Acoustic Herring Survey report for RV "DANA"

25th June – 9th July 2019

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Cruise summary

Total days	15
Days of monitoring	13
Number of nautical miles monitored	2130 + 164 miles for calibration
Number of trawl hauls	36
Number of CTD stations	35
Number of WP2 stations	21
Fish catch in kg	21385
Number of measured herring	13608
Number of measured mackerel	2170
Number of measured sprat	2650
Number of species measured	45
Total number of measured fish	27272
Number of herring frozen for age and race-split	2781
Number of sprat frozen for age	699

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 2019-survey with R/V DANA, covering the Skagerrak and Kattegat, was conducted in the period June 25 June to July 9 2019, while calibration was done during June 25 to June 27 2019.

2. SURVEY

2.1 Personnel

During calibration 25/6– 27/6 2019
Karl-Johan Stæhr (cruise leader)
Torben Filt Jensen (assisting cruise leader)
Ronny Sørensen
Christian Petersen

Ghebrehiwet Yacob Tesfa, student
Alexander Niel Holdgate, student
Enrique Garcia-Argudo Garcia, student
Ruairi James Gallagher, student

During acoustic monitoring 27/6 - 9/7-2019
Karl-Johan Stæhr (cruise leader)
Torben Filt Jensen (assisting cruise leader)
Annegrete D. Hansen (acoustic)
Nina Fuglsang (fishlab)
Thomas Møller(fiskelab)
Rene Erlandsen (fiskelab)
Jan Wener Thomsen (fishlab)
Ghebrehiwet Yacob Tesfa, student
Alexander Niel Holdgate, student
Enrique Garcia-Argudo Garcia, student
Ruairi James Gallagher, student

2.2 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 6 sub-areas.

In principal the survey is designed with parallel survey tracks at right angles to the depth lines with a spacing of 15 nm in strata 151, 17.5 nm in strata 41 and 10 nm in strata 31 and 21. 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.

2.3 Calibration

The echosounders were calibrated at Bornö in the Gullmar Fjord, Sweden during June 25 - June 27 2019. 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 April. 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 April, 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.

2.4 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 500 m depth.

2.5 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 6 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.

2.6 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

2.7 Plankton data

During the survey WP2 samples has been taken 2 times a day late evening and noon. Sampling has been conducted from 150 m or 5 m above bottom to surface with a 180 µm netting. The samples have been fractionised in size groups by filters of 2000 µm, 1000 µm and 180 µm. The samples have been dried for 24 hours and frozen for dry weight measurements at shore.

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 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. 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 (21, 31, 41, 42, 151 and 152 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 ICES SIPS 9: Manual for International Pelagic Surveys (IPS):

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

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 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.

2.9 Cruise leader course

Four students from DTU-Aqua`s MSc Eng. In Aquatic Science and Technology have participated in the survey during a 5 ECTS Cruise leader course. Two students has been working with linking plankton samples from WP2 and stomach contents by herring, Two students have been testing freezing techniques for preservation of stomach contents by mackerel for analysis at shore. The students have worked together with the rest of the scientific crew under supervision of Karl-Johan Stæhr.

3. RESULTS & DISCUSSION

3.1 Narrative

The survey of R/V Dana started on June 25th at 04.00 UTC with departure from Hirtshals heading for Bornö in Gullmar Fjord, Sweden for calibration of the acoustic equipment. The vessel was anchored at Bornö in the Gullmar Fjord, Sweden June 25th at 11.30 UTC. The calibration was initiated in the afternoon of June 25th and continued until the morning of June 27th.

At June 27th at 04.04 UTC Dana left Bornö to arrive in Skagen June 27th at 09.30 UTC for exchange of the scientific crew. R/V Dana left Skagen at 11.00 UTC to steam northwest towards the border between Skagerrak and the North Sea.

Monitoring data collection was started the June 28 at 57º 56'N, 6º 39'E at 00.04 UTC with a CTD and a trawl haul.

The North Sea was covered during the period June 28 – July 1, Skagerrak during July 1 - July 6 and Kattegat during July 6-9.

Due to strong wind (up to 25 m/s) and heavy swell (4-6 meters) the most western transect in strata 42 could not be covered. Furthermore 5 trawl hauls (3 pelagic and 2 demersal) had to be cancelled compared to the original plan. The strong wind and heavy swell continued in the southern half of Skagerrak in the hole period Skagerrak was covered.

The acoustic integration was ended July 9 at 57º 15'N, 010º 42'E at 4.52 UTC.

R/V Dana arrived at Hirthals at 11.30 UTC on July 9.

Totally the survey covered about miles of monitoring. Data from the 38 kHz echosounder were recorded mainly using a 38 kHz paravane transducer running at depths of 4 – 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. During trawling hull-mounted transducers were used for all three frequencies.

3.2 Acoustic data

The total number of acoustic sample units of 1 nm (ESDU's) collected for the stock size calculation is aprox. 1928. Cruise line for integration is given in Figure 2. During the survey acoustic data have been prepared for scrutinization at shore and stock calculation in the Danish program. Data from transect shown in Figure 4 will be used in the stock estimation by StoX.

3.3 Biological data

During the survey in 2018 36 trawl hauls were conducted, 20 surface hauls and 16 bottom hauls. The geographical distribution of hauls and details on the hauls are given in Figure 2 and Table 2. Catches by species is given in Table 3.

Length distributions of herring, mackerel and sprat by haul are given in table 5 to 7.

The total catch for the survey was 21.4 tons. Herring was present in 34 hauls with a total catch of 12.4 tons or 58,2 % of the total catch. Totally 13,608 herring have been measured. Length distributions of herring per haul are given in Table 5.

The total sprat catch was 1.4 tons or 6.8 % of the total catch. Totally 2,650 sprat have been measured. Length distributions of sprat per haul are given in table 6.

Mackerel were present in 29 hauls with a total catch of 2.4 ton or 11.3 % of the total catch. Totally 2,170 mackerel have been measured. Length distributions of Mackerel per haul are given in table 7.

For the total survey area herring, mackerel and sprat contributed to the total catch by 58.2 %, 11.3 % and 6.8 % respectively.

Herring maturity

Based on the frozen single fish herring samples (2512 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 ≥2 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:

Maturity Autumn spawning herring in Kattegat, Strata 21						
WR	1i	1m	2i	2m	3i	3m
%	98.5	1.5	75.0	25.0	0.0	100.0

Maturity Autumn spawning herring in Skagerrak, Strata 21, 41 and 42										
WR	1i	1m	2i	2m	3i	3m	4i	4m	5m	6m
%	99.7	0.3	87.8	12.2	69.3	30.7	46.3	53.7	100.0	100.0

Maturity Autumn spawning herring in North Sea, Strata 151 and 152										
WR	1i	1m	2i	2m	3i	3m	4i	4m	5m	6m
%	98.7	1.3	74.3	25.7	49.1	50.9	57.5	42.5	100.0	100.0

Baltic Sea spring spawners:

Maturity Spring spawning herring in Kattegat, Strata 21											
WR	1i	1m	2i	2m	3i	3m	4i	4m	5m	6m	7m
%	98.9	1.1	86.0	14.0	75.4	24.6	89.7	10.3	100.0	100.0	100.0

Maturity Spring spawning herring in Skagerrak, Strata 21, 41 and 42												
WR	1i	1m	2i	2m	3i	3m	4i	4m	5m	6m	7m	8m
%	100.0	0.0	92.1	7.9	83.7	16.3	75.2	24.8	100.0	100.0	100.0	100.0

Maturity Spring spawning herring in North Sea, Strata 151 and 152											
WR	1i	1m	2i	2m	3i	3m	4i	4m	5m	6m	7m
%	100.0	0.0	85.7	14.3	71.8	28.2	61.4	38.6	100.0	100.0	100.0

Sprat maturity

Based on 701 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 ≥2 and/or age ≥3 are regarded as mature

Maturity in Kattegat, Strata 21								
WR	0I	1I	1M	2I	2M	3M	4M	5M
%	100.0	11.8	88.2	3.9	96.1	100.0	100.0	100.0

Maturity in Skagerrak, Strata 41 and 42					
WR	1I	1M	2I	2M	3M
%	0.0	100.0	0.0	100.0	100.0

Maturity in North Sea, Strata 151					
WR	1I	1M	2I	2M	3M
%	0.0	100.0	0.7	99.3	100.0

3.4 Biomass estimates

Herring

The total herring biomass estimate for the Danish acoustic survey with R/V Dana in June-July 2019 is 162,243 tonnes of which 69.2 % or 112,267 tonnes is North Sea autumn spawners and 30.8 % or 49,976 tonnes is Baltic Sea spring spawners.
For the total number of herring the survey results give 4,133 mill, of which 75.1 % are North Sea autumn spawners and 24.9 % 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 9 and 10 for North Sea autumn spawners and Baltic spring spawners respectively.

The distribution of NASC for all herring (combined North Sea autumn spawners and Baltic spring spawners) is given in Figure 4.

A comparison for the results of the last 103 years surveys are given in the text table below.

	Autumn spawners		Spring spawners	
Year	Number in mill.	Biomass in tons	Number in mill.	Biomass in tons
2006	1530	98786	6407	471850
2007	4443	315176	8847	614048
2008	4473	80469	7367	450505
2009	9679	157707	1326	146590
2010	2723	148946	1461	88597
2011	5156	165589	3699	179898
2012	4805	259947	1955	122901
2013	1070	62126	1013	83601
2014	4576	58974	798	32875
2015	2950	103423	4874	179954
2016	1163	38650	1085	59660
2017	646	31196	703	36687
2018	1463	27333	278	23331
2019	3105	112266	1027	49976

Sprat

The total abundance estimate of sprat for the Danish acoustic survey with R/V Dana in June-July 2019 is 2336 million corresponding to a biomass at 31,399 ton. Sprats were in 2019 found in Kattegat, Strata 21, with 94.0 %, Skagerrak, Strata 42, with 4.4 % and in the North Sea, Strata 151, with 1.6 %.

Abundance, biomass, mean length and mean weight per WR and strata are given in Table 11.
The distribution of NASC for sprat is given in Figure 4.

3.5 Hydrography

35 CTD stations have been taken. Information on the stations and distribution is given in Table 7 and Figure 3. Data from the CTD stations will be delivered to ICES hydrographical data base.

3.6 Plankton

21 WP2 stations have been taken. Information on the stations and distribution is given in Table 8 and Figure 3. Dry weight will be measured ashore for each of the three fractions 2000 µm, 1000 µm and 180 µm.

4 Cruise leader course

Four students from DTU-Aqua`s MSc Eng. In Aquatic Science and Technology have participated in the survey during a 5 ECTS Cruise leader course. Two students has been working with linking plankton samples from WP2 and stomach contents by herring, Two students have been testing freezing techniques for preservation of stomach contents by mackerel for analysis at shore. The students have worked together with the rest of the scientific crew under supervision of Karl-Johan Stæhr.

For more details see appendix 1.

Appendix 1

Cruise Leader Special Course

Cruise De-brief

Group 1: Alexander Holdgate (s190061) and Ghebrehiwet Yacob (s180286)

Aim 1

The first aim of our project is to test the difference in stomach integrity between mackerel (*Scomber scrombus*) stomachs processed using two different preservation treatments.

The established method of extracting and processing mackerel stomachs on scientific cruises is both labour intensive and time consuming. As such, the first aim of this project is to test if flash-freezing whole mackerel samples at -80°C (treatment 1) is a viable alternative to the established method which involves removing individual stomachs before freezing them at -20°C (treatment 2).

Experiment 1 sampling methodology

At 8 stations, four mackerel were selected at each length class in the catch. One whole mackerel and one extracted stomach were then processed using treatment 1 and treatment 2 respectively. In situations where less than four mackerel in a length group were available for sampling, the following order of precedence for sample processing was applied:

- One fish available in length group - Extracted stomach processed using treatment 2
- Two fish available in length group - Extracted stomach processed using treatment 2; Whole fish processed using treatment 1
- Three fish available in length group – Extracted stomach processed using treatment 2; Whole fish processed using treatment 1; Extracted stomach processed using treatment 1

By following this order, at least one mackerel stomach per length group at each station was collected using the established method (treatment 2). As such, mackerel stomach contents can be compared between all stations over the duration of the cruise (see aim 2).

Aim 2

The second aim of our project is to carry out continuous stomach content analysis for mackerel caught at over the duration of the cruise.

Experiment 2 sampling methodology

At every station, two extracted mackerel stomachs were collected at each length class in the catch and frozen at -20 (treatment 2). In situations where only one fish was available for a length group, one stomach was collected and processed using treatment 2. Unless at stations where experiment 1 was carried out – see experiment 1 sampling methodology

Summary of Samples

TABLE 1 - SUMMARY OF SAMPLES COLLECTED DURING THE SUMMER HERRING CRUISE ON BOARD RV DANA, 28TH JUNE - 08TH JULY 2019

Station	No. Samples	Length Range (cm)	Experiment 1	Experiment 2
78	6	28-36	x	x
138	51	19-37	x	x
153	48	24-41	x	x
244	14	23-33	x	x
311	55	20-37	x	x
326	60	20-43	x	x
405	3	27-36	x	x
488	56	18-36	x	x
505	38	17-39		x
796	9	20-35		x
886	32	18-39		x
984	14	20-39		x
1025	33	22-38		x
1037	33	21-40		x
1181	33	21-39		x
1193	32	20-36		x
1362	34	20-39		x
1374	38	20-38		x
1451	24	24-35		x
1520	32	20-38		x
1535	22	19-33		x
1635	18	20-36		x
1689	15	19-26		x
1709	14	20-27		x
	4	21-37		x

Initial Observations

Mackerel were mostly caught during surface night trawls. Initial stomach fullness observations indicate mackerel feed more actively at the surface during the night. Smaller mackerel (<25cm) stomachs showed evidence of krill and plankton, whereas larger mackerel (25cm – 43cm) stomachs contained small fish (e.g. sprat and small herring). Furthermore, length distributions recorded during the cruise show a larger size-range of mackerel present during the night as opposed to day. However, the average size of mackerel caught in day trawls was larger than night.

Outline of post-cruise processing

Samples are to be returned to DTU, Lyngby Campus for processing.

Experiment 1

Whole fish in each length group will be thawed and their stomachs extracted. For each treatment and length group, the two stomach samples will have their integrity recorded (e.g. surface elasticity, colouration etc.) and compared to one another. Pairs of stomachs will be scored on integrity compatibility i.e. if stomach integrity is similar between whole fish and extracted stomachs, that

pair will receive a higher score. The final scores will be assessed to evaluate the success of the proposed methodology.

Experiment 2

Stomach content analysis will be carried out for each stomach collected at all stations. Firstly, stomachs will are to be thawed and their fullness recorded on a general numerical scale (e.g. 1 – 5). Subsequently, stomachs will be dissected, and their contents observed, recording information such as species composition and percentage, digestion state etc. The contents will then be compared across length groups and stations.

Cruise Leader Group 2 Report – Enrique & Ruairí

Long-term plankton monitoring is crucial to understanding their changes in abundance and biodiversity, as well as changes in their distribution due to variations in different parameters like temperature, salinity or pH. Traditional monitoring methods include bongo plankton nets, vertical plankton nets and neuston nets; however more precise methods are needed, which justify the purpose of this study: comparing the vertical plankton net (WP2) method, with herring stomach analysis. Herring are planktovores, and they follow the zooplankton in their vertical migration. Therefore, by analyzing the herring stomach contents, we could have a more precise monitor to measure the plankton biodiversity. Nevertheless, a reliance on stomachs may cause us to underestimate or over estimate certain species due to processes such as selective feeding, while the hydrological drag caused by the net can casue other speices to take evasive action from the net. Therefore, we believe a combination of the two methods may result in the most reliable monitoring of the zooplankton community.

Accordingly, we spent two weeks in the north sea, skaggerak and kattegat deployoying a vertical plankton net (WP2) at a total of 21 stations (see figure 1). The net, with a 180 micron mesh, was deployed in each station at a maximum depth of 150m and 5m above the bottom at stations with depth less than 150m. The net was cleaned with sea water and the plankton was filtered through 3 sieves: 2000, 1000 and 180 microns respectively. Plankton collected in each sieve was stored in 100mL containers labeled with cruise name (HER19), station number and sieve size in a 4% formalin solution previously prepared using seawater to avoid the effect of osmosis on the organisms. For example, the 2000 micron sample collected from station 1115 is labeled: HER19_1115_2000 .

Regarding the herring stomach analysis, a maximum of 4 stomach were extracted per each available size class where available. They were frozen immediately after dissection in zip bags, with appropriate labels stating the station, size class (in semi-cm), and date.
With the exception of the WP2 station 667, all stations had a corresponding trawl. There are therefore a total of 63 formalin samples. Unfortunately, due to conflicting needs for the herring captured, we only had access to herring from 12 out of the 20 trawls. Nonetheless, this provided us with a total of 474 stomachs from herring ranging from 23 to 55 semicm (mean=39) (see figure 2.). All samples have been boxed, and are ready to be sent to DTU (Lyngby Campus). The exact details of storage location and handling responsibility are to be confirmed by Heidi (she has been contacted regarding the matter and is aware that samples will be arriving). It is hoped that both the formalin samples and stomahcs will be systematically analyzed for zooplankton biodiversity, and if possible compared.

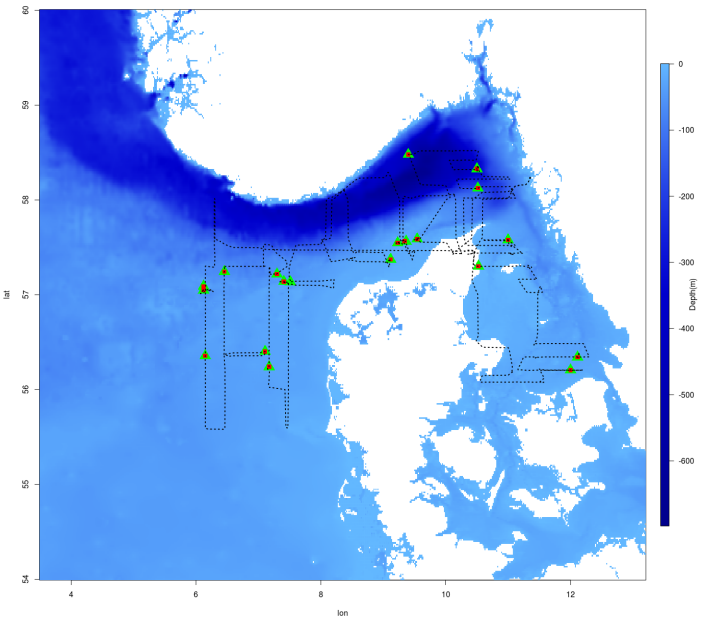

Figure 1: Map of transects (dotted line) with WP2 stations and Trawls indicated by green triangles and red dots respectively

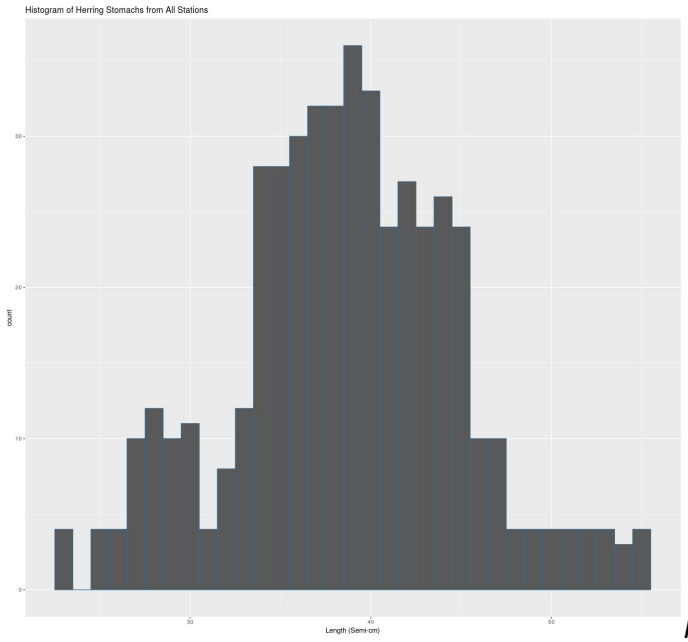

Figure 2: Histogram of all stomach contents collecetd

Figure 1. Map showing the survey area for the Danish acoustic survey with R/V Dana in June-July 2019. The map shows the subareas (strata) used in the abundance estimation.

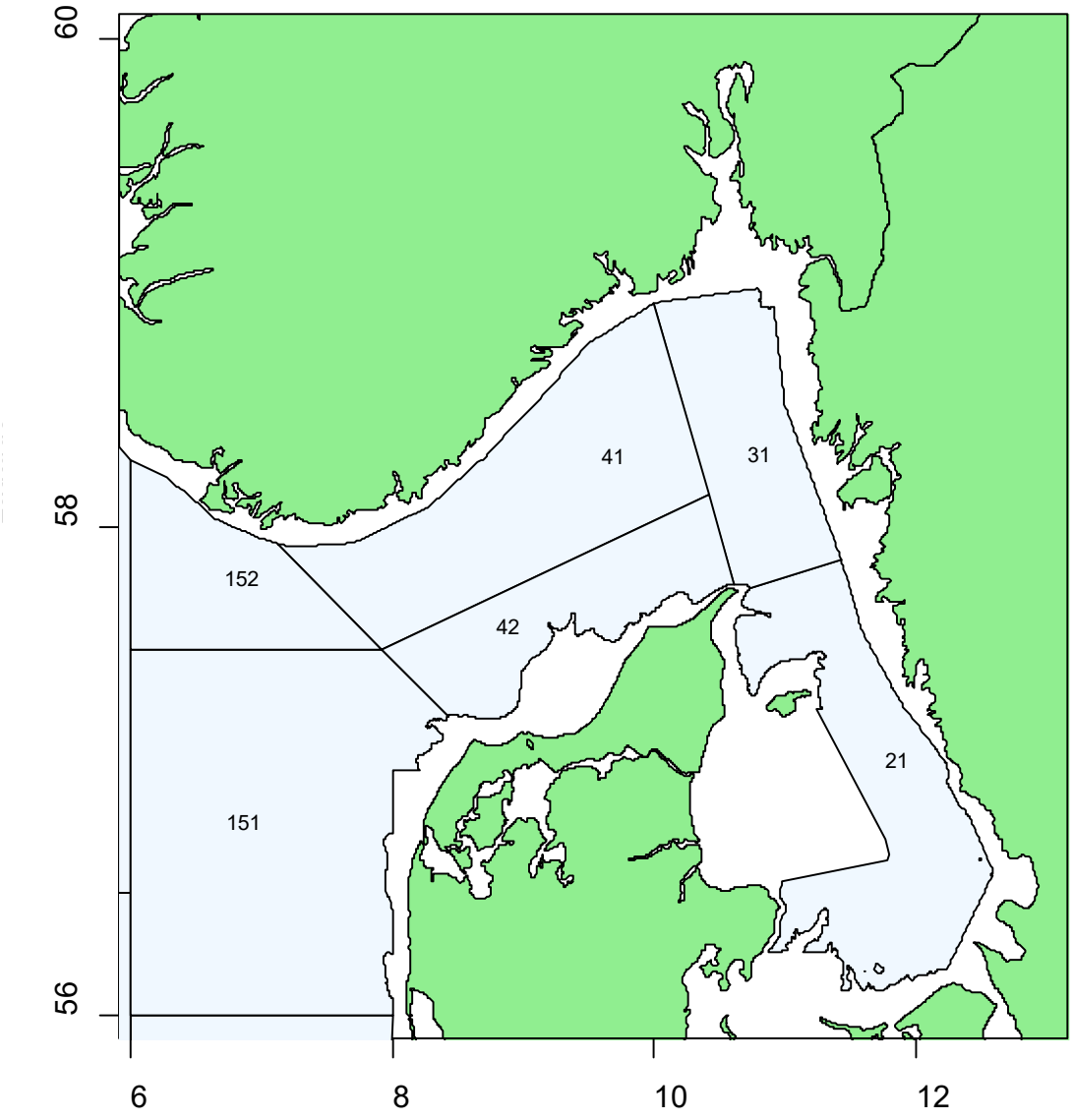

Figure 2. Map showing sailed route and trawl stations during the Danish acoustic survey with R/V Dana in June-July 2019. Read is pelagic hauls and blue is demersal hauls.

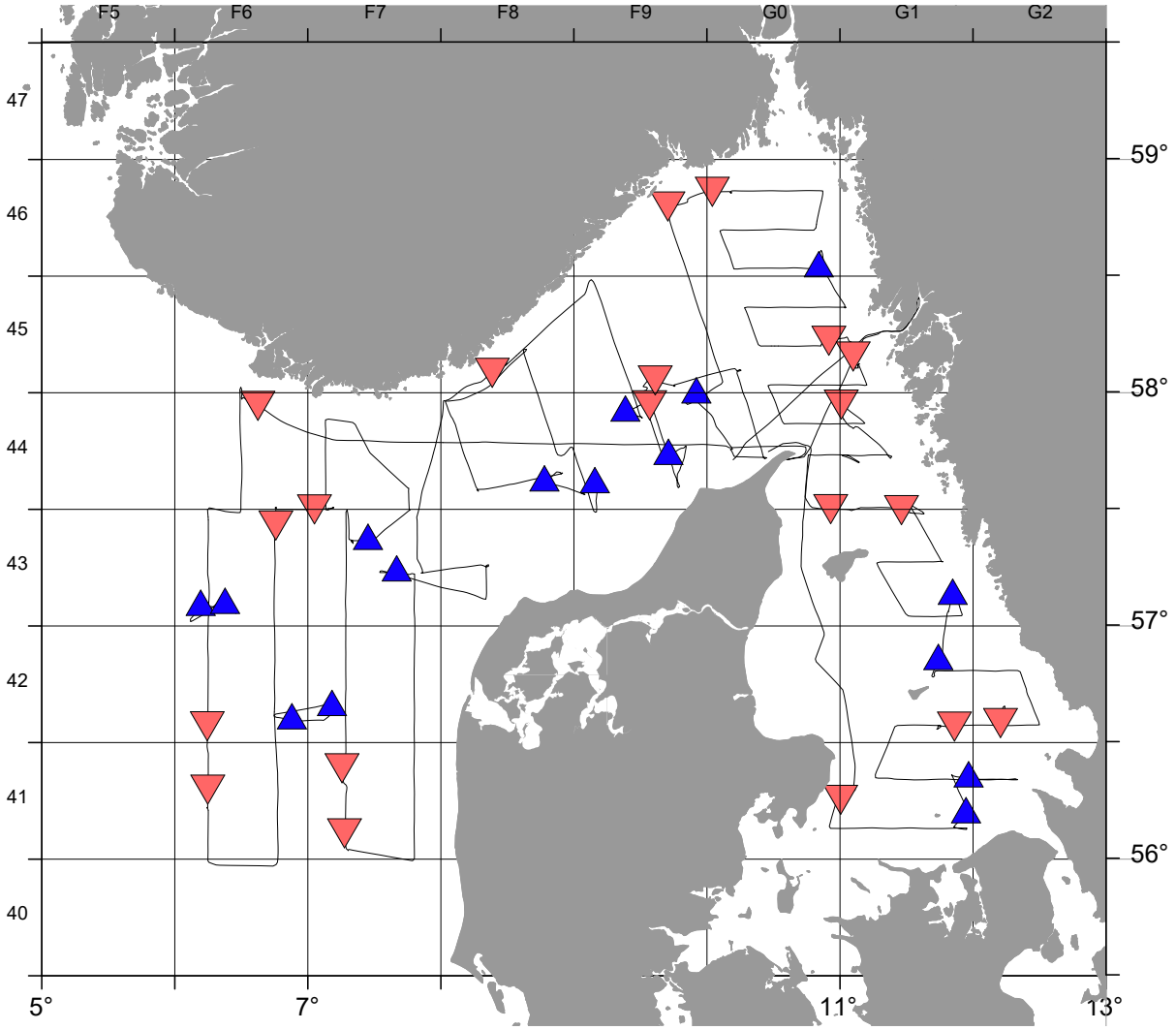

Figure 3. Map showing CTD and WP2 stations during the Danish acoustic survey with R/V Dana in June-July 2019. X are CTD stations and squares are combined CTD and WP2 stations.

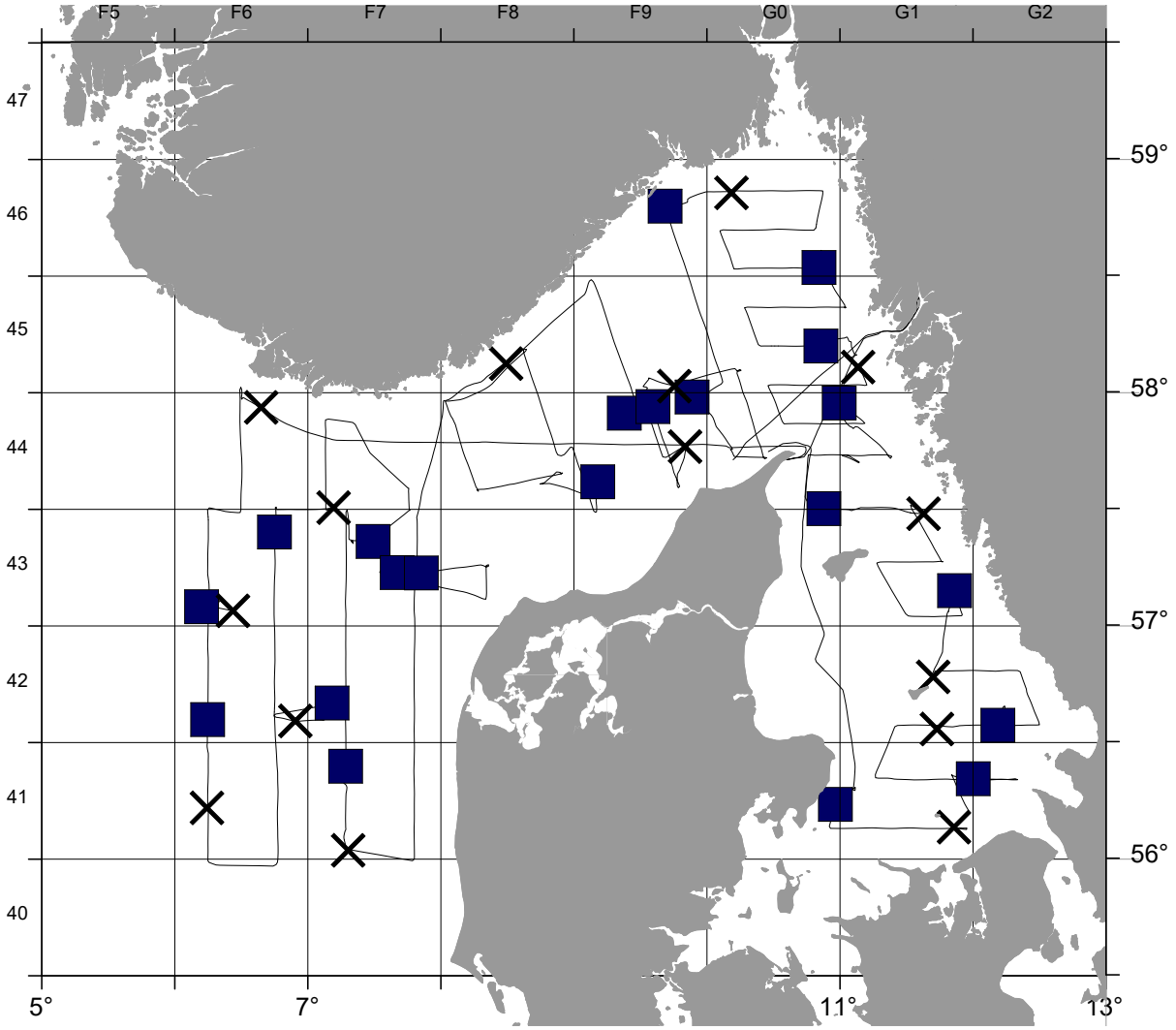

Figure 4. The distribution of NSAC for all herring (Spring spawners and autumn spawners) along the track of the Danish acoustic survey with R/V Dana in June-July 2019.

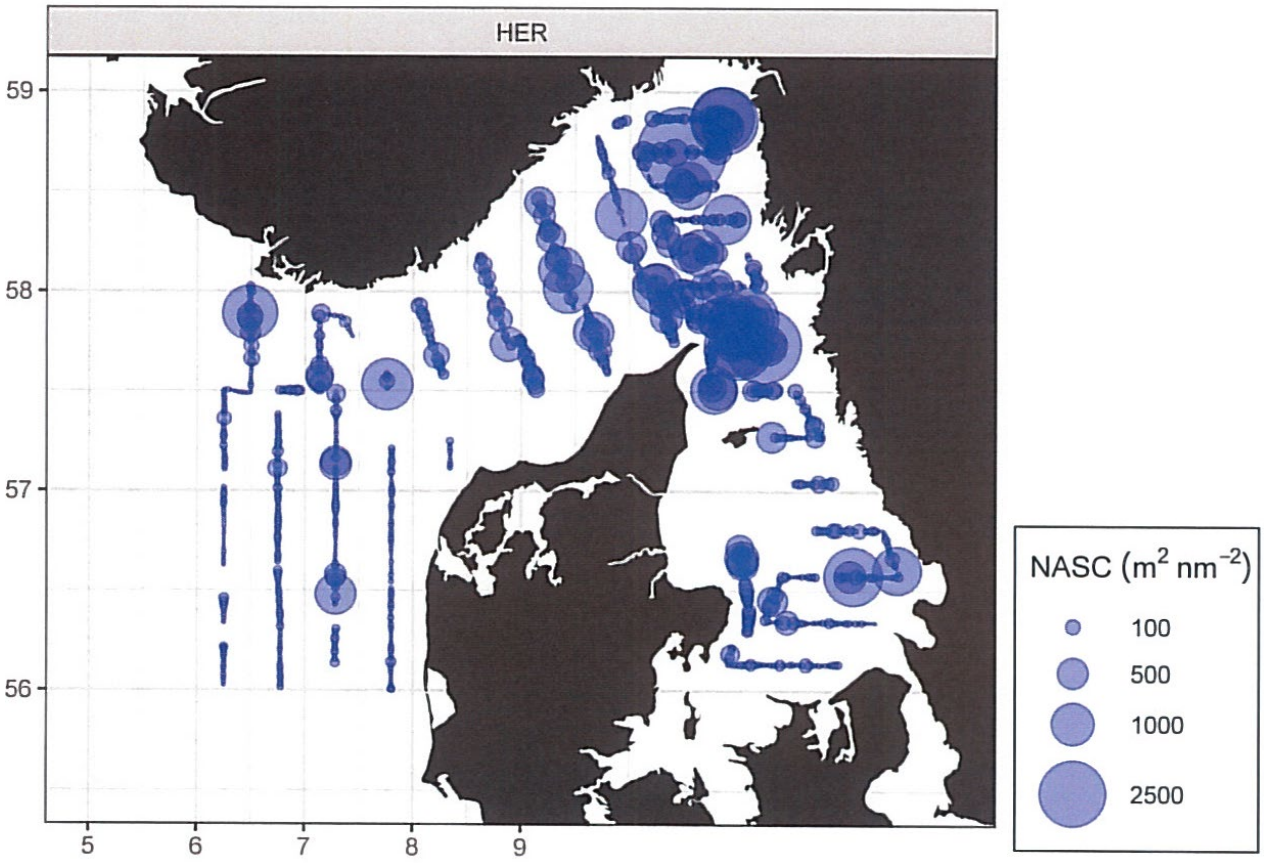

Figure 5. The distribution of NSAC for sprat along the track of the Danish acoustic survey with R/V Dana in June-July 2019.

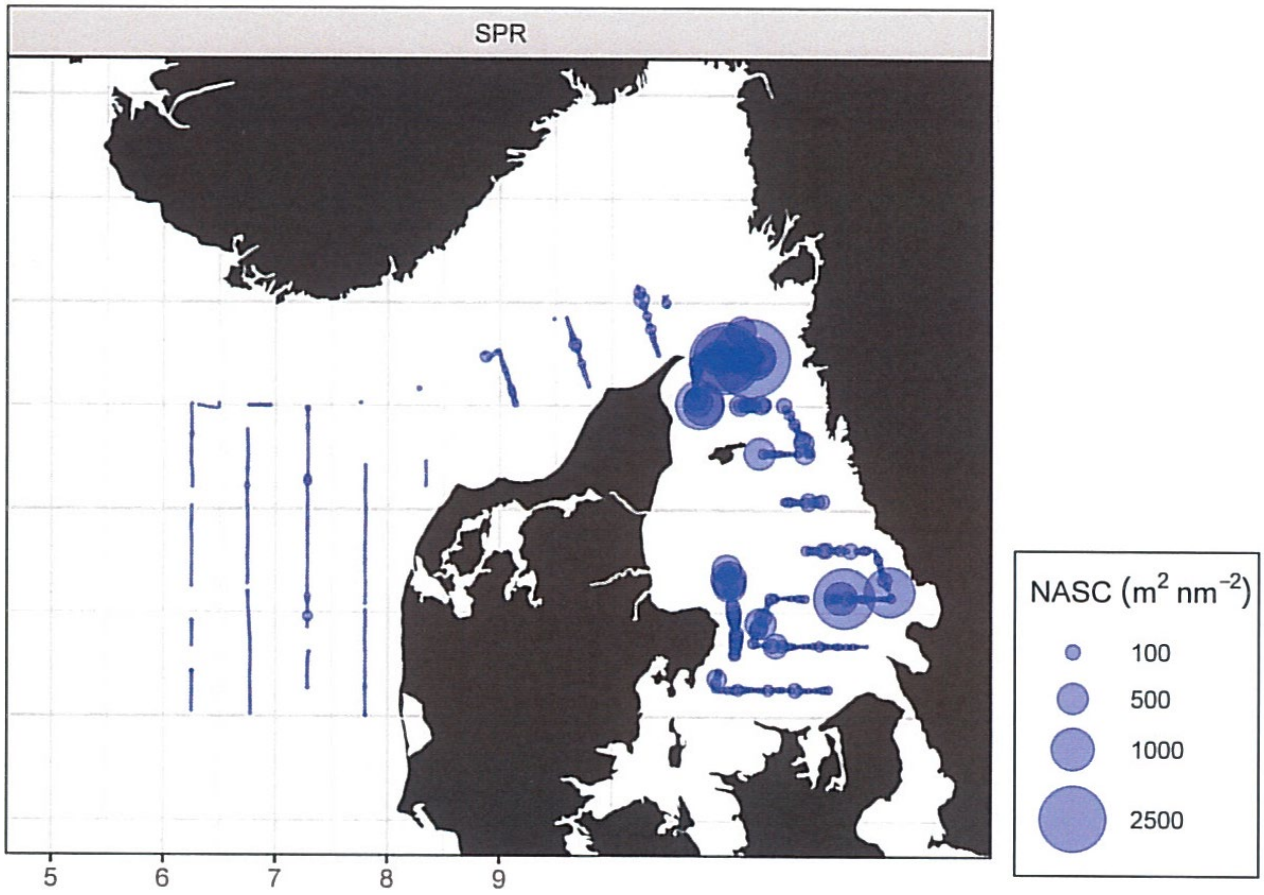

Table 1. . Simrad EK60 and analysis settings used during the Acoustic Herring Survey with R/V Dana Cruise June-July 2019

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. Trawl hauls details for the Danish acoustic survey with R/V Dana in June-July 2019.

Date	Haul	Time	ICES	Position		Trawl Direction	Wire length	Trawl type	Cath depth	Mean depth	Total catch	Main Species	Trawling speed	Trawling duratin	Wind speed	Sea state
dd-mm-yy	no.	UTC	Square	Latitude	Longitude	deg.	m		m	m	kg		Kn	min,	m/s	
28-06-19	2	01:00	44F6	57.56.632 N	006.37.481 E	297	300	Fotö	Surface	362	237	Herring	3.9	60	14.1	6
28-06-19	78	12:15	43F6	57.04.886 N	006.11.676 E	220	400	Expo	Bottom	49	74	Jellyfish	3.9	60	11.1	6
28-06-19	96	14:52	43F6	57.05.396 N	006.22.664 E	125	360	Expo	Bottom	56	42	Gurnard, Dab	3.9	45	11.8	6
28-06-19	138	21:35	42F6	56.34.206 N	006.14.636 E	181	300	Fotö	Surface	36	110	Gurnard, Mackerel	3.9	60	7.4	6
29-06-19	153	00:21	41F6	56.17.893 N	006.14.872 E	181	300	Fotö	Surface	43	153	Mackerel	4.0	60	5.5	6
29-06-19	244	11:14	42F7	56.39.123 N	007.10.896 E	232	250	Expo	Bottom	36	1449	Herring	4.0	60	7.0	6
29-06-19	259	14:13	42F6	56.35.690 N	006.52.810 E	259	260	Expo	Bottom	42	1879	Herring	4.0	60	5.7	6
29-06-19	311	21:45	43F6	57.25.853 N	006.45.569 E	359	300	Fotö	Surface	129	280	Mackerel, Pearlside	3.8	60	2.5	2
30-06-19	326	00:21	44F7	57.29.994 N	007.02.980 E	86	300	Fotö	Surface	214	600	Herring, Mackerel	3.8	60	9.7	2
30-06-19	405	11:03	43F7	57.21.864 N	007.27.133 E	269	570	Expo	Bottom	89	97	Norway pout	4.0	60	14.9	3
30-06-19	488	21:23	41F7	56.23.387 N	007.15.412 E	159	300	Fotö	Surface	34	200	Mackerel	3.9	60	11.5	3
01-07-19	505	00:23	41F7	56.06.651 N	007.16.522 E	168	380	Fotö	Surface	29	1097	Mackerel	4.1	60	12.5	3
01-07-19	606	13:21	43F7	57.13.743 N	007.40.068 E	268	360	Expo	Bottom	54	44	Jelly fish	3.9	60	14.4	4
02-07-19	796	11:26	44F9	57.36.448 N	009.09.438 E	235	300	Expo	Bottom	55	942	Herring	3.8	60	18.6	4
02-07-19	815	14:46	44F8	57.36.897 N	008.46.698 E	45	400	Expo	Bottom	84	2197	Herring	3.9	60	18.9	6
03-07-19	880	00:42	45F8	58.05.126 N	008.23.174 E	54	700	Fotö	Surface	227	710	Herring	4.7	60	5.7	6
03-07-19	960	11:41	44F9	57.54.862 N	009.23.214 E	60	760	Expo	Bottom	177	790	Saith, Norway pout	4.0	60	13.1	6
03-07-19	984	14:46	44F9	57.43.726 N	009.42.621 E	69	250	Expo	Bottom	38	1735	Herring	4.1	54	14.7	6
03-07-19	1025	21:59	45F9	57.56.777 N	009.34.133 E	351	400	Fotö	Surface	207	708	Herring	4.1	60	15.6	4
04-07-19	1037	00:28	45F9	58.03.174 N	009.36.666 E	98	370	Fotö	Surface	294	845	Herring	4.3	60	12.6	4
04-07-19	1118	12:44	44F9	57.59.541 N	009.55.233 E	230	460	Expo	Bottom	105	339	Herring, Norway pout	3.5	60	19.0	4
04-07-19	1181	21:57	46F9	58.47.923 N	009.42.369 E	72	400	Fotö	Surface	325	275	Krill	4.1	60	6.1	4
05-07-19	1193	00:25	46G0	58.51.704 N	010.02.412 E	91	570	Fotö	Surface	203	405	Herring	4.4	60	7.1	4
05-07-19	1290	12:26	46G0	58.31.991 N	010.50.443 E	3	440	Expo	Bottom	84	1554	Herring	4.0	60	10.4	4
05-07-19	1362	22:00	45G1	58.13.377 N	010.54.967 E	84	315	Fotö	Surface	124	485	Herring	4.0	60	11.4	4
06-07-19	1374	00:25	45G1	58.09.330 N	011.05.930 E	150	580	Fotö	Surface	104	1570	Herring	4.3	60	13.8	4
06-07-19	1451	11:09	44G1	57.56.961 N	011.00.566 E	163	320-630	Fotö	0-50	95	117	Herring	4.3	90	11.4	4
06-07-19	1520	21:29	43G1	57.30.058 N	010.55.797 E	94	470	Fotö	Surface	40	300	Jelly fish, Herring	4.3	60	11.2	2
07-07-19	1535	00:35	43G1	57.29.802 N	011.27.713 E	92	315	Fotö	Surface	60	394	Picked dogfish	3.8	60	8.8	2
07-07-19	1618	10:53	43G1	57.07.727 N	011.50.823 E	194	390	Expo	Bottom	57	81	Sprat, Herring	3.6	60	5.4	1
07-07-19	1635	13:25	42G1	56.50.944 N	011.44.347 E	202	280	Expo	Bottom	39	1005	Sprat	4.0	60	4.7	1
07-07-19	1689	21:10	42G2	56.35.024 N	012.12.375 E	8	340	Fotö	Surface	47	170	Jerlly fish	4.0	60	10.7	1
08-07-19	1709	00:29	42G1	56.34.114 N	011.51.621 E	280	275	Expo	Surface	33	44	Herring, Jelly fish	3.6	60	9.0	1
08-07-19	1792	11:16	41G1	56.20.755 N	011.57.994 E	289	340	Expo	Bottom	32	204	Sprat	3.9	60	7.8	1
08-07-19	1808	13:48	41G1	56.11.523 N	011.56.834 E	223		Expo	Bottom	25	53	Dab	3.9	60	6.7	1
08-07-19	1859	20:50	41G1	56.15.265 E	011.00.298 E	46	215	Expo	Surface	22	42	Herring, Sprat	3.7	60	10.4	1

Table 3. Catch composition in trawl hauls for the Danish acoustic survey with R/V Dana in June – July 2019

			Station	2	78	96	138	153	244	258	311	326	405	488	505
			ICES sq.	44F6	43F6	43F6	42F6	41F6	42F7	42F6	43F6	44F7	43F7	41F7	41F7
			Gear	Fotö	Expo	Expo	Fotö	Fotö	Expo	Expo	Fotö	Fotö	Expo	Fotö	Fotö
			Fishing depth	Surface	Bottom	Bottom	Surface	Surface	Bottom	Bottom	Surface	Surface	Bottom	Surface	Surface
			Total depth	369	49	56	36	43	36	42	129	214	85	34	29
			Day/Night	N	D	D	N	N	D	D	N	N	D	N	N
%			Total catch	237	74	42	110	322	1 449	1 879	280	600	97	200	1 097
0.009	Anchovy	*Engraulis encrasicolus*	1.986												
0.007	Lesser silver smelt	*Argentina sphyraena*	1.555												
1.075	Blue whiting	*Micromesistius poutassou*	229.926								3.26	85.892			
6.753	Sprat	*Sprattus sprattus*	1444.129			0.013	0.27	0.66	68.493	99.334	1.452			0.11	0.114
0.073	Squids, octopusses	*Cephalopoda sp*	15.584	0.397	0.658	0.555	0.094	0.028	0.18	0.03		1.102		0.108	0.515
0.052	Northern pink shrimp	*Pandalus borealis*	11.183												
0.015	Norway lobster	*Nephrops norvegicus*	3.109												
0.006	Four-bearded rockling	*Enchelyopus cimbrius*	1.356												
0.242	Common weaver	*Trachinus draco*	51.684												
0.000	Poor-cod	*Trisopterus minutus*	0.106			0.024									
0.006	Anglerfish	*Lophiuspiscatorius*	1.354												
0.003	Horse mackerel	*Trachurus trachurus*	0.723												0.286
0.278	Garfish	*Belone belone*	59.368	1.12			0.654	3.36				0.62		1.067	3.02
0.079	Long rough dab	*Hippoglosides plattessoides*	16.837						0.206	1.54					
2.161	Whiting	*Merlangius merlangus*	462.226		0.942	5.8	0.18		5.46	10.14	0.052			0.103	
0.429	Invertebrates	*Invertebrata*	91.687			0.022									
0.783	Dab	*Limanda limanda*	167.424		2.57	14.16			18.14	36.3					0.271
0.480	Hake	*Merluccius merluccius*	102.697							4.48					
0.642	Gurnard	*Trigala spp.*	137.228		13.43	17.25	56.4	9.31	3.74	6.22				5	9.5
0.981	Krill	*Euphausidae spp.*	209.745	0.521							9.132				
0.530	Haddock	*Melanogrammus aeglefinus*	113.377	0.036	0.702	0.927			0.018		0.03		0.391		
0.000	Lesser weever	*Echiichthys vipera*	0.031												
0.027	Ling	*Molva molva*	5.725												
0.016	Pollack	*Pollachius pollachius*	3.48												
0.495	Pearlside	*Mauorolicus muelleri*	105.863	0.022							102.736				
11.344	Mackerel	*Scomber scombrus*	2426.003	2.62	1.67		48.6	317.1	2.5		103.6	143.861	0.824	153.9	1082.654
2.569	Saithe	*Pollachius virens*	549.31												
0.013	Turbot	*Psetta maxima*	2.82							2.82					
1.825	Picked Dogfish	*Squalus acanthias*	390.268	3.271											
0.006	Sardin	*Sardina pilchardus*	1.362					1.19							
0.052	Plaice	*Pleuronectes platessa*	11.109						0.75	1.26					
0.035	Lemon sole	*Microstomus kitt*	7.575		0.874	0.32			0.172						
0.001	Common dragonet	*Callionymus lyra*	0.207												
58.227	Herring	*Clupea harengus*	12451.81	213.7		0.062	1.288	0.514	1337.189	1715.678	26.218	330.919	6.366	0.206	0.49
0.001	Flounder	*Platichthys flesus*	0.295												
0.006	Snake blenny	*Lumpenus lampretaeformis*	1.242												
0.000	Hagfish	*Myxine glutinosa*	0.014												
5.733	Norway pout	*Trisopterus esmarki*	1226.022										86.477		
0.362	Lumpsucker	*Cyclopterus lumpus*	77.489	0.456							0.52				
4.116	Large Medusa	Scyphozoa sp.	880.312	15.1	52.622	2.02	3		10		33	37.604	2.64	39.286	
0.000	Silvery pout	*Gadiculus argenteus*	0.014												
0.023	Greater sandeel	*Hyperoplus lanceolatus*	4.891		0.476	0.468			1.884	0.21					
0.007	Sandeel	*Ammodytes marinus*	1.485			0.379			0.146	0.96					
0.516	Cod	*Gadus Morhua*	110.341										0.257		
0.000	Scaldfish	*Amoglossus laterna*	0.012												
0.002	Sculpin	*Myoxocephalus scorpius*	0.402												
0.017	Vahls eelpout	*Lycodes vahli*	3.71												
100.000			21385.076	237.243	73.944	42	110.486	332.162	1448.878	1878.972	280	599.998	96.955	200	1096.85

Table 3. continued.

			Station	606	796	815	880	960	984	1025	1037	1118	1181	1193	1290
			ICES sq.	43F7	44F9	44F8	45F8	44F9	44F9	45F9	45F9	44F9	46F9	46G0	46G0
			Gear	Expo	Expo	Expo	Fotö	Expo	Expo	Fotö	Fotö	Expo	Fotö	Fotö	Expo
			Fishing depth	Bottom	Bottom	Bottom	Surface	Bottom	Bottom	Surface	Surface	Bottom	Surface	Surface	Bottom
			Total depth	54	55	84	227	177	38	207	294	105	325	203	84
			Day/Night	D	D	D	N	D	D	N	N	D	N	N	D
%			Total catch	44	942	2 197	710	790	1 735	708	845	339	275	405	1 554
0.013	Anchovy	*Engraulis encrasicolus*	1.986												
0.010	Lesser silver smelt	*Argentina sphyraena*	1.555			0.015		1.49				0.05			
0.939	Blue whiting	*Micromesistius poutassou*	140.774					39.9		100.874					
8.498	Sprat	*Sprattus sprattus*	1273.683		0.568				292.948						
0.080	Squids, octopusses	*Cephalopoda sp*	11.917	0.355	0.988	0.826	1.449	0.595	1.207	1.106	0.708	1.006	0.348	0.152	0.367
0.075	Northern pink shrimp	*Pandalus borealis*	11.183					9.892							1.291
0.021	Norway lobster	*Nephrops norvegicus*	3.109					0.842	0.095						1.134
0.009	Four-bearded rockling	*Enchelyopus cimbrius*	1.356					1.29				0.066			
0.345	Common weaver	*Trachinus draco*	51.684		31.1		0.201		1.37						
0.001	Poor-cod	*Trisopterus minutus*	0.082												0.082
0.009	Anglerfish	*Lophiuspiscatorius*	1.354		1.354										
0.003	Horse mackerel	*Trachurus trachurus*	0.437		0.326				0.111						
0.330	Garfish	*Belone belone*	49.527				1.51			0.204	1.474				
0.101	Long rough dab	*Hippoglosides plattessoides*	15.091			0.873		5.32				1.068			5.06
2.933	Whiting	*Merlangius merlangus*	439.549	0.722	3.98	92			312			4.85	0.034		3.1
0.612	Invertebrates	*Invertebrata*	91.665		0.455				5.725						
0.640	Dab	*Limanda limanda*	95.983	0.369	33.2	0.425			17.44						
0.655	Hake	*Merluccius merluccius*	98.217	2.427	54.4	3.75		7.94	21.38			4.18			1.62
0.108	Gurnard	*Trigala spp.*	16.158	0.532	3.82	0.378			8.84						
1.335	Krill	*Euphausidae spp.*	200.092										191.168		
0.742	Haddock	*Melanogrammus aeglefinus*	111.273	0.079	0.039	95.1		0.959	0.064			5.85			0.154
0.000	Lesser weever	*Echiichthys vipera*	0.031		0.031										
0.038	Ling	*Molva molva*	5.725			1.325		4.4							
0.023	Pollack	*Pollachius pollachius*	3.48			3.48									
0.021	Pearlside	*Mauorolicus muelleri*	3.105					0.378				2.727			
3.794	Mackerel	*Scomber scombrus*	568.674		2.128		58.3		3.5	70.1	33.3		21.5	76.7	
3.665	Saithe	*Pollachius virens*	549.31		0.402	86.4		456.6				5.27			0.638
0.000	Turbot	*Psetta maxima*	0												
2.582	Picked Dogfish	*Squalus acanthias*	386.997			1.761	32.34				0.096				49.88
0.001	Sardin	*Sardina pilchardus*	0.172							0.11					
0.061	Plaice	*Pleuronectes platessa*	9.099		6.62	0.593			1.042						
0.041	Lemon sole	*Microstomus kitt*	6.209		1.404	2.493			1.8			0.128			0.162
0.001	Common dragonet	*Callionymus lyra*	0.207		0.083				0.124						
58.843	Herring	*Clupea harengus*	8819.18	0.432	798.925	1092.953	591.987		1062.144	477.359	742.363	152.1	56.7	272.385	1448.287
0.002	Flounder	*Platichthys flesus*	0.295												
0.008	Snake blenny	*Lumpenus lampretaeformis*	1.242												1.242
0.000	Hagfish	*Myxine glutinosa*	0.014					0.014							
7.603	Norway pout	*Trisopterus esmarki*	1139.545		0.096	722.453		241.268				145.369			30.311
0.511	Lumpsucker	*Cyclopterus lumpus*	76.513				4.211	4.6		15.49	47.15				
4.571	Large Medusa	Scyphozoa sp.	685.04	37.983	2		20.002	4.301		42.757	19.909	11.804	5.25	55.763	10
0.000	Silvery pout	*Gadiculus argenteus*	0.014					0.014							
0.012	Greater sandeel	*Hyperoplus lanceolatus*	1.853	0.049	0.081										
0.000	Sandeel	*Ammodytes marinus*	0												
0.735	Cod	*Gadus Morhua*	110.084	1.052		92.1		6.48	5.21			4.49			0.672
0.000	Scaldfish	*Amoglossus laterna*	0.012												
0.003	Sculpin	*Myoxocephalus scorpius*	0.402												
0.025	Vahls eelpout	*Lycodes vahli*	3.71					3.71							
100.000			14987.588	44	942	2196.925	710	789.993	1735	708	845	338.958	275	405	1554

Table 3. continued.

			Station	1362	1374	1451	1520	1535	1618	1635	1689	1709	1792	1808	1859
			ICES sq.	45G1	45G1	44G1	43G1	43G1	43G1	42G1	42G2	42G1	41G1	41G1	41G1
			Gear	Fotö	Fotö	Fotö	Fotö	Fotö	Expo	Expo	Fotö	Expo	Expo	Expo	Expo
			Fishing depth	Surface	Surface	0-50	Surface	Surface	Bottom	Bottom	Surface	Surface	Bottom	Bottom	Surface
			Total depth	124	104	95	40	60	57	39	47	33	32	25	22
			Day/Night	N	N	D	N	N	D	D	N	N	D	D	N
%			Total catch	485	1 570	117	300	374	81	1 005	170	44	204	53	42
0.045	Anchovy	*Engraulis encrasicolus*	1.986		0.158	1.136	0.036	0.126	0.02	0.058	0.028	0.062			0.362
0.000	Lesser silver smelt	*Argentina sphyraena*	0												
0.000	Blue whiting	*Micromesistius poutassou*	0												
22.057	Sprat	*Sprattus sprattus*	980.167				11.634	0.453	31.3	803.198	2.148	3.718	110.726	6.95	10.04
0.063	Squids, octopusses	*Cephalopoda sp*	2.81	1.22	1.214	0.088	0.266			0.022					
0.000	Northern pink shrimp	*Pandalus borealis*	0												
0.023	Norway lobster	*Nephrops norvegicus*	1.038						0.452	0.308			0.278		
0.000	Four-bearded rockling	*Enchelyopus cimbrius*	0												
0.428	Common weaver	*Trachinus draco*	19.013		0.162	0.138	1.584	2.32		10.56	1.29	0.7	0.142	0.975	1.142
0.000	Poor-cod	*Trisopterus minutus*	0												
0.000	Anglerfish	*Lophiuspiscatorius*	0												
0.000	Horse mackerel	*Trachurus trachurus*	0												
1.043	Garfish	*Belone belone*	46.339	1.172	0.838	4.76	1.52	0.116			0.174		37	0.425	0.334
0.062	Long rough dab	*Hippoglosides plattessoides*	2.77						1.150	0.878			0.742		
0.515	Whiting	*Merlangius merlangus*	22.863				0.288		1.67	10.84	0.804	0.064	8.08	1.065	0.052
1.924	Invertebrates	*Invertebrata*	85.485							40.557		10.07	5.358	20.5	9
1.003	Dab	*Limanda limanda*	44.549						0.372	21.08			8.547	14.55	
0.057	Hake	*Merluccius merluccius*	2.52						2.52						
0.058	Gurnard	*Trigala spp.*	2.588						0.29	0.734	0.102		1.078	0.31	0.074
0.201	Krill	*Euphausidae spp.*	8.924	8.924											
0.203	Haddock	*Melanogrammus aeglefinus*	9.028						0.07	8.846	0.012		0.08	0.02	
0.000	Lesser weever	*Echiichthys vipera*	0												
0.000	Ling	*Molva molva*	0												
0.000	Pollack	*Pollachius pollachius*	0												
0.000	Pearlside	*Mauorolicus muelleri*	0												
6.822	Mackerel	*Scomber scombrus*	303.146	84.2	143.443	9.24	27.97	15.590	0.114	5.5	2.54	4.28	1.104	0.135	9.03
0.000	Saithe	*Pollachius virens*	0												
0.000	Turbot	*Psetta maxima*	0												
6.817	Picked Dogfish	*Squalus acanthias*	302.92		3.42			295.1	1.368		3.032				
0.001	Sardin	*Sardina pilchardus*	0.062				0.062								
0.019	Plaice	*Pleuronectes platessa*	0.844						0.074	0.162			0.178	0.43	
0.005	Lemon sole	*Microstomus kitt*	0.222										0.222		
0.000	Common dragonet	*Callionymus lyra*	0												
47.788	Herring	*Clupea harengus*	2123.545	353.771	1381.211	91.2	83.228	52.15	13.462	92.849	4.443	13.232	20.041	6.444	11.514
0.007	Flounder	*Platichthys flesus*	0.295											0.295	
0.000	Snake blenny	*Lumpenus lampretaeformis*	0												
0.000	Hagfish	*Myxine glutinosa*	0												
0.001	Norway pout	*Trisopterus esmarki*	0.048						0.048						
0.114	Lumpsucker	*Cyclopterus lumpus*	5.062	0.416					3.038				1.288	0.32	
10.695	Large Medusa	Scyphozoa sp.	475.271	35.297	39.554	10.6	173.412	8	24.65	7.794	155.527	11.38	9.057		
0.000	Silvery pout	*Gadiculus argenteus*	0												
0.039	Greater sandeel	*Hyperoplus lanceolatus*	1.723						0.028	1.44				0.235	0.02
0.000	Sandeel	*Ammodytes marinus*	0												
0.002	Cod	*Gadus Morhua*	0.08										0.08		
0.000	Scaldfish	*Arnoglossus laterna*	0.012							0.012					
0.009	Sculpin	*Myoxocephalus scorpius*	0.402							0.162				0.24	
0.000	Vahls eelpout	*Lycodes vahli*	0												
100.000			4443.712	485	1570	117.162	300	373.855	80.626	1005	170.1	43.506	204.001	52.894	41.568

Table 4. Measured length distribution of herring by haul for the Danish acoustic survey with R/V Dana in June-July 2019.

Station	2	96	138	153	244	258	311	326	405	488	505	606
ICES sq.	44F6	43F6	42F6	41F6	42F7	42F6	43F6	44F7	43F7	41F7	41F7	43F7
Gear	Fotö	Expo	Fotö	Fotö	Expo	Expo	Fotö	Fotö	Expo	Fotö	Fotö	Expo
Fishing depth	Surface	Bottom	Surface	Surface	Bottom	Bottom	Surface	Surface	Bottom	Surface	Surface	Bottom
Total depth	369	56	36	43	36	42	129	214	85	34	29	54
Day/Night	N	D	N	N	D	D	N	N	D	N	N	D
Total catch,kg	237	42	110	322	1 449	1 879	280	600	97	200	1 097	44
Total catch Herring,	213.700	0.062	1.288	0.514	1337.189	1715.678	26.218	330.919	6.366	0.206	0.490	0.432
Sample Herring,kg	40.107	0.062	1.288	0.514	16.230	11.990	26.218	57.199	6.366	0.206	0.490	0.432
5.5												
6												
6.5												
7												
7.5												
8												
8.5												
9												
9.5												
10												
10.5												
11										1		
11.5												
12					5	3						
12.5			2		30	11						
13			5	1	85	36				1		
13.5			6		92	56	1			1	3	
14			10	2	96	90			2		3	
14.5			12	1	100	149			3		3	
15	1		7		105	102	2		12		2	
15.5	2	1	9	3	65	34	4		13		2	
16	2	1	1		35	16	1		8		1	
16.5	6				27	1	4		5			1
17	4			2	13		2		6			
17.5	3				1	1	6		4			
18	11			1	3		3		4			2
18.5	11				1		6	2	2			1
19	16				1		3	1	2			1
19.5	42						23	7	2			
20	49						18	6	8			
20.5	79						37	20	12			3
21	89						44	33	7		1	
21.5	68			1			48	39	14	1		
22	36				1		34	43	8			
22.5	33						35	54	5			
23	18						16	38	2	1	1	
23.5	9						18	39	2			
24	8						6	30				
24.5	6						6	23				
25	4						3	30				
25.5	9			1			4	22				
26	3						2	23	1			
26.5	4						1	32				
27	3						3	11				
27.5	1							13				
28	1							8				
28.5	1						1	3				
29								6				
29.5								1				
30	1							3				
30.5												
31												
31.5								1				
32												
32.5												
Total no.	520	2	52	12	660	499	331	488	122	5	16	8
Mean Length	21.07692	15.75	14.33654	16.75	14.41818	14.35872	21.31118	23.6373	18.71311475	16.4	15.4375	18.9375

Table 4. continued.

Station	796	815	880	984	1025	1037	1118	1181	1193	1290		1362
ICES sq.	44F9	44F8	45F8	44F9	45F9	45F9	44F9	46F9	46G0	46G0		45G1
Gear	Expo	Expo	Fotô	Expo	Fotö	Fotö	Expo	Fotö	Fotö	Expo		Fotö
Fishing depth	Bottom	Bottom	Surface	Bottom	Surface	Surface	Bottom	Surface	Surface	Bottom		Surface
Total depth	55	84	227	38	207	294	105	325	203	84		124
Day/Night	D	D	N	D	N	N	D	N	N	D		N
Total catch,kg	942	2 197	710	1 735	708	845	339	275	405	1 554		485
Total catch Herring,	798.925	1092.953	591.987	1062.144	477.359	742.363	152.100	56.700	272.385	6.542	1441.745	353.771
Sample Herring,kg	30.110	54.364	39.517	17.396	63.838	62.515	53.368	34.479	33.457	0.922	30.320	26.133
5.5												
6												
6.5												
7												
7.5												
8												
8.5								1		83		
9										87		
9.5										22		
10								1				
10.5												
11												
11.5												
12												
12.5	1			2								
13	2			42								
13.5	3			92								
14				33								
14.5	4			86								
15				49			1					
15.5	4		1	39							2	
16	7		2	28	1		1		1			1
16.5	18		4	20	2			27			11	
17	73		7	23	1	1	1	1	2		39	1
17.5	160		4	18	4			3	4		109	16
18	148	1	10	14		3		12	12		158	25
18.5	88	3	28	14	4			30	51		167	82
19	48	1	37	23	1	2		61	84		100	89
19.5	29	7	47	19	12	2	1	98	116		38	69
20	30	28	69	12	18	10	16	90	98		10	70
20.5	13	44	49	1	51	18	41	52	45		2	48
21	9	64	67	1	47	18	85	53	47		3	27
21.5		83	51	3	71	22	119	27	22		3	19
22	3	93	37		78	32	121	18	25		2	17
22.5	1	73	32		64	26	92	18	13			11
23		52	26		48	26	38	6	8			4
23.5		41	16		40	38	41	8	4			5
24		26	12		35	28	14	5	2			3
24.5		15	6		38	26	8	2	1			
25		18	8		33	22	11	4	1			1
25.5		6	2		18	15	4		1			
26		3	4		16	25	3					
26.5			2		16	20						
27		1	2		10	18						
27.5					11	18						
28					4	17						
28.5			1		1	12						
29		1			2	19						
29.5					1	17						
30					3	11						
30.5						8						
31												
31.5					1							
32												
32.5												
Total no.	641	560	524	519	631	454	597	517	537	192	644	488
Mean Length	18.03822	22.13571	20.880725	15.43353	22.81933	24.65859	21.98995	19.98066	19.96927	8.841146	18.2764	19.68033

Table 4. continued

Station	1374	1451	1520		1535	1618	1635	1689	1709	1792	1808	1859
ICES sq.	45G1	44G1	43G1		43G1	43G1	42G1	42G2	42G1	41G1	41G1	41G1
Gear	Fotö	Fotö	Fotö		Fotö	Expo	Expo	Fotö	Expo	Expo	Expo	Expo
Fishing depth	Surface	0-50	Surface		Surface	Bottom	Bottom	Surface	Surface	Bottom	Bottom	Surface
Total depth	104	95	40		60	57	39	47	33	32	25	22
Day/Night	N	D	N		N	D	D	N	N	D	D	N
Total catch,kg	1 570	117	300		374	81	1 005	170	44	204	53	42
Total catch Herring,	1381.211	91.200	15.627	67.601	52.150	13.462	92.849	4.443	13.232	20.041	6.444	11.514
Sample Herring,kg	30.292	38.1	1.418	20.426	27.338	13.462	18.704	4.443	13.232	20.041	6.444	11.514
5.5												
6												
6.5												
7									3			
7.5						1			4			
8			1			1			6			
8.5			13						1			
9			61			2			1			
9.5			60			1						
10			53			1						
10.5			22									
11			9									
11.5			3									
12				2								
12.5				6		1						
13				19		2						
13.5				47	5	2	1			1		
14				62	10	11	6					
14.5				40	2	6	3					
15				27		12	11			2		1
15.5	1			14		8	18			1		
16		1		22		14	17		1	6	2	3
16.5	9	3		31		28	37			39	4	21
17	42	38		52	6	42	88	2	2	69	14	83
17.5	129	40		98	8	63	155	4	9	123	21	89
18	187	47		70	13	50	105	12	8	108	31	39
18.5	145	67		60	25	28	31	4	8	57	14	10
19	59	63		19	22	16	13	8	6	21	11	12
19.5	39	63		16	35	14	6	5	4	19	7	10
20	17	65		6	35	15	4	10	4	24	14	7
20.5	8	61		5	28	11	2	4	12	16	9	6
21	3	47		3	38	12	1	9	22	9	8	2
21.5	4	48		4	46	4		6	41	5	2	2
22	1	47		1	46	4		7	28	2	2	4
22.5		31			29	1	1	4	22	1		4
23	1	8			24			2	13		1	1
23.5		6			9				6			
24		2		2	4		1		2			
24.5		1			7			1	1			1
25					3							
25.5					2							
26					2				1			
26.5					3							
27					2							
27.5					2							
28												
28.5												
29												
29.5		1										
30												
30.5												
31												
31.5												
32												
32.5												
Total no.	645	639	222	606	406	350	500	78	205	503	140	295
Mean Length	18.23798	19.79734	9.603604	16.49752	20.68596	17.52857	17.384	19.97436	20.13171	18.01789	18.63214	17.83559

Table 5. Measured length distribution of mackerel by haul for the Danish acoustic survey with R/V Dana in June-July 2019.

Station	2	78	138	153	244	311	326	405	488	505	796	880	984	1025
ICES sq.	44F6	43F6	42F6	41F6	42F7	43F6	44F7	43F7	41F7	41F7	44F9	45F8	44F9	45F9
Gear	Fotö	Expo	Fotö	Fotö	Expo	Fotö	Fotö	Expo	Fotö	Fotö	Expo	Fotô	Expo	Fotö
Fishing depth	Surface	Bottom	Surface	Surface	Bottom	Surface	Surface	Bottom	Surface	Surface	Bottom	Surface	Bottom	Surface
Total depth	369	49	36	43	36	129	214	85	34	29	55	227	38	207
Day/Night	N	D	N	N	D	N	N	D	N	N	D	N	D	N
Total catch,kg	237	74	110	322	1 449	280	600	97	200	1 097	942	710	1 735	708
Total catch Mackerel,kg	2.620	1.670	48.600	317.100	2.500	103.600	143.861	0.824	153.900	1082.654	2.128	58.300	3.500	70.100
Sample Mackerel,kg	2.620	1.670	32.200	28.700	2.500	15.140	14.500	0.824	28.100	31.080	2.128	18.930	3.500	20.17
Length in cm														
15														
16									1					
17	1								4	11				
18			2			1			11	13				
19							1		5	6				
20			1						2	4	1		2	
21			3	1		1			8	14	1		4	
22			2			1			6	7	2			4
23			2	1	1	1			12	26	4		2	9
24	1	1	5	5	2	8			15	33	4		2	11
25			17	3	1	14	6		11	46	2	1		18
26	2		26	6	4	24	9		25	48		3	3	11
27			34	15	2	19	18		37	17		7		13
28			24	20	1	11	19	1	11	6		5		11
29		2	11	15	1	2	7		4			3		2
30		1	7	9	1	1	2	1	1	1		5		4
31	1		7	7			2					4	2	4
32			3	5	1	1	2		4			6		1
33			2	8		1	1		1		1	2		1
34	1		6	9		1	3		4			3		2
35			6	3		1	1		1		1	7		3
36	3	1	2	4		1	2	1	2			6		1
37		1		3					1			5		2
38	1		2	2		1	1		1			3	2	1
39				1								4	1	1
40			1						1					
41														1
42														1
43														1
44														
45														
46														
47														
48														
49														
50														
51														
52														
53														
54														
55														
56														
57														
58														
59														
60														
61														
Total no.	10	6	163	117	14	89	74	3	168	232	16	64	18	102
Mean length	30.4	30.83333	27.79141	29.80342	26.64286	26.59551	28.24324	31.33333	25.29762	23.74138	24.4375	32.32813	26.27778	27.51961

Table 5. continued

Station	1037	1181	1193	1362	1374	1451	1520	1535	1618	1635	1689	1709	1792	1808	1859
ICES sq.	45F9	46F9	46G0	45G1	45G1	44G1	43G1	43G1	43G1	42G1	42G2	42G1	41G1	41G1	41G1
Gear	Fotö	Fotö	Fotö	Fotö	Fotö	Fotö	Fotö	Fotö	Expo	Expo	Fotö	Expo	Expo	Expo	Expo
Fishing depth	Surface	Surface	Surface	Surface	Surface	0-50	Surface	Surface	Bottom	Bottom	Surface	Surface	Bottom	Bottom	Surface
Total depth	294	325	203	124	104	95	40	60	57	39	47	33	32	25	22
Day/Night	N	N	N	N	N	D	N	N	D	D	N	N	D	D	N
Total catch,kg	845	275	405	485	1 570	117	300	374	81	1 005	170	44	204	53	42
Total catch Mackerel,kg	33.300	21.500	76.700	84.200	143.443	9.240	27.970	15.590	0.114	5.500	2.540	4.280	1.104	0.135	9.03
Sample Mackerel,kg	33.3	21.5	15.1	16.800	18.060	9.240	27.970	15.590	0.114	5.500	2.540	4.280	1.104	0.135	9.03
Length in cm															
15															
16															
17															
18							1			1	1	1			
19			1				1	8			2				
20			1	1		1		17		1	6	5			2
21		1		8	3	2		29		10	2	7	1		8
22	7	8	8	14	25	4	3	45		10	4	8			14
23	16	11	21	30	33	10	1	28		10	5	4			15
24	19	16	28	26	16	12	1	22	1	3	5	3			13
25	6	12	13	19	8	4	1	6		1	1			1	5
26	9	14	15	6	13	8	1	4		1	2				7
27	5	14	13	7	7	9	2	2			1	2			4
28	4	8	6	7	7	5	7	6		1		1			1
29		5	5	5	3	3	4			1					2
30	1	6	1	2	1	2	9						1		
31	1				3		5	1							
32	2	1			1		5								1
33	3	3			2		10	1		1					
34	5	2	2	1	1		12					2	1		
35	5	4			2		5			1		1			1
36	6	2		2		2	6			2					1
37	5	2		1			6			1					
38	3				2		4					1	1		
39	3						4								
40	1	1													
41	3														1
42							2								
43															
44															
45															
46															
47															
48															
49															
50															
51															
52															
53															
54															
55															
56															
57															
58															
59															
60															
61															
Total no.	104	110	114	129	127	62	90	169	1	44	29	35	4	1	75
Mean length	28.58654	26.81818	24.97368	24.60465	24.93701	25.45161	32.16667	22.50296	24	23.97727	22.24138	23.65714	30.75	25	24.24

Table 6. Measured length distribution of sprat by haul for the Danish acoustic survey with R/V Dana in June-July 2019.

Station	96	138	153	244	258	488	505	796	984	1520	1535	1618	1635	1689	1709	1792	1808	1859
ICES sq.	43F6	42F6	41F6	42F7	42F6	41F7	41F7	44F9	44F9	43G1	43G1	43G1	42G1	42G2	42G1	41G1	41G1	41G1
Gear	Expo	Fotö	Fotö	Expo	Expo	Fotö	Fotö	Expo	Expo	Fotö	Fotö	Expo	Expo	Fotö	Expo	Expo	Expo	Expo
Fishing depth	Bottom	Surface	Surface	Bottom	Bottom	Surface	Surface	Bottom	Bottom	Surface	Surface	Bottom	Bottom	Surface	Surface	Bottom	Bottom	Surface
Total depth	56	36	43	36	42	34	29	55	38	40	60	57	39	47	33	32	25	22
Day/Night	D	N	N	D	D	N	N	D	D	N	N	D	D	N	N	D	D	N
Total catch.kg	42	110	322	1 449	1 879	200	1 097	942	1 735	300	374	81	1 005	170	44	204	53	42
Total catch Sprat,kg	0.013	0.27	0.660	68.493	99.334	0.110	0.114	0.568	292.948	11.634	0.453	31.300	803.198	2.148	3.718	110.726	6.950	10.040
Sample Sprat,kg	0.013	0.270	0.660	5.298	2.588	0.110	0.114	0.568	3.146	1.318	0.453	3.806	4.279	2.148	3.718	3.840	3.812	3.876
Length in cm																		
5.5																		
6																		
6.5																		
7																		
7.5														1				
8														3				
8.5														4				
9													1	4				
9.5			1		5					5			7	2				
10			11	10	8	2			1	20			23	5		2		
10.5		2	20	41	24	2	2		8	44	1	2	45	6	1	7		
11			18	74	23	4			57	39		3	45	14	4	10	2	1
11.5	1	5	3	84	35		1		80	10	1	3	35	25	10	23	15	8
12		4	3	82	49	1	3	6	39	4	4	32	39	18	21	37	22	10
12.5		8		54	30		2	6	21	3	11	34	44	23	31	37	47	42
13		2		35	12	1		6	12		6	35	31	18	31	45	45	38
13.5					5			10	1	1	3	30	29	15	46	38	39	53
14							1	4			3	27	14	11	34	24	29	33
14.5								1			1	26	4	7	23	11	18	19
15												15		1	6	5	7	10
15.5												3			3	1		1
16													1					
16.5																		
17																		
17.5																		
18																		
18.5																		
19																		
19.5																		
20																		
20.5																		
21																		
21.5																		
22																		
22.5																		
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23.5																		
24																		
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25																		
25.5																		
26																		
26.5																		
27																		
27.5																		
28																		
28.5																		
29																		
29.5																		
30																		
30.5																		
31																		
31.5																		
32																		
32.5																		
Total no.	1	21	56	380	191	10	9	33	219	126	30	210	318	157	210	240	224	215
Mean Length	11.5	12.02381	10.67857	11.64342	11.63089	11	11.94444	13.04545	11.60274	10.73413	12.75	13.25714	11.81761	12.00955	13.23333	12.74375	13.07813	13.30465

Table 7. CTD station details for the Danish acoustic survey with R/V Dana in June-July 2019.

Dana station	Date dd-mm-yy	Stat. no.	Time UTC	ICES Square	Position Latitude	Longitude	Bottom depth m	Wind speed m/s	Sea state	Associated fishery station
1	28-06-19	1	00:04	44F6	57.56.233 N	006.38.975 E	372	12.5	6	2
3	28-06-19	78	10:16	43F6	57.04.961 N	006.12.048 E	49	11.1	6	78
8	28-06-19	96	16:12	43F6	57.03.893 N	006.26.260 E	57	11.0	6	96
9	28-06-19	138	20:35	42F6	56.35921 N	006.14.807 E	44	6.1	6	138
14	29-06-19	153	01:51	41F6	56.13197 N	006.14.519 E	43	6.1	6	153
15	29-06-19	244	10:26	42F7	56.40.178 N	007.10.924 E	32	6.6	6	244
19	29-06-19	258	13:49	42F6	56.35.568 N	006.54.374 E	38	8.4	6	258
21	29-06-19	311	20:38	43F6	57.24.180 N	006.44.942 E	108	4.8	2	312
26	30-06-19	326	01:50	44F7	57.30.437 N	007.11.652 E	220	8.1	2	326
27	30-06-19	405	09:59	43F7	57.21.748 N	007.29.427 E	79	11.8	2	405
31	30-06-19	487	20:34	41F7	56.23.914 N	007.17.044 E	35.5	9.7	3	488
36	01-07-19	505	02:03	41F7	56.02.273 N	007.18.219 E	29	10.3	3	505
38	01-07-19	606	12:33	43F7	57.13.744 N	007.40.305 E	52	11.9	3	606
42	01-07-19	667	20:36	43F7	57.13.649 N	007.51.181 E	50	15.5	4	Cancel
44	02-07-19	796	10:25	44F9	57.37.211 N	009.10.760 E	35	15.0	4	796
51	03-07-19	880	02:20	45F8	58.07.500 N	008.29.451 E	228	7.4	6	880
52	03-07-19	960	10:00	44F9	57.54.758 N	009.22.711 E	176	13.1	6	960
57	03-07-19	984	16:17	44F9	57.46.139 N	009.50.135 E	41	16.3	4	984
58	03-07-19	1025	20:39	44F9	57.56.441 N	009.35.628 E	140	16.5	4	1026
63	04-07-19	1037	02:05	45F9	58.01.690 N	009.45.311 E	211	12.1	4	1037
64	04-07-19	1115	11:36	44F9	57.58.905 N	009.53.277 E	101	17.4	4	1115
68	04-07-19	1180	20:38	46F9	58.48.012 N	009.41.115 E	171	3.1	4	1181
73	05-07-19	1193	01:56	46G0	58.51.433 N	010.11.060 E	202	6.0	4	1193
74	05-07-19	1284	10:55	46G0	58.32.234 N	010.50.522 E	90	6.9	4	1290
78	05-07-19	1361	20:35	45G0	58.12.028 N	010.51.391 E	165	13.2	4	1362
83	06-07-19	1374	02:03	45G1	58.06.596 N	011.08.180 E	94	13.3	4	1374
84	06-07-19	1449	10:01	44G0	57.57.364 N	010.59.625 E	118	9.1	4	1451
88	06-07-19	1519	20:30	44G0	57.30.190 N	010.52.740 E	36	8.5	4	1520
93	07-07-19	1535	02:14	43G1	57.28.882 N	011.37.710 E	50	7.1		1535
94	07-07-19	1617	10:05	43G1	57.09.092 N	011.51.654 E	54	3.4		1618
99	07-07-19	1635	14:54	42G1	56.46.893 N	011.42.033 E	30	5.1	1	1635
100	07-07-19	1688	20:12	42G2	56.34.456 N	012.11.187 E	36	7.3	1	1689
105	08-07-19	1709	02:04	42G1	56.33.488 N	011.43.733 E	34	10.1	1	1709
106	08-07-19	1791	10:29	41G2	56.20.695 N	012.00.102 E	33	7.2	1	1792
111	08-07-19	1808	15:11	41G1	56.08.232 N	011.51.402 E	21	6.4	1	1808
112	08-07-19	1858	19:58	41G0	56.14.102 N	010.57.922 E	21	8.4	1	1859

Table 8. WP2 station details for the Danish acoustic survey with R/V Dana in June-July 2019.

Dana Station	Date dd-mm-yy	Station no.	Time UTC	ICES Square	Position Latitude	Position Longitude	Mean depth m	WP2 depth m	Wind speed m/s	Sea state	Associated CTD Station	Associated Fishery Station
4	28-06-19	78	11:02	43F6	57.04.954 N	006.12.113 E	49	43.4	12.0	6	78	78
10	28-06-19	138	20:50	42F6	56.35.852 N	006.14.782 E	44	40.2	7.1	6	138	138
16	29-06-19	244	10:38	42F7	56.40.216 N	007.10.782 E	33	24.7	7.5	6	244	244
22	29-06-19	311	21:01	43F6	57.24.396 N	006.45.252 E	109	98.3	5.2	2	311	312
28	30-06-19	405	10:18	43F7	57.21.817 N	007.29.658 E	79	66.7	11.3	2	405	405
32	30-06-19	487	20:45	41F7	56.23.979 N	007.17.116 E	35	31.3	10.9	3	487	488
39	01-07-19	606	12:38	43F7	57.13.853 N	007.40.633 E	53	39.3	17.5	3	606	606
43	01-07-19	667	20:50	43F7	57.13.697 N	007.51.519 E	53	39.1	16.8	4	667	Cancel
45	02-07-19	796	10:36	44F9	57.37.238 N	009.11.192 E	35	Cancel	14.2	4	796	796
46	02-07-19	796	10:47	44F9	57.37.311 N	009.11.634 E	35	27.3	14.2	4	796	796
53	03-07-19	960	10:33	44F9	57.54.749 N	009.23.080 E	176	152.4	12.4	6	960	960
59	03-07-19	1025	21:02	44F9	57.56.399 N	009.36.319 E	139	119.3	14.5	4	1025	1026
65	04-07-19	1115	11:54	44F9	57.58.893 N	009.53.964 E	101	75.3	18.9	4	1115	1115
69	04-07-19	1180	21:02	46F9	58.47.948 N	009.40.623 E	175	150.0	6.7	4	1180	1181
75	05-07-19	1284	11:14	46G0	58.32.596 N	010.50.325 E	89	74.5	6.8	4	1284	1290
79	05-07-19	1361	20:58	45G0	58.12.234 N	010.51.538 E	164	157.0	11.2	4	1361	1362
85	06-07-19	1449	10:25	44G0	57.57.729 N	010.59.929 E	119	103.3	8.2	4	1449	1451
89	06-07-19	1519	20:50	44G0	57.30.170 N	010.52.690 E	36	26.8	9.5	4	1519	1520
95	07-07-19	1617	10:18	43G1	57.09.020 N	0.11.51.769 E	54	46.1	3		1617	1618
101	07-07-19	1688	20:35	42G2	56.34.381 N	012.11.291 E	40	29.7	8.4	1	1688	1689
107	08-07-19	1791	10:42	41G2	56.20.685 N	012.00.287 E	33	26.6	7.1	1	1791	1792
113	08-07-19	1858	20:09	41G0	56.14.216 N	010.58.016 E	21	13.2	9.1	1	1858	1859

Table 9. 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 2019

Number Autumn spawning herring in mill.											
WR	0	1i	1m	2i	2m	3i	3m	4i	4m	5m	6m
21	631.1879	297.1029	4.39668	6.011803	2.004187		2.439495				
31	21.79177	897.6134	3.721409	59.79561	4.721352	1.716339	1.742788		0.587774		
41		326.2647	0.350096	40.51644	9.865076	1.63672	1.038473	0.412285	0.349121	0.491398	0.012223
42		371.6726		61.38934	7.877926	4.070464	0.515006	0.396497		0.404369	
151		221.7384	1.162599	0.84578	0.034445	0.035287		0.01374			0.002466
152		61.73683	0.963144	32.48232	11.49731	3.475251	2.90072	2.369638	1.758582	1.408124	0.601216
Biomass Autumn spawning herring in ton.											
WR	0	1i	1m	2i	2m	3i	3m	4i	4m	5m	6m
21	3644.429	9941.859	200.0221	378.0564	132.0532		212.5296				
31	80.43741	41596.15	152.5778	3350.293	308.4854	134.3082	143.1593		38.2053		
41		11066.43	39.91094	3587.288	1188.514	207.0618	168.6931	57.09409	58.31224	82.53517	2.371262
42		13501.3		4989.208	828.0471	395.7309	86.69706	59.24676		38.81946	
151		4930.404	34.87798	38.85397	4.522773	2.722233		1.037927			0.498132
152		4184.08	87.64607	2956.456	1728.133	388.191	404.6463	242.7595	261.4324	226.4358	104.3773
Mean length Autumn spaawning herring in cm.											
WR	0	1i	1m	2i	2m	3i	3m	4i	4m	5m	6m
21	9.59	16.75	18.74	20.93	21.15		22.94				
31	8.88	18.34	17.00	19.35	20.24	22.03	22.20		21.50		
41		16.00	23.00	21.80	23.57	24.55	26.10	25.15	26.52	26.49	29.50
42		16.54		21.19	22.57	22.61	26.01	25.14		24.00	
151		14.37	16.00	18.24	24.49	22.28		22.22			28.50
152		20.39	22.00	22.10	25.43	24.24	24.74	23.69	26.71	27.01	27.84
Mean weight Atumn spawning herring in g.											
WR	0	1i	1m	2i	2m	3i	3m	4i	4m	5m	6m
21	5.77	33.46	45.49	62.89	65.89		87.12				
31	3.69	46.34	41.00	56.03	65.34	78.25	82.14		65.00		
41		33.92	114.00	88.54	120.48	126.51	162.44	138.48	167.03	167.96	194.00
42		36.33		81.27	105.11	97.22	168.34	149.43		96.00	
151		22.24	30.00	45.94	131.30	77.15		75.54			202.00
152		67.77	91.00	91.02	150.31	111.70	139.50	102.45	148.66	160.81	173.61

Table 10. 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 2019

Number of Spring spawning herring in mill.												
WR	1i	1m	2i	2m	3i	3m	4i	4m	5m	6m	7m	8m
21	321.4736	3.700623	81.02914	13.18722	22.31734	7.267486	5.575724	0.6372	2.990359	3.103509	0.602965	
31	113.807		41.68189	1.866004	13.28608	1.670341	0.509016	0.365247				
41	59.84414		27.98969	3.741436	7.239041	2.001341	1.113083	0.169217	1.098909	0.836405	0.18524	0.055034
42	76.33223		27.55166	2.756351	7.067603	1.71448			0.404369			
151	87.10129		0.434612	0.025527	0.110852	0.022869	0.018497	0.004933	0.002466			
152	3.938475		36.29838	6.125813	18.43137	4.986114	4.46864	2.81219	2.706089	3.847773	1.165707	
Biomass of Spring spawning herring in ton.												
WR	1i	1m	2i	2m	3i	3m	4i	4m	5m	6m	7m	8m
21	11020.53	141.1139	4530.627	830.5056	1549.137	514.9306	469.7958	92.126	198.9787	294.3744	69.23127	
31	5050.745		2558.609	127.3321	959.21	94.37429	45.45049	42.72977				
41	1804.423		2130.242	475.9396	632.1183	225.9087	126.7416	23.69031	169.1358	135.946	35.68041	11.50146
42	2465.762		1716.128	389.2568	659.452	220.193			38.81946			
151	1927.04		30.1327	2.600979	8.082101	1.714703	1.403301	0.458723	0.268812			
152	215.3402		2981.944	688.1413	1543.41	608.3567	487.0323	384.2307	377.7473	673.9695	192.9989	
Mean length of Spring spawning herring in cm.												
WR	1i	1m	2i	2m	3i	3m	4i	4m	5m	6m	7m	8m
21	17.12	17.91	20.02	21.15	21.50	22.01	22.43	26.19	21.76	23.56	25.31	
31	18.16		20.17	20.72	21.74	21.00	23.09	24.66				
41	15.72		20.90	24.15	22.03	24.08	24.27	24.50	26.44	26.94	28.41	29.25
42	16.22		19.53	24.29	22.52	24.39			24.00			
151	14.37		21.21	23.25	22.04	22.61	24.20	23.00	24.50			
152	19.27		21.85	23.36	22.64	24.43	24.37	26.15	26.09	27.81	27.41	
Mean weight of Spring spawning herring in g.												
WR	1i	1m	2i	2m	3i	3m	4i	4m	5m	6m	7m	8m
21	34.28	38.13	55.91	62.98	69.41	70.85	84.26	144.58	66.54	94.85	114.82	
31	44.38		61.38	68.24	72.20	56.50	89.29	116.99				
41	30.15		76.11	127.21	87.32	112.88	113.87	140.00	153.91	162.54	192.62	208.99
42	32.30		62.29	141.22	93.31	128.43			96.00			
151	22.12		69.33	101.89	72.91	74.98	75.87	93.00	109.00			
152	54.68		82.15	112.33	83.74	122.01	108.99	136.63	139.59	175.16	165.56	

Table 11. 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 2019

Number sprat in mill								
WR	0	1l	1m	2i	2m	3m	4m	5m
21	0.031011	24.71856	184.3088	55.19552	1368.975	405.9897	143.7639	13.02185
31								
41								
42			58.62337		43.47247	0.072864		
151			3.404258	0.194726	29.11318	4.658872		
152								
Biomass sprat in ton.								
WR	0	1l	1m	2i	2m	3m	4m	5m
21	0.093033	212.4897	1690.356	533.8493	16950.7	6970.766	2791.587	337.1097
31								
41								
42			770.9721		648.4265	1.343606		
151			35.23436	1.440972	381.2118	73.48914		
152								
Mean length Sprat in cm.								
WR	0	1l	1m	2i	2m	3m	4m	5m
21	7.50	10.03	10.31	10.57	11.65	13.22	13.92	15.32
31								
41								
42			11.22		12.12	13.59		
151			10.96	9.50	11.61	12.37		
152								
Mean weight sprat in g.								
WR	0	1l	1m	2i	2m	3m	4m	5m
21	3.00	8.60	9.17	9.67	12.38	17.17	19.42	25.89
31								
41								
42			13.15		14.92	18.44		
151			10.35	7.40	13.09	15.77		
152								