North Sea Herring Acoustic Survey (HERAS) on R/V "TRIDENS" 25 June – 20 July 2012

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Summary

This report presents the results of the 2012 Dutch participation in the North Sea acoustic survey for herring and sprat. This survey is carried out yearly and is coordinated by ICES. Other participating countries are Scotland, Norway, Germany, Denmark and Ireland.

For the Netherlands, R/V Tridens covered an area east of Great Britain in the western North Sea.
The stock biomass estimate of herring found in the Tridens survey area:

Immature	336.4	thousand tonnes
Spawning stock	404.2	thousand tonnes

The stock biomass estimate of sprat found in the Tridens survey area:

Immature	24.3	thousand tonnes
Spawning stock	107.8	thousand tonnes

The total amount of herring in the area covered by R/V Tridens was about 80% higher than in the previous year. The amount of mature fish was lower by about 14% compared to 2011. On the other hand, there was a lot more immature herring: compared to the previous year, the amount of immature herring observed in 2012 was over 30x higher.

1. Introduction

The Dutch Institute for Marine Resources & Ecosystem Studies (IMARES) has been participating in the international North Sea acoustic survey for herring since 1991. Participants in this survey are Scotland, Norway, Germany, Denmark, The Netherlands and Ireland. The survey is part of the EU data collection framework (DCF) and is coordinated by the Working Group for International Pelagic Surveys (WGIPS, formerly PGIPS/PGHERS). 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) in its assessment of the population size. In this report the results are presented for the survey in the central North Sea, carried out by the Dutch vessel R/V Tridens.

Cruise plan

The survey was split into two periods of 2 weeks. The executed cruise track and hydrographical positions are presented in Figures 1a and 1b. The actual surveyed transects may differ from the planned transects.

2. Methods

2.1 Scientific Staff

Name	Organisation	Role	Wk 26	Wk 27	Wk 28	Wk 29
Sascha Fässler	IMARES	**Cruise leader & Acoustics**	**x**	**x**		
Kees Bakker	IMARES	**Technician**	**x**	**x**		
Hendrik-Jan Westerink	IMARES	**Fish lab**	**x**	**x**		
Momo Kochen	IMARES	**Fish lab**	**x**	**x**		
Willem Brugge	Guest	**Fish lab**	**x**	**x**		
Dirk Burggraaf	IMARES	**Technician & Acoustics**	**x**	**x**	**x**	**x**
Bram Couperus	IMARES	**Cruise leader & Acoustics**			**x**	**x**
Ingeborg de Boois	IMARES	**Fish lab**			**x**	
Marcel de Vries	IMARES	**Fish lab**			**x**	**x**

2.2 Narrative

Tridens departed from Scheveningen on Monday 25th June and steamed up north-west towards the proposed calibration location in Scapa Flow, Orkney Islands. During passage, the trawl gear was tested, and in a separate experiment, towing forces of the MIK plankton net that will be used in a future survey were determined. Arrival in Scapa Flow was on Wednesday 27th June in the morning at 8:00 UTC. Calibration of the acoustic equipment took place during the whole day and was completed before the vessel departed again at 21:00 UTC. Arrival at the start of the first survey transect (58.17N 2.45W) was on Thursday 28th June at 4:00 UTC. During the first week, the data cable of the CTD that is currently operated on the port side (but with the winch on the starboard side) got caught in another steel wire and snapped. This was repaired by the IMARES technician onboard. Communication issues with the COM server onboard resulted in missing GPS data for 3,5 hours. During week 26, four hauls were carried out. The weather was fine and allowed good progress. The survey was stopped on Saturday 30th June at 11:10 UTC when position 57.47N 2.00W was reached and Tridens steamed to Aberdeen for the week end break. Arrival in Aberdeen was 12:30 UTC. Departure from Aberdeen was on Monday morning, 2nd July at 5:00 UTC. The survey continued on the same day at 07:30 UTC at the start of the next transect (57.41N 1.39W). During week 27, three hauls were carried out. The remaining transects were covered as planned until Wednesday 4th July at 56.41N 1.45E. On 5th July, several tests were executed by IMARES personnel to find the cause of the strong noise signature seen on the 200 kHz acoustic data. Most likely explanation was the long cable setup to the towed body. These problems can be overcome by use of an acoustic drop keel platform. ETA in Scheveningen was on Thursday 5th July at 20:00 UTC.
After departure on Monday 9th July from the port of Scheveningen, Tridens steamed up to 56.11N 2.27W to pick up the transect where the survey was interrupted on 5th July. The survey was resumed at 10:00 UTC. In the remaining days until the weekend stop in Newcastle, 7 hauls were carried out. The survey was interrupted at 55.41N 1.30W at 19:00 UTC for the stop in Newcastle. The survey continued according to the planned transects until Wednesday 18 July 22:00 UTC at 54.04N 1.54E. Arrival in Scheveningen was on Thursday 20 July at 19:00 UTC.
Since 2010, cruise leaders keep a weblog during the survey, which can be found at:
http://www.imares.wur.nl/UK/publications/weblog/northseaherring/

2.3 Survey design

The actual survey was carried out from 28th June to 18th July 2012, covering an area east of Great Britain from latitude 54°11' to 58°17' North and from longitude 3° West (off the Scottish/English coast) to 6° East between 55°30' and 56°30' North. Following the survey design since 2005, a stratified survey design with random start was applied. Parallel transects along latitudinal lines were used with spacing set at 15 or 30 nmi, depending on expected herring distribution from previous years. Acoustic data from transects running north-south close to the shore (that is parallel to the depth isoclines) were excluded from the dataset. The actual cruise track, trawl - and hydrographical station positions is presented in Figure 1.

2.4 Calibration of acoustic equipment

The calibration of the three transducers (38, 200, 333 kHz) mounted in the towed body was executed in Scapa Flow. Conditions allowed for an optimal and good calibration of the 38 and 200 kHz frequencies. Calibration values of the 333 kHz transducer were not acceptable. However, since there was no additional time available, the 333 kHz used for the first time this year, and the data not directly used for herring abundance estimation, no further calibration was attempted. Transducer settings used during the survey are given in Table 1.

2.5 Acoustic data collection

Data collection

A Simrad 38 kHz split beam transducer was operated in a towed body (type “Shark”) 5-6 m under the water surface. Acoustic data were collected with a Simrad EK60 scientific echo sounder and post-processed with the LSSS software to produce acoustic area densities (NASC) at 1 nautical mile intervals. The settings of the EK60 are listed in Table 1. The EK60 received the vessel speed from the ship’s GPS. An average survey speed of 10.0 knots was used.

All echoes were recorded with a threshold of -70dB up to a depth of 150 meters below the transducer. A ping rate of 0.6 sec was used during the entire survey. This ping rate has proven most suitable at the depths of 50 - 150 m observed in most of the area covered.

NOTE: As in previous years, there were substantial sinusoid noise bands on the 200 kHz data caused by a combination of vessel and electronic (long cable leading to the towed body) noise. These noise bands mask recordings at 200 kHz up to depths of about 50 m and present significant problems for multi-frequency data analysis. At present, the noise bands are so severe, that the 200 kHz data CANNOT be used for analysis! A solution to this problem would be the use of an acoustic drop keel (presently unavailable on Tridens).

2.6 Biological data collection

Fishing

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 to identify species-composition of major 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 Simrad SD570 60kHz sonar was used in order 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 20 to 30 m (specifications are listed in the PGHERS manual).

A Furuno FS20/25 trawl sonar (vertical and horizontal scan direction) was used to monitor catch performance.

Biological samples

For all fish:

- Total species weight of the catch
- 150 to 250 specimens for individual length measurement. Depending of the catch weight, a subsample technique is used, based on weights.

Stratified samples of 5 fish per length class were taken from the 150-250 herring and sprat. The following parameters are sampled from these fish:

- Age of herring and sprat, by means of otolith reading
- Gender
- Maturity stage

2.7 Hydrographical data

Hydrographical data were collected at 48 stations, all at fixed locations (Figure 1b). A Seabird CTD device, type SBE 9plus in combination with a corresponding water sampler 9plus in combination with a corresponding Seabird SBE 32C carousel water sampler was used in this survey. It had been successfully calibrated in advance by the manufacturer. Conductivity, temperature and depth were measured.

2.8 Data handling, analysis and presentation

Data analysis
The echograms were scrutinized with Large Scale Survey System (LSSS) software.
For each ICES rectangle, species composition and length distribution were determined as the un-weighted mean of all trawl results for this rectangle. From these distributions the mean acoustic backscattering cross-section "sigma" (σ_{bs}) was calculated according to the target strength-length relationships (TS) recommended by the ICES Working Group on International Pelagic Surveys.

The numbers of herring and sprat per ICES rectangle were calculated by dividing the NASC within each rectangle by the overall σ_{bs} in the corresponding rectangle.

The biological samples used for stock structure and biomass calculations were grouped in 4 strata for herring and 1 stratum for sprat, based on similar length frequency distribution in the area (Figure 2). 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 results

Largest herring concentrations were found in the north-eastern part of the Dutch survey area (rectangle with highest concentration: 44E9) (Figure 3a). Sprat was found mostly close to the coast in the southern part of the survey area, in the Moray Firth and the Firth of Forth (rectangle with highest concentration: 39E8) (Figure 3b). Unlike in 2010, amounts of observed aggregations of Norway pout in the survey area were insignificant.

3.2 Trawl data results

In total, 14 trawl hauls were conducted. Herring was found in 11 hauls of which 9 samples of more than 20 herring were taken. Sprat was found in 5 hauls. 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 used in the analysis for herring are presented in Table 2c. Norway pout was observed in one trawl but in insignificant amounts. The biological samples contained a total of 534 herring and 208 sprat that were collected and used for length, age, weight, sex and maturity keys**.**

3.3 Stock estimates

The stock biomass estimate of herring found in the Tridens survey area:

Immature	336.4	thousand tonnes
Spawning stock	404.2	thousand tonnes

The stock biomass estimate of sprat found in the Tridens survey area:

Immature	24.3	thousand tonnes
Spawning stock	107.8	thousand tonnes

The total amount of herring in the area covered by R/V Tridens was about 80% higher as in the previous year. The amount of mature fish was lower by about 14% compared to 2011. On the other hand, there was a lot more immature herring: compared to the previous year, the amount of immature herring observed in 2012 was over 30x higher.
The amount of sprat observed was about 9x the amount observed in the previous year in the Tridens survey area. Similarly to herring, a lot more immature fish were observed (24.3 x 10^3 tonnes) compared to the last year (0.1 x 10^3 tonnes).

Figure 4 shows the estimated numbers and biomass of herring by ICES rectangle in the area surveyed by R/V Tridens. Table 3 summarizes stock estimates per stratum and Tables 4 and 5 summarise the sub stock estimates for herring and sprat.

Table 1. Simrad EK60 calibration settings used on the 2012 North Sea herring acoustic survey on R/V Tridens.

```
#  Calibration  Version   2.1.0.12
#
#  Date:  27-6-2012
#
#  Comments:
#    Scapa Flow, 2nd calibration, 27.06.2012
#
#  Reference Target:
#    TS                  -42.30 dB       Min. Distance          7.70 m
#    TS Deviation          5.0 dB        Max. Distance          9.80 m
#
#  Transducer:  ES38B  Serial No.   30501
#    Frequency           38000 Hz        Beamtype                Split
#    Gain                26.50 dB        Two Way Beam Angle   -20.6 dB
#    Athw. Angle Sens.      21.90        Along. Angle Sens.      21.90
#    Athw. Beam Angle    7.10 deg        Along. Beam Angle    7.10 deg
#    Athw. Offset Angle  0.00 deg        Along. Offset Angle  0.00 deg
#    SaCorrection         0.00 dB        Depth                0.00  m
#
#  Transceiver:  GPT  38 kHz 009072017a3b 2-1 ES38B
#    Pulse Duration      1.024 ms        Sample Interval     0.190   m
#    Power                2000  W        Receiver Bandwidth   2.43 kHz
#
#  Sounder Type:
#    EK60 Version  2.2.0
#
#  TS Detection:
#    Min. Value          -50.0 dB        Min. Spacing           100 %
#    Max. Beam Comp.       6.0 dB        Min. Echolength         80 %
#    Max. Phase Dev.          8.0        Max. Echolength        180 %
#
#  Environment:
#    Absorption Coeff.   9.9 dB/km       Sound Velocity     1486.9 m/s
#
#  Beam Model results:
#    Transducer Gain    = 25.47 dB       SaCorrection       = -0.57 dB
#    Athw. Beam Angle   = 7.06 deg       Along. Beam Angle  = 6.97 deg
#    Athw. Offset Angle = 0.06 deg       Along. Offset Angle=-0.07 deg
#
#  Data deviation from beam model:
#    RMS =    0.30 dB
#    Max =    0.86 dB  No. =   370  Athw. = -3.7 deg  Along = -3.0 deg
#    Min =   -1.01 dB  No. =   101  Athw. = -2.6 deg  Along =  0.3 deg
#
#  Data deviation from polynomial model:
#    RMS =    0.26 dB
#    Max =    0.77 dB  No. =   331  Athw. =  4.5 deg  Along = -2.2 deg
#    Min =   -0.76 dB  No. =   110  Athw. = -1.6 deg  Along = -0.2 deg
```

Table 2a. Details of the trawl hauls taken on R/V Tridens during the North Sea herring acoustic survey 2012.

haul	day	month	year	hour	minute	haul	lat	lon	depth	wind	wind	gear
1	28	6	2012	4	28	62	58.16	-1.22	156	90	7	pelagic trawl
2	28	6	2012	9	40	60	58.13	0.28	144	90	7	pelagic trawl
3	29	6	2012	6	18	20	58.04	0.48	164	135	9	pelagic trawl
4	30	6	2012	3	30	33	57.51	-2.44	85	270	7	pelagic trawl
5	2	7	2012	11	22	45	57.41	-0.48	113	180	2	pelagic trawl
6	2	7	2012	15	4	27	57.41	-0.21	102	135	4	pelagic trawl
7	3	7	2012	18	0	57	57.1	-1.26	79.89063	90	1	pelagic trawl
8	12	7	2012	6	58	50	55.59	5.44	46.89844	315	4	pelagic trawl
9	13	7	2012	11	29	62	55.41	0.26	74.89063	315	4	pelagic trawl
10	16	7	2012	6	51	66	55.11	-1.06	82	315	4	pelagic trawl
11	16	7	2012	14	7	61	55.11	0.18	73	315	4	pelagic trawl
12	17	7	2012	12	43	56	54.4	0.2	65.09375	315	4	pelagic trawl
13	18	7	2012	11	38	59	54.11	0.13	53.29688	315	4	pelagic trawl
14	18	7	2012	20	0	60	54.05	1.52	70	225	7	pelagic trawl

Table 2b. Trawl catches in kg on R/V Tridens during the North Sea herring acoustic survey 2012.

haul no	herring	N. pout	other gadoids	mackerel	sprat	others
1	2576		23	261		0
2	2211		7	52		2
3	1267		8	29		
4	0	4	9	10	524	
5	11195		42	25		
6	1982		4	52		
7						
8	277		5		9	12
9	4		2	1013		1
10	4		73	2	985	
11			1	0		
12			29	38		0
13	11		3		435	10
14	0		2		160	14

Table 2c. Length frequency proportions of herring by haul caught on R/V Tridens during the North Sea herring acoustic survey 2012.

length/haul-no proportion %	1	2	3	5	6	8	9	10	13
13.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.3
14.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.2	9.3
15	0.0	0.0	0.0	0.0	0.0	0.6	0.0	8.3	7.0
15.5	0.0	0.0	0.0	0.0	0.0	6.1	0.0	8.3	4.7
16	0.0	0.0	0.0	0.0	0.0	24.2	0.0	12.5	2.3
16.5	0.0	0.0	0.0	0.0	0.0	32.1	0.0	0.0	3.5
17	0.0	0.0	0.0	0.0	0.0	23.6	0.0	0.0	1.2
17.5	0.0	0.0	0.0	0.0	0.0	9.7	0.0	0.0	0.0
18	0.0	0.0	0.0	0.0	0.0	1.8	0.0	0.0	2.3
18.5	0.0	0.0	0.0	0.2	0.0	1.8	0.0	4.2	1.2
19	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2
19.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.3
20	0.0	0.0	0.0	0.4	0.7	0.0	0.0	0.0	0.0
20.5	0.0	0.0	0.0	3.1	2.2	0.0	0.0	4.2	0.0
21	0.0	0.5	0.0	7.4	2.9	0.0	0.0	0.0	0.0
21.5	0.0	0.0	0.3	15.1	4.7	0.0	4.3	0.0	1.2
22	0.5	0.5	0.0	14.2	6.7	0.0	4.3	0.0	0.0
22.5	0.5	0.0	0.3	15.5	6.7	0.0	0.0	0.0	2.3
23	4.1	0.5	0.3	14.2	10.4	0.0	0.0	0.0	1.2
23.5	1.0	0.0	1.0	10.3	6.7	0.0	0.0	4.2	1.2
24	9.3	1.0	1.4	4.7	8.9	0.0	0.0	4.2	2.3
24.5	7.3	2.4	1.4	3.3	8.4	0.0	0.0	0.0	2.3
25	12.4	2.9	2.4	3.5	8.9	0.0	0.0	4.2	4.7
25.5	18.7	2.0	3.8	2.5	9.3	0.0	8.7	16.7	1.2
26	20.2	3.4	7.2	2.3	8.0	0.0	13.0	4.2	5.8
26.5	5.2	7.3	8.9	1.6	4.0	0.0	13.0	4.2	7.0
27	11.4	15.1	8.9	1.0	4.4	0.0	13.0	8.3	9.3
27.5	4.1	14.6	13.7	0.6	2.4	0.0	17.4	4.2	9.3
28	2.1	10.2	16.7	0.2	1.8	0.0	17.4	0.0	4.7
28.5	2.1	11.7	13.7	0.0	0.7	0.0	4.3	4.2	2.3
29	1.0	11.7	8.9	0.0	1.3	0.0	0.0	0.0	3.5
29.5	0.0	8.8	4.8	0.0	0.7	0.0	0.0	0.0	3.5
30	0.0	3.4	2.7	0.0	0.0	0.0	4.3	4.2	1.2
30.5	0.0	1.5	2.4	0.0	0.0	0.0	0.0	0.0	0.0
31	0.0	1.5	0.7	0.0	0.2	0.0	0.0	0.0	0.0
31.5	0.0	0.5	0.7	0.0	0.0	0.0	0.0	0.0	0.0
32	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
32.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
33	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
33.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
34	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
no in sample	193	205	293	515	450	165	23	24	86

Table 3. Age/maturity-length keys for herring –Stratum A - D. Tridens, North Sea acoustic survey 2012.

			Stratum A				
Age	Year	Mean Length (cm)	Mean weight (g)	Number (millions)	%	Biomass (1000 tons)	%
0I	2011im			0	0.0	0.000	0.0
0M	2011ad			0	0.0	0.000	0.0
1I	2010im			0	0.0	0.000	0.0
1M	2010ad			0	0.0	0.000	0.0
2I	2009im	24.4	131.4	161	8.4	21.122	6.3
2M	2009ad	25.4	151.2	422	22.1	63.778	18.9
3I	2008im	26.1	159.6	75	3.9	12.026	3.6
3M	2008ad	27.3	188.4	456	23.8	85.911	25.5
4I	2007im	27.4	169.7	219	11.5	37.174	11.0
4M	2007ad	27.7	196.0	229	12.0	44.961	13.3
5I	2006im	27.9	180.4	144	7.5	25.950	7.7
5M	2006ad	28.7	205.4	85	4.5	17.491	5.2
6M	2005	29.5	231.1	95	5.0	22.060	6.5
7M	2004			0	0.0	0.000	0.0
8M	2003	29.9	245.0	18	1.0	4.453	1.3
9M	2002	31.5	284.0	3	0.1	0.795	0.2
10M	2001	30.5	262.0	4	0.2	0.965	0.3
11M	2000	32.0	312.0	1	0.1	0.364	0.1
12+	<2000			0	0.0	0.000	0.0
Mean		28.3	208.9				
Total				1913	100.0	337.049	100.0
Immature				599	31.3	96.272	28.6
Mature				1314	68.7	240.778	71.4

			Stratum B				
Age	Year	Mean Length (cm)	Mean weight (g)	Number (millions)	%	Biomass (1000 tons)	%
0I	2011im			0	0.0	0.000	0.0
0M	2011ad			0	0.0	0.000	0.0
1I	2010im	21.5	82.9	138	4.4	11.407	3.1
1M	2010ad			0	0.0	0.000	0.0
2I	2009im	22.5	101.3	1726	55.7	174.901	47.1
2M	2009ad	24.6	141.6	790	25.5	111.837	30.1
3I	2008im	23.7	118.7	92	3.0	10.879	2.9
3M	2008ad	26.2	172.1	191	6.2	32.920	8.9
4I	2007im	27.3	176.4	55	1.8	9.631	2.6
4M	2007ad	26.9	174.8	49	1.6	8.487	2.3
5I	2006im	27.8	180.7	25	0.8	4.503	1.2
5M	2006ad	28.3	202.7	18	0.6	3.647	1.0
6M	2005			0	0.0	0.000	0.0
7M	2004			0	0.0	0.000	0.0
8M	2003	30.4	246.6	6	0.2	1.484	0.4
9M	2002	28.2	195.6	8	0.3	1.523	0.4
10M	2001			0	0.0	0.000	0.0
11M	2000			0	0.0	0.000	0.0
12+	<2000			0	0.0	0.000	0.0
Mean		26.1	163.0				
Total				3096	100.0	371.219	100.0
Immature				2035	65.7	211.320	56.9
Mature				1061	34.3	159.899	43.1

			Stratum C				
Age	Year	Mean Length (cm)	Mean weight (g)	Number (millions)	%	Biomass (1000 tons)	%
0I	2011im			0	0.0	0.000	0.0
0M	2011ad			0	0.0	0.000	0.0
1I	2010im	16.1	33.6	15	39.4	0.513	12.3
1M	2010ad			0	0.0	0.000	0.0
2I	2009im	21.5	80.0	0	0.6	0.018	0.4
2M	2009ad	23.4	110.0	1	2.0	0.083	2.0
3I	2008im	23.3	100.5	1	3.2	0.126	3.0
3M	2008ad	25.3	146.8	0	1.3	0.073	1.8
4I	2007im			0	0.0	0.000	0.0
4M	2007ad	25.3	138.4	4	9.5	0.512	12.3
5I	2006im			0	0.0	0.000	0.0
5M	2006ad	26.0	148.6	6	16.8	0.965	23.1
6M	2005	27.7	163.3	2	4.2	0.268	6.4
7M	2004	27.3	179.8	3	6.7	0.465	11.1
8M	2003	27.3	170.1	2	5.5	0.360	8.6
9M	2002	27.9	181.0	1	3.6	0.250	6.0
10M	2001	28.3	190.9	1	3.2	0.234	5.6
11M	2000	28.6	194.2	2	4.1	0.306	7.3
12+	<2000			0	0.0	0.000	0.0
Mean		25.2	141.3				
Total				39	100.0	4.173	100.0
Immature				17	43.3	0.657	15.7
Mature				22	56.7	3.516	84.3

			Stratum D				
Age	Year	Mean Length (cm)	Mean weight (g)	Number (millions)	%	Biomass (1000 tons)	%
0I	2011im			0	0.0	0.000	0.0
0M	2011ad			0	0.0	0.000	0.0
1I	2010im	16.6	34.5	818	100.0	28.194	100.0
1M	2010ad			0	0.0	0.000	0.0
2I	2009im			0	0.0	0.000	0.0
2M	2009ad			0	0.0	0.000	0.0
3I	2008im			0	0.0	0.000	0.0
3M	2008ad			0	0.0	0.000	0.0
4I	2007im			0	0.0	0.000	0.0
4M	2007ad			0	0.0	0.000	0.0
5I	2006im			0	0.0	0.000	0.0
5M	2006ad			0	0.0	0.000	0.0
6M	2005			0	0.0	0.000	0.0
7M	2004			0	0.0	0.000	0.0
8M	2003			0	0.0	0.000	0.0
9M	2002			0	0.0	0.000	0.0
10M	2001			0	0.0	0.000	0.0
11M	2000			0	0.0	0.000	0.0
12+	<2000			0	0.0	0.000	0.0
Mean		16.6	34.5				
Total				818	100.0	28.194	100.0
Immature				818	100.0	28.194	100.0
Mature				0	0.0	0.000	0.0

Table 4. Mean length, mean weight, biomass (thousands of tonnes) and numbers (millions) **herring** breakdown by age and maturity obtained during the July 2012 North Sea herring acoustic survey on R/V Tridens.

		Total area (all strata summarized)			
Age	Year	Number (millions)	%	Biomass (1000 tons)	%
0I	2011im	0	0.0	0.000	0.0
0M	2011ad	0	0.0	0.000	0.0
1I	2010im	971	16.6	40.114	5.4
1M	2010ad	0	0.0	0.000	0.0
2I	2009im	1887	32.2	196.041	26.5
2M	2009ad	1212	20.7	175.698	23.7
3I	2008im	168	2.9	23.032	3.1
3M	2008ad	648	11.0	118.904	16.1
4I	2007im	274	4.7	46.805	6.3
4M	2007ad	282	4.8	53.960	7.3
5I	2006im	169	2.9	30.453	4.1
5M	2006ad	110	1.9	22.104	3.0
6M	2005	97	1.7	22.327	3.0
7M	2004	3	0.0	0.465	0.1
8M	2003	26	0.4	6.297	0.9
9M	2002	12	0.2	2.568	0.3
10M	2001	5	0.1	1.199	0.2
11M	2000	3	0.0	0.670	0.1
12+	<2000	0	0.0	0.000	0.0
Total		5865	100.0	740.635	100.0
Immature		3468	59.1	336.443	45.4
Mature		2397	40.9	404.192	54.6

Table 5. Mean length, mean weight, biomass (thousands of tonnes) and numbers (millions) **sprat** breakdown by age and maturity obtained during the July 2012 North Sea herring acoustic survey on R/V Tridens.

		Total area (all strata summarized)			
Age	Year	Number (millions)	%	Biomass (1000 tons)	%
0I	2011im	1927	17.4	15.275	11.6
0M	2011ad	703	6.3	7.139	5.4
1I	2010im	546	4.9	6.991	5.3
1M	2010ad	6082	54.9	76.978	58.3
2I	2009im	103	0.9	2.019	1.5
2M	2009ad	1167	10.5	17.540	13.3
3I	2008im	0	0.0	0.000	0.0
3M	2008ad	263	2.4	6.172	4.7
4I	2007im	0	0.0	0.000	0.0
4M	2007ad	0	0.0	0.000	0.0
5I	2006im	0	0.0	0.000	0.0
5M	2006ad	0	0.0	0.000	0.0
6M	2005	0	0.0	0.000	0.0
7M	2004	0	0.0	0.000	0.0
8M	2003	0	0.0	0.000	0.0
9M	2002	0	0.0	0.000	0.0
10M	2001	0	0.0	0.000	0.0
11M	2000	0	0.0	0.000	0.0
12+	<2000	290	2.6	0.000	0.0
Total		11081	100.0	132.113	100.0
Immature		2576	23.2	24.284	18.4
Mature		8505	76.8	107.829	81.6

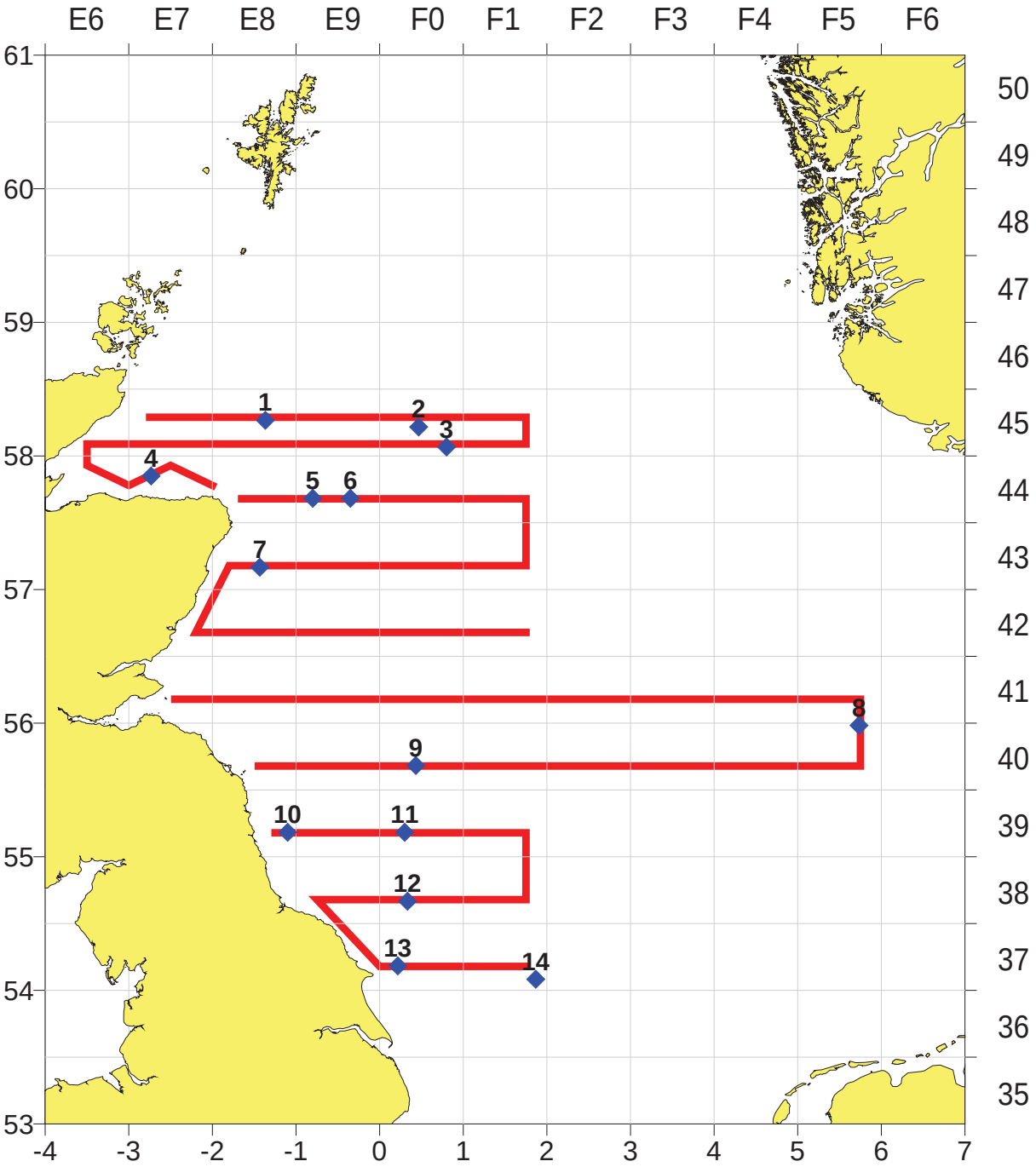

Figure 1a. Map of executed cruise track and positions of trawl stations (blue diamonds with numbers) during the July 2012 North Sea herring acoustic survey on R/V Tridens.

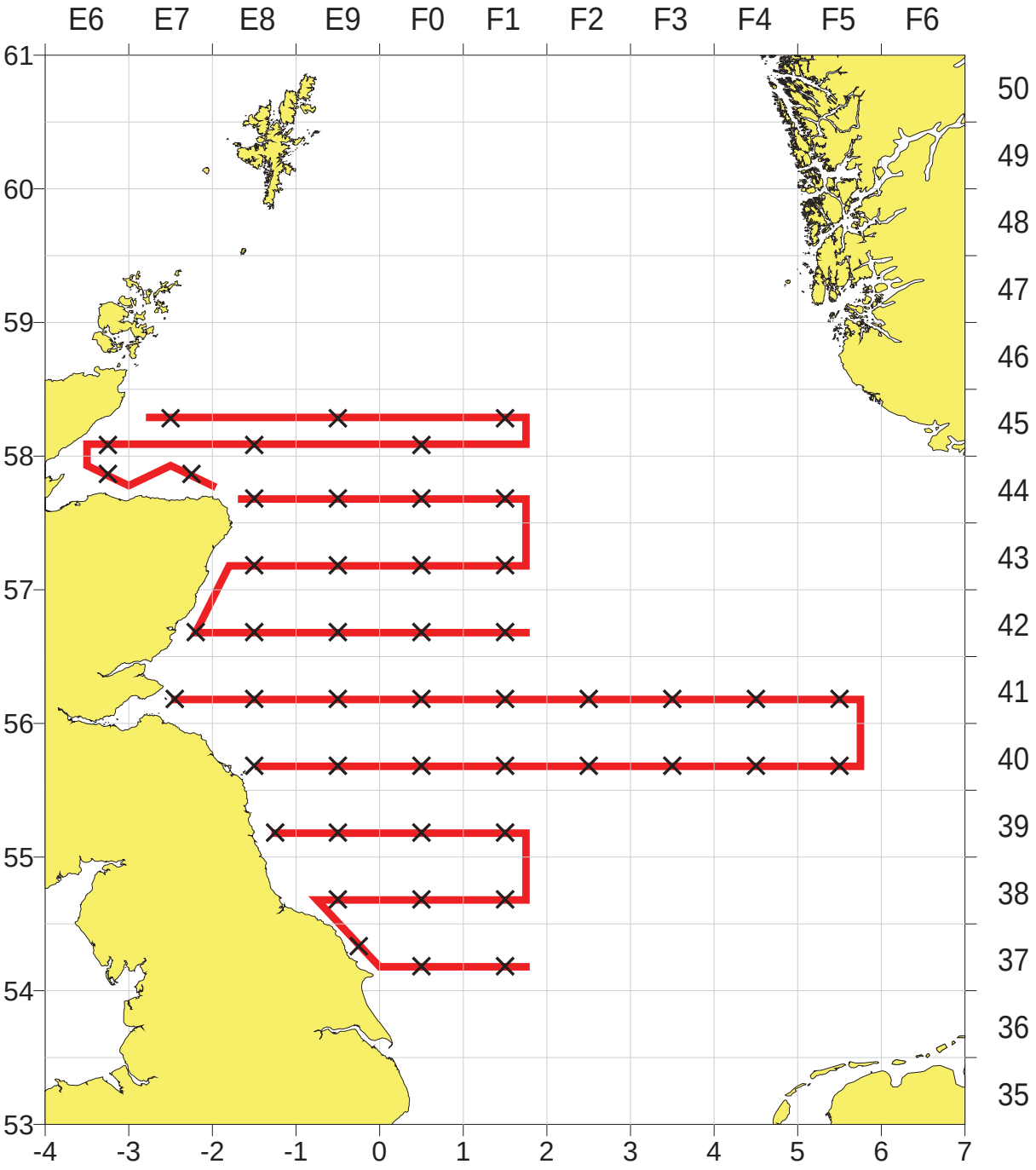

Figure 1b. Map of hydrographical stations (crosses) during the July 2012 North Sea herring acoustic survey on R/V Tridens.

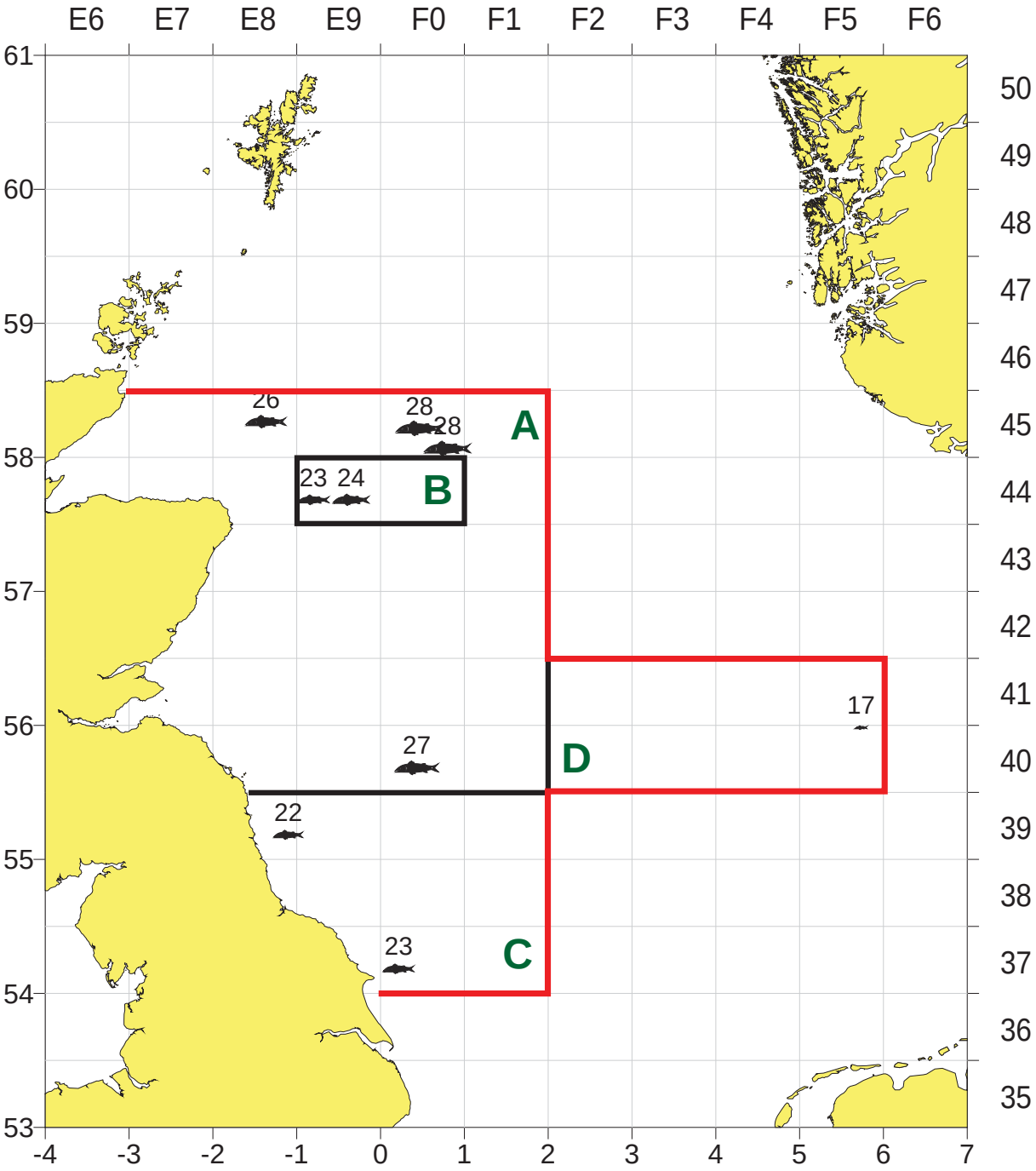

Figure 2. Survey strata used to pool length frequency distributions of herring and to raise NASC's by rectangle to numbers and biomass during the July 2012 North Sea herring acoustic survey on R/V Tridens. Size of fish symbols represent relative mean lengths of herring caught in the hauls that contained more than 20 herring.

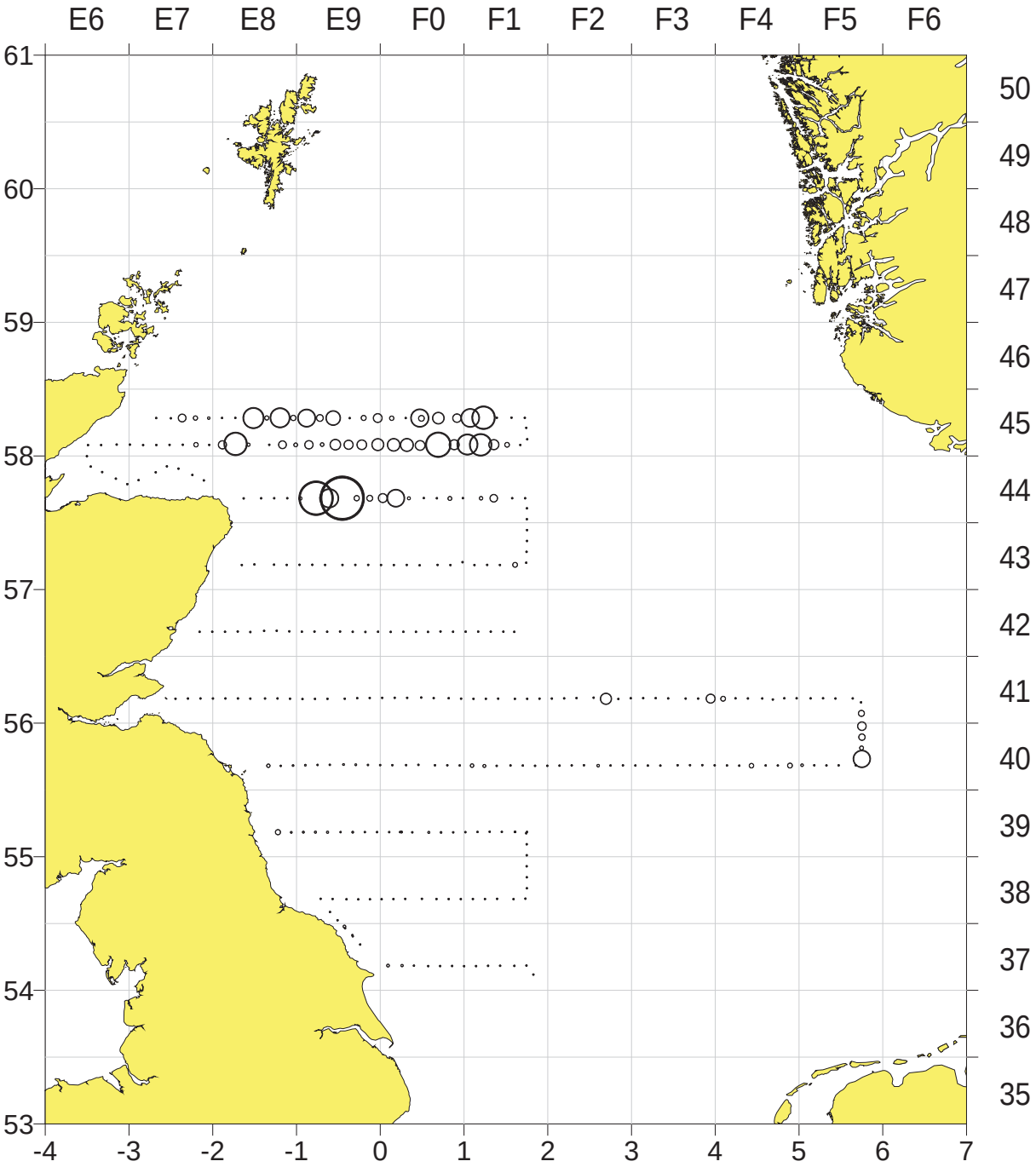

Figure 3a. Post plot showing the distribution of **total herring** NASC's of 5 nm intervals (on a proportional square root scale relative to the largest value of 5514.46) obtained during the July 2012 North Sea herring acoustic survey on R/V Tridens.

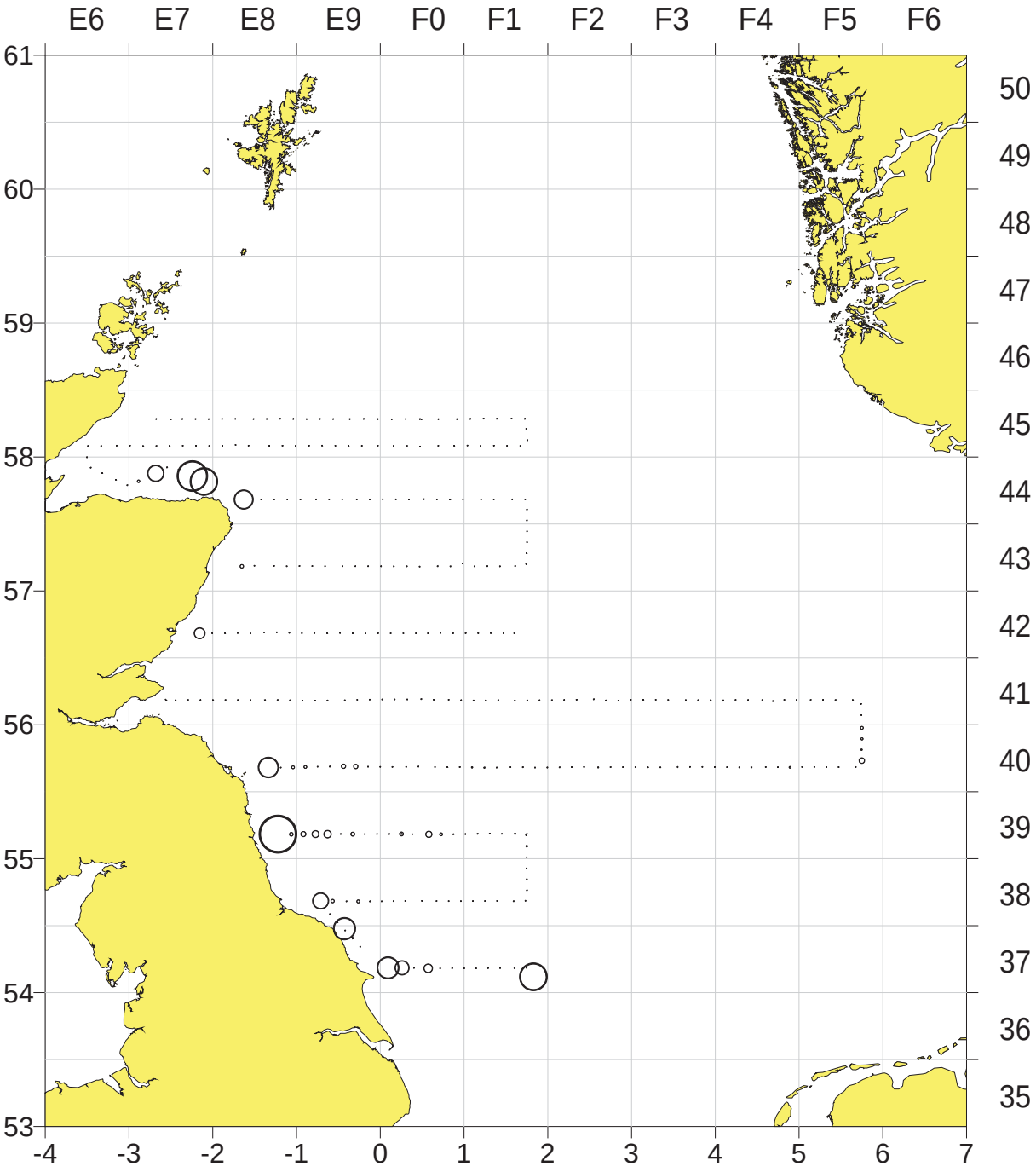

Figure 3b. Post plot showing the distribution of **total sprat** NASC's by 5 nm intervals (on a proportional square root scale relative to the largest value of 1638.82). Obtained during the July 2012 North Sea herring acoustic survey on R/V Tridens.

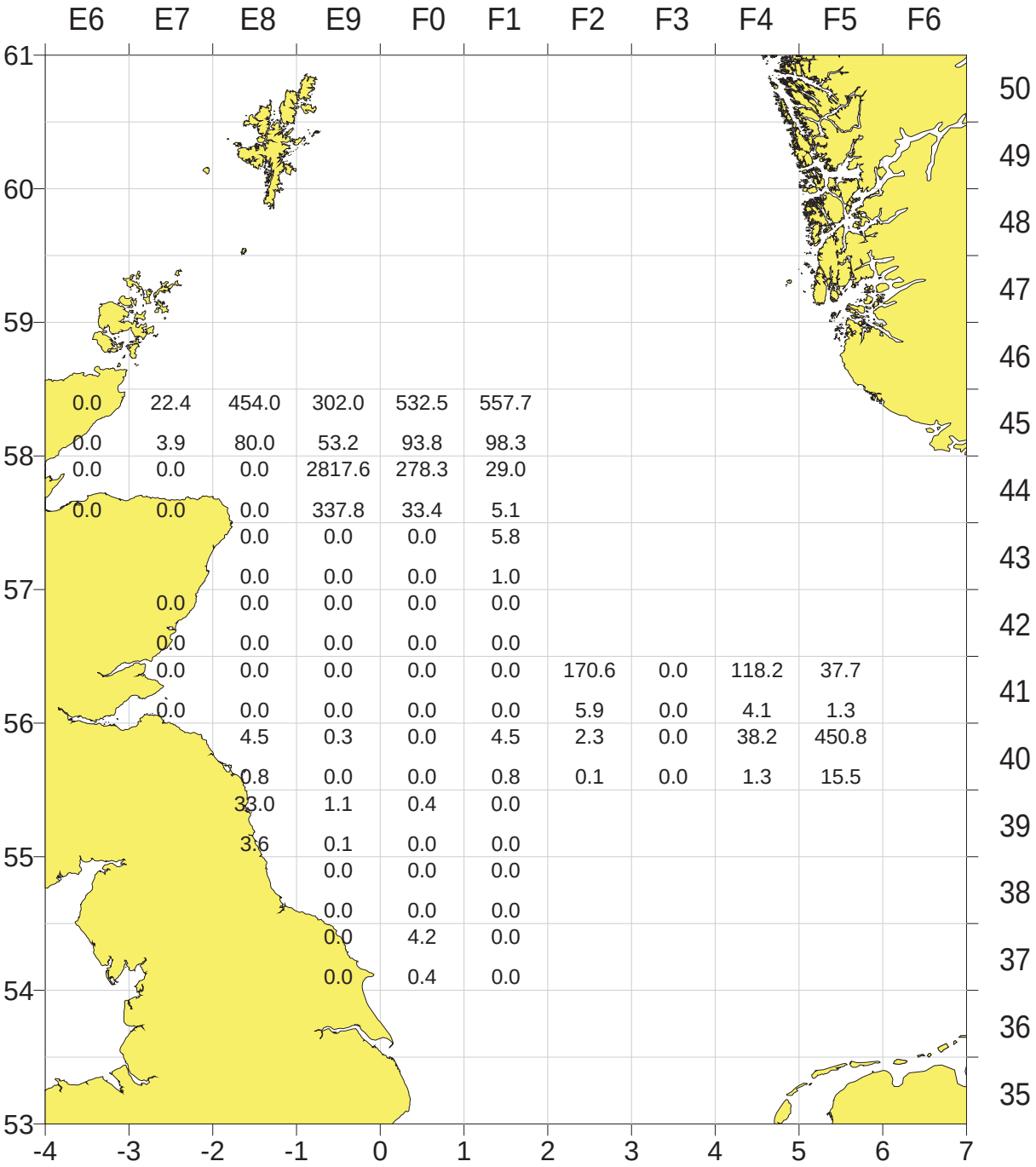

Figure 4. Estimated numbers of **herring** in millions (upper half square) and biomass in thousands of tonnes (lower half of square) by ICES rectangle. Results from the July 2012 North Sea herring acoustic survey on R/V Tridens.

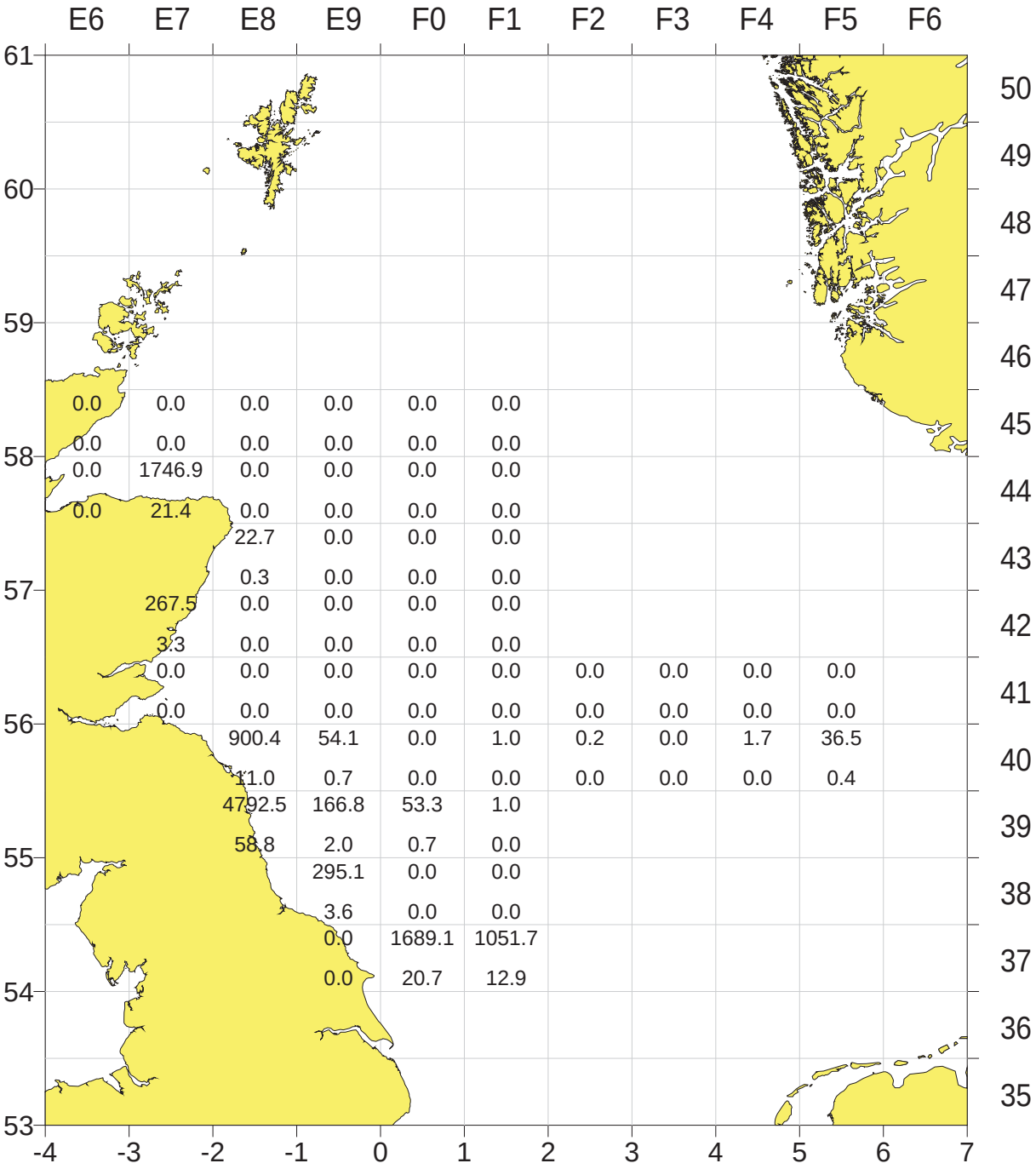

Figure 5. Estimated numbers of **sprat** in millions (upper half square) and biomass in thousands of tonnes (lower half of square) by ICES rectangle. Results from the July 2012 North Sea herring acoustic survey on R/V Tridens.