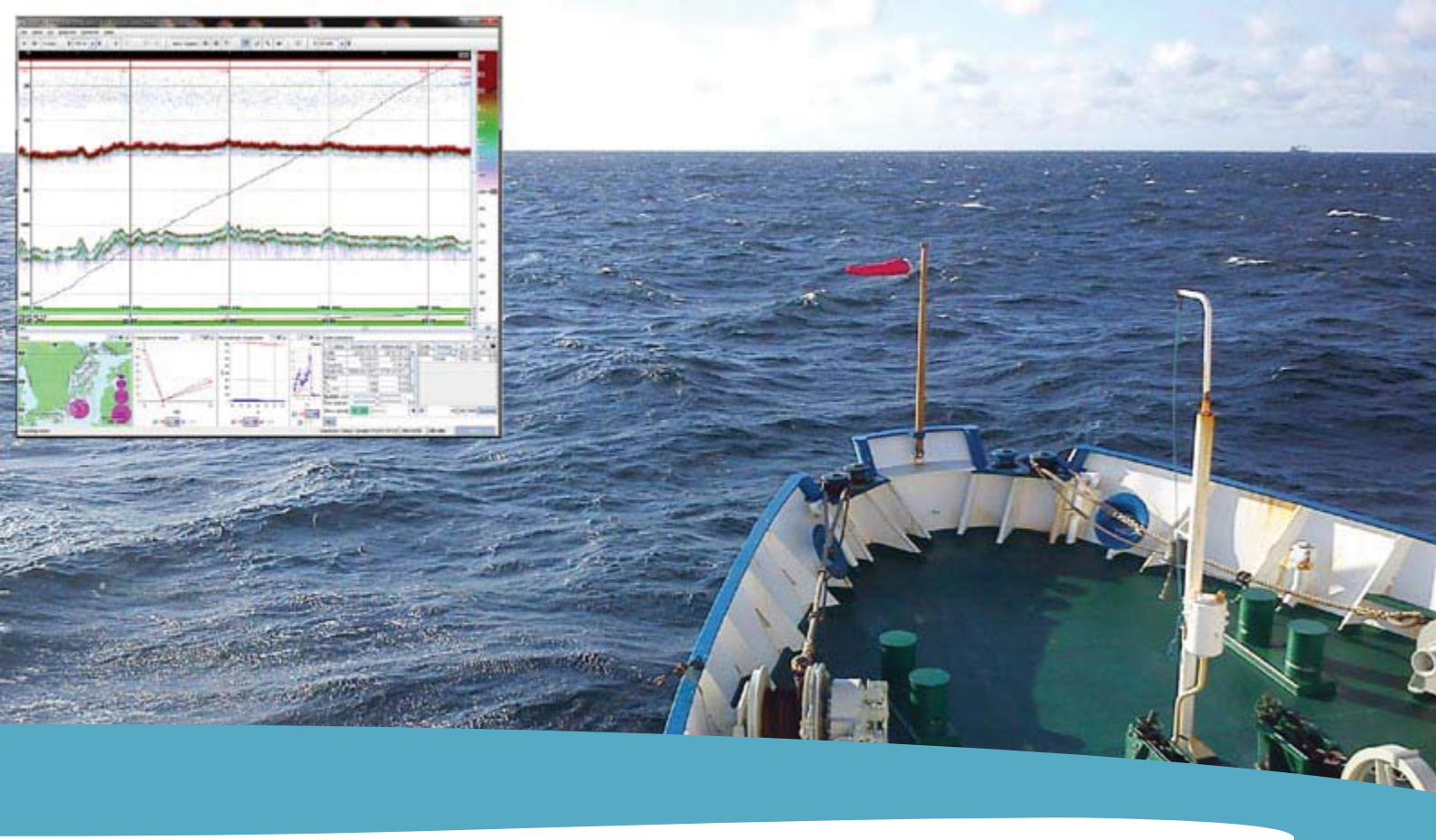

Aqua reports 2014:11

Baltic International Acoustic Survey report, October 2013

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Baltic International Acoustic Survey report, October 2013

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Baltic International Acoustic Survey Report for R/V Dana

2013-10-01 - 2013-10-14

Niklas Larson
SLU - Institute of Marine Research, Lysekil, Sweden

Scientific Leader: Niklas Larson
Expedition Leader: Anders Svenson, Niklas Larson

Contents

1 Svensk Sammanfattning

Internationellt koordinerade hydroakustiska surveyer har regelbundet genomförts av Havsfiskelaboratoriet i Lysekil sedan 1978 i Östersjön. Baltic International Acoustic Survey (BIAS), som utförs varje år i oktober, regleras under Europeiska Commissionens Data collection Framework (DCF) och är obligatorisk för varje medlemsland i EU runt Östersjön. Sverige ansvarar för ICES subdivision(SD) 27 och för delar av 25, 26, 28 och 29 (figur 1 & 2). Dessutom har Sverige 2007-2012 tillsammans med Finland täckt SD30. Syftet med undersökningen är att bedöma sillbeståndet och resultaten rapporteras till Baltic International Fish Survey Working Group (WGBIFS) och Baltic Fisheries Assessment Working Group (WGBFAS), båda är arbetsgrupper inom International Council for the Exploration of the Sea (ICES). Från 2011 används det danska forskningsfartyget R/V Dana efter det att svenska R/V Argos, som dessförinnan användts sedan 1978, tagits ur bruk utan befintlig svenskt fartyg som kunde ersätta.

Årets expedition startade 2013-10-01 i Gullmarsfjorden och slutade 2013-10-14 i Köpenhamn. Under expeditionen samlas akustisk rå data in från ett kalibrerat vetenskapligt ekolod[1] och pelagisk trålning utförs för att få information om art och längfördelning. Den akustiska rådatan efterbehandlas i programvaran LSSS[2]. Trålfångsten analyseras vad gäller arter samt längder, dessutom tar man fram en åldersstruktur på målarterna i fångsten som i detta fallet är sill, skarpsill och torsk. Därefter sammanställs de akustiska värdena med resultatet av analysen utav trålfångsterna.

[1] simrad.com
[2] Marec.no

De deltagande länderna skickar årligen de som är vetenskapligt ansvariga för undersökningen, samt eventuellt även expeditionsledarna, till arbetsgruppen WGBIFS. Där tas gemensamma riktlinjer och manualer fram och resultaten från varje land bedöms och kombineras i en gemensam databas som rapporteras till WGBFAS, vilka använder BIAS resultaten tillsammans med annan information i en modell för att uppskatta det totala beståndet.
Resultatet från 2013 års svenska BIAS survey bedömdes av WGBIFS vara representativt för mängden sill och skarpsill i Östersjön för SD 25 - 29. Tidigare års resultat samt mer information kring BIAS samt WGBIFS arbete finns i WGBIFS rapport (ICES CM 2012/SSGESST:02).

2 The Baltic International Acoustic Survey

International hydroacoustic surveys have been conducted in the Baltic Sea since 1978. The starting point was the cooperation between Institute of Marine Research (IMR) in Lysekil, Sweden and the Institute für Hochseefisherei und Fishverarbeitung in Rostock, German Democratic Republic in October 1978, which produced the first acoustic estimates of total biomass of herring and sprat in the Baltic Main basin (Håkansson et al., 1979). Since then there has been in general one annual hydroacoustic survey for herring and sprat stocks and results have been reported to ICES.
The Baltic International Acoustic Survey (BIAS), is mandatory for the countries that have exclusive economic zone (EEZ) in the Baltic Sea, that is Finland, Estonia, Latvia, Lithuania, Russia, Poland, Germany, Denmark and Sweden. BIAS is a priority one survey of the Data Collection Framework as stipulated by the European Council and the Commission (Council Regulation (EC) No 199/2008 and the Commission DCF web page). IMR in Lysekil is part of the department of Aquatic Resources within Swedish University of Agricultural Sciences and is responsible for the Swedish part of the EU Data Collection Framework and survey the marine environment. The Institute assesses the status of the marine ecosystems, develops and provides biological advices for managers for the sustainable use of aquatic resources.
The BIAS survey in September/October are co-ordinated and managed by the ICES working group Baltic International Fish Survey Working Group (WGBIFS). The main objective of BIAS is to assess clupeoid resources in the Baltic Sea and follows manuals and standards in order to produce figures that can be representative. The survey will be combined with the results from all the other countries that does the survey, and the combined result will provide indexes to be used in stock assessment done by ICES Baltic Fisheries Assessment Working Group (WGBFAS). During 2007-2011, Finland and Sweden joined together to additionally cover the Bothnian Sea (ICES Subdivision 30).

3 Methods

3.1 Narrative

Due to that R/V Argos was taken out of order, Sweden has rented R/V Dana since 2011 for the BIAS survey. The scientific staff was Swedish and the ship crew was Danish in this years survey.
This year's calibration of the SIMRAD EK60 sounder was made at Gullmarsfjorden east of Lysekil, 2013-10-01 and 2013-10-02, the location change occurred because the calibration sites used previous years is inaccessible for Dana due to the draft. The data collection started when Dana entered the survey area west of Bornholm 2013-10-03 and ended 2013-10-13. The scientific staff disembarked 2013-10-14 in Copehagen. The total cruise covered ICES subdivision (SD) 27 and parts of SD 25, 26, 28 and 29 (figure 1 and 2).

3.2 Survey design

The stratification is based on ICES statistical rectangles with a range of 0.5 degrees in latitude and 1 degree in longitude. The areas of all strata are limited by the 10 m depth line. The aim is to use transects spaced on regular rectangle basis at a maximum distance of 15 nautical miles and with a transect density

of about 60 nautical miles per 1000 square nautical miles. The irregular shape of the survey area assigned to Sweden and the weather conditions makes it difficult to fulfill this aim.
The total area covered by the survey (SD25-29) was 21752 square nautical miles and the distance used for acoustic estimates was 1374 nautical miles (see the WGBIFS report[3] for more information). The cruise track and positions of trawl hauls is shown in figure 1.

3.3 Calibration

The SIMRAD EK60 echo sounder with the transducer ES38B was calibrated at Bornö in Gullmarsfjordenrden according to the BIAS manual[4]. Values from the calibration were within required accuracy.

3.4 Acoustic data collection

The acoustic sampling was performed around the clock. SIMRAD EK60 echo sounder with the 38 kHz transducer (ES38b) mounted on a towed body is used for the acoustic transect data collection, additionally a hull mounted 38 kHz transducer (ES38B) was used during the fishing stations (the towed body is taken aboard when fishing), the data from the bottom mounted transducer is not used in the abundance calculations. The settings of the hydroacoustic equipment were as described in the BIAS manual. The post processing of the stored raw data was made using the software LSSS[5] for SD25 - SD29. The mean volume back scattering values (Sv) were integrated over 1 nautical mile elementary sampling units (ESDUs) from 10 m below the surface to the bottom. Contributions from air bubbles, bottom structures and scattering layers were removed from the echogram by the use of LSSS.

3.5 Data analysis

The pelagic target species sprat and herring are usually distributed in mixed layers in combination with other species so that it is impossible to allocate the integrator readings to a single species. Therefore the species composition was based on the trawl catch results. For each rectangle the species composition and length distribution were determined as the unweighted mean of all trawl results in this rectangle. In the case of lack of sample hauls within an individual ICES rectangle (due to gear problems, bad weather conditions or other limitations) a mean from hauls from neighboring rectangles was used. From these distributions the mean acoustic cross-section was calculated according to the target strength-length (TS) relationships (table 1).

Table 1: Target strength-length (TS) relationships

Clupeoids	TS = 20 log L (cm) - 71.2	(ICES 1983/H:12)
Gadoids	TS = 20 log L (cm) - 67.5	(Foote et al. 1986)
Trachurus trachurus	TS = 20 log L (cm) - 73.0	(Misund, 1997 in Peña, 2007)
Fish without swim bladder	TS = 20 log L (cm) - 84.9	ICES CM2011/SSGESST:02,Addendum 2
Salmonids and 3-spined stickleback were assumed to have the same acoustic properties as herring.		

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

[3]ICES CM 2012/SSGESST:02
[4]ICES CM 2012/SSGESST:02, Addendum 2
[5]www.marec.no/english/products.htm

3.6 Hydrographic data

CTD casts were made with a "Seabird 9+" CTD when calibrating the acoustic instruments and whenever a haul was conducted, additional hydrographic data was collected on a selection of these stations.

3.7 Personnel

The participating scientific crew (table 2).

Table 2: Participating scientific crew

Iliç, Eva	IMR, Lysekil, Sweden	Fish sampling
Jernberg, Carina	IMR, Lysekil, Sweden	Fish sampling
Johansson, Jan-Erik	IMR, Lysekil, Sweden	Fish sampling
Larson, Niklas	IMR, Lysekil, Sweden	Scientific & Expedition leader, Acoustics
Lövgren, Olof	IMR, Lysekil, Sweden	Acoustics
Palmen-Bratt, Anne-Marie	IMR, Lysekil, Sweden	Fish sampling
Sjöberg, Rajlie	IMR, Lysekil, Sweden	Fish sampling
Svenson, Anders	IMR, Lysekil, Sweden	Expedition leader, Acoustics
Yhlen, Bengt	SMHI, Gothenburg	Oceanography

4 Results

4.1 Biological data

In total 48 trawl hauls were carried out, 13 in SD 25, 2 in SD 26, 15 in SD 27,10 in SD 28 and 8 hauls in SD 29. 2072 herrings and 1327 sprats were aged. Catch compositions by trawl haul is presented in Table 8. Length distributions f or herring and sprat by I CES subdivision are shown in figures 3 to 12.

4.2 Acoustic data

The survey statistics concerning the survey area, the mean backscatter [s_A], the mean scattering cross section [σ], the estimated total number of fish, the percentages of herring, sprat and cod per Subdivision/rectangle are shown in Table 3.

4.3 Abundance estimates

The total abundances of herring and sprat by age group per rectangle are presented in Table 4 and 6. The corresponding mean weights by age group per rectangle are shown in Tables 5 and 7.

5 Discussion

The data collected during the survey was considered by WGBIFS as representative for the index of abundance of the pelagic species during the BIAS in 2013 for SD25 to 29 and thus can be used in the assessment work done by WGBFAS.

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7 Tables, map and figures

Table 3: Survey statistics

SD	RECT	AREA	SA	SIGMA	NTOT	HHer	HSpr	HCod
25	39G4	287.3	916.6	4.199	627.14	84.34	15.51	0.077
25	39G5	979.0	513.7	3.054	1646.61	63.13	36.56	0.248
25	40G4	677.2	720.7	3.400	1435.61	67.18	32.58	0.143
25	40G5	1012.9	493.7	2.203	2270.07	24.99	74.89	0.055
25	40G6	1013.0	493.8	2.062	2426.48	33.18	66.13	0.009
25	40G7	1013.0	184.1	1.725	1081.53	0.58	99.33	0.027
25	41G6	764.4	489.7	1.578	2371.93	8.74	90.88	0.000
25	41G7	1000.0	655.6	1.720	3812.66	10.73	86.82	0.926
26	41G8	1000.0	294.7	3.131	941.51	72.19	27.61	0.098
27	42G6	266.0	231.3	1.797	342.28	18.70	81.04	0.002
27	42G7	986.9	622.5	1.705	3602.65	25.91	60.27	0.019
27	43G7	913.8	492.5	0.933	4824.29	9.88	29.14	0.039
27	44G7	960.5	409.0	0.644	6096.75	11.30	0.67	0.000
27	44G8	456.6	228.9	0.887	1178.12	20.30	7.52	0.016
27	45G7	908.7	802.6	1.119	6519.65	31.45	20.39	0.000
27	45G8	947.2	257.2	0.579	4204.97	10.04	1.04	0.027
27	46G8	884.8	846.2	1.124	6660.17	7.65	59.13	0.000
28	42G8	945.4	502.8	2.219	2141.79	54.62	12.55	0.221
28	43G8	296.2	1907.2	1.559	3623.92	13.23	86.75	0.003
28	43G9	973.7	511.7	1.456	3421.38	38.31	6.95	0.344
28	44G9	876.6	406.1	0.790	4507.63	10.12	13.19	0.060
28	45G9	924.5	569.3	0.575	9146.76	6.04	2.91	0.007
29	46G9	933.8	548.8	0.532	9634.05	5.39	5.08	0.000
29	46H0	933.8	704.4	1.113	5909.91	30.84	10.25	0.000
29	47G9	876.2	641.8	0.897	6267.93	18.15	20.95	0.001
29	47H0	920.3	704.3	1.082	5991.25	23.72	37.02	0.000

Table 4: Estimated number (millions) of sprat

SD	RECT	NSprTOT	NSpr0	NSpr1	NSpr2	NSpr3	NSpr4	NSpr5	NSpr6	NSpr7	NSpr8
25	39G4	97.24	1.02	10.65	33.57	18.42	6.55	25.79	1.23	0.00	0.00
25	39G5	602.07	10.25	69.85	126.44	189.26	68.61	90.41	8.64	38.60	0.00
25	40G4	467.72	1.63	67.54	106.33	132.98	37.96	87.79	10.15	3.22	20.12
25	40G5	1699.95	133.67	109.60	433.24	289.49	131.55	505.00	97.40	0.00	0.00
25	40G6	1604.69	363.47	250.09	134.17	382.13	25.84	330.08	50.13	0.00	68.76
25	40G7	1074.24	5.94	81.90	262.33	192.29	233.84	292.00	0.00	5.94	0.00
25	41G6	2155.66	366.41	409.10	557.39	130.92	116.84	537.39	25.85	11.77	0.00
25	41G7	3310.06	695.26	160.21	571.33	396.00	577.37	746.65	163.24	0.00	0.00
26	41G8	259.91	0.00	3.99	29.11	42.55	35.95	67.34	55.84	0.00	25.12
27	42G6	277.39	8.45	46.75	101.66	14.08	0.00	86.17	10.98	3.10	6.20
27	42G7	2171.16	215.02	455.11	465.82	225.17	329.14	457.37	23.52	0.00	0.00
28	42G8	268.86	0.00	1.83	37.18	34.03	8.52	148.78	17.44	10.54	10.54
27	43G7	1405.85	159.79	255.47	166.78	133.26	122.62	404.51	94.47	68.94	0.00
28	43G8	3143.68	365.93	269.46	1487.01	316.03	206.25	482.36	0.00	0.00	16.63
28	43G9	237.92	0.97	10.64	89.97	10.68	27.63	74.45	6.63	15.07	1.89
27	44G7	41.14	1.28	12.32	8.62	1.60	3.51	10.35	2.90	0.56	0.00
27	44G8	88.58	0.00	8.37	32.41	7.03	0.21	26.32	8.87	4.94	0.43
28	44G9	594.55	34.81	21.55	356.02	52.79	50.28	79.10	0.00	0.00	0.00
27	45G7	1329.47	144.24	553.34	133.86	210.46	27.62	138.88	76.76	16.69	27.62
27	45G8	43.81	0.62	3.70	13.69	13.90	0.00	10.39	0.51	0.51	0.51
28	45G9	266.48	59.25	41.70	84.15	15.94	15.54	29.67	20.22	0.00	0.00
27	46G8	3938.20	71.61	1515.36	1072.69	771.91	173.65	307.23	0.00	17.16	8.58
29	46G9	488.94	186.49	51.08	142.30	34.26	5.66	56.63	1.18	11.33	0.00
29	46H0	605.55	216.12	90.71	170.08	31.45	13.12	60.31	1.47	3.94	18.33
29	47G9	1313.23	342.53	380.89	316.35	51.65	62.36	103.89	24.94	12.26	18.36
29	47H0	2218.23	481.00	462.43	1025.67	73.34	57.95	113.16	0.00	0.00	4.68

Table 5: Estimated mean weights (g) of sprat

SD	RECT	WSpr0	WSpr1	WSpr2	WSpr3	WSpr4	WSpr5	WSpr6	WSpr7	WSpr8
25	39G4	5.00	11.57	15.88	15.83	18.00	18.38	19.00		
25	39G5	5.20	11.67	14.20	15.22	16.00	17.67	18.50	15.00	
25	40G4	4.00	11.15	14.00	15.56	17.00	17.29	20.00	20.50	17.50
25	40G5	3.31	10.71	12.50	15.14	15.33	16.17	14.50		
25	40G6	3.80	8.88	12.25	13.30	16.00	15.67	15.50		12.50
25	40G7	5.00	16.00	13.25	14.25	16.00	16.43		21.00	
25	41G6	3.53	9.12	13.08	16.00	17.00	14.70	15.00	18.00	
25	41G7	4.08	9.78	12.14	14.50	14.57	15.56	14.50		
26	41G8		12.00	13.75	14.50	16.40	16.67	16.20		15.00
27	42G6	3.33	8.85	12.00	14.00		15.71	16.67	15.00	15.50
27	42G7	3.65	8.21	12.33	12.67	13.50	14.85	15.67		
28	42G8		9.50	11.57	14.50	12.00	14.93	15.50	14.00	16.00
27	43G7	4.32	9.44	13.25	14.00	14.50	15.58	16.00	15.00	
28	43G8	4.07	9.40	11.83	12.00	14.00	14.12			16.00
28	43G9	4.00	10.57	11.89	12.00	14.50	14.30	16.33	14.00	16.00
27	44G7	4.25	9.31	12.00	16.00	14.00	15.25	15.80	16.00	
27	44G8		9.29	11.36	14.50	17.00	14.45	15.80	13.50	16.00
28	44G9	4.00	9.50	11.67	14.33	14.67	15.25			
27	45G7	4.00	9.35	13.20	11.57	13.00	14.75	12.67	15.00	13.00
27	45G8	3.00	10.00	12.11	12.88		15.44	17.00	15.00	16.00
28	45G9	4.22	9.11	11.58	12.00	13.00	14.14	14.20		
27	46G8	4.40	9.62	12.86	12.75	14.50	14.14		15.00	17.00
29	46G9	4.17	9.00	11.36	12.67	14.00	14.70	16.00	13.00	
29	46H0	4.20	8.92	11.20	13.33	13.50	14.00	16.00	14.00	13.00
29	47G9	3.33	8.62	10.22	11.50	12.50	13.56	13.00	13.50	13.00
29	47H0	3.73	8.70	11.47	13.00	14.50	14.00			14.00

Table 6: Estimated number (millions) of herring

SD	RECT	NHerTOT	NHer0	NHer1	NHer2	NHer3	NHer4	NHer5	NHer6	NHer7	NHer8
25	39G4	528.93	32.93	33.48	140.50	128.42	60.51	50.77	37.05	33.75	11.53
25	39G5	1039.45	91.66	74.22	129.42	65.18	98.38	227.81	189.75	72.11	90.92
25	40G4	964.38	68.02	138.30	319.38	98.71	53.64	70.79	50.80	58.78	105.95
25	40G5	567.20	21.87	23.99	103.74	56.93	28.45	170.94	126.41	17.78	17.09
25	40G6	805.14	2.01	93.65	243.39	40.96	88.23	175.18	108.09	53.62	0.00
25	40G7	6.27	0.00	0.00	1.11	0.18	0.73	1.52	2.13	0.47	0.15
25	41G6	207.27	0.00	4.57	46.02	28.49	39.26	37.80	39.63	7.30	4.20
25	41G7	409.22	0.00	2.26	88.63	25.77	55.17	132.94	81.39	11.76	11.30
26	41G8	679.69	0.00	12.33	65.89	19.91	23.14	168.42	231.83	90.27	67.90
27	42G6	64.02	0.00	4.83	26.88	4.59	13.23	8.76	5.44	0.00	0.30
27	42G7	933.55	2.84	34.17	262.64	24.38	139.35	238.07	182.43	43.72	5.96
28	42G8	1169.77	0.00	0.00	32.82	60.36	109.95	421.13	413.50	120.33	11.68
27	43G7	476.66	1.09	5.23	135.26	35.29	76.17	93.97	109.22	13.52	6.93
28	43G8	479.54	0.00	31.00	133.53	45.89	65.32	85.16	102.11	16.54	0.00
28	43G9	1310.69	0.00	16.20	103.82	89.34	335.01	378.62	294.83	61.66	31.22
27	44G7	689.20	0.00	44.03	251.91	50.55	88.68	108.67	122.96	16.20	6.20
27	44G8	239.21	0.00	15.19	93.79	19.82	27.51	39.50	35.07	6.13	2.21
28	44G9	456.04	0.00	5.86	47.36	68.58	108.53	114.67	91.89	17.79	1.36
27	45G7	2050.22	0.00	616.86	924.47	71.22	182.55	179.20	23.81	47.53	4.59
27	45G8	422.34	0.00	19.07	126.35	41.28	97.59	107.42	19.20	10.80	0.62
28	45G9	552.34	0.00	23.47	133.72	22.04	128.16	122.16	91.28	25.37	6.14
27	46G8	509.67	16.67	97.50	231.57	24.74	68.69	59.34	9.01	1.31	0.84
29	46G9	519.45	14.19	14.24	111.50	78.36	70.27	91.99	100.32	24.51	14.07
29	46H0	1822.40	36.57	32.71	491.72	214.49	535.19	387.55	89.12	35.04	0.00
29	47G9	1137.42	32.28	174.27	307.84	172.92	201.17	189.07	54.09	0.62	5.15
29	47H0	1421.40	111.00	502.43	543.48	60.38	45.91	118.60	27.50	12.11	0.00

Table 7: Estimated mean weights (g) of herring

SD	RECT	WHer0	WHer1	WHer2	WHer3	WHer4	WHer5	WHer6	WHer7	WHer8
25	39G4	8.31	38.91	49.85	97.23	127.42	115.71	125.91	82.60	97.25
25	39G5	14.10	31.64	39.53	52.38	59.55	57.75	63.29	60.40	65.88
25	40G4	10.45	36.62	45.27	68.44	73.33	65.38	76.00	73.67	80.70
25	40G5	12.87	29.83	32.24	50.00	69.25	56.36	61.21	68.75	78.25
25	40G6	19.00	25.20	31.40	44.80	44.71	52.59	55.17	56.83	
25	40G7			36.86	62.00	52.40	44.67	52.08	60.00	68.00
25	41G6		27.00	29.71	44.00	37.10	49.14	46.40	46.50	49.00
25	41G7		18.00	27.33	44.60	37.75	42.19	50.07	55.00	44.00
26	41G8		34.00	28.43	30.00	31.67	42.64	52.44	61.09	66.94
27	42G6		18.45	28.20	27.67	36.85	39.80	45.89		49.00
27	42G7	7.50	18.50	29.90	42.00	34.14	42.62	44.62	71.67	61.00
28	42G8			24.20	30.00	32.00	42.20	45.56	50.62	66.00
27	43G7	6.00	18.50	27.22	30.50	35.62	41.25	44.88	45.67	52.33
28	43G8		18.14	24.07	33.40	31.43	40.43	35.67	43.50	
28	43G9		21.50	24.00	30.40	29.17	38.24	38.20	49.57	39.50
27	44G7		16.00	23.83	29.75	32.62	36.70	41.15	42.00	44.00
27	44G8		16.45	25.35	26.50	30.33	40.25	39.42	43.00	53.60
28	44G9		18.50	22.22	26.80	29.10	35.92	40.38	44.29	44.50
27	45G7		14.82	23.50	29.00	31.00	31.73	41.60	37.60	44.00
27	45G8		16.25	23.41	29.00	32.54	39.78	47.50	47.83	52.00
28	45G9		17.10	24.67	26.00	29.55	37.64	40.00	39.50	50.50
27	46G8	5.89	15.17	22.12	24.00	31.56	30.92	36.67	37.00	39.00
29	46G9	5.50	18.00	21.21	26.00	29.00	36.00	35.08	41.00	28.00
29	46H0	5.50	15.50	20.33	24.75	26.54	31.33	35.88	35.33	
29	47G9	5.15	15.20	20.29	25.33	29.20	33.36	38.00	43.00	43.50
29	47H0	4.96	15.57	23.35	26.00	30.00	29.89	33.50	36.67	

Table 8: Catch composition per haul.

Species/Trawlnumber	2	4	6	8	10	12	14	16
Ammodytes								
Ammodytidae						0.00		
Clupea harengus	432.98	273.22	71.22		32.34	26.12	41.52	31.48
Cyclopterus lumpus	1.15	0.66	0.05		0.37	0.16	0.55	0.13
Gadus morhua	7.83	0.01	0.78		0.22	0.00	0.01	
Gasterosteus aculeatus	0.02		0.14	0.18	6.35	21.78	23.55	267.06
Hyperoplus lanceolatus						0.01	0.02	
Merlangius merlangus	0.34							
Nerophis ophidion								0.00
Platichthys flesus	0.34							
Pleuronectes platessa								
Psetta maxima								
Pungitius pungitius		0.02	0.01	0.03	0.03	0.12	0.17	
Salmo salar								
Scomber scombrus								
Sprattus sprattus	89.51	171.01	81.82	327.76	62.14	5.97	2.76	72.19

Table 8 (continued): Catch composition per haul.

Species/Trawlnumber	18	20	22	24	26	28	30	32
Ammodytes						0.02		
Ammodytidae								
Clupea harengus	151.20	55.89	145.82	46.02	59.36	94.37	78.09	123.62
Cyclopterus lumpus	0.21	0.24	0.37	0.09			0.62	0.27
Gadus morhua				0.00				
Gasterosteus aculeatus	40.32	7.37	18.09	92.03	49.87	17.57	11.23	10.26
Hyperoplus lanceolatus	0.02		0.07				0.02	
Merlangius merlangus								
Nerophis ophidion			0.01					0.00
Platichthys flesus								
Pleuronectes platessa								
Psetta maxima						0.35		
Pungitius pungitius		0.01	0.01			0.06	0.02	0.12
Salmo salar						0.42		
Scomber scombrus							0.31	
Sprattus sprattus	689.47	1.37	23.31	145.89	222.81	410.99	11.19	62.83

Table 8 (continued): Catch composition per haul.

Species/Trawlnumber	34	36	38	40	42	44	46	48
Ammodytes								
Ammodytidae								
Clupea harengus	291.23	0.42	287.43	84.44	96.40	114.79	424.14	66.83
Cyclopterus lumpus	1.58	0.43	0.26	0.54	0.37	0.04	0.24	0.28
Gadus morhua			0.83	0.02				0.00
Gasterosteus aculeatus	81.06	258.65	36.38	45.57	61.73	58.37	29.53	83.05
Hyperoplus lanceolatus								
Merlangius merlangus								
Nerophis ophidion		0.00			0.00			
Platichthys flesus								
Pleuronectes platessa								
Psetta maxima								
Pungitius pungitius	0.29		0.04	0.07			0.02	0.01
Salmo salar								
Scomber scombrus								
Sprattus sprattus	5.90	2.68	44.80	1.58	14.02	27.33	41.07	14.97

Table 8 (continued): Catch composition per haul.

Species/Trawlnumber	50	52	56	59	61	63	65	67	69
Ammodytes									
Ammodytidae									
Clupea harengus	33.76	156.36	0.70	132.39	381.99	144.06	0.29	216.78	539.15
Cyclopterus lumpus		1.06	1.05	1.02	0.29		0.37		
Gadus morhua	0.14	0.01	0.02	0.03	0.15	0.12	0.01		4.41
Gasterosteus aculeatus	37.30	37.23	118.02	17.01	31.02		333.09		
Hyperoplus lanceolatus									
Merlangius merlangus									
Nerophis ophidion									
Platichthys flesus	0.19			0.51	0.21	0.84		0.12	0.45
Pleuronectes platessa									
Psetta maxima					0.14				
Pungitius pungitius	0.17	0.02	0.20	0.03			0.04		
Salmo salar									
Scomber scombrus									
Sprattus sprattus	3.47	28.55	123.59	2.93	43.45	353.94	37.37		110.06

Table 8 (continued): Catch composition per haul.

Species/Trawlnumber	71	73	75	77	79	81	83	85	87
Ammodytes									
Ammodytidae									
Clupea harengus	219.52	86.45	286.50	614.34	128.57	18.44	1032.89	184.91	2.15
Cyclopterus lumpus	0.76	0.31		0.38	0.97	0.66	0.59	0.57	1.21
Gadus morhua	0.34	0.01	0.03	1.00		5.16	3.40		0.39
Gasterosteus aculeatus	6.97	41.74	0.85	0.29		0.10	0.06	0.02	
Hyperoplus lanceolatus									
Merlangius merlangus									
Nerophis ophidion									
Platichthys flesus	0.79		0.36		0.14				
Pleuronectes platessa									
Psetta maxima									
Pungitius pungitius	0.21	0.12							
Salmo salar									2.61
Scomber scombrus									
Sprattus sprattus	80.54	16.33	570.77	971.54	168.69	43.43	6.05	79.67	111.09

Table 8 (continued): Catch composition per haul.

Species/Trawlnumber	89	91	93	95	97	99
Ammodytes						
Ammodytidae						
Clupea harengus	118.13	168.00	125.59	165.69	103.50	255.38
Cyclopterus lumpus	1.31	0.61	0.53	1.48		1.32
Gadus morhua		0.01	1.28	2.46	0.21	1.11
Gasterosteus aculeatus						
Hyperoplus lanceolatus						
Merlangius merlangus						
Nerophis ophidion						
Platichthys flesus		0.12				
Pleuronectes platessa			0.40			
Psetta maxima						
Pungitius pungitius						
Salmo salar			3.50		2.46	
Scomber scombrus						
Sprattus sprattus	42.93	11.80	53.58	175.15	8.39	9.42

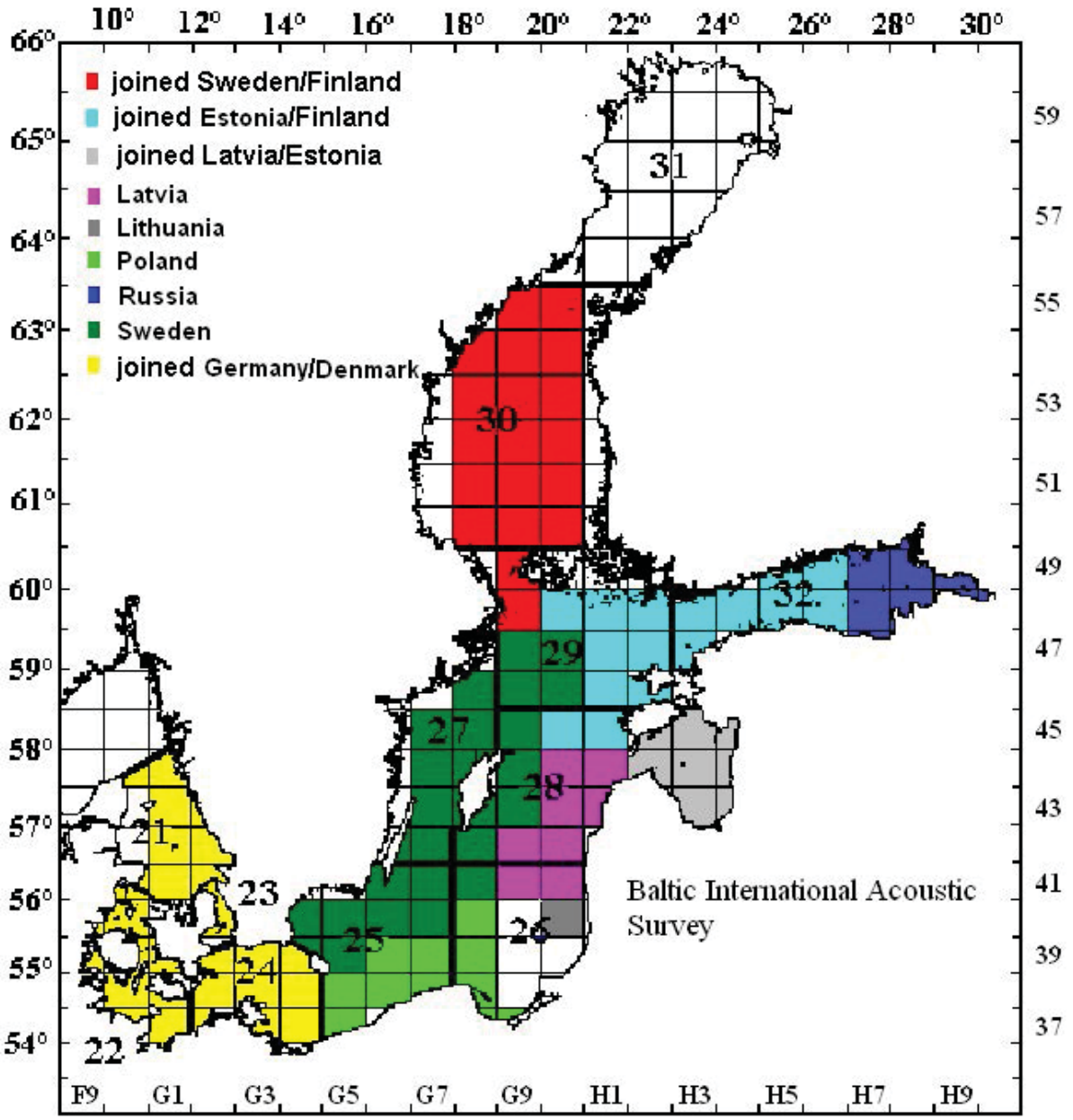

Figure 1: Map over which ICES square are allocated to each country (On axes: longitude, latitude and ICES name of square eg: 41G8)

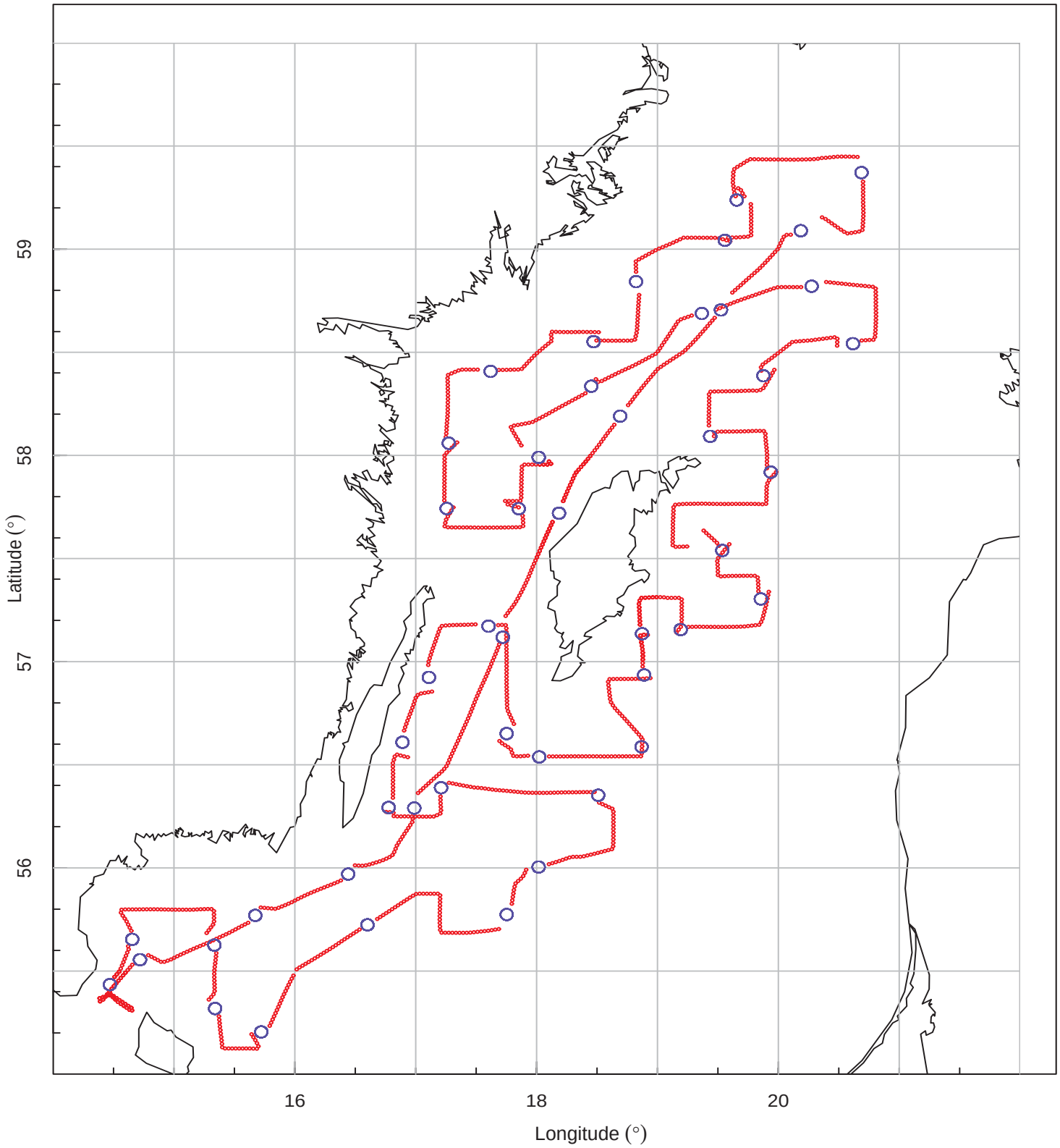

Figure 2: cruise track(red), positions of trawl hauls (blue) and survey grid (ICES squares)(grey)

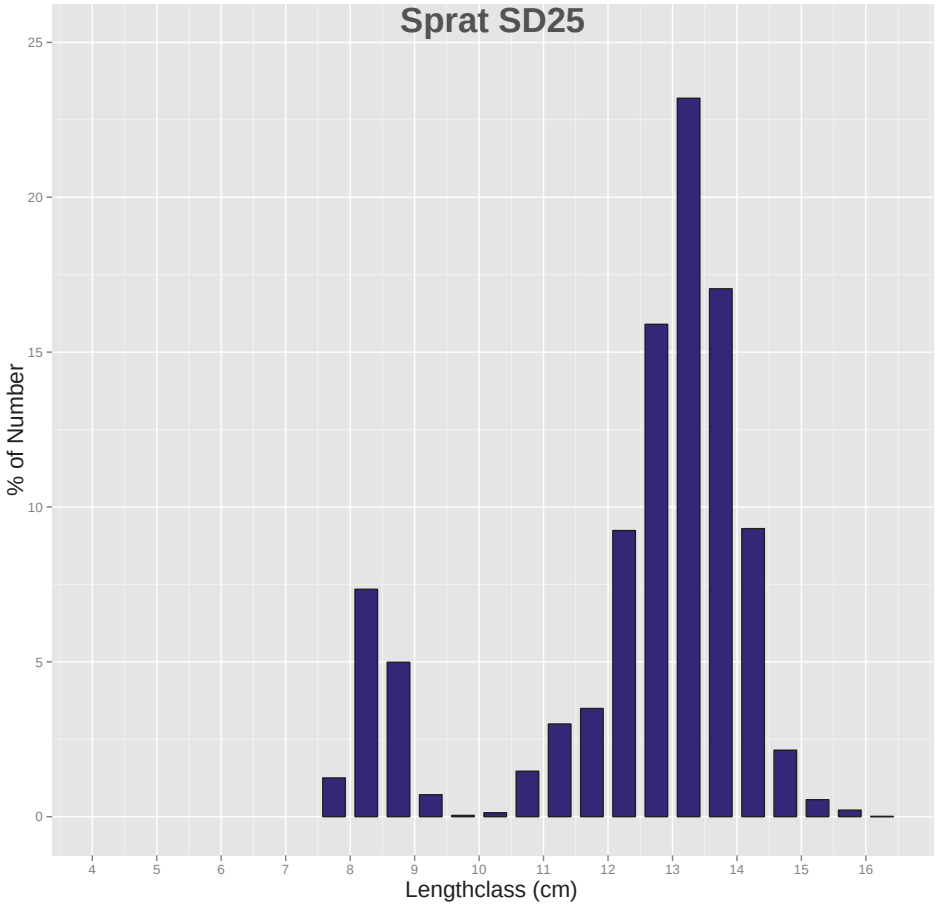

Figure 3: Length distribution of sprat

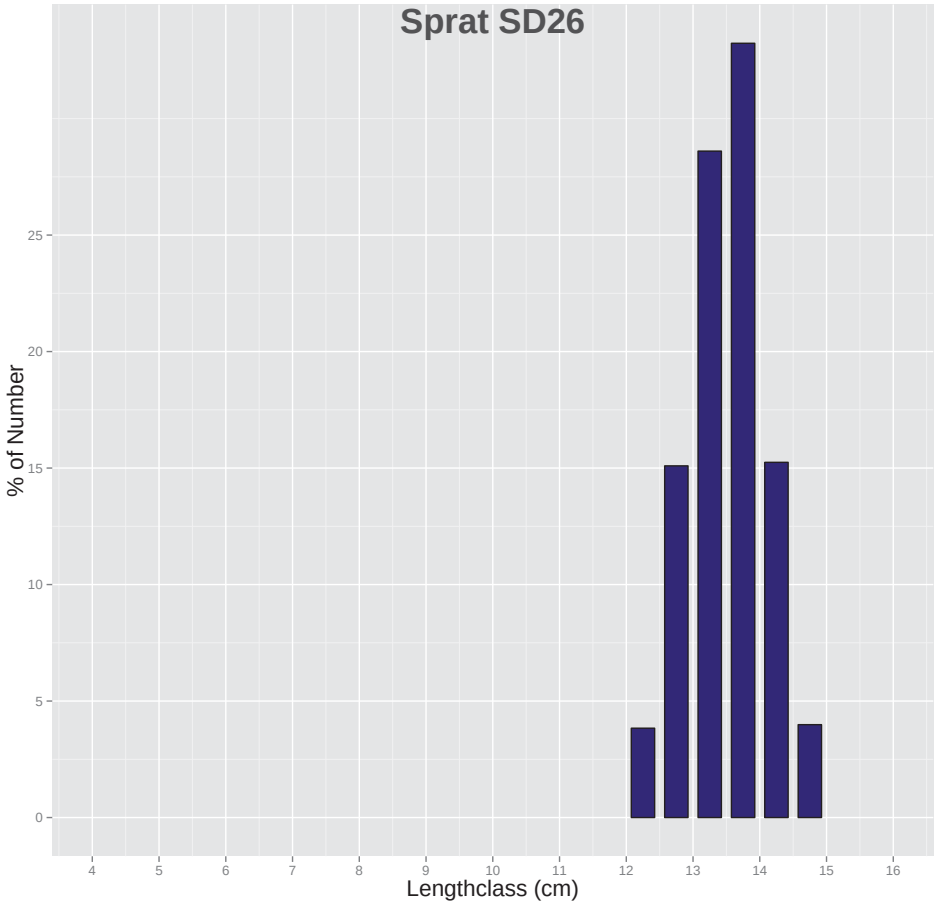

Figure 4: Length distribution of sprat

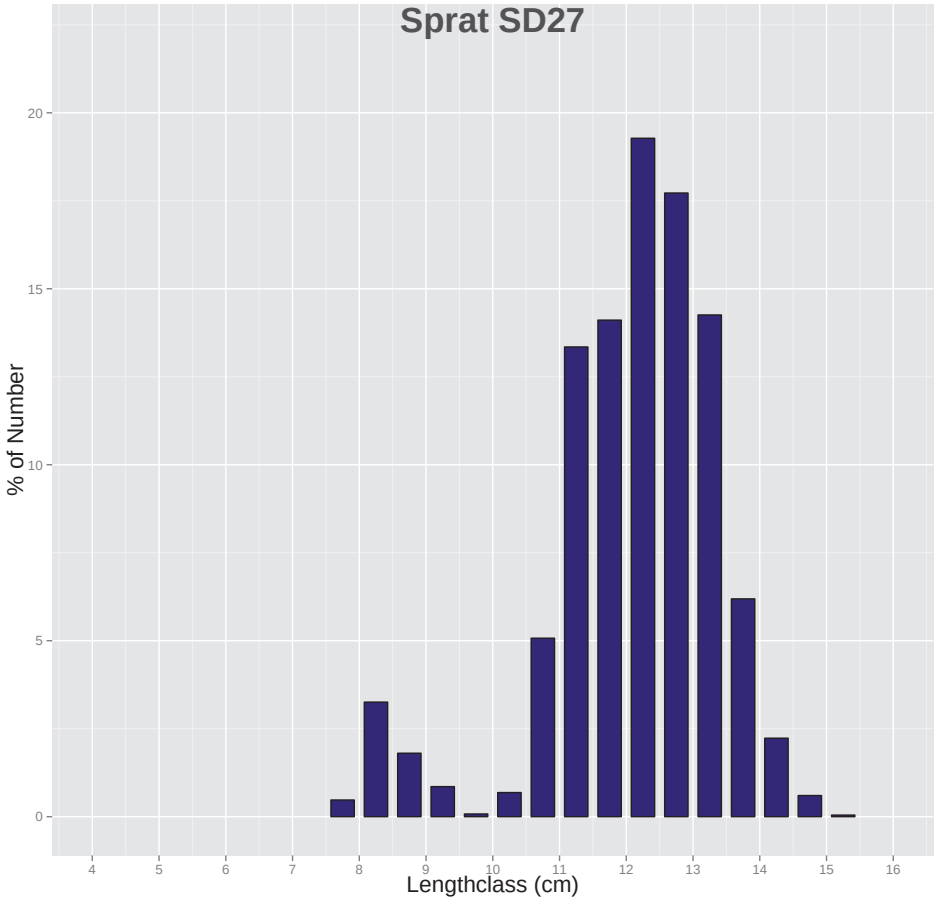

Figure 5: Length distribution of sprat

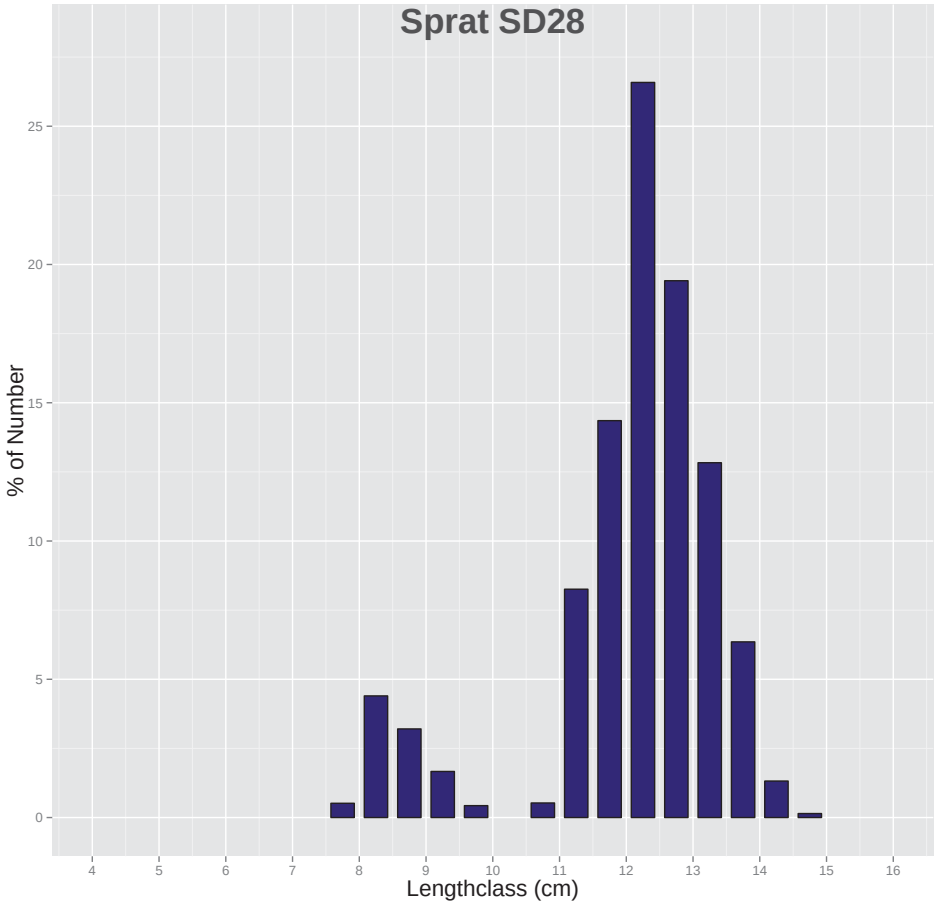

Figure 6: Length distribution of sprat

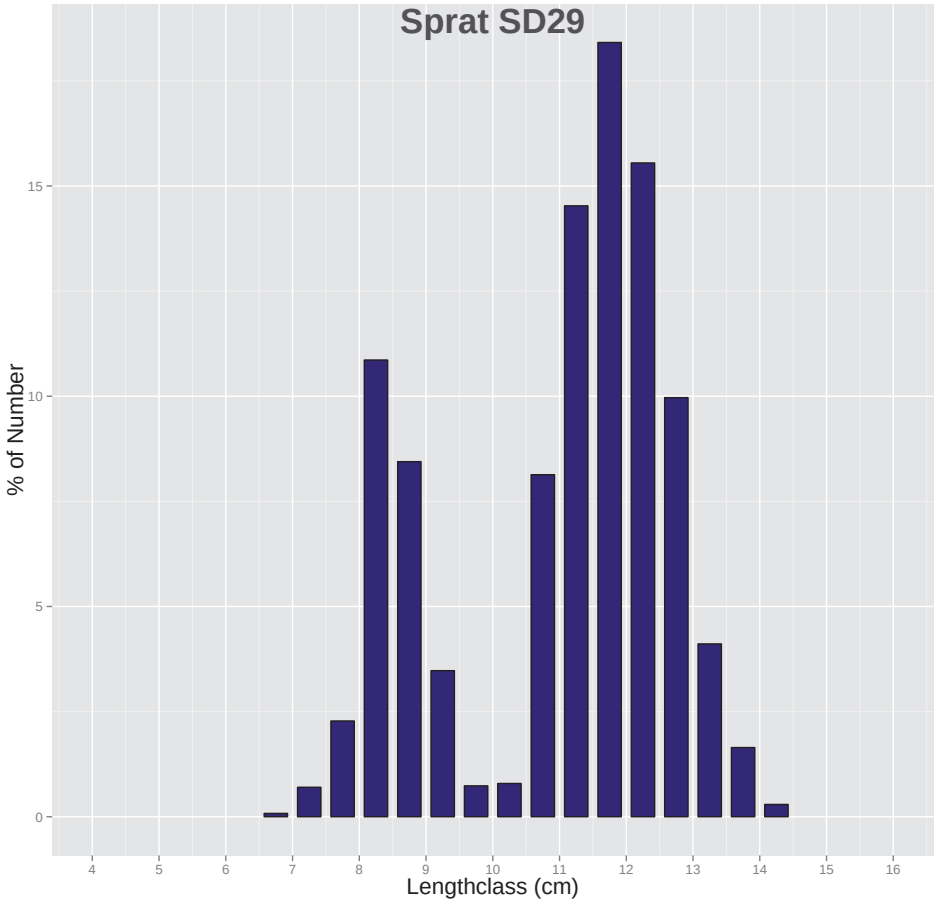

Figure 7: Length distribution of sprat

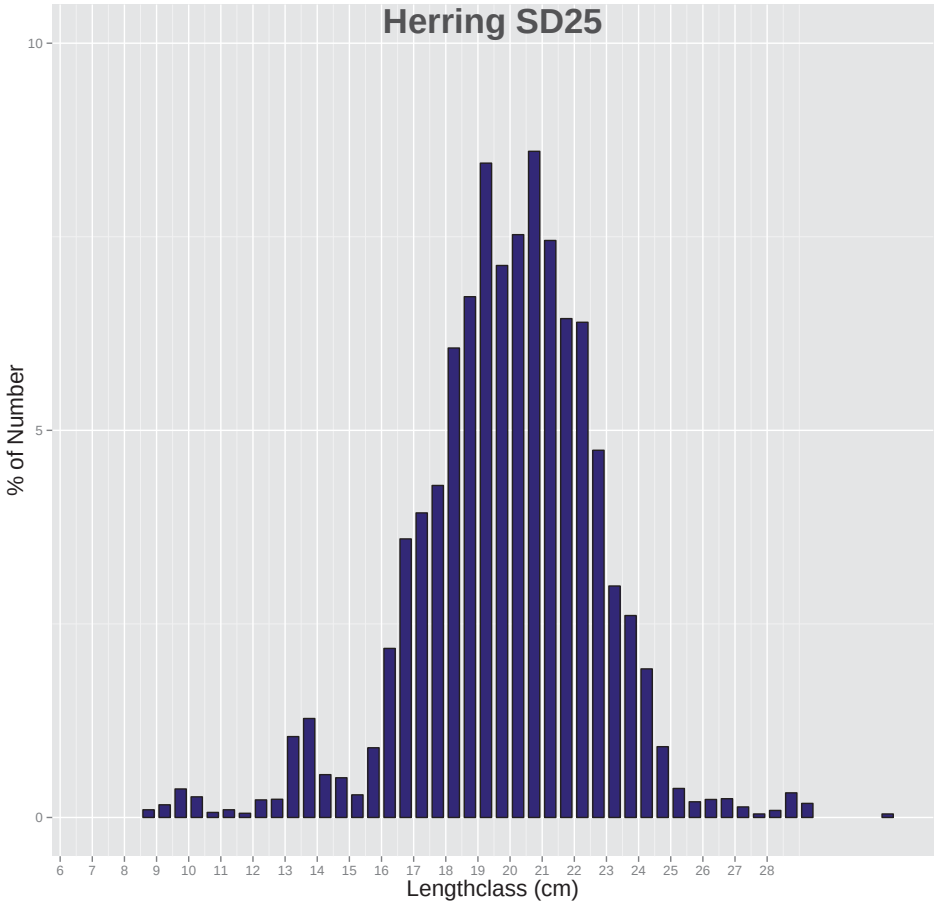

Figure 8: Length distribution of herring

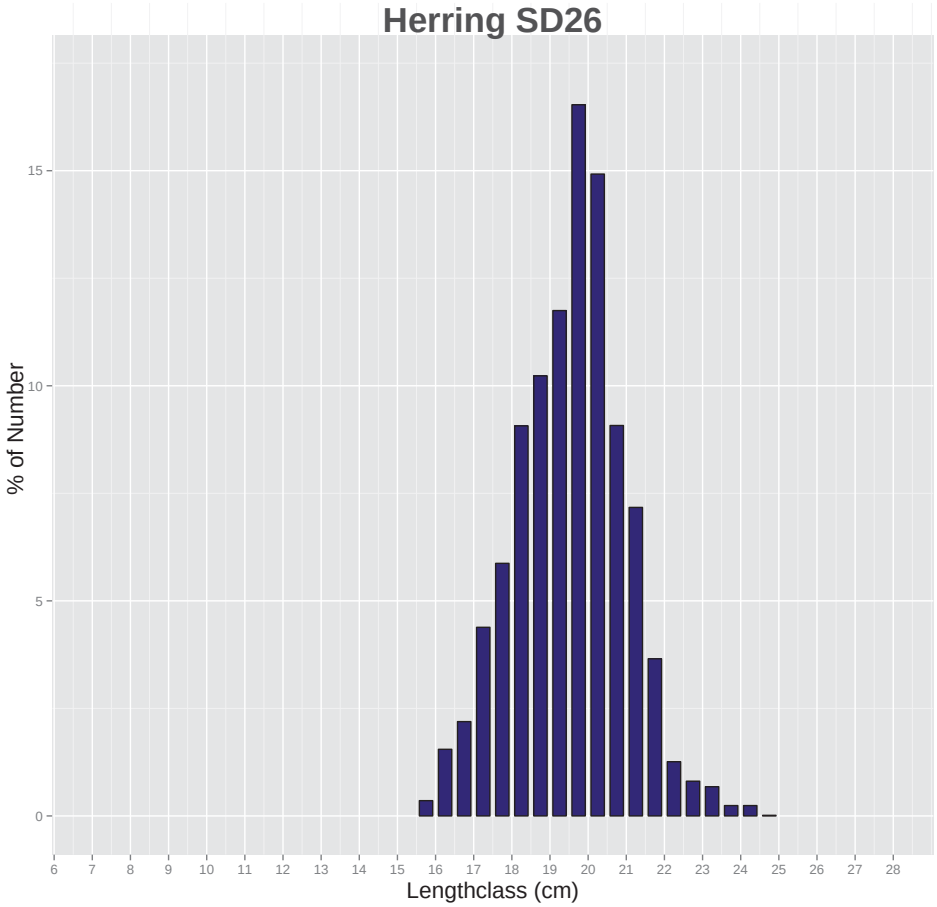

Figure 9: Length distribution of herring

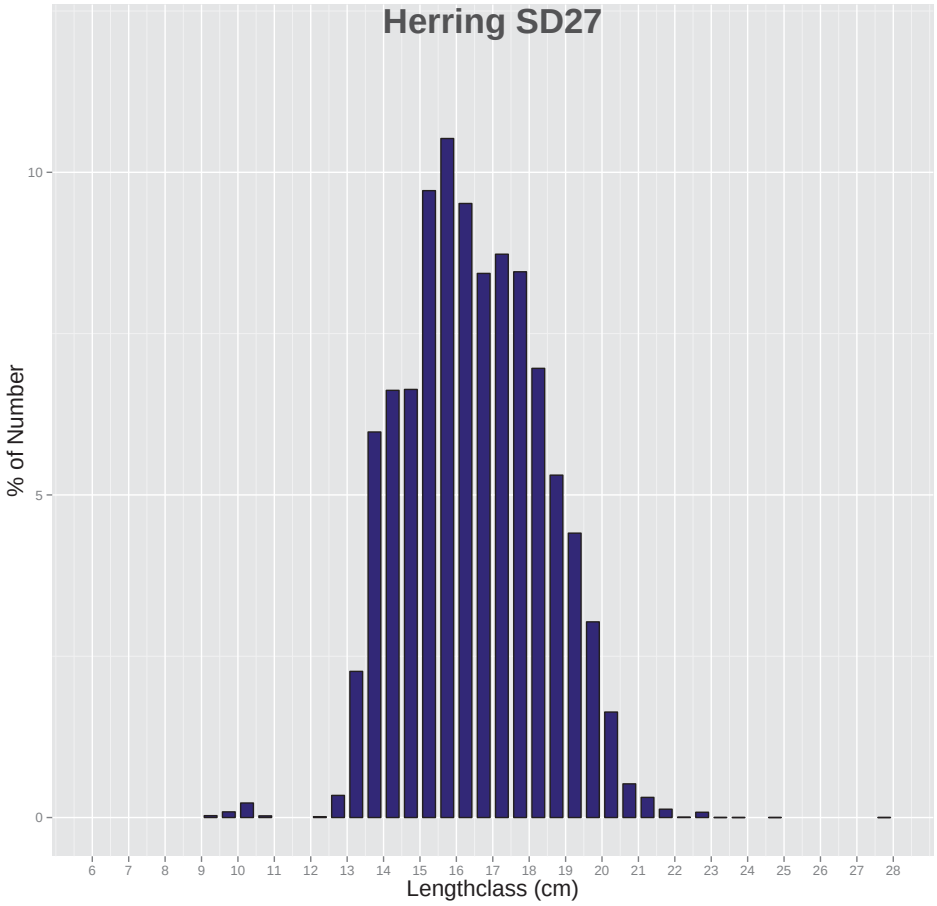

Figure 10: Length distribution of herring

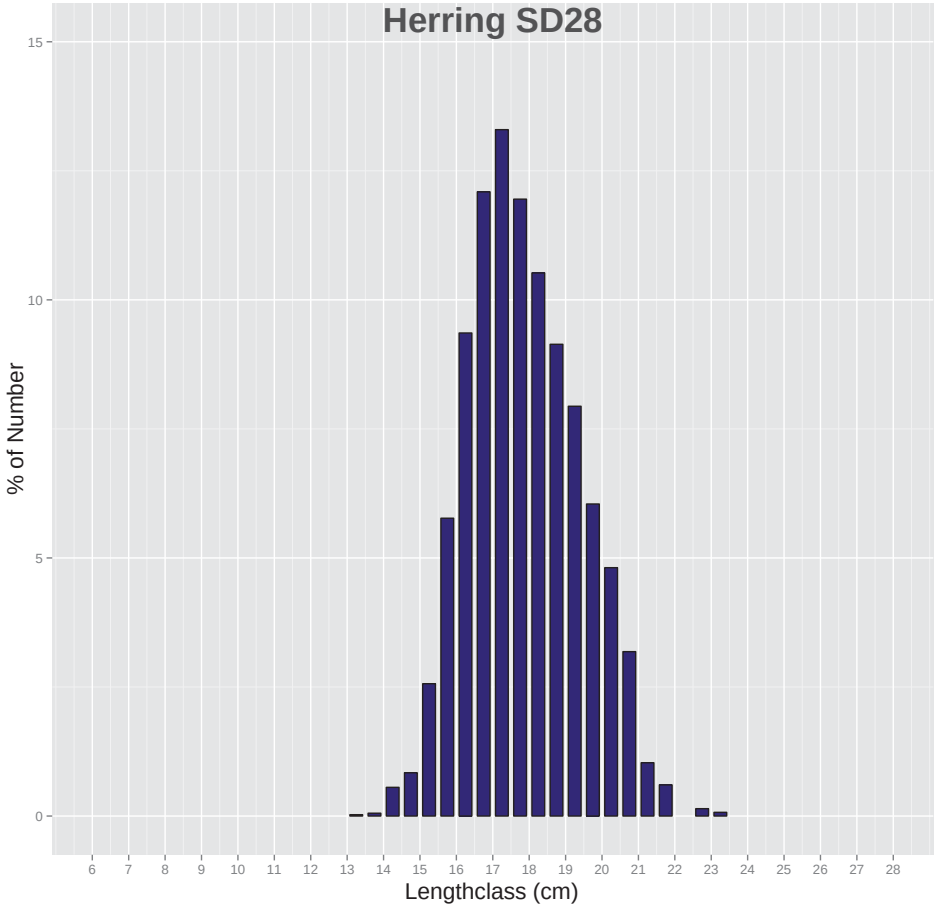

Figure 11: Length distribution of herring

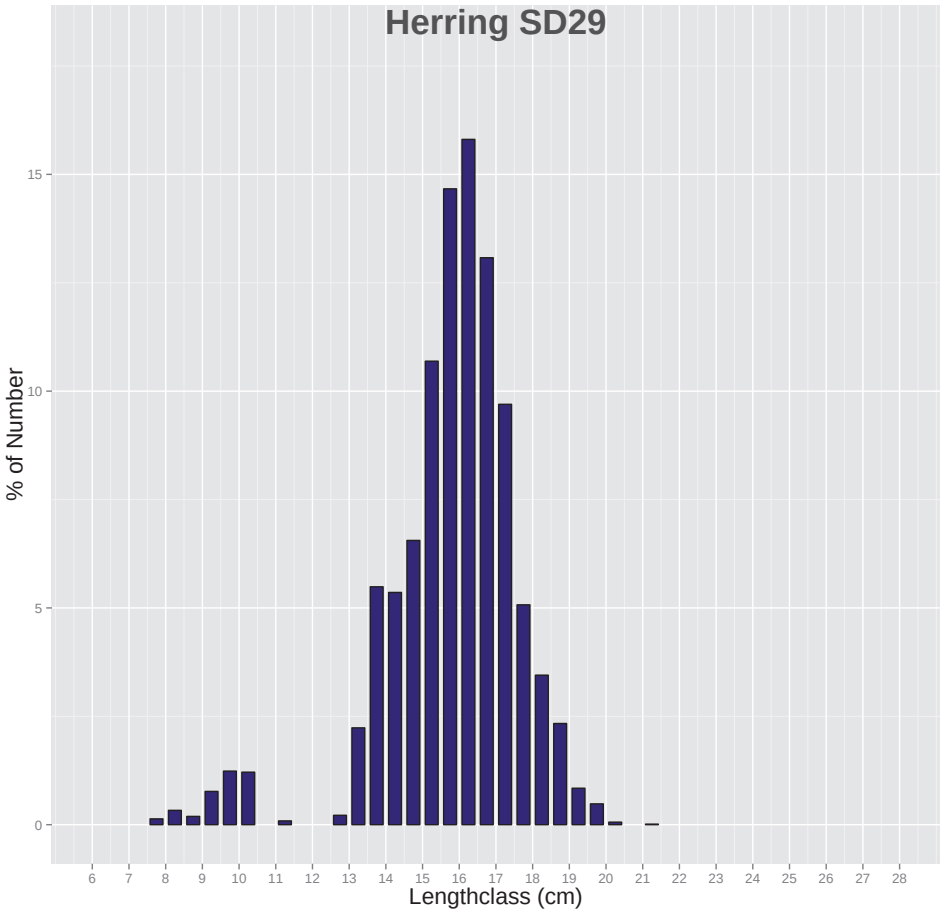

Figure 12: Length distribution of herring