,64	0,58						0,61				
Norway haddock	Sebastes marinus																					
Jellyfish		31,44	5	9,29	19,64	22,60	13,01	1,07	7,00		10,31	0,46	2,75			2,37		16,90		23,38	25,90	0,22
Other			0,009		0,14							0,01	1,03					0,04	0,21	0,60	1,95	0,38

Table 3. Cont.

Trawl station		**360**	**361**	**362**	**363**	**364**	**365**	**366**	**367**	**368**	**369**	**370**	**371**	**372**	**373**	**374**	**375**	**376**	**377**	**378**	**379**	**380**
Total catch (kg)		**96.76**	**395.13**	**31.89**	**9.16**	**22.77**	**103.96**	**1.01**	**5.72**	**32.02**	**201.33**	**58.39**	**7.16**	**643.20**	**14.73**	**38.72**	**9.30**	**1.25**	**591.67**	**2.03**	**56.27**	**411.22**
Herring	Clupea harengus	0,23			2,37	1,00	0,13			1,07	108,89		4,63	586,00	13,00				0,65		52,71	347,34
Sprat	Sprattus sprattus																					
Pilchard	Sardina pilchardus																					
Anchovy	Engraulis encrasicolus																					
Mackerel	Scombrus scombrus	85,75			3,25	19,80	4,40	0,26		17,39	67,24		1,67	57,20	1,17	1,01	4,99					63,84
Horse mackerel	Tracurus tracurus																					
Norway pout	Trisopterus esmarkii				0,02														283,60			
Haddock	Melanogrammus aeglefinus		64,40	23,80			8,80												18,92	1,04		
Whiting	Merlangius merlangus	1,65		2,45		0,02	9,36	0,01		0,18	0,21				0,03	0,16	0,02			0,01	1,11	
Blue-whiting	Micromesistius poutassou									1,94	1,20	58,39										
Saithe	Pollachius virens																		224,00		2,20	
Hake	Merluccius merluccius																		2,37			
Pollack	Pollachius pollachius																		20,30			
Torsk	Brosme brosme																					
Cod	Gadus morhua																					
Poor cod	Trisopterus minutus																					
Ling	Molva molva																		3,46			
Argentine	Argentina sphyraena																					
Sandeels	Ammodytidae spp																					
Gurnard	Trigla spp	0,34	42,30	4,64			4,04															
Dab	Limanda limanda		227,60				67,12															
Plaice	Pleuronectes platessa						1,32															
Witch	Glyptocephalus cynoglossus		9,16				2,54															
Lemon sole	Microstomus kitt																					
Long rough dab	Hippoglossoides platessoides		51,60				5,84												6,74			
Wolffish	Anarhichas lupus																		24,37			
Lumpsucker	Cyclopterus lumpus	1,34							3,05							0,14		0,78				
Monkfish	Lophius piscatorius																					
Garpike	belona belona															0,38						
Norway haddock	Sebastes marinus																					
Pigghå																						
Jellyfish		7,45		1,00	3,51	1,95		0,75	2,67	11,45	23,80		0,79		0,50	37,00	4,27	0,47		0,99	0,25	
Other			0,07		0,02	0,00	0,40						0,07		0,03	0,03	0,02		7,26			0,04

Table 3. Cont.

Trawl station		**381**	**382**	**383**	**384**	**385**	**386**	**387**	**388**	**389**	**390**	**391**	**392**	**393**	**394**	**395**	**396**	**397**	**398**	**399**	**400**	**401**
Total catch (kg)		**82.13**	**34.36**	**1618.50**	**174.58**	**23.12**	**22.77**	**0.00**	**98.41**	**736.03**	**420.19**	**19.51**	**37.35**	**118.16**	**113.24**	**172.90**	**306.79**	**27.66**	**128.88**	**15.93**	**86.48**	**45.16**
Herring	Clupea harengus	70,08	21,55	630,25	17,84	1,21	0,27		86,76	250,95	394,53		5,48	2,44	10,67	2,60	155,57		5,14		71,34	8,93
Sprat	Sprattus sprattus																					
Pilchard	Sardina pilchardus																					
Anchovy	Engraulis encrasicolus																					
Mackerel	Scombrus scombrus	10,08	9,14	944,75	129,50	6,20	1,16		3,44	474,90	21,38	0,72	11,22	48,37	33,12	8,64	94,71				12,72	26,80
Horse mackerel	Tracurus tracurus					0,49							2,77	2,23		1,85	13,96	0,19	0,60		0,99	7,71
Norway pout	Trisopterus esmarkii																		38,35			
Haddock	Melanogrammus aeglefinus																		28,80			
Whiting	Merlangius merlangus	1,92	0,01		0,22	0,17	0,17					0,03	0,01	0,07	0,28	0,08	0,03	0,10	13,65	0,02	0,01	0,18
Blue-whiting	Micromesistius poutassou															94,85			0,38			0,01
Saithe	Pollachius virens															5,96	9,34		7,27			
Hake	Merluccius merluccius																		2,57			
Pollack	Pollachius pollachius																					
Torsk	Brosme brosme																					
Cod	Gadus morhua																					
Poor cod	Trisopterus minutus																					
Ling	Molva molva																					
Argentine	Argentina sphyraena																		3,24		0,00	
Sandeels	Ammodytidae spp																					
Gurnard	Trigla spp										3,03		0,07	0,11				0,63	1,90			
Dab	Limanda limanda																					
Plaice	Pleuronectes platessa																					
Witch	Glyptocephalus cynoglossus																					
Lemon sole	Microstomus kitt																					
Long rough dab	Hippoglossoides platessoides																		3,46			
Wolffish	Anarhichas lupus																					
Lumpsucker	Cyclopterus lumpus			31,00	0,22				4,96			4,19		3,75	1,77		0,71	1,99		7,08		0,72
Monkfish	Lophius piscatorius																					
Garpike	Belona belona		1,13																			
Norway haddock	Sebastes marinus																					
Jellyfish			2,50	12,50	26,60	15,00	21,18		3,23	10,18		14,57	12,49	61,02	67,40	57,20	32,43	24,06		8,77	0,81	0,52
Other		0,05	0,04		0,21	0,06			0,03		1,25		5,32	0,18		1,72	0,04	0,69	23,52	0,06	0,61	0,29

Table 3. Cont.

Trawl station		**402**	**403**	**404**	**405**	**406**	**407**	**408**	**409**
Total catch (kg)		**25,66**	**693,58**	**572,84**	**7,54**	**20,06**	**166,20**	**772,75**	**52,61**
Herring	Clupea harengus	14,37	5,73	311,20		0,35	1,55		2,31
Sprat	Sprattus sprattus								
Pilchard	Sardina pilchardus								
Anchovy	Engraulis encrasicolus								
Mackerel	Scombrus scombrus		3,05	248,40			70,80	737,50	17,50
Horse mackerel	Tracurus tracurus		1,66	7,80			9,20	11,75	
Norway pout	Trisopterus esmarkii		47,60						
Haddock	Melanogrammus aeglefinus		6,21			0,02	0,02		
Whiting	Merlangius merlangus	0,00	23,12		0,01	0,03	0,10		
Blue-whiting	Micromesistius poutassou		133,00	0,16				6,00	
Saithe	Pollachius virens		441,00						
Hake	Merluccius merluccius								
Pollack	Pollachius pollachius								
Torsk	Brosme brosme								
Cod	Gadus morhua								
Poor cod	Trisopterus minutus								
Ling	Molva molva								
Argentine	Argentina sphyraena		1,56						
Sandeels	Ammodytidae spp								
Gurnard	Trigla spp	0,00				0,62	1,15		
Dab	Limanda limanda								
Plaice	Pleuronectes platessa								
Witch	Glyptocephalus cynoglossus		4,29						
Lemon sole	Microstomus kitt								
Long rough dab	Hippoglossoides platessoides		11,59						
Wolffish	Anarhichas lupus								
Lumpsucker	Cyclopterus lumpus	4,00			1,78	1,05	3,34		
Monkfish	Lophius piscatorius								
Garpike	belona belona								
Norway haddock	Sebastes marinus								
Jellyfish		6,95		4,60	4,10	16,93	80,00	17,50	32,50
Other		0,34	14,77	0,68	1,67	1,07	0,04		0,30

Table 4. RV "Johan Hjort" 8 - 30 July 2004. Herring length (cm) distribution in trawl hauls where sample size>20 herring.

Trawl st	339	342	343	347	356	363	369	371	372	379	380	381	382	383	384	388	389	390
ser.no	24301	24304	24305	24309	24318	24325	24331	24333	24334	24341	24342	24343	24344	24345	24346	24350	24351	24352
ICES rect	44F8	42F7	42F7	41F7	43F5	45F3	45F5	46F2	46F2	47F2	47F1	47F1	47F2	47F3	47F4	48F2	48F2	48F3
8,0																		
8,5																		
9,0																		
9,5																		
10,0		1																
10,5		3																
11,0		6																
11,5		2																
12,0		11																
12,5		2																
13,0		1																
13,5																		
14,0		2																
14,5		11	5	1														
15,0		24	21	12														
15,5		20	45	29	1													
16,0		13	21	11	12													
16,5		3	5	2	21													
17,0		1	1	1	28													
17,5					16													
18,0			1		8													
18,5			1		4													
19,0				1	4													
19,5					2													
20,0	1				1													
20,5																		
21,0	2				1													
21,5	3				1						1							
22,0	7																	
22,5	6						2		1		1				1			
23,0	8				1	1	2		3		6		2	1		1		
23,5	12					3	3	4	11	3	2	2	5	1	2	5	2	
24,0	13					6	12	7	21	4	10	4	12	2	8	7	9	2
24,5	6					4	16	7	21	13	19	6	25	4	11	19	9	4
25,0	14					3	9	7	13	9	11	16	16	8	13	23	15	4
25,5	9					2	11	5	16	8	10	16	12	12	20	14	9	9
26,0	3					1	16	3	7	13	15	16	10	13	14	10	13	11
26,5	3						7	2	4	10	7	11	10	15	9	7	8	16
27,0	2						7	1	1	8	8	8	4	12	11	11	7	9
27,5	3						5		2	12	5	3	2	7	2	2	5	9
28,0	4						6			9	1	6		7	5		10	15
28,5	1									3	1	6	2	4	3		6	5
29,0	3									4	2	6		10		1	2	7
29,5							2							1			4	1
30,0							1			2				2	1			3
30,5										1								
31,0											1							3
31,5							1							1			1	
32,0																		1
32,5										1								
33,0																		
33,5																		
34,0																		
34,5																		
35,0																		
35,5																		1
36,0																		
Total N	100	100	100	57	100	20	100	36	100	100	100	100	100	100	100	100	100	100
mean W(g)	127,500	23,000	29,100	28,4	41,4	118,7	154,1	128,7	129,0	172,8	139,0	153,4	130,6	180,5	143,3	136,7	158,4	186,3
mean L(cm)	24,7	14,6	15,8	15,8	17,5	24,6	25,9	25,1	25,0	26,6	25,6	26,4	25,4	27,0	26,0	25,6	26,5	27,5
mean verteb	56,17		55,92		56,14	56,60	56,03	56,29	56,33	56,50	56,46	56,50	56,37	56,26	55,92	56,28	56,36	56,34

Table 4. Cont.

Trawl st	392	394	396	398	400	401	402	403	404
ser.no	24354	24356	24358	24360	24362	24363	24364	24365	24366
ICES rect	49F2	49F3	49F5	50F2	50F1	50F0	50E9	50E9	50E9
8,0									
8,5									
9,0									
9,5									
10,0									
10,5									
11,0									
11,5									
12,0									
12,5									
13,0									
13,5									
14,0									
14,5									
15,0									
15,5									
16,0									
16,5									
17,0									
17,5									
18,0									
18,5									
19,0									
19,5									
20,0									
20,5									
21,0									
21,5									
22,0									
22,5									
23,0						1			
23,5	1			1		1			
24,0	4		2		2	4			6
24,5	10	1	2	1	6	9	4		8
25,0	13	7	11	1	11	13	1		8
25,5	11	10	14	1	16	6			18
26,0	2	5	8	1	13	6	2		15
26,5	1	9	14	6	12	8	7		14
27,0		9	16	6	14	6	8		8
27,5		5	8	2	6	1	14	1	6
28,0	1	5	2	2	7	1	16	1	3
28,5		6	10	1	3	2	3	2	4
29,0		3	3	2	1		7	7	5
29,5		3	2	2	1		3	1	2
30,0			1	2	1		3	6	
30,5							1	1	2
31,0			2		1			3	
31,5		1	1		1				
32,0			1						1
32,5		1			3				
33,0			1						
33,5					2	1			
34,0			1						
34,5									
35,0									
35,5									
36,0			1			1			
Total	43	65	100	28	100	60	69	22	100
mean W(g)	127,3	164,1	185,2	183,7	163,5	148,8	208,3	260,5	161,4
mean L(cm)	25,3	27,2	27,3	27,5	27,0	26,1	27,9	29,7	26,6
mean verteb	56,09	56,45	56,05	56,32					

Table 5. RV "Johan Hjort" 8 - 30 July 2004. Number of otoliths collected by age-group (wr) and length and maturity stages (number of fish sampled) in the Norwegian target area.

Length	1	2		3		4	5	6	7	8	9+	Total
cm	im	im	mat	im	mat	mat	mat	mat	mat	mat	mat	
15,0												
15,5												
16,0	5											5
16,5	10											10
17,0	8	5										13
17,5	6	2										8
18,0	3	1										4
18,5	3	1										4
19,0	1											1
19,5	1	1										2
20,0		1										1
20,5												
21,0												
21,5		2										2
22,0												
22,5		3	1		1							5
23,0		3	5		9	1						18
23,5		4	8	3	30	1						46
24,0			19	4	92	3		1				119
24,5			33	11	129	9			1			183
25,0		1	35	7	126	15	10	1				195
25,5		1	26	3	121	23	20	3				197
26,0		1	18	2	93	32	17	4				167
26,5			11		59	27	37	6	1			141
27,0			8		37	32	32	11	1	1		122
27,5			3		17	14	25	12	3	3		77
28,0					16	11	21	13	6	3		70
28,5					7	10	14	7	3	6	1	48
29,0					3	6	7	7	8	3	3	37
29,5					2	1	3	2	1	3	3	15
30,0					1		4	2	2	1	3	13
30,5										1		1
31,0					1		1	1			1	4
31,5						1	1		2	1	1	6
32,0								1				1
32,5							2	3				5
33,0							1					1
33,5								2				2
34,0												
34,5												
35,0												
35,5												
36,0											1	1
Sum	62	53	212	52	886	236	238	84	32	25	13	1524

Table 6. RV "Johan Hjort" 8 - 30 July 2004. Herring mean length, mean weight, numbers (millions) and biomass (thousands of tonnes) by age and maturity stages.

Age-group	L_{mean}	W_{mean}	North Sea Autumn Spawners				Western Baltic Spring Spawners			
			No (mill)	%	Biom (10^3)	%	No (mill)	%	Biom (10^3)	%
1I	16,6	39,2	31	2,7	1	0,8	76	9,8	3	2,8
1M										
2I	22,0	76,7	48	4,2	4	2,3	21	2,7	2	1,5
2M	25,1	140,3	168	14,7	24	14,6	69	8,9	10	9,0
3I	24,3	124,7	36	3,1	4	2,7	27	3,5	3	3,2
3M	25,4	137,9	597	52,3	82	50,8	308	39,7	42	40,0
4	26,6	158,9	92	8,0	15	9,2	118	15,3	18	17,4
5	27,3	173,5	101	8,8	18	11,0	95	12,3	16	15,3
6	28,1	187,3	39	3,4	8	4,7	35	4,5	6	5,9
7	28,5	198,0	15	1,3	3	1,9	14	1,8	3	2,6
8	29,0	191,9	10	0,9	2	1,2	7	0,9	1	1,2
9+	30,5	215,2	7	0,6	1	0,9	5	0,7	1	1,0
Total	25,6	141,8	1142	100	162	100	775	100	106	100
Immature	20,4	81,5	114	10	9	6	123	16	8	7
Mature	26,2	148,5	1028	90	153	94	652	84	98	93

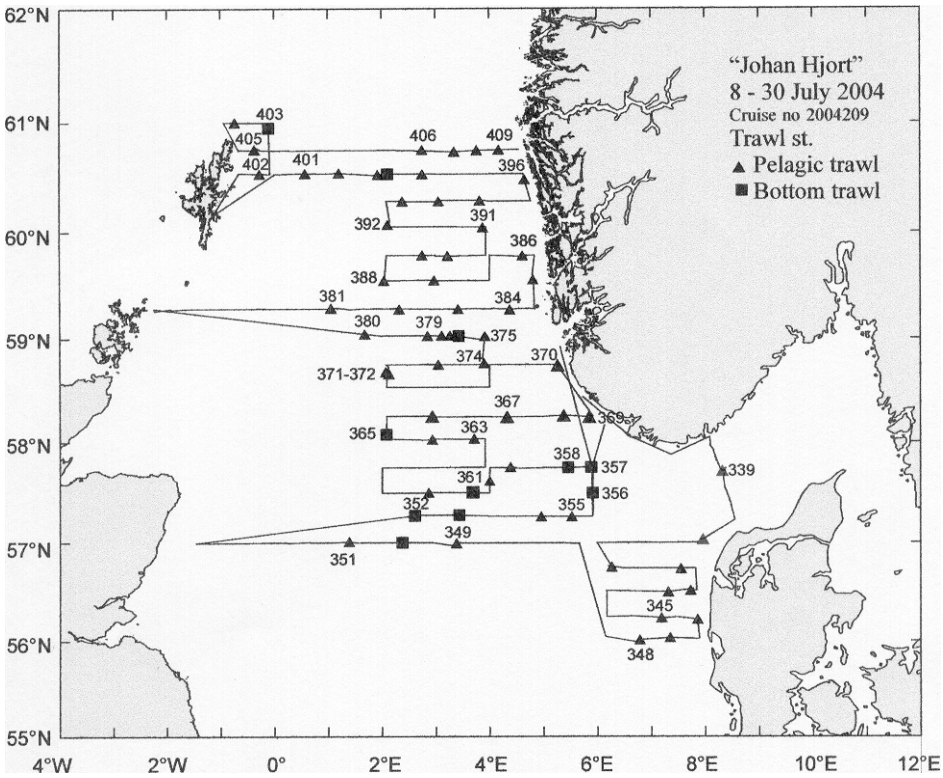


Figure 1. RV "Johan Hjort" 8 - 30 July 2004. Cruise track and fishing trawls undertaken during the acoustic survey.

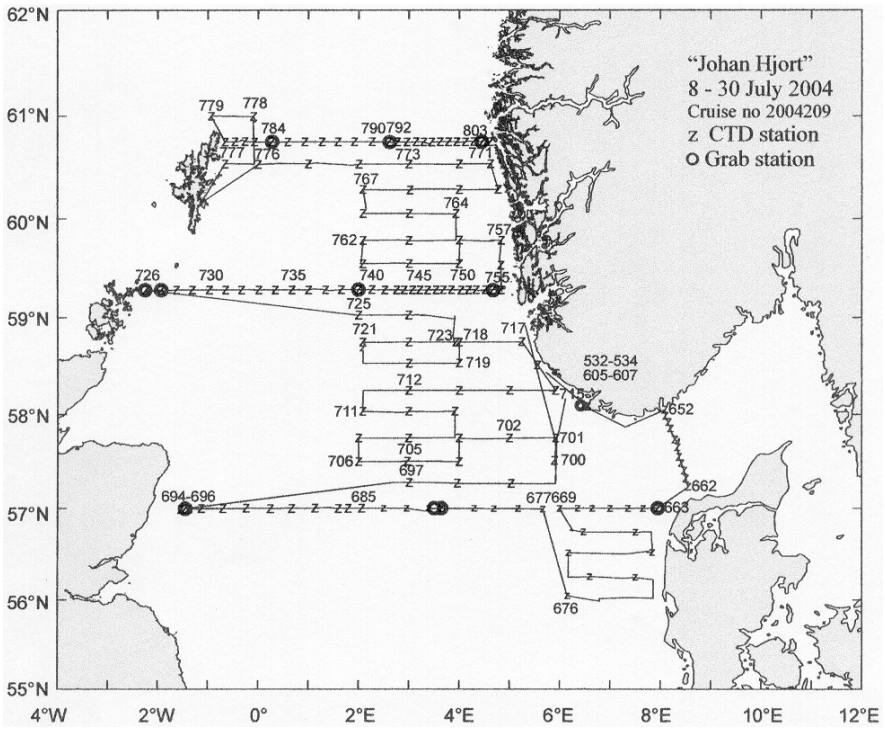


Figure 2. RV "Johan Hjort" 8 - 30 July 2004. Cruise track and CTD-stations undertaken during the acoustic survey.

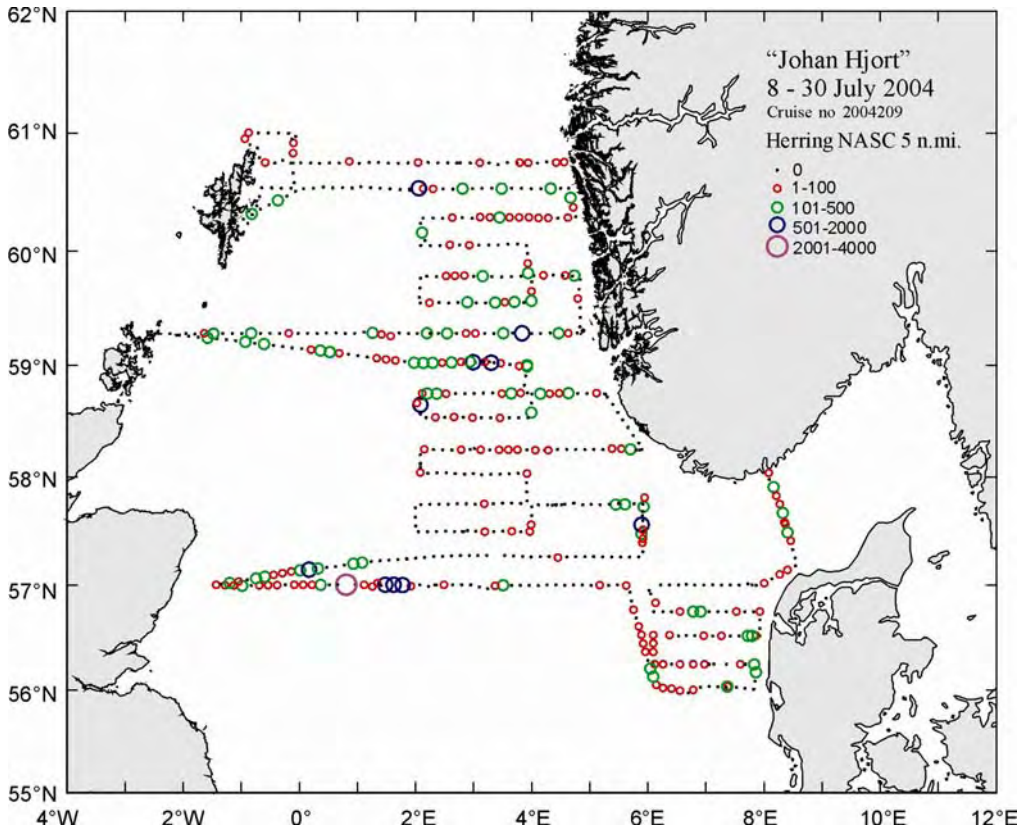


Figure 3. RV "Johan Hjort" 8 - 30 July 2004. Distribution of NASC -values attributed to herring per 5 n.mi. along the cruise track.

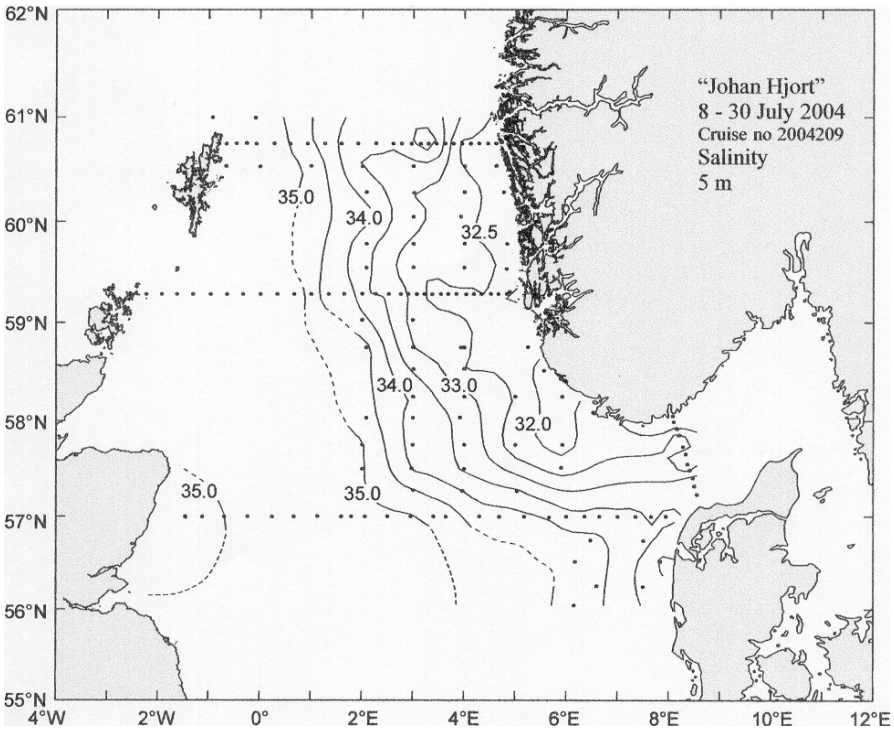


Figure 4a. RV "Johan Hjort" 8 - 30 July 2004. The horizontal distribution of temperature at 5 m.

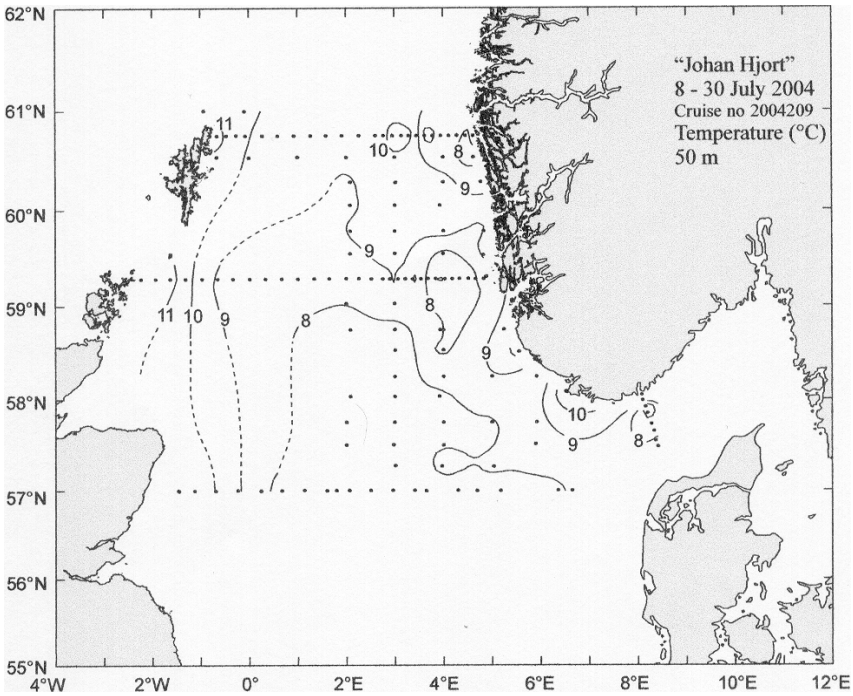


Figure 4b. RV "Johan Hjort" 8 - 30 July 2004. The horizontal distribution of temperature at 50m depth.

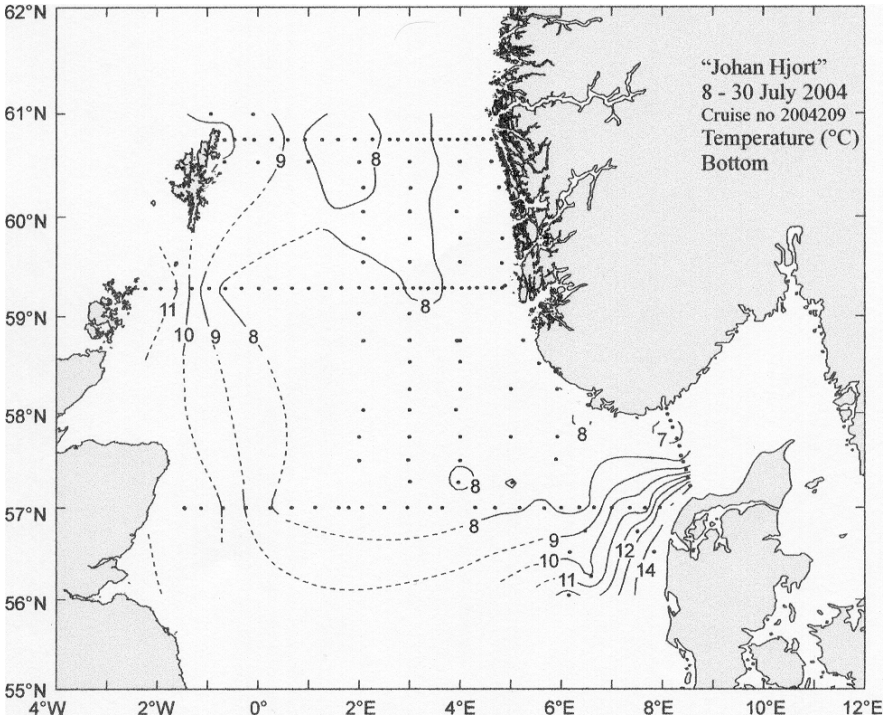


Figure 4c. RV "Johan Hjort" 8 - 30 July 2004.The horizontal distribution of temperature at bottom.

Annex 2D: Survey report for RV Scotia

1 July – 22 July 2004

E. J. Simmonds, FRS Marine Lab Aberdeen.

1. Introduction

1.1 Background

This survey was developed from 1979 to 1983 and has been carried out annually since 1984 to provide estimates of adult herring in the Orkney Shetland area. The survey is designed to provide indices of abundance at age for herring.

1.2 Objectives

1. To conduct an acoustic survey to estimate the abundance and distribution of herring in the north western North Sea and north of Scotland between 58º15-61.45'N and 4ºW to 2ºE, excluding Faroese waters.
2. To obtain echosounder trace identification using pelagic trawl.
3. To obtain samples of herring for biological analysis, including age, length, weight, sex, maturity and ichthyophonus infection
4. To obtain photographic records for fish maturity analysis.
5. To obtain hydrographic data for comparison with the horizontal and vertical distribution of herring.
6. To obtain plankton samples for acoustic identification work.
7. To obtain plankton data using Utow.
8. To conduct SAT (Sea Acceptance Trial) on new EK60 echo sounder system.

2. Survey description and methods

2.1 Staff

John Simmonds	C1(in charge)
Sandy Robb	B3
Phil Copland	B2
Marco Kienzle	B2
Stephen Keltz	B1
Robert Watret	A4
Owen Goudie	A4
Angus Mair	Phd Student
Rita Santos	MSc Student Aberdeen, 2nd pt
Mathieu Woillez	ENSMP, 1st pt
Benjamin Heywood	St Andrews University, 2nd pt

2.2 Narrative

Scotia sailed at 1000 on 1 July 2001 and made passage to the Buchan Deeps to test deployment of the fishing gear and the proceeded to Scapa Flow and anchored to calibrate the acoustic instruments on all scientific sounders. At 0730 Scotia left Scapa Flow and commenced survey at 0820 BST at 58º 26' N 2º 59 W. The survey was carried out on east west transects on a 15n.mi. spacing progressing northwards between 2E or the Norwegian line, the Scottish mainland, and the Orkney and Shetland Islands from 0300 to 2300 BST. Additional short transects were added into the survey in areas of expected higher herring abundance to the around

Shetland. Scotia broke off the survey at 23:00 on 9 July FRV Scotia at 60° 56'N 0°42'W and docked in Lerwick at 0800 BST on 12 July for a mid cruise break. Scotia sailed again at 0800 BST on 13 July and recommenced the survey at 60° 56'N 0° 42'W at 1345 BST. FRV Scotia continued the survey north to 61° 56'N and then progressed southwards to the west of Shetland carrying out 7.5 n.mi spaced transects to the north west of Shetland and 15n.mi. transects west of Shetland south to Orkney. Scotia finished the survey at 0930 BST on 21 July.(58° 45'N 3° 20'W). FRV Scotia then proceeded to Scappa Flow to carry out a second calibration of the acoustic instruments. FRV Scotia departed Scappa Flow following a successful calibration of acoustic instruments at 1730 BST and sailed to Aberdeen and docked at 0530 BST on 22 July 2004.

2.3 Survey design

The survey track (Figure 1) was selected to cover the area in two levels of sampling intensity based on agreed boundaries to the east, west and south, and the limits of herring densities found in previous years to the north and north west. A transect spacing of 15 nautical miles was used in most parts of the area with the exception areas both east and west of Shetland where short additional transects were carried out at 7.5 n.mi. spacing. On the administrative boundaries of 2°E and 4°W the ends of the tracks were positioned at twice the track spacing from the area boundary, giving equal track length in any rectangle within the area. The between-track data was then included in the data analysis. Transects at shelf break were continued to the limits of the stock and the transect ends omitted from the analysis. Transects at the coast were continued as close inshore as practical, those on average less than half a transect spacing from the coast were excluded from the analysis, those at greater distance were included in the analysis. The origin of the survey grid was selected randomly within a 15 n.mi. interval the track was then laid out with systematic spacing from the random origin. Where the 7.5 n.mi. transect spacing was used the same random origin was used.

2.4 Calibration

Two calibrations were carried out in Scappa Flow on the transducer systems used during the survey one at the beginning of the survey on the night of 2 July and one at the end of the survey on 22 July. Standard sphere calibrations were carried using 38.1mm diameter tungsten carbide sphere for 18, 38 and 120kHz. A 36.4mm sphere was used for 200kHz. Agreement between the calibrations was better poor, the weather conditions for the second calibration caused considerable problems and no clear maximum could be obtained. The first calibration was used to define instrument sensitivity for the cruise. .For the 38kHz agreement between this years calibration and the previous year was better than 0.2 dB. The calibration settings and results for 38kHz are given in Table 2D1.

2.5 Acoustic data collection

The acoustic survey on FRV *Scotia* was carried out using a Simrad EK500 38 kHz sounder echo-integrator with transducer mounted on the drop keel. For most of the survey the keel was kept at 1m extension placing the transducer at 7m depth. Only during bad weather was the keel lowered to 3m extension with the transducer at 9m depth. Additional data was collected at 18 120 and 200kHz. Data was archived for further data analysis carried out using Echoview software and Marine Lab Analysis systems. Only data from 38,120 and 200kHx systems were used in the analysis. Data was collected from 0200 to 2200 UTC. Paper records were kept for acoustic data at 38. A total of 2,732 n.mi. were surveyed and included in the analysis.

Biological data - fishing trawls

Pelagic trawl hauls (positions shown in Figure 2D1) were carried out during the survey on the denser echo traces. The pelagic fishing gear used throughout the survey was PT160. The haul was monitored using Simrad FS903 scanning netsonde and computer recordings of the hauls

were archived to PC using screen capture software. Each haul was sampled for length, age, maturity and weight of individual herring. In addition weights of gonads and livers were also collected. Between 250 and 500 fish were measured at 0.5 cm intervals from each haul. Otoliths were collected with one per 0.5 cm class below 20.5 cm, five per 0.5cm class from 21-27cm and ten per 0.5 cm class for 27.5 cm and above. The same fish were sampled for whole weight, gonad weight, liver weight, sex, maturity, stomach contents and macroscopic evidence of Ichthyophonus infection. The maturity scale used in data collection was the Scottish 8 point scale.

2.6 Hydrographic data

Surface temperature and salinity was collected throughout the survey. CTD stations were taken at each night location (2200hrs) and mini-logger recordings of temperature were taken at each haul location.

2.7 Data analysis

Data from the echo integrator were averaged over quarter hour periods (2.5 n.mi. at 10 knots). Echo integrator data was collected from 11 m below the surface (transducer at 7 m depth) to 0.5 m above the seabed, for most of the survey. The data were divided into seven categories, by visual inspection of the echo-sounder paper record and the integrator cumulative output;

1. “herring traces”,
2. “probably herring traces” and
3. “probably not herring traces” all below 50 m
4. shallow herring schools above 50 m,
5. shallow schools not herring above 50m,
6. mixture including herring and haddock

To calculate integrator conversion factors the target strength of herring and for gadoid species in the mixture were estimated using the TS/length relationship recommended by the acoustic survey planning group (Anon, 1992):

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

$$TS = 20\log_{10}L - 67.5 \text{ dB per individual for all gadoids}$$

The weight of herring at length was determined by weighing individual fish from each pelagic trawl haul. Lengths were recorded by 0.5 cm intervals to the nearest 0.5 cm below.

To process the data for extraction of schools the variable computation method available in Echo View was used. The method used in 2001 was used again this year. Previously when processing by hand (2000 and before) a small ‘background’ value for scattered fish was removed from integrator layers with many fish schools. It was noted that fish schools appear consistently on 38,120 and 200kHz echograms while other features such as plankton may be strong on some frequencies and week on others. The processing was

$$Sv_{used} = Sv38*[Sv_{38} + Sv_{120} + Sv_{200} ** \text{Blur} > -170\text{dB}]$$

Where Blur is a convolution matrix:

[1 2 1

2 1 2

1 2 1]

The Blur convolution filter is chosen as a suitable smoothing function as previous experiences suggests it is well suited to the types of amplitude distributions expected from echoes from fish aggregations. It provides a smoother spatial filter for filling in values in a school than either a centered weighted or uniform averaging filters.

Data are allocated to quarter statistical rectangles by their mid point location, the estimate of density is obtained as the arithmetic mean of all values weighted by duration of the run to accommodate the small number of short ESDUs.

Biological information in post stratified method based on kolmogerof Smirnov test (see MacLennan and Simmonds 1992). The length frequency data is given in Table 2D4.

The mixed species categories were apportioned using the catches in the local area. For the gadoid mixtures hauls 245 and 257 were used individually to give numbers by species. For mackerel herring mixture to the west of Shetland catches from hauls 287, 288 and 289 were combined. These mixtures contribute less than 2% to the total estimate of herring.

3. Results

3.1 Acoustic data

The distribution of NASC values along the cruise track is shown in Figure 2D2. The herring are distributed more randomly in 2004 than in 2003 the largest single 2.5n.mi. ESDU contributes 5% of the population estimate from FRV Scotia.

3.2 Biological data

A total of 40 pelagic trawl hauls were carried out (Figure 2D1), the locations, dates and time of these are shown in Table 2D2. Of the 40 hauls 36 had more than 100 herring and were used to define eight herring survey sub areas (Figure 2D3). Of the remaining 4 hauls one was a foul haul due to netsonde failure, two had no catch at all and one had only 47 herring and the length frequency distribution was not used. Table 2D3 shows the total catch by species. The mean length keys, mean lengths, weights and target strengths for each haul and for each sub area are shown in Table 2D4. The spatial distribution of mean length is shown in Figure 2D3. A total of 3,897 otoliths were taken to establish 5 age length keys, one per area, the total number of otoliths taken by length and age is given in Table 2D6. There is again evidence of only very small amounts of icthyophonus in the population. This was similar to last year. The stratified weight at length data was used to define the weight-length relationship for herring, which was:

$$W = 1.589\ 10^{-3}\ L^{3.538}\ g \quad (L \text{ measured in cm})$$

The proportions of mature 2 ring and 3 ring herring were estimated at 82% and 90% respectively. This is a typical proportion of 2 ring and a low proportion of three ring and is consistent with low fraction mature at 2 ring for the large 2000 year class. Thus there is confirmation that the 2000 year class has grown more slowly and is maturing later than earlier year classes.

3.3 Biomass and Abundance estimates

The numbers and biomass of fish by quarter ICES statistical rectangle are shown in Figure 2D4 A total estimate of 7,134 million herring or 1,577 thousand tonnes was calculated for the

survey area. 1,508 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 edge between 0°. and 4°W. Herring were generally found in similar water depths and location to 2002 however, the distributions were slightly more southerly. The abundance of 3 ring herring dominates the population in this area Table 2D6 shows the estimated herring numbers mean lengths weights and biomass and proportion mature at age 2 and 3 ring by age class.

In addition to the 1.6 million tonnes of herring, approximately 50 thousand tonnes of other fish species were observed in mid water in similar depths and conditions but not allocated as herring. Examination of the catch by species (Table 2D1) shows that the numbers of fish species other than herring caught in pelagic hauls were very small and very variable indicating the difficulty of allocating this component among these species so this has not been attempted. The dominant species other than herring must be considered to be, mackerel with some haddock. For the third year no cod were caught as bycatch in any of the pelagic hauls. The survey indicates that the overall biomass is lower than last year with 5 and 3 ring herring dominating. 300 thousand tones of 3 ring herring was found to be immature, normally almost all of this would have been mature giving an SSB of 1.8 million tonnes

3.4 Ichthyophonus Infection

Only 3 herring from 3,897 herring sampled were found to show macroscopic evidence of infection. From these numbers its not possible to infer age or size of the infected fish..

Table 2D1. Simrad EK500 38 kHz system and analysis settings used on the Scotia herring acoustic survey 2/7-20/7/2004.

Transceiver Menu	
Frequency	38 kHz
Sound speed	1490 $m.s^{-1}$
Max. Power	2000 W
Equivalent two-way beam angle	-21.0 dB
Default Transducer Sv gain	26.50 dB
3 dB Beamwidth	7.1°
Calibration details	
TS of sphere	-42.36 dB
Range to sphere in calibration	10.6m
Measured NASC value for calibration	3600
Calibration factor for NASCs	0.86
Calibration constant for MILAP (optional)	0.93 at -35 dB
Log Menu	
Simulated	2.5 n.mi. at 10 knots
Operation Menu	
Ping interval	1.5 s at 250 m range 2.5 at 500 m range
Analysis settings	
Bottom margin (backstep)	0.5 m
Integration start (absolute) depth	11 m
Range of thresholds used	-70 dB on 38 -170 on combined blurred 38,120,200

Table 2D2. Details of the fishing trawls taken during the Scotia herring acoustic survey, 2-23/7/2004: No. = trawl number; Trawl depth = depth (m) of headrope *if net is on bottom; Gear type P=pelagic, D=demersal, O=other; Duration of trawl (minutes); Total catch in kg Use: h=used to qualify herring acoustic data, s= used to qualify sprat acoustic data (blank if neither).

NO	Date	Position	time (UTC)	Water Depth	Trawl Depth	Gear Type	Duration (min)		Total Kg
196	3/7/2004	58 56.00N 001 43.10W	1756	101	89*	P	42	h	60
197	4/7/2004	58 56.04N 000 27.43W	0405	139	127*	P	50	h	75
198	4/7/2004	58 55.94N 000 20.48E	0857	147	135*	P	18	h	2400
199	5/7/2004	59 26.01N 000 55.84W	1342	131	119*	P	28	h	1200
200	6/7/2004	59 41.23N 000 21.77E	0856	130	118*	P	38	h	1200
201	6/7/2004	59 41.14N 000 38.30W	1400	131	119*	P	27	h	300
202	6/7/2004	59 48.01N 000 59.32W	2025	113	101*	P	22	h	1200
203	7/7/2004	59 48.00N 000 20.91W	0354	140	128*	P	51	h	300
204	7/7/2004	60 02.15N 000 00.44E	0842	150	138*	P	28	h	90
205	8/7/2004	60 11.01N 001 33.12E	0550	117	105*	P	60		0
206	8/7/2004	60 11.00N 000 38.29E	1112	144	132*	P	33	h	1200
207	8/7/2004	60 10.94N 000 04.65E	1454	162	150*	P	47	h	240
208	9/7/2004	60 18.00N 000 41.67E	0443	165	153*	P	21	h	2100
209	9/7/2004	60 26.22N 001 08.12E	1203	145	133*	P	39	h	1500
210	9/7/2004	Foul Haul							
211	9/7/2004	60 32.96N 000 42.12W	2152	120	108*	P	20	h	900
212	10/7/2004	60 40.99N 001 05.74E	1149	152	140*	P	31	h	1050
213	10/7/2004	60 40.98N 000 20.21W	1825	90	78*	P	16		20
214	11/7/2004	60 48.01N 000 19.92W	0330	150	138*	P	22	h	750
215	11/7/2004	60 55.95N 001 15.41E	1304	148	136*	P	27	h	1800
216	11/7/2004	60 56.00N 000 00.24W	1830	167	155*	P	28	h	60
217	13/7/2004	61 03.06N 001 20.68E	1942	152	140*	P	20	h	1800
218	14/7/2004	61 10.59N 000 04.33E	0752	160	148*	P	26	h	360
219	14/7/2004	61 11.00N 000 31.98W	1117	162	150*	P	46	h	150
220	14/7/2004	61 17.97N 000 35.22W	1546	174	162*	P	26	h	450
221	14/7/2004	61 17.99N 000 15.36W	1837	169	157*	P	41	h	180
222	15/7/2004	61 25.96N 000 02.11E	1210	182	170*	P	33	h	900
223	16/7/2004	61 11.13N 001 09.98W	1652	158	146*	P	25	h	360
224	17/7/2004	60 56.20N 001 00.22W	0358	110	98*	P	26	h	2250
225	17/7/2004	60 55.98N 002 00.14W	0838	156	144*	P	32	h	360
226	17/7/2004	60 48.00N 002 05.43W	1400	140	128*	P	36	h	1200
227	17/7/2004	60 41.01N 001 47.58W	2125	130	118*	P	28	h	900

NO	Date	Position	time (UTC)	Water Depth	Trawl Depth	Gear	Type	Duration	(min)	Total Kg
228	18/7/2004	60 32.94N 002 26.19W	0758	135	123*		P	18	h	1200
229	18/7/2004	60 25.99N 002 17.22W	1517	151	139*		P	12	h	900
230	19/7/2004	60 11.09N 003 12.18W	0405	140	128*		P	30		0
231	19/7/2004	60 10.95N 002 16.10W	0817	116	104*		P	20	h	1200
232	19/7/2004	60 01.61N 001 29.89W	1245	133	121*		P	29	h	180
233	19/7/2004	59 56.03N 003 27.35W	2059	146	134*		P	17	h	300
234	20/7/2004	59 32.98N 003 45.23W	0927	165	153*		P	18	h	240
235	20/7/2004	59 41.09N 003 23.30W	1408	160	148*		P	9	h	1500
196	3/7/2004	58 56.00N 001 43.10W	1756	101	89*		P	42	h	60
197	4/7/2004	58 56.04N 000 27.43W	0405	139	127*		P	50	h	75
198	4/7/2004	58 55.94N 000 20.48E	0857	147	135*		P	18	h	2400
199	5/7/2004	59 26.01N 000 55.84W	1342	131	119*		P	28	h	1200
200	6/7/2004	59 41.23N 000 21.77E	0856	130	118*		P	38	h	1200
201	6/7/2004	59 41.14N 000 38.30W	1400	131	119*		P	27	h	300

Table 2D3 Total catch in number by species for trawl hauls from the Scotia acoustic survey 2-23/7/2004. Estimated total catch is given in kg.

HAUL NO	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210	211	212	213	214	215
Est. catch (Kgs)	60	75	2400	1200	1200	300	1200	300	90	0	1200	240	2100	1500		900	1050	20	750	1800
Herring	208	489	13840	7980	5419	1888	10000	1567	548	0	5453	1226	9590	7183		3950	3967	47	3475	8100
Mackerel			27	60		4												2	17	
Sprat																				
Saithe								3			27									
Blue Whiting																				
Lumpsucker																				
Haddock	101			240		62		135	6	2		45						7	17	
Whiting		3		40		9		13				6						1		
Ommastrephids	1	1																		
Sample (kg)	60	75	90	60	113	68	45	90	60	0	90	75	90	90		90	90	20	90	90

HAUL NO	216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235
Est. catch (Kgs)	60	1800	360	150	450	180	900	360	2250	360	1200	900	1200	900	0	1200	180	300	240	1500
Herring	161	9240	1365	697	1390	722	3500	1765	10925	1022	5973	4380	3580	4020		7060	1044	1460	1325	7300
Mackerel			144	5	55	30	510		100	645	346	240	500	180		420		57	37	
Sprat																			3	
Saithe		24																		
Blue Whiting																		33		
Lumpsucker		24																		
Haddock																				
Whiting																				
Ommastrephids																				
Sample (kg)	60	75	120	90	90	90	90	90	90	120	90	90	120	90	0	60	60	90	90	90

Table 2D4. Herring length frequency proportion for individual trawl hauls for sub-area I (Figure 3) for the *Scotia* acoustic survey (2-23/7/2004) length in cm, weight in g, calculated target strength in dB per individual using TS=-71.2+20log(L).

LENGTH	220	221	223	224	225	226	228	229	233	MEAN
19.50										0.00
20.00										0.00
20.50										0.00
21.00										0.00
21.50										0.00
22.00										0.00
22.50				0.00						0.00
23.00				0.01					0.00	0.00
23.50				0.02	0.01				0.00	0.00
24.00			0.00	0.03	0.02	0.01		0.00	0.00	0.01
24.50	0.01		0.04	0.07	0.05	0.03		0.00	0.03	0.03
25.00	0.03		0.07	0.08	0.07	0.06		0.00	0.05	0.04
25.50	0.02		0.06	0.07	0.06	0.08		0.01	0.06	0.04
26.00	0.01	0.00	0.07	0.08	0.06	0.10		0.03	0.07	0.05
26.50	0.02	0.02	0.06	0.06	0.06	0.08		0.04	0.07	0.05
27.00	0.02	0.01	0.06	0.06	0.08	0.08		0.08	0.09	0.05
27.50	0.04	0.02	0.06	0.08	0.08	0.07		0.11	0.07	0.06
28.00	0.05	0.06	0.07	0.09	0.11	0.10	0.03	0.16	0.08	0.08
28.50	0.09	0.10	0.06	0.07	0.07	0.07	0.06	0.13	0.05	0.08
29.00	0.14	0.11	0.08	0.09	0.08	0.07	0.09	0.14	0.08	0.10
29.50	0.13	0.10	0.06	0.07	0.07	0.06	0.14	0.10	0.08	0.09
30.00	0.14	0.15	0.08	0.06	0.06	0.08	0.19	0.09	0.08	0.10
30.50	0.10	0.12	0.06	0.03	0.05	0.06	0.15	0.04	0.05	0.07
31.00	0.09	0.13	0.05	0.02	0.04	0.02	0.15	0.03	0.05	0.07
31.50	0.04	0.09	0.07	0.01	0.00	0.02	0.09	0.02	0.02	0.04
32.00	0.03	0.05	0.02	0.00	0.01	0.00	0.04	0.01	0.01	0.02
32.50	0.02	0.01	0.02	0.00	0.00	0.00	0.03	0.00	0.02	0.01
33.00	0.01	0.02	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.01
33.50	0.01	0.01	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00
34.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
34.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
35.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
35.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Number	278	361	439	437	438	448	358	402	438	
mean length	29.9	30.4	28.8	27.7	28.1	28.2	30.8	29.0	28.6	29.1
mean weight	267	284	239	207	217	219	296	241	230	244
TS/indvid	-41.7	-41.5	-42.0	-42.3	-42.2	-42.2	-41.4	-41.9	-42.1	-41.9
TS/kg	-35.9	-36.1	-35.8	-35.5	-35.6	-35.6	-36.1	-35.7	-35.7	-35.8

Table 2D4 (cont). Herring length frequency proportion for individual trawl hauls for Sub-area II (Figure 3) for the *Scotia* acoustic survey (2-23/7/2004) length in cm, weight in g, calculated target strength in dB per individual using TS=-71.2+20log(L).

LENGTH	196	197	199	201	202	203	204	227	231	232	234	235	MEAN
19.5	0.00												0.00
20.0	0.00										0.00		0.00
20.5	0.00										0.00		0.00
21.0	0.00										0.00		0.00
21.5	0.00										0.00		0.00
22.0	0.00										0.00		0.00
22.5	0.11	0.00								0.00	0.00		0.01
23.0	0.22	0.02	0.03	0.01		0.00				0.00	0.01		0.02
23.5	0.20	0.09	0.10	0.04	0.07	0.01	0.00	0.01	0.05	0.07	0.02	0.05	0.06
24.0	0.24	0.14	0.15	0.04	0.13	0.05	0.01	0.03	0.11	0.09	0.07	0.05	0.09
24.5	0.12	0.13	0.16	0.07	0.15	0.08	0.04	0.07	0.14	0.08	0.09	0.05	0.10
25.0	0.06	0.17	0.19	0.13	0.20	0.13	0.14	0.10	0.18	0.14	0.11	0.06	0.13
25.5	0.02	0.15	0.12	0.14	0.17	0.09	0.14	0.08	0.15	0.12	0.10	0.07	0.11
26.0	0.01	0.14	0.11	0.20	0.14	0.13	0.20	0.10	0.16	0.16	0.11	0.09	0.13
26.5	0.01	0.08	0.06	0.09	0.07	0.10	0.17	0.08	0.08	0.14	0.06	0.08	0.08
27.0	0.00	0.04	0.04	0.09	0.04	0.11	0.15	0.10	0.06	0.12	0.06	0.06	0.07
27.5	0.00	0.01	0.02	0.06	0.02	0.09	0.07	0.08	0.03	0.06	0.07	0.05	0.05
28.0	0.00	0.01	0.01	0.04	0.00	0.10	0.05	0.09	0.03	0.02	0.07	0.05	0.04
28.5	0.00	0.00	0.01	0.04	0.00	0.05	0.02	0.08	0.01	0.01	0.06	0.05	0.03
29.0	0.00	0.00	0.00	0.02	0.00	0.03	0.01	0.09	0.00	0.00	0.06	0.04	0.02
29.5	0.00	0.00	0.00	0.02	0.00	0.01	0.00	0.04	0.00	0.00	0.04	0.05	0.01
30.0	0.00	0.00	0.00	0.01	0.00	0.01	0.00	0.02	0.00	0.01	0.02	0.05	0.01
30.5	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.01	0.05	0.01
31.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.01	0.04	0.00
31.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.03	0.00
32.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00
32.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	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	0.01	0.00
33.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00
34.0	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
34.5	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
35.0	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
35.5	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
Number	208	489	399	428	375	470	365	438	353	348	497	438	
mean length	24.2	25.6	25.5	26.6	25.6	26.9	26.7	27.5	25.9	26.2	27.0	28.1	26.3
mean weight	126	154	152	177	154	185	179	199	161	167	188	220	172
TS/ind	-43.5	-43.0	-43.1	-42.7	-43.0	-42.6	-42.7	-42.4	-42.9	-42.8	-42.6	-42.2	-42.8
TS/kg	-34.5	-34.9	-34.9	-35.2	-34.9	-35.3	-35.2	-35.4	-35.0	-35.1	-35.3	-35.6	-35.1

Table 2D4 (cont). Herring length frequency proportion for individual trawl hauls by sub-area III, IV and V (Figure 3) for the *Scotia* acoustic survey (2-23/7/2004) length in cm, weight in g, calculated target strength in dB per individual using TS=-71.2+20log(L).

LENGTH	198	200	206	207	208	209	211	214	219	MEAN	212	215	216	218	MEAN	217	222	MEAN
19.5										0.00					0.00			0.00
20.0										0.00					0.00			0.00
20.5										0.00					0.00			0.00
21.0										0.00					0.00			0.00
21.5										0.00					0.00			0.00
22.0										0.00					0.00			0.00
22.5	0.00									0.00				0.00	0.00			0.00
23.0	0.00									0.00				0.00	0.00			0.00
23.5	0.03	0.00					0.00	0.01	0.00	0.01				0.00	0.00			0.00
24.0	0.04	0.00			0.00		0.01	0.02	0.00	0.01				0.01	0.00			0.00
24.5	0.04	0.01	0.00		0.01	0.02	0.01	0.03	0.04	0.02				0.00	0.00			0.00
25.0	0.08	0.03	0.00	0.00	0.01	0.04	0.02	0.05	0.08	0.03	0.00	0.00		0.02	0.01			0.00
25.5	0.06	0.04	0.01	0.01	0.04	0.07	0.05	0.06	0.08	0.05	0.01	0.04		0.04	0.02			0.00
26.0	0.11	0.06	0.05	0.03	0.08	0.09	0.06	0.10	0.10	0.08	0.01	0.04		0.07	0.03	0.01		0.00
26.5	0.10	0.06	0.05	0.08	0.09	0.10	0.07	0.08	0.08	0.08	0.05	0.07		0.10	0.06	0.00	0.00	0.00
27.0	0.14	0.10	0.10	0.11	0.13	0.12	0.09	0.12	0.10	0.11	0.06	0.10	0.02	0.10	0.07	0.00	0.00	0.00
27.5	0.11	0.07	0.09	0.13	0.14	0.10	0.10	0.13	0.09	0.11	0.11	0.11	0.04	0.11	0.09	0.02	0.00	0.01
28.0	0.11	0.14	0.11	0.14	0.15	0.10	0.14	0.12	0.09	0.12	0.11	0.12	0.07	0.08	0.10	0.01	0.01	0.01
28.5	0.09	0.12	0.11	0.12	0.09	0.11	0.12	0.09	0.07	0.10	0.11	0.12	0.10	0.07	0.10	0.06	0.03	0.05
29.0	0.05	0.13	0.13	0.13	0.09	0.11	0.10	0.07	0.08	0.10	0.12	0.16	0.13	0.07	0.12	0.08	0.10	0.09
29.5	0.03	0.10	0.10	0.07	0.06	0.07	0.07	0.05	0.05	0.07	0.09	0.08	0.13	0.07	0.09	0.09	0.10	0.09
30.0	0.01	0.06	0.10	0.07	0.05	0.04	0.08	0.02	0.05	0.05	0.11	0.07	0.16	0.08	0.10	0.15	0.15	0.15
30.5	0.00	0.03	0.06	0.06	0.03	0.01	0.05	0.02	0.03	0.03	0.09	0.05	0.12	0.06	0.08	0.11	0.13	0.12
31.0	0.00	0.03	0.03	0.01	0.00	0.01	0.02	0.00	0.02	0.01	0.06	0.02	0.10	0.04	0.05	0.15	0.18	0.16
31.5	0.00	0.00	0.03	0.02	0.01	0.00	0.01	0.01	0.02	0.01	0.03	0.01	0.07	0.02	0.03	0.10	0.10	0.10
32.0	0.00	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.01	0.01	0.02	0.00	0.02	0.02	0.02	0.08	0.08	0.08
32.5	0.00	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.00	0.01	0.00	0.02	0.01	0.01	0.10	0.05	0.08
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	0.01	0.02	0.01	0.04	0.05	0.05
33.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.01	0.01	0.01
34.0	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	0.00	0.00	0.01	0.00
34.5	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	0.00	0.00	0.00	0.00
35.0	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	0.00	0.00	0.00	0.00
35.5	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	0.00	0.00	0.00	0.00
Number	519	508	409	383	411	431	395	417	418		340	405	161	455		385	350	

LENGTH	198	200	206	207	208	209	211	214	219	MEAN	212	215	216	218	MEAN	217	222	MEAN
mean length	27.3	28.6	29.1	28.9	28.3	28.1	28.5	27.8	28.0	28.3	29.5	28.8	30.3	28.8	29.3	31.1	31.2	31.1
mean weight	193	228	242	236	221	215	227	206	213	220	254	235	278	236	251	307	308	308
TS/ind	-42.5	-42.1	-41.9	-42.0	-42.1	-42.2	-42.1	-42.3	-42.2	-42.2	-41.8	-42.0	-41.6	-42.0	-41.8	-41.3	-41.3	-41.3
TS/kg	-35.3	-35.6	-35.8	-35.7	-35.6	-35.5	-35.6	-35.5	-35.5	-35.6	-35.8	-35.7	-36.0	-35.7	-35.8	-36.2	-36.2	-36.2

Table 2D5 FRV Scotia 2-23/7/2004 Numbers of herring otolithed at length and at age, lengths in mm measured to the nearest 0.5cm below, ages in winter rings(wr). Of the 3881 otoliths taken 2 were unreadable.

LENGTH	1	2I	2M	3I	3M	4	5	6	7	8	9+	GRAND TOTAL
195	1											1
200	1											1
205	1											1
210												0
215												0
220												0
225	1	2	1	7								11
230		6	1	18	4							29
235		5	9	40	22	1	1					78
240		6	17	45	33	1	1					103
245		6	20	37	62	4	2					131
250		3	24	14	87	11	1		1			141
255		1	20	1	115	12	3					152
260		2	9		112	13	16	1		1		154
265			4		117	26	14	3	1			165
270			6		90	37	25		1			159
275			3		155	82	68	8	1			317
280			2		113	98	82	10	6	4		315
285			1		57	113	104	11	7	10	4	307
290			2		37	99	131	8	10	5	4	296
295					15	76	158	8	12	11	3	283
300					8	58	154	16	18	16	6	276
305					4	38	126	23	23	33	4	251
310					1	22	89	17	38	34	13	214
315						6	44	27	32	53	13	175
320						3	17	20	24	45	16	125
325					1	6	12	21	9	24	22	95
330						3	7	21	2	7	20	60
335						2	5	8	1	4	8	28
340									2		4	6
345								1	1	1	1	4
350												0
355											1	1
Grand Total	4	31	119	162	1033	711	1060	203	189	248	119	3879

Table 2D6. Mean length, mean weight, biomass (thousands of tonnes) and numbers (millions) breakdown by age and maturity obtained during the Scotia 2 - 23 July 2004 herring acoustic survey.

AGE/MATURITY	NUMBER (MILLIONS)	MEAN WEIGHT (G)	MEAN LENGTH(CM)	BIOMASS (THOUSANDS OF TONNES)
1A	3.9	90.1	21.47	0.4
2I	66.0	135.4	24.20	8.9
2M	297.3	156.2	25.21	46.4
3I	302.6	130.6	23.98	39.5
3M	2,660.1	183.8	26.40	489.0
4A	1,325.1	231.7	28.22	307.0
5A	1,719.8	255.8	29.04	439.8
6A	206.8	284.4	29.89	58.8
7A	221.9	287.3	30.02	63.7
8A	238.1	307.5	30.64	73.2
9+	92.7	328.9	31.22	30.5
Total	7,134.3	218.3	27.62	1,557.3

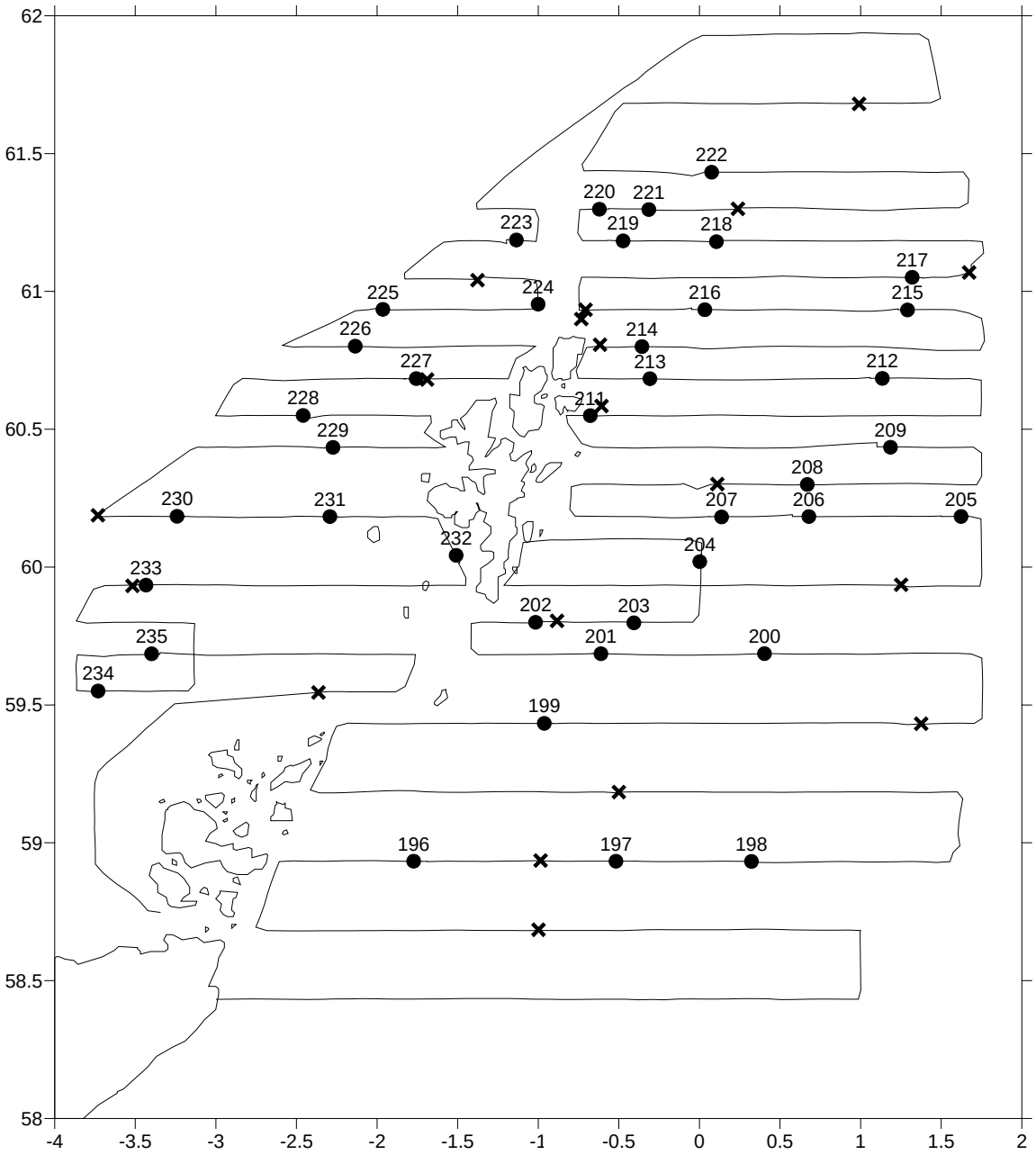


Figure 2D1. Cruise track FRV SCOTIA for 2-23 July 2004 pelagic trawl stations (●), CTD stations (X)

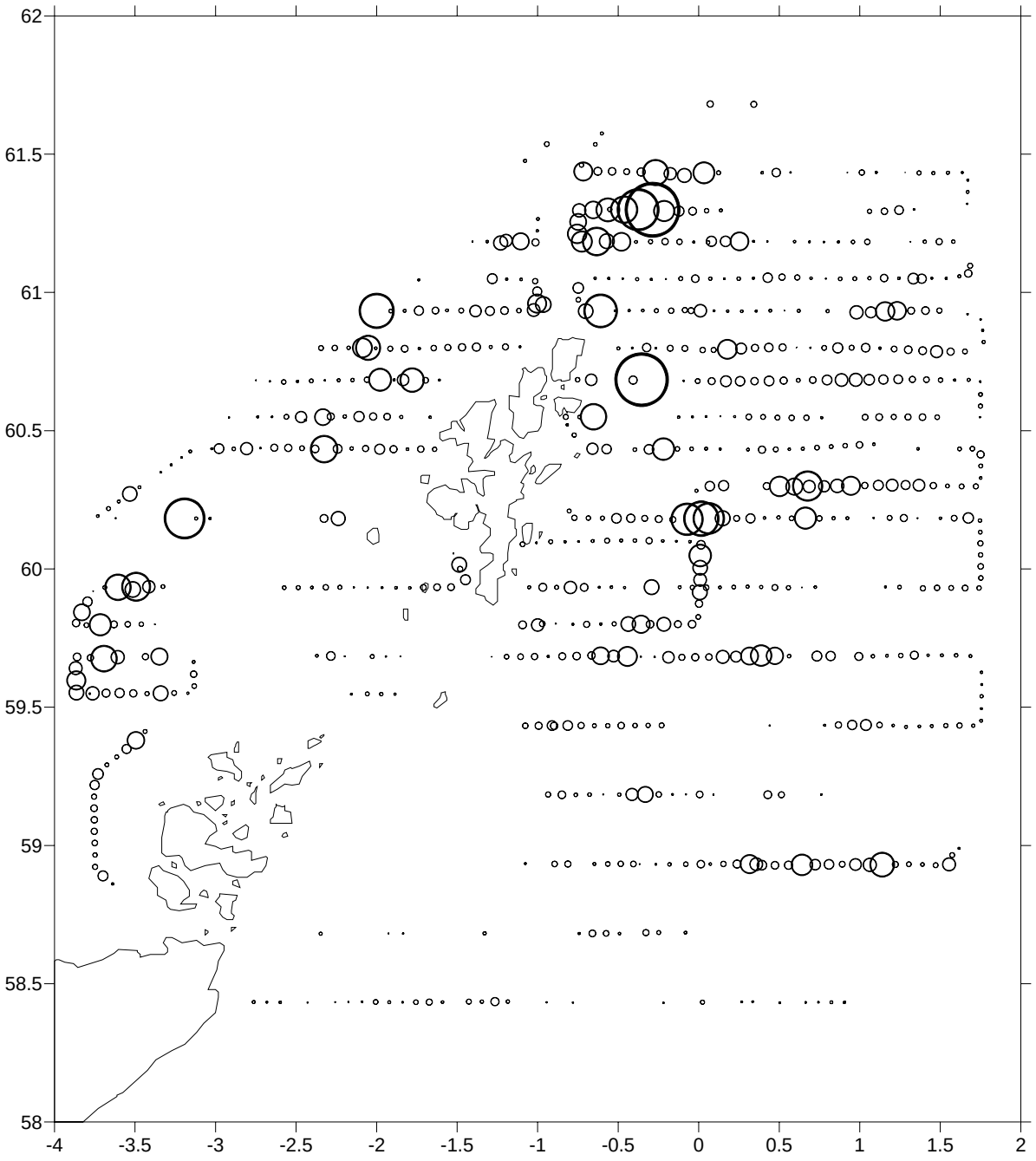


Figure 2D2. Post plot of NASC values attributed to herring from FRV SCOTIA 2-23 July 2004

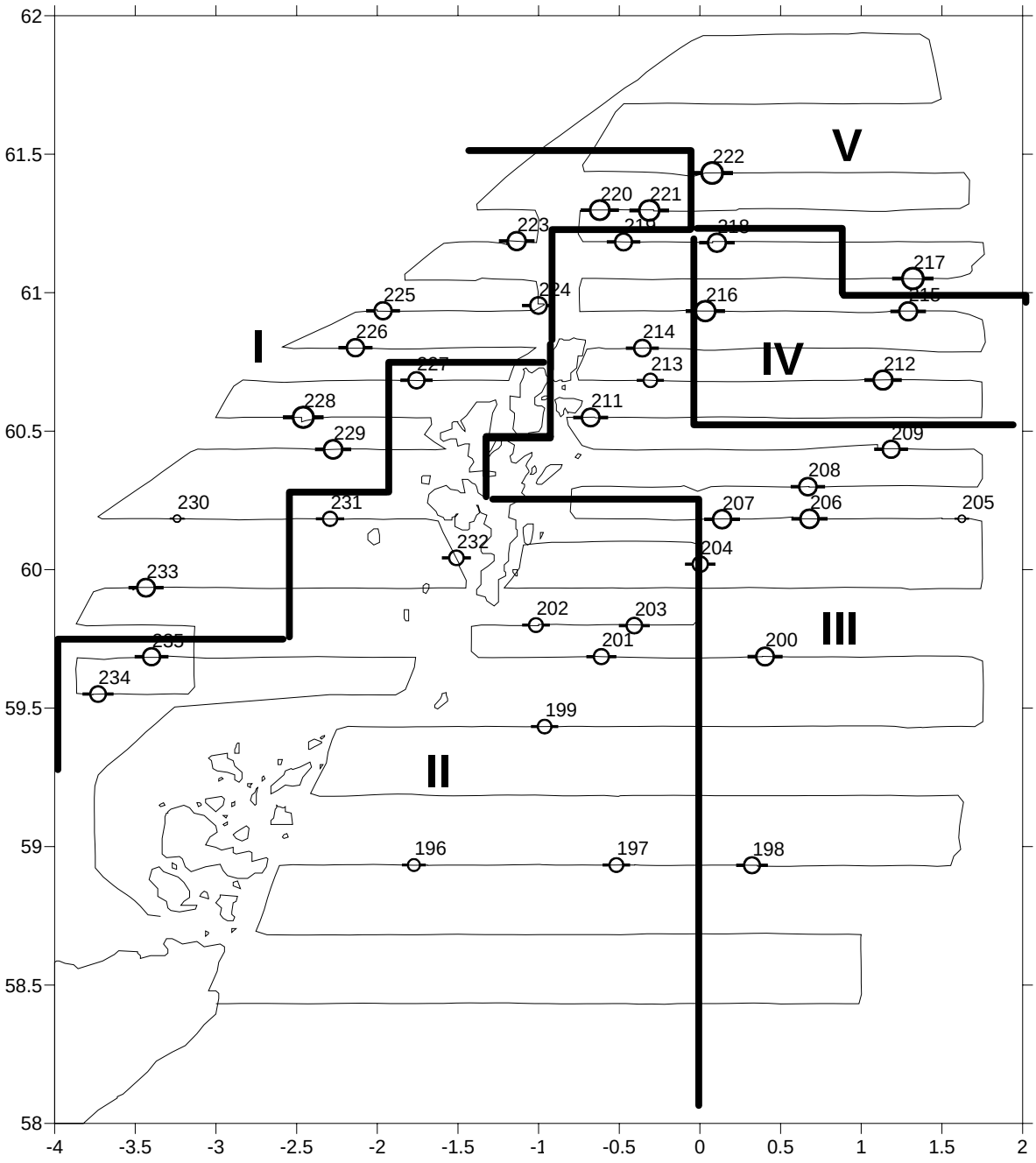


Figure 2D3. Mean Length of herring from pelagic trawl catches, FRV SCOTIA for 2e-23 July 2004 trawl station numbers are given in Figure 1 and details in Tables 1 and 2. The five analysis areas are shown in roman numerals and the length distributions, mean lengths, weights and target strengths are given by haul and area in Table 4.

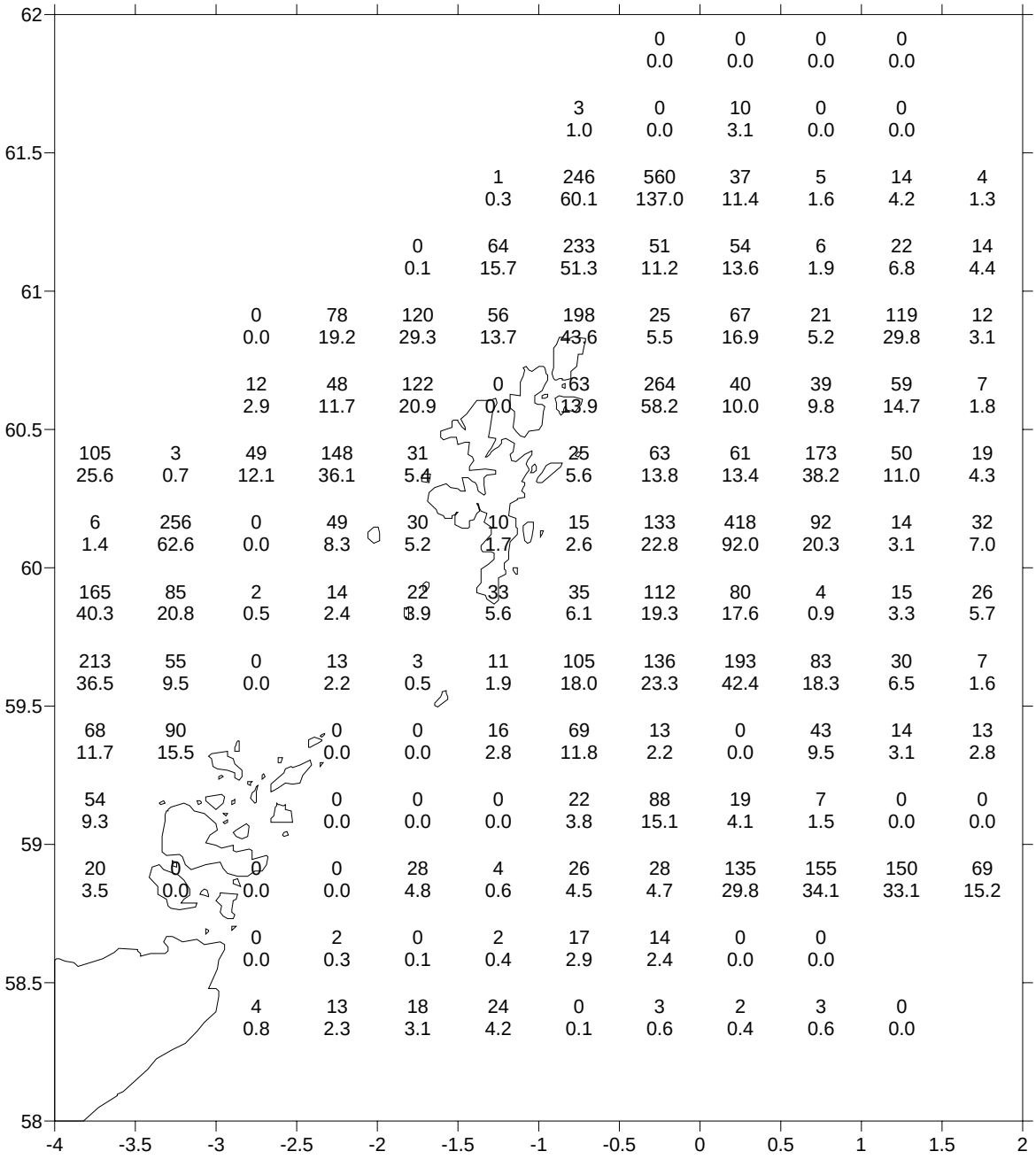


Figure 2D4. Estimated numbers (millions) and biomass (thousands of tonnes) by quarter statistical rectangle FRV SCOTIA for 27 June-20 July 2004 (numbers upper and biomass lower values)

Annex 2E: Netherlands

Survey report for MFV *TRIDENS*

28 June–21 July 2004

Sytse Ybema and Bram Couperus, RIVO, IJmuiden

1. Introduction

The Netherlands Institute for Fisheries Research (RIVO) participates in the international North Sea hydro acoustic survey for herring since 1991. The survey is part of the EU data collection framework. The aim of this survey is to provide an abundance estimate of the whole North Sea herring population. This estimate is used as a tuning index by the ICES Herring Assessment Working Group (HAWG) to determine the population size. In this report the results are presented of the survey in the central North Sea, carried out by FRV "Tridens".

2. Survey description and methods

2.1 Scientific Staff

Bram Couperus	(cruise leader first two weeks)
Kees Bakker	(cruise leader second two weeks)
Sytse Ybema	(Second two weeks)
Henk Heessen	(First week)
Andre Dijkman Dulkes	(First two weeks)
Mario Stoker	(Second two weeks)
Kees Camphuysen	(Ornithologist)
Hans Verdaat	(Ornithologist 1st two weeks)
Sabine Wilhelm	Canadian Wildlife Service, ornithologist; 2nd two weeks)
Mohammed Ahmed Ould Taleb	(IMROP, Mauritania)

2.2 Narrative

On Monday 28 June "Tridens" left the port of IJmuiden and headed towards Scapa Flow. On its way the equipment for the calibration was prepared. Arrival at Scapa Flow was Tuesday at 24.00 Dutch time. Next morning the calibration started (see paragraph "Calibration").

On Wednesday 30 June the survey started at the western end of the 58°10 transect (Moray Firth). The rest of the week, only few echo's assigned to herring were recorded and only 3 hauls were made. Sunday was spent in Aberdeen.

In the night from Sunday to Monday, "Tridens" set course for the 57º15, 56º55 and 56º40 transects. Again, only 3 hauls were made. On Wednesday a north-south transect was made at 2º50 up to the Doggersbank. Arrival at IJmuiden to spend the weekend was on Thursday 8 July at 12.00

On Monday morning 12 July the port was left at 11.30 local time. On 13 July the 56º25 transect was picked up. The rest of the trip developed without difficulties with a cruise break in Newcastle during the weekend. Only few schools of fish were detected and therefore only 10 hauls were made in this second part of the cruise. Tuesday 20 July many large schools were seen on the 55º10 transect and the catch consisted of sprat and immature herring. At the end of the 54º54 transect, a dense layer, close to the sea floor was found and appeared to be small transparent gobies. On Thursday 21 July the survey was terminated and course was set to Scheveningen. Arrival at 14.00.

2.3 Survey design

The survey was carried out from 28 June to 21 July 2004, covering an area east of Scotland from latitude 54°39 to 58°10 North and from longitude 3° West (or the Scottish/English coast) to 3° East. An adapted survey design was applied, partly based on the herring distribution from previous years. Parallel transects along latitudinal lines were used with spacing between the lines set at 15 or 30 nm depending on the expected distributions. Acoustic data from transects running north-south close to the shore (that is parallel to the depth isolines) were excluded from the dataset.

The surveyed cruise track and trawl positions are presented in Figure 1.

2.4 Calibration

Three calibrations were executed:

1. 38 kHz in the towed body: good results.
2. 200 kHz in the towed body: good results.
3. 38 kHz hull mounted: good results.

The three calibrations were successful. The transducers in the towed body were checked before the survey and some adjustments on the keel were made to perform a good calibration of the hull mounted transducer.

During the calibration of the 200 kHz transducer, it took a relative long time (several minutes), for each individual point in the beam to become detected. Also, the deviation from the expected beam-shape was high (RMS 0.4). We do not know the cause.

2.5 Acoustic data collection

A Simrad 38 kHz split beam transducer was operated in a towed body (type “Shark”) 6-7 m under the water surface. The settings of the EK60 are listed in Table 1. Acoustic data were collected with a Simrad EK60 scientific echo sounder. The data were logged with Sonardata Echoview software. The EK60 received the vessel speed (approximately 10-12 knots) from the ship’s GPS. A ping rate of 0.6 s was used. This ping rate has proven most suitable at depths of 50 - 150 m as they occur in most of the area.

The data were logged in 1 nm intervals.

During several days, the weather conditions allowed us to use the hull mounted transducer in stead of the towed body. Using the hull mounted, the vessel speed was increased (up to 12 knots, compared to 10 knots when using the towed body) and the saved time was used to perform an extra transect in the south.

2.6 Biological data

The acoustic recordings were verified by fishing with a 2000 mesh pelagic trawl with 20 mm meshes in the cod-end. Fishing was carried out when there was doubt about the species composition of recordings observed on the echo sounder and to obtain biological samples of herring and sprat. In general, after it was decided to make a tow with a pelagic trawl, the vessel turned and fished back on its track line. If the recordings showed schools, a 60 kHz sonar was used to be able to track schools that were swimming away from the track line. In all hauls the footrope was very close to the ground with vertical net openings varying from 10 to 20 m. It was not possible to make near-surface hauls, because the necessary floating buoys were not available on board.

Fish samples were divided into species by weight. Length measurements were taken to the 0.5 cm below for sprat, herring and to the cm below for other species. For herring and sprat length

stratified samples were taken for maturity, age (otolith extraction) and weight, five specimens per 0.5 cm class as a maximum. Three specimens of immature 4w-ring herring were found but were treated as “mature” during data analysis.

2.7 Hydrographical data

Hydrographical data have been collected in 37 CTD stations, all at fixed locations (Figure 2). The CTD-data are used for other studies.

2.8 Data analysis

The acoustic values (NASCs) from each log interval were assigned to the following categories: “definitely herring”, “probably herring”, “possibly herring”, “definitely sprat”, “probably sprat”, “possibly sprat”, “gadoids”, “mackerel”, “pelagics” and “sand eel”. The breakdown of sprat and herring in “definitely”, “probably” and “possibly” serves merely as a relative indication of certainty within the subjective process of integral partitioning (“scrutinising”). For the analysis “definitely –” and “possibly herring/sprat” integrator counts were summed to obtain a “best herring/sprat” estimate. The TS/length relationships used were those recommended by the ICES Planning Group for Herring Surveys (ICES 2000). The numbers of herring and sprat per ICES rectangle were calculated.

The biological samples were grouped in 5 strata for herring and 1 stratum for sprat, based on similar length distribution and geographical position (Figure 3). The numbers per year/maturity class were calculated, based on the age/length key for each stratum. For each separate stratum the mean weight per year/maturity class was then calculated.

3. Results

3.1 Acoustic data

Figure 4 shows the acoustic values (NASCs) per five nautical mile interval along the track lines for herring.

3.2 Biological data

In all, 16 trawl hauls have been conducted (Figure 1). Herring was found in 14 hauls of which 13 samples were taken. Sprat was found in 3 hauls of which 1 sample was taken (see also 2.8 *Data analysis*). In 13 hauls herring was the most abundant species in weight. In none of the hauls sprat was the most abundant species. In haul 16 the meshes were stuck with small transparent gobies indicating that this species would have been an abundant species in the catch if the mesh size had been smaller. The trawl list is presented in table 2a, the catch weights per haul and species are presented in table 2b and the length frequency proportions are presented in table 2c.

Table 3 shows the age/maturity length keys for herring (strata A-E) and sprat.

3.3 Biomass estimates

Table 4 summarizes numbers and biomass for stratum A-E for herring. Table 5a and 5b summarize numbers and biomass for the whole area for herring and sprat. The stock biomass estimate of herring is 991.9 tonnes and for sprat 1.9 tonnes. Figure 5 shows the estimated numbers and biomass of herring by ICES rectangle.

4. Discussion

The herring was equally distributed over the survey area, whereas in the previous years the highest concentrations were found around the Devil holes.

For the first time in four years, when the 1998 year class appeared as matures in the catches, the estimated biomass of mature herring is lower than the year before: 558 thousand tons vs. 623 thousand tons in 2003. Also the amount of immature herring is lower than in the previous year: 434 thousand tons vs. 780 thousand tons in 2003, due to an apparently week 2002 year class. The results of this years survey show that the number of 2 winter-ringers is lower than the number of 3 winter-ringers. This is something that rarely happens and is explained by the strong 2000 year class, combined with a weak 2001 year class.

Considering the lower biomass compared to previous years, one may speculate if the feeding conditions were not good this year, because the condition of the herring from the catches were generally low.

Table 1. Simrad EK60 settings used on the June 2004 North Sea hydro acoustic survey for herring, FRV "Tridens". TB=Towed Body HM=Hull Mounted.

Transceiver Menu		
	TB	**HM**
Absorption coefficient	9.4 dB/km	9.4 dB/km
Pulse length	1.024 ms	1.024 ms
Bandwidth	2.43 kHz	2.43 kHz
Max Power	2000 W	2000 W
Two-way beam angle	-20.6 dB	-20.6 dB
3 dB Beam width	7.02 dg	7.02 dg
Calibration details		
	TB	**HM**
Calibration details		
TS of sphere	-33.6 dB	-33.6 dB
Range to sphere in calibration	13.00 m	18.50 m
Transducer gain	25.64 dB	25.50 dB
Calibration factor for NASCs	-	-
Log/Navigation Menu		
	TB	**HM**
Speed	Serial from ship's GPS	Serial from ship's GPS
Operation Menu		
	TB	**HM**
Ping interval	0.6 s	0.6 s
Display/Printer Menu		
	TB	**HM**
TVG	20 log R	20 log R
Integration line	N/A	N/A
TS colour min.	-50 dB	-50 dB
Sv colour min.	-70 dB	-70 dB

Table 2a. Details of the trawl hauls taken during the July 2004 North Sea hydro acoustic survey, FRV "Tridens".

HAUL	DATE	POSITION	ICES RECTANGLE	TIME UTC	HAUL DURATION (MIN)	DEPTH	GEAR	SAMPLE ID
1	01/07/2004	58 10N 01 20W	45E8	08:00	45	89	pelagic trawl	5400701
2	01/07/2004	58 10N 01 48E	45F1	20:04	45	80	pelagic trawl	5400702
3	03/07/2004	57 15N 00 10E	43F0	08:30	37	88	pelagic trawl	5400703
4	05/07/2004	57 15N 01 32E	43F1	09:00	30	90	pelagic trawl	5400704
5	05/07/2004	56 54N 00 10E	42F0	18:35	30	92	pelagic trawl	5400705
6	06/07/2004	56 55N 00 44W	42E9	06:20	48	68	pelagic trawl	5400706
7	13/07/2004	56 25N 02 09E	41F2	09:10	130	84	pelagic trawl	5400707
8	13/07/2004	56 25N 00 30W	41E9	20:25	20	69	pelagic trawl	5400708
9	14/07/2004	56 09N 01 09W	41E8	14:50	20	66	pelagic trawl	5400709
10	14/07/2004	56 10N 00 26W	41E9	18:45	20	50	pelagic trawl	5400710
11	15/07/2004	56 10N 00 43E	41F0	07:07	83	68	pelagic trawl	5400711
12	15/07/2004	55 55N 01 16E	40F1	19:13	53	67	pelagic trawl	5400712
13	16/07/2004	55 39N 00 43E	40F0	19:43	53	60	pelagic trawl	5400713
14	19/07/2004	55 26N 01 04E	39F1	06:46	53	73	pelagic trawl	5400714
15	20/07/2004	55 10N 01 13E	39F1	11:52	108	52	pelagic trawl	5400715
16	20/07/2004	54 54N 01 12E	38F1	17:31	30	40	pelagic trawl	5400716

Table 2b. Trawl catches during the July 2004 North Sea hydro acoustic survey, FRV "Tridens" in kg.

Haul	RIVO sample_id	Herring	Sprat	Norway pout	Grey gurnard	Haddock	Mackerel	Whiting	Cod	Saithe	Spurdog
1	5400701	1251.6			2.1	148.2	46.3	0.8			
2	5400702	2033.2		0.9	0.6	2.9		1.4			
3	5400703	5803.1			1.1	100.5	398.8	29.5			
4	5400704	4697.0		0.3	1.6		94.8				
5	5400705	21099.8									
6	5400706	1710.1			1.3	33.2	36.1	4.5	117.4		
7	5400707	5863.2			1.6	14.8		1.3	0.2	7.2	0.5
8	5400708	435.9			3.8	5.5		3.3			
9	5400709	716.7	21.2				11.2				
10	5400710	115.0	0.1		5.1	5.6	6.4	0.8			
11	5400711	1553.6			24.4	4.5	7.5	2.3			
12	5400712	428.2			12.3	5.5	5.5	0.3			
13	5400713					6.6	0.3	0.8			
14	5400714	2.8			2.0	3.8	5.98	0.1			
15	5400715	5204.2	1294.2		33.7	50.1	0.9	1			
16	5400716										

Table 2c. Length frequency proportions of herring by haul during the July 2004 North Sea hydro acoustic survey, FRV "Tridens".

L.CLASS/HAUL:	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16
7																
7.5																
8																
8.5																
9																
9.5																
10																
10.5																
11																
11.5																
12																
12.5																
13																
13.5																
14																
14.5																
15									0.4					1.7	0.8	
15.5									0.4					1.7	7.9	
16														3.4	15.9	
16.5														13.6	19.0	
17									0.7					18.6	32.5	
17.5														16.9	17.5	
18														20.3	4.0	
18.5									0.4					13.6	1.6	
19										0.5				10.2	0.8	
19.5									0.4	0.5	0.3					
20									1.4	3.1	0.6	1.2				
20.5						1.0				0.5	0.6	0.3				
21						0.3		1.1		1.6	3.1	2.9				
21.5						2.1		2.4		1.6	4.6					
22	0.4			0.2		3.1		0.8		3.9	6.2	4.7				
22.5	6.2		1.8	1.6	1.5	9.4		1.6		5.2	6.2	15.2				
23	27.1	3.3	5.7	5.2	2.6	29.9	5.5	7.3	5.4	18.1	30.8	30.5				
23.5	27.1	6.8	17.0	16.1	11.7	22.9	5.5	22.7	24.5	17.8	13.8	21.1				
24	18.1	24.8	29.3	19.6	25.4	17.4	12.9	27.0	34.3	24.9	22.2	16.4				
24.5	10.7	21.7	14.1	21.0	19.2	8.3	11.1	20.5	21.7	8.4	6.5	1.8				
25	2.3	18.6	11.7	14.0	17.2	1.2	12.4	6.5	7.2	10.5		0.9				
25.5	3.0	9.3	8.8	8.4	13.0	1.4	19.4	4.3	2.9	2.1	2.8	1.8				
26	4.5	6.0	4.8	3.1	1.0	2.8	8.3	2.7		0.5	0.6	0.6				
26.5	0.4	1.9	3.5	2.8	4.8		3.7	0.8		0.5	0.6					
27	0.2	3.7	1.8	2.8	1.4		14.7		0.4		1.2	2.3				
27.5		3.1	1.5	4.4		0.2		0.3				0.3				
28					0.2		5.5	1.6								
28.5		0.9		0.5	2.1											
29				0.2			0.9	0.3								
29.5																
30				0.2												
30.5																

L.CLASS/HAUL:	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16
31																
31.5																
32																
32.5																
33																
total	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**0**	**100**	**100**	**0**

Table 3a. Age/maturity-length key for herring – Stratum A, B, C, D, E and F. "Tridens", North Sea acoustic survey 2004.

STRATUM	LENGTH CLASS	1IMM	1MAT	2IMM	2MAT	3IMM	3MAT	4MAT	5MAT	6MAT	7MAT	8MAT	9MAT
A	16												
A	16.5												
A	17												
A	17.5												
A	18												
A	18.5												
A	19												
A	19.5												
A	20												
A	20.5	2		1									
A	21	2											
A	21.5	2		3									
A	22			1		5							
A	22.5			4	1	5							
A	23			1	2	6	1						
A	23.5				2	7	1						
A	24				4	2	3	1					
A	24.5				4	3	3						
A	25						9						
A	25.5				4		5						
A	26				2		5	1	1				
A	26.5						2						
A	27				1								
A	27.5											1	
A	28												
A	28.5												
A	29												
A	30												

STRATUM	LENGTH CLASS	1IMM	1MAT	2IMM	2MAT	3IMM	3MAT	4MAT	5MAT	6MAT	7MAT	8MAT	9MAT
B	16												
B	16.5												
B	17												
B	17.5												
B	18												
B	18.5												
B	19												
B	19.5												
B	20												
B	20.5												
B	21												
B	21.5												
B	22			1									
B	22.5			2	1	7							

Table 3a Continued.

STRATUM	LENGTH CLASS	1IMM	1MAT	2IMM	2MAT	3IMM	3MAT	4MAT	5MAT	6MAT	7MAT	8MAT	9MAT
B	23			2	4	14							
B	23.5			1	3	14	2						
B	24			4	4	8	4						
B	24.5				5	5	9	1					
B	25				11	1	6	1	1				
B	25.5				5	1	11	3					
B	26				3		12	2					
B	26.5				2		8	3	4				
B	27				1		10	2	2				
B	27.5						4	4	3	1	1		
B	28						1						
B	28.5						2	1	1				
B	29									1			
B	30										1		

STRATUM	LENGTH CLASS	1IMM	1MAT	2IMM	2MAT	3IMM	3MAT	4MAT	5MAT	6MAT	7MAT	8MAT	9MAT
C	15	1											
C	15.5	1											
C	16												
C	16.5												
C	17	2											
C	17.5												
C	18												
C	18.5	1											
C	19	2											
C	19.5	3											
C	20	5		1									
C	20.5	4											
C	21	6		1									
C	21.5	1		5		1							
C	22	1		6		1							
C	22.5			3		5							
C	23			2		11	2						
C	23.5			2	1	11		1					
C	24			1	1	10	2	1					
C	24.5				5	7	2	1					
C	25				2	1	11	1					
C	25.5				1		5	1	1				
C	26						4	2					
C	26.5						5						
C	27								1				
C	27.5							1					
C	28						1		2				
C	28.5												
C	29								1				
C	30												

Table 3a Continued.

STRATUM	LENGTH CLASS	1IMM	1MAT	2IMM	2MAT	3IMM	3MAT	4MAT	5MAT	6MAT	7MAT	8MAT	9MAT
D	16												
D	16.5												
D	17												
D	17.5												
D	18												
D	18.5												
D	19												
D	19.5	1											
D	20	2		1									
D	20.5	3											
D	21	5		5									
D	21.5	1		6		1							
D	22			4		6							
D	22.5			3		8							
D	23			3	1	12	1						
D	23.5				1	7	1						
D	24			1	4	6	4						
D	24.5				2	3	7						
D	25				4		1	1					
D	25.5				4		5		1				
D	26				3		4						
D	26.5				2		3						
D	27						2	2	3	1			
D	27.5								1				
D	28								2		1		1
D	28.5												
D	29										2		
D	30												

Table 3a Continued.

STRATUM	LENGTH CLASS	1IMM	1MAT	2IMM	2MAT	3IMM	3MAT	4MAT	5MAT	6MAT	7MAT	8MAT	9MAT
E	15	1											
E	15.5	5											
E	16	5											
E	16.5	5											
E	17	5											
E	17.5	5											
E	18	5											
E	18.5	2											
E	19	1											
E	19.5												
E	20												
E	20.5												
E	21												
E	21.5												
E	22												
E	22.5												
E	23												
E	23.5												
E	24												
E	24.5												
E	25												
E	25.5												
E	26												
E	26.5												
E	27												
E	27.5												
E	28												
E	28.5												
E	29												
E	30												

Table 3b. Age/maturity-length key for sprat - Total area. "Tridens", North Sea acoustic survey 2004

LENGTH CLASS	1IMM	1MAT	2IMM	2MAT	3IMM	3MAT	4MAT	5MAT	6MAT	7MAT	8MAT	9MAT
10.5			2		1							
11				4		1						
11.5				4		1						
12				1		3						
12.5				2		4						
13						5						
13.5						5						
14						3						

Table 4. Herring. Mean length, mean weight, biomass (thousands of tonnes) and numbers (millions) breakdown by age and maturity per stratum obtained during the July 2004 North Sea hydro acoustic survey for herring, FRV "Tridens".

STRATUM	YEAR CLASS	AGE	MEAN WEIGHT (G)	MEAN LENGTH (CM)	NUMBERS (MILLIONS)	BIOMASS (THOUSAND TONNES)	NUMBERS (%)	BIOMASS (%)
A	2002	1imm	66.25	21.03	32.15	2.38	1.83	1.27
A	2002	1mat	0.00	0.00	0.00	0.00	0.00	0.00
A	2001	2imm	89.41	22.40	129.45	11.65	7.36	6.23
A	2001	2mat	114.80	23.91	398.17	43.93	22.64	23.49
A	2000	3imm	102.15	23.27	778.37	78.78	44.27	42.12
A	2000	3mat	122.03	24.50	379.42	45.14	21.58	24.13
A	1999	4mat	121.07	24.37	30.20	3.53	1.72	1.89
A	1998	5mat	142.00	26.00	5.58	0.79	0.32	0.42
A	1997	6mat	0.00	0.00	0.00	0.00	0.00	0.00
A	1996	7mat	0.00	0.00	0.00	0.00	0.00	0.00
A	1995	8mat	163.00	27.50	5.02	0.85	0.29	0.45
A	1994	9mat	0.00	0.00	0.00	0.00	0.00	0.00
Immature					**939.97**	**92.81**	**53.46**	**49.62**
Mature					**818.39**	**94.24**	**46.54**	**50.38**
Total							**100.00**	**100.00**

Table 4 Continued.

STRATUM	YEAR CLASS	AGE	MEAN WEIGHT (G)	MEAN LENGTH (CM)	NUMBERS (MILLIONS)	BIOMASS (THOUSAND TONNES)	NUMBERS (%)	BIOMASS (%)
B	2002	1imm	0.00	0.00	0.00	0.00	0.00	0.00
B	2002	1mat	0.00	0.00	0.00	0.00	0.00	0.00
B	2001	2imm	104.01	23.75	304.66	32.80	6.66	5.93
B	2001	2mat	120.40	24.58	1074.01	128.91	23.48	23.32
B	2000	3imm	107.04	23.78	1362.51	147.50	29.79	26.68
B	2000	3mat	133.06	25.14	1452.70	187.39	31.76	33.89
B	1999	4mat	142.17	25.88	243.94	34.42	5.33	6.23
B	1998	5mat	159.31	26.59	108.61	16.66	2.37	3.01
B	1997	6mat	156.08	28.31	13.55	2.51	0.30	0.45
B	1996	7mat	187.83	28.85	13.55	2.68	0.30	0.48
B	1995	8mat	0.00	0.00	0.00	0.00	0.00	0.00
B	1994	9mat	0.00	0.00	0.00	0.00	0.00	0.00
Immature					**1667.17**	**180.31**	**36.45**	**32.61**
Mature					**2906.36**	**0.00**	**63.55**	**67.39**
Total							**100.00**	**100.00**

STRATUM	YEAR CLASS	AGE	MEAN WEIGHT (G)	MEAN LENGTH (CM)	NUMBERS (MILLIONS)	BIOMASS (THOUSAND TONNES)	NUMBERS (%)	BIOMASS (%)
C	2002	1imm	54.08	19.48	34.78	2.08	8.51	4.75
C	2002	1mat	0.00	0.00	0.00	0.00	0.00	0.00
C	2001	2imm	89.73	22.67	44.34	4.16	10.85	9.51
C	2001	2mat	119.24	24.37	36.08	4.21	8.83	9.63
C	2000	3imm	105.50	23.62	194.75	20.65	47.64	47.21
C	2000	3mat	129.71	24.93	69.32	8.71	16.96	19.92
C	1999	4mat	118.39	24.63	22.41	2.72	5.48	6.21
C	1998	5mat	164.60	27.50	7.12	1.21	1.74	2.77
C	1997	6mat	0.00	0.00	0.00	0.00	0.00	0.00
C	1996	7mat	0.00	0.00	0.00	0.00	0.00	0.00
C	1995	8mat	0.00	0.00	0.00	0.00	0.00	0.00
C	1994	9mat	0.00	0.00	0.00	0.00	0.00	0.00
Immature					**273.87**	**26.88**	**66.99**	**61.47**
Mature					**134.94**	**0.00**	**33.01**	**38.53**
Total							**100.00**	**100.00**

Table 4 Continued.

STRATUM	YEAR CLASS	AGE	MEAN WEIGHT (G)	MEAN LENGTH (CM)	NUMBERS (MILLIONS)	BIOMASS (THOUSAND TONNES)	NUMBERS (%)	BIOMASS (%)
D	2002	1imm	66.25	20.60	59.39	4.12	3.98	2.55
D	2002	1mat	0.00	0.00	0.00	0.00	0.00	0.00
D	2001	2imm	86.32	22.28	198.73	17.62	13.32	10.90
D	2001	2mat	121.78	24.67	215.44	26.20	14.44	16.21
D	2000	3imm	98.61	23.11	659.15	65.29	44.18	40.39
D	2000	3mat	123.31	24.85	262.97	32.73	17.63	20.25
D	1999	4mat	146.46	26.25	22.56	3.32	1.51	2.05
D	1998	5mat	158.97	26.96	46.11	7.36	3.09	4.55
D	1997	6mat	156.00	27.00	7.02	1.12	0.47	0.69
D	1996	7mat	181.33	28.67	15.33	2.95	1.03	1.83
D	1995	8mat	0.00	0.00	0.00	0.00	0.00	0.00
D	1994	9mat	160.00	28.00	5.11	0.91	0.34	0.57
Immature					**917.27**	**87.04**	**61.49**	**53.85**
Mature					**574.55**	**0.00**	**38.51**	**46.15**
Total							**100.00**	**100.00**

STRATUM	YEAR CLASS	AGE	MEAN WEIGHT (G)	MEAN LENGTH (CM)	NUMBERS (MILLIONS)	BIOMASS (THOUSAND TONNES)	NUMBERS (%)	BIOMASS (%)
E	2002	1imm	38.34	17.02	1203.05	46.59	100.00	100.00
E	2002	1mat	0.00	0.00	0.00	0.00	0.00	0.00
E	2001	2imm	0.00	0.00	0.00	0.00	0.00	0.00
E	2001	2mat	0.00	0.00	0.00	0.00	0.00	0.00
E	2000	3imm	0.00	0.00	0.00	0.00	0.00	0.00
E	2000	3mat	0.00	0.00	0.00	0.00	0.00	0.00
E	1999	4mat	0.00	0.00	0.00	0.00	0.00	0.00
E	1998	5mat	0.00	0.00	0.00	0.00	0.00	0.00
E	1997	6mat	0.00	0.00	0.00	0.00	0.00	0.00
E	1996	7mat	0.00	0.00	0.00	0.00	0.00	0.00
E	1995	8mat	0.00	0.00	0.00	0.00	0.00	0.00
E	1994	9mat	0.00	0.00	0.00	0.00	0.00	0.00
Immature					**1203.05**	**46.59**	**100.00**	**100.00**
Mature					**0.00**	**0.00**	**0.00**	**0.00**
Total							**100.00**	**100.00**

Table 5a. Herring. Mean length, mean weight, biomass (thousands of tonnes) and numbers (millions) breakdown by age and maturity obtained during the July 2004 North Sea hydro acoustic survey for herring, FRV "Tridens".

YEAR CLASS	AGE	NUMBERS (MILLIONS)	BIOMASS (THOUSAND TONNES)	NUMBERS (%)	BIOMASS (%)	MEAN WEIGHT (G)	MEAN LENGTH (CM)
2002	1imm	1329.38	55.17	14.09	5.56	40.67	17.34
2002	1mat						
2001	2imm	677.17	66.24	7.18	6.68	95.09	22.99
2001	2mat	1723.70	203.26	18.27	20.49	119.25	24.43
2000	3imm	2994.79	312.23	31.74	31.48	103.81	23.49
2000	3mat	2164.41	273.97	22.94	27.62	129.84	24.99
1999	4mat	319.11	43.99	3.38	4.43	138.80	25.68
1998	5mat	167.42	26.03	1.77	2.62	158.86	26.71
1997	6mat	20.58	3.64	0.22	0.37	156.05	27.86
1996	7mat	28.88	5.63	0.31	0.57	184.38	28.75
1995	8mat	5.02	0.85	0.05	0.09	163.00	27.50
1994	9mat	5.11	0.91	0.05	0.09	160.00	28.00
Immature		**5001.33**	**433.63**	**53.01**	**43.72**		
Mature		**4434.23**	**558.28**	**46.99**	**56.28**		
Total		**9435.57**	**991.91**	**100.00**	**100.00**		

Table 5b. Sprat. Mean length, mean weight, biomass (thousands of tonnes) and numbers (millions) breakdown by age and maturity obtained during the July 2004 North Sea hydro acoustic survey for herring, FRV "Tridens".

YEAR CLASS	AGE	NUMBERS (MILLIONS)	BIOMASS (THOUSAND TONNES)	NUMBERS (%)	BIOMASS (%)	MEAN WEIGHT (G)	MEAN LENGTH (CM)
2002	1imm						
2002	1mat						
2001	2imm	1.80	0.01	1.18	0.69	9.50	10.50
2001	2mat	48.43	0.55	31.79	28.31	13.93	11.84
2000	3imm	0.90	0.01	0.59	0.34	10.00	10.50
2000	3mat	101.24	1.38	66.44	70.66	15.39	12.45
Immature		**2.71**	**0.02**	**1.78**	**1.03**		
Mature		**149.68**	**1.93**	**98.22**	**98.97**		
Total		**152.38**	**1.95**	**100.00**	**100.00**		

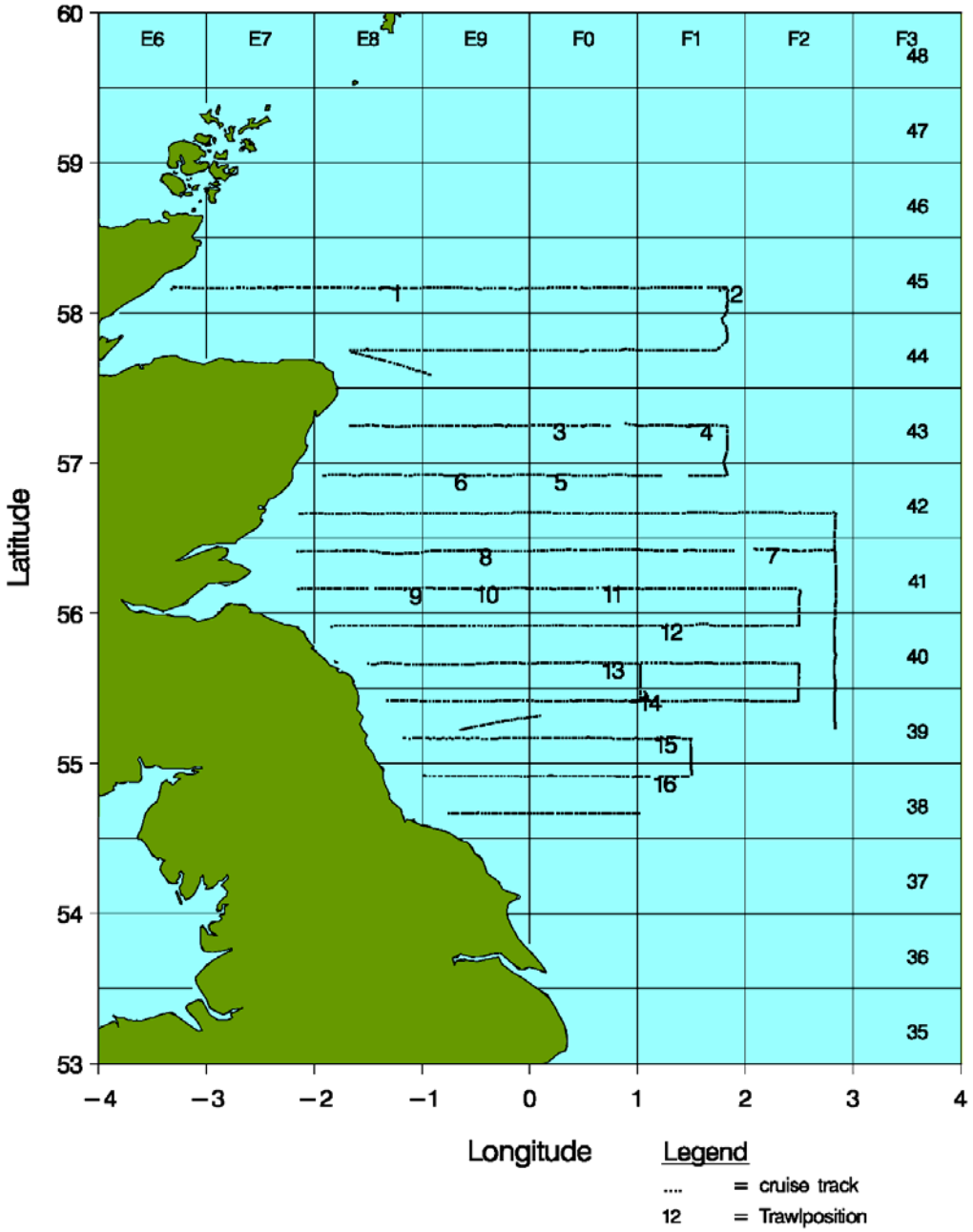


Figure 1. Cruise track and positions of fishing trawls undertaken during the July 2004 North Sea hydro acoustic survey for herring by RV "Tridens". Sprat was caught in haul 9, 10 and 15.

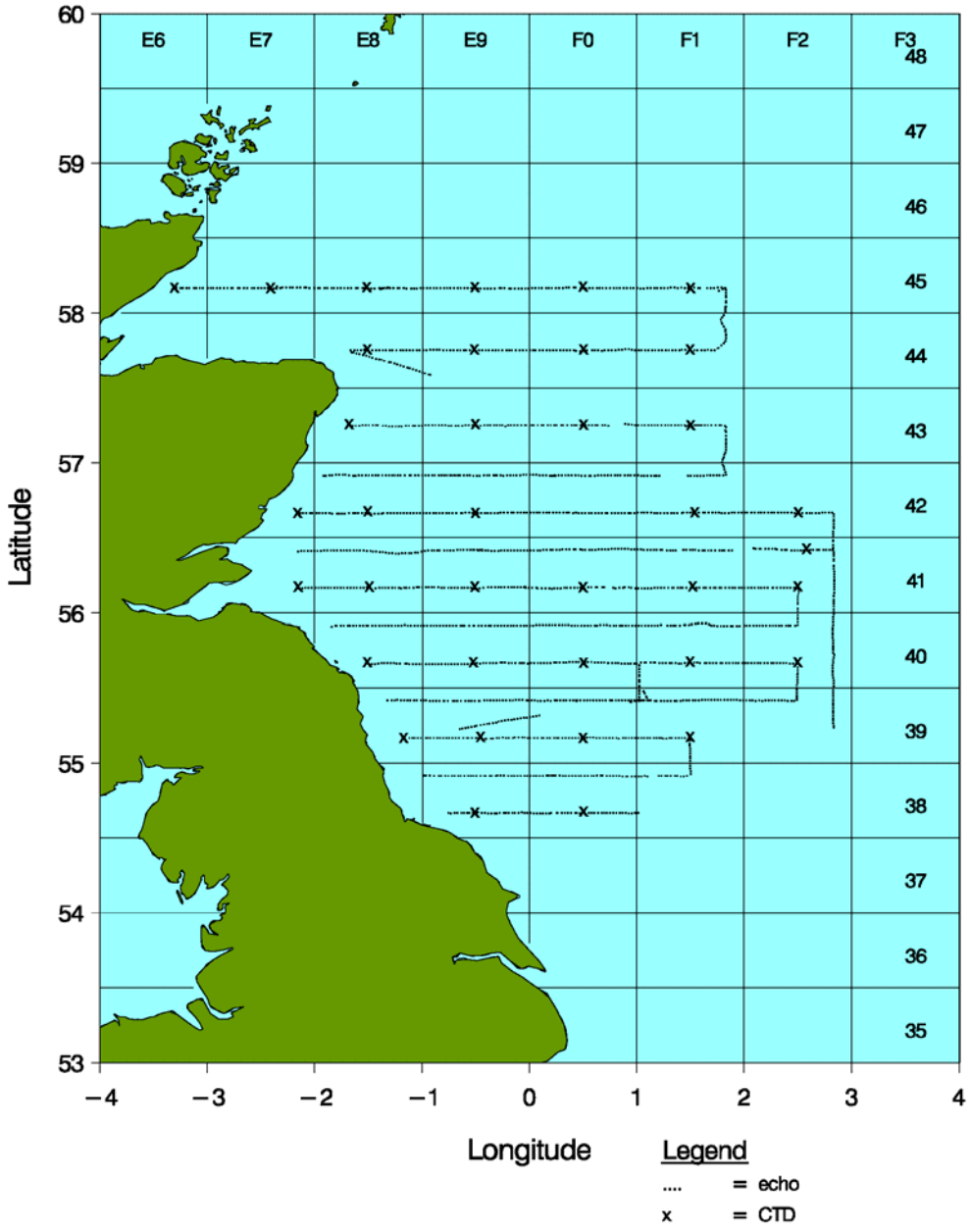


Figure 2. Positions of CTD stations during the July 2004 North Sea hydro acoustic survey for herring by FRV "Tridens".

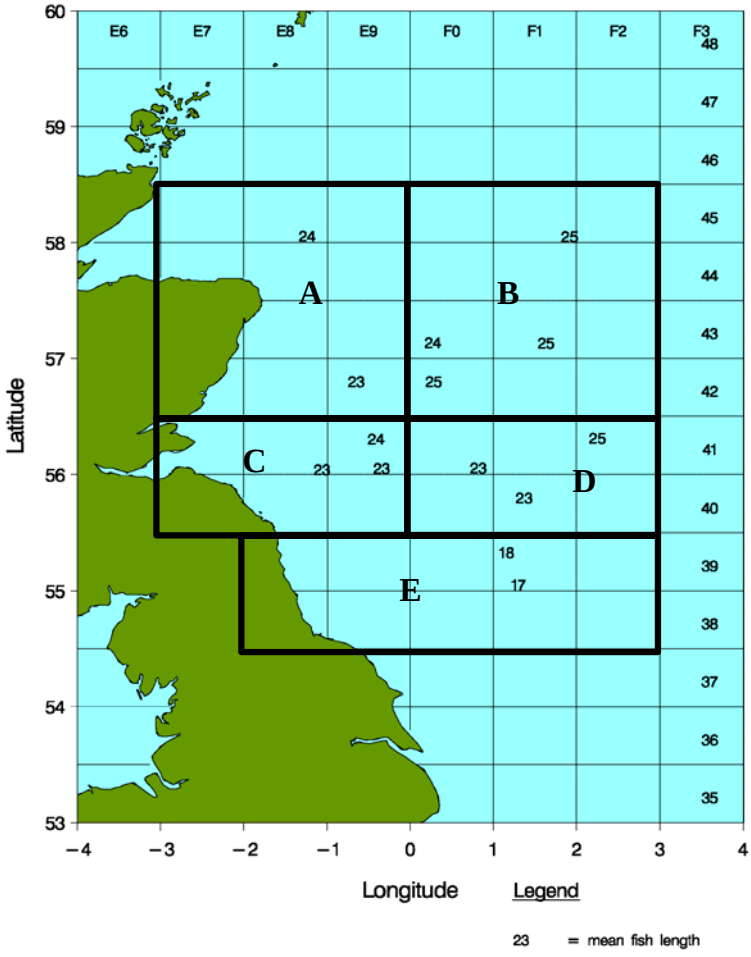


Figure 3. Post plot of herring mean length from FRV "Tridens", observed during the July 2004 North Sea hydro acoustic survey for herring. Strata-areas A to E are indicated.

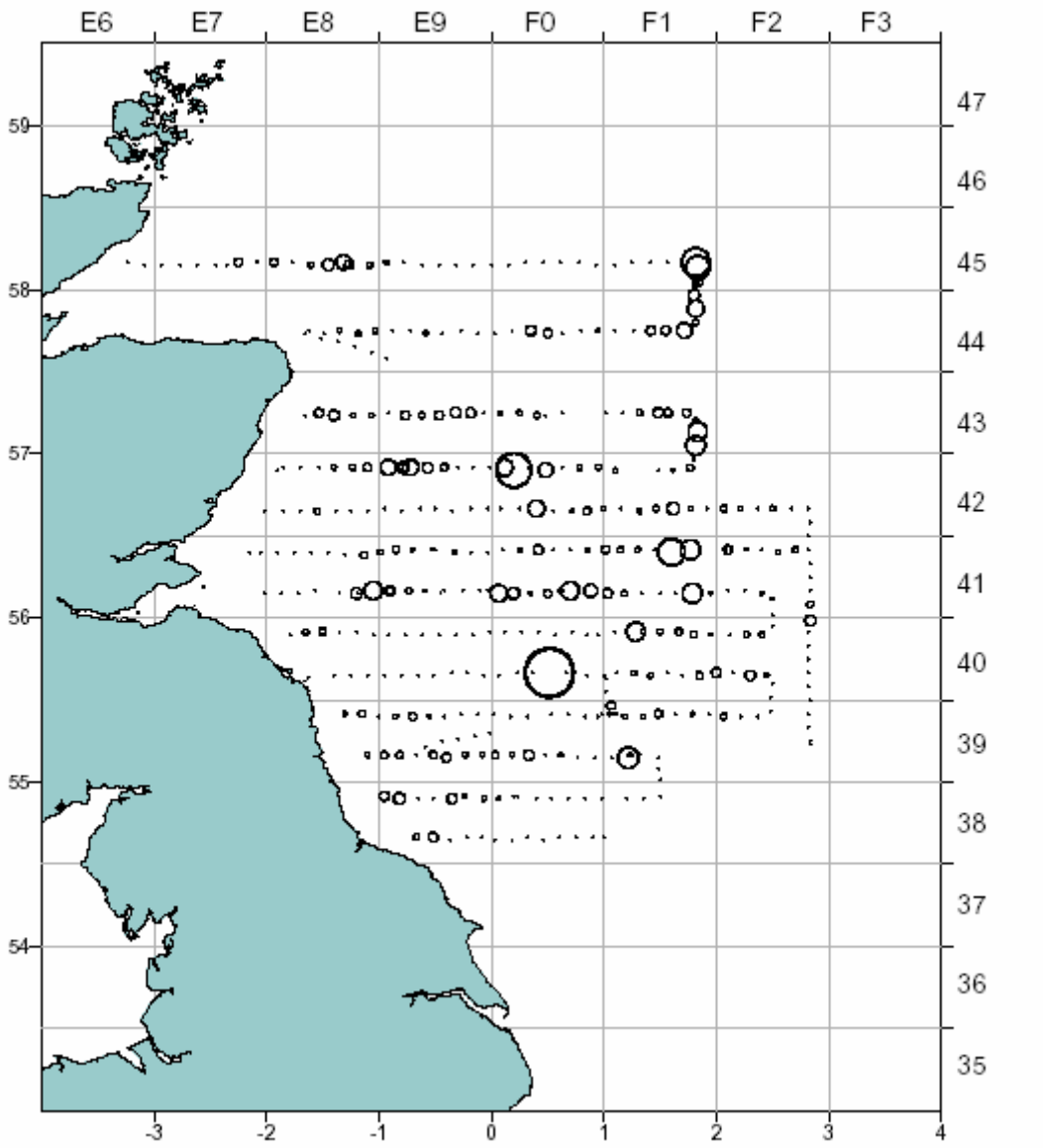


Figure 4. Post plot showing the distribution of total herring NASC values (on a proportional square root scale relative to the largest value of 4760,2) obtained during the July 2004 North Sea herring hydro acoustic survey on FRV "Tridens".

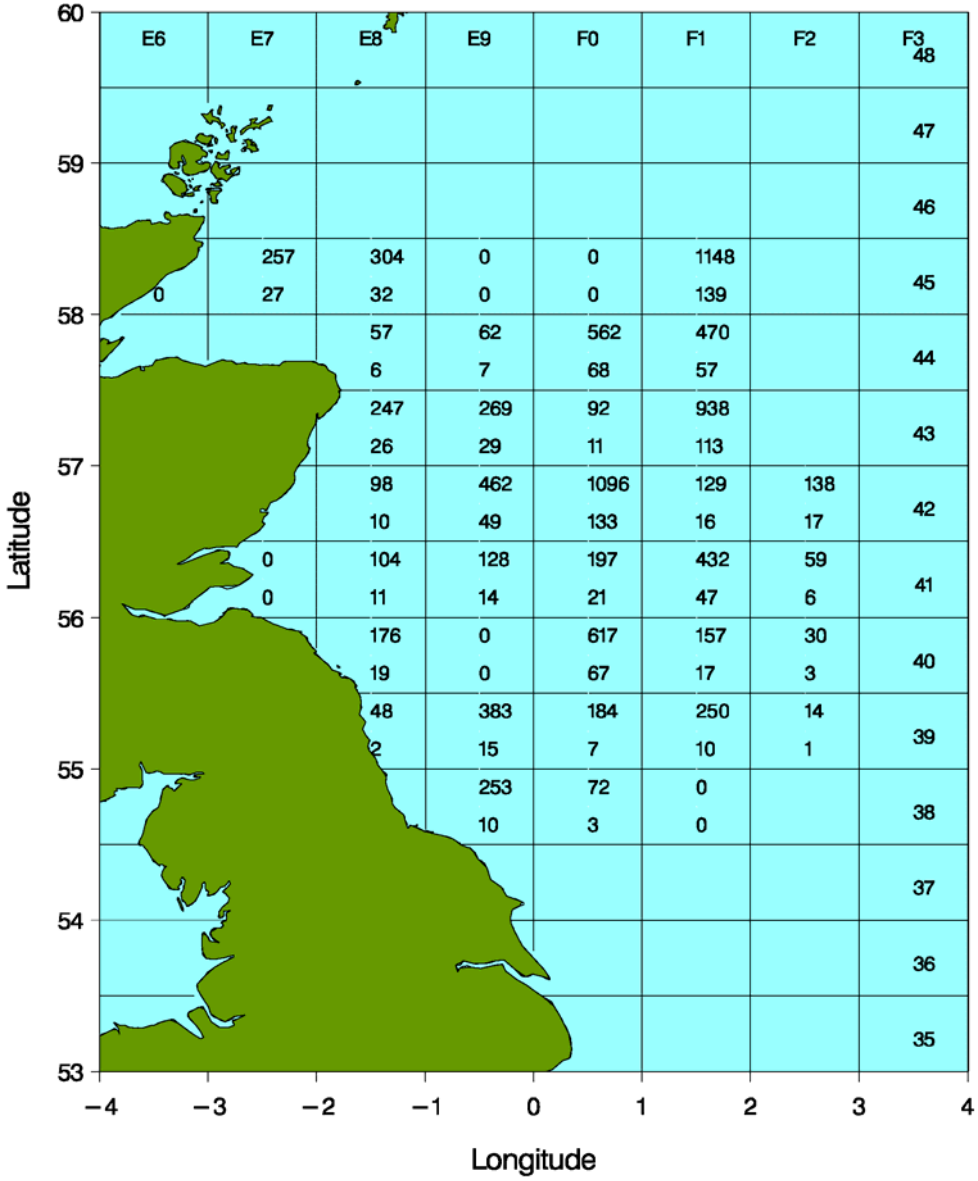


Figure 5. Estimated numbers of herring in millions (upper half square) and biomass in thousands of tonnes (lower half of square) by ICES rectangle. Results from the July 2004 North Sea hydro acoustic survey, FRV "Tridens".

Annex 2F: Germany

Survey report for FRV "Walther Herwig III" cruise 265
International Herring Acoustic Survey in the North Sea
28 Jun 2003 – 19 Jul 2004

Christopher Zimmermann, Inst Sea Fisheries (ISH),

Eberhard Götze, Eckhard Bethke, Inst Fishing Technology and Fishery Economics (IFF), Hamburg

1. Introduction

Context: "Walther Herwig III" cruise 265 was conducted in the framework of the international hydroacoustic survey on pelagic fish in the North Sea, which is coordinated by the ICES Planning Group for Herring Surveys (PGHERS). Further contributors to the quasi-synoptic survey are the national fisheries research institutes of Scotland, Norway, Denmark and The Netherlands. The results are delivered to the ICES herring assessment working group. Since 1984 they represent the most important fishery independent data (i.e. biomass estimate) for the assessment of herring stocks in the area.

The working area for "Walther Herwig III" was confined to the Southern and South-Eastern North Sea. This area is regarded to be one of the main distribution areas for juvenile herring. Since 2001, PGHERS calculates a juvenile biomass index for the North Sea herring assessment, mainly based on the survey results from the SE North Sea and the Kattegat/Skagerrak area. Last year, the survey area was significantly extended to the south (to about 52°N) in an attempt to reach the southern distribution limit of sprat, and this area was again covered this year. Survey intensity therefore had to be reduced in most of the area.

Objectives: Hydroacoustic recording of pelagic fish stocks for abundance and biomass estimation, biological sampling for the verification of echoes, calibration of the hydroacoustic equipment, hydrographic investigations, sampling of data and specimens for a number of national and international projects (BFA Fi: Univ. Aberdeen/ISH and IFÖ; FTZ Büsum, IfM Kiel).

2. Survey description and methods

2.1 Personnel

Dr.-Ing. E. Bethke	scientist in charge, hydroacoustics	IFF
M. Drenckow	hydroacoustics	IFF
Mrs. G. Gentschow	fishery biology	ISH
A. Baer	fishery biology	ISH
S. Bednarz	fishery biology	ISH
Mrs. A. Enge	fishery biology	ISH
Mrs. P. Jantschik	fishery biology	ISH
K. Kumpart	fishery biology	ISH
J. Menking	fishery biology	ISH
M. Bernreuther	guest researcher	Univ. Hamburg (GLOBEC Germany)
Mrs. M. Blume	guest researcher	FTZ/Univ. Kiel (cetaceans)
Mrs. D. Risch	guest researcher	FTZ/Univ. Kiel (cetaceans)

2.2 Narrative

FRV "Walther Herwig III" left the port of Bremerhaven on 28 June, and calibrated the hydroacoustic equipment under reasonable conditions until 29 June noon off Helgoland. Therefore, it was again not necessary to sail to Kristiansand. Recording of hydroacoustic measurements started immediately in the river Elbe estuary (Figure 1). The work in the southern part of the survey's eastern half could be completed with east-west-transects by 5 July, interrupted only by an unscheduled port call due to illness of a crew member. The vessel then surveyed the central and western survey area, and work in the "overlap area" (see below) was conducted between 10 and 12 July. Thereafter, the survey commenced with transects south of the Dogger Bank. The northern part was surveyed with double intensity (15 n.mi. transect spacing) to account for the importance of that area for the calculation of juvenile herring abundance. Most of the remaining area was surveyed with 30 n.mi. transect spacing. After excellent weather during last year's survey, it was back to normal this year, and work had to be stopped for half a day due to strong winds. "Walther Herwig III" reached Bremerhaven at 19 July 2004 in the afternoon, having sailed 3199 n.mi.

2.3 Survey design

As in last year, the working area for the German vessel contributing to the survey was extended to the west and the south, aiming at defining a southern distribution limit of sprat in July. This would be a prerequisite for the development of a sprat biomass index in the near future using this acoustic survey. The survey area was confined to the southern and south-eastern North Sea between 51.5°N and the 20 m depth contour off Frisia to the south, the 20 m depth line off the English coast to the west and off the German and Danish coast to the east, and 57°N (eastern part) and 54.5°N (western part) to the north, respectively.

Hydroacoustic measurements were conducted on east-west or north-south transects with 15 or 30 n.mi. intertransect distance (as done by other research vessels participating in the survey) on fixed longitudes (mostly 7.5 n.mi. distance to upper and lower limits of statistical rectangle). In general, each ICES statistical rectangle was surveyed with at least one transect, and with two transects where historically a high abundance or variability of abundance of juvenile herring had been detected. Fishing activities had to be kept at a minimum to account for the extension of the survey area.

2.4 Calibration

The hull mounted transducer ES38B (starboard blister) was calibrated at the start of the survey (June 29th) at open sea east of Helgoland under reasonable conditions. The calibration procedure required less than 6 hrs. It was carried out with the PC program "Calibrate" (Bethke 2000) which gives equivalent results as the "Lobe" (Simrad) program and the methods described in the 'Manual for Herring Acoustic Surveys in ICES Divisions III, IV and VI' (ver. 3.1, ICES CM 2003/G:03, Appendix 4). Important parameters and settings are listed in Tab. 1. The difference to the last calibration on "Herwig" (conducted in the Western Baltic in early June 2004 under good conditions and recalculated for the North Sea environment) was found to be minimal and it was decided to use the new values.

2.5 Intercalibration/overlap area

Instead of an intercalibration with different vessels participation in the survey, "Walther Herwig III" surveyed an overlap area at the same time with the Norwegian vessel "Johan Hjort" and the Danish vessel "Dana". ICES rectangles 42F6-F7 and 41F6-F7 were surveyed by different tracks between 10 and 12 July. This area was chosen because it was close to the survey areas of each vessel, and there was a reasonable amount of herring schools found in recent years. This year, however, there appeared to be significantly less herring schools in the area. A

detailed analysis of the results of the three vessels for the overlap area can be found in the main body of the PGHERS report.

2.6 Acoustic data collection

The acoustic investigations were performed during daylight (0400 to 2000 hrs UTC), using a Simrad EK500 echosounder with a standard frequency of 38 kHz. The echo telegrams were continuously recorded with the Bergen integrator BI500. The specific settings of the hydroacoustic equipment were used as described in the 'Manual for Herring Acoustic Surveys in ICES Divisions III, IV and VI' (ver. 3.1, ICES CM 2003/G:03, Appendix 4). Basic settings are documented in Table 1. The transducer ES38B was mounted on starbord in the vessel's hull. The vessel was running at a speed of 10-11 knots. During cruise 265, "Herwig" sailed 3199 n.mi. Of these, 2324 n.mi. could be used for acoustic data sampling.

2.7 Biological data - fishing trawls

For the identification of echo traces and further biological sampling, 32 trawl hauls were conducted either on specific large schools (after turning the ship) or, if small schools occurred frequently, continuing the survey track. On "Walther Herwig III", a small pelagic trawl (PSN205, approx. 13 m vertical opening, and mesh size in the codend 10 mm) was used both in the midwater and close to the bottom. The net was equipped with a Krupp-Atlas net sonde. Standard tow periods were 30 mins; however, they varied between 9 and 61 mins depending on the indications of net filling.

From each trawl, the mass of the total catch and species composition (on subsamples, if needed) was determined. Length frequency distributions were produced for each species. Length-stratified samples (10 samples per half cm class per ICES stat rectangle) of herring and sprat were taken for the determination of maturity (using a 4 point scale), sex and individual body mass, and otoliths were removed for age reading (from 930 herring, 995 sprat, 61 anchovies and 26 sardines). If conditions did not allow conducting this work immediately after the haul, fish was frozen for further processing at the institute.

2.8 Hydrographic data

After each of the hauls and on additional hydrographic stations, vertical profiles of temperature, salinity and depth were recorded using a "Seabird 911- multiprobe" CTD-water sampler rosette (Figure 1). Water samples for calibration have been taken close to the bottom.

2.9 Data analysis

The echo integration, i.e. the allocation of the nautical area backscattering cross section (NASC) to the species herring and sprat was done using a Bergen integrator BI500, using information from trawl hauls usually targeting specific schools. Herring and sprat were exclusively found in characteristic "pillars". The NASC attributed to clupeoids was estimated for each ESDU of 1 nautical mile. Contributions from air bubbles, bottom structures and scattering layers were manually removed from the echogram using the BI500.

As it was not possible to distinguish between herring and sprat within clupeid schools and to allocate the integrator readings to a single species. species composition was based on the trawl catch results (see above).

For each rectangle the species composition and length distribution of herring and sprat were determined as the weighted mean of all trawl results in this rectangle. For rectangles without valid hauls a mean of the catch results of the neighbouring rectangles was used. From these distributions the mean cross section σ was calculated according to the following target strength-length (TS) relationship:

$$TS = 20 \log L \text{ (cm)} - 71.2 \quad \text{(ICES 1983/H:12)}$$

The total number of fish (total N) in one rectangle was estimated to be the product of the mean area scattering cross section NASC and the rectangle area (or more precisely the area with a water depth of more than 20 m), divided by the corresponding mean cross section. This total number was divided into species and age/maturity classes according to the trawl catch results.

3. Results and discussion

3.1 Acoustic data

As in previous years, clupeids were exclusively found in characteristic schools which appeared in single clusters of some n.mi. extension. Echoes attributed to plankton were not considered to be problematic for the identification of fish schools.

The highest nautical area scattering coefficients (NASCs) have been found in the south and the south-east of the investigation area. 75% of all measured 1 n.mi.-intervals contained no clupeid schools (44% of 5 n.mi.-intervals). The highest value for 5 n.mi.-intervals occurred off the coast of East Anglia (3818 $m^2 n.mi.^{-2}$). Figure 2 gives the NASC distribution for clupeids on 5 n.mi. EDSUs.

Note that only little indications for the presence of clupeids were found south of 52.5°N, which could indicate that the southern distribution limit of sprat was reached this year. It should, however, be noted that the one rectangle in the south where the highest abundance of sprat was found in 2003 (33F1 off Lowestoft) was unfortunately not surveyed this year (see Figure 6 for a detailed comparison of the 2004 and 2003 surveys).

3.2 Biological data

32 hauls with the pelagic trawl PSN205 have been deployed. Due to time constraints caused by the extension of the survey area, 27 statistical rectangles out of 46 covered during the survey could not be sampled with trawl hauls (Figure 1 and Table 2; 2003: 28 unsampled rectangles out of 49 covered by acoustics) – 17 of these without or with only minimal NASCs. 13 rectangles have been sampled successfully (with more than 200 clupeids per hour trawling; 2003: 16 rectangles) and were used for raising unsampled rectangles. The limited amount of valid trawl hauls appears to be increasingly problematic: While there were only 6 rectangles with almost no NASCs where no sampling information in the neighbouring rectangles was available for raising in 2003, the number of these increased to 8 this year, and 3 of them contained significant NASCs. The effect becomes obvious for the westernmost rectangle (37E9 off Flamborough Head): While most of the clupeids in that rectangle appeared to be mature herring in 2003, NASCs were interpreted to be almost exclusively 0-group sprat, based on successful sampling some 60 n.mi. away. Data for the south-western part of the survey area should therefore be treated with extreme care – the high number of juvenile sprat may reflect a sampling artefact (see Figure 6).

The total catch varied between 0.1 and 2831 kg. Herring was mainly found in the eastern part of the area, but also in two rectangles in the south (between 52.5° and 53.5°N), while sprat was clearly concentrated in warmer water close to the Frisian, English and Dutch coasts.

26 species have been caught (mean 5 species per haul). Highest presence was recorded for mackerel (in 24 of 32 hauls), whiting (23), sprat (21) and grey gurnard (20). The main share of the total catch of approx. 8 tons could be attributed to sprat (67%, 583’000 ind) and herring (24%, 103'000 ind), followed by mackerel and horse mackerel (Tab. 3).

3.3 Biomass and abundance estimates

The total biomass estimates for the survey:

Total herring	**173,700 t**	(2003: 110,900 t)
Spawning stock biomass	2,400 t / 1.4%	(2003: 49,900 t / 45%)
Total sprat	**359,600 t**	(2003: 266,100 t tonnes)
Spawning stock biomass	174,200 t / 48%	(2003: 158,500 t / 59%)

The total abundance estimates for the survey:

Total herring	**13,800 mill.**	**(2003: 4,100 mill.)**
Spawning stock abundance	0.02 mill. / 0.2%	(2003: 1,200 mill. / 31%)
Total sprat	**51,600 mill.**	**(2003: 29,600 mill.)**
Spawning stock abundance	14,300 mill. / 28%	(2003: 14,700 mill. / 50%)

Note that these values are not directly comparable to values prior to 2003 as the survey area has been significantly expanded. Compared to last year, herring abundance has tripled. The age composition has again slightly changed to previous years' results. However, the vast majority (>99%) of herring in this area still consists of 0- and 1-wr (Age 1 and 2). The fraction of older, mature herring is back to the low level known from previous years, possibly because no sampling was conducted close to Flamborough Head where almost all mature herring was found last year. These findings may therefore reflect an insufficient sampling and should therefore treated with caution. Sprat biomass and abundance have been increased as compared to last year. This may be caused by a more northerly distribution of the sprat stock (and thus a better accessibility to the survey) this year. Note that 0-group sprat has been recorded for the first time since 1998, and that 34% of the total sprat abundance (but only 5% of the total biomass) have been attributed to 0-group fish. However, these fish are so small that they have probably not been caught representatively.

Detailed information on abundance and biomass by statistical rectangle can be found in Figure 4 and 5; they are further split into age group and maturity in Tab. 5a and 6 for herring, and in Tab. 5b and 7 for sprat.

3.4 Hydrographic data

To promote an analysis of the influence of bottom water temperature on clupeid distribution, 93 vertical profiles have been recorded at stations spread over the whole area, with a maximum distance of about 30 n.mi. between any station. The water column was clearly stratified on most of the offshore stations; surface temperatures ranged between 13.0 and 17.4°C (2003: 12.7 and 18.0°C) and bottom temperatures between 8.2 and 16.9°C (at 29-49 m water depth; 2003: 6.9 and 17.7° at 24-63 m water depth).

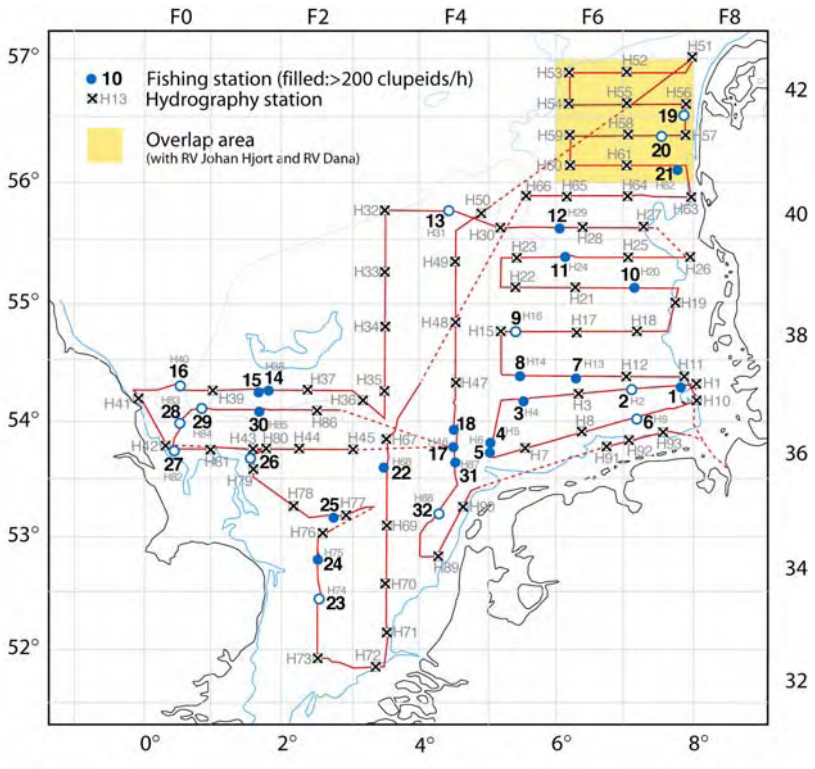


Figure 1. FRV "Walther Herwig III", cruise 265: International hydroacoustic survey on herring in the North Sea, 28 June 2004 -19 July 2004: Cruise track, fishing stations and hydrographic stations. 20 and 50 m depth contour drawn.

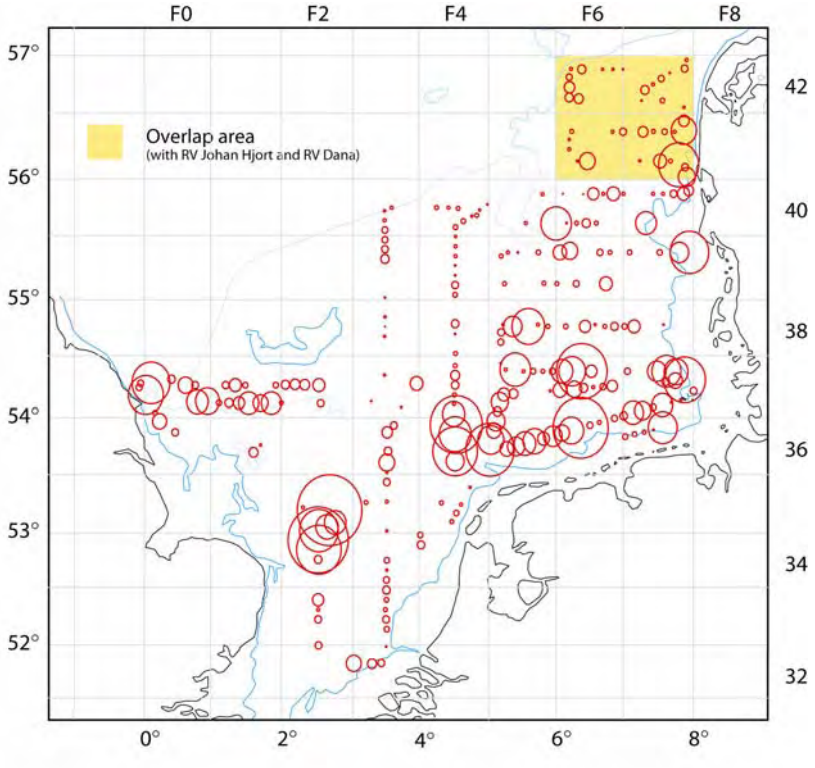


Figure 2. FRV "Walther Herwig III", cruise 265: International hydroacoustic survey on herring in the North Sea, 28 June 2004 -19 July 2004: Post plot showing the distribution of total NASC values attributed to clupeoids (sum per 5 n.mi., on a proportional sq. root scale relative to the largest value of 3818 $m^2 n.mi.^{-2}$). Smallest dots indicate zero values.

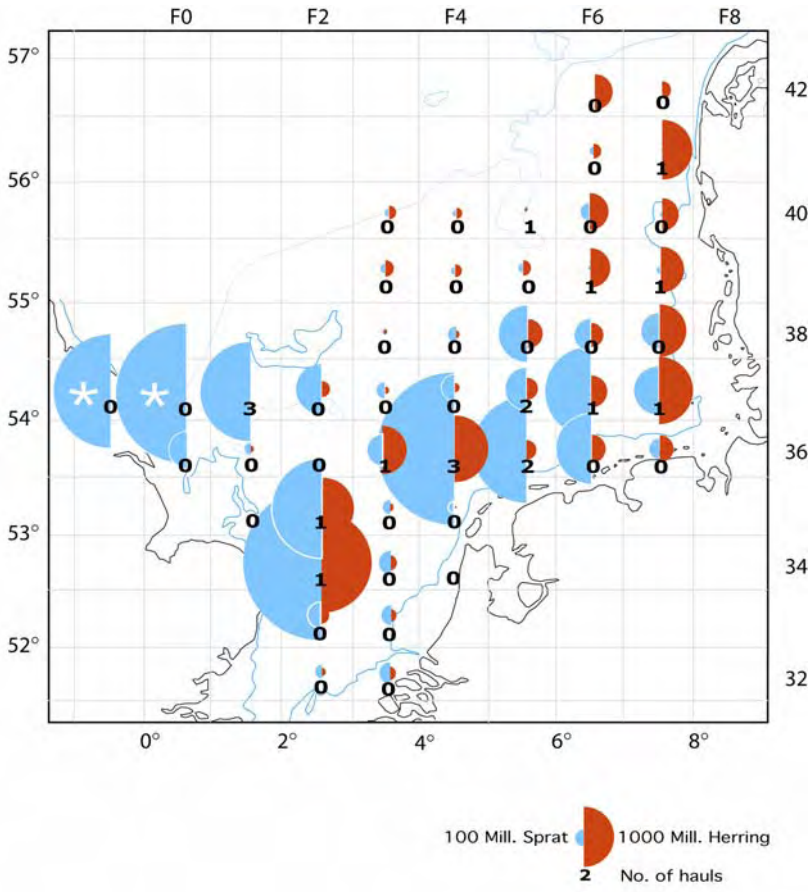


Figure 3. FRV "Walther Herwig III", cruise 265: International hydroacoustic survey on herring in the North Sea, 28 June 2004 — 19 July 2004: Abundance of herring and sprat (circle diameter is proportional to abundance), proportion of the two clupeoid species, and number of valid hauls per statistical rectangle. * marks rectangles for which information is derived from distant catches, and where information is considered highly uncertain based on last year's survey results.

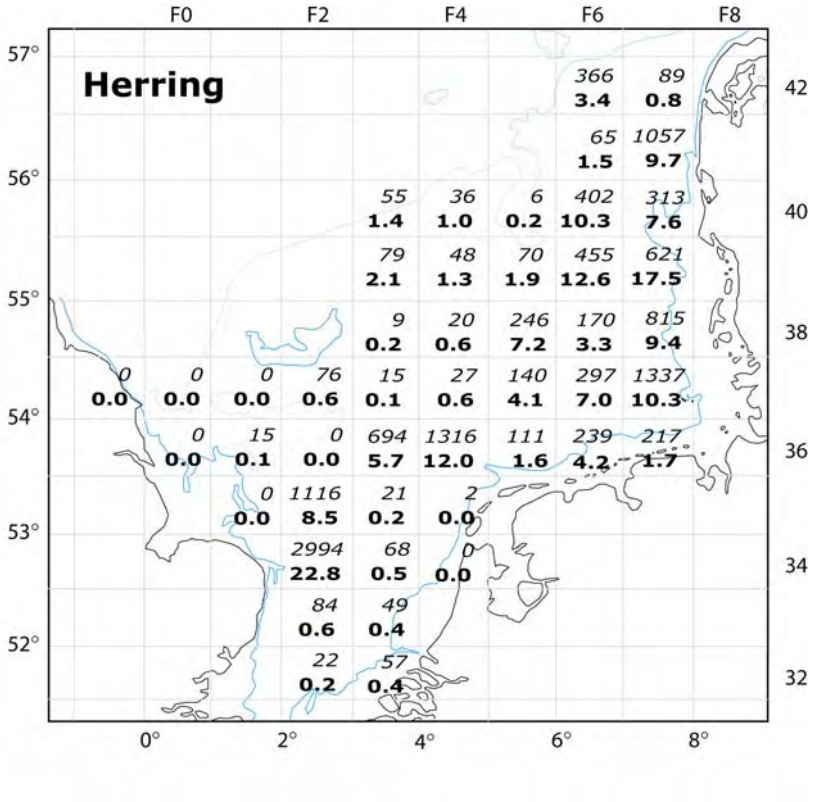


Figure 4. FRV "Walther Herwig III", cruise 265: International hydroacoustic survey on herring in the North Sea, 28 June 2004 -19 July 2004: Abundance (Mill. individuals, upper value in italics) and biomass (thousand t, lower value in bold) of herring per statistical rectangle.

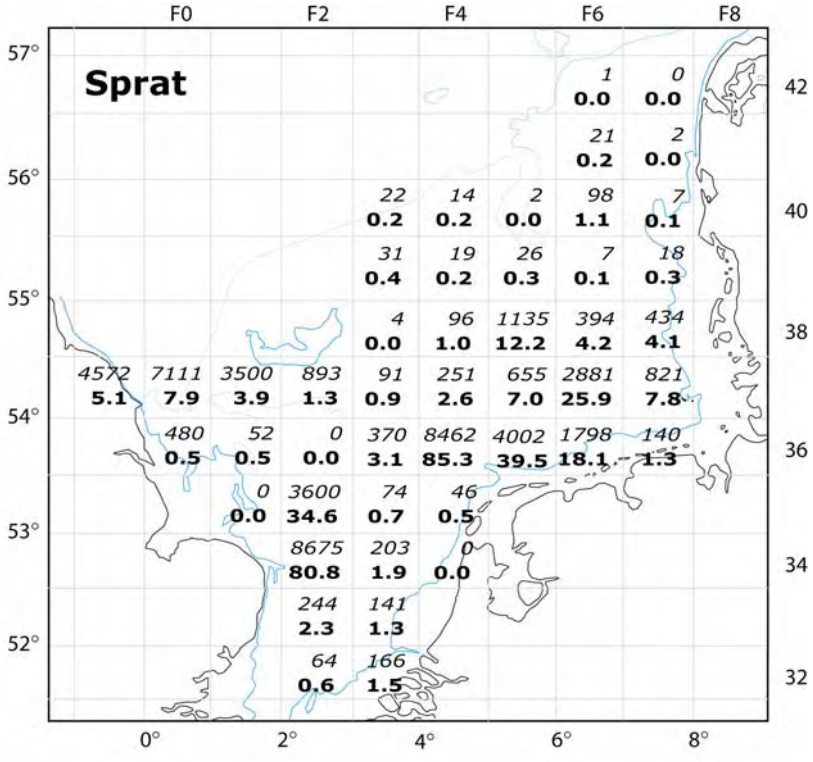


Figure 5. FRV "Walther Herwig III", cruise 265: International hydroacoustic survey on herring in the North Sea, 28 June 2004 – 19 July 2004: Abundance (Mill. individuals, upper value in italics) and biomass (thousand t, lower value in bold) of sprat per statistical rectangle.

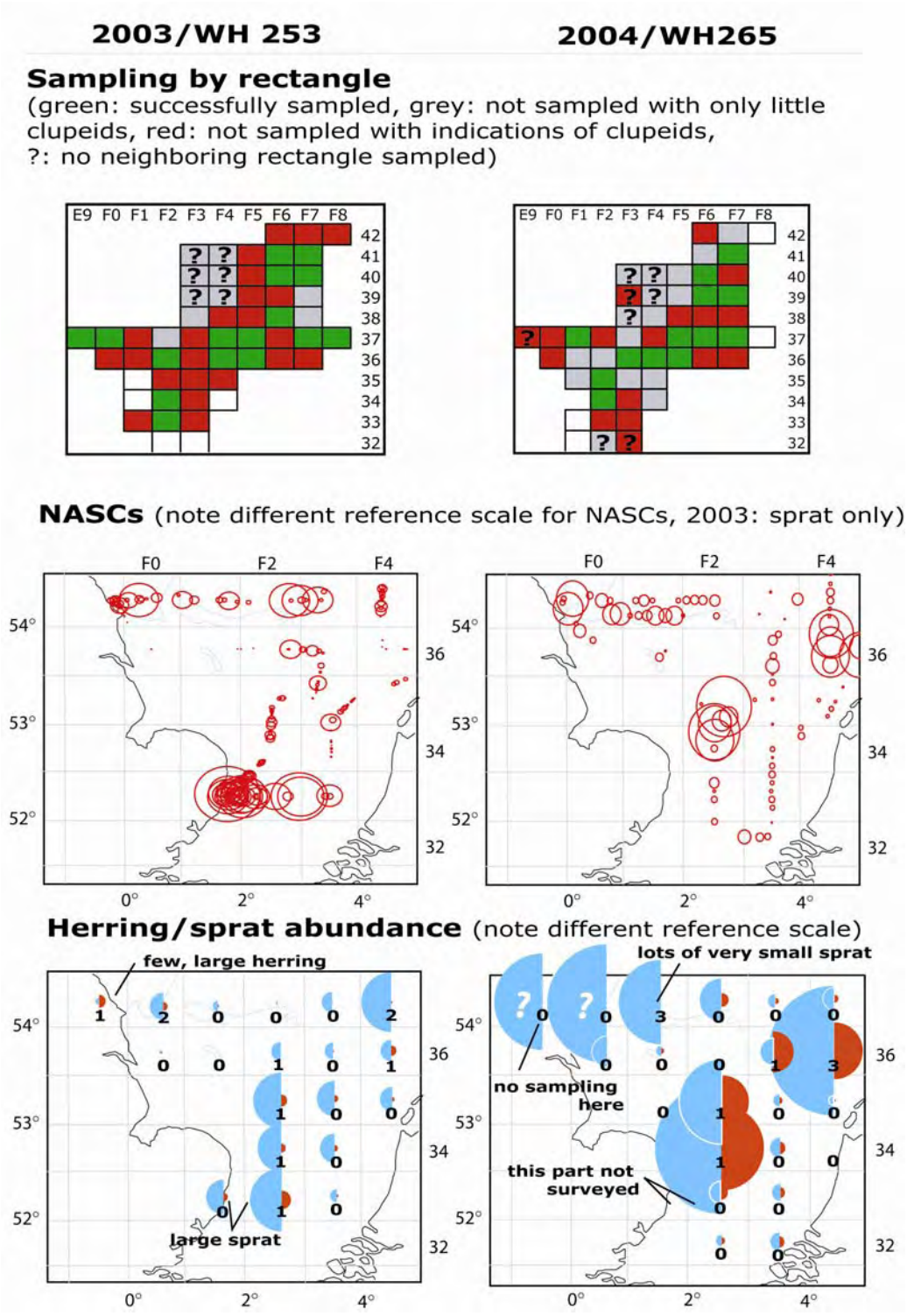


Figure 6. FRV "Walther Herwig III", International hydroacoustic survey on herring in the North Sea. Comparison of various aspects of cruise 253 in 2003 (left) and cruise 265 in 2004 (right).

Table 1. FRV "Walther Herwig III", cruise 265: International hydroacoustic survey on herring in the North Sea, 28 June 2004 -19 July 2004: Simrad EK500 and analysis settings used.

TRANSCEIVER MENU	
Frequency	38 kHz
Transducer	FL1 STB-Blister ES38B
Sound speed	1502 ms^{-1}
Max. Power	2000 W
Equivalent two-way beam angle	-20.2 dB
Default Transducer Sv gain	24.9 dB
Calibration details	
TS of sphere	-33.6 dB
Range to sphere in calibration	13.5 m
Measured NASC value for calibration	9374.5
Log Menu	
Speed	1 n.mi.
Operation Menu	
Ping interval	1 s
Analysis settings	
Bottom margin (backstep)	0.5 m
Integration start (absolute) depth	9.5 m
Range of thresholds used	-50 dB

Table 2. FRV "Walther Herwig III", cruise 265: International hydroacoustic survey on herring in the North Sea, 28 June 2004 – 19 July 2004:

Trawl station data

Stat	Haul	Rect	Dat	Time of day (hhmm UTC)	Trawl	ShotPosLat (°°MM.MM)	Shot PosLon (°°MM.MM)	Water Depth (m)	Catch Depth (m)	Catch time (min)
781	1	37F7	20040629	1212	PSN388	541745N	0074883E	23.3	16.8	9
783	2	37F7	20040629	1528	PSN205	541565N	0070787E	38.5	32.0	32
788	3	37F5	20040630	0627	PSN205	541082N	0053390E	39.8	33.3	30
790	4	36F5	20040630	1048	PSN205	534998N	0050314E	36.0	29.5	30
792	5	36F5	20040630	1219	PSN205	534250N	0050052E	33.0	26.5	30
801	6	37F7	20040701	0612	PSN205	540213N	0071460E	33.8	27.3	60
810	7	37F6	20040702	0620	PSN205	542185N	0061086E	40.5	34.0	40
812	8	37F5	20040702	1039	PSN205	542209N	0052552E	42.3	35.8	30
816	9	38F5	20040702	1707	PSN205	544501N	0052800E	44.0	37.5	39
827	10	39F7	20040703	1446	PSN205	550770N	0070424E	36.0	29.5	30
836	11	39F6	20040704	1144	PSN205	552211N	0060048E	49.5	43.0	61
846	12	40F5	20040705	0930	PSN205	553740N	0055992E	49.0	42.5	30
850	13	40F4	20040705	1651	PSN205	554511N	0042316E	38.0	31.5	31
866	14	37F1	20040706	0641	PSN205	541525N	0014355E	49.8	43.3	45
868	15	37F1	20040706	0844	PSN205	541501N	0013641E	38.5	32.0	30
872	16	37F0	20040706	1343	PSN205	541604N	0003302E	61.5	55.0	30
885	17	36F4	20040709	0444	PSN205	534891N	0042947E	41.3	34.8	30
887	18	36F4	20040709	0642	PSN205	535666N	0043109E	43.8	37.3	30
910	19	41F7	20040711	0722	PSN205	562964N	0074979E	28.8	22.3	30
914	20	41F7	20040711	1047	PSN205	562204N	0072790E	35.0	28.5	30
925	21	41F7	20040712	0733	PSN205	560647N	0074332E	28.5	22.0	20
937	22	36F3	20040713	1018	PSN205	533406N	0032882E	36.5	30.0	30
949	23	33F2	20040714	1319	PSN205	522410N	0023025E	43.5	37.0	43
951	24	34F2	20040714	1637	PSN205	524988N	0023047E	43.3	36.8	30
958	25	35F2	20040715	0647	PSN205	530985N	0024120E	34.8	28.3	30
964	26	36F1	20040715	1400	PSN205	534199N	0013446E	26.5	20.0	30
971	27	36F0	20040716	0518	PSN205	534487N	0002192E	34.8	28.3	31
973	28	36F0	20040716	0733	PSN205	535665N	0003142E	48.5	42.0	30
975	29	37F0	20040716	1014	PSN205	540616N	0005476E	48.3	41.8	30
979	30	37F1	20040716	1451	PSN205	540514N	0014346E	90.0	83.5	37
984	31	36F4	20040717	0521	PSN205	533662N	0043012E	31.3	24.8	30
986	32	35F4	20040717	0937	PSN205	531027N	0041314E	29.3	22.8	45

Table 3. FRV "Walther Herwig III", cruise 265: International hydroacoustic survey on herring in the North Sea, 28 June 2004 – 19 July 2004: Species distribution per haul (catch in kg), relative composition of the clupeid catch, and total raised number of clupeids. Stations marked yellow were used for verification of echo traces.

Station	Haul	*Agonus cataphractus*	*Callionymus lyra*	***Clupea harengus***	*Alosa fallax*	*Echichthys vipera*	***Engraulis encrasicolus***	*Entelurus aequorus*	*Eutrigla gurnardus*	*Gadus morhua*	*Hyperoplus immaculatus*	*Hyperoplus lanceolatus*	*Lampetra fluviatilis*	*Limanda limanda*	*Melanogrammus aeglefinus*	*Merlangius merlangus*	*Myoxocephalus scorpius*	*Pleuronectes platessa*	*Argentina sphyraena*	*Pomatoschistus minutus*	*Salmo trutta*	***Sardina pilchardus***	*Scomber scombrus*	***Sprattus sprattus***	*Trachurus trachurus*	*Trigla lucerna*	*Trisopterus minutus*	**Total**	**No of Species**	Herring (n in 60 min haul)	Herring (% of clupeid catch)	Sprat (n in 60 min haul)	Sprat (% of clupeid catch)	**Number of clupeids / 60 min**
781	1	0.03		81.2	0.49		0.51		0.86			1.00		4.15			0.15	0.44					0.76	55.8	2.40	0.25		**148.0**	13	69280	**62%**	42373	**38%**	111653
783	2								0.05																1.56			**1.6**	2					0
788	3		0.02	3.6					0.04			0.02				0.12			0.01				7.42	48.5			0.00	**59.8**	9	918	**6%**	14242	**94%**	15160
790	4			10.6												0.00							0.32	102.4				**113.3**	4	7090	**22%**	25656	**78%**	32746
792	5			103.9			0.02					0.14							0.01				70.31	2656.1	0.73			**2831.2**	7	10564	**2%**	602076	**98%**	612640
801	6								1.69													3.13	116.29		73.99			**195.1**	4					0
810	7			6.5		0.04		0.01	0.33			0.06		0.07		0.01							15.76	20.3	1.54			**44.6**	10	410	**9%**	3972	**91%**	4382
812	8			878.1			0.04		0.79							0.00							39.99	1619.9				**2538.8**	6	63550	**18%**	288194	**82%**	351744
816	9								0.92							0.04		0.19										**1.1**	3					0
827	10			214.0					1.86			0.03				2.64							1.99	3.9				**224.4**	6	14454	**97%**	428	**3%**	14882
836	11			62.2					3.05							0.09								0.3	0.32			**66.0**	5	2102	**99%**	30	**1%**	2132
846	12			324.2					2.50			0.18		0.03		0.02							0.17	55.7				**382.7**	7	24014	**72%**	9422	**28%**	33436
850	13								10.30							0.01												**10.3**	2					0
866	14								0.00							0.01								0.1				**0.1**	3		**0%**	272	**100%**	272
868	15															0.03								0.1				**0.1**	2		**0%**	244	**100%**	244
872	16			0.5		0.78			9.31						0.36	8.70							3.27					**22.9**	6	14	**100%**		**0%**	14
885	17			0.4												0.02				0.02			0.55	0.0				**1.0**	5	446	**83%**	94	**17%**	540
887	18			2.3												0.01				0.01			5.41	1.7				**9.4**	5	1658	**28%**	4202	**72%**	5860
910	19			0.1			0.06		1.17			0.02				0.00							5.22		0.09			**6.7**	7	10	**100%**		**0%**	10
914	20								6.55														0.43					**7.0**	2					0
925	21			19.2					2.45														10.21	0.0	0.67			**32.6**	5	4128	**100%**	6	**0%**	4134
937	22			0.6												0.01				0.00			2.01	0.5			0.01	**3.2**	6	332	**65%**	176	**35%**	508
949	23			0.1		0.20																	15.82		28.94			**45.1**	4	1	**100%**		**0%**	1
951	24			98.6		0.48			0.09							0.13							43.64	341.5	0.15			**484.5**	7	29116	**26%**	83926	**74%**	113042
958	25			51.5		0.31	0.04						0.34			0.00					3.41		4.64	221.5				**281.7**	8	15998	**24%**	51626	**76%**	67624
964	26										5.59	0.01				0.01								0.0				**5.6**	4		**0%**	6	**100%**	6
971	27					0.02																	21.63					**21.7**	2					0
973	28					0.04			0.12							0.23							1.28					**1.7**	4					0
975	29															0.01								0.0				**0.0**	2		**0%**	114	**100%**	114
979	30								0.98	14.34			0.03			13.42							0.00	1.8				**30.6**	6		**0%**	2267	**100%**	2267
984	31			62.0			1.84					0.06				0.00							0.44	339.0				**403.3**	6	8624	**12%**	64640	**88%**	73264
986	32								0.13														49.88		32.26			**82.3**	3					0
Total		0.0	0.0	1919.5	0.5	1.9	2.5	0.0	43.2	14.3	5.6	1.5	0.4	4.2	0.4	25.5	0.1	0.6	0.0	0.0	3.4	3.1	417.4	5469.1	142.6	0.2	0.0	**8056.3**	26	7897	**17%**	37311	**83%**	45209

Table 4a. FRV "Walther Herwig III", cruise 265: International hydroacoustic survey on herring in the North Sea, 28 June 2004 – 19 July 2004: Herring length frequency proportion (%) by trawl haul. Length in cm.

Stat.Rect.		37F7	37F5	36F5	36F5	37F6	37F5	39F7	39F6	40F5	37F1	37F1	37F0	36F4	36F4	41F7	41F7	36F3	33F2	34F2	35F2	36F1	37F0	37F1	36F4
Haul		1	3	4	5	7	8	10	11	12	14	15	16	17	18	19	21	22	23	24	25	26	29	30	31
Length (cm)	Total	781	788	790	792	810	812	827	836	846	866	868	872	885	887	910	925	937	949	951	958	964	975	979	984
4.75	**0.0**			0										2											
5.25	**0.1**			3										1							1				
5.75	**0.2**		2	5										4	1						1				
6.25	**0.3**			5										38	7			2			1				
6.75	**0.8**			13										41	16			22			3				
7.25	**1.9**		4	25	17									12	37			25			3				
7.75	**1.8**		11	26		5				1				3	18			31			12				
8.25	**2.3**		15	13	8	2				1					13			13		1	19				
8.75	**2.9**	0	17	5		12			2	3					5			1		10	16				2
9.25	**5.7**	7	4	1	17	2	2		1	1					2			1		13	12				1
9.75	**12.9**	28	4	0	8		1			0										33	12				1
10.25	**12.9**	34	4	0						0								1		23	10				2
10.75	**8.4**	23	9				1										2			11	5				2
11.25	**3.1**	4	7	1	8												15			8	3				4
11.75	**1.7**	1	7	0		2											27			1	1				22
12.25	**1.7**		7	1	8		1			1							22								19
12.75	**1.4**	0	2	0	8										1		21								16
13.25	**0.6**		2				1										6								7
13.75	**2.3**	0			8		5	0		1															11
14.25	**3.9**					5	13	1	1	4							0								4
14.75	**9.5**					16	30	11	9	11							2	1							1
15.25	**12.8**		2			35	29	40	36	30						20	3								
15.75	**7.7**					16	10	35	36	30						60	2	1							
16.25	**2.4**		2			5	2	8	14	13						20	0								3
16.75	**1.0**						2	4	1	2							0	2							3
17.25	**0.3**						1	1		1															
17.75	**0.0**							0																	
18.25	**0.3**				8																				
19.25	**0.0**												14												
20.25	**0.0**												43												
20.75	**0.0**												14												
21.25	**0.0**												29												
21.75	**0.3**				8														100						
22.75	**0.2**						1																		
23.25	**0.2**						1																		
25.25	**0.2**						1																		
Total n ('000)	**252.7**	69.3	0.9	7.1	10.6	0.4	63.5	14.5	2.1	24.0	0.0	0.0	0.0	0.4	1.7	0.0	4.1	0.3	0.0	29.1	16.0	0.0	0.0	0.0	8.6
mean lgth	**12.2**	10.2	9.8	7.5	11.8	13.8	15.0	15.5	15.3	15.0	0.0	0.0	20.5	6.6	7.5	15.8	12.4	7.8	21.8	9.9	8.9	0.0	0.0	0.0	12.6

Table 4b. FRV "Walther Herwig III", cruise 265: International hydroacoustic survey on herring in the North Sea, 28 June 2004 -19 July 2004: Sprat length frequency proportion (%) by trawl haul. Length in cm.

Stat.Rect.		37F7	37F5	36F5	36F5	37F6	37F5	39F7	39F6	40F5	37F1	37F1	37F0	36F4	36F4	41F7	41F7	36F3	33F2	34F2	35F2	36F1	37F0	37F1	36F4
Haul		1	3	4	5	7	8	10	11	12	14	15	16	17	18	19	21	22	23	24	25	26	29	30	31
Length (cm)	Total	781	788	790	792	810	812	827	836	846	866	868	872	885	887	910	925	937	949	951	958	964	975	979	984
2.75	**0.0**											1													
3.25	**0.0**										11	4													
3.75	**0.0**										39	20		6									4		
4.25	**0.0**										45	34		32	1								14		
4.75	**0.2**										5	25		38	53								44	5	
5.25	**0.2**											11		11	35								32	33	
5.75	**0.1**											3		6	10								7	42	
6.25	**0.2**													4	2			1			3			16	
6.75	**0.2**																	2			4			4	
7.25	**0.1**																				2				
7.75	**0.0**		1	0														1			0				
8.25	**0.3**		5	3	0	0												13			2				
8.75	**1.2**	0	25	10	1	6	0		3					2				32		1	5				0
9.25	**9.4**	1	27	21	14	22	1		3	1								24		13	7				3
9.75	**18.3**	17	16	20	24	38	7		29	6								15		28	15				10
10.25	**25.1**	53	14	28	22	21	26		39	10								8		36	18				25
10.75	**17.4**	26	7	12	15	7	23		6	21								3		14	10	67			24
11.25	**12.3**	2	3	5	11	3	19	5	13	28							50			8	11				12
11.75	**6.3**		1	2	6	1	8	13		17							50			0	7				11
12.25	**3.8**		0	1	3	0	7	17		8										0	7				5
12.75	**2.2**		0	0	1	0	4	25	6	7								1			5				5
13.25	**1.4**		0		1		3	21		1											2	33			2
13.75	**1.1**				2	0	1	14		2											2				1
14.25	**0.1**							4													0				1
Total n ('000)	**1194**	42.4	14.2	25.7	602.1	4.0	288.2	0.4	0.0	9.4	0.3	0.2	0.0	0.1	4.2	0.0	0.0	0.2	0.0	83.9	51.6	0.0	0.1	2.3	64.6
mean lgth	**10.5**	10.3	9.5	9.9	10.4	9.8	11.0	12.8	10.3	11.3	4.0	4.4	0.0	4.8	5.0	0.0	11.5	9.1	0.0	10.1	10.3	11.6	4.9	5.7	10.9

Table 5a. FRV "Walther Herwig III", cruise 265: International hydroacoustic survey on herring in the North Sea, 28 June 2004 -19 July 2004: Age/maturity-length key for herring (absolute numbers (millions) raised to the abundance in the survey area).

WR	0	1	1	2	2	3	4	5+	
Age	1	2	2	3	3	4	5	6+	
Length (cm)	**1 imm.**	**2 imm.**	**2 mat.**	**3 imm.**	**3 mat.**	**4 mat.**	**5 mat.**	**5+mat.**	Sum
4.75	1								1
5.25	13								13
5.75	18								18
6.25	63								63
6.75	264								264
7.25	343								343
7.75	461								461
8.25	41								401
8.75	639								639
9.25	831								831
9.75	1915								1915
10.25	1729								1729
10.75	148								1048
11.25	719								719
11.75	743								743
12.25	558	2							578
12.75	526								526
13.25	153	18							171
13.75	98	78							176
14.25	18	163							181
14.75		56							506
15.25		1138							1138
15.75		99							909
16.25		35							305
16.75		127							127
17.25		18							18
17.75		4							4
18.25		8							8
21.75					8				8
22.75						5			5
23.25						5			5
25.25							5		5
Sum	**1542**	**3293**			**8**	**1**	**5**		**13858**

Table 5b. FRV "Walther Herwig III", cruise 265: International hydroacoustic survey on herring in the North Sea, 28 June 2004 -19 July 2004: Age/maturity-length key for sprat (absolute numbers (millions) raised to the abundance in the survey area), separately for the western and the eastern part (divided at 3°E).

	West of 3°E							East of 3°E							
wr	0	1	1	2	2	3	total	0	1	1	2	2	3	total	grand
Age	0	1	1	2	2	3	west of 3°E	0	1	1	2	2	3	east of 3°E	total
Length (cm)	**0 imm.**	**1 imm.**	**1 mat.**	**2 imm.**	**2mat.**	**3 mat.**		**0 imm.**	**1 imm.**	**1 mat.**	**2 imm.**	**2mat.**	**3 mat.**		
2,75	12	0	0	0	0	0	12	0	0	0	0	0	0	0	12
3,25	240	0	0	0	0	0	240	0	0	0	0	0	0	0	240
3,75	923	0	0	0	0	0	923	1	0	0	0	0	0	1	924
4,25	1221	0	0	0	0	0	1221	8	0	0	0	0	0	8	1229
4,75	1087	0	0	0	0	0	1087	281	0	0	0	0	0	281	1368
5,25	4609	0	0	0	0	0	4609	184	0	0	0	0	0	184	4793
5,75	5760	0	0	0	0	0	5760	54	0	0	0	0	0	54	5813
6,25	2273	0	0	0	0	0	2273	16	0	0	0	0	0	16	2289
6,75	657	0	0	0	0	0	657	12	0	0	0	0	0	12	669
7,25	58	0	0	0	0	0	58	1	1	0	0	0	0	1	59
7,75	0	17	0	0	0	0	17	0	6	0	0	0	0	6	23
8,25	10	61	0	0	0	0	71	0	85	0	0	0	0	85	156
8,75	0	248	0	23	0	0	270	0	418	0	0	0	0	418	688
9,25	0	1442	0	0	0	0	1442	0	1735	106	35	0	0	1877	3319
9,75	0	2905	153	0	0	0	3058	0	3614	314	0	0	0	3928	6986
10,25	0	1757	1757	0	391	0	3905	0	3875	1416	75	224	0	5589	9494
10,75	0	534	610	76	381	0	1601	0	1814	2073	130	130	0	4146	5746
11,25	0	96	384	48	576	0	1103	0	386	1544	96	289	0	2316	3419
11,75	0	0	131	26	131	0	289	0	0	892	28	641	0	1560	1849
12,25	0	0	40	0	241	0	281	0	0	183	0	633	0	817	1097
12,75	0	0	0	0	173	0	173	0	0	76	0	503	13	591	764
13,25	0	0	0	0	51	6	58	0	0	0	0	288	16	305	362
13,75	0	0	0	0	53	13	66	0	0	0	0	172	7	179	244
14,25	0	0	0	0	7	10	16	0	0	0	0	26	31	57	73
total	16850	7059	3075	173	2002	29	29189	556	11934	6604	364	2907	66	22430	51620

Table 6. FRV "Walther Herwig III", cruise 265: International hydroacoustic survey on herring in the North Sea, 28 June 2004 -19 July 2004: Mean weight, biomass (tonnes) and numbers (millions) for herring by age and maturity per statistical rectangle. Note that for rectangles marked in orange/violet LFDs for the whole survey area have been used, as no catch information from neighbouring rectangles was available.

		E9		F0		F1		F2		F3		F4		F5		F6		F7		F8	
		W [t]	N [10^6]	W [t]	N [10^6]	W [t]	N [10^6]	W [t]	N [10^6]	W [t]	N [10^6]	W [t]	N [10^6]	W [t]	N [10^6]	W [t]	N [10^6]	W [t]	N [10^6]	W [t]	N [10^6]
42	total															**3'364.8**	**365.9**	**817.8**	**88.9**		
	1i															2'576.3	338.1	626.1	82.2		
	2i															788.6	27.8	191.6	6.7		
	2m	no stations and		no stations and		no stations and		no stations and		no stations and		no stations and		no stations and		0.0	0.0	0.0	0.0	no stations and	
	3i	no echo-information		no echo-information		no echo-information		no echo-information		no echo-information		no echo-information		no echo-information		0.0	0.0	0.0	0.0	no echo-information	
	3m															0.0	0.0	0.0	0.0		
	4m															0.0	0.0	0.0	0.0		
	5m															0.0	0.0	0.0	0.0		
	6+															0.0	0.0	0.0	0.0		
41	total															**1'525.2**	**65.4**	**9'718.4**	**1'056.7**		
	1i															121.9	16.0	7'440.9	976.5		
	2i															1'403.3	49.4	2'277.5	80.2		
	2m	no stations and		no stations and		no stations and		no stations and		no stations and		no stations and		no stations and		0.0	0.0	0.0	0.0	no stations and	
	3i	no echo-information		no echo-information		no echo-information		no echo-information		no echo-information		no echo-information		no echo-information		0.0	0.0	0.0	0.0	no echo-information	
	3m															0.0	0.0	0.0	0.0		
	4m															0.0	0.0	0.0	0.0		
	5m															0.0	0.0	0.0	0.0		
	6+															0.0	0.0	0.0	0.0		
40	total									**1'448.9**	**54.6**	**955.9**	**36.0**	**161.0**	**6.1**	**10'348.5**	**401.7**	**7'603.9**	**312.7**		
	1i									37.1	4.9	24.5	3.2	4.1	0.5	388.3	51.0	468.0	61.4		
	2i									1'411.8	49.7	931.4	32.8	156.9	5.5	9'960.2	350.7	7'136.0	251.3		
	2m	no stations and		no stations and		no stations and		no stations and		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	no stations and	
	3i	no echo-information		no echo-information		no echo-information		no echo-information		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	no echo-information	
	3m									0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
	4m									0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
	5m									0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
	6+									0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
39	total									**2089.1**	**78.7**	**1'273.9**	**48.0**	**1'861.9**	**69.9**	**12'650.0**	**455.2**	**17'505.9**	**621.4**		
	1i									53.5	7.0	32.6	4.3	44.7	5.9	102.0	13.4	51.9	6.8		
	2i									2'035.7	71.7	1'241.3	43.7	1'817.1	64.0	12'548.0	441.8	17'454.0	614.6		
	2m	no stations and		no stations and		no stations and		no stations and		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	no stations and	
	3i	no echo-information		no echo-information		no echo-information		no echo-information		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	no echo-information	
	3m									0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
	4m									0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
	5m									0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
	5+									0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
38	total									**237.4**	**8.9**	**596.7**	**20.4**	**7'187.5**	**246.0**	**3'273.6**	**170.3**	**9'430.9**	**815.4**		
	1i									6.1	0.8	9.6	1.3	115.5	15.2	630.2	82.7	5'033.1	660.5		
	2i									231.3	8.1	527.9	18.6	6'375.4	224.5	2'433.5	85.7	4'397.8	154.9		
	2m	no stations and		no stations and		no stations and		no stations and		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	no stations and	
	3i	no echo-information		no echo-information		no echo-information		no echo-information		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	no echo-information	
	3m									0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
	4m									0.0	0.0	35.7	0.4	420.0	4.2	126.6	1.3	0.0	0.0		
	5m									0.0	0.0	23.4	0.2	276.5	2.1	83.3	0.6	0.0	0.0		
	6+									0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
37	total	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**625.2**	**75.8**	**133.6**	**14.7**	**623.4**	**26.6**	**4'090.4**	**139.7**	**7'002.5**	**297.1**	**10'300.3**	**1'337.4**		
	1i	0.0	0.0	0.0	0.0	0.0	0.0	560.0	73.5	104.4	13.7	67.9	8.9	65.6	8.6	526.5	69.1	10'151.4	1'332.2		
	2i	0.0	0.0	0.0	0.0	0.0	0.0	65.2	2.3	29.3	1.0	482.0	17.0	3'619.0	127.4	6'476.0	228.0	149.0	5.2		
	2m	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	no stations and	
	3i	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	no echo-information	
	3m	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	18.1	0.2	0.0	0.0	0.0	0.0	0.0	0.0		
	4m	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	33.3	0.3	244.7	2.5	0.0	0.0	0.0	0.0		
	5m	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	22.0	0.2	161.1	1.2	0.0	0.0	0.0	0.0		
	6+	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		

Table 6. continued: herring.

36	total			**0.0**	**0.0**	**113.0**	**14.8**	**0.0**	**0.0**	**5'721.2**	**693.5**	**11'982.3**	**1'315.8**	**1'561.7**	**111.2**	**4'190.0**	**239.0**	**1'683.7**	**216.9**	
	1i			0.0	0.0	113.0	14.8	0.0	0.0	5'124.3	672.5	9'309.2	1'221.7	719.1	94.4	1'072.0	140.7	1'641.3	215.4	
	2i			0.0	0.0	0.0	0.0	0.0	0.0	596.8	21.0	2'673.1	94.1	319.5	11.3	2'668.6	94.0	42.4	1.5	
	2m			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	no stations and
	3i			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	no echo-information
	3m			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	523.1	5.6	165.5	1.8	0.0	0.0	
	4m			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	171.2	1.7	0.0	0.0	
	5m			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	112.7	0.9	0.0	0.0	
	6+			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
35	total					**0.0**	**0.0**	**8'503.1**	**1'115.9**	**162.1**	**20.6**	**24.0**	**2.1**							
	1i					0.0	0.0	8'503.1	1'115.9	154.7	20.3	14.6	1.9							
	2i					0.0	0.0	0.0	0.0	7.4	0.3	4.2	0.1							
	2m			no stations and		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	no stations and		no stations and				
	3i			no echo-information		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	no echo-information		no echo-information				
	3m					0.0	0.0	0.0	0.0	0.0	0.0	5.1	0.1							
	4m					0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0							
	5m					0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0							
	6+					0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0							
34	total							**22'810.7**	**2'993.5**	**519.9**	**68.2**	**0.0**	**0.0**							
	1i							22'810.7	2'993.5	519.9	68.2	0.0	0.0							
	2i							0.0	0.0	0.0	0.0	0.0	0.0							
	2m			no stations and		no stations and		0.0	0.0	0.0	0.0	0.0	0.0							
	3i			no echo-information		no echo-information		0.0	0.0	0.0	0.0	0.0	0.0							
	3m							0.0	0.0	0.0	0.0	0.0	0.0							
	4m							0.0	0.0	0.0	0.0	0.0	0.0							
	5m							0.0	0.0	0.0	0.0	0.0	0.0							
	6+							0.0	0.0	0.0	0.0	0.0	0.0							
33	total							**641.4**	**84.2**	**370.6**	**48.6**									
	1i							641.4	84.2	370.6	48.6									
	2i							0.0	0.0	0.0	0.0									
	2m					no stations and		0.0	0.0	0.0	0.0	no stations and								
	3i					no echo-information		0.0	0.0	0.0	0.0	no echo-information								
	3m							0.0	0.0	0.0	0.0									
	4m							0.0	0.0	0.0	0.0									
	5m							0.0	0.0	0.0	0.0									
	6+							0.0	0.0	0.0	0.0									
32	total							**168.5**	**22.1**	**436.0**	**57.2**									
	1i							168.5	22.1	436.0	57.2									
	2i							0.0	0.0	0.0	0.0									
	2m					no stations and		0.0	0.0	0.0	0.0									
	3i					no echo-information		0.0	0.0	0.0	0.0									
	3m							0.0	0.0	0.0	0.0									
	4m							0.0	0.0	0.0	0.0									
	5m							0.0	0.0	0.0	0.0									
	6+							0.0	0.0	0.0	0.0									

Weight at age&maturity [g]	
1i	7.62
2i	28.40
2m	
3i	
3m	93.00
4m	99.49
5m	131.00
6+	

Totals [t]:	
Weight	**173'715**
1i	80'840.34
2i	90'451.84
2m	0.00
3i	0.00
3m	711.92
4m	1'031.61
5m	679.10
6+	0.00

Totals [mio]:	
Numbers	**13'738**
1i	10'608.9680
2i	3'184.9240
2m	0.0000
3i	0.0000
3m	7.6550
4m	10.3690
5m	5.1840
6+	0.0000

biomass from validly sampled squares	100'268	58%
biomass from interpolated squares	73'447	42%

calculated with mean weigh per age&maturity-class

= interpolated square

no haul info and too remote for interpolation. Calculated "against the rules" with whole survey mean LFD-data to avoid unpleasant gaps.

Table 7. FRV "Walther Herwig III", cruise 265: International hydroacoustic survey on herring in the North Sea, 28 June 2004 -19 July 2004: Mean weight, biomass (tonnes) and numbers (millions) for sprat by age and maturity per statistical rectangle. Note that for rectangles marked in violet LFDs for the whole survey area have been used, as no catch information from neighbouring rectangles was available.

		E9		F0		F1		F2		F3		F4		F5		F6		F7		F8	
		W [t]	N [10^6]	W [t]	N [10^6]	W [t]	N [10^6]	W [t]	N [10^6]	W [t]	N [10^6]	W [t]	N [10^6]	W [t]	N [10^6]	W [t]	N [10^6]	W [t]	N [10^6]	W [t]	N [10^6]
42	total															**6.3**	**0.5**	**1.5**	**0.1**		
	0i															0.0	0.0	0.0	0.0		
	1i															0.3	0.0	0.1	0.0		
	1m	no stations and		no stations and		no stations and		no stations and		no stations and		no stations and		no stations and		3.4	0.3	0.8	0.1	no stations and	
	2i	no echo-information		no echo-information		no echo-information		no echo-information		no echo-information		no echo-information		no echo-information		0.1	0.0	0.0	0.0	no echo-information	
	2m															2.5	0.2	0.6	0.0		
	3+m															0.0	0.0	0.0	0.0		
41	total															**238.6**	**21.0**	**18.3**	**1.5**		
	0i															0.0	0.0	0.0	0.0		
	1i															43.9	5.3	0.9	0.1		
	1m	no stations and		no stations and		no stations and		no stations and		no stations and		no stations and		no stations and		96.6	8.8	9.8	0.9	no stations and	
	2i	no echo-information		no echo-information		no echo-information		no echo-information		no echo-information		no echo-information		no echo-information		4.1	0.5	0.4	0.0	no echo-information	
	2m															92.4	6.4	7.1	0.5		
	3+m															1.6	0.1	0.0	0.0		
40	total									**244.9**	**21.6**	**161.6**	**14.2**	**27.2**	**2.4**	**1'120.3**	**97.9**	**99.2**	**7.1**		
	0i									0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
	1i									45.1	5.4	29.8	3.6	5.0	0.6	199.4	23.9	2.1	0.3		
	1m	no stations and		no stations and		no stations and		no stations and		99.1	9.0	65.4	5.9	11.0	1.0	440.3	40.0	13.5	1.2	no stations and	
	2i	no echo-information		no echo-information		no echo-information		no echo-information		4.2	0.5	2.8	0.3	0.5	0.1	18.5	2.2	0.4	0.0	no echo-information	
	2m									94.9	6.6	62.6	4.3	10.5	0.7	451.3	31.4	75.4	5.2		
	3+m									1.6	0.1	1.1	0.0	0.2	0.0	10.7	0.5	7.8	0.4		
39	total									**353.1**	**31.1**	**215.3**	**19.0**	**295.9**	**26.1**	**64.0**	**6.6**	**261.2**	**18.5**		
	0i									0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
	1i									65.1	7.8	39.7	4.8	54.7	6.6	34.3	4.1	1.1	0.1		
	1m	no stations and		no stations and		no stations and		no stations and		142.9	13.0	87.1	7.9	119.7	10.9	18.3	1.7	33.1	3.0	no stations and	
	2i	no echo-information		no echo-information		no echo-information		no echo-information		6.1	0.7	3.7	0.4	5.1	0.6	0.7	0.1	0.9	0.1	no echo-information	
	2m									136.8	9.5	83.4	5.8	114.5	8.0	10.6	0.7	204.7	14.2		
	3+m									2.3	0.1	1.4	0.1	1.9	0.1	0.2	0.0	21.4	1.0		
38	total									**40.1**	**3.5**	**1'026.8**	**95.6**	**12'168.6**	**1'134.8**	**4'156.1**	**393.5**	**4'121.2**	**433.8**		
	0i									0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0		
	1i									7.4	0.9	307.0	36.9	3'676.9	441.5	1'379.0	165.6	2'267.0	272.2		
	1m	no stations and		no stations and		no stations and		no stations and		16.2	1.5	381.1	34.6	4'501.0	408.8	1'523.1	138.4	1'414.8	128.5	no stations and	
	2i	no echo-information		no echo-information		no echo-information		no echo-information		0.7	0.1	16.1	1.9	190.5	22.1	64.2	7.4	57.2	6.6	no echo-information	
	2m									15.5	1.1	315.8	21.9	3'720.2	258.5	1'165.2	81.0	377.3	26.2		
	3+m									0.3	0.0	6.8	0.3	79.9	3.7	24.6	1.1	4.9	0.2		
37	total	**5088.9**	**4571.8**	**7'915.3**	**7'111.0**	**3'895.7**	**3'499.9**	**1'285.3**	**892.6**	**915.5**	**90.8**	**2'563.4**	**251.2**	**7'039.0**	**655.5**	**25'860.8**	**2'881.1**	**7'786.9**	**821.0**		
	0i	5'088.9	4'571.8	7'915.3	7'111.0	3'895.7	3'499.9	950.3	853.7	6.3	5.6	1.6	1.5	0.0	0.0	0.4	0.4	0.0	0.0		
	1i	0.0	0.0	0.0	0.0	0.0	0.0	293.8	35.3	289.9	34.8	1'033.8	124.1	2'104.6	252.7	19'054.2	2'288.1	4'262.2	511.8		
	1m	0.0	0.0	0.0	0.0	0.0	0.0	27.4	2.5	325.9	29.6	847.7	77.0	2'612.5	237.3	5'070.8	460.6	2'766.1	251.3	no stations and	
	2i	0.0	0.0	0.0	0.0	0.0	0.0	3.8	0.4	13.9	1.6	36.7	4.3	110.5	12.8	253.7	29.5	111.2	12.9	no echo-information	
	2m	0.0	0.0	0.0	0.0	0.0	0.0	9.9	0.7	267.6	18.6	628.0	43.6	2'164.8	150.4	1'467.0	101.9	647.3	45.0		
	3+m	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	11.9	0.6	15.6	0.7	46.5	2.2	14.6	0.7	0.0	0.0		

Table 7. continued: sprat.

36	total		**533.8**	**479.6**	**464.2**	**51.7**	**0.0**	**0.0**	**3'080.8**	**369.8**	**85'346.8**	**8'461.5**	**39'511.5**	**4'002.0**	**18'124.0**	**1'798.4**	**1'326.5**	**140.3**	
	0i		533.8	479.6	9.0	8.1	0.0	0.0	15.3	13.8	586.7	527.1	0.3	0.3	0.1	0.1	0.0	0.0	
	1i		0.0	0.0	182.1	21.9	0.0	0.0	2'688.3	322.8	26'875.0	3'227.2	19'472.6	2'338.3	8'019.3	963.0	740.0	88.9	
	1m	no stations and	0.0	0.0	124.5	11.3	0.0	0.0	250.4	22.7	30'455.3	2'766.3	11'750.8	1'067.4	5'785.2	525.5	459.5	41.7	no stations and
	2i	no echo-information	0.0	0.0	5.3	0.6	0.0	0.0	34.8	4.0	1'300.0	150.9	519.4	60.3	251.4	29.2	18.6	2.2	no echo-information
	2m		0.0	0.0	137.2	9.5	0.0	0.0	90.3	6.3	25'014.8	1'738.0	7'589.9	527.3	3'978.7	276.4	108.3	7.5	
	3+m		0.0	0.0	6.0	0.3	0.0	0.0	1.6	0.1	1'114.9	52.0	178.4	8.3	89.2	4.2	0.0	0.0	
35	total				**0.0**	**0.0**	**34'609.4**	**3'599.9**	**713.6**	**74.0**	**452.1**	**45.7**							
	0i				0.0	0.0	353.8	317.9	3.9	3.5	0.5	0.4							
	1i				0.0	0.0	13'707.3	1'646.0	320.8	38.5	211.0	25.3							
	1m		no stations and		0.0	0.0	9'369.1	851.0	218.7	19.9	138.4	12.6	no stations and		no stations and				
	2i		no echo-information		0.0	0.0	400.5	46.5	9.3	1.1	6.1	0.7	no echo-information		no echo-information				
	2m				0.0	0.0	10'324.2	717.3	155.0	10.8	93.6	6.5							
	3+m				0.0	0.0	454.5	21.2	5.9	0.3	2.6	0.1							
34	total						**80'818.9**	**8'674.8**	**1'914.8**	**203.5**									
	0i						0.0	0.0	6.3	5.7									
	1i						49'566.7	5'952.2	1'040.2	124.9									
	1m		no stations and		no stations and		23'654.3	2'148.6	546.9	49.7	no stations and								
	2i		no echo-information		no echo-information		990.3	115.0	23.0	2.7	no echo-information								
	2m						6'607.6	459.1	290.3	20.2									
	3+m						0.0	0.0	8.1	0.4									
33	total						**2'272.5**	**243.9**	**1'313.0**	**140.9**									
	0i						0.0	0.0	0.0	0.0									
	1i						1'393.7	167.4	805.3	96.7									
	1m				no stations and		665.1	60.4	384.3	34.9	no stations and								
	2i				no echo-information		27.8	3.2	16.1	1.9	no echo-information								
	2m						185.8	12.9	107.3	7.5									
	3+m						0.0	0.0	0.0	0.0									
32	total						**597.1**	**64.1**	**1544.9**	**165.8**									
	0i						0.0	0.0	0.0	0.0									
	1i						366.2	44.0	947.5	113.8									
	1m				no stations and		174.8	15.9	452.2	41.1	no stations and								
	2i				no echo-information		7.3	0.8	18.9	2.2	no echo-information								
	2m						48.8	3.4	126.3	8.8									
	3+m						0.0	0.0	0.0	0.0									

Weight at age&maturity [g]	
0i	1.11
1i	8.33
1m	11.01
2i	8.61
2m	14.39
3+m	21.44

Totals [t]:	
Weight	359'594.64
0i	19'368.48
1i	161'533.16
1m	105'056.92
2i	4'534.88
2m	66'984.46
3+m	2'116.73

Totals [mio]:	
Numbers	51'619.63
0i	17'400.49
1i	19'397.50
1m	9'542.63
2i	526.43
2m	4'653.89
3+m	98.71

biomass from validly sampled squares	289'413	80%
biomass from interpolated squares	70'181	20%

calculated with mean weigh per age&maturity-class

= interpolated square

no haul info and too remote for interpolation. Calculated "against the rules" with whole survey mean LFD-data to avoid unpleasant gaps.

Annex 3: Western Baltic acoustic survey

Survey Report for RV "SOLEA"
29.09. – 18.10.2004
Federal Research Centre for Fisheries, Germany
Eberhard Götze [1] and Tomas Gröhsler [2]
[1]Institute for Fishery Technology and Fishery Economy, Hamburg
[2] Institute for Baltic Sea Fisheries, Rostock

1 Introduction

The main objective is to assess clupeoid resources in the Baltic Sea. The joint German/Danish survey in September/October is traditionally coordinated within the frame of the **Baltic International Acoustic Survey.** The reported acoustic survey is conducted every year to supply the ICES:

- 'Herring Assessment Working Group for the Area South of 62°N (HAWG)' and 'Baltic Fisheries Assessment Working Group (WGBFAS)'with an index value for the stock size of herring and sprat, respectively, in the Western Baltic area (Subdivisions 22, 23 and 24).

2 Methods

2.1 Personnel

A. Gebel	Institute for Baltic Sea Fisheries, Rostock
E. Götze	Institute for Fishery Technology and Fishery Economy, Hamburg, in charge
Dr. T. Gröhsler	Institute for Baltic Sea Fisheries, Rostock
M. Koth	Institute for Baltic Sea Fisheries, Rostock
S.-E. Levinsky	DIFRES, Charlottenlund, Denmark
R. Oeberst	Institute for Baltic Sea Fisheries, Rostock

2.2 Narrative

The 532nd cruise of RV 'Solea' represents the 17th subsequent survey and took place from 29th September to 18th October in 2004. RV "Solea" left the port of Rostock/ Marienehe on 29th October 2004. The joint German-Danish acoustic survey covered the area of Subdivisions 21, 22, 23 and 24. The survey ended on 18th October 2004 in Rostock/Marienehe.

2.3 Survey design

The ICES statistical rectangles were used as strata for all Subdivisions (ICES 2003). The area was limited by the 10 m depth line. The survey area in the Western Baltic Sea is characterised by a number of islands and sounds. Parallel transects would lead in consequence to an unsuitable coverage of the survey area. Therefore a zig-zag track was used to cover all depth strata regularly. The survey area was 13,850 NM^2. The cruise track (Figure 1) totally reached a length of 1,268 nautical miles.

2.4 Calibration

The hull mounted transducer ES38B was calibrated at the beginning of the survey east of Ruegen Island in a water depth of 20m. The calibration procedure was carried out as described in the 'Manual for the Baltic International Acoustic Surveys (BIAS)' (ICES 2003).

2.5 Acoustic data collection

The acoustic investigations were performed during night time. The main pelagic species of interest were herring and sprat. The acoustic equipment was an echosounder EK60 on 38 kHz. The specific settings of the hydroacoustic equipment were used as described in the 'Manual for the Baltic International Acoustic Surveys (BIAS)' (ICES 2003). The post processing of the stored echo signals was done by EchoView 3.10. The mean volume back scattering values (s_v) were integrated over 1 nm intervals from 8 m below the surface to the bottom. Contributions from air bubbles, bottom structures and scattering layers were removed from the echogram.

2.6 Biological data – fishing stations

Trawling was done with the pelagic gear "PSN388" in the midwater as well as near the bottom. The mesh size in the codend was 10 mm. The intention was to carry out at least two hauls per ICES statistical rectangle. The trawling depth and the net opening were controlled by a netsonde. The trawl depth was chosen in accordance to the 'characteristic indications' by the echogram. Normally a net opening of about 8-10 m was achieved. The trawling time lasted usually 30 minutes, but in dense concentrations the duration was reduced. From each haul subsamples were taken to determine length and weight of fish. Samples of herring and sprat were frosted for further investigations in the lab (i.e. sex, maturity, age). The hydrographic condition was investigated after each trawl haul by a CTD-probe.

2.7 Data analysis

The pelagic target species sprat and herring are usually distributed in mixed layers in combination with other species so that the integrator readings cannot be allocated to a single species. Therefore the species composition was based on the trawl catch results. For each rectangle the species composition and length distribution were determined as the unweighted mean of all trawl results in this rectangle. From these distributions the mean acoustic cross section σ was calculated according to the following target strength-length (TS) relation:

Clupeoids	TS = 20 log L (cm) - 71.2	(ICES 1983)
Gadoids	TS = 20 log L (cm) - 67.5	(Foote *et al*. 1986)

The total number of fish (total N) in one rectangle was estimated as the product of the mean area scattering cross section (s_A) and the rectangle area, divided by the corresponding mean cross section. The total number was separated into herring and sprat according to the mean catch composition.

3 Results

3.1 Biological data

In total 51 trawl hauls were carried out (17 hauls in Subdivision 21, 13 hauls in Subdivision 22, 4 hauls in Subdivision 23 and 17 hauls in Subdivision 24). 1,897 herring and 1,098 sprats were frozen for further investigations in the lab.

The results of the catch composition by Subdivision are presented in Table 1-4. The catch in the northern part of Subdivision 21 contained bigger amounts of sardine.

The length distributions of herring and sprat of the years 2003 and 2004 are presented by Subdivision in Figures 2 and 3. As in the years before, the new incoming year class (ca. <16 cm) is dominating in Subdivisions 22 and 24. The 2004 year class is characterised by two maxima, which could be explained either by different growth pattern or by spring and autumn spawned herring. In contrast to the year before the amount of older herring (> 24 cm) slightly decreased in Subdivision 23.

The length distributions of sprat in 2003 and 2004 show a complete different picture in all subdivisions (Figure 4). Compared to last year the contribution of older sprat (>10 cm) increased in Subdivisions 22, 23 and 24 and decreased in Subdivision 21. The new incoming year class is in 2004 only dominating in Subdivision 21.

3.2 Acoustic data

The survey statistics concerning the survey area, the mean s_A, the mean scattering cross section σ, the estimated total number of fish, the percentages of herring and sprat per Subdivision/rectangle are shown in Table 4.

The horizontal distribution of s_A values is similar compared to the results in the years before. The highest values were observed in the Sound (SD23), whereby in the northern part less fish was present. This picture is typical for the distribution pattern in autumn. A quite homogeneous spatial distribution was found in the Arkona Basin and the Mecklenburg Bay. Higher fish concentrations normally occurring of Ruegen Island were missing in 2004. The small fish densities in the Belt Sea and in the SW Kattegat correspond to the results in former years. High values, which were caused by small squids and mysidacea, were measured in the north-eastern part of the Kattegat.

3.3 Abundance estimates

The total abundance of herring and sprat are presented in Table 5. The estimated number of herring and sprat by age group and Subdivision/rectangle are given in Table 6 and Table 9. The corresponding mean weights by age group and Subdivision/rectangle are shown in Table 7 and Table 10. The estimates of herring and sprat biomass by age group and Subdivision/rectangle are summarised in Table 8 and Table 11.

The herring stock was estimated to be 5.9×10^9 fish or about 199.4×10^3 tonnes in Subdivisions 21-24. For the included area of Subdivisions 22-24 the number of herring was calculated to be 5.7×10^9 fish or about 192.1×10^3 tonnes. The abundance estimates were dominated by young herring as in former years. Adult herring, which was concentrated in former years only in the Sound, could be found during the last three years in deeper areas of the Arkona Sea.

The estimated sprat stock was 8.74×10^9 fish or 88.0×10^3 tonnes in Subdivisions 21-24. For the included area of Subdivisions 22-24 the number of sprat was calculated to be 7.18×10^9 fish or 78.7×10^3 tonnes. In contrast to last year's results, the abundance estimates of sprat were not dominated by young sprat (Figure 3 and Table 9). The estimate of year-class strength 2004 is low.

4 Discussion

The total number of herring in Subdivisions 22–24 slightly increased by 7% compared to the results in 2003. This overall small increase is characterised by

- lower numbers in Subdivision 21 (- 72%, although the coverage was higher in 2004: + 53%) and in Subdivision 22 (- 9%),
- higher numbers in Subdivision 23 (+ 27%) and in Subdivision 24 (+ 6%, overall decrease in numbers, which were compensated by the numbers in the newly investigated rectangles 37G3 and 37G4).

As in 2003 the age-groups 0-1 in numbers are the main contributors in Subdivisions 22-24 (2004: 73% and 2003: 84%)

The age groups 2-4 in numbers constitutes in 2004 by 22% (2003: 13%). The smaller numbers of age groups 2-4 during the last few years could be explained by the migration behaviour. A lower proportion of adult herring may have been migrated during survey time from the Sound into the Arkona Sea on the way to the spring spawning areas around Rügen Island.

The actual contribution of the age-group 0 in Subdivisions 22-24 is 56% in numbers and 13% in biomass (2003: 69% in numbers and 20% in biomass)

The total biomass in Subdivisions 22-24 is about 23% higher than last years estimate (155.8 x 103 t) and reached about the same size level as in 2002 (195.3 x 10^3 t).

The abundance of sprat in the Western Baltic (Subdivisions 22-24) decreased and is now estimated to be about 55% lower than last years estimate. The decrease in numbers was mainly caused by the low 0-group estimate in Subdivision 22, which is about 36 times lower than in 2003 (2003: 11.0 x 10^9 fish and 2004: 0.3 x 10^9 fish). The actual contribution of the age-group 0 in Subdivisions 22-24 is 12% in numbers and 4% in biomass (2003: 87% in numbers and 61% in biomass).

5 REFERENCES

ICES 1983. Report of the Planning Group on ICES Co-ordinated Herring and Sprat Acoustic Surveys. ICES CM 1983/H:12.

ICES 2003. Report of the Baltic International Fish Survey Working Group. ICES CM 2003/G:05 Ref.: D,H.: Annex 3.

Foote, K.G., Aglen, A. and Nakken, O. 1986. Measurement of fish target strength with a split-beam echosounder. J.Acoust.Soc.Am. 80(2): 612-621.

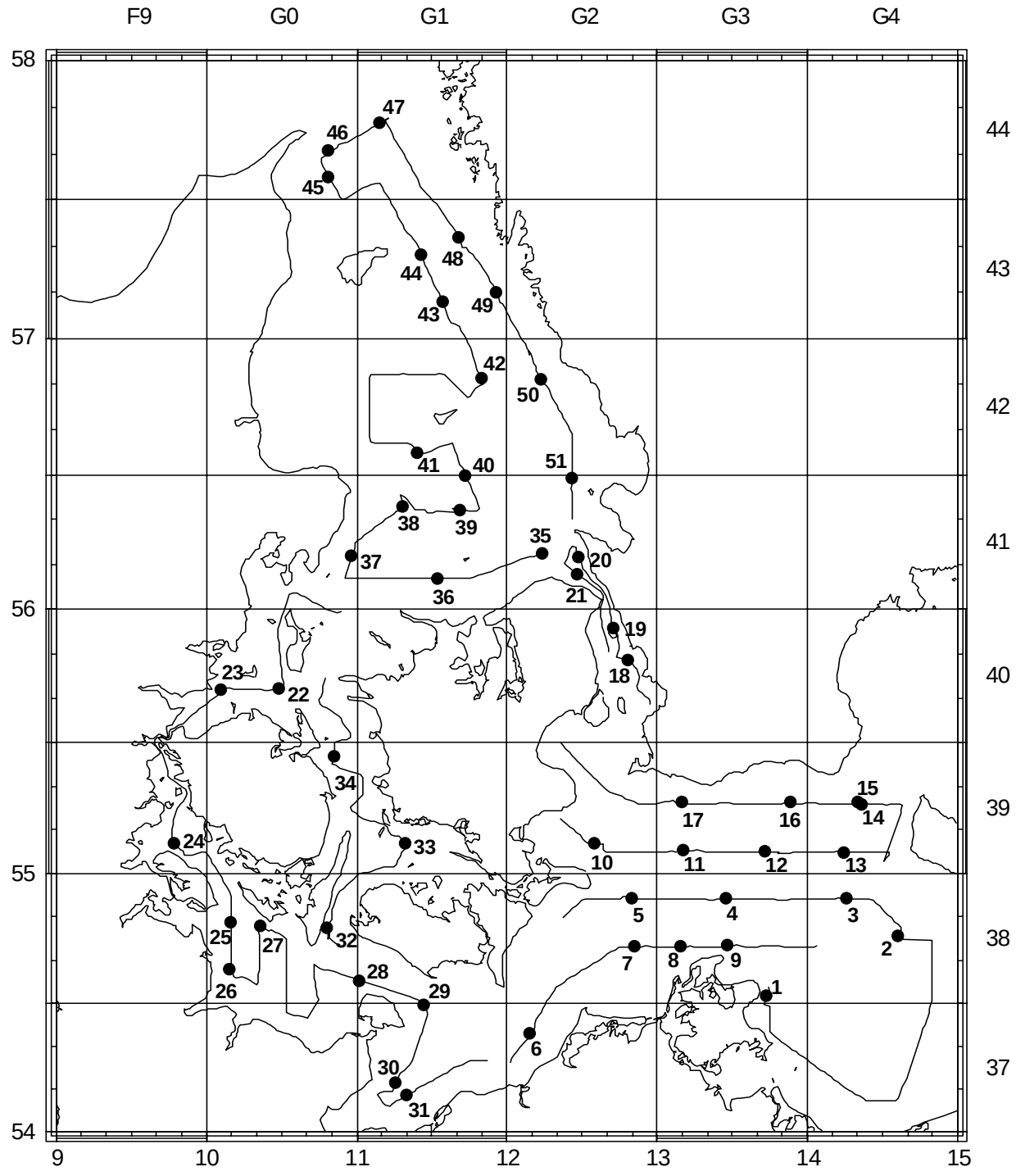


Figure 1: Cruise track and trawl positions for RV "SOLEA" in October 2004.

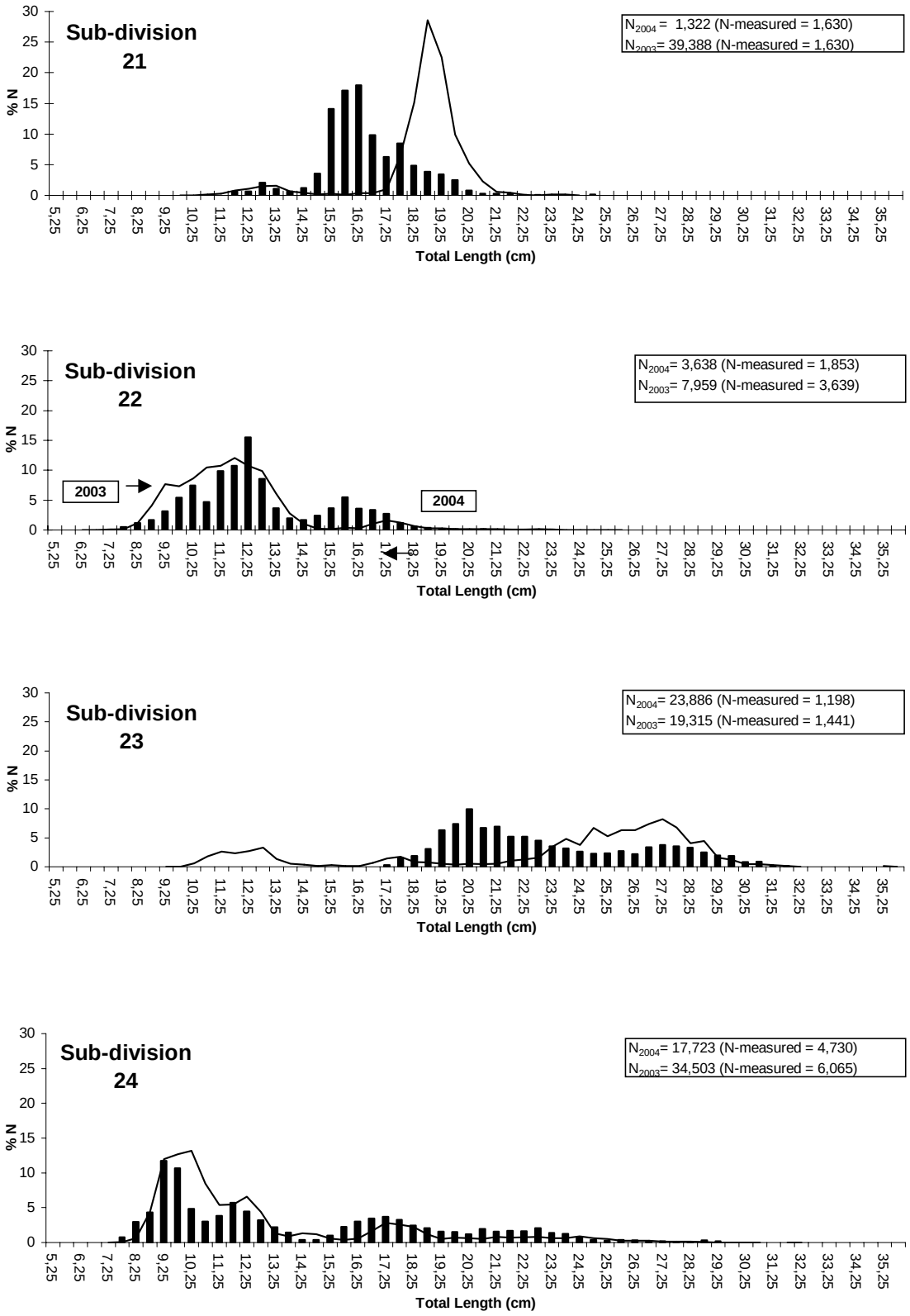


Figure 2 Length distribution of herring in Sub-divisions 21, 22, 23 and 24 in 2003 (=line) and in 2004 (=bar).

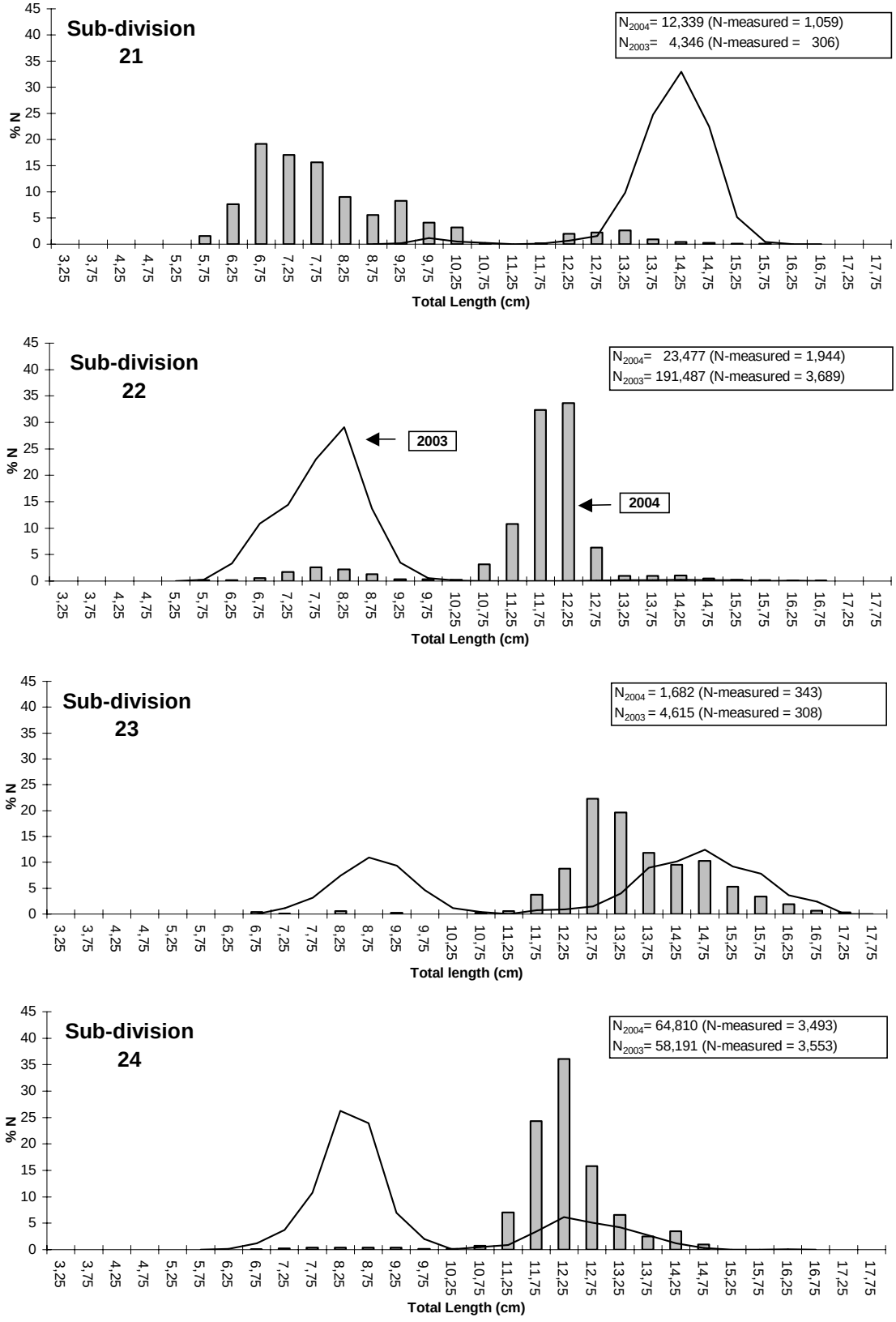


Figure 3 Length distribution of sprat in Sub-divisions 21, 22, 23 and 24 in 2003 (=line) and in 2004 (=bar).

Table 1: Catch composition (kg/0.5 h) per haul No. in Sub-division 21

Haul No.	35	36	37	38	39	40	41	42	43
Species/ICES Rectangle	41G2	41G1	41G0	41G1	41G1	41G1	42G1	42G1	43G1
ALOSA FALLAX									
APHIA MINUTA								+	+
ARGENTINA SPHYRAENA									
CLUPEA HARENGUS	0,08	1,17	0,28	0,41	0,19	0,69	0,40	1,14	4,57
CRANGON CRANGON									
CTENOLABRUS RUPESTRIS									
CYCLOPTERUS LUMPUS					0,16				
ELEDONE CIRROSA								0,02	0,01
ENGRAULIS ENCRASICOLUS	+	0,06		0,07	0,87	2,37	0,14	18,34	6,63
EUTRIGLA GURNARDUS									0,29
GADUS MORHUA			0,23						
GLYPTOCEPHALUS CYNOGLOSSUS									
HIPPOGLOSSOIDES PLATESSOIDES									
LIMANDA LIMANDA		0,19	0,01	0,04		0,08	0,17		0,07
LOLIGO FORBESI	+	+	+		0,03	0,04	+	1,23	0,36
MAUROLICUS MUELLERI									
MELANOGRAMMUS AEGLEFINUS									
MERLANGIUS MERLANGUS		0,10	0,02	0,07		0,32	0,05	0,67	0,89
MERLUCCIUS MERLUCCIUS								0,02	+
MICROSTOMUS KITT									
MULLUS SURMULETUS									
MYSIS SPEC								0,60	
PANDALUS BOREALIS									
PLEURONECTES PLATESSA				0,11					
POMATOSCHISTUS MINUTUS		+	+	+		+	+	0,01	0,01
SARDINA PILCHARDUS								0,17	1,78
SCOMBER SCOMBRUS								0,27	
SPRATTUS SPRATTUS		0,15	0,06	0,20	0,68	0,06		0,24	1,71
SQUALUS ACANTHIAS									
TRACHINUS DRACO	0,07	0,02	0,08	0,15	0,05			0,82	0,35
TRACHURUS TRACHURUS	0,50	0,06	+	0,01	0,18	0,09	0,04	0,08	0,10
TRISOPTERUS ESMARKI									
TRISOPTERUS MINUTUS									
Total	**0,65**	**1,75**	**0,68**	**1,06**	**2,16**	**3,65**	**0,80**	**23,61**	**16,77**
Medusae	4,03	10,92	17,43	6,81	9,19	6,40	8,07	4,81	2,50

Haul No.	44	45	46	47	48	49	50	51	Total
Species/ICES Rectangle	43G1	44G0	44G0	44G1	43G1	43G1	42G2	41G2	
ALOSA FALLAX				0,16					**0,16**
APHIA MINUTA	+		0,03			+	0,00	0,02	**0,05**
ARGENTINA SPHYRAENA					+				+
CLUPEA HARENGUS	0,63	0,25	1,21	2,10	2,04	1,08	0,10	23,15	**39,49**
CRANGON CRANGON					0,01	0,05			**0,06**
CTENOLABRUS RUPESTRIS		+							+
CYCLOPTERUS LUMPUS			1,16			1,85			**3,17**
ELEDONE CIRROSA	+			0,02	0,02	0,10	0,05	0,03	**0,25**
ENGRAULIS ENCRASICOLUS	20,38	22,37	5,28	6,77	0,96	0,64	1,70	0,60	**87,18**
EUTRIGLA GURNARDUS		0,03	0,04	0,03		0,05	0,01	0,01	**0,46**
GADUS MORHUA					0,01				**0,24**
GLYPTOCEPHALUS CYNOGLOSSUS						+			+
HIPPOGLOSSOIDES PLATESSOIDES					0,03		0,03		**0,06**
LIMANDA LIMANDA					0,06	0,04		0,17	**0,83**
LOLIGO FORBESI	0,16	1,90	1,41	0,90	2,69	0,46	1,82	0,70	**11,70**
MAUROLICUS MUELLERI					0,01				**0,01**
MELANOGRAMMUS AEGLEFINUS					0,16				**0,16**
MERLANGIUS MERLANGUS	0,13	4,23	2,32	0,89	2,31	0,18	0,55	1,67	**14,40**
MERLUCCIUS MERLUCCIUS	0,06	0,01		0,20	0,07	0,01	0,01		**0,38**
MICROSTOMUS KITT					0,06				**0,06**
MULLUS SURMULETUS		0,01				0,01	0,01		**0,03**
MYSIS SPEC	0,04				68,08	0,13			**68,85**
PANDALUS BOREALIS					0,03				**0,03**
PLEURONECTES PLATESSA									**0,11**
POMATOSCHISTUS MINUTUS	0,10	0,02	0,02	0,10	0,07	0,02	+	0,01	**0,36**
SARDINA PILCHARDUS	1,31	36,00	75,25	38,10	5,91	1,05	0,64	0,31	**160,52**
SCOMBER SCOMBRUS	0,17	0,30	0,37	0,29					**1,40**
SPRATTUS SPRATTUS	0,05	1,61	28,34	15,25	0,39	0,36		6,17	**55,27**
SQUALUS ACANTHIAS					8,39	1,86			**10,25**
TRACHINUS DRACO		0,01	0,04	0,08		0,42	1,42	0,11	**3,62**
TRACHURUS TRACHURUS	0,47	0,22	0,12	0,20	0,22	0,03	0,18	0,38	**2,88**
TRISOPTERUS ESMARKI				0,01					**0,01**
TRISOPTERUS MINUTUS	0,01				0,05		+		**0,06**
Total	**23,51**	**66,96**	**115,59**	**65,10**	**91,57**	**8,34**	**6,52**	**33,33**	**462,05**
Medusae	0,90	1,00	1,00	0,33	0,60	0,99	1,31	1,54	77,80

+ = < 0,01 kg

Table 2: Catch composition (kg/0.5 h) per haul No. in Sub-division 22

Haul No.	22	23	24	25	26	27	28	29	30
Species/ICES Rectangle	**40G0**	**40G0**	**39F9**	**38G0**	**38G0**	**38G0**	**38G1**	**37G1**	**37G1**
AGONUS CATAPHRACTUS	+								
APHIA MINUTA		+							
CLUPEA HARENGUS		0,06	0,06	1,63	12,70	3,95	12,85	1,94	10,00
CRANGON CRANGON							+		
CYCLOPTERUS LUMPUS			0,32						
ENGRAULIS ENCRASICOLUS						+		+	
EUTRIGLA GURNARDUS						0,02			
GADUS MORHUA	0,02								0,34
GASTEROSTEUS ACULEATUS		0,01	1,49	0,22				+	+
GOBIUS NIGER	0,01	0,01							
LEANDER ADSPERSUS							+		
LIMANDA LIMANDA	0,01							0,15	
LOLIGO FORBESI	+	0,01	+						
MERLANGIUS MERLANGUS	0,14	0,10	+	0,02	0,17	0,03	0,03		4,00
MULLUS SURMULETUS									
PHOLIS GUNNELLUS									
POMATOSCHISTUS MINUTUS	+	0,02			+	+			
SCOMBER SCOMBRUS			0,02						
SPRATTUS SPRATTUS	0,05	0,71	6,35	19,92	29,05	0,63	5,52	0,17	50,00
SYMPHODUS MELOPS									
SYNGNATHUS ROSTELLATUS									
TRACHINUS DRACO									
TRACHURUS TRACHURUS	0,06	0,06	+		0,03	+	0,04	+	0,03
Total	**0,29**	**0,98**	**8,24**	**21,79**	**41,95**	**4,63**	**18,44**	**2,26**	**64,37**
Medusae	15,8	7,9	84,3	46,9	11,3	23,0	39,1	19,3	85,5

Haul No.	31	32	33	34	Total
Species/ICES Rectangle	**37G1**	**38G0**	**39G1**	**39G0**	
AGONUS CATAPHRACTUS					+
APHIA MINUTA					+
CLUPEA HARENGUS	3,90	0,48	0,05	0,14	47,76
CRANGON CRANGON					+
CYCLOPTERUS LUMPUS					0,32
ENGRAULIS ENCRASICOLUS		0,04			0,04
EUTRIGLA GURNARDUS					0,02
GADUS MORHUA	2,21		0,25		2,82
GASTEROSTEUS ACULEATUS	+	+	0,02	0,01	1,75
GOBIUS NIGER			+		0,02
LEANDER ADSPERSUS			0,01		0,01
LIMANDA LIMANDA		0,14	0,05	0,03	0,38
LOLIGO FORBESI					0,01
MERLANGIUS MERLANGUS	0,74	0,01	+	0,06	5,30
MULLUS SURMULETUS	0,01				0,01
PHOLIS GUNNELLUS			0,01		0,01
POMATOSCHISTUS MINUTUS			+	+	0,02
SCOMBER SCOMBRUS			0,02		0,04
SPRATTUS SPRATTUS	145,20	2,68	0,25	0,08	260,61
SYMPHODUS MELOPS				0,04	0,04
SYNGNATHUS ROSTELLATUS			+		+
TRACHINUS DRACO				0,01	0,01
TRACHURUS TRACHURUS	0,02	0,02	0,01	+	0,27
Total	**152,08**	**3,37**	**0,67**	**0,37**	**319,44**
Medusae	35,6	56,5	12,8	18,9	**456,85**

+ = < 0,01 kg

Table 3: Catch composition (kg/0.5 h) per haul No. in Sub-division 23

Haul No.	18	19	20	21	Total
Species/ICES Rectangle	40G2	40G2	41G2	41G2	
APHIA MINUTA				+	+
CLUPEA HARENGUS	1342,18	875,08	25,35	0,67	**2243,28**
CYCLOPTERUS LUMPUS				0,16	**0,16**
ENGRAULIS ENCRASICOLUS				0,04	**0,04**
GADUS MORHUA	69,40	54,60			**124,00**
GASTEROSTEUS ACULEATUS			+		**+**
LOLIGO FORBESI				0,04	**0,04**
MERLANGIUS MERLANGUS	3,86	18,94	+	0,01	**22,81**
MULLUS SURMULETUS			0,01		**0,01**
POMATOSCHISTUS MINUTUS			+	+	**+**
SPRATTUS SPRATTUS	13,54	14,82	0,17	+	**28,53**
TRACHINUS DRACO				0,02	**0,02**
TRACHURUS TRACHURUS	0,02	0,03	0,04	0,05	**0,14**
Total	**1429,00**	**963,47**	**25,57**	**0,99**	**2419,03**
Medusae	0	1,7	20,8	3,7	26,2

+ = < 0,01 kg

Table 4: Catch composition (kg/0.5 h) per haul No. in Sub-division 24

Haul No.	1	2	3	4	5	6	7	8	9
Species/ICES Rectangle	38G3	38G4	38G4	38G3	38G2	37G2	38G2	38G3	38G3
CLUPEA HARENGUS	29,67	2,82	26,22	4,29	5,77	16,54	8,24	4,15	14,99
ENGRAULIS ENCRASICOLUS				+					
GADUS MORHUA	4,83		11,06	0,47			0,87		
GASTEROSTEUS ACULEATUS					+		0,01	0,03	0,01
HYPEROPLUS LANCEOLATUS	0,02							0,01	
LIMANDA LIMANDA									
MERLANGIUS MERLANGUS	8,05		0,86	0,72	0,01	0,02	0,04		3,18
PLATICHTHYS FLESUS	0,25		0,44				0,79		
POMATOSCHISTUS MINUTUS	0,11		0,04	0,13	+			0,06	0,03
PSETTA MAXIMA	0,24								
SPRATTUS SPRATTUS	7,28	2,25	14,09	14,37	3,48	58,47	14,65	1,34	101,33
TRACHURUS TRACHURUS				+	+	0,02	0,21	0,02	
Total	**50,45**	**5,07**	**52,71**	**19,98**	**9,26**	**75,05**	**24,81**	**5,61**	**119,54**
Medusae	24,2	16,3	1,0	10,2	97,8	34,5	9,0	6,3	70,0

Haul No.	10	11	12	13	14	15	16	17	Total
Species/ICES Rectangle	39G2	39G3	39G3	39G4	39G4	39G4	39G3	39G3	
CLUPEA HARENGUS	4,91	31,80	23,40	14,64	59,97	12,72	40,60	141,58	442,31
ENGRAULIS ENCRASICOLUS									+
GADUS MORHUA		1,16			8,15	5,12	1,76	3,49	36,91
GASTEROSTEUS ACULEATUS					+				0,05
HYPEROPLUS LANCEOLATUS	0,02								0,05
LIMANDA LIMANDA							0,18		0,18
MERLANGIUS MERLANGUS	+	2,32	8,34		6,88		4,21	0,31	34,94
PLATICHTHYS FLESUS									1,48
POMATOSCHISTUS MINUTUS	+	0,01			+			0,01	0,39
PSETTA MAXIMA									0,24
SPRATTUS SPRATTUS	1,43	11,43	75,70	20,70	401,23	18,58	24,60	9,86	780,79
TRACHURUS TRACHURUS	0,15	0,02				+		+	0,42
Total	**6,51**	**46,74**	**107,44**	**35,34**	**476,23**	**36,42**	**71,35**	**155,25**	**1297,76**
Medusae	164,8	6,0	182,7	0,8	0,9	0,5	23,3	5,2	653,4

+ = < 0,01 kg

Table 5 Survey statistics RV "SOLEA" October 2004

Sub-division	ICES Rectangle	Area (nm^2)	Sa (m^2/NM^2)	Sigma (cm^2)	N total (million)	Herring (%)	Sprat (%)	NHerring (million)	NSprat (million)
21	41G1	946,8	35,2	0,932	357,55	3,32	9,17	11,87	32,80
21	41G2	432,3	84,5	0,868	420,63	17,81	10,09	74,93	42,46
21	42G1	884,2	42,4	0,889	421,55	9,69	0,10	40,84	0,41
21	42G2	606,8	124,6	0,404	1869,81	0,08	0	1,55	0,00
21	43G1	699	203,3	0,51	2786,71	1,81	2,42	50,45	67,50
21	44G0	239,9	403,9	0,669	1449,24	0,13	14,2	1,95	205,76
21	44G1	580,5	756,8	0,66	6660,41	0,49	18,29	32,54	1218,52
	Total	**4389,5**			**13965,90**			**214,13**	**1567,45**
22	37G1	723,3	380,7	1,409	1954,91	37,5	61,39	733,01	1200,16
22	38G0	735,3	113,7	1,339	624,52	30,7	66,09	191,73	412,75
22	38G1	173,2	97,4	1,591	106,07	59,05	39,27	62,63	41,65
22	39F9	159,3	59,3	0,561	168,34	0,16	75,71	0,27	127,44
22	39G0	201,7	42,3	1,256	67,95	33,33	33,33	22,65	22,65
22	39G1	250,0	54,3	0,739	183,76	5	55	9,19	101,07
22	40G0	538,1	23,7	0,576	221,58	0,96	57,01	2,12	126,31
	Total	**2780,9**			**3327,13**			**1021,60**	**2032,03**
23	40G2	164,0	2995,2	5,232	938,82	92,48	6,9	868,26	64,79
23	41G2	72,3	235,1	3,905	43,52	92,76	2,94	40,37	1,28
	Total	**236,3**			**982,34**			**908,63**	**66,07**
24	37G2	192,4	193,9	1,400	266,42	17,11	82,58	45,60	220,01
24	37G3	167,7	395,5	0,938	707,10	75,44	21,76	533,47	153,83
24	37G4	875,1	206,7	1,804	1002,87	51,32	44,82	514,71	449,51
24	38G2	832,9	175,2	1,456	1002,21	45,62	51,52	457,20	516,33
24	38G3	865,7	420,5	1,327	2743,68	37,23	52,93	1021,55	1452,20
24	38G4	1034,8	233,8	2,040	1185,78	28,96	68,59	343,35	813,33
24	39G2	406,1	155,7	1,491	424,00	63,10	23,59	267,57	100,02
24	39G3	765,0	355,8	2,246	1211,67	40,78	58,27	494,13	706,05
24	39G4	524,8	264,7	1,762	788,56	15,55	84,41	122,59	665,64
	Total	**5664,5**			**9332,29**			**3800,17**	**5076,92**
22-24	**Total**	**8681,7**			**13641,76**			**5730,40**	**7175,02**
21-24	**Total**	**13071,2**			**27607,66**			**5944,53**	**8742,47**

Table 6 Estimated numbers (millions) of herring RV "SOLEA" October 2004

Sub-division	Rectangle/ W-rings	0	1	2	3	4	5	6	7	8+	Total
21	41G1	5,68	5,25	0,85	0,02	0,04	0,04				11,88
21	41G2	45,25	24,96	2,43	0,46	0,49	1,35				74,94
21	42G1	6,39	24,73	8,04	0,98	0,57	0,12				40,83
21	42G2	0,24	1,02	0,29							1,55
21	43G1	11,48	27,73	10,07	0,49	0,61	0,06				50,44
21	44G0	1,61	0,25	0,06	0,01		0,01				1,94
21	44G1	19,21	11,29	1,47	0,16	0,16	0,25				32,54
	Total	89,86	95,23	23,21	2,12	1,87	1,83	0,00	0,00	0,00	214,12
22	37G1	618,55	73,43	30,12	3,55	5,01	1,62	0,74			733,02
22	37G3	141,06	35,08	13,04	1,62	0,93					191,73
22	38G1	40,37	14,51	6,25	0,63	0,74	0,07	0,07			62,64
22	39F9	0,20	0,05	0,02							0,27
22	39G0	20,20		0,94			0,76	0,76			22,66
22	39G1	5,89	2,38	0,92							9,19
22	40G0	0,71	1,13	0,24		0,04					2,12
	Total	826,98	126,58	51,53	5,80	6,72	2,45	1,57	0,00	0,00	1021,63
23	40G2	0,00	258,89	234,97	134,85	81,45	74,20	60,37	14,00	9,53	868,26
23	41G2	0,00	23,06	13,95	2,71	0,39	0,11	0,13		0,01	40,36
	Total	0,00	281,95	248,92	137,56	81,84	74,31	60,50	14,00	9,54	908,62
24	37G2	30,40	8,93	2,96	1,96	0,65	0,59	0,10		0,01	45,60
24	37G3	528,08	1,48	2,00	1,16	0,28	0,23	0,19		0,05	533,47
24	37G4	282,07	74,56	53,32	48,95	24,07	21,29	6,03	3,33	1,10	514,72
24	38G2	364,16	52,27	17,92	12,97	4,59	4,41	0,77	0,12		457,21
24	38G3	758,57	127,10	61,65	40,97	14,27	13,40	3,76	1,29	0,53	1021,54
24	38G4	54,65	107,6	73,94	54,05	23,29	20,08	6,38	2,52	0,81	343,35
24	39G2	198,67	41,74	11,02	10,01	2,82	2,94	0,15	0,22		267,57
24	39G3	143,49	120,52	98,09	71,66	25,98	22,02	6,99	4,48	0,91	494,14
24	39G4	23,80	45,08	24,03	16,77	5,74	5,10	1,13	0,60	0,34	122,59
	Total	2383,89	579,31	344,93	258,50	101,69	90,06	25,50	12,56	3,75	3800,19
22-24	Total	3210,87	987,84	645,38	401,86	190,25	166,82	87,57	26,56	13,29	5730,44
21-24	Total	3300,73	1083,07	668,59	403,98	192,12	168,65	87,57	26,56	13,29	5944,56

Table 7 Herring mean weight (g) per age group RV "SOLEA" October 2004

Sub-division	Rectangle/ W-rings	0	1	2	3	4	5	6	7	8+	Total
21	41G1	25,33	33,52	38,69	34,03	39,07	25,12				29,97
21	41G2	26,40	30,94	41,82	35,27	35,21	25,12				28,50
21	42G1	32,79	40,03	44,47	67,71	41,22	25,12				40,41
21	42G2	36,19	56,37	59,73							53,84
21	43G1	31,04	42,48	56,15	43,27	39,18	25,12				42,55
21	44G0	17,03	33,03	49,22	54,00		25,12				20,33
21	44G1	24,56	31,08	32,39	34,03	34,03	25,12				27,27
	Total	26,84	37,10	48,49	52,10	38,32	25,12	0,00	0,00	0,00	34,09
22	37G1	9,03	24,36	26,51	30,76	41,08	66,97	43,33			11,77
22	38G0	8,90	23,52	24,67	39,60	28,69					13,00
22	38G1	10,39	25,42	28,74	32,78	35,41	43,33	43,33			16,29
22	39F9	9,94	22,83	21,07							13,18
22	39G0	10,41		37,05			43,33	43,33			13,71
22	39G1	12,06	23,81	24,81							16,38
22	40G0	6,38	26,80	25,55		30,58					19,93
	Total	9,13	24,26	26,47	33,45	38,68	58,96	43,33	0,00	0,00	12,38
23	40G2	0,00	53,42	76,87	117,39	162,05	174,06	181,30	181,68	186,68	102,62
23	41G2	0,00	52,26	68,96	89,19	119,06	150,77	131,37		110,00	61,72
	Total	0,00	53,33	76,43	116,83	161,85	174,03	181,19	181,68	186,60	100,80
24	37G2	9,21	28,97	30,99	30,15	34,00	33,55	44,77		80,00	16,15
24	37G3	5,27	28,33	48,18	54,70	67,68	62,37	69,17		84,00	5,69
24	37G4	5,85	32,76	55,92	73,94	97,86	96,81	99,31	117,32	93,55	31,47
24	38G2	8,67	30,22	38,65	38,61	38,58	37,14	42,48	71,32		13,80
24	38G3	6,79	31,88	44,96	49,51	51,53	53,56	70,18	70,80	92,45	15,53
24	38G4	11,68	33,09	52,78	65,07	81,49	81,21	81,51	111,31	92,59	46,67
24	39G2	10,30	28,36	34,50	34,40	37,95	30,57	39,68	72,01		15,60
24	39G3	10,26	33,38	55,97	66,65	80,24	83,43	93,63	117,81	96,15	42,40
24	39G4	10,94	32,32	47,32	53,26	56,21	55,01	55,08	70,50	173,53	36,82
	Total	7,32	32,11	50,86	61,13	75,93	75,67	84,54	108,04	100,88	23,11
22-24	Total	7,78	37,16	58,77	79,80	111,57	119,24	150,58	146,86	162,42	33,51
21-24	Total	8,30	37,15	58,42	79,65	110,86	118,22	150,58	146,86	162,42	33,54

Table 8 Herring total biomass (t) per age group RV "SOLEA" October 2004

Sub-division	Rectangle/ W-rings	0	1	2	3	4	5	6	7	8+	Total
21	41G1	143,9	176,0	32,9	0,7	1,6	1,0				356,1
21	41G2	1194,6	772,3	101,6	16,2	17,3	33,9				2135,9
21	42G1	209,5	989,9	357,5	66,4	23,5	3,0				1649,8
21	42G2	8,7	57,5	17,3							83,5
21	43G1	356,3	1178,0	565,4	21,2	23,9	1,50				2146,3
21	44G0	27,4	8,3	3,0	0,5		0,3				39,5
21	44G1	471,8	350,9	47,6	5,4	5,4	6,3				887,4
	Total	2412,2	3532,9	1125,3	110,4	71,7	46,0	0,0	0,0	0,0	7298,5
22	37G1	5585,5	1788,8	798,5	109,2	205,8	108,5	32,1			8628,4
22	38G0	1255,4	825,1	321,7	64,2	26,7					2493,1
22	38G1	419,4	368,8	179,6	20,7	26,2	3,0	3,0			1020,7
22	39F9	2,0	1,1	0,4							3,5
22	39G0	210,3		34,8			32,9	32,9			310,9
22	39G1	71,0	56,7	22,8							150,5
22	40G0	4,5	30,3	6,1		1,20					42,1
	Total	7548,1	3070,8	1363,9	194,1	259,9	144,4	68,0	0,0	0,0	12649,2
23	40G2	0,0	13829,9	18062,1	15830,0	13199,0	12915,3	10945,1	2543,5	1779,1	89104,0
23	41G2	0,0	1205,1	962,0	241,7	46,4	16,6	17,1		1,1	2490,0
	Total	0,0	15035,0	19024,1	16071,7	13245,4	12931,9	10962,2	2543,5	1780,2	91594,0
24	37G2	280,0	258,7	91,7	59,1	22,1	19,8	4,5		0,8	736,7
24	37G3	2783,0	41,9	96,4	63,5	19,0	14,3	13,1		4,2	3035,4
24	37G4	1650,1	2442,6	2981,7	3619,4	2355,5	2061,1	598,8	390,7	102,9	16201,6
24	38G2	3157,3	1579,6	692,6	500,8	177,1	163,8	32,7	8,6		6312,5
24	38G3	5150,7	4051,9	2771,8	2028,4	735,3	717,7	263,9	91,3	49,0	15860,0
24	38G4	638,3	3561,5	3902,6	3517,0	1897,9	1630,7	520,0	280,5	75,0	16023,5
24	39G2	2046,3	1183,7	380,2	344,3	107,0	89,9	6,0	15,8		4173,2
24	39G3	1472,2	4023,0	5490,1	4776,1	2084,6	1837,1	654,5	527,8	87,5	20952,9
24	39G4	260,4	1457,0	1137,1	893,2	322,6	280,6	62,2	42,3	59,0	4514,4
	Total	17438,3	18599,9	17544,2	15801,8	7721,1	6815,0	2155,7	1357,0	378,4	87811,4
22-24	Total	24986,4	36705,7	37932,2	32067,6	21226,4	19891,3	13185,9	3900,5	2158,6	192054,6
21-24	Total	27398,6	40238,6	39057,5	32178,0	21298,1	19937,3	13185,9	3900,5	2158,6	199353,1

Table 9 Estimated numbers (millions) of sprat RV "SOLEA" October 2004

Sub-division	Rectangle/ Age group	0	1	2	3	4	5	6	7	8+	Total
21	41G1	9,37	20,80	1,51	1,04	0,07					32,79
21	41G2	17,65	17,60	4,03	2,59	0,51		0,08			42,46
21	42G1	0,03	0,10	0,13	0,12	0,02		0,01			0,41
21	42G2										0,00
21	43G1	24,38	12,16	11,20	12,80	5,67	0,64	0,65			67,50
21	44G0	194,62	9,16	1,11	0,73	0,13					205,75
21	44G1	1061,45	109,37	29,78	14,88	2,80		0,25			1218,53
	Total	1307,50	169,19	47,76	32,16	9,20	0,64	0,99	0,00	0,00	1567,44
22	37G1	6,69	1012,98	120,08	48,66	7,86	1,78		2,12		1200,17
22	38G0	15,64	345,06	36,92	12,40	2,50	0,23				412,75
22	38G1		36,97	3,73	0,85	0,08	0,02				41,65
22	39F9	118,08	9,16	0,19	0,02						127,45
22	39G0	6,80	14,40	1,21	0,25						22,66
22	39G1	45,97	44,03	8,06	2,13	0,44	0,44				101,07
22	40G0	114,89	10,95	0,46	0,02						126,32
	Total	308,07	1473,55	170,65	64,33	10,88	2,47	0,00	2,12	0,00	2032,07
23	40G2	0,76	32,58	11,62	11,45	6,23	1,94	0,22			64,80
23	41G2	0,30	0,71	0,12	0,11	0,04	0,02				1,30
	Total	1,06	33,29	11,74	11,56	6,27	1,96	0,22	0,00	0,00	66,10
24	37G2	0,65	205,71	11,99	0,61	0,88	0,05	0,06	0,03	0,03	220,01
24	37G3	110,94	41,95	0,95							153,84
24	37G4	163,60	248,78	21,50	7,45	5,80	0,97	0,75	0,33	0,33	449,51
24	38G2	9,50	445,97	39,99	8,90	9,47	0,89	1,05	0,28	0,28	516,33
24	38G3	263,26	1067,68	84,06	15,43	16,81	2,11	1,94	0,46	0,46	1452,21
24	38G4	2,73	609,88	98,21	53,10	32,08	9,07	5,05	1,60	1,60	813,32
24	39G2	0,85	88,19	7,63	1,01	2,08	0,07	0,11	0,04	0,04	100,02
24	39G3	20,68	514,08	86,49	42,14	30,84	5,44	4,42	0,98	0,98	706,05
24	39G4	0,53	468,64	90,86	55,18	33,35	6,84	6,39	1,93	1,93	665,65
	Total	572,74	3690,88	441,68	183,82	131,31	25,44	19,77	5,65	5,65	5076,94
22-24	Total	881,87	5197,72	624,07	259,71	148,46	29,87	19,99	7,77	5,65	7175,11
21-24	Total	2189,37	5366,91	671,83	291,87	157,66	30,51	20,98	7,77	5,65	8742,55

Table 10 Sprat mean weight (g) per age group RV "SOLEA" October 2004

Sub-division	Rectangle/ Age group	0	1	2	3	4	5	6	7	8+	Total
21	41G1	3,59	14,85	16,97	15,48	18,06					11,76
21	41G2	5,68	16,42	19,08	20,19	20,94		22,03			12,50
21	42G1	4,48	19,88	21,62	22,74	22,47		22,03			20,25
21	42G2										0,00
21	43G1	3,72	18,23	22,07	23,96	24,61	29,48	22,03			15,39
21	44G0	3,18	15,71	17,90	17,22	18,06					3,88
21	44G1	3,52	17,56	18,52	18,74	18,77		22,03			5,37
	Total	3,50	17,06	19,34	20,81	22,48	29,48	22,03	0,00	0,00	5,94
22	37G1	4,53	11,28	12,09	13,41	15,96	15,06		28,00		11,48
22	38G0	3,12	10,51	11,54	14,00	19,23	15,16				10,48
22	38G1		10,53	11,21	12,62	15,50	15,43				10,65
22	39F9	3,18	6,32	10,38	11,20						3,41
22	39G0	2,63	10,46	10,98	11,72						8,16
22	39G1	3,08	10,21	13,14	13,89	15,43	15,43				7,32
22	40G0	3,64	6,92	8,63	11,20						3,94
	Total	3,35	10,98	11,98	13,52	16,69	15,14	0,00	28,00	0,00	10,04
23	40G2	3,50	14,64	18,68	20,36	21,16	20,34	32,00			17,10
23	41G2	2,00	14,88	20,00	20,66	16,04	24,65				13,04
	Total	3,08	14,65	18,69	20,36	21,13	20,38	32,00	0,00	0,00	17,02
24	37G2	3,79	11,14	11,59	15,66	14,26	15,52	15,55	16,79	16,79	11,17
24	37G3	3,94	8,21	10,78							5,15
24	37G4	3,96	10,83	13,19	15,90	14,95	16,63	15,91	16,79	16,79	8,61
24	38G2	3,14	11,82	12,81	15,48	14,20	16,69	15,31	16,79	16,79	11,86
24	38G3	3,94	11,40	12,64	15,71	14,08	17,32	15,59	16,79	16,79	10,22
24	38G4	5,18	12,0	14,12	15,96	15,12	16,61	16,33	16,79	16,79	12,68
24	39G2	2,52	11,90	12,61	15,36	13,84	15,52	15,13	16,79	16,79	11,95
24	39G3	2,96	12,37	13,96	15,52	14,75	16,39	15,55	16,79	16,79	12,64
24	39G4	5,73	12,11	14,31	15,78	15,61	16,74	15,91	16,79	16,79	12,99
	Total	3,90	11,69	13,58	15,75	14,92	16,66	15,87	16,79	16,79	11,26
22-24	Total	3,71	11,51	13,24	15,41	15,31	16,78	16,04	19,86	16,80	10,97
21-24	Total	3,59	11,68	13,67	16,00	15,73	17,05	16,33	19,86	16,80	10,07

Table 11 Sprat total biomass (t) per age group RV "SOLEA" October 2004

Sub-division	Rectangle/ Age group	0	1	2	3	4	5	6	7	8+	Total
21	41G1	33,6	308,9	25,6	16,1	1,3					385,5
21	41G2	100,3	289,0	76,9	52,3	10,7		1,8			531,0
21	42G1	0,1	2,0	2,8	2,7	0,4		0,2			8,2
21	42G2										0,0
21	43G1	90,7	221,7	247,2	306,7	139,5	18,9	14,3			1039,0
21	44G0	618,9	143,9	19,9	12,6	2,3					797,6
21	44G1	3736,3	1920,5	551,5	278,9	52,6		5,5			6545,3
	Total	4579,9	2886,0	923,9	669,3	206,8	18,9	21,8	0,0	0,0	9306,6
22	37G1	30,3	11426,4	1451,8	652,5	125,4	26,8		59,4		13772,6
22	38G0	48,8	3626,6	426,1	173,6	48,1	3,5				4326,7
22	38G1	0,0	389,3	41,8	10,7	1,2	0,3				443,3
22	39F9	375,5	57,9	2,0	0,2						435,6
22	39G0	17,9	150,6	13,3	2,9						184,7
22	39G1	141,6	449,5	105,9	29,6	6,8	6,8				740,2
22	40G0	418,2	75,8	4,0	0,2						498,2
	Total	1032,3	16176,1	2044,9	869,7	181,5	37,4	0,0	59,4	0,0	20401,3
23	40G2	2,7	477,0	217,1	233,1	131,8	39,5	7,0			1108,2
23	41G2	0,6	10,6	2,4	2,3	0,6	0,5				17,0
	Total	3,3	487,6	219,5	235,4	132,4	40,0	7,0	0,0	0,0	1125,2
24	37G2	2,5	2291,6	139,0	9,6	12,5	0,8	0,9	0,5	0,5	2457,9
24	37G3	437,1	344,4	10,2							791,7
24	37G4	647,9	2694,3	283,6	118,5	86,7	16,1	11,9	5,5	5,5	3870,0
24	38G2	29,8	5271,4	512,3	137,8	134,5	14,9	16,1	4,7	4,7	6126,2
24	38G3	1037,2	12171,6	1062,5	242,4	236,7	36,5	30,2	7,7	7,7	14832,5
24	38G4	14,1	7288,1	1386,7	847,5	485,0	150,7	82,5	26,9	26,9	10308,4
24	39G2	2,1	1049,5	96,2	15,5	28,8	1,1	1,7	0,7	0,7	1196,3
24	39G3	61,2	6359,2	1207,4	654,0	454,9	89,2	68,7	16,5	16,5	8927,6
24	39G4	3,0	5675,2	1300,2	870,7	520,6	114,5	101,7	32,4	32,4	8650,7
	Total	2234,9	43145,3	5998,1	2896,0	1959,7	423,8	313,7	94,9	94,9	57161,3
22-24	Total	3270,5	59809,0	8262,5	4001,1	2273,6	501,2	320,7	154,3	94,9	78687,8
21-24	Total	7850,4	62695,0	9186,4	4670,4	2480,4	520,1	342,5	154,3	94,9	87994,4

Annex 4: Manual for herring acoustic surveys in ICES Divisions III, IV and VIa

Version 3.2

January 2004

1 Transducer and calibration

The standard frequency used for the survey is 38 kHz. In order of preference, it is advisable to mount the transducer in a dropped keel, a towed body or on the hull of the vessel. Steps should be taken to ensure that the flight of the towed body is stable and level, this should ideally be achieved with the aid of a motion sensor.

Calibration of the transducer should be conducted at least once during the survey. Calibration procedures are described in the Simrad EK500 and EK60 manuals and by Foote *et al.* (1987). Ideally, the procedure as described in the Simrad manuals should be followed with certain exceptions (see below). Minimum target range for the calibration of a split beam 38 kHz echosounder is 10 metres, although greater distances are recommended (about 20 m), particularly with hull mounted transducers, where centering of the target below the transducer is facilitated if the target is suspended at a greater depth. An average integrated value for the sphere, taken when it is centrally located, should be taken as the measured NASC. The calculations should be then performed a number of times (two or three) in an iterative procedure such that the values of measured NASC and theoretical NASC should converge, as described in the Simrad manual. A choice is then made as to whether the S_v Transducer gain should be changed, rendering absolute **NASCs**, or alternatively, the S_v Transducer gain can be unaltered and a correction factor applied to the **NASCs**. Only one strategy should be applied during a cruise, such that for example, the latter option is to be employed when calibration is only possible after the cruise has started. If possible, the transducer should be calibrated both at the beginning and the end of the survey; with a mean correction factor applied to the data. If a new calibration differs by more than 0.4 dB, the system should be thoroughly inspected.

There are a number of parameters that require knowledge of the speed of sound in water. It is therefore recommended that appropriate apparatus be used to determine the temperature and salinity of the water so that sound speed can be calculated (see MacLennan and Simmonds 1992 for equations) and entered into the chosen echosounder.

It is evident that all versions of the EK500 up to and including version 5.* do not take account of the receiver delay in the calculation of target range (see Fernandes and Simmonds 1996). This is particularly important when calibrating at short range (10 m) as it can lead to a systematic underestimate of biomass of 3%. The correct range to the target should therefore be applied in calibration (see below). The equivalent two way beam angle (ψ) should also be corrected for sound speed according to Bodholt (1999).

Currently there is insufficient experience with the EK60 system to provide a complete list of variables that must be held constant to maintain comparable survey conditions. This will be

developed over the next year. Presently operators are requested to identify the equivalent features to those listed for the EK500 and to ensure the settings for these are held constant.

There are a number of changes in system specification between EK500 and EK60. Some of these are expected to provide improvements for the user. For example the method for computing range to a target is expected to be an improvement, following a presentation at the FAST WG, 2003. However, concerns were raised about the possibility of range dependent effects in measuring target echoes during calibration where the target is held at a fixed range. The sampling rate of 4 samples per pulse length synchronised to the transmit time may give different echo integral results depending on the relative timing of samples and the echo. These problems have been found with very short pulse systems such as multibeam sounders (Simmonds *et al*,2000). This will be checked with Simrad before FAST WG in April, 2004.

A number of calibration parameters and results should be included as a minimum in the survey report. These are tabulated in Table 1. Some of these parameters are not included in the Simrad operator manuals and are defined as follows.

Table 1. Calibration report sheet.

CALIBRATION REPORT			
Frequency (kHz)			
Echosounder type			
Transducer serial no.			
Vessel			
Date			
Place			
Latitude			
Longitude			
Bottom depth (m)			
Temperature (°C)			
Salinity (ppt)			
Speed of sound (m.s-1)			
TS of sphere (dB)			
Pulse duration (s)			
Equivalent 2-way beam angle (dB)			
Receiver delay (s)*			
Default S_v transducer gain			
Iteration no.	1	2	3
Time			
Range to half peak amplitude (m)*			
Range to sphere (m)			
Theoretical NASC (m2.nmile-2)			
Measured NASC (m2.nmile-2)			
Calibated S_v transducer gain			
DeltaG = New gain - Old gain			
Correction factor for pre-calibration NASCs on EK			
Correction factor for pre-calibration S_v's			

CALIBRATION REPORT			
Default TS transducer gain			
Iteration no.	1	2	3
Time			
Measured TS			
Calibrated TS gain			

Note:* Parameters may not be necessary when using the Simrad EK60 echosounder.

Receiver delay = $\mathbf{t_{del}}$. This is very specific to the echosounder bandwidth (due to the band pass filters), to the transducer bandwidth, and to a lesser extent to the standard target and the pulse duration which may affect the peak value. Target, bandwidth and pulse duration specific values for the Simrad EK400 are given in Foote *et al.* (1987, their Table 1). Values for the EK500 are not available, but Simrad recommend using 3 sample distances (10 cm) in wide bandwidth (3 kHz). This equates to a value of $\mathbf{t_{del}}$ of 0.00039 s at 38 kHz.

Range to half peak amplitude = $\mathbf{r_m}$. This is the measured range between the start of the transmit pulse and the point on the leading edge of the echo at which the amplitude has risen to half the peak value (m). This is usually determined from experience with the readings from an oscilloscope display. For example, for a 38.1 mm tungsten carbide standard target insonified at 38 kHz at a colour threshold setting of -70 dB (S_v colour min.), it is measured as from the top of the transmit pulse to the leading edge of the pink colour on the target sphere echo.

Range to sphere = $\mathbf{r_{sph}}$ may then be calculated from:

$$\mathbf{r_{sph} = r_m - ((c \times t_{del})/2)}$$

Correction factor for pre-calibration NASCs on EK500 = K = 1/(10^(DeltaG/5))

Where:

DeltaG = Calibrated S_v Transducer Gain – Default S_v Transducer gain

Correction factor for pre-calibration S_v's on EK = $10(\log_{10}(s_A$ correction factor))

2 Instrument settings during the survey (for the Simrad EK500).

For most settings the default values from the manufacturer may be used, or alternatively the operator can choose his own settings depending on the circumstances. It is recommended that each year the same settings be used for the printer in order to facilitate comparison of echograms.

There are a number of settings that are set during calibration that have a direct influence on the fundamental operation for echo-integration and target strength measurement and therefore affect logged data. Once set according to the particular transducer, these should **NOT** be changed during the survey. These important settings are listed in Table 2.

The minimum detection level on the bottom detection menu depends on the water depth and bottom type. At depths less than 100 m and hard bottoms, the threshold level may be set at –30 dB: this will enable the instrument to detect dense schools close to the bottom. At depths greater than 100 m or soft bottoms, the threshold has to be lowered (-60 dB), otherwise the upper layer of the bottom will be counted as fish as well.

In the operation menu it is recommended to use as short a regular ping interval as possible. It is not advisable to use a ping rate of 0.0 seconds (variable interval according to depth) as this brings about irregular sample (ping) numbers per equivalent distance sampling unit which may bias the analysis.

A bottom margin of the order of 0.5 m is recommended for the layer menus. In shallow areas (<100 m) this can be somewhat reduced.

The S_v minimum for echo integration and presentation of the echogram should be set at –70 dB. Increasing the S_v minimum will reduce the integration values if the herring occur in scattering layers or in loose aggregations. This setting is less important when the data is collected by a post processing package such as Simrads BI500 or Sonardata's echoview software as the threshold can be determined in post processing.

Table 3 lists those settings which are important for target strength measurements. It should be noted however, that the transducer depth setting may affect the calibration if the range to target is read form the echo sounder.

In the future it is the intention of the users to provide a list of survey settings for other echosounder systems, namely the EK60. Users are asked to compile a list of variables over the coming year that must be held constant to maintain comparable survey conditions. The absorption coefficient on the EK60 can be set to 1 decimal place. Calculations using Temperature of 10.5 degrees, salinity of 34.5 ppt depth of 60m, ph 7.5 gives absorption of 9.8dB/km at 38kHz (from Echoview calculator using Francois and Garrison (1982) formula).

3 Survey design

Transects are spaced at a maximum distance of 15 nautical miles. Two aspects should be considered in choosing the direction of the transects. Transects should preferably run perpendicular to the greatest gradients in fish density, which are often related to gradients in bottom topography and hydrography. This means that transects will normally run perpendicular to the coast. The second aspect considers the direction in which the fish are migrating. If there is evidence of rapid displacement of the fish throughout the area, it is advisable to run the transects parallel to the direction of the migration. This survey design will minimise the bias caused by migration. A detailed simulation study of the effects of motion on the survey design of North Sea herring is available in Rivoirard *et al*. (2000).

Ship's speed during the survey is typically 10–12 knots. At higher speeds, problems are encountered with engine noise or propeller cavitation. These problems, however, depend on the vessel. In rough weather, the ship's speed may be reduced in order to avoid problems with air bubbles under the ship, although this problem is alleviated by the use of a dropped keel.

If species identification depends on recognition of schools on the echogram (see section 4.3), the survey will have to be interrupted during periods in the 24 hour cycle when the schools disperse. This occurs during the hours of darkness, depending on the area. When schools disperse during darkness, some of the herring may rise to the surface and get above the transducer. During this time (23:00 – 03:00 around Shetland / Orkney for example) it is advisable to cease surveying. It is recommended – if time permits during the survey – to study the diurnal behaviour of fish schools, in order to determine at what time during the 24hr period the fish may not be available to the echosounder.

A review of survey design will be considered at the 2005 PGHERS meeting after the ICES led survey design workshop WKSDDA, findings are taken into consideration (workshop due in June 2004, Aberdeen).

Table 2. Important calibration and survey settings for the EK500, which should not be changed during the survey. Those marked * indicate settings that are specific to the transducer / transceiver.

/TRANSCEIVER MENU/TRANSCEIVER-1 MENU/BANDWIDTH
/TRANSCEIVER MENU/TRANSCEIVER-1 MENU/PULSE LENGTH
/TRANSCEIVER MENU/TRANSCEIVER-1 MENU/MAX. POWER*
/TRANSCEIVER MENU/TRANSCEIVER-1 MENU/2-WAY BEAM ANGLE*
/TRANSCEIVER MENU/TRANSCEIVER-1 MENU/SV TRANSD. GAIN*
/TRANSCEIVER MENU/TRANSCEIVER-1 MENU/TS TRANSD. GAIN*
/TRANSCEIVER MENU/TRANSCEIVER-1 MENU/ABSORPTION COEF.*
/OPERATION MENU/TRANSMIT POWER
/BOTTOM DETECTION MENU/BOTTOM DETECTION-1 MENU/MINIMUM DEPTH
/BOTTOM DETECTION MENU/BOTTOM DETECTION-1 MENU/MAXIMUM DEPTH
/BOTTOM DETECTION MENU/BOTTOM DETECTION-1 MENU/MINIMUM LEVEL
/SOUND-VELOCITY MENU/PROFILE TYPE
/SOUND-VELOCITY MENU/VELOCITY MIN
/SOUND-VELOCITY MENU/ VELOCITY MAX

Table 3. Settings affecting tracking or locating objects within the beam for the EK500. Those marked * indicate settings that are specific to the transducer / transceiver.

/TRANSCEIVER MENU/TRANSCEIVER-1 MENU/TRANSDUCER DEPTH
/TRANSCEIVER MENU/TRANSCEIVER-1 MENU/ANGLE SENS.ALONG*
/TRANSCEIVER MENU/TRANSCEIVER-1 MENU/ANGLE SENS.ATHW.*
/TRANSCEIVER MENU/TRANSCEIVER-1 MENU/ALONGSHIP OFFSET*
/TRANSCEIVER MENU/TRANSCEIVER-1 MENU/ATHW.SHIP OFFSET*
/TS DETECTION MENU/TS DETECTION-1 MENU/MIN. VALUE
/TS DETECTION MENU/TS DETECTION-1 MENU/MIN. ECHO LENGTH
/TS DETECTION MENU/TS DETECTION-1 MENU/MAX. ECHO LENGTH
/TS DETECTION MENU/TS DETECTION-1 MENU/MAX. GAIN COMP.
/TS DETECTION MENU/TS DETECTION-1 MENU/MAX. PHASE DEV.
/MOTION SENSOR MENU/HEAVE
/MOTION SENSOR MENU/ROLL
/MOTION SENSOR MENU/PITCH
/MOTION SENSOR MENU/TD-1 ATH. OFFSET
/MOTION SENSOR MENU/TD-1 ALO. OFFSET
/MOTION SENSOR MENU/TD-2 ATH. OFFSET
/MOTION SENSOR MENU/TD-2 ALO. OFFSET
/MOTION SENSOR MENU/TD-3 ATH. OFFSET
/MOTION SENSOR MENU/TD-3 ALO. OFFSET

4 Species allocation of acoustic records

Different methods of species allocation are being used in the various areas. The method used depends largely upon the schooling behaviour of the herring and sprat, and the mixing with other species. In the North Sea and Division VIa the species allocation is based mainly on the identification of individual schools on the echogram. In the Skagerrak-Kattegat and Baltic the identification is based on composition of trawl catches. Both methods are described in more detail below.

Only persons who are familiar with the area and the way fish aggregations of different species occur in the area should scrutinise the echo records. The way species aggregate either in schools or in layers, mixed or not mixed with other species is very different per (sub) area. Allocation of **NASCs** to species always needs support of trawl-information. However, one has to be aware that the catch composition is influenced by the fish behaviour in response to the net. It is therefore necessary to judge whether the catch-composition is a reflection of the real species composition and whether the allocated percentage of sprat/herring needs correction.

It is obvious that during the scrutinising process subjective decisions have to be made. However, joint sessions of scientists from participating countries who scrutinised each others data has shown that the deviation between the estimated quantities of herring are within the range of 10%, provided that trawl information of the recordings is available (Reid *et al.* 1998).

4.1 Using the EK500 printer output and/or post processing systems

Scrutiny of the echo recordings may be done by measuring the increment of the integrator line on the printed paper output of the echogram. This is a simple and efficient way of scrutinising if one deals with single species schools and if there are no problems with bottom integration. Post processing systems may then be used as backup. More generally, computer based post-processing systems such as the Simrad BI500 or Sonar data Echoview systems are currently being used for scrutinising. The printer output is mostly used as a visual backup.

It is recommended that one depth-range is used for the whole area in the printer output and on post-processing systems. This will ensure that similar echo traces from all parts of the survey area will have the same appearance and hence are visually more comparable.

Echoview post-processing system

The following section describes preliminary protocol for the use of Echoview for processing as used in FRS Marine Lab in Aberdeen. It is expected that this will develop further.

Start of analysis load template

Load template
C:\Program files\sonardata\echoview2\templates\NS2001template.ev

1) Make one day file set

Goto FILESET window
---Add one days file set to include 0200 to 2200

Save as using cruise and daily file name to d:\s1002\mainevfiles\ cruise_date.ev
(e.g., S1002_280602.ev)

2) Cruise track process

View ------- cruise track ------- primary fileset ----- SV Q1 telegram T1
Cruise track --------process
Just check to see if cruise track is in the correct place and OK
If not this might be due to freak start so add extra file at the beginning of file set
Or edit cruise processing
View evfile properties cruise track
Save

3) Assign line

First ensure that you open SV Q1 Telegrams T1----
Go to FILESET window Raw Variables section. Highlight SV Q1 Telegram T1
click Echogram-----this opens the file window on the screen and allows you to update the lines and save as detailed below.
Go Primary fileset SV Q1 Telegram T1 window
View ---- evfile properties ----- lines ----- bottom ----- new

Check ----- Existing line ----------select---------primary fileset sv Q1 telegrams T1
Check --------Overwrite existing line ----------select -------- bottom
OK

Save

4) Block out data not required

On the primary fileset SVQ1 telegrams T1
Use vertical band tool (5) --------- select region (mouse and keys) --------- define region (right mouse button over region) -------- trawl (bad data) --------- close

Sections to block out:

1) Period before 0200 (to check data start is correct as well)
2) All trawls start block at end of run before fishing (take start position here from echoview) end at point where track crosses start position on restarted survey
3) Any other periods not to be included because data in not to analysed; such as: extra stations, parts of track when ship is steaming or between transect sections not to be included
4) Period after 2200 (and to check data at end is included) Note: cntl right arrow steps screen to right as you drag with mouse

Save

Check to if all files are there (somehow! Check for Continuous Cruise track and or smooth echograms etc.) IF you find files missing—gaps in data or start too late or finish too early load these and go back to **3) ASSIGN LINE**

ALWAYS make sure all the data are in and 'bottom' assigned before next step.

Adding data or changing files at this point requires the following work to be redone.

4.2 Allocation to classified schools

In the western and northern part of the area covered by the survey, most of the herring occur in well-defined schools, often of a characteristic shape as pillar-shaped large dense schools or as layers of very small and dense school at the surface. In the northern and central part, schools of Norway pout and herring are difficult to distinguish from each other. In low density area's of the western area mixed layers and aggregation of small schools consisting of gadoids and herring may occur.

Sprat marks in the North Sea and VIa appear mostly as quite large, typical, pillar-shaped marks, usually slightly more diffuse than herring and usually in shallow water.

Use of trawl Information

The allocation of echo-traces to species is governed by the results of trawl hauls. In many cases these are considered together with observations from the netsonde and the echogram during the haul. In some cases it is not possible to assign schools (echo traces) to species directly e.g., where the haul contains a mixture of species and no clear differentiation can be made between the observed schools. In such situations the integral is assigned to a species mixture category according to the trawl results. This is defined as percentage by number or weight taking into account the correct conversion to scattering length (see section 6.2); post processing software is then used to apply weights and lengths. There are two main problems with using trawl data to define "acoustic" mixtures:

- Different species are known to have different catchabilities, so the exact proportions in the trawl are unlikely to be an exact sample of the true mixture. For instance herring are likely to be faster swimmers than Norway pout.
- Herring are often found in a mixture with "0" group pout, which are mostly lost through the meshes. This may also occur with other small gadoids. In this case the exact proportions are unavailable and the operator must make an informed guess.

Thresholding to filter out plankton

An advantage of using a post-processing system like the BI500 and EchoView, is the ability to change the threshold-value of the received echo's. By changing the threshold the non-target-species (plankton in particular) can be filtered out. The threshold used may differ, depending on a variety of conditions, including the water depth (more care should be taken at greater depth) and the particular size of fish. Examples of conditions where certain thresholds have been applied are described below; they should not be used without verification. At the beginning of the survey it is advisable to find the right thresholds by isolating schools and changing the threshold.

In stratified waters (mainly in the northern - and north-eastern part of the survey area) there is often a layer of plankton in the upper 50 m. In this layer, very small, dense schools of herring may be found. Normally all the plankton is filtered out at –42 dB. The remaining **NASCs** may be assigned to herring if clear schools are still visible and, of course, trawl information indicates that herring are present. In the range of 30–60 m the same procedure may be used. Here **NASCs** are normally assigned to schools of fish after filtering out plankton by putting the threshold in the range of –48 to –51 dB. In the layer below 60 m a threshold of –54 to –60 dB may be applied. In the deeper parts of the area (>150m) a lower threshold than –60 dB may be applied. At these depths, often close to the bottom, herring schools are normally, larger and easier to recognise.

Use of other frequencies

The echosounder frequency routinely used in the North Sea echo survey is 38 kHz. However, data may be collected at 120 and 200 kHz. In some cases these can be used as an aid to identify marks to species. For instance, herring and mackerel may have different target strengths at different frequencies. Mackerel is believed to backscatter more strongly at 200 kHz than at 38 kHz, whilst for herring the reverse is the case. In the absence of good observations of such relationships, this approach should be used with caution.

To process the data for extraction of schools the variable computation method available in Echo View has been used at FRS Marine Lab. The method has been used in 2001–2003 and was developed under the EU program SIMFAMI. Previously when processing by hand (2000 and before) a small 'background' value for scattered fish was removed from integrator layers with many fish schools. It was noted that fish schools appear consistently on 38, 120 and 200kHz echograms while other features such as plankton may be strong on some frequencies and weak on others. The processing was

$$Sv_{used} = Sv38*[Sv_{38}+ Sv_{120}+Sv_{200} ** Blur>-170dB]$$

Where Blur is a convolution matrix

$$\begin{bmatrix} 1 & 2 & 1 \\ 2 & 1 & 2 \\ 1 & 2 & 1 \end{bmatrix}$$

The Blur convolution filter is chosen as a suitable smoothing function as previous experiences suggests it is well suited to the types of amplitude distributions expected from echoes from fish aggregations (Reid and Simmonds 1993). It provides a smoother spatial filter for filling in values in a school than either centred weighted or uniform averaging filters.

Use of single target TS distribution data

The SIMRAD EK500 used with a split-beam transducer allows the collection of TS values for all single targets detected in the beam. A TS distribution can then be produced for each EDSU. In some situations there may be two species present in an area with substantially different TS values, and this could be used to determine the species allocation. Again, this data must be used with caution. There are doubts about the precision of the TS detection algorithm, particularly in older firmware releases. By definition, single targets are unlikely to be detected from fish in schools. As schools are often the main subject for herring acoustic surveys, such data may be unrepresentative. However, where the survey encounters diffuse mixtures, there may be value in such data.

Use of image analysis techniques

The Marine Laboratory Aberdeen has developed an image processing system for post processing of echograms. This can extract a range school descriptors; energetic, morphometric and positional, which can be used to define the characteristics of schools of a particular species. Such systems have also been developed elsewhere and one example is available with Sonardata's Echoview post processing software. In general such systems can differentiate most observed schools to species; however, these are usually the schools which an experienced survey operator can also discriminate by more traditional methods. These systems are likely to become more invaluable in the future when they can be combined with multi-frequency data.

4.3 Allocation to mixed layers or mixed schools

Sometimes herring occur mixed with other species in aggregations of smaller schools. In this case, species allocation is based on the composition of trawl catches.

In the southern North Sea, Skagerrak, Kattegat and the Baltic, herring and sprat may occur in mixed schools. Those schools are separated from other fish using the standard scrutinising procedures (see above) and the allocation of the proportion of herring (spring and/or autumn spawners) and sprat is done afterwards on the basis of catch composition. Trawl catches within each stratum (or statistical rectangle) are combined to give an average species, stock, age and length composition of the clupeid fraction of the catch.

5 Biological sampling

5.1 Trawling

Species allocation of the acoustic records is impossible if no trawl information is available. The general rule is to make as many trawl hauls as possible, especially if echo traces are visible on the echosounder after a blank period. If surface schools are known to occur in the area it is often advisable to take occasional surface trawls even in the absence of any significant marks.

The principal objective is to obtain a sample from the school or the layer that appears as an echo trace on the sounder. The trawling gear used is of no importance as long as it is suitable to catch a sample of the target-school or layer. Some dimensions of the trawls used by the participants are given in Table 4.

Table 4. Characteristics of trawl gear used in the North Sea and Celtic Sea herring surveys. "Mesh sizes in all panels" are listed for panels from the mouth of the net to the cod end; the number of entries is not an indication of the number of panels as adjacent panels may have the same mesh size.

COUNTRY	VESSEL	POWER	CODE	NAME	TYPE	PANELS	HEADL	GROUNDR	SWEEPS	LENGTH	CIRCUM	MESH SIZES IN ALL PANELS						CODEND	HEIGHT	SPREAD (WINGS)
		kW			B/P	2/4	m	m	m	m	m	mm	mm	mm	mm	mm	mm	**mm**	m	m
DEN	DAN2																	**16**		
GFR	WAH3	2900	GOV	GOV	B	2	36.0	52.8	110.0	51.7	76.0	200	160	120	80	50			4	23
GFR	WAH3	2900	PS205	PSN205	P	4	50.4	55.4	99.5	84.3	205.0	400	200	160	80	50		**10**	15	28
GFR	SOL	588	AAL	Aalhopser	B	2	31.0	29.7	63.5	57.5	119.0	160	120	80	40				6	19
GFR	SOL	588	PS388	Krake	P	4	42.0	42.0	63.5	59.8	142.4	400	200	80				**10**	10	21
NED	TRI2	2940		2000 M Pel. Trawl	P	4	64.0	72.0	100.0	140.0	400	800	400	200	120	80		**20**	16	45
NOR	GOS	1700	3532	Akratral	P	4	72.0	72.0	160.0	130.0	486.4	3200	1620	400	200	100	38	**10**	33	
NOR	GOS	1700		[bottom trawl]	B															
SCO	SCO2	3000	PT160	Pel. Sampl. Trawl	P	4	38.0	38.0	70–115	87.0	256.0	800	600	400	200	100	38	**38**	12	32
IRE	CEX	3000	PMT	Pel. midwater trawl	P	4	58.0	58.0	55.0	40.0	330.0	3200	1600	400	200	100	50	**20**	15	45

During trawling it is important to take note of the traces on the echosounder and the netsonde in order to judge if the target-school entered the net or if some other traces “spoil” the sample. It is recommended that notes be made on the appearance and behaviour of fish in the net during every haul. If a target is missed during a haul, the catch composition should not be used for species allocation.

5.2 Biological sampling procedure

The fish sample obtained from the trawl catch is to be divided into species by weight and by number. Length measurements are taken to the 0.5 cm below for and herring (and to the whole cm below for other species). For herring and sprat either representative or length stratified samples are taken for maturity, age (otolith extraction) and weight.

Maturity should be determined according to the scales given in Tables 9 and 10, although reporting of the data varies according to participants (Table 8). The 8 point scale is based on Bowers and Holliday (1961).

6 Data analysis

This section describes the calculation of numbers and biomass by species from the echo-integrator data and trawl data. Most of this section is taken from Simmonds *et al.* 1992.

The symbols used in this section are defined in the text but for completeness they have been collated and are given below:

F_i	estimated area density of species i
K	equipment physical calibration factor
$<\sigma_i>$	mean acoustic cross-section of species i
E_i	partitioned echo-integral for species i
E_m	echo-integral of a species mixture
c_i	echo-integrator conversion factor for species i
TS	target strength
TS_n	target strength of one fish
TS_w	target strength of unit weight of fish
a_i, b_i	constants in the target strength to fish length formula
a_n, b_n	constants in formula relating TS_n to fish length
a_w, b_w	constants in formula relating TS_w to fish length
a_f, b_f	constants in the fish weight-length formula
L	fish length
W	weight
L_j	fish length at midpoint of size class j
f_{ij}	relative length frequency for size class j of species i
w_i	proportion of species i in trawl catches
A_k	area of the elementary statistical sampling rectangle k
Q	total biomass
Q_i	total biomass for species i

The objective is to estimate the density of targets from the observed echo-integrals. This may be done using the following equation from Foote *et al.* (1987):

$$F_i = \left(\frac{K}{< \sigma_i >} \right) E_i \quad \textbf{(1)}$$

The subscript i refers to one species or category or target. K is a calibration factor, $<\sigma_i>$ is the mean acoustic cross-section of species i, E_i is the mean echo-integral after partitioning and F_i is the estimated area density of species i. The quantity is the number or weight of species i, depending on whether σ_i is the mean cross-section per fish or unit weight. $c_i = (K/<\sigma_i>)$ is the integrator conversion factor, which may be different for each species. Furthermore, c_i depends upon the size-distribution of the insonified target, and if this differs over the whole surveyed area, the calculated conversion factors must take the regional variation into account.

K is determined from the physical calibration of the equipment, which is described in section 1 above. K does not depend upon the species or biological parameters. Several calibrations may be performed during a survey. The measured values of K or the settings of the EK500 may be different but they should be within 10% of one another. If two successive measurements are very different the cause should be investigated since the equipment may be malfunctioning. Otherwise, K should be taken as the average of two measurements before and after the relevant part of the survey.

6.1 Conversion factors for a single species

The mean cross-section $<\sigma_i>$ should be derived from a function which describes the length-dependence of the target-strength, normally expressed in the form:

$$TS = a_i + b_i Log_{10}(L) \quad \textbf{(2)}$$

Where a_i and b_i are constants for the i'th species, which by agreement with the other participants in the survey are given in Table 5.

Table 5. The recommended target strength relationships for herring surveys in the North Sea and adjacent waters.

	TARGET STRENGTH EQUATION COEFFICIENTS	
Species	**b_i**	**a_i**
Herring	20	-71.2
Sprat	20	-71.2
Gadoids	20	-67.5
Mackerel	20	-84.9
horse mackerel	20	-71.2

The equivalent formula for the cross-section is:

$$\sigma_i = 4\pi 10^{\left(\left(a_i + b_i Log(L) \right)/10 \right)} \quad \textbf{(3)}$$

The mean cross-section is calculated as the σ average over the size distribution of the insonified fish. Thus L_j is the mid-point of the j'th size class and f_{ij} is the corresponding frequency as deduced from the fishing samples by the method described earlier. The echo-integrator conversion factor is $c_i = K/\langle\sigma_i\rangle$. The calculation may be repeated for any species with a target strength function.

$$\langle \sigma_i \rangle = 4\pi \sum_j f_{ij} 10^{\left(\left(a_i + b_i Log(L_j)\right)/10\right)} \qquad \textbf{(4)}$$

Note that it is the cross-section that is averaged, not the target-strength. The arithmetic average of the target-strengths gives a geometric mean, which is incorrect. The term "mean target-strength" may be encountered in the literature, but this is normally the target-strength equivalent to $\langle\sigma_i\rangle$, calculated as $10\log_{10}(\langle\sigma_i\rangle/4\pi)$. Some authors refer to TS as $10\log(\sigma_{bs})$ the definition of σ is different from σ_{bs} and should not be confused.

6.2 Conversion factors for mixed species layers or categories

Sometimes several species are found in mixed concentrations such that the marks on the echogram due to each species cannot be distinguished. From inspection of the echogram, the echo-integrals can be partitioned to provide data for the mixture as one category, but not for the individual species. However, further partitioning to species level is possible by reference to the composition of the trawl catches (Nakken and Dommasnes, 1975).

Suppose E_m is the echo-integral of the mixture, and w_i is the proportion of the i'th species, calculated from fishing data. It is necessary to know the target-strength or the acoustic cross-section, which may be determined in the same manner as for single species above. The fish density contributed by each species is proportional to w_i. Thus the partitioned fish densities are:

$$F_i = \frac{w_i K}{\left(\sum_i w_i \langle\sigma_i\rangle\right)} E_m \qquad \textbf{(5)}$$

The w_i may be expressed as the proportional number or weight of each species, according to the units used for $\langle\sigma_i\rangle$ and c_i. Consistent units must be used throughout the analysis, but the principles are the same whether it is the number of individuals or the total weight that is to be estimated.

6.3 Using weight-length relationships

The abundance is expressed either as the total weight or the number of fish in the stock. When considering the structure of the stock, it is convenient to work with the numbers at each age. However, an assessment of the commercial fishing opportunities would normally be expressed as the weight of stock yield. Consistent units must be used throughout the analysis. Thus if the abundance is required as a weight while the target-strength function is given for individual fish, the latter must be converted to compatible units. This may be done by reference to the weight-length relationship for the species in question.

For a fish of length L, the weight W is variable but the mean relationship is given by an equation of the form:

$$W = a_f L^{b_f} \quad \textbf{(6)}$$

Where a_f and b_f are taken as constants for one species. However, a_f and b_f could be considered as variables varying differently with stock and time of year as well as species. Suppose the target-strength of one fish is given as:

$$TS_n = a_n + b_n \log_{10}(L) \quad \textbf{(7)}$$

The corresponding function TS_w, the target-strength of unit weight of fish has the same form with different constants:

$$TS_w = a_w + b_w \log_{10}(L) \quad \textbf{(8)}$$

The number of individuals in a unit weight of fish is (1/W), so the constant coefficients are related to the formulae:

$$b_w = b_n - 10b_f \quad \textbf{(9)}$$

$$a_w = a_n - 10\log_{10}(a_f) \quad \textbf{(10)}$$

6.4 Abundance estimation

So far the analysis has produced an estimate of the mean density of the insonified fish, for each part of the area surveyed, and for each species considered. The next step is to determine the total abundance in the surveyed area. The abundance is calculated independently for each species or category of target for which data have been obtained by partitioning the echo-integrals. The calculations are the same for each category:

$$Q_i = \sum_{k=1}^{n} A_k F_i \quad \textbf{(11)}$$

The total biomass for all species is:

$$Q = \sum_i Q_i \qquad \textbf{(12)}$$

The F_i are the mean densities and A_k are the elements of the area that have been selected for spatial averaging. The may be calculated from the shape of an area or measured, depending upon the complexity of the area. The presence of land should be taken into account, possibly by measuring the proportions of land and sea.

7 Data exchange

Each individual country is responsible for working up its own survey data. However, the results need to be submitted to the Chair of PGHERS in a standard format for the coordinated survey results. In addition, the **NASCs** per sampling unit allocated to target species together with all trawl information should be entered in the international database for acoustic herring surveys in the North Sea (HERSUR-database).

7.1 Exchange of data for the combined survey result.

The standard spreadsheet template should be used to enter the results of the survey by ICES statistical rectangles on four data sheets: 1) the cruise sheet by ICES statistical rectangle (Table 6); and the proportions by age/maturity class sheet (Table 7a) mean weights at age/maturity sheet (Table 7b) and mean length sheet (Table 7c).

The cruise sheet consists of six columns of data with as many rows as required for the survey. There must be at least one entry for each rectangle covered but to allow more flexible strata to be accommodated, multiple entries for abundance belonging to different strata may be entered with the same rectangle reference. The abundance must sum to the total for the rectangle.

The six columns are:

1. The central (decimalised) latitude of the data or ICES rectangle;
2. Central (decimalised) longitude of the data or ICES rectangle;
3. The biological sub-area to which the ICES rectangle belongs;
4. The ICES statistical rectangle code for the rectangle
5. (This may be calculated according to the first two columns);
6. Herring abundance in millions of fish;
7. Survey weight (in nautical miles of survey track per rectangle).

Part of an example data sheet is given in Table 6.

The proportions data (Table 7a) contains the proportion of Autumn spawners (North Sea and VIa north) and Spring spawners (Western Baltic) broken down according to strata (in rows) and age/maturity (in columns). There are currently 26 columns covering both spawning types. These proportions can be submitted as actual proportions or as total abundances. Ages of autumn spawning herring should be submitted as winter rings (where winter rings = age class – 1). Sprat and spring spawning herring ages are expressed as age class. Currently different maturity scales are in use, Table 8 provides the scales and their relationship. Tables 9 and 10 describe the maturity scales in detail according to Bowers and Holliday (1961). Data should be prepared according to the following age/maturity classes: 1 immature (maturity stage 1 or 2), 1 mature (maturity stage 3+), 2 immature, 2 mature, 3 immature, 3 mature, 4, 5, 6, 7, 8, 9+ (c.f. 1–8 scale in Tables 9 and 10).

The mean weights (Table 7b) at age/maturity by biological sub-area for North Sea autumn spawners and Baltic spring spawners.

The mean length (Table 7c) at age/maturity by biological sub-area for North Sea autumn spawners and Baltic spring spawners.

A cruise report should also be produced, and sent with the data file, following a standardised format. A description and an example of this format is given in the current report in Annex 2A. Text should be provided under the headings given (sections 1–4). All Figures (1–4) and Tables (1–6) are required, although the exact format of Figure 3 (mean length post plot and area subdivisions) may vary for clarity (see for example Figure 2E.3).

7.2 Data exchange for the international acoustic database (HERSUR)

All acoustic data from the national surveys is to be entered in the international database for acoustic surveys in the North Sea (HERSUR) together with the biological data from trawling.

Acoustic data, consisting of the NASC value per sampling unit allocated to species, together with additional information on time, position and instrumentation shall be exchanged according to the format described in the HERSUR Exchange Format Specification (to be submitted March 2000). This specification also described how trawl information is to be submitted.

Data exchange will be performed through the Internet (ff07.dfu.min.dk/hersur) through XLM files described in the HERSUR Exchange Format Specification, refer to International Acoustic Survey Database Manual (Ver. 1.0), also HERSUR users manual (Faber, 2001).

8 References

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Table 6. An example of the excel worksheet used to submit survey data by ICES statistical rectangle - the 'cruise sheet' with data from four ICES statistical rectangles.

2003 Cruise sheet on ICES stat square scale.							
Ship name and country (in here):			TRIDENS Netherlands			FILL THIS!	
VERSION 20.11.2003							
			Total Numbers (millions)			16558.204	FILL THIS!
			Total Biomass (thousands t)			1432.5295	FILL THIS!
					Stat	Abund'ce	Survey
		Latitude	Longitude	Stratum	square	Millions	milage
Origin:	00A0	54.75	-0.5	F	38E9	170.88	30.0
lat	35.5	54.75	0.5	F	38F0	3104.93	37.0
long	-50	54.75	1.5	F	38F1	0.00	35.0
		54.75	2.5	F	38F2	0.00	15.0
		55.25	-1.5	C	39E8	146.47	12.0
		55.25	-0.5	E	39E9	208.25	46.0
		55.25	0.5	F	39F0	357.77	69.0
		55.25	1.5	F	39F1	0.00	38.0
		55.25	2.5	F	39F2	0.00	21.0
		55.75	-1.5	C	40E8	40.78	51.0
		55.75	-0.5	D	40E9	1081.54	68.0
		55.75	0.5	D	40F0	192.62	68.0
		55.75	1.5	D	40F1	0.00	69.0
		55.75	2.5	D	40F2	164.78	79.0
		56.25	-2.5	C	41E7	0.00	6.0
		56.25	-1.5	C	41E8	0.00	61.0
		56.25	-0.5	D	41E9	157.76	68.0
		56.25	0.5	D	41F0	1844.79	67.0
		56.25	1.5	D	41F1	1228.26	68.0
		56.75	2.5	D	41F2	892.54	82.0
		56.75	-2.5	C	42E7	0.00	12.0

Table 7.

a) An example of the excel worksheet used to submit survey data broken down by age/sub area - the 'proportions sheet'

	NORTH SEA AUTUMN SPAWNERS.								WESTERN BALTIC SPRING SPAWNERS >>>>>>>>>>>>>>>>>>>>					
		Abundance (Millions).....												
Sum	Stratum	0	1i	1m	2i	2m	3i	3m	4	5	6	7	8	9+
1	A	0.00	0.06	0.00	0.46	0.44	0.01	0.03	0.01	0.00	0.00	0.00	0.00	0.00
1	B	0.00	0.00	0.00	0.19	0.46	0.01	0.13	0.16	0.02	0.01	0.01	0.00	0.00
1	C	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1	D	0.00	0.19	0.00	0.58	0.18	0.00	0.02	0.02	0.00	0.00	0.00	0.00	0.00
1	E	0.00	0.24	0.00	0.06	0.00	0.00	0.00	0.00	0.24	0.29	0.06	0.00	0.12
1	F	0.00	0.27	0.00	0.38	0.29	0.00	0.01	0.02	0.01	0.01	0.00	0.00	0.00

b) An example of the excel worksheet used to submit survey data broken down by age/sub area - the 'mean weights sheet'

NORTH SEA AUTUMN SPAWNERS....												
Mean weight (grams).....												
0	1i	1m	2i	2m	3i	3m	4	5	6	7	8	9+
	57.3		90.7	127.0	110.0	144.4	160.0		166.0			
			98.7	138.1	126.0	167.3	199.8	190.8	269.0	264.0	280.0	267.0
2.8												
	53.3		75.6	118.9	90.0	132.7	156.3	165.7	163.6		194.0	
	37.0		64.0					125.0	134.8	134.0		182.0
	57.3		79.5	133.7		152.0	173.0	176.7	175.5	185.0		

c) An example of the excel worksheet used to submit survey data broken down by age/sub area - the 'mean lengths sheet'

North Sea Autumn spawners												
Mean length (cm)												
0	1i	1m	2i	2m	3i	3m	4	5	6	7	8	9+
	19.29		22.48	24.09	24.50	24.88	26.53		26.50			
			23.24	25.07	24.50	26.29	27.48	28.11	30.05	29.74	32.50	30.50
7.68												
	19.61		20.90	23.60	22.46	24.84	26.19	27.29	27.79		28.00	
	17.88		20.00					26.38	25.55	25.50		29.00
	19.65		20.87	23.47		25.18	26.27	27.10	27.08	27.75		

Table 8. Maturity scales currently used by the participants in ICES coordinated acoustic surveys in ICES Divisions III, IV and Va.

REPORTING STATE	8 POINT SCALE (SCOTLAND, NORWAY, DENMARK)	5 POINT SCALE (HERSUR)	4 POINT SCALE NETHERLANDS*	4 POINT SCALE (GERMANY)
Immature	Virgin	1. Virgin	(I) Virgin	1. Virgin
	Small gonads			
Mature	Gonads half cavity	2. Maturing		2. Maturing
	Gonads long cavity		(M). Maturing	
	Gonads fill cavity			
	Ripe and running	3. Spawning	(R) Spawning	3. Spawning
	Spent	4. Spent	(S) Spent and	4. Spent
	Recovering spents	5. Resting	Resting	

***Dutch Code (I-M-R-S) between brackets**

Table 9. Maturity classification of female herring as used in the 2003 survey.

NETHERLANDS AND GERMANY	NORWAY	SCOTLAND AND DENMARK*	IRELAND
0= undefined	0= undecided / not checked		
1= virgin (**I**mmature) ovaries are thin, whitish, translucent and long ribbons; no sign of development; pointed end	1= immature (a) thread-like, thin, completely transparent and colourless; sex difficult to determine	1= Virgin herring gonads very small – threadlike; 2–3 mm broad; ovaries wine red	1= Virgin individuals: small sexual organs close under vertebral column Wine in colour, torpedo-shaped ovaries about 2–3 cm long and 0.66 mm thick
	2= immature (b) somewhat larger in volume; sex easier determined; still transparent with hint of colour	2= Virgin herring with small gonads the height of ovaries is about 3–8 mm; eggs not visible to the naked eye but can be seen with a magnifying glass; ovaries bright red colour	2= Maturing Virgins. Slightly larger than stage 1, still transparent.
2= maturing (**M**ature) ribbons are already larger, reddish colour; lightly ribbed and milky or development has clearly started, eggs are becoming larger; ovaries are more and more filling in the body cavity; eggs still cannot be extruded using moderate pressure	3= maturing (a) opaque but developed in volume; distinct veins; ovaries with yellow/white eggs in lamellae; can occupy half body cavity or more	3= maturing gonads occupy about half of the ventral cavity; breadth of the sexual organs is between 1 and 2 cm; eggs are small but can be distinguished with the naked eye; the ovaries are organs	3= Sexual Organs become more swollen, occupying about half of the ventral cavity
	4= maturing (b) gonads larger in volume; distinct veins; ovaries yellowish or white, can occupy 2/3 or more of the body cavity depending on fish condition; Eggs distinct, feel like grain, becoming transparent in the front part of the gonad	4= maturing gonads are almost as long as the body cavity; eggs larger than in 3, varying in size and opaque; ovaries orange or pale yellow in colour	4= Ovaries become more swollen, filling two thirds of ventral cavity, eggs not transparent.
	5= maturing (c) ovaries fill the entire body cavity; most eggs transparent	5= maturing gonads fill the body cavity; eggs are large and round; some are transparent; ovaries are yellowish; eggs do not flow	5= Sexual Organs filling ventral cavity, ovaries with some large transparent eggs
3= spawning (**R**unning) eggs are freely extruding or developed eggs are extruding using moderate pressure to the fish body	6= spawning running gonads when light pressure is applied	6= spawning ripe gonads; eggs transparent; eggs flow freely	6= Roe running – Spawning
4= spent (**S**pent) gonads are shrunken, drained, not translucent, reddish, lightly ribbed; residues of eggs; showing no development	7= spent gonads loose; some remaining eggs	7= spent gonads baggy and bloodshot; ovaries are empty or only contain a few residual eggs; body cavity may contain bloody fluid. At this stage there can be difficulty in deciding sex; if the gonads are spread out it is easier to view the leading edge – sharp for male and rounded for female	7= Spents, ovaries slack with residual eggs, baggy and bloodshot
*Dutch Code (**I-M-R-S**) between brackets	8= resting gonads small; eggs not visible; difficult to distinguish from stage 2–3	8= recovering ovaries are firm and larger than virgin herring in Stage 2. Eggs are not visible to the naked eye. The walls of the gonads are striated vertically and blood vessels are prominent. Gonads are wine-red in colour. (This stage passes into Stage 3)	8= Recovering spents, no eggs visible. Blood vessels showing.

*** Denmark most often use to go directly from stage 7 to stage 3**

Table 10. Maturity classification of male herring as used in the 2003 survey.

NETHERLANDS AND GERMANY	NORWAY	SCOTLAND AND DENMARK*	IRELAND
0= undefined	0= undecided / not checked		
1= virgin (**I**mmature) testes are long, very thin, translucent and transparent ribbons lying along an unbranched blood vessel; no sign of development; round end	1= immature (a) juvenile phase, gonads thread-like, thin, completely transparent and colourless; sex difficult to determine	1= Virgin herring gonads very small – thread-like; 2-3 mm broad; testes whitish or grey brown	1= Virgin individuals: small sexual organs close under vertebral column whitish or greyish brown in colour, knife shaped testes 2- 3 cm long and 0.66 mm thick.
	2= immature (b) somewhat larger in volume; sex easier determined; still transparent with hint of colour	2= Virgin herring with small sexual organs height of testes is about 3-8 mm; testes a reddish grey colour	2= Maturing Virgins. Slightly larger than stage 1, still transparent colouration.
2= maturing (**M**) ribbons are already larger, reddish colour; smooth and transparent or development has clearly started, whitish/creamy colour of the gonades; gonads are more and more filling in the body cavity; sperm/milk still cannot be extruded using moderate pressure	3= maturing (a) opaque but developed in volume; distinct veins; testes white or with white spots, firm; can occupy half body cavity or more	3= maturing gonads occupy about half of the ventral cavity; breadth of the sexual organs is between 1 and 2 cm; testes reddish grey or greyish	3= Sexual Organs become more swollen, occupying about half of the ventral cavity
	4= maturing (b) gonads larger in volume; distinct veins; testes light grey or white; milt thick and slow-flowing	4= maturing gonads are almost as long as the body cavity; testes whitish	4= Gonads become more swollen, filling two thirds of ventral cavity, milt whitish
	5= maturing (c) testes are grey or white; The gonads are not yet running, however, a light pressure on the abdomen causes the milt to run	5= maturing gonads fill the body cavity; testes are milky white; sperm does not flow but can be extruded by pressure	5= Sexual Organs filling ventral cavity, milt is white in colour but not yet running
3= spawning (**R**unning) sperm/milk is flowing out or is extruded using moderate pressure to the fish body	6= spawning running gonads when light pressure is applied	6= spawning ripe gonads; testes white; sperm flow freely	6= milt running – Spawning
4= spent (**S**) gonads are shrunken, drained, transparent and reddish; residues of sperma/milk; showing no development	7= spent gonads loose; contain remaining milt	7= spent gonads baggy and bloodshot; testes may contain remains of sperm. The body cavity may contain bloody fluid. At this stage there can be difficulty in deciding sex; if the gonads are spread out it is easier to view the leading edge – sharp for male and rounded for female	7= Spents, testes slack, baggy and bloodshot
*Dutch Code (**I-M-R-S**) between brackets	8= resting gonads small; difficult to distinguish from stage 2-3	8= recovering testes are firm and larger than virgin herring in Stage 2. The walls of the gonads are striated laterally and blood vessels are prominent. Gonads are wine-red in colour. (This stage passes into Stage 3)	8= Recovering spents. Blood vessels showing.

*** Denmark most often use to go directly from stage 7 to stage 3**

Annex 5: ICES coordinated acoustic survey of ICES Divisions IIIa, IVa, IVb, IVc and VIa (North) – 2004 results

International Council for
The Exploration of the Sea

Draft for PGHERS

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ABSTRACT

Six surveys were carried out during late June and July covering most of the continental shelf north of 51.5°N in the North Sea and to the west of Scotland to a northern limit of 62°N. The eastern edge of the survey area was bounded by the Norwegian and Danish, Swedish and German coasts, and to the west by the shelf edge between 200 and 400 m depth. The surveys are reported individually in the report of the planning group for herring surveys, 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 statistical rectangle; and distributions of mean weight and fraction mature at age.

The estimates of North Sea autumn spawning herring SSB are reasonably consistent with previous years, at 2.6 million tonnes and 14,000 millions herring individuals. The survey again shows two well-above average year classes of herring (1998 and 2000). Growth of the 2000 year class seems still to be slower than average, individuals of this year class are 1.4 cm smaller and 33g lighter than the 1998 year class at the same age. Only 65% are mature at age 3 compared to 97% and 93% for the 1998 and 1999 year classes.

The estimates of Western Baltic spring spawning herring SSB are 143,000 tonnes and 1,038 million herring (Table 2) which is a moderate increase following last years reduction. The Western Baltic survey produces a rather noisy signal but the indications are still that the stock is higher now than between 1996 and 2000.

The West of Scotland estimates of SSB are 400,000 tonnes and 2,260 million herring (Table 3). Again, the 1998 year class appears to be strong (Table 6). Total adult mortality estimated from the survey is rather variable. The mean mortality over the last 6 years has been approximately 0.4, this is a little higher than the assessment indicated but is still consistent with the

2004 assessment that the stock is relatively lightly exploited (ICES 2003). The survey still indicates a slightly rising stock over the last 7 years.

INTRODUCTION

Six surveys were carried out during late June and July covering most of the continental shelf north of 51.5°N in the North Sea and to the west of Scotland to a northern limit of 62°N. The eastern edge of the survey area was bounded by the Norwegian and Danish, Swedish and German coasts and to the west by the shelf edge between 200 and 400 m depth. The surveys are reported individually in Annexes 2a-f of the report of the planning group for herring surveys (ICES, 2004). The vessels, areas and dates of cruises are given below and in Figure 1:

VESSEL	PERIOD	AREA
FV Enterprise	6 July – 25 July	56°- 60°N, 3° - 7° W
R.V Johan Hjort	8 – 30 July	57°- 61° N, 2° - 6° E
Scotia	1 - 22 July	58 15°- 62° N, 4° W - 2° E
Tridens	28 June – 23 July	54°30 – 58° 15' N, west of 3° E
Walther Herwig III	28 June – 19 July	51.5° - 57° N, east England / 3° E / 6° E
Dana	29 June – 12 July	North of 57°NS and 56° N, Kattegat east of 6° E

The data have been combined to provide an overall estimate. Estimates of numbers at age, maturity stage and mean weights at age are calculated as weighted means of individual survey estimates by ICES statistical rectangle. The weighting applied is proportional to the length of survey track for each vessel that has covered each statistical rectangle. The data have been combined and estimates of North Sea autumn spawning herring, Western Baltic spring spawning herring, and West of Scotland (VIa_{north}) herring are shown in Tables 1-3.

METHODS

The acoustic surveys were carried out using Simrad EK60, EK500 and EY500 38 kHz sounder echo-integrator with transducers mounted on the hull, drop keel and towed bodies. Further data analysis was carried out using either BI500, Echoview or Echoann software. The survey track was selected to cover the area giving a basic sampling intensity over the whole area 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 some relatively high density sections, east and west of Shetland, in the Skagerrak where short additional transects were carried out at 7.5 nmi spacing, and in most of the southern North Sea, where transect spacing was reduced to 30 nmi.

The following target strength to fish length relationships have been used to analyse the data:

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

A small low density area of 6 ICES stat rectangles (41F3, 41F4, 41F5, 42F3 42F4 42F5) has been omitted from the survey. These have been filled in by interpolation. Figure 2 shows the relative proportions contributed by these rectangles to an area surrounded by one and two more rectangles for the years 1999 to 2003 for North Sea autumn spawning herring. The mean for this period and the whole period for which data is available is also shown in Figure 2. The 5 years mean is very similar to the longer term. The variability of the interpolation factors

using one or two surrounding rectangles was estimated using the CV of the factor from years 1999 to 2003. The CV of the factor for one rectangle is slightly smaller suggesting that the use of the closest rectangles is more reliable than an extended area. So the factor of 0.19 of the surrounding area has been used for interpolation for the six rectangles when estimated from the surrounding twelve. This procedure increases estimates of North Sea herring juveniles by 0.5%, with the largest part 1 group, and adults by 0.2%. This change has negligible impact on the utility of the survey results. For the Western Baltic spring spawning herring the factor needs to be different. The lower three rectangles have not been observed to contain any WBSS herring from 1999 to 2003 and have been set to zero for 2004. Table 1 shows a comparison between survey estimates of western Baltic Spring spawning herring in ICES rectangles 42F345 and surrounding rectangles to the north, east and west and a comparison with the total estimate for years 2000 to 2004. There is some indication of trend, with the percentage in the surrounding rectangles higher in 2002/3 than in 2000/2001. Thus the long term average seems less appropriate. The highest value for the unsurveyed area was seen in 2003. However, to use the 2003 percentage alone assuming a step change repeated in 2004 cannot be justified. The mean of the last two years (approximately 1.5% of the total) has been chosen as the best compromise. The influence of this at 1.5% of the total estimate is small.

Combined Acoustic Survey Results for 2004

The estimates of North Sea adult autumn spawning herring SSB are 2.6 million tonnes and 14,000 millions herring (Table 1). The survey is reasonably consistent with previous years, giving a total adult fishing mortality of about 0.5 over the last 3 years, however, this is higher than the estimates from the assessment. The SSB rose from 2.4 million tonnes in 2001 (Table 4) to 2.9 million tonnes in 2002 and again to 3.1 million tonnes in 2003 and has now declined to 2.6 million tonnes. Part of the reduction in SSB is due to the below average maturing 2001 year class. This is still seen to be less than averagely abundant, consistent with earlier surveys. Growth of the 2000 year class seems still to be slower than average, these fish are 1.4 cm smaller and 33g lighter than the 1998 year class at the same age. In addition only 65% are mature at age 3 compared to 97% and 93% for 1998 and 1999 year classes. The SSB would be 21% higher if this year class was normally mature at 95% and grown at an average weight of 174g. The survey again shows two well- above average year classes of herring (the 1998 and 2000 year classes) in the North Sea, which is consistent with the observation of these large year classes observed in the MIK and IBTS surveys and the acoustic survey last year (ICES 2004). The 2004 estimate of the 2000 year class in the North Sea suggests it is still 1.1 times higher than the 1998 year class at age 3wr, though this is a lower ratio than previous estimates.

The estimates of Western Baltic spring spawning herring SSB are 143,000 tonnes and 1,038 million herring (Table 2) and show a moderate increase following last years reduction. This survey produces a rather noisy signal but the indications are still that of a stock that is higher now than between 1996 to 2000. The 2002 estimate was high, the 2003 estimate was a little low, and the current one is comparable with 2000.

The West of Scotland estimates of SSB are 400,000 tonnes and 2,260 million herring (Table 3), and show the large 1998 year class again this year (Table 6). The early indication that the 2000 year class is also a large one, are not really confirmed this year. The year class now seems more average. Total adult mortality estimated from the survey is rather variable; the mean mortality over the last 6 years has been approximately 0.4. This is a little higher than the value derived from the assessment but is still consistent with the 2003 assessment that the stock is relatively lightly exploited (ICES 2003). The survey still indicates a slightly rising stock over the last 7 years.

The spatial distributions of the abundance (numbers and biomass) of autumn spawning herring are shown in Figure 3. The distribution of numbers by age are shown in Figure 4 for 1 ring, 2 ring and 3+ ring autumn spawning herring. The survey provides estimates of maturity and

weight at age: the mean weight at age for 1 and 2 ring herring along with the proportion mature for 2 and 3 ring herring are shown in Figure 5. The spatial distribution of mature and immature autumn spawning herring is shown in Figures 6 and 7 respectively. The spatial distributions of the abundance (numbers and biomass) of Western Baltic spring spawning herring are shown in Figure 8. The distribution of numbers by age are shown in Figure 9 for 1 ring, 2 ring and 3+ ring. The mean weight at age for 1 and 2 ring herring along with the proportion mature for 2 and 3 ring herring are shown in Figure 10. The spatial distribution of mature and immature Western Baltic spring spawning herring is shown in Figures 11 and 12 respectively.

The time series of abundance for all three stocks, North Sea autumn spawners, Western Baltic spring spawners and West of Scotland herring are illustrated in figures 13, 14 and 15 respectively. In each of them, a 3 year running mean is included to show the general trend more clearly.

Reference

ICES 2004 Report of the Herring Assessment Working Group for the Area South of 62°N. ICES CM 2003/ACFM:10.

ICES. 2003. Report of the planning group for herring surveys. ICES CM 2003/G:03.

Table 1 Comparison between survey estimates of western Baltic Spring spawning herring in ICES rectangles 42F345 and surrounding rectangles to the north, east and west and the total estimate for years 2000 to 2004. Estimated values for 2004 are shown in bold.

YEAR	2000	2001	2002	2003	2004
% of total in 42F345	0%	0%	0%	3%	
%of total in 43F23456/42F26	3%	1%	17%	12%	10%
% of 43F23456/42F26 in 42F345			0%	23%	**11.5%**

Table 1 Total numbers (millions of fish) and biomass (thousands of tonnes) of North Sea autumn spawning herring in the area surveyed in the acoustic surveys July 2004, with mean weights, mean lengths and fraction mature by age ring.

AGE (RING)	NUMBERS	BIOMASS	MATURITY	WEIGHT(G)	LENGTH (CM)
0	10693.4	81.5	0.00	7.6	10.1
1	5225.0	180.5	0.00	34.5	16.3
2	3445.0	397.6	0.70	115.4	24.0
3	9196.7	1279.4	0.65	139.1	25.0
4	2167.8	445.4	1.00	205.4	27.6
5	2590.7	597.7	1.00	230.7	28.5
6	317.1	80.3	1.00	253.3	29.2
7	327.6	85.7	1.00	261.5	29.6
8	342.1	95.3	1.00	278.6	30.1
9+	185.6	50.1	1.00	269.6	29.9
Immature	20192.3	709.0			
Mature	14298.7	2584.3			
Total	34491.1	3293.4			

Table 2 Total numbers (millions of fish) and biomass (thousands of tonnes) of Western Baltic spring spawning herring in the area surveyed in the acoustic surveys July 2004, with mean weights, mean length and fraction mature by age ring.

AGE (RING)	NUMBERS	BIOMASS	MATURITY	WEIGHT(G)	LENGTH (CM)
0	0.0	0.0	0.00		
1	1696.1	63.6	0.00	37.51	17.0
2	958.2	75.2	0.11	78.52	21.5
3	746.6	89.7	0.51	120.1	24.6
4	318.6	41.5	1.00	130.3	25.4
5	189.5	29.3	1.00	154.8	26.7
6	73.1	11.5	1.00	156.8	26.8
7	29.8	4.2	1.00	141.5	25.7
8	12.1	1.9	1.00	159.4	28.1
9+	6.2	1.3	1.00	207.7	30.0
Immature	2911.1	163.1			
Mature	1119.1	155.2			
Total	4030.2	318.3			

Table 3 Total numbers (millions of fish) and biomass (thousands of tonnes) of autumn spawning of West of Scotland herring in the area surveyed in the acoustic surveys July 2004, with mean weights, mean lengths and fraction mature by age ring.

AGE (RING)	NUMBERS	BIOMASS	MATURITY	WEIGHT(G)	LENGTH (CM)
0	0.0	0.0	0.00		
1	564.0	33.4	0.00	53.7	19.0
2	274.5	37.8	0.83	135.7	24.9
3	760.2	120.6	0.97	157.0	26.0
4	442.3	79.7	1.00	180.0	27.1
5	577.2	109.3	1.00	189.2	27.5
6	55.7	11.2	1.00	201.7	28.1
7	61.8	13.2	1.00	213.4	28.6
8.00	82.2	17.6	1.00	213.6	28.6
9+	76.3	15.7	1.00	205.6	28.2
Immature	635.1	42.6			
Mature	2258.9	395.9			
Total	2894.1	438.5			

Table 4 Estimates of North Sea autumn spawners (millions) at age from acoustic surveys, 1984-2004. For 1984-1986 the estimates are the sum of those from the Division IVa summer survey, the Division IVb autumn survey, and the Divisions IVc, VIId winter survey. The 1987 to 2004 estimates are from the summer survey in Divisions IVa,b and IIIa excluding estimates of Division IIIa/Baltic spring spawners. For 1999 and 2000 the Kattegat was excluded from the results because it was not surveyed. Smoothed Z are those estimated over 2 years providing an estimate of total mortality that is less noisy.

AGE (RINGS)	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
1	551	726	1,639	13,736	6,431	6,333	6,249	3,182	6,351	10,399	3,646	4,202	6,198	9,416	4,449	5,087	24,735	6,837	23,055	9,829	5,225
2	3,194	2,789	3,206	4,303	4,202	3,726	2,971	2,834	4,179	3,710	3,280	3,799	4,557	6,363	5,747	3,078	2,922	12,290	4,875	18,949	3.445
3	1,005	1,433	1,637	955	1,732	3,751	3,530	1,501	1,633	1,855	957	2,056	2,824	3,287	2,520	4,725	2,156	3,083	8,220	3,081	9,196
4	394	323	833	657	528	1,612	3,370	2,102	1,397	909	429	656	1,087	1,696	1,625	1,116	3,139	1,462	1,390	4,189	2,168
5	158	113	135	368	349	488	1,349	1,984	1,510	795	363	272	311	692.1	982.4	506.4	1,006	1,676	794.6	675.1	2,591
6	44	41	36	77	174	281	395	748	1,311	788	321	175	98.7	259.2	445.2	313.6	482.5	449.6	1,031	494.8	317.1
7	52	17	24	38	43	120	211	262	474	546	238	135	82.8	78.6	170.3	138.6	266.4	169.6	244.4	568.3	327.6
8	39	23	6	11	23	44	134	112	155	178	220	110	132.9	78.3	45.2	54.3	120.4	97.7	121	145.5	342.1
9+	41	19	8	20	14	22	43	56	163	116	132	84	206	158.3	121.4	87.2	97.2	58.9	149.5	177.7	185.6
Total	5,478	5,484	7,542	20,165	13,496	16,377	18,262	12,781	17,173	19,326	13,003	11,220	18,786	22,028	16,104	15,107	34,928	26,124	39,881	38,110	23,798
$Z_{2+/3+}$	.	0.92	0.57	1.02	0.81	0.11	0.11	0.57	0.37	0.74	1.21	0.53	0.43	0.40	0.76	0.52	0.32	0.38	0.47	0.59	0.62
Smooth $Z_{2+/3+}$	.	.	0.73	0.76	0.91	0.30	0.11	0.25	0.46	0.52	0.94	0.80	0.48	0.41	0.55	0.63	0.41	0.35	0.425	0.53	0.60
SSB ('000 t)	807	697	942	817	897	1,637	2,174	1,874	1,545	1,216	1,035	1,082	1446.2	1,780	1,792	1,534	1,833	2,622	2,948	2,999	2,548

Table 5 Numbers (millions) of Western Baltic Spring Spawning herring at age (rings) from acoustic surveys 1989 to 2004 The 1999 survey was incomplete due to the lack of participation by RV DANA.

YEAR	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
0		31		3,853	372	964										0.0
1		135		277	103	5	2,199	1,091	128	138	1367	1509	66	3346	1833	1696
2	1,105	1,497	1,864	2,092	2,768	413	1,887	1,005	715	1,682	1143	1891	641	1576	1110	958
3	714	549	1,927	1,799	1,274	935	1,022	247	787	901	523	674	452	1392	394.6	746.6
4	317	319	866	1,593	598	501	1,270	141	166	282	135	364	153	524	323.4	318.6
5	81	110	350	556	434	239	255	119	67	111	28	186	96	88	103.4	189.5
6	51	24	88	197	154	186	174	37	69	51	3	56	38	40	25.2	73.1
7	16	10	72	122	63	62	39	20	80	31	2	7	23	18	12.0	29.8
8+	4	5	10	20	13	34	21	13	77	53	1	10	12	19	5.4	18.3
Total	2,288	2,680	5,177	10,509	5,779	3,339	6,867	2,673	2,088	3,248	3,201	4,696	1,481	7,002	3,807	4,030
3+ group	1,183	1,017	3,313	4,287	2,536	1,957	2,781	577	1,245	1,428	691	1,295	774	2,081	864	1,376

Table 6 Numbers at age (millions) and SSB of West of Scotland Autumn Spawning herring at age (rings) from acoustic surveys 1987, 1991 to 2004 #In 1997 the survey was carried out one month early in June as opposed to July when all the other surveys were carried out.

AGE	1987	1991	1992	1993	1994	1995	1996	1997#	1998
1	249.1	338.3	74.3	2.8	494.2	441.2	41.2	792.3	1,221.7
2	578.4	294.5	503.4	750.3	542.1	1,103.4	576.5	641.9	794.6
3	551.1	327.9	211.0	681.2	607.7	473.2	802.5	286.2	666.8
4	353.1	367.8	258.1	653.1	285.6	450.3	329.1	167.0	471.1
5	752.6	488.3	414.8	544.0	306.8	153.0	95.4	66.1	179.1
6	111.6	176.3	240.1	865.2	268.1	187.1	60.6	49.5	79.3
7	48.1	98.7	105.7	284.1	406.8	169.1	77.4	16.3	28.1
8	15.9	89.8	56.7	151.7	173.7	236.5	78.2	29.0	13.9
9+	6.5	58.0	63.4	156.2	131.9	201.5	114.8	24.4	36.8
SSB:	273.0	452.0	351.5	866.2	533.7	452.1	370.3	140.9	375.9

AGE	1999	2000	2001	2002	2003	2004			
1	534.2	447.6	313.1	424.7	438.8	564.0			
2	322.4	316.2	1,062.0	436.0	1039.4	274.5			
3	1,388.8	337.1	217.7	1,436.9	932.5	760.2			
4	432.0	899.5	172.8	199.8	1471.8	442.3			
5	308.0	393.4	437.5	161.7	181.3	577.2			
6	138.7	247.6	132.6	424.3	129.2	55.7			
7	86.5	199.5	102.8	152.3	346.7	61.8			
8	27.6	95.0	52.4	67.5	114.3	82.2			
9+	35.4	65.0	34.7	59.5	75.2	76.3			
SSB:	460.2	500.5	359.2	548.8	739.2	395.9			

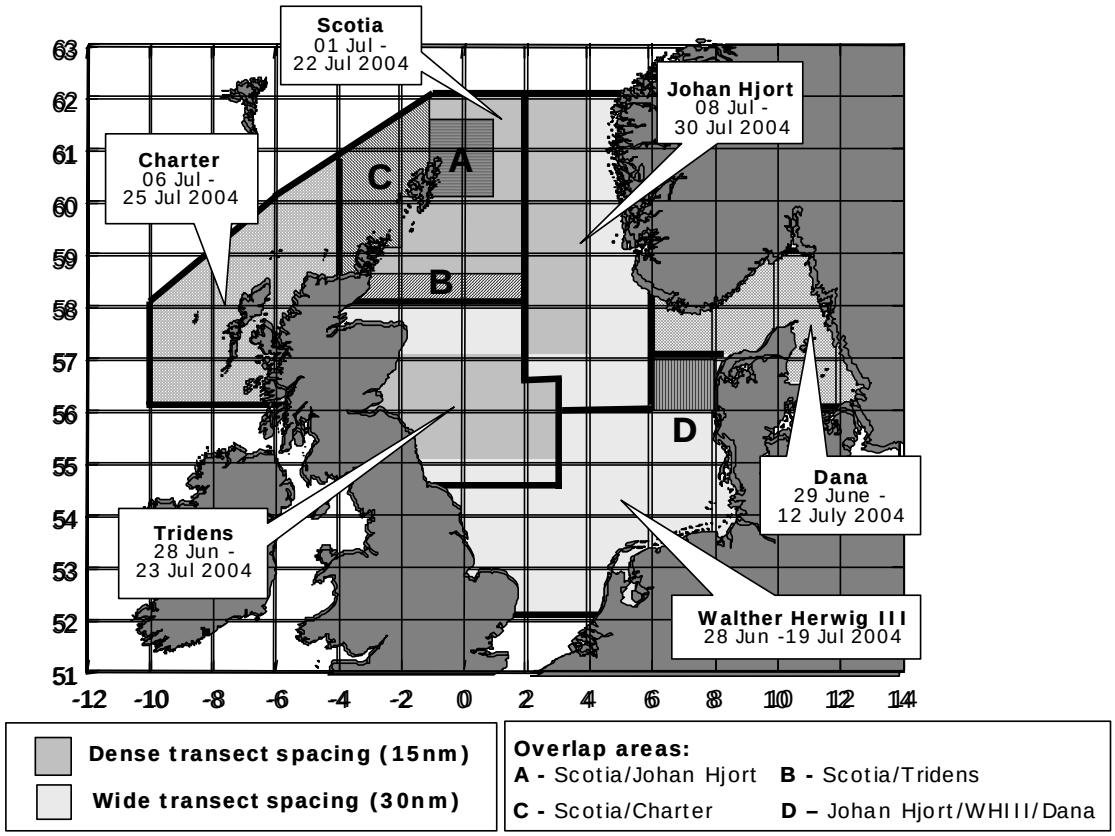


Figure 1. Survey area layouts and dates for all participating vessels in the 2004 acoustic survey of the North Sea and adjacent areas. Heavily shaded areas indicate areas of overlap.

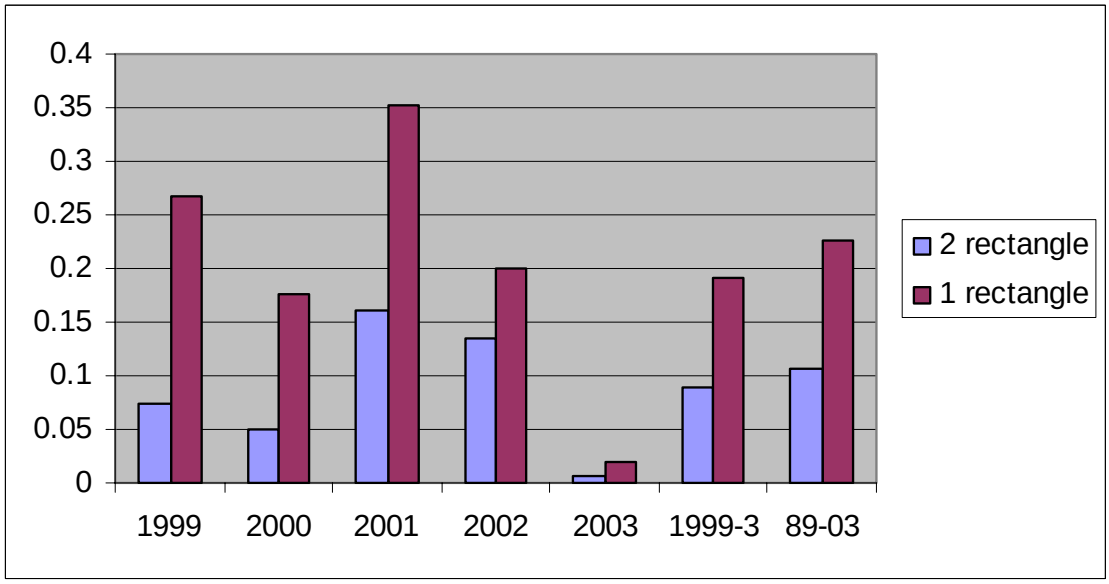


Figure 2. Proportions of 1-9+ herring in ICES rectangles 41F3, 41F4, 41F5, 42F3 42F4 42F5 and surrounding 12 and 34 rectangles forming a border 1 and 2 rectangles deep. For 1999 to 2003 and the average for 1989 to 2003.

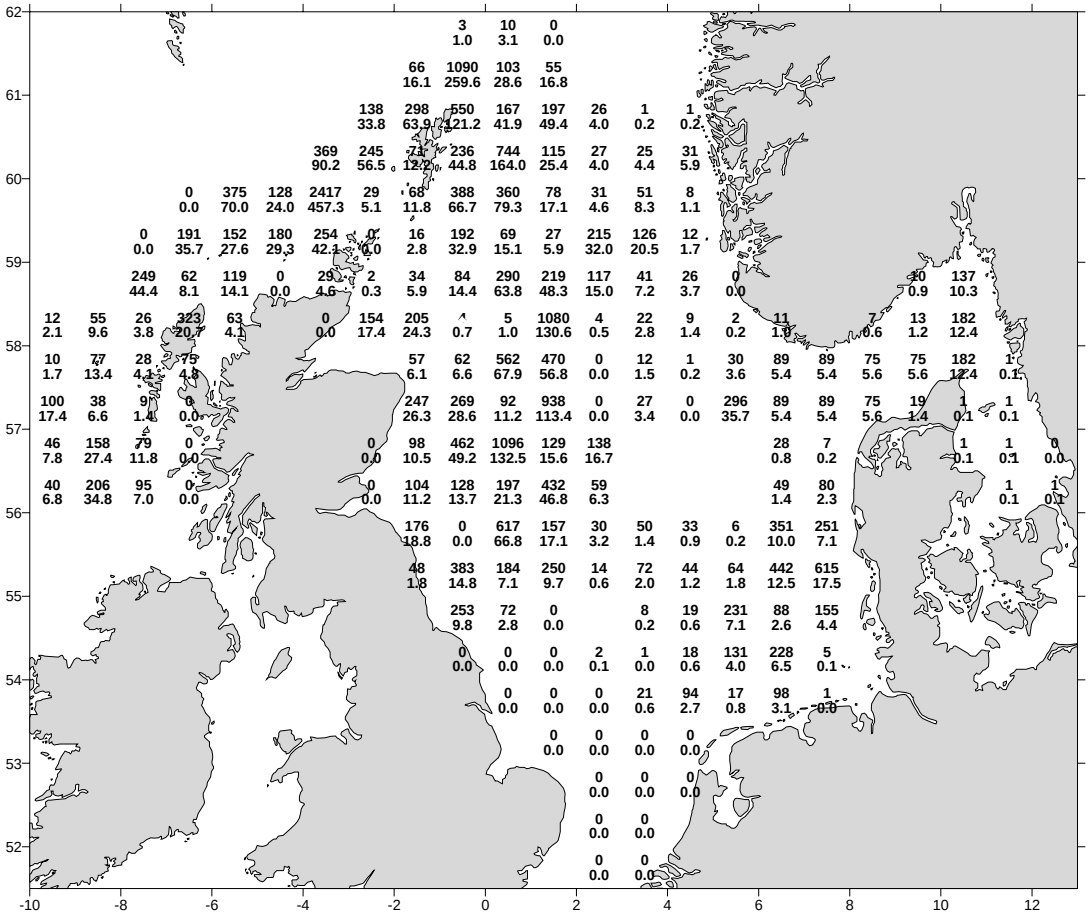


Figure 3. Abundance of Autumn spawning herring 1-9+ from combined acoustic survey July 2004. Numbers (millions) (upper figure) and biomass (thousands of tonnes) (lower figure).

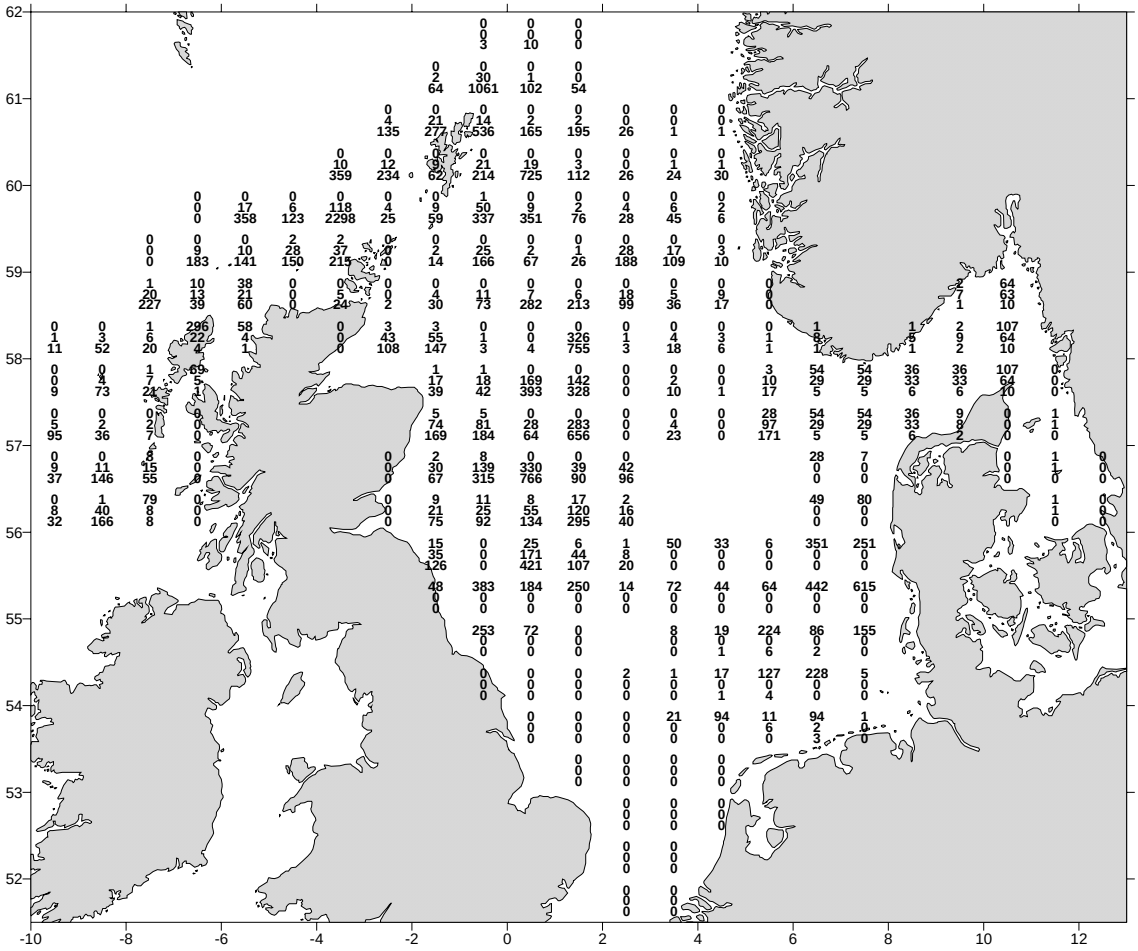


Figure 4. Numbers (millions) of Autumn spawning herring from combined acoustic survey June - July 2004. 1 ring (upper figure), 2 ring (centre figure), 3+ (lower figure).

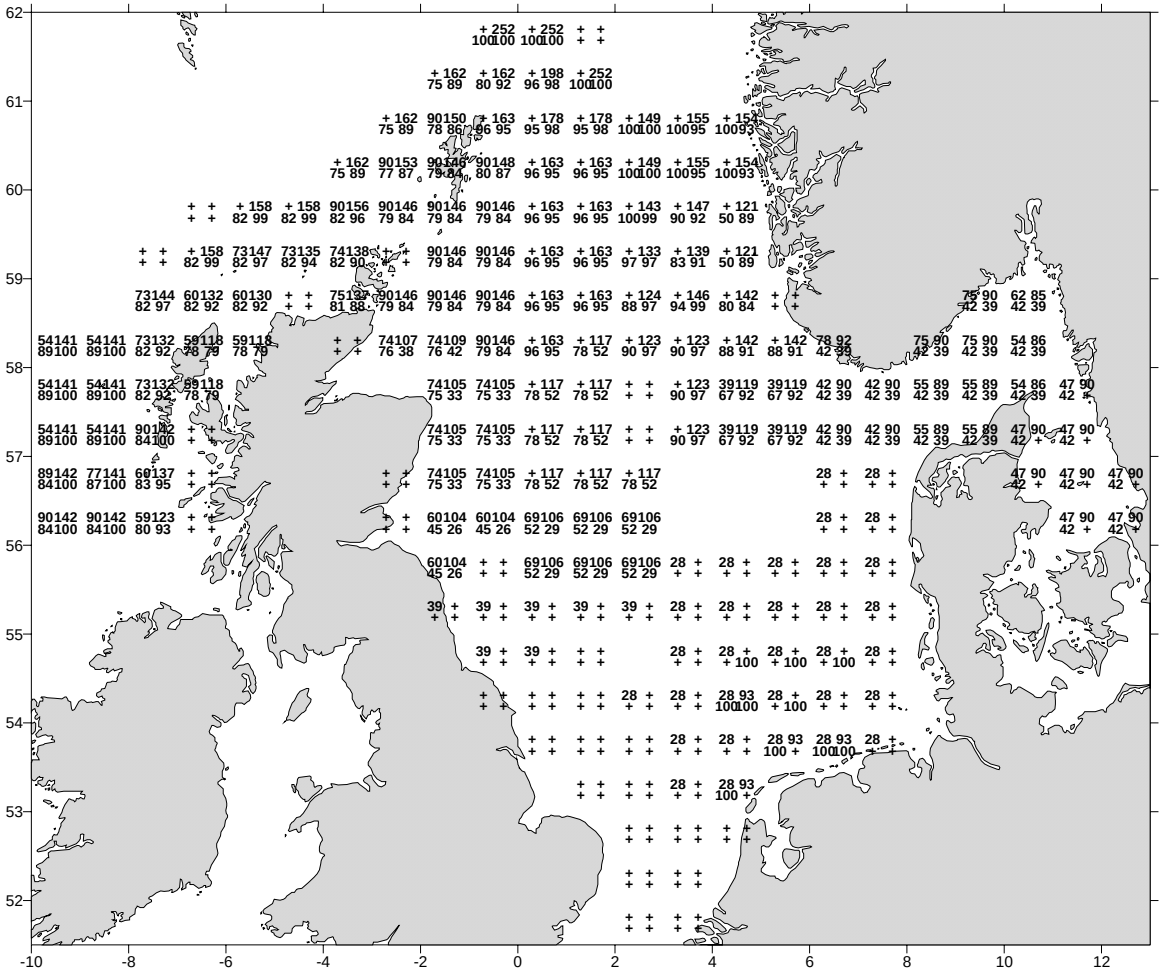


Figure 5. Mean weight and maturity of Autumn spawning herring from combined acoustic survey June - July 2004. Four values per ICES rectangle, percentage mature (lower),2 ring (left), 3 ring (right), mean weights gram (upper),1 ring (left) ,2 ring (right) ,0 indicates measured percentage mature, + indicates surveyed with zero abundance blank indicates an unsurveyed rectangle.

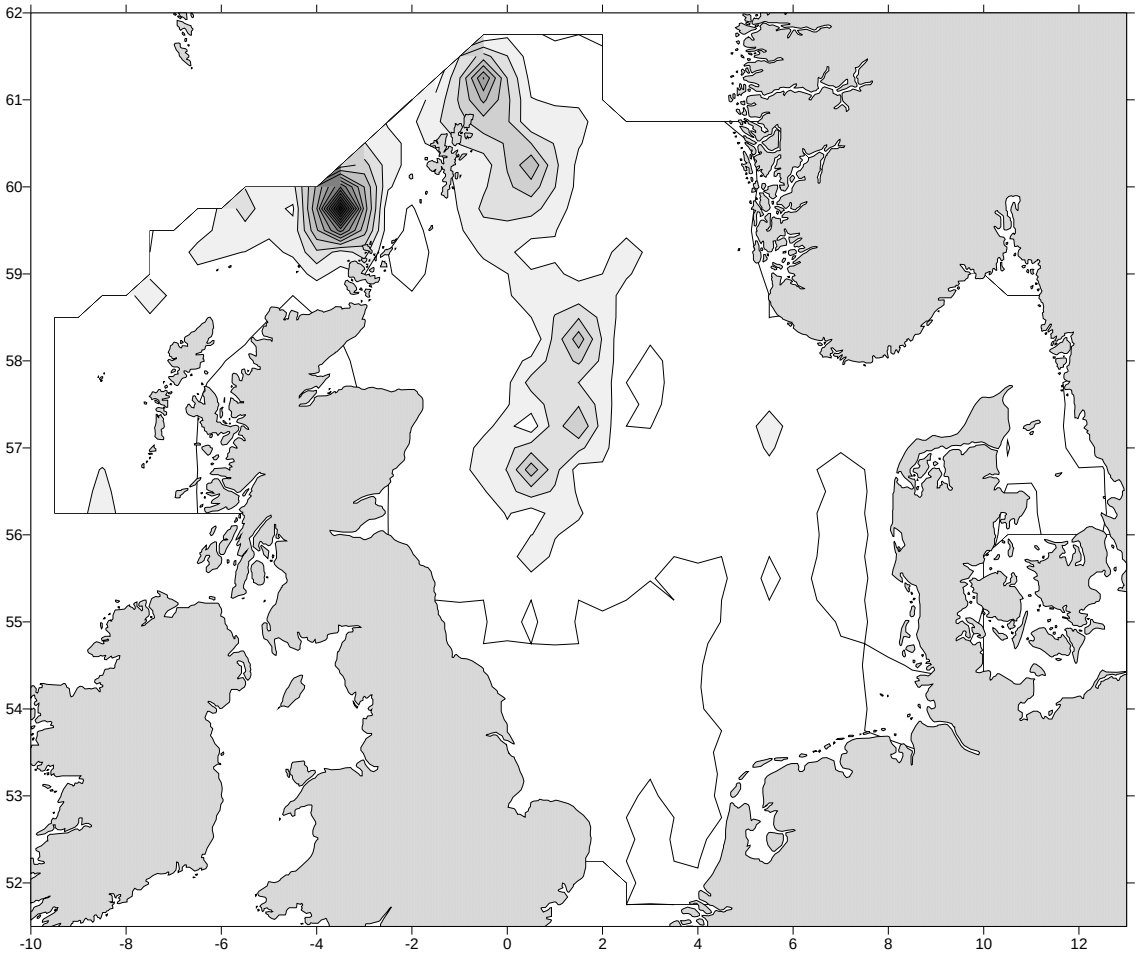


Figure 6. Numbers of mature autumn spawning herring from combined acoustic survey June -July 2004.

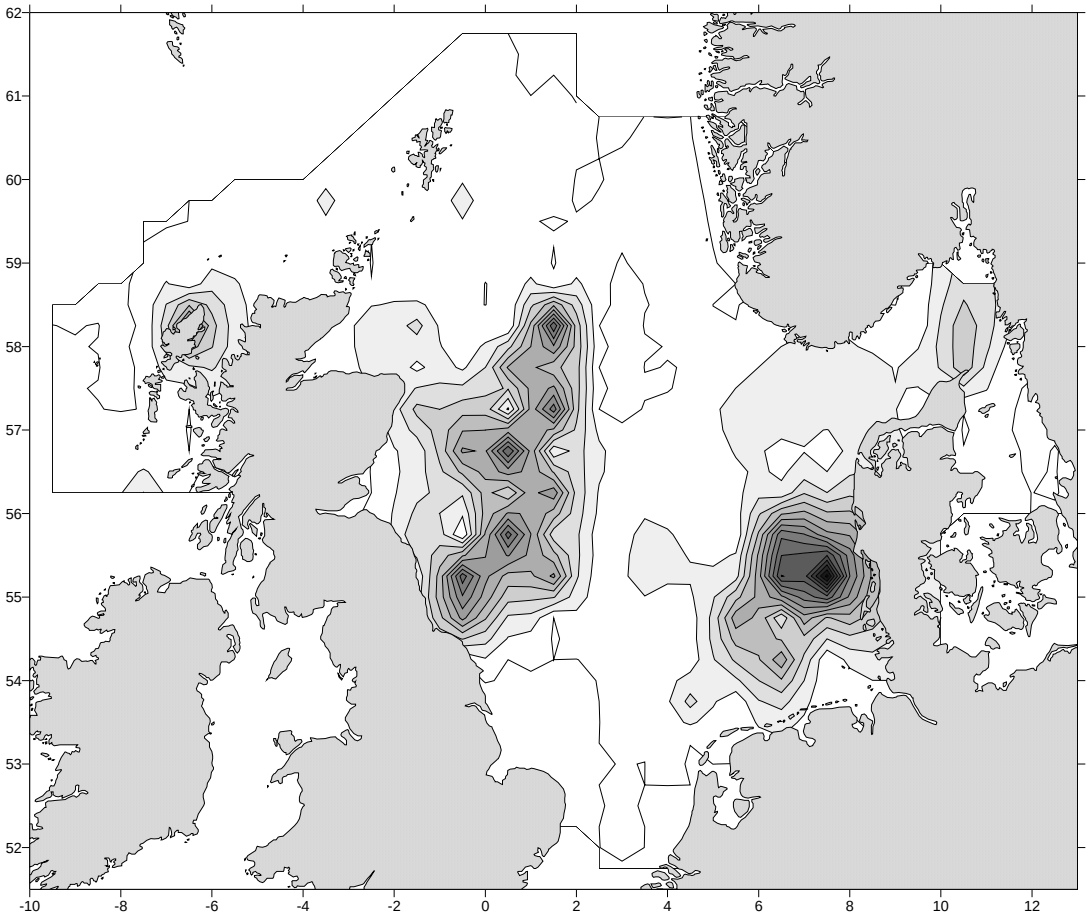


Figure 7. Biomass of immature autumn spawning herring from combined acoustic survey June - July 2004.

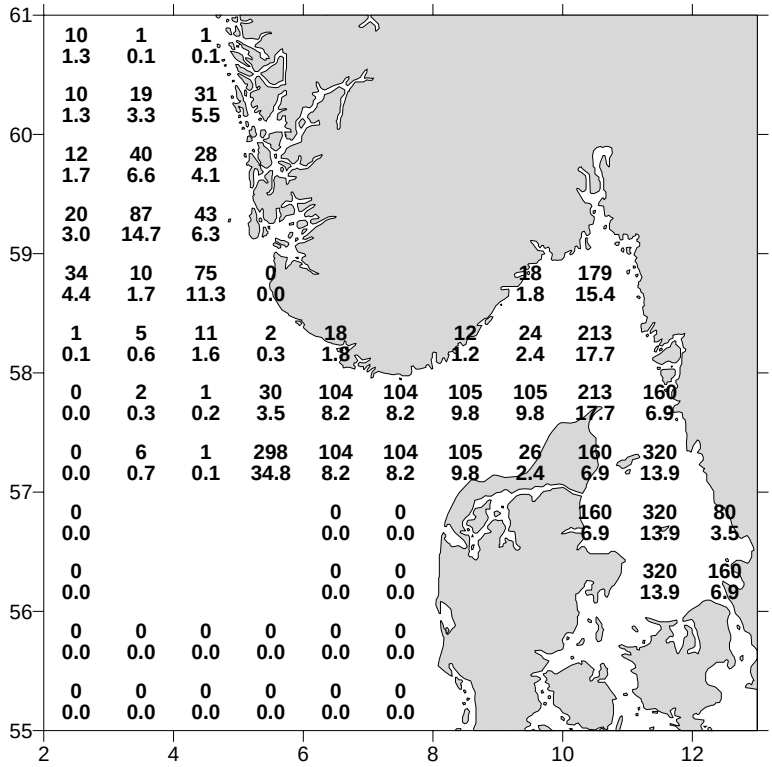


Figure 8. Numbers (millions) (upper) and biomass (thousands of tonnes) (lower) of Western Baltic spring spawning herring from combined acoustic survey June - July 2004.

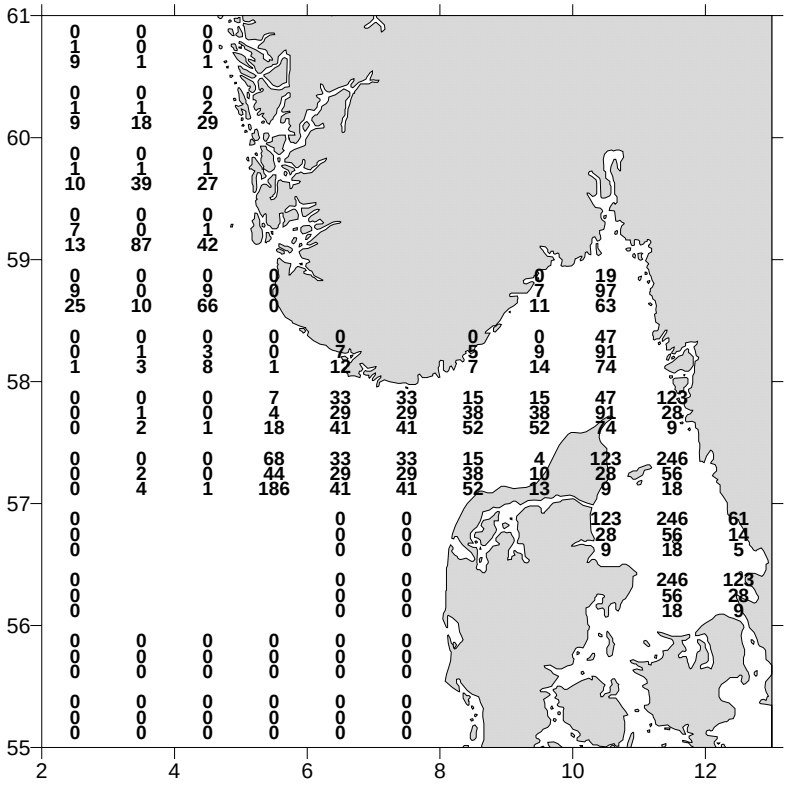


Figure 9. Numbers (millions) of Western Baltic spring spawning herring from combined acoustic survey June - July 2004. 1 ring (upper figure), 2 ring (centre figure), 3+ (lower figure).

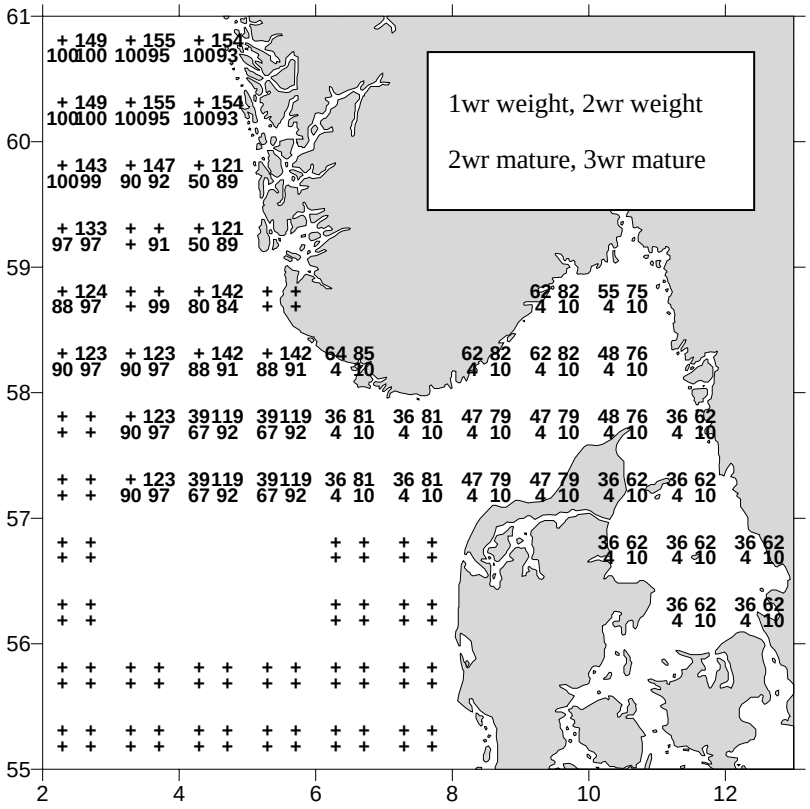


Figure 10. Mean weight and maturity of Western Baltic spring spawning herring from combined acoustic survey June - July 2004. Four values per ICES rectangle, percentage mature (lower),2 ring (left), 3 ring (right), mean weights gram (upper),1 ring (left) ,2 ring (right) ,0 indicates measured percentage mature, + indicates surveyed with zero abundance blank indicates an unsurveyed rectangle.

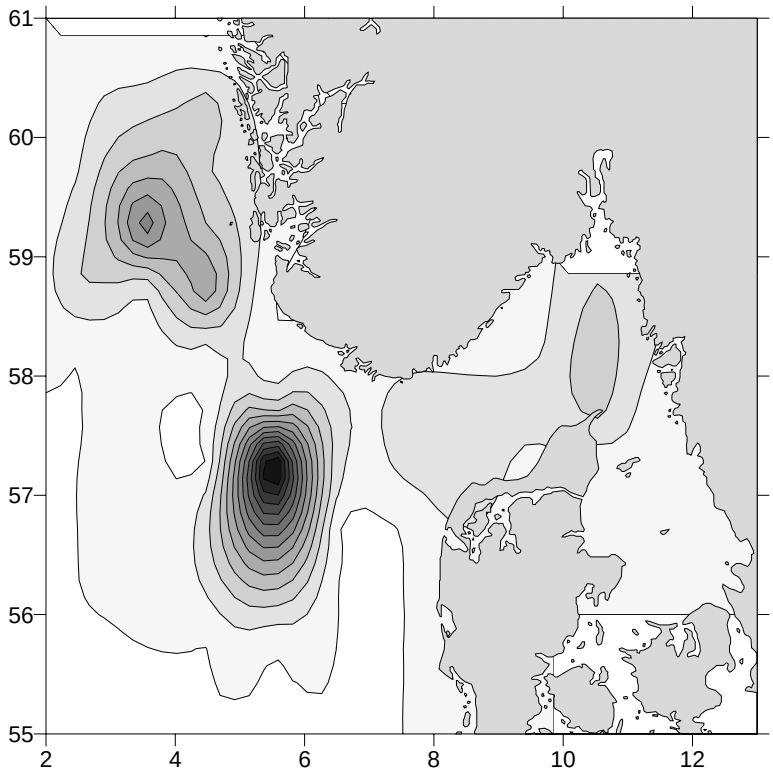


Figure 11. Abundance of mature Western Baltic spring spawning herring from combined acoustic survey July 2004. Numbers of herring.

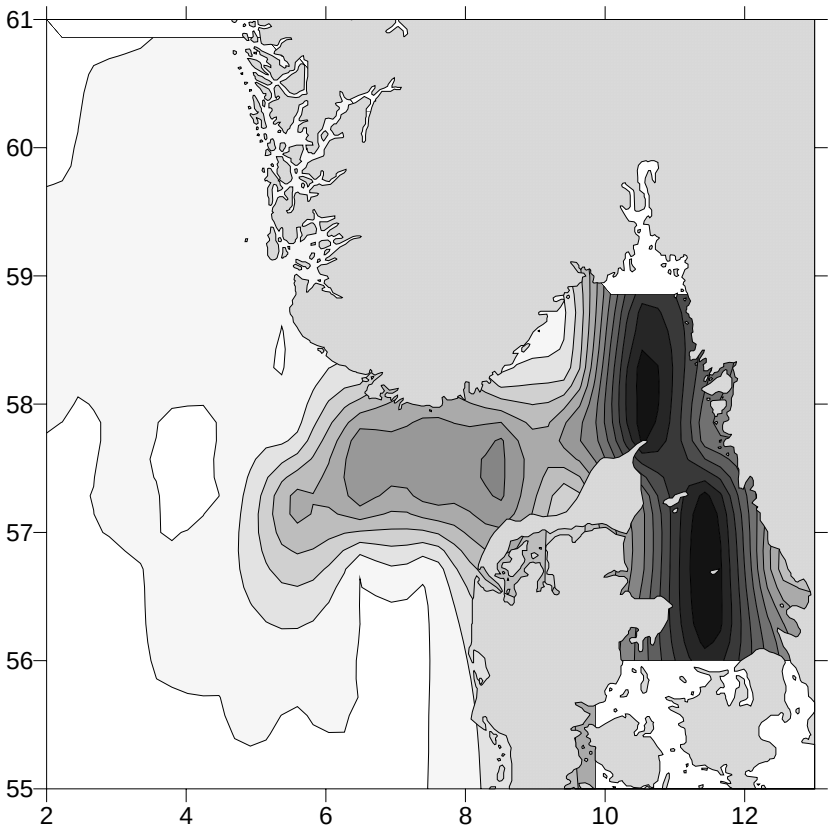


Figure 12. Abundance of immature Western Baltic spring spawning herring from combined acoustic survey July 2004. Numbers of herring.

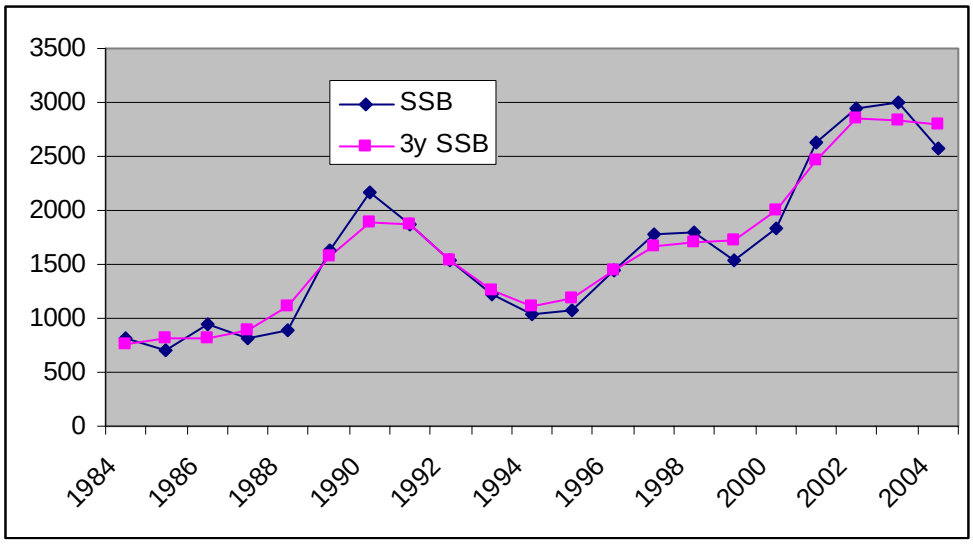


Figure 13. Time series of SSB of North Sea autumn spawning herring with three year running mean.

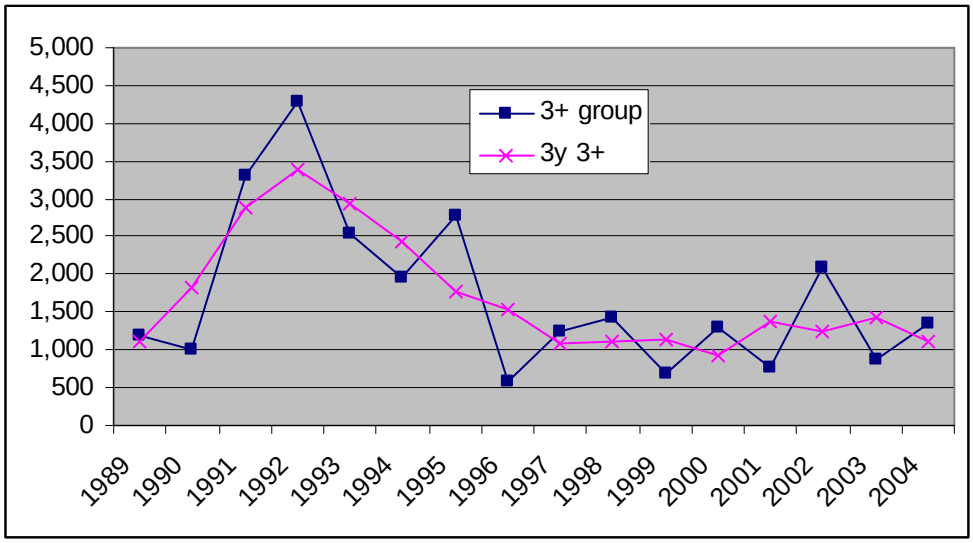


Figure 14. Time series of 3+ abundance of Western Baltic spring spawning herring with three year running mean.

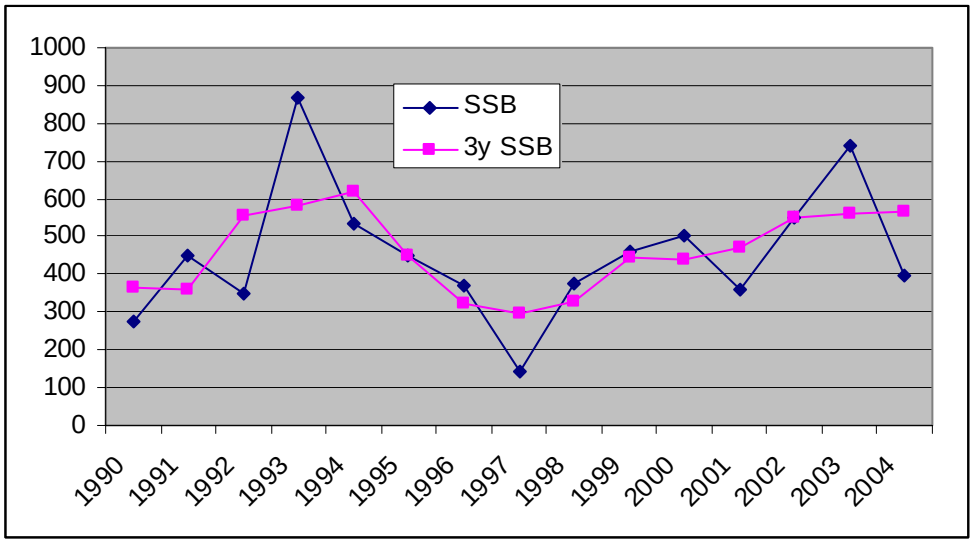


Figure 15. Time series of SSB of West of Scotland herring with three year running mean.

Annex 6: Hydrographic data from the 2004 herring acoustic survey in the North Sea

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During the last meeting of the Planning Group it was agreed to collect all results of the 2004 hydrographic measurements and prepare the data for a summarized presentation. A set of 320 CTD stations have been made available after the survey:

157 Norway
93 Germany
36 Netherlands
34 Denmark

Scotland was not able to deliver CTD data this year, but two standard hydrographic transects conducted by Norway provided a sufficient coverage of the NW area. (Figure 1). There and in the Dogger Bank and Fischer Bank region some gaps exist, but overall the whole ICES sub-area. IV was reasonably covered. The waters west of Scotland could not be examined as the charter vessel could not carry a CTD.

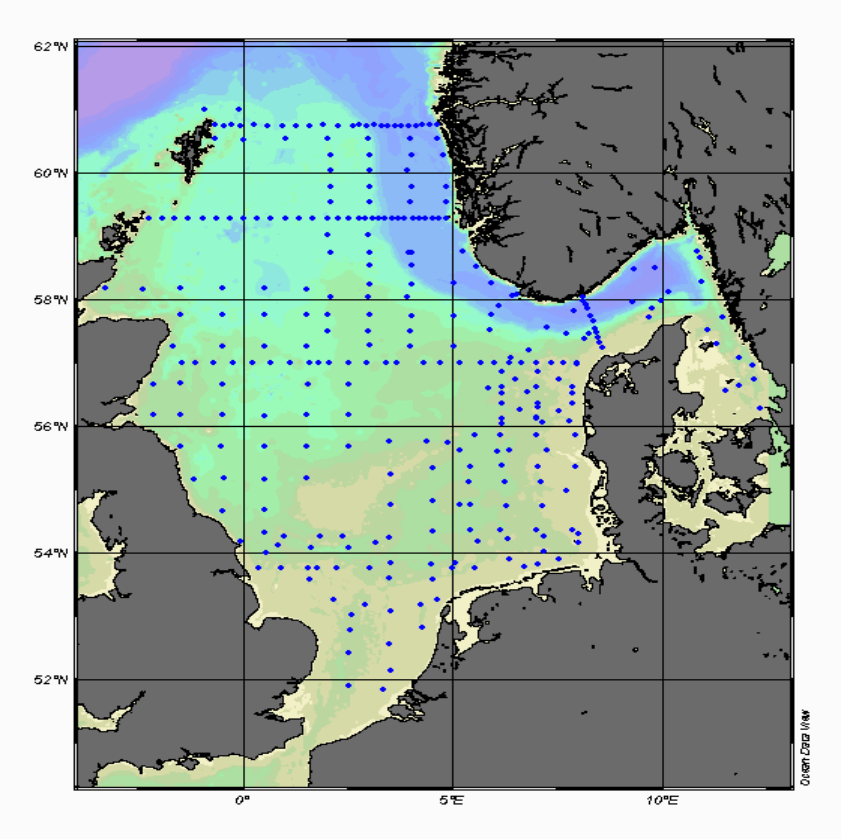


Figure 1. Hydrographic stations during the 2004 acoustic survey.

Data were supplied in different formats; they were all converted into the internal ODV binary database files. During this procedure obvious outliers/spikes were eliminated. No further processing was conducted. Some data suppliers marked that their data was considered to be raw data.

By using Ocean Data View (Schlitzer 2004) a basic analysis of the hydrographic situation was conducted. It is not intended here to present an in-depth investigation of the hydrography. The intention of this document is to demonstrate the complexity of the data and which results could be useful for an improvement of the acoustic survey in the medium term.

Figure 2 shows a diagonal section of the North Sea from the German Bight to the Shetlands. An almost stable thermocline at 30 m water depth can be observed in the central North Sea. Below the thermocline there is only cold winter water. The strong vertical temperature gradient is reduced towards NW, where the North Sea is connected to the Atlantic Ocean. The water is completely mixed in the German Bight. In this area the salinity is very low because of the influx of the rivers Elbe and Weser.

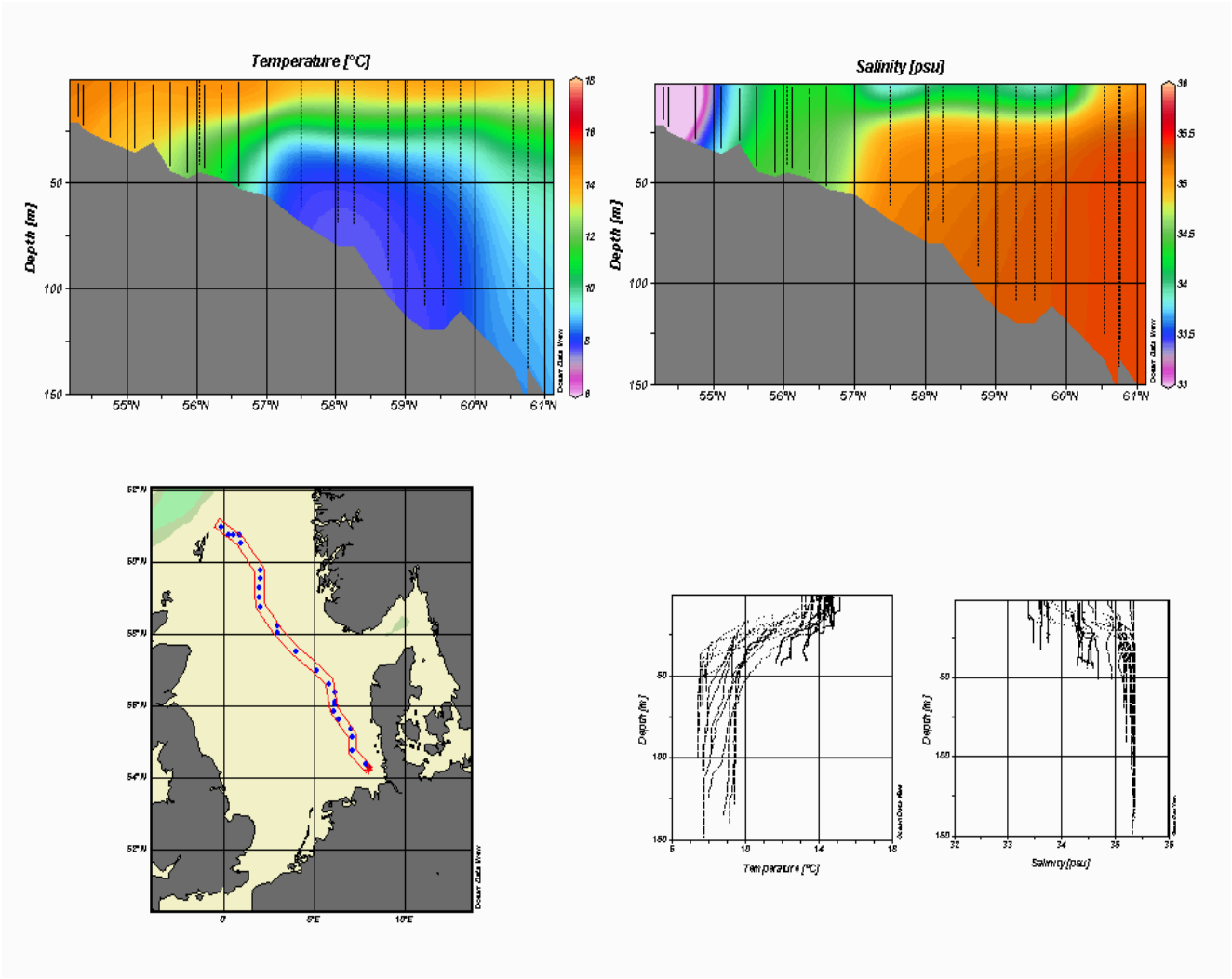


Figure 2. Vertical section - German Bight to S A better overview is offered in the horizontal representation. In Figure 3 the temperature distribution in different depth layers is demonstrated. All four plots have the same scale.

At the surface continuous temperature decay can be observed. The temperature drops down from the German coast toward north of Scotland. In the 20 m layer we have quite different conditions. Depending on the exact depth of the thermocline the temperature in some parts prevail as at the surface, like in the west part. In the Norwegian trench the thermocline is closer to the surface, therefore lower temperatures arise. The 40 m level is situated well below the thermocline on the entire North Sea. Cold water spreads over the central basin. In the representation of the bottom temperature this situation is more strongly pronounced.

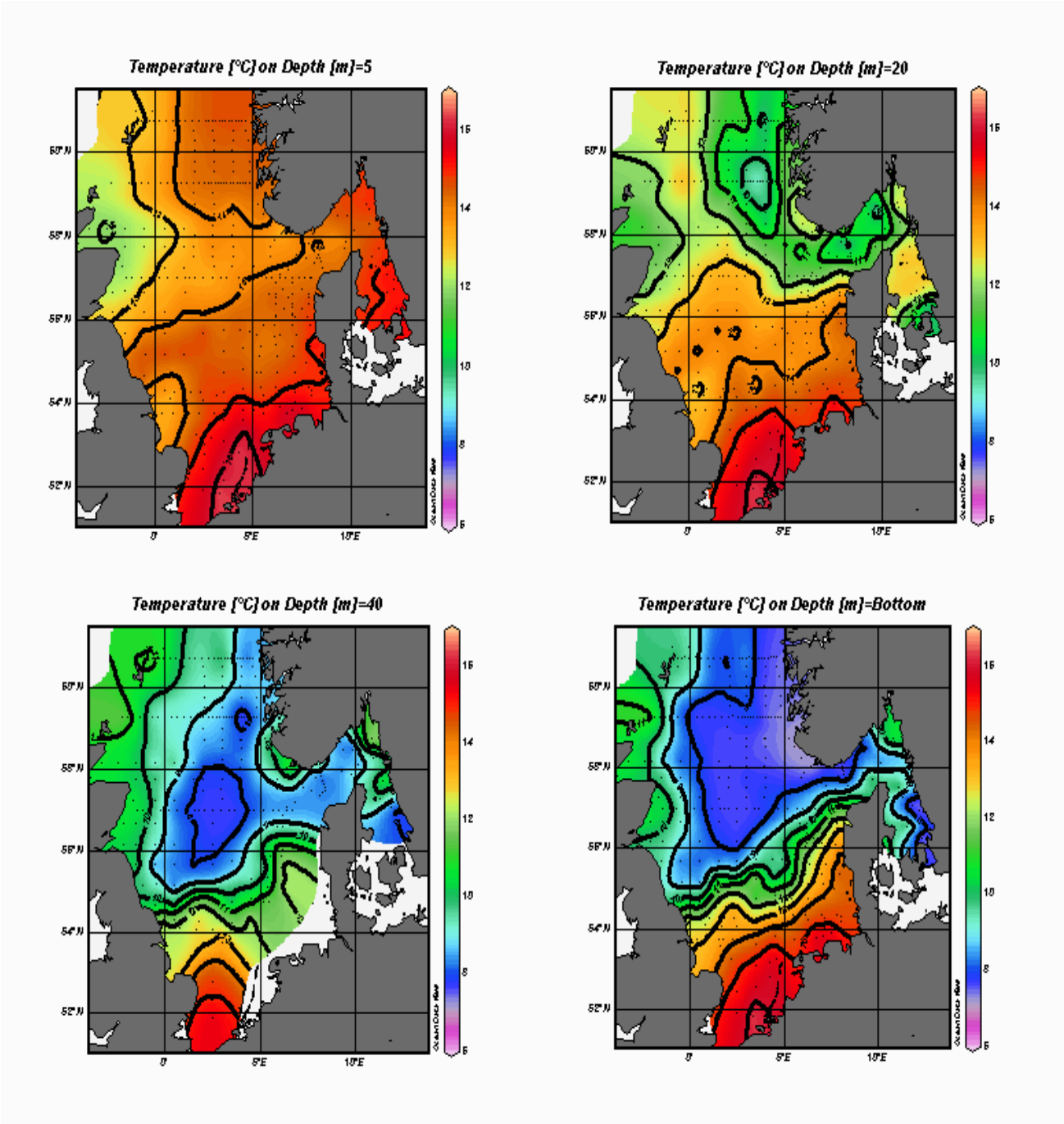


Figure 3. Temperature in different depth layers Shetlands.

The distribution of the salinity shows other typical patterns (Figure 4). A non-linear scale was used in order to point out small changes within the range of 35 psu. The salinity has a strong vertical discontinuity layer in the central North Sea (see Figure 2). Thus also sharply separated water bodies are to be counted.

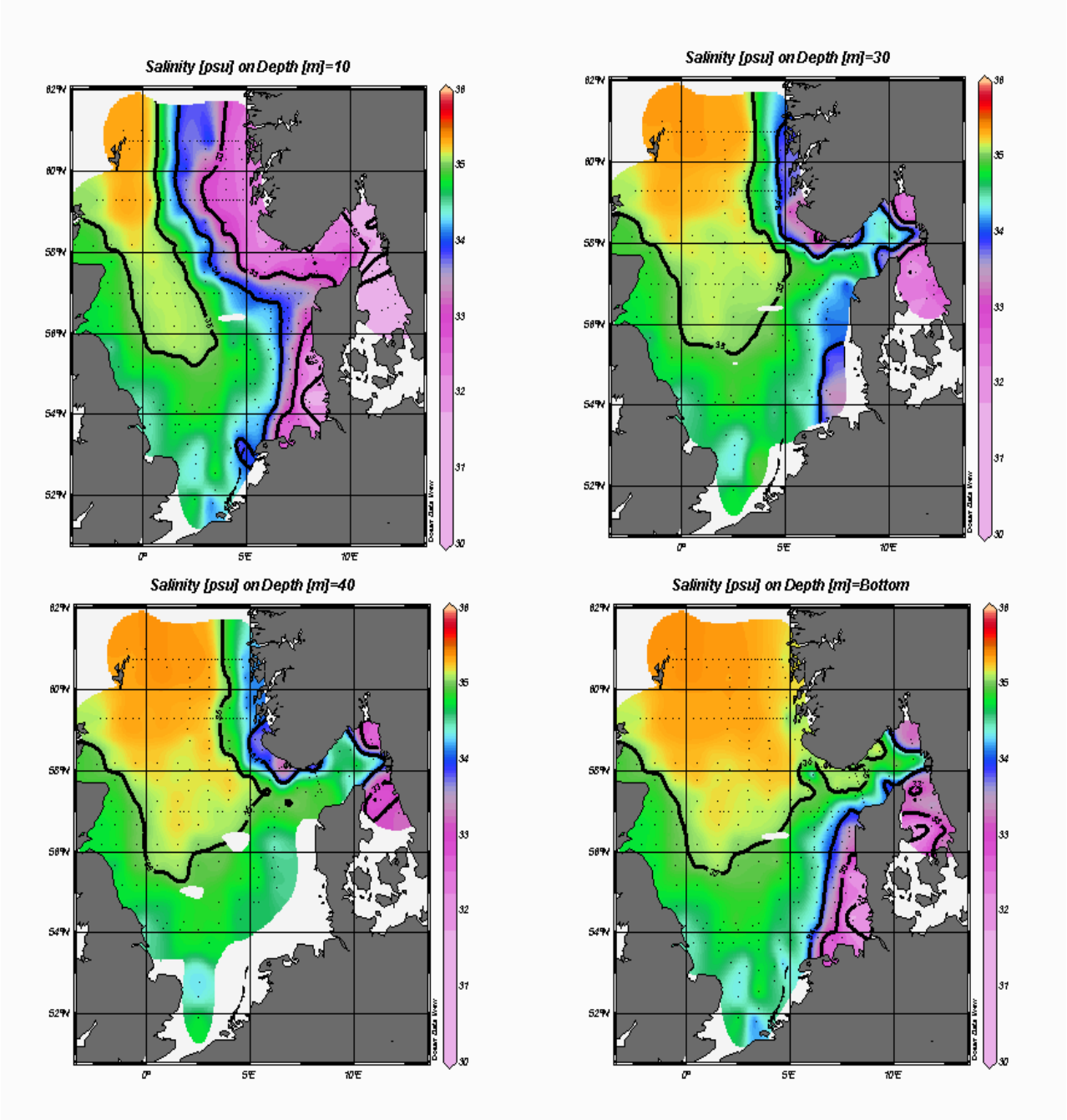


Figure 4. Salinity in different depth layers.

At the surface a clear separator goes through the North Sea. In the eastern part we find water with low salinity from the inflow of the Baltic Sea and the rivers. This water body does not achieve large depths, because the water density is small. In the western part we find the inflow from the North Atlantic with high salinity. In greater depths this water extends to the whole northern part of the area. Below 30 m the salinity remains nearly stable.

Was the water situation 2004 rather normal or have there been large differences to the past years? In June/July it was still cool, so that no extreme summer condition could be achieved.

A comparison with a standard condition of the North Sea may be informative. As reference data a period from 1980 to 1999 of the World Ocean Database was used. These data are temporally quite unevenly distributed; therefore some deviations to other standard data sets are possible.

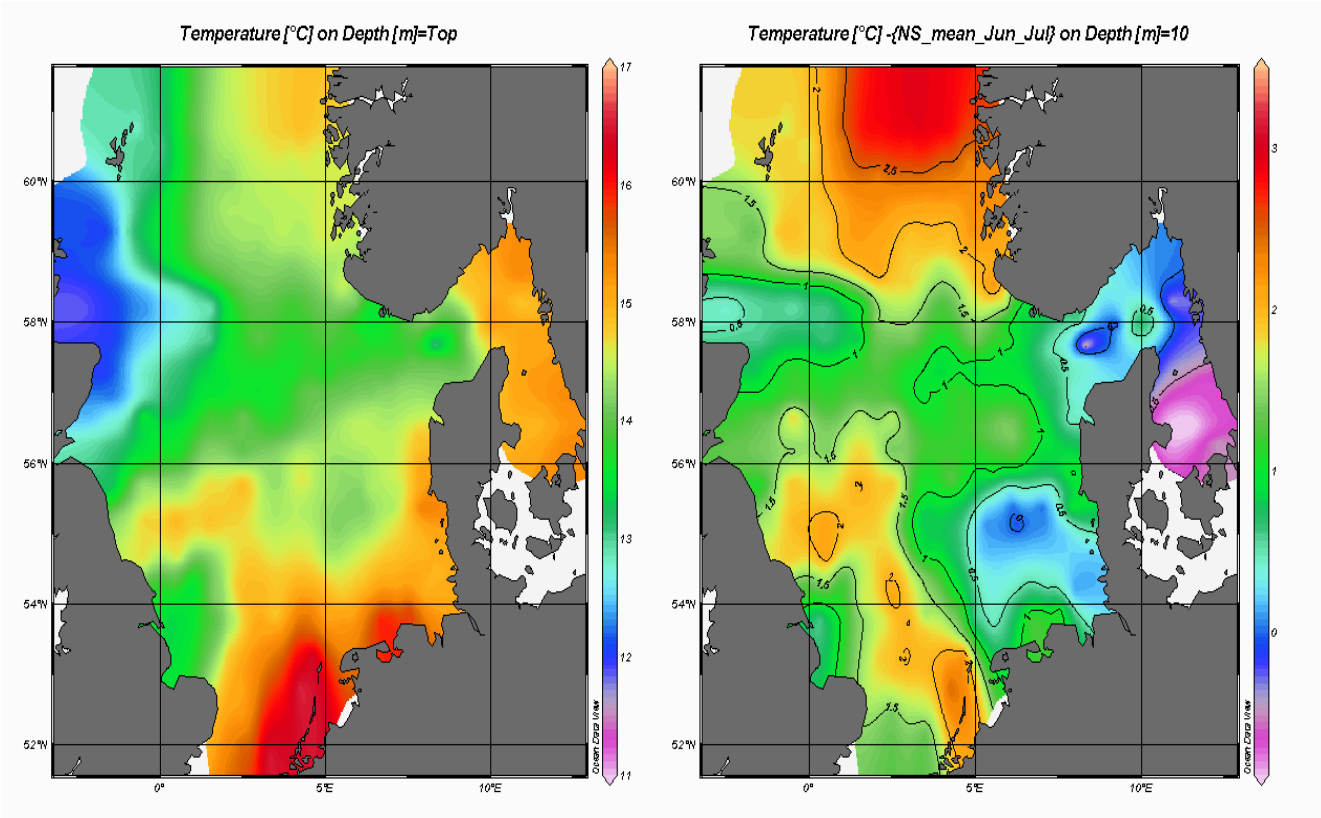


Figure 5. Surface temperature (left) and anomaly relative to the long-term mean (right).

The difference between average value and the current temperature at the surface is to be seen in Figure 5. In most of the areas the temperature is slightly higher than the average value. We can regard this condition as normal, as from the beginning of the 1990s a rise of the temperature in relation to the reference period is observed. In the NE at the Norwegian coast we have a difference up to 2°C. On the other hand mean values prevail in the German Bight and in the Skagerrak. In the Kattegat it is colder than usual. The observed temperature distribution agrees well with the satellite measurements of the SST, which are published by hydrographic services.

There are surely no satellite data for the bottom temperature. We must be content here with the own measurements. The general picture shows also the slight increase up to 1°C. This is to be interpreted as the secular trend of heating. Additionally still hotspots exist at the English coast and the coast of Jutland, where the temperature difference is 2 °C.

All in all we had a nearly “normal” June/July 2004 concerning hydrographic conditions. It would be interesting to study the effects of the “hot” summer 2003 especially in connection with the spatial distribution of fish.

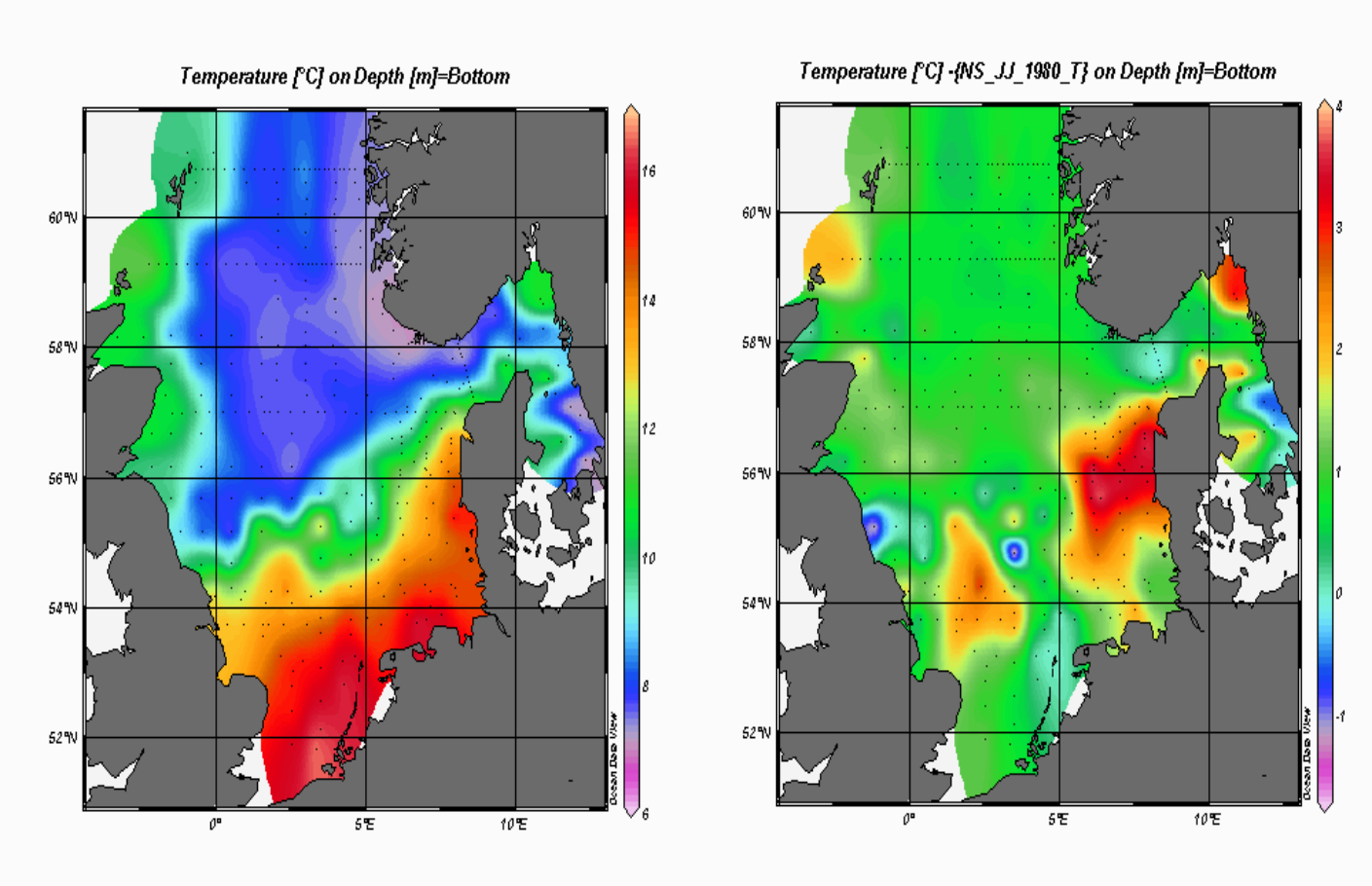


Figure 6. Bottom temperature (left) and anomaly relative to the long-term mean (right).

It is not to be discussed here, whether this information is useful. With the results from only one year naturally no statement about the usability is to be met. Hydrographic data should be collected from the past years, to make additional analyses and to connect this information with the acoustic results.

Reference

Schlitzer, R. Ocean Data View, http://www.awi-bremerhaven.de/GEO/ODV, 2004.