Acoustic Herring Survey report for RV "DANA"

3rd July2010 – 13th July 2010

Karl Johan Stæhr
DTU-Aqua, National Institute of Aquatic Resources

Cruise summary

Total days	14
Days of monitoring	11
Number of acoustic samples, ESDU	1578
Number of trawl hauls	38
Number of CTD stations	38
Number of measured fish	21404
Number of aged and race-splitted herring.	3678
Number of aged sprat	635

1. INTRODUCTION

Since 1991 the DTU National Institute of Aquatic Resources (DTU AQUA) 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 2010-survey with R/V DANA, covering the Skagerrak and Kattegat, was conducted in the period July 5 to July 16 2010, while calibration was done during July 3 to July 5 2010.

2. SURVEY

2.1 Personnel

During calibration 3/7 – 5/7-2010
Karl-Johan Stæhr (cruise leader)
Bo Lundgren (assisting cruise leader)
Torben Filt Jensen
Thyge Dyrnesli
Peter Faber
Jesper Knudsen
Mads Larsen
Bjarne Stage
Helle Rasmussen
Claus Halle
An Hoai Pham
Jønne Marcher
Martin Petrella

During acoustic monitoring 5/7 - 16/7-2009
Karl-Johan Stæhr (cruise leader)
Bjarne Stage (assisting cruise leader)
Torben Filt Jensen
Lise Sindahl
Helle Rasmussen
Helle Andersen
Nina Fuglsang
Thyge Dyrnesli
Jønne Marcher
Martin Petrella

2.2 Narrative

The survey of R/V Dana started on July 3 at 10.00 UTC with departure from Hirtshals heading towards Bornö in Gullmar Fjord, Sweden for calibration of the acoustic equipment. The vessel was anchored at Bornö in the Gullmar Fjord, Sweden early in the evening of July 3. The calibration was initiated in the morning of July 4 and continued until the morning of July 5.

At July 5 noon the scientific crew was exchanged outside the harbour of Skagen. At this point a technician from Ødegaard & Danneskjold-Samsøe was taken onboard to do noise measurements on the trawl deck. These noise measurements were conducted north of Skagen during setting and hauling of a trawl and continued until 16.00 UTC after which the ship returned to Skagen with the technician. After the short break, R/V Dana steamed west towards the border between Skagerrak and the North Sea. The acoustic integration was initiated on July 6 at 0503 UTC at 57º15'N, 07º34'E.

The North Sea and western Skagerrak area was covered during the period July 5 – 10, eastern Skagerrak during July 11 – 13 and Kattegat during July 14 – 16. The acoustic integration was ended July 16 at 57º25'N, 10º46'E at 04.48 UTC. R/V Dana arrived at Hirthals at 1100 UTC on July 16.

Totally the survey covered about 2000 nautical miles. Data from the 38 kHz echosounder were recorded mainly using a 38 kHz paravane transducer running at depths of 3 – 5 m, the depth depending on the sea state and sailing direction relative to the waves. Simultaneously, data from the 120 kHz and 18 kHz echosounders using hull-mounted transducers were also recorded. The quality of the latter data is strongly dependent on the weather conditions, but this year the weather was calm, so no data had to be excluded due to the weather. During trawling hull-mounted transducers were used for all three frequencies.

2.3 Survey design

The survey was carried out in the Kattegat and Skagerrak area, east of 6° E and north of 56° N (Fig. 1). The area is split into 8 sub-areas.

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 limitations regarding available time periods and places for fishing (late morning, early afternoon and immediately before and after midnight; and a 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 pattern adapted to the depth curves and the relatively heavy ship traffic.

2.4 Calibration

The echosounders were calibrated at Bornö in the Gullmar Fjord, Sweden during July 3 - July 5 2010. The calibration was performed according to the procedures established for EK60 with three frequencies (18, 38 and 120 kHz). This was the second calibration of the year, the previous one just before a cruise to the Norwegian Sea in May. The calibration of the paravane split-beam transducer at 38 kHz was done against a 60 mm copper sphere. The calibration of the three hull-mounted split-beam transducers at 18, 38 and 120 kHz were carried out against 63mm, 60 mm and 23 mm copper spheres, respectively. The results were close to those from the previous calibration earlier in May, and for 38 kHz on the towed body close to results from previous years. The calibration and setup data of the EK60 38 kHz used during the survey are shown in Table 1.
The impedance data for the hull-mounted 38 kHz transducer showed that two of the four segments had significantly lower values than normal. Therefore, this transducer has been replaced during docking in October 2010

2.5 Acoustic data collection

Acoustic data were collected using mainly the Simrad EK60 38 kHz echosounder with the transducer (Type ES 38 7x7 degrees main lobe) in a towed body. The towed body runs at approx. 3 m depth in good weather and down to about 6 -7 m, as needed, depending on the weather conditions, this year mostly at 4 – 5 m. The speed of the vessel during acoustic sampling was 9 – 11 knots. Also EK60 18 kHz and 120 kHz data were collected. They have not been directly used for the survey estimate, but as an aid during judging when distinguishing between fish and plankton. The acoustic data were recorded as raw data on hard disk 24 hours a day also during fishing operations. During trawl hauls the towed body is taken aboard and the EK60 38 kHz echosounder run on the hull transducer, but data taken during fishing periods are not used for the biomass estimate. The sampling unit (ESDU) was one nautical mile (nm). For the purpose of the later judging process, raw data is pre-integrated into 1 m meter samples for each ping. These samples are stored in separate files one for each ESDU. Integration is conducted from 3 m below the transducer to 1 m above the bottom or to max 300 m depth.

2.6 Biological data - fishing trawls

The 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 were carried out using an EXPO trawl (16 mm in the codend). Trawling was carried out in the time intervals 1000 to 1600 and 2030 to 0300 UTC , usually two day hauls (pelagic on larger depth and demersal in shallow waters) and two night hauls (mostly surface or midwater). The strategy was to cover most depth zones within each geographical stratum with trawl hauls. One-hour hauls were used as a standard during the survey.
The total weight of each catch was estimated and the catch sorted into species. Total weight per species and length measurements were made. The clupeid fish were measured to the nearest 0.5 cm

total length below, other fish to 1 cm, and the weight to the nearest 0.1g wet weight. From each trawl haul 10 herring (if available) per 0.5 cm length class were collected and frozen for individual determination in land-laboratory of length, weight, age, race (North Sea autumn spawners or Baltic Sea spring spawners) and maturity. Fourier Shape Analyses calibrated to micro-structure formed in the otoliths during the larval period was used for the discrimination of herring race. Maturity was determined according to an 8-stage scale as also used by Scotland.

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 similar to trawl hauls and shown in Fig. 2.

2.8 Data analysis

The raw data is pre-integrated into 1 m samples for each ping and divided into 1 mile datasets and stored on harddisk 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. The software allows ignoring data from layers and/or intervals with interference from wave- or ship wake-bubbles or rarely with interference from bottom-integration. In areas with heavy abundance of jellyfish or zooplankton, usually krill, manually adjustable thresholds are applied separately to each layer to suppress background echoes.

For each subarea (56E06 – 58E08, C – E in Fig.1) the mean backscattering cross section was estimated for herring, sprat, gadoids and mackerel based on the standardized TS-relationships given in the Manual for Herring Acoustic Surveys in ICES Division III, IV, and IVa (ICES 2000):

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 = 20 log L – 84.9 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 combined length-race and length-age distributions in the allocated trawl hauls.

Length-age and length weight relationships by race for the herring were made based on the age and race analysis made on the frozen samples of single fish after the cruise.

.

3. RESULTS & DISCUSSION

3.1 Acoustic data

The total number of acoustic sample units of 1 nm (ESDU's) used in the stock size calculation is 11578. The numbers of ESDU's per stratum are given in Table 2. Table 2 also shows the mean Sa and mean TS per stratum used in the abundance estimation. The outline of the strata is shown in Figure 1 and the cruise track for the survey is shown in Figure 2.

Historically, herring and sprat have not been observed in midwater trawl hauls at depths below 150 meters. Therefore, layers below 150 meter have been excluded from the estimation.

The relative herring density in numbers per nm^2 along the cruise track is shown in Figure 3. The main concentration of herring is in 2010 primarily distributed in ICES squares 43F8, 44F9, 44G0, 44G1. This distribution is quite different from 2008 when the main concentration was further west (west of 8˚ E) (see fig 5). The main distribution pattern is more like the pattern in 2009 except that a larger part is found in Skagerrak along the Danish coast and in Kattegat than in 2009 (see Fig. 4).

3.2 Biological data

During the survey in 2010 38 hauls were conducted, 26 surface hauls and 12 bottom hauls. The geographical distribution of hauls is shown in Fig. 2 and details on the hauls and catches are given in Table 3 and 4.

The total catch for the survey was 29.2 tons. Herring was present in 32 hauls with a total catch of 19.4 tons or 66% of the total catch. In 2010, like in the last three years, herring was fished best during daytime in surface hauls in the deeper parts of Skagerrak. Length distributions of herring per haul are given in Table 5.
Sprat was present in the hauls in the North Sea (ICES square 41F7, Skagerrak west of Hirtshals (ICES square 44F9 and Kattegat (stratum E). For the total survey area herring, mackerel and sprat contributed to the total catch by 66%, 8 % and 4 % respectively.

Herring maturity

Based on the frozen single fish herring samples (3678 specimens) from each haul, where race analysis of the otoliths was used to differentiate between North Sea herring and Western Baltic herring, a maturity by age key was made for both races. It is given in the text table below. For North Sea autumn spawners specimens with maturity stage ≥3 and/or age ≥5 are regarded as mature and for Baltic spring spawners specimens with maturity stage ≥2 and/or age ≥5 are regarded as mature.

North Sea autumn spawners:

Skagerrak											
WR	0	1i	1m	2i	2m	3i	3m	4i	4m	5	6	7
%	100.00	99.76	0.24	79.55	20.45	85.19	14.81	60.00	40.00	100.00	100.00	100.00

Kattegat							
WR	0	1i	1m	2i	2m	3i	3m
%	100.00	99.20	0.80	27.27	72.73	40.00	60.00

North Sea					
WR	0	1i	1m	2i	2m
%	100	100	0	50	50

Baltic Sea spring spawners:

Skagerrak																	
WR	0	1i	1m	2i	2m	3i	3m	4i	4m	5	6	7	8	9	10	11	12
%	100.00	79.41	20.59	11.43	88.57	2.43	97.57	0.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Kattegat													
WR	0	1i	1m	2i	2m	3i	3m	4i	4m	5	6	7	8
%	100.00	87.69	12.31	24.23	75.77	21.62	78.38	6.90	93.10	100.00	100.00	100.00	100.00

North Sea							
WR	0	1i	1m	2i	2m	3i	3m
%	100	100	0	0	100	0	100

Sprat maturity

Based on 635 sprat collected over all length classes and hauls including sprat age, weight and maturity keys were established. The maturity key for sprat is shown in the text table below. Sprat with maturity stage ≥3 and/or age ≥3 are regarded as mature

WR	0	1i	1m	2i	2m	3	4	5	6
%	100.00	81.03	18.97	55.03	44.97	100.00	100.00	100.00	100.00

Ichthyophonus.

The herring sampled for race analyses were also visually inspected for Ichthyophonus. At 6 stations in the western Skagerrak and Kattegat (see Figure 6) Ichthyophonus was found at herring smaller than 18 cm.

3.3 Biomass estimates

Herring

The total herring biomass estimate for the Danish acoustic survey with R/V Dana in July 2010 is 237,542 tonnes of which 62.7% or 148,946 tonnes is North Sea autumn spawners and 37.3 % or 88,597 tonnes is Baltic Sea spring spawners.
For the total number of herring the survey results give 4,184 mill, of which 65.1 % are North Sea autumn spawners and 34.9 % are Baltic Sea spring spawners.

The estimated total number of herring, mean weight, mean length and biomass per age and maturity stage in each of the surveyed strata are given in Table 6 and 7 for North Sea autumn spawners and Baltic spring spawners respectively.

A comparison for the results of the last three years surveys are given in the text table below.

	2006	2007	2008	2009	2010
Autumn spawners					
Number in mill.	1530	4443	4473	9679	2723
Biomass in tons	98786	315176	80469	157707	148946
Spring spawners					
Number in mill.	6407	8847	7367	1326	1461
Biomass in tons	471850	614048	450505	146590	88597

North Sea autumn spawners

From 2006 to 2007 there was an increase in the abundance of autumn spawners of 190 % and in the biomass of 219 %. The age structure in the abundance for 2006 and 2007 showed the same pattern with 86 % and 91 % of the total abundance as 1 WR for the two years respectively (seeTable 8). This increase corresponds to an overall increase of the abundance of autumn spawners in the survey area.

From 2007 to 2008 the abundance of autumn spawners showed an increase of 0.7% whereas the biomass showed a decrease of 74%. As it can be seen from Table 8 this contradictory development between abundance and biomass is the result of a dramatic change in age composition of the abundance from 2007 to 2008. In 2007 1 WR contributed to 91 % of the abundance of autumn spawners, whereas the 0 WR contributes to 88 % of the abundance in 2008. (Table 8).

From 2008 to 2009 the abundance of autumn spawners showed an increase of 116 % and the biomass showed an increase of 96%. As it can be seen from Table 8 the abundance in 2009 is dominated by 0 and 1 WR (81 and 19 % respectively. The abundance of 0 WR are the double of what was seen in 2008 and 1 WR are than 4 times the abundance in 2008.

From 2009 to 2010 the abundance of autumn spawners has decreased by 72 % where as the biomass has decreased with 6%. From Table 8 it can be seen that the abundance is dominated by 1 WR in 2010 where it was dominated by 0 WR in 2008 and 2009. It looks as if the age structure in the abundance is on it way back to the structure seen in 2006 and 2007 (see Table 8)

Baltic Sea spring spawners

For the spring spawners no large changes in the age structure over the years from 2006 to 2008 have been seen (see Table 9).

From 2008 to 2009 there has been a decrease in the abundance of 82 % and in the biomass of 67 %. From Table 9 it can be seen that the major part of the difference in abundance between 2008 and 2009 lies in a decrease in the abundance of 0-3 WR.

From2009 to 2010 the abundance has increased with 9 %, whereas the biomass has decreased with 39.6%. From Table 9 it can be seen that there has been a change in the age structure of the spring spawners from 2009 to 2010. The abundance of 0-3 WR has increased with 39 % and the abundance of 4-13 WR has decreased with 83 %. This shift in the age structure of the abundance is reflected in the biomass.

Sprat

The total abundance estimate of sprat for the Danish acoustic survey with R/V Dana in July 2010 is 3102.65 million with 1543.93 millions in ICES square 41F7 (Stratum 560E06), 1558.29 millions in Kattegat (Stratum E) and 0.42 millions in 44F9 (Stratum 570E08).

Abundance, biomass, mean length and mean weight per WR and strata are given in Table 10.

Figure 1. Map showing the survey area for the Danish acoustic survey with R/V Dana in July 2010. The map shows the subareas (strata) used in the abundance estimation.

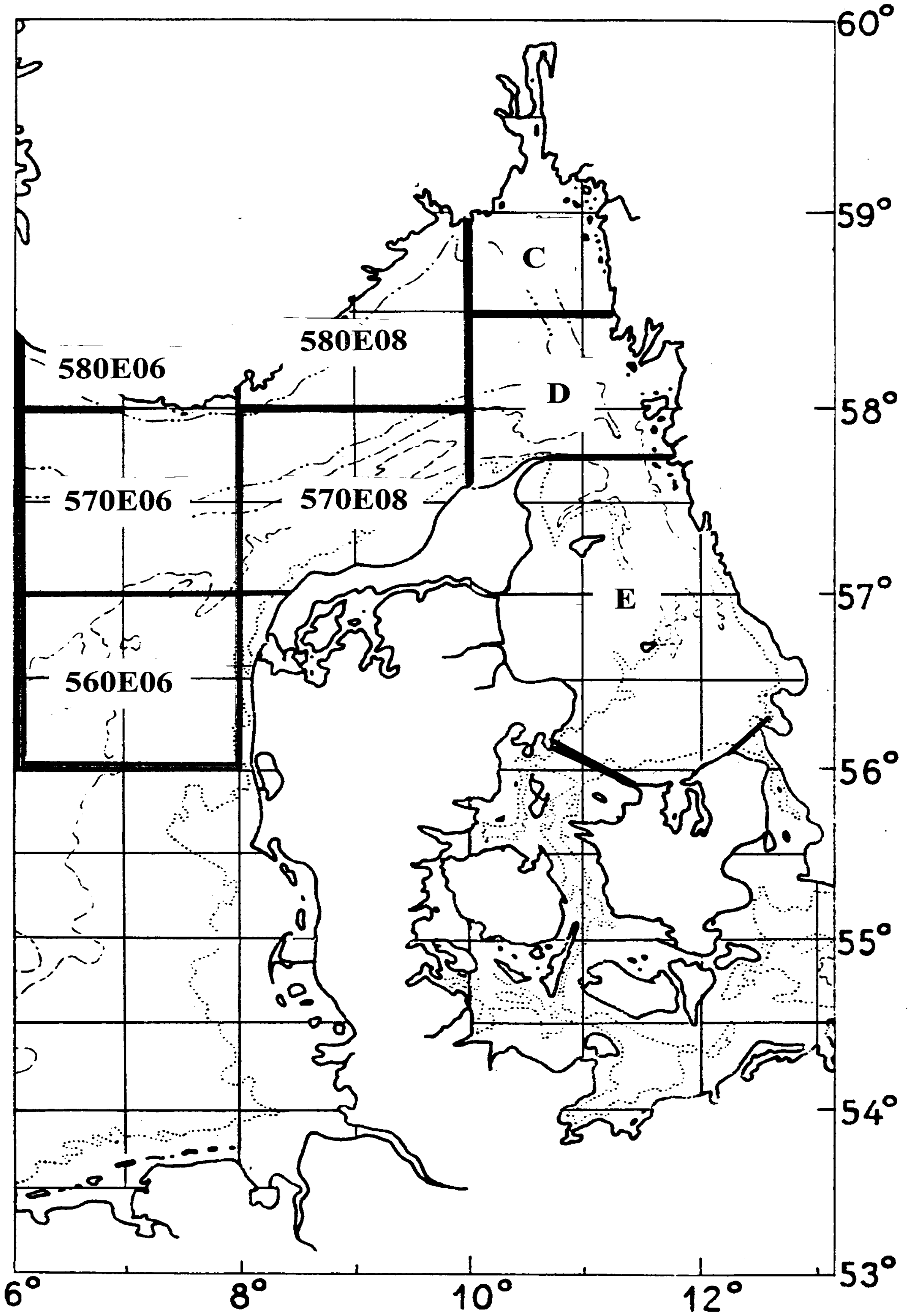

Figure 2. Map showing cruise track and trawl stations during the Danish acoustic survey with R/V Dana in July 2010.

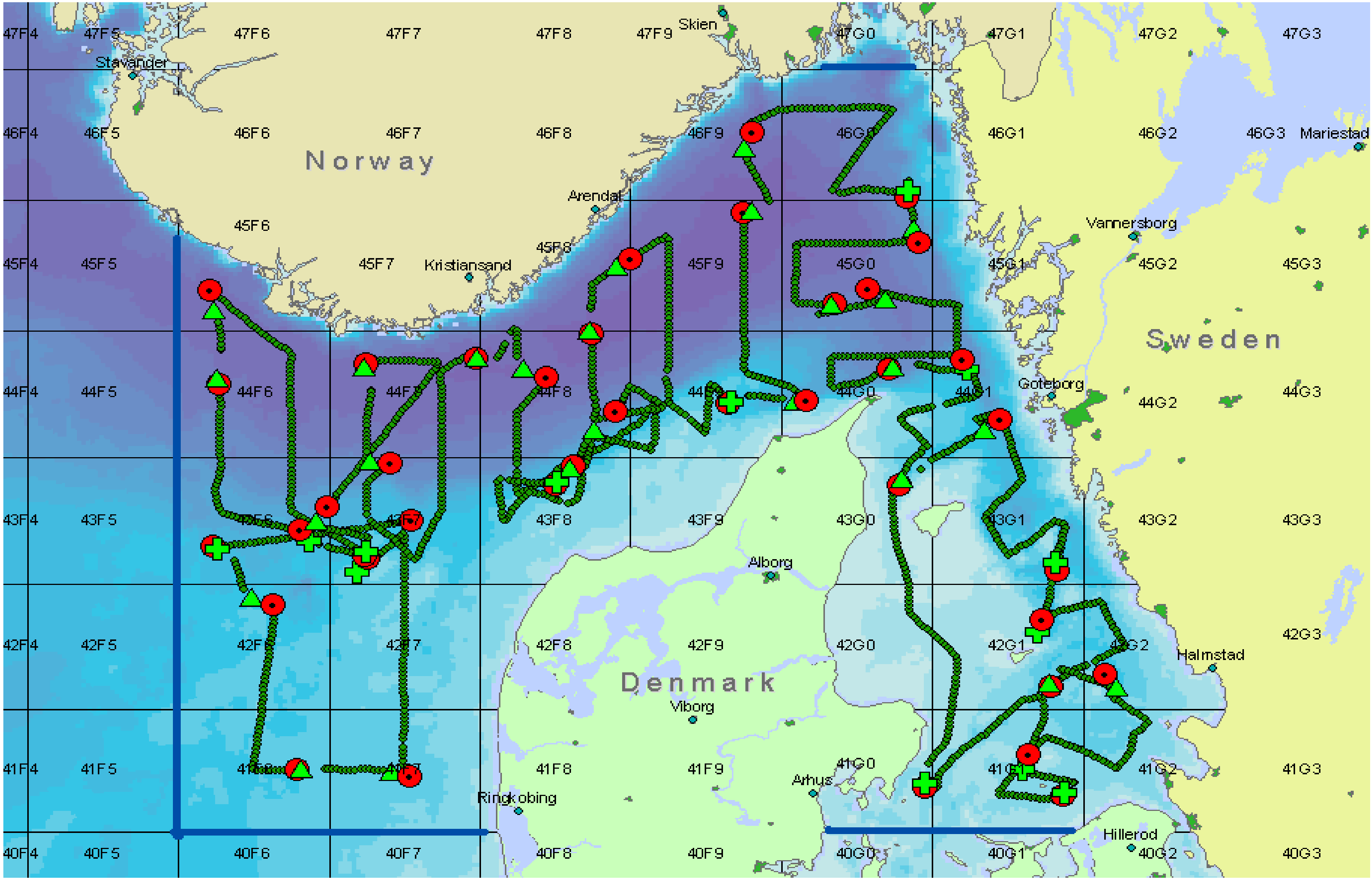

Figure 3. Relative herring density (in numbers per nm²) along the track of the July 2010 Danish acoustic survey in the eastern North Sea, Skagerrak and Kattegat. Red circles indicate relative density of herring per ESDU.

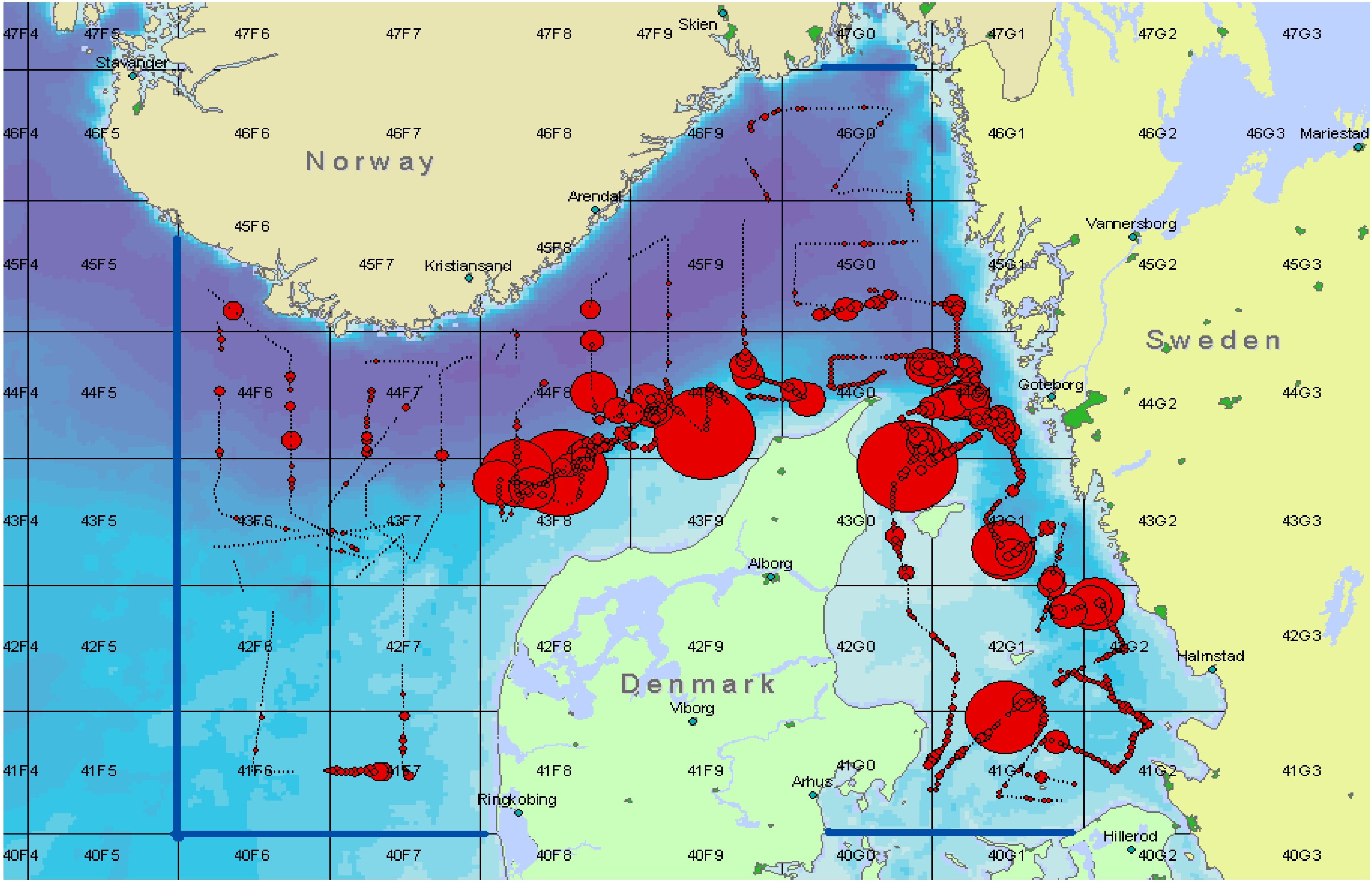

Figure 4. Relative herring density (in numbers per nm²) along the track of the June-July 2009 Danish acoustic survey in the eastern North Sea, Skagerrak and Kattegat. Red circles indicate relative density of herring per ESDU

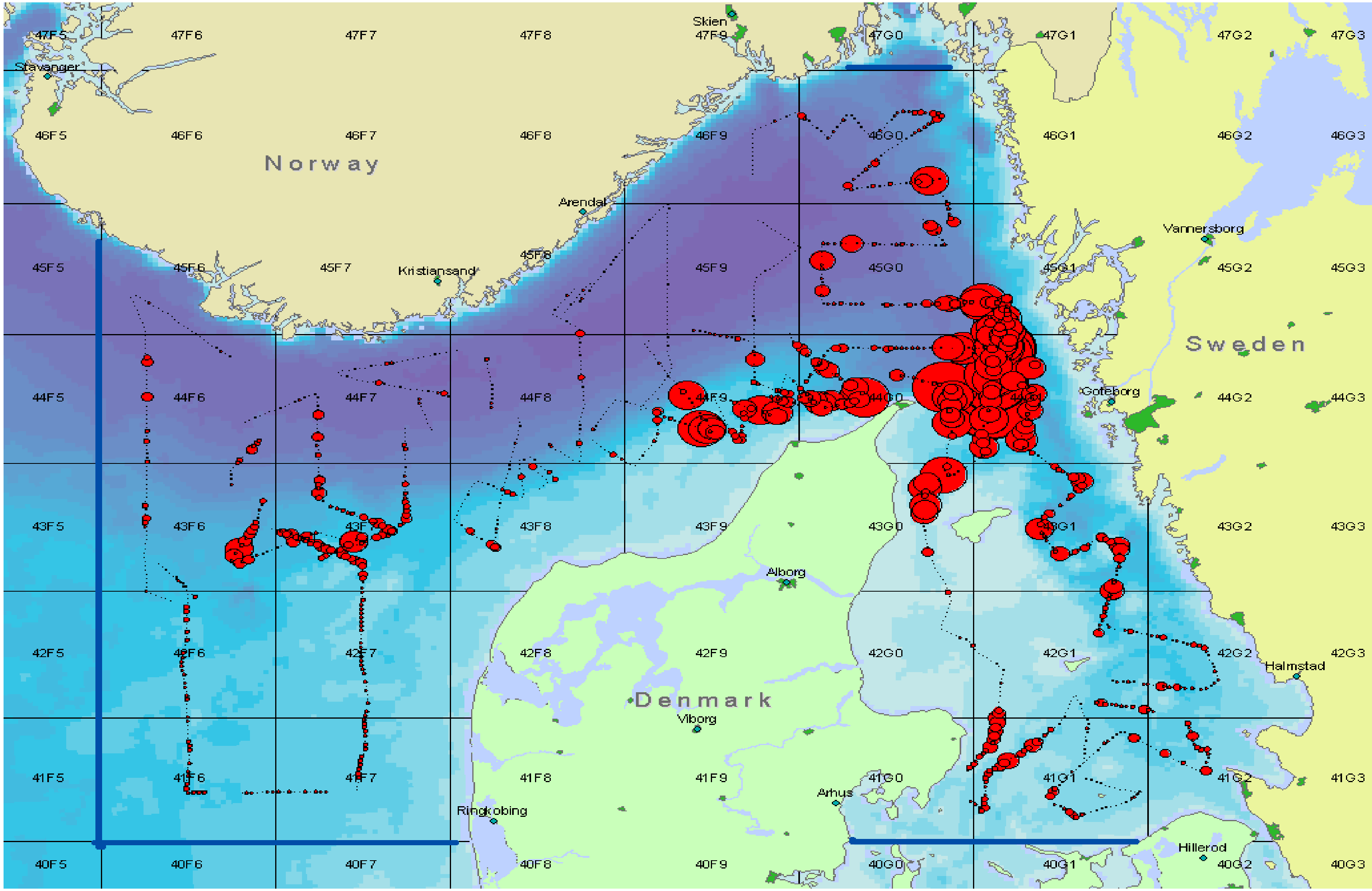

Figure 5. Relative herring density (in numbers per nm²) along the track of the June-July 2008 Danish acoustic survey in the eastern North Sea, Skagerrak and Kattegat. Red circles indicate relative density of herring per ESDU

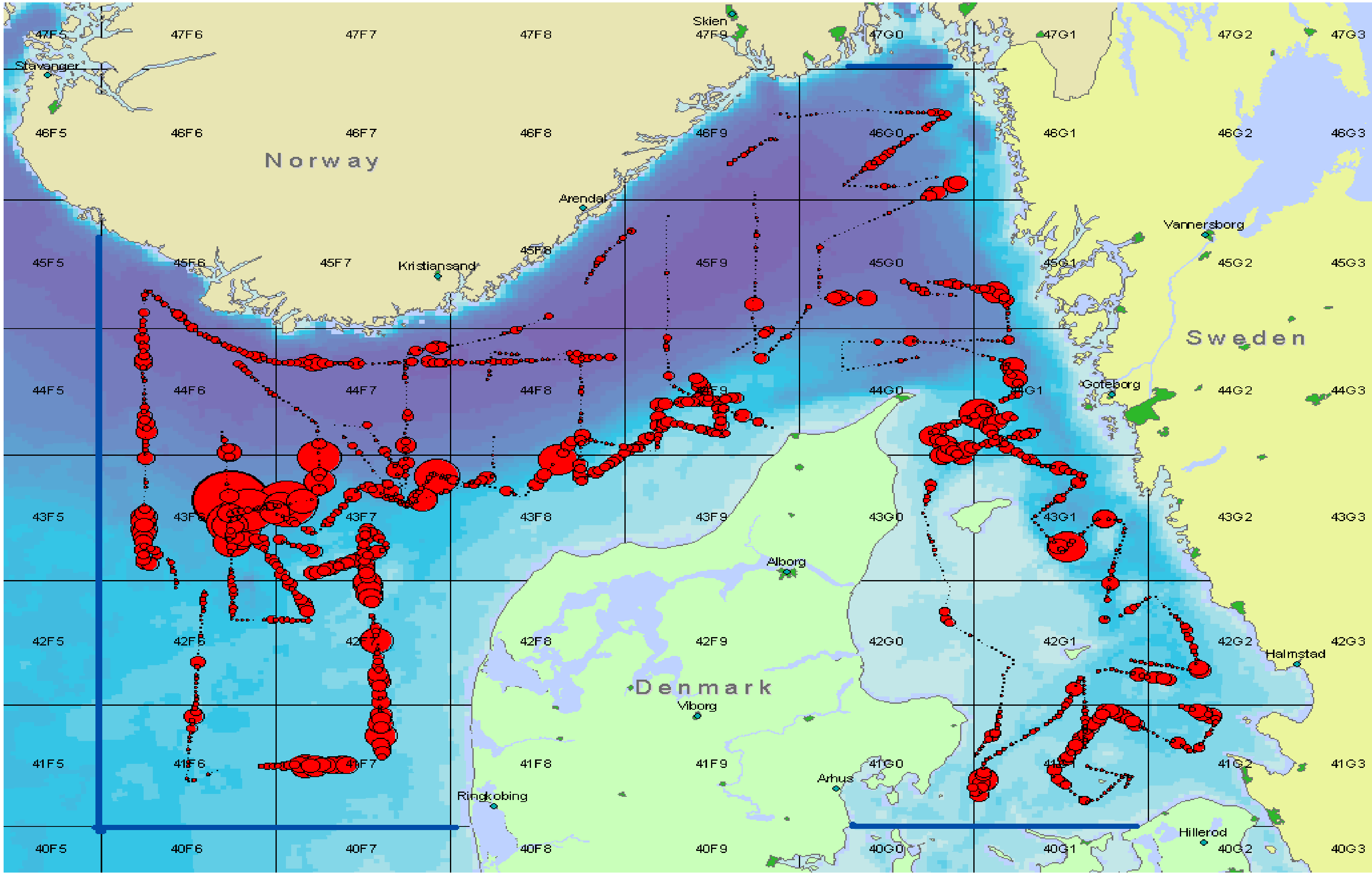

Figure 6. Stations with herring infected with Ichthyophonus (green crosses) and relative herring density (in numbers per nm²) along the track of the July 2010 Danish acoustic survey in the eastern North Sea, Skagerrak and Kattegat. Red circles indicate relative density of herring per ESDU

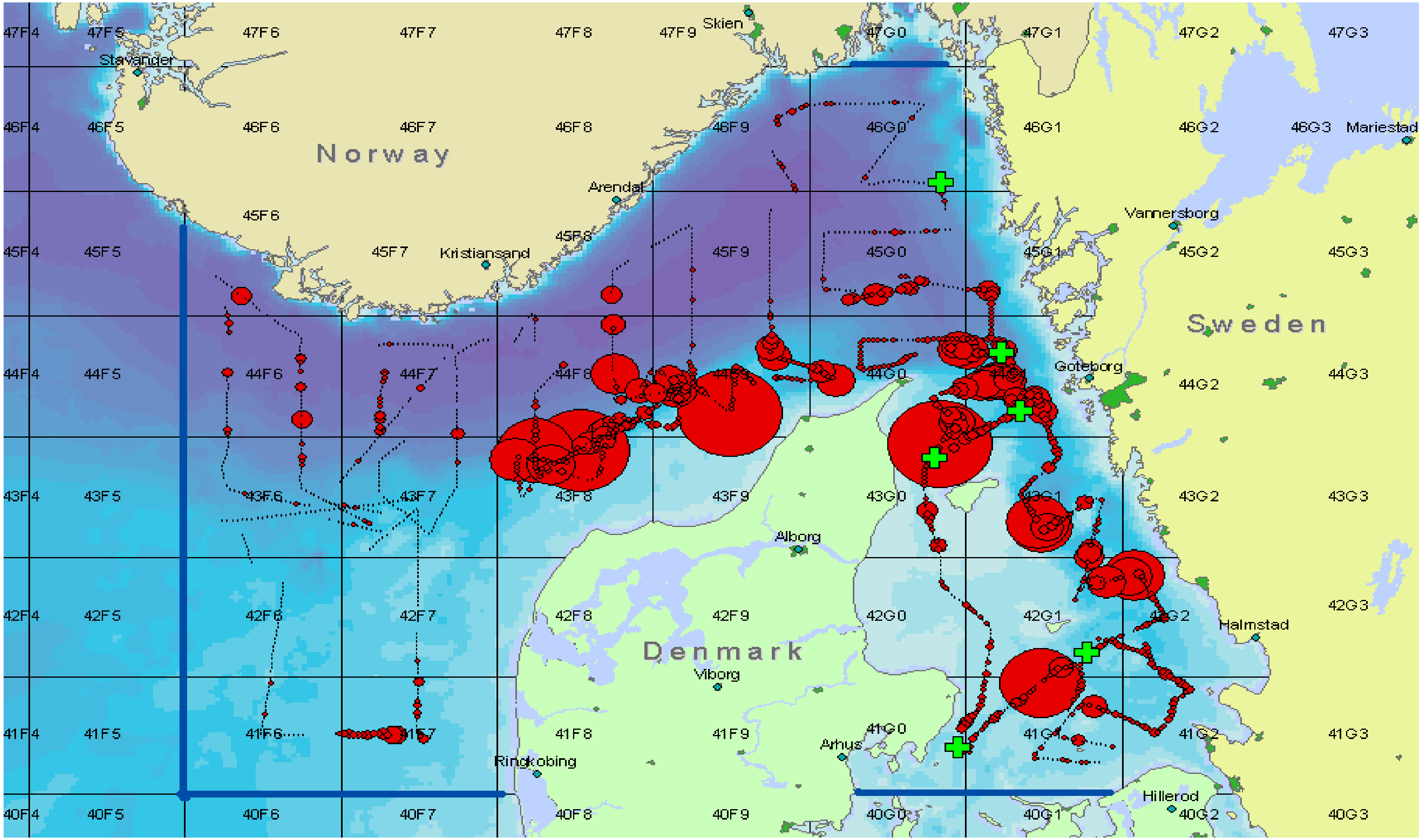

Table 1. . Simrad EK60 and analysis settings used during the Acoustic Herring Survey with R/V Dana Cruise July 2010

Transceiver Menu	
Frequency	38 kHz
Sound speed	1508 $m.s^{-1}$
Max. Power	2000 W
Equivalent two-way beam angle	-20.5 dB
Transducer Sv gain	25.40 dB
3 dB Beamwidth	6.9°
Calibration details	
TS of sphere	-33.6 dB
Range to sphere in calibration	9.56 m
Measured NASC value for calibration	19300 m^2/nmi^2
Calibration factor for NASCs	1.00
Absorption coeff	6.063 dB/km
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 2 Survey statistics for the Danish acoustic survey with R/V Dana in July 2010.

Stratum	Area, Nm*2	ESDU	Hauls	Mean Sa	Mean TS
560E06	3980	109	6	3.03E-06	6.47E-05
570E06	3600	369	10	1.10E-06	5.02E-05
570E08	3406	279	8	7.70E-06	3.58E-05
580E06	209	16	1	3.09E-06	3.59E-06
580E08	1822	90	5	5.35E-07	1.22E-05
C	988	64	4	3.63E-07	2.49E-05
D	1837	167	8	2.46E-06	1.86E-05
E	5228	413	10	5.05E-06	1.83E-05

Table 3. Trawl haul details for the Danish acoustic survey with R/V Dana in July 2010.

Date dd-mm-yy	Haul no.	Time UTC	ICES Square	Position Latitude	Longitude	Trawl Direction deg.	Wire length m	Trawl type	Cath depth m	Mean depth m	Total catch kg	Main Species	Trawling speed Kn	Trawling duratin min,	Wind speed m/s	Sea state
06-07-10	160	10:38	43F6	57.08.474 N	006.16.129 E	132	350	Expo	Bottom	63	33	Hake, Gunard	3.5	60	9.6	4
06-07-10	172	13:36	42F6	56.56.838N	006.29.708 E	112	270	Fotö	20	46	140	Large medusa	4	60	11.9	4
06-07-10	229	20:57	41F6	56.15.301 N	006.49.615 E	90	360	Fotö	Surface	35	800	Mackerel, Herring	4.2	60	7	4
07-07-10	248	00:20	41F7	56.124.652 N	007.25.416 E	108	350	Fotö	Surface	28	2920	Herring	3.7	60	5.8	4
07-07-10	329	10:45	43F7	57.02.970 N	007.11.786 E	34	210	Expo	Bottom	33	212	Large medusa	3.3	60	12.5	4
07-07-10	345	14:02	43F6	57.10.499 N	006.52.268 E	327	200	Expo	Bottom	65	116	Haddock, Herring	3	60	10.3	4
07-07-10	400	21:05	44F6	57.48.705 N	006.16.198 E	4	380	Fotö	Surface	314	1116	Herring	4.4	61	9.6	4
07-07-10	413	23:49	45F6	58.04.495 N	006.14.795 E	354	320	Fotö	Surface	330	540	Krill, Herring, Mackerel	4.4	61	8.7	4
08-07-10	500	10:37	43F7	57.07.959 N	007.15.214 E	0	260	Expo	Bottom	60	62	Cod, Haddock	2.8	60	5.3	4
08-07-10	515	13:34	43F6	57.15.002 N	006.55.508 E	33		Expo	12	82	9	Gunard, Large medusa	3.8	59	4.7	4
08-07-10	578	21:04	44F7	57.51.383 N	007.14.430 E	169	310	Fotö	Surface	418	460	Herring, Mackerel	4.7	60	4.8	3
09-07-10	600	00:22	43F7	57.29.222 N	007.16.749 E	94	300	Fotö	Surface	207	530	Mackerel	4.5	60	5.3	3
09-07-10	688	10:46	44F8	57.53.653 N	007.59.361 E	96	310	Fotö	Surface	487	200	Herring, Large medusa	3.9	60	5.8	3
09-07-10	709	14:11	44F8	57.50.952 N	008.17.611 E	110	350	Fotö	Surface	492	310	Herring, Mackerel	4.1	60	2.7	3
09-07-10	760	21:00	43F8	57.27,717 N	008.36.207 E	237	330	Fotö	Surface	52	4722	Herring	4.2	50	9.2	3
10-07-10	874	10:45	43F8	57.24.255 N	008.31.060 E	56	260	Expo	Bottom	37	440	Haddock	3.6	60	4.1	2
10-07-10	887	13:20	44F8	57:36,563 N	008.45.822 E	48	350	Fotö	Surface	91	72	Mackerel, Large medusa	4.6	60	4.9	3
10-07-10	945	21:06	45F8	57.59.836 N	008.44.315 E	1	340	Fotö	Surface	563	240	Large medusa, Krill, Mackerel	3.8	60	3.5	2
11-07-10	963	00:18	45F9	58.14.565 N	008.54.833 E	55	350	Fotö	Surface	403	205	Mackerel, Lumpsuker, Krill	4.4	60	3	2
11-07-10	1043	10:38	44F9	57.43.193 N	009.40.633 E	62	235	Expo	Bottom	37	1100	Herring, Large medusa	2.8	60	0.7	2
11-07-10	1057	13:23	44G0	57.43.300 N	010.05.800 E	87		Fotö	10	41	10000	Herring	4	24	6	2
11-07-10	1113	21:12	45F9	58.27.712 N	009.48.513 E	59	320	Fotö	Surface	524	522	Herring, Mackerel, Medusa	3.9	60	7.5	2
12-07-10	1131	00:20	46F9	58.42.080 N	009.45.675 E	26	320	Fotö	Surface	350	230	Krill	4.3	60	10.1	2
12-07-10	1209	10:39	46G0	58.32.156 N	010.50.607 E	1	400	Expo	Bottom	82	1100	Krill	2.5	58	1.4	2
12-07-10	1223	13:47	45G0	58.23.639 N	010.53.114 E	166	310	Fotö	Surface	124	65	Large medusa	4.1	60	4.5	2
12-07-10	1276	21:00	45G0	58.08.842 N	010.20.500 E	229	350	Fotö	Surface	137	250	Mackerel, Herring	4.3	60	5.4	3
13-07-10	1295	00:18	45G0	58.07.153 N	010.41.869 E	300	330	Fotö	Surface	223	500	Krill, Herring, Mackerel	4.1	60	8	3
13-07-10	1379	10:35	44G0	57.51.276 N	010.44.746 E	81	330	Fotö	Surface	110	245	Large medusa, Herring	4.2	60	8.3	3
13-07-10	1395	13:38	44G1	57.50.826 N	011.14.438 E	325	345	Expo	Bottom	60	100	Haddock, Medusa, Herring	3.2	60	5.3	3
13-07-10	1448	21:00	43G0	57.25.016 N	010.48.201 E	66	320	Fotö	Surface	41	645	Herring	4.3	60	9.6	3
14-07-10	1468	00:39	44G1	57.36.566 N	011.21.273 E	53	330	Fotö	Surface	86	280	Krill	4.7	62	6.9	3
14-07-10	1551	10:35	43G1	57.05.205 N	011.49.537 E	5	270	Expo	Bottom	53	57	Large medusa	3.4	61	6.5	3
14-07-10	1576	14:21	42G1	56.48.525 N	011.42.142 E	21	200	Expo	Bottom	47	330	Herring, Medusa, Sprat	3.2	61	8	3
14-07-10	1625	20:54	42G1	56.36.242 N	011.47.053 E	45	320	Fotö	Surface	38	195	Large medusa	4.3	60	10	3
15-07-10	1642	00:04	42G2	56.35.248 N	012.13.792 E	320	310	Fotö	Surface	49	190	Large medusa	4.8	58	11.6	3
15-07-10	1728	10:25	41G1	56.09.440 N	011.53.217 E	45	170	Expo	Bottom	27	78	Large medusa	3.3	61	5.9	3
15-07-10	1743	13:09	41G1	56.15.376 N	011.36.177 E	24	170	Expo	Bottom	30	107	Large medusa, Herring	3.7	60	8.8	3
15-07-10	1800	20:11	41G0	56.11.83 N	010.57.66 E	10	155	Expo	Bottom	20	97	Large medusa	3.6	60	4.9	3

Table 4. Catch composition in trawl hauls for the Danish acoustic survey with R/V Dana in June-July 210.

	Station	160	172	229	248	329	345	400	413	500	515	578	600	688
	ICES sq.	43F6	42F6	41F6	41F7	43F7	43F6	44F6	45F6	43F7	43F6	44F7	43F7	44F7
	Gear	Expo	Fotö	Fotö	Fotö	Expo	Expo	Fotö	Fotö	Expo	Fotö	Fotö	Fotö	Fotö
	Fishing depth	Bottom	20	Surface	Surface	Bottom	Bottom	Surface	Surface	Bottom	12	Surface	Surface	Surface
	Total depth	67	46	35	28	33	65	314	330	60	82	418	207	487
	Day/Night	D	D	N	N	D	D	N	N	D	D	N	N	D
	Total catch	33	140	800	2,920	212	116	1,116	540	62	9	460	530	200
Herring	*Clupea harengus*			245.269	1531.091	0.064	26.972	819.748	117.2			269.397	38.872	88.8
Large Medusa	*Medusa, spp*	0.84	127.486	77.023	4.325	176.134	4.262	34.383	32.668	18.8	3.942	21.988	16.351	62.949
Krill	*Euphausidae spp.*							8.552	201.325			2.192	20.832	
Mackerel	*Scomber scombrus*	0.264	2.768	391.91	257.7			238.013	97.7		1.07	161.034	415.011	31.199
Sprat	*Sprattus sprattus*				1051.32									
Haddock	*Melanogrammus aeglefinus*	16	0.77			0.052	38.156		0.008	6.092	0.008			0.022
Lumpsucker	*Cyclopterus lumpus*		5.84			0.46	1.114	9.94	9.2			2.56	20.3	15.9
Gurnard	*Trigala spp.*	3.73	3.068	83.299	10.71	12.2				2.952	4.208			
Pearlside	*Mauorolicus muelleri*							0.481	75.161			0.217	1.799	
Cod	*Gadus Morhua*	0.32				14.2	20			27.4				
Horse mackere	*Trachurus trachurus*			2.5	64.2									
Whiting	*Merlangius merlangus*	0.622	0.068		0.116	0.434	0.79		0.006	1.574				0.1
Invertebrates	*Invertebrates*	0.9					10.44							
Hake	*Merluccius merluccius*	4.97				5.4	2.256							
Norway pout	*Trisopterus esmarki*						0.074		0.258					
Garfish	*Belone belone*							4.688	0.184			2.536		1.03
Common weav	*Trachinus draco*				0.246							0.076		
Greater sandee	*Hyperoplus lanceolatus*				0.02	0.17				0.042				
Dab	*Limanda limanda*	2.62			0.1	0.864	1.01			1.374				
Plaice	*Pleuronectes platessa*	0.356			0.172	1.112	3.84			1.122				
Blue whiting	*Micromesistius poutassou*												13.1	
Saithe	*Pollachius virens*					0.158			3.344	0.104				
Long rough dal	*Hippoglosides plattessoides*	0.39								0.084				
Picked Dogfish	*Squalus acanthias*						2.584		2.946					
Squids	*Cephalopoda sp*						0.478	0.196		1.242				
Pollack	*Pollachius pollachius*													
	Trachipterus arctius												3.734	
Halibut	*Hippoglossus hippoglossus*						3.6							
Lemon sole	*Microstomus kitt*					0.74	0.338			1.258				
Brill	*Scophthalmus rhombe*	2.014												
Norway lobster	*Nephrops norvegicus*													
Anchovy	*Engraulis encrasicolus*													
Flounder	*Platichthys flesus*													
	Allionymus lyra													
Sandeel	*Ammodytes marinus*					0.012								
Gray sole	*Glyptocephalus cynoglossus*													
Snake blenny	*Lumpenus lampretaeformis*													

Table 4. continued.

	Station	**709**	**760**	**874**	**887**	**945**	**963**	**1043**	**1057**	**1113**	**1131**	**1209**	**1223**	**1276**
	ICES sq.	**44F8**	**43F8**	**43F8**	**44F8**	**45F8**	**45F8**	**44F9**	**44G0**	**45F9**	**46F9**	**46G0**	**45G0**	**45G0**
	Gear	**Fotö**	**Fotö**	**Expo**	**Fotö**	**Fotö**	**Fotö**	**Expo**	**Fotö**	**Fotö**	**Fotö**	**Expo**	**Fotö**	**Fotö**
	Fishing depth	**Surface**	**Surface**	**Bottom**	**Surface**	**Surface**	**Surface**	**Bottom**	**10**	**Surface**	**Surface**	**Bottom**	**Surface**	**Surface**
	Total depth	**492**	**52**	**39**	**80**	**563**	**403**	**35**	**41**	**576**	**416**	**89**	**120**	**137**
	Day/Night	**D**	**N**	**D**	**D**	**N**	**N**	**D**	**D**	**N**	**N**	**D**	**D**	**N**
	Total catch	**310**	**4,722**	**440**	**72**	**240**	**205**	**1,100**	**10,019**	**522**	**230**	**1,110**	**65**	**250**
Herring	***Clupea harengus***	169.613	4581.359		0.198	0.128	0.212	641.764	9730	187.102		10.972	8.28	45.338
Large Medusa	***Medusa, spp***	38.149	71.659	50.067	29.3	81.726	31.249	383.143	270	3.843	2.906		55.9	1.97
Krill	***Euphausidae spp.***					65.663	33.613			144.113	175.44	1064.02		40.733
Mackerel	***Scomber scombrus***	80.351	68.1		36.374	56.407	86.7		16.5	151.524	22.422	0.918		143.2
Sprat	***Sprattus sprattus***							0.958						
Haddock	***Melanogrammus aeglefinus***	0.006		272.517	0.008			2.124				0.284	0.02	
Lumpsucker	***Cyclopterus lumpus***	16.9			3.47	33.4	41.5	0.926	2	35.4	18.1			17.7
Gurnard	***Trigala spp.***			10.542				3.988						
Pearlside	***Mauorolicus muelleri***					1.536	4.313				9.714	0.096		0.043
Cod	***Gadus Morhua***			65.8				0.396				0.512		
Horse mackere	***Trachurus trachurus***		0.292					2.13				0.168		0.19
Whiting	***Merlangius merlangus***	0.026		15.854	0.086		0.585	27.257				2.624	0.094	0.012
Invertebrates	***Invertebrates***											9.635		
Hake	***Merluccius merluccius***							24.4						
Norway pout	***Trisopterus esmarki***											20.062		
Garfish	***Belone belone***	4.956			2.618	1.048	2.034				1.268		0.24	0.814
Common weav	***Trachinus draco***					0.096		0.218						
Greater sandee	***Hyperoplus lanceolatus***			22.072										
Dab	***Limanda limanda***			0.32				4.292						
Plaice	***Pleuronectes platessa***		0.59	1.446				3.564						
Blue whiting	***Micromesistius poutassou***													
Saithe	***Pollachius virens***			0.348			4.7							
Long rough dal	***Hippoglosides plattessoides***							0.532				0.629		
Picked Dogfish	***Squalus acanthias***													
Squids	***Cephalopoda sp***			1.054				0.317			0.15			
Pollack	***Pollachius pollachius***							3.77						
	Trachipterus arctius													
Halibut	***Hippoglossus hippoglossus***													
Lemon sole	***Microstomus kitt***							0.29						
Brill	***Scophthalmus rhombe***													
Norway lobster	***Nephrops norvegicus***											0.056		
Anchovy	***Engraulis encrasicolus***													
Flounder	***Platichthys flesus***													
	Allionymus lyra									0.018				
Sandeel	***Ammodytes marinus***													
Gray sole	***Glyptocephalus cynoglossus***													
Snake blenny	***Lumpenus lampretaeformis***											0.0023		

Table 4. continued.

	Station	1295	1379	1395	1448	1468	1551	1576	1625	1642	1728	1743	1800
	ICES sq.	45G0	44G0	44G1	43G0	44G1	43G1	42G1	42G1	42G2	41G1	41G1	41G0
	Gear	Fotö	Fotö	Expo	Fotö	Fotö	Expo	Expo	Fotö	Fotö	Expo	Expo	Expo
	Fishing depth	Surface	Surface	Bottom	Surface	Surface	Bottom	Bottom	Surface	Surface	Bottom	Bottom	Surface
	Total depth	242	92	60	41	86	53	47	38	49	27	30	20
	Day/Night	N	D	D	N	N	D	D	N	N	D	D	N
	Total catch	500	245	100	645	280	57	330	195	190	78	107	97
Herring	*Clupea harengus*	47.809	37.919	17.73	516.357	12.9	0.734	163.059	21.768	0.296	3.292	51	8.165
Large Medusa	*Medusa, spp*	25.912	195.699	27.349	99.482		50.4	89.854	154.434	185.354	44.5	30.5	76.662
Krill	*Euphausidae spp.*	341.087				264.99							
Mackerel	*Scomber scombrus*	27.468	9.392		7.13	2.108			9.29		2.186		0.454
Sprat	*Sprattus sprattus*				0.257		0.098	73.681	5.304	1.562	7.41	5.894	9.925
Haddock	*Melanogrammus aeglefinus*		0.034	25.695			0.26		0.01	0.058			
Lumpsucker	*Cyclopterus lumpus*	17.7	1.426				1.716	3.346	0.36	0.808	0.042		0.964
Gurnard	*Trigala spp.*			0.264						0.038	0.188	0.056	0.046
Pearlside	*Mauorolicus muelleri*	37.61											
Cod	*Gadus Morhua*			0.74							0.086		
Horse mackere	*Trachurus trachurus*				0.19								
Whiting	*Merlangius merlangus*		0.146	11.583		0.002	2.586	0.05	0.424	0.53	1.398	1.476	0.01
Invertebrates	*Invertebrates*			1.99			0.286				11.7	14.1	0.482
Hake	*Merluccius merluccius*			0.342									
Norway pout	*Trisopterus esmarki*			9.022			0.074						
Garfish	*Belone belone*	2.414	0.384		4.206								
Common weav	*Trachinus draco*				17.379		0.372		3.41	1.102	1.02	0.476	0.146
Greater sandee	*Hyperoplus lanceolatus*												
Dab	*Limanda limanda*						0.288				4.002	3.386	
Plaice	*Pleuronectes platessa*			0.08							1.896		0.146
Blue whiting	*Micromesistius poutassou*												
Saithe	*Pollachius virens*												
Long rough dal	*Hippoglosides plattessoides*			3.994			0.031					0.046	
Picked Dogfish	*Squalus acanthias*												
Squids	*Cephalopoda sp*			0.748									
Pollack	*Pollachius pollachius*												
	Trachipterus arctius												
Halibut	*Hippoglossus hippoglossus*												
Lemon sole	*Microstomus kitt*			0.218									
Brill	*Scophthalmus rhombe*												
Norway lobster	*Nephrops norvegicus*			0.202			0.134				0.048		
Anchovy	*Engraulis encrasicolus*									0.252			
Flounder	*Platichthys flesus*										0.11		
	Allionymus lyra			0.076									
Sandeel	*Ammodytes marinus*												
Gray sole	*Glyptocephalus cynoglossus*							0.01					
Snake blenny	*Lumpenus lampretaeformis*												

Table 5. Measured length distribution of herring by haul for the Danish acoustic survey with R/V Dana in June-July 2010.

Station	229	248		345	400	413	578	600	688	709	760	1043	1057	1113	1209	1223	1276	1295	1379	1395	1448	1468	1551	1576	1625	1642	1743	1800
ICES sq.	41F6	41F7		43F6	44F6	45F6	44F7	43F7	44F7	44F8	43F8	44F9	44G0	45F9	46G0	45G0	45G0	45G0	44G0	44G1	43G0	44G1	43G1	42G1	42G1	42G2	41G1	41G0
Gear	Fotö	Fotö		Expo	Fotö	Fotö	Fotö	Fotö	Fotö	Fotö	Fotö	Expo	Fotö	Fotö	Expo	Fotö	Fotö	Fotö	Fotö	Expo	Fotö	Fotö	Expo	Expo	Fotö	Fotö	Expo	Expo
Fishing depth	Surface	Surface		Bottom	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Bottom	10	Surface	Bottom	Surface	Surface	Surface	Surface	Bottom	Surface	Surface	Bottom	Bottom	Surface	Surface	Bottom	Surface
Total depth	35	28		65	314	330	418	207	487	492	52	35	41	576	89	120	137	242	92	60	41	86	53	47	38	49	30	20
Day/Night	N	N		D	N	N	N	N	D	D	N	D	D	N	D	D	N	N	D	D	N	N	D	D	N	N	D	N
Total catch,kg	800	2,920		116	1,116	540	460	530	200	310	4,700	1,100	10,019	522	1,110	65	250	500	245	100	645	280	57	330	195	190	107	97
Total catch Herring,kg		1487.151	43.94	26.972	819.748	117.2	269,397	38,872	88.8	169,613	4,581,359	641,764	9730	187,102	10,972	8.28	45,388	47,809	37,919	17.73	516,357	12.9	0.734	163,059	21,768	0.296	51.00	8,165
Sample Herring,kg	31	1.992	16.532	26.972	61.546	41.304	38.978	38,872	54,782	53,218	36,924	43.791	32,063	68,161	10,972	8.28	45,388	47,809	37,919	17.73	28.85	12.9	0.734	36,294	21,768	0.296	26,680	8,165
Length in cm								.																				
5.5																												
6																												
6.5																												
7																												
7.5																												
8		60																										
8.5		122																										
9		85																		12								
9.5		78																		7								
10		59																		8								
10.5		23																		4								
11		5																										
11.5																												
12															1								1					
12.5			2												2													
13			2												2													
13.5			68												8					1					3			2
14			132												14					1	3		1		12			1
14.5			76												17					2	10				36			2
15			40												24					16	4		4		28			
15.5			13												25					16	7		7		29			
16	2		61									1			28					18	8		8	1	23			3
16.5	7		67												29					35	8	4	3	3	9			11
17	29		77												19					36	18	1		4	7			39
17.5	140		46				1					1			17					29	48	4	1	34	4		3	58
18	262		22	8		1			2			4			13			1		36	123	4	1	149	16		29	46
18.5	186		3	52		5	1	4	1	3	7	37	12		3			1		31	204	7		213	41		62	13
19	43		2	113	1	7	1	9	5	15	26	125	34		2		1			25	123	7		213	64		47	3
19.5	11			96		8	7	19	1	27	54	215	99		4		1	6	6	20	39	15		61	33		53	2
20	1		1	71	4	41	7	28	10	64	99	172	141	25	6			7	8	11	18	7		30	29		65	4
20.5			1	48	15	11	31	55	11	71	124	81	94	14	4		9	18	11	15	4	10		25	44	1	77	6
21			2	22	14	45	38	62	21	98	102	30	68	17	11	12	9	43	29	28	9	19	1	18	33		61	4
21.5				17	13	28	42	54	23	86	47	13	23	15	18	19	26	68	37	10		25	1	2	19	1	37	
22				2	10	35	62	26	34	57	24	2	3	18	12	10	38	72	49	10		26		2	11		16	2
22.5				1	14		43	27	29	64	8		2	18	11	15	47	75	73	11		11			10	1	9	1
23					17	22	33	11	39	39	1			25	2	16	39	55	55	9		8			7		8	
23.5					27	35	38	6	50	25				30	2	8	54	43	39	4		6			5			
24			1		25	33	27	5	46	18				34	1	5	40	24	24	1		6			3	1		
24.5					28	31	22	4	40	10				21	1	3	19	14	18			4			2			
25					38	12	5	8	21	4				37			21	17	4	2		2			3			
25.5				1	42	14	7	4	26	3				26		1	13	12	9			1						
26				1	36	5	11	7	30	3				29	2		20	7	10	1		2						
26.5					38	13	6	4	16	2				30		1	17	14	7									
27					24	5	7	10	11	2				24			21	6	4			4						
27.5					24	6		5	12					24			3	4	7									
28					23	5	1	12	6	1				20		2	3	3	4									
28.5					12	3		12	11					20			3	5	2									
29					19	3		7	10					13			6	2	2			1						
29.5					3	1	1	3	1	1				8			2	2	2									
30					8	1								4			2	2										
30.5					4			3						5														
31						2		3	2					1			1											
31.5					2									2				1										
32					1			1	1					2														
32.5					2									1														
Total no.	681	432	616	432	444	372	391	389	459	593	492	681	476	463	278	92	395	502	400	399	626	174	28	755	471	4	467	197
Mean Length	18.06020558	9.049769	15.44156	19.6169	25.32883	22.86962	22.59207	23.929	23.96623	21.55818	20.49187	19.69383	20.12395	24.90065	17.40468	22.55978	23.86329	22.87749	22.96875	17.82331	18.33546	21.33621	16.07143	18.76159	18.54883	22.125	20.00321	17.74365

Table 6. Abundance, mean weight, mean length and biomass by age group and sub area for North Sea autumn spawning herring in the Danish acoustic survey with R/V Dana in June-July 2010

Numbers in mill											
	WR										
Strata	0	1i	1m	2i	2m	3i	3m	4i	4m	5	6	7
580E06	0	5.150866	0.012367	0.165169	0.042472	0.082123	0.014282	0.022247	0.014832	0	0	0
570E06	0	18.96277	0.045529	4.888424	1.257023	0.55836	0.097106	0.418063	0.278708	0.143378	0	0.114731
580E08	0	6.718286	0.01613	1.617231	0.415859	0.600958	0.104514	0.394745	0.263163	0.16652	0	0
570E07	0	1219.405	2.927743	4.738073	1.218362	0.992676	0.172639	0.011754	0.007836	0.039464	0	0.005211
C	0.260738	3.021327	0.007254	0.404774	0.104085	0.094562	0.016446	0.123667	0.082445	0	0	0
D	0.062474	202.3751	0.485894	5.861047	1.507126	1.450402	0.252244	0.012092	0.008062	0.007773	0	0
E	49.68213	958.7771	7.690725	2.371008	6.322687	0.85614	1.28421	0	0	0	0	0
560E06	205.3609	2.885927	0	0.000637	0.000637	0	0	0	0	0	0	0

Biomass in ton											
	WR										
Strata	0	1i	1m	2i	2m	3i	3m	4i	4m	5	6	7
580E06	0	387.4968	0.930364	13.21356	3.397772	10.78967	1.876464	2.936641	1.957761	0	0	0
570E06	0	1480.509	3.554643	609.9164	156.8356	67.71749	11.77696	68.25208	45.50139	21.50677	0	22.70551
580E08	0	544.6681	1.307726	196.6299	50.56199	70.81552	12.31574	49.63512	33.09008	23.14625	0	0
570E07	0	85130.38	204.3947	365.7641	94.05362	95.07096	16.53408	1.966097	1.310731	6.985128	0	0.99009
C	4.780114	133.8417	0.321349	57.02042	14.66239	13.35458	2.322537	19.86015	13.2401	0	0	0
D	0.753882	12833.15	30.81188	412.3452	106.0316	95.3839	16.58851	1.706658	1.137772	0.930599	0	0
E	1067.091	42125.63	337.9061	150.5085	401.356	75.91762	113.8764	0	0	0	0	0
560E06	977.7124	126.7792	0	0.076122	0.076122	0	0	0	0	0	0	0

Mean length in cm											
	WR										
Strata	0	1i	1m	2i	2m	3i	3m	4i	4m	5	6	7
580E06	0.00	20.51	20.51	21.50	21.50	25.27	25.27	26.00	26.00	0.00	0.00	0.00
570E06	0.00	20.85	20.85	24.22	24.22	25.18	25.18	27.07	27.07	27.00	0.00	28.80
580E08	0.00	20.94	20.94	23.75	23.75	24.31	24.31	25.53	25.53	26.00	0.00	0.00
570E07	0.00	20.14	20.14	20.59	20.59	22.60	22.60	27.32	27.32	28.00	0.00	29.00
C	14.76	17.69	17.69	24.90	24.90	25.59	25.59	26.62	26.62	0.00	0.00	0.00
D	12.17	19.90	19.90	20.73	20.73	20.78	20.78	25.91	25.91	24.49	0.00	0.00
E	14.83	18.35	18.35	19.91	19.91	22.32	22.32	0.00	0.00	0.00	0.00	0.00
560E06	9.05	18.09	0.00	24.00	24.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Mean weight in g											
	WR										
Strata	0	1i	1m	2i	2m	3i	3m	4i	4m	5	6	7
580E06	0.00	75.23	75.23	80.00	80.00	131.38	131.38	132.00	132.00	0.00	0.00	0.00
570E06	0.00	78.07	78.07	124.77	124.77	121.28	121.28	163.26	163.26	150.00	0.00	197.90
580E08	0.00	81.07	81.07	121.58	121.58	117.84	117.84	125.74	125.74	139.00	0.00	0.00
570E07	0.00	69.81	69.81	77.20	77.20	95.77	95.77	167.28	167.28	177.00	0.00	190.00
C	18.33	44.30	44.30	140.87	140.87	141.23	141.23	160.59	160.59	0.00	0.00	0.00
D	12.07	63.41	63.41	70.35	70.35	65.76	65.76	141.13	141.13	119.71	0.00	0.00
E	21.48	43.94	43.94	63.48	63.48	88.67	88.67	0.00	0.00	0.00	0.00	0.00
560E06	4.76	43.93	0.00	119.50	119.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 7. Abundance, mean weight, mean length and biomass by age group and sub area for Baltic Sea spring spawning herring in the Danish acoustic survey with R/V Dana in June-July 2010

Numbers in mill

	WR																
Strata	0	1i	1m	2i	2m	3i	3m	4i	4m	5	6	7	8	9	10	11	12
580E06	0	0.509398	0.132066	0.409668	3.174931	0.070435	2.829132	0	1.332058	0.582138	0.32444	0.037079	0	0	0	0	0
570E06	0	2.087684	0.541251	1.681124	13.02871	0.543288	21.82207	0	8.572289	4.510022	2.235875	0.748243	0.385288	0.487195	0.244976	0.012684	0.09729
580E08	0	0.303158	0.078597	1.34457	10.42042	0.455828	18.30907	0	6.750455	3.592728	1.620802	1.557212	0.696305	0.384448	0	0	0
570E07	0	88.67	22.98852	6.353667	49.24092	0.476805	19.15165	0	0.286793	0.096791	0.055151	0.022986	0	0.010422	0	0	0
C	0	0.116317	0.030156	0.46707	3.61979	0.129042	5.183201	0	1.53883	1.050715	0.453805	0.461956	0.235397	0.146857	0	0	0
D	0	36.48444	9.45893	10.55839	81.82754	0.371845	14.93577	0	1.596527	0.375543	0.10216	0.065546	0.027841	0.009079	0.002009	0	0
E	0.663616	535.9844	75.22588	74.42143	232.7146	12.84707	46.57062	0.513266	6.929091	3.490358	0.565281	0.388632	0.120652	0	0	0	0
560E06	0	1.815998	0	0	0.013141	0	0.002329	0	0	0	0	0	0	0	0	0	0

Biomass in ton

	WR																
Strata	0	1i	1m	2i	2m	3i	3m	4i	4m	5	6	7	8	9	10	11	12
580E06	0	34.6862	8.992717	41.05721	318.1934	7.9395	318.9032	0	166.168	76.98684	47.90596	7.082089	0	0	0	0	0
570E06	0	152.8902	39.63821	181.2831	1404.944	66.84431	2684.913	0	1197.035	706.6239	382.398	146.0194	76.69178	102.0709	57.24676	2.803227	22.96032
580E08	0	25.81362	6.692419	148.8771	1153.797	54.99694	2209.044	0	995.6512	638.6234	306.2614	305.8332	152.4415	73.88241	0	0	0
570E07	0	5922.267	1535.402	508.8477	3943.57	38.42007	1543.206	0	39.17301	15.32901	7.787387	4.876478	0	2.006235	0	0	0
C	0	9.955801	2.581134	46.53303	360.631	15.84929	636.6133	0	244.3243	177.1588	91.66349	94.44846	51.21064	26.75315	0	0	0
D	0	2400.846	622.4414	704.7792	5462.039	26.79713	1076.352	0	129.2742	37.21327	15.64447	11.02159	5.837035	1.804326	0.331532	0	0
E	12.43979	23929.14	3358.476	4048.366	12659.18	759.7844	2754.218	36.19847	488.6794	224.6285	65.74027	42.06864	16.64998	0	0	0	0
560E06	0	62.66036	0	0	0.874701	0	0.220459	0	0	0	0	0	0	0	0	0	0

Mean length in cm

	WR																
Strata	0	1i	1m	2i	2m	3i	3m	4i	4m	5	6	7	8	9	10	11	12
580E06	0.00	19.98	19.98	22.87	22.87	24.45	24.45	0.00	25.53	25.78	26.60	31.00	0.00	0.00	0.00	0.00	0.00
570E06	0.00	20.30	20.30	23.19	23.19	24.92	24.92	0.00	26.25	27.24	27.77	29.12	29.62	30.08	31.11	31.00	32.50
580E08	0.00	21.35	21.35	23.39	23.39	24.65	24.65	0.00	26.42	28.12	28.55	28.90	29.99	28.54	0.00	0.00	0.00
570E07	0.00	19.91	19.91	21.11	21.11	21.57	21.57	0.00	25.62	26.96	26.14	29.47	0.00	29.00	0.00	0.00	0.00
C	0.00	21.27	21.27	22.59	22.59	24.57	24.57	0.00	26.58	27.58	28.78	28.62	29.80	27.99	0.00	0.00	0.00
D	0.00	19.91	19.91	20.54	20.54	21.11	21.11	0.00	21.85	23.82	26.66	27.60	29.75	28.82	29.50	0.00	0.00
E	13.87	18.22	18.22	19.69	19.69	20.54	20.54	21.77	21.77	21.37	24.20	24.24	26.50	0.00	0.00	0.00	0.00
560E06	0.00	16.72	0.00	0.00	20.44	0.00	24.55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Mean weight in g

	WR																
Strata	0	1i	1m	2i	2m	3i	3m	4i	4m	5	6	7	8	9	10	11	12
580E06	0.00	68.09	68.09	100.22	100.22	112.72	112.72	0.00	124.75	132.25	147.66	191.00	0.00	0.00	0.00	0.00	0.00
570E06	0.00	73.23	73.23	107.83	107.83	123.04	123.04	0.00	139.64	156.68	171.03	195.15	199.05	209.51	233.68	221.00	236.00
580E08	0.00	85.15	85.15	110.72	110.72	120.65	120.65	0.00	147.49	177.75	188.96	196.40	218.93	192.18	0.00	0.00	0.00
570E07	0.00	66.79	66.79	80.09	80.09	80.58	80.58	0.00	136.59	158.37	141.20	212.15	0.00	192.50	0.00	0.00	0.00
C	0.00	85.59	85.59	99.63	99.63	122.82	122.82	0.00	158.77	168.61	201.99	204.45	217.55	182.17	0.00	0.00	0.00
D	0.00	65.80	65.80	66.75	66.75	72.07	72.07	0.00	80.97	99.09	153.14	168.15	209.66	198.73	165.00	0.00	0.00
E	18.75	44.65	44.65	54.40	54.40	59.14	59.14	70.53	70.53	64.36	116.30	108.25	138.00	0.00	0.00	0.00	0.00
560E06	0.00	34.50	0.00	0.00	66.56	0.00	94.66	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 8. Age distribution in estimate of autumn spawners during the Danish acoustic survey with R/V Dana in June-July from 2006 to 2010 given as number per age and strata in mill.and % of total abundance given by age and strata.

Autumn spawners in 2006

Number in millions

	WR								
Strata	0	1	2	3	4	5	6	7	Totalt
580E06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
570E06	0.00	313.22	77.82	1.31	0.00	0.00	0.00	0.00	392.36
580E08	0.00	72.47	5.61	0.00	0.00	0.28	0.00	0.00	78.36
570E08	30.99	425.10	40.41	2.00	0.00	0.00	0.00	0.00	498.50
C	0.00	125.25	21.23	0.00	0.00	0.32	0.00	0.00	146.79
D	0.00	265.61	13.04	1.53	0.00	0.00	0.00	0.00	280.17
E	6.57	107.84	17.39	1.23	0.00	0.00	1.09	0.00	134.12
560E06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
All stratas	37.56	1309.49	175.49	6.07	0.00	0.60	1.09	0.00	1530.29

Age distribution in % of total abundance

	WR							
Strata	0	1	2	3	4	5	6	7
580E06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
570E06	0.00	79.83	19.83	0.33	0.00	0.00	0.00	0.00
580E08	0.00	92.48	7.16	0.00	0.00	0.36	0.00	0.00
570E08	6.22	85.28	8.11	0.40	0.00	0.00	0.00	0.00
C	0.00	85.32	14.46	0.00	0.00	0.22	0.00	0.00
D	0.00	94.80	4.65	0.55	0.00	0.00	0.00	0.00
E	4.90	80.41	12.97	0.92	0.00	0.00	0.81	0.00
560E06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
All stratas	2.45	85.57	11.47	0.40	0.00	0.04	0.07	0.00

Autumn spawners in 2007

Number in millions

	WR								
Strata	0	1	2	3	4	5	6	7	Totalt
580E06	0.00	4.28	0.78	0.00	0.00	0.00	0.00	0.00	5.05
570E06	0.00	121.40	56.69	5.73	0.08	0.00	0.00	0.00	183.90
580E08	0.00	59.15	26.53	0.00	0.00	0.00	0.00	0.00	85.68
570E08	0.00	753.58	118.42	0.00	0.00	0.00	0.00	0.00	872.00
C	0.00	75.63	7.93	0.00	0.00	0.00	0.00	0.00	83.56
D	0.00	1365.50	109.44	5.59	0.00	0.00	0.00	0.00	1480.53
E	0.00	1542.98	46.92	7.76	0.00	0.00	0.00	0.00	1597.67
560E06	0.00	134.85	0.00	0.00	0.00	0.00	0.00	0.00	134.85
All stratas	0.00	4057.35	366.72	19.08	0.08	0.00	0.00	0.00	4443.24

Age distribution in % of total abundance

	WR							
Strata	0	1	2	3	4	5	6	7
580E06	0.00	84.62	15.38	0.00	0.00	0.00	0.00	0.00
570E06	0.00	66.01	30.83	3.12	0.04	0.00	0.00	0.00
580E08	0.00	69.03	30.97	0.00	0.00	0.00	0.00	0.00
570E08	0.00	86.42	13.58	0.00	0.00	0.00	0.00	0.00
C	0.00	90.51	9.49	0.00	0.00	0.00	0.00	0.00
D	0.00	92.23	7.39	0.38	0.00	0.00	0.00	0.00
E	0.00	96.58	2.94	0.49	0.00	0.00	0.00	0.00
560E06	0.00	100.00	0.00	0.00	0.00	0.00	0.00	0.00
All stratas	0.00	91.32	8.25	0.43	0.00	0.00	0.00	0.00

Autumn spawners in 2008

Numbers in millions

	WR								
Strata	0	1	2	3	4	5	6	7	Totalt
580E06	0.00	5.76	5.27	1.14	0.00	0.00	0.00	0.00	12.17
570E06	0.00	233.35	44.02	10.12	1.83	0.97	1.17	0.00	291.45
580E08	0.00	14.77	0.80	0.95	0.00	0.00	0.00	0.00	16.52
570E08	0.00	30.46	35.50	15.28	12.23	0.00	0.00	0.00	93.47
C	0.00	17.00	1.81	0.29	0.00	0.00	0.00	0.00	19.09
D	11.88	61.84	12.28	3.66	1.16	0.71	0.00	0.00	91.51
E	2347.35	13.79	1.01	3.67	0.00	0.00	0.00	0.00	2365.82
560E06	1556.12	26.99	0.00	0.00	0.00	0.00	0.00	0.00	1583.12
All stratas	3915.35	403.95	100.68	35.11	15.21	1.68	1.17	0.00	4473.15

Age distribution in % of total abundance

	WR							
Strata	0	1	2	3	4	5	6	7
580E06	0.00	47.34	43.32	9.35	0.00	0.00	0.00	0.00
570E06	0.00	80.06	15.10	3.47	0.63	0.33	0.40	0.00
580E08	0.00	89.39	4.83	5.77	0.00	0.00	0.00	0.00
570E08	0.00	32.59	37.98	16.35	13.08	0.00	0.00	0.00
C	0.00	89.02	9.46	1.52	0.00	0.00	0.00	0.00
D	12.98	67.58	13.41	3.99	1.27	0.77	0.00	0.00
E	99.22	0.58	0.04	0.16	0.00	0.00	0.00	0.00
560E06	98.29	1.71	0.00	0.00	0.00	0.00	0.00	0.00
All stratas	87.53	9.03	2.25	0.78	0.34	0.04	0.03	0.00

Autumn sawners in 2009

Numbers in millions

	WR								
	0	1	2	3	4	5	6	7	Total
580E06	0.00	0.69	0.09	0.02	0.00	0.00	0.00	0.00	0.81
570E06	31.06	171.89	42.79	7.42	0.00	0.00	0.00	0.00	253.16
580E08	0.00	9.70	4.14	0.27	0.53	0.26	0.05	0.00	14.95
570E08	108.09	747.46	8.76	0.31	0.68	0.27	0.06	0.00	865.63
C	260.15	0.59	0.06	0.00	0.00	0.00	0.00	0.00	260.80
D	3864.97	482.56	3.47	0.16	0.85	0.37	0.00	0.00	4352.38
E	3409.91	277.26	0.30	0.00	0.00	0.00	0.00	0.00	3687.48
560E06	138.33	103.89	1.80	0.00	0.00	0.00	0.00	0.00	244.03
All Strata	7812.52	1794.04	61.42	8.18	2.07	0.91	0.10	0.00	9679.24

Age distribution in % of total abundance

	WR							
	0	1	2	3	4	5	6	7
580E06	0.00	85.88	11.60	2.53	0.00	0.00	0.00	0.00
570E06	12.27	67.90	16.90	2.93	0.00	0.00	0.00	0.00
580E08	0.00	64.85	27.70	1.84	3.55	1.75	0.31	0.00
570E08	12.49	86.35	1.01	0.04	0.08	0.03	0.01	0.00
C	99.75	0.23	0.02	0.00	0.00	0.00	0.00	0.00
D	88.80	11.09	0.08	0.00	0.02	0.01	0.00	0.00
E	92.47	7.52	0.01	0.00	0.00	0.00	0.00	0.00
560E06	56.69	42.57	0.74	0.00	0.00	0.00	0.00	0.00
All Strata	80.71	18.53	0.63	0.08	0.02	0.01	0.00	0.00

Autumn sawners in 2010

Numbers in millions

	WR								
	0	1	2	3	4	5	6	7	Total
580E06	0.00	5.16	0.21	0.10	0.04	0.00	0.00	0.00	5.50
570E06	0.00	19.01	6.15	0.66	0.70	0.14	0.00	0.11	26.76
580E08	0.00	6.73	2.03	0.71	0.66	0.17	0.00	0.00	10.30
570E08	0.00	1222.33	5.96	1.17	0.02	0.04	0.00	0.01	1229.52
C	0.26	3.03	0.51	0.11	0.21	0.00	0.00	0.00	4.12
D	0.06	202.86	7.37	1.70	0.02	0.01	0.00	0.00	212.02
E	49.68	966.47	8.69	2.14	0.00	0.00	0.00	0.00	1026.98
560E06	205.36	2.89	0.00	0.00	0.00	0.00	0.00	0.00	208.25
All Strata	255.37	2428.48	30.91	6.58	1.64	0.36	0.00	0.12	2723.45

Age distribution in % of total abundance

	WR							
	0	1	2	3	4	5	6	7
580E06	0.00	93.80	3.77	1.75	0.67	0.00	0.00	0.00
570E06	0.00	71.02	22.96	2.45	2.60	0.54	0.00	0.43
580E08	0.00	65.40	19.74	6.85	6.39	1.62	0.00	0.00
570E08	0.00	99.42	0.48	0.09	0.00	0.00	0.00	0.00
C	6.34	73.59	12.37	2.70	5.01	0.00	0.00	0.00
D	0.03	95.68	3.48	0.80	0.01	0.00	0.00	0.00
E	4.84	94.11	0.85	0.21	0.00	0.00	0.00	0.00
560E06	98.61	1.39	0.00	0.00	0.00	0.00	0.00	0.00
All Strata	9.38	89.17	1.14	0.24	0.06	0.01	0.00	0.00

Table 9. Age distribution in estimate of spring spawners during the Danish acoustic survey with R/V Dana in June-July from 2006 to 2010 given as number per age and strata.

Spring spawners in 2007															
Numbers in millions															
	WR														
Strata	0	1	2	3	4	5	6	7	8	9	10	11	12	13	Total
580E06	0	0.59	10.71	6.52	6.76	1.13	0.91	0.10	0.10	0	0	0	0	0	26.82
570E06	0	38.76	240.73	133.30	63.70	22.19	4.99	3.71	0.88	0	0	0	0	0	508.26
580E08	0	18.16	104.65	52.34	32.00	11.00	2.02	0.26	1.24	0.47	0	0	0	0	222.14
570E08	0	523.57	651.64	295.67	141.30	52.41	12.08	3.48	4.91	2.66	0	0	0	0	1687.73
C	0	500.81	329.72	87.72	27.43	6.10	1.21	0	1.40	0	0	0	0	0	954.39
D	0	531.74	612.87	161.57	51.80	10.31	0	0	1.76	0	0	0	0	0	1370.05
E	0	2138.61	1676.06	193.05	129.39	42.04	11.33	18.17	1.37	0	0	0	0	0	4210.02
560E06	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
All stratas	0	3752.24	3626.38	930.17	452.37	145.18	32.54	25.73	11.66	3.14	0	0	0	0	8979.40
													Total 4-13 WR		670.61
													Total 0-3 WR		8308.79
Spring spawners in 2008															
Numbers in millions															
	WR														
Strata	0	1	2	3	4	5	6	7	8	9	10	11	12	13	total
580E06	0	4.75	22.36	11.44	4.64	1.63	0.23	0	0	0	0	0	0	0	45.06
570E06	0	2263.75	377.97	116.59	51.42	23.77	13.53	5.64	2.24	0.17	0.14	0	0	0	2855.22
580E08	0	49.79	59.90	36.90	7.15	5.02	1.89	1.00	0.48	0.13	0.00	0	0	0	162.26
570E08	0	701.72	228.78	147.20	71.33	46.00	41.03	15.91	6.89	5.64	0.00	0	0	0	1264.51
C	0	108.72	96.90	26.02	7.22	5.07	0.58	0.34	0	0	0.34	0	0	0	245.18
D	1.38	124.71	151.89	59.98	20.05	11.58	3.96	1.21	0	0	0.29	0	0	0	375.05
E	23.86	216.22	125.10	41.38	11.35	6.16	3.85	0.45	0.68	0.36	0	0	0	0	429.43
560E06	81.17	1903.13	5.62	0	0	0	0	0	0	0	0	0	0	0	1989.92
All stratas	106.42	5372.77	1068.54	439.52	173.17	99.23	65.08	24.55	10.28	6.31	0.77	0	0	0	7366.64
													Total 4-13 WR		379.39
													Total 0-3 WR		6987.25
Spring spawners in 2009															
Number in millions															
	WR														
Strata	0	1	2	3	4	5	6	7	8	9	10	11	12	13	total
580E06	0	0.18	0.85	0.44	0.32	0.19	0.02	0	0	0.01	0	0	0	0	2.01
570E06	0	60.72	136.57	138.97	116.99	51.61	44.13	15.51	11.38	1.72	2.16	1.16	0	1.52	582.44
580E08	0	0.00	17.81	9.09	7.78	3.76	2.29	0.71	0.16	0.24	0.05	0	0	0	41.88
570E08	0	87.86	59.76	19.24	13.05	6.39	3.68	1.12	0.21	0.28	0.07	0	0	0	191.66
C	0	0.00	2.61	1.01	0.64	0.09	0.03	0.03	0.03	0	0	0	0	0	4.43
D	0	1.12	66.37	22.03	14.97	5.02	3.51	1.26	0.23	0.39	0.12	0	0	0	115.03
E	0.94	155.35	27.00	5.35	1.99	0.68	0.65	0	0	0	0	0	0	0	191.95
560E06	0	194.39	1.80	0.72	0	0	0	0	0	0	0	0	0	0	196.91
All stratas	0.94	499.62	312.76	196.86	155.73	67.73	54.30	18.63	12.01	2.64	2.40	1.16	0	1.52	1326.32
													Total 4-13 WR		316.13
													Total 0-3 WR		1010.19
Spring spawners in 2010															
Number in millions															
	WR														
Strata	0	1	2	3	4	5	6	7	8	9	10	11	12	13	total
580E06	0	0.64	3.58	2.90	1.33	0.58	0.32	0.04	0	0	0	0	0	0	9.40
570E06	0	2.63	14.71	22.37	8.57	4.51	2.24	0.75	0.39	0.49	0.24	0.01	0.10	0	57.00
580E08	0	0.38	11.76	18.76	6.75	3.59	1.62	1.56	0.70	0.38	0	0	0	0	45.51
570E08	0	111.66	55.59	19.63	0.29	0.10	0.06	0.02	0	0.01	0	0	0	0	187.35
C	0	0.15	4.09	5.31	1.54	1.05	0.45	0.46	0.24	0.15	0	0	0	0	13.43
D	0	45.94	92.39	15.31	1.60	0.38	0.10	0.07	0.03	0.01	0	0	0	0	155.82
E	0.66	611.21	307.14	59.42	7.44	3.49	0.57	0.39	0.12	0.00	0	0	0	0	990.43
560E06	0	1.82	0.01	0	0	0	0	0	0	0	0	0	0	0	1.83
All stratas	0.66	774.43	489.28	143.70	27.52	13.70	5.36	3.28	1.47	1.04	0.25	0.01	0.10	0	1460.78
													Total 4-13 WR		52.72
													Total 0-3 WR		1408.06

Table 10. Abundance, mean weight, mean length and biomass by age group and sub area for sprat in the Danish acoustic survey with R/V Dana in June-July 2010.

Abundance i mill.

	WR									
Strata	**0**	**1i**	**1m**	**2i**	**2m**	**3**	**4**	**5**	**6**	**7**
580E06	0	0	0	0	0	0	0	0	0	0
570E06	0	0	0	0	0	0	0	0	0	0
580E08	0	0	0	0	0	0	0	0	0	0
570E07	0	0.022407	0.005244	0.083495	0.068222	0.097868	0.082392	0.046466	0.012117	0.001399
C	0	0	0	0	0	0	0	0	0	0
D	0	0	0	0	0	0	0	0	0	0
E	2.719978	677.4839	158.5601	189.069	154.4832	195.6962	121.3697	46.7424	9.216227	2.95871
560E06	0	1244.624	291.295	2.940072	2.402254	2.671163	0	0	0	0

Biomass in ton

	WR									
Strata	**0**	**1i**	**1m**	**2i**	**2m**	**3**	**4**	**5**	**6**	**7**
580E06	0	0	0	0	0	0	0	0	0	0
570E06	0	0	0	0	0	0	0	0	0	0
580E08	0	0	0	0	0	0	0	0	0	0
570E07	0	0.282109	0.066026	1.254102	1.024693	1.687511	1.637918	0.917959	0.230694	0.018183
C	0	0	0	0	0	0	0	0	0	0
D	0	0	0	0	0	0	0	0	0	0
E	5.439956	5855.911	1370.532	2714.518	2217.96	3115.75	2221.821	859.8532	162.7388	38.46322
560E06	0	8978.537	2101.36	35.28086	28.82705	34.72512	0	0	0	0

Mean length in cm

	WR									
Strata	**0**	**1i**	**1m**	**2i**	**2m**	**3**	**4**	**5**	**6**	**7**
580E06	0	0	0	0	0	0	0	0	0	0
570E06	0	0	0	0	0	0	0	0	0	0
580E08	0	0	0	0	0	0	0	0	0	0
570E07	0	12.22514	12.22514	13.09758	13.09758	13.74368	14.4808	14.74646	14.95671	13.5
C	0	0	0	0	0	0	0	0	0	0
D	0	0	0	0	0	0	0	0	0	0
E	6.75	10.70682	10.70682	12.87331	12.87331	13.28303	13.9409	14.32156	14.49511	13.5
560E06	0	9.596522	9.596522	11.75	11.75	12	0	0	0	0

Mean weight in g

	WR									
Strata	**0**	**1i**	**1m**	**2i**	**2m**	**3**	**4**	**5**	**6**	**7**
580E06	0	0	0	0	0	0	0	0	0	0
570E06	0	0	0	0	0	0	0	0	0	0
580E08	0	0	0	0	0	0	0	0	0	0
570E07	0	12.59035	12.59035	15.02002	15.02002	17.24268	19.87946	19.7557	19.0389	13
C	0	0	0	0	0	0	0	0	0	0
D	0	0	0	0	0	0	0	0	0	0
E	2	8.643616	8.643616	14.35729	14.35729	15.92136	18.30623	18.39557	17.65786	13
560E06	0	7.213855	7.213855	12	12	13	0	0	0	0