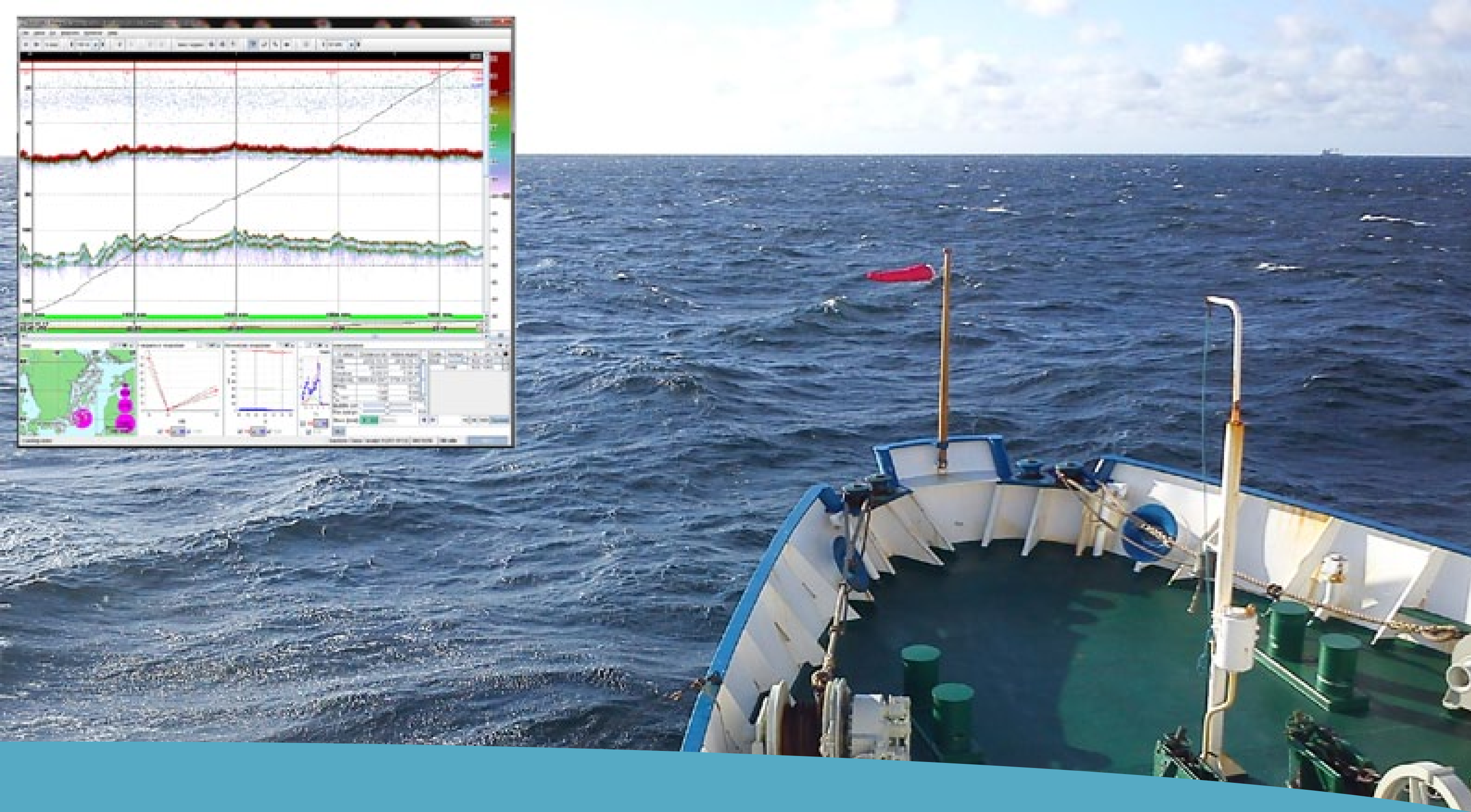

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Baltic International Acoustic Survey report, October 2018

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Baltic International Acoustic Survey report, October 2018

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Baltic International Acoustic Survey Report for R/V Dana

Survey 2018-10-02 - 2018-10-14

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

Contents

1 Svensk Sammanfattning

Internationellt koordinerade hydroakustiska expeditioner 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 subdivision(SD) 27 och för delar av subdivisionerna 25, 26, 28 samt 29. Syftet med expeditionen är att bedöma beståndstatus för sill samt skarpsillbeståndet, resultaten rapporteras årligen 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).
I år utfördes kalibrering av ekoloden den 2018-10-02 i Gullmarsfjorden och därefter tog sig Dana till gränsen mellan SD24 och SD25 där datainsamlingen startade. Expeditionen slutade 2018-10-14 i Köpenhamn. Under expeditionen samlas akustisk rådata in med ett vetenskapligt ekolod (EK60 38kHz) och pelagisk trålning utförs för att få information om art och längfördelning. Den akustiska rådatan efterbehandlas i LSSS. 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. Informationen om arter och längder som fås från trålfångsterna används tillsammans information från ekolodet för att räkna fram ett index för biomassan av fiskarterna och deras åldersstruktur.
I WGBIFS tas gemensamma riktlinjer och manualer fram och resultaten från varje land kombineras i en gemensam databas som rapporteras till WGBFAS(ICES), vilka använder BIAS-resultaten tillsammans med annan information i en modell för att uppskatta det totala beståndet av sill respektive skarpsill. Resultatet från 2018 års svenska BIAS survey bedömdes av WGBIFS vara representativt för mängden sill och skarpsill i Östersjön vid mötet i Klaipeda, 2019. Tidigare års resultat samt mer information kring BIAS samt WGBIFS arbete finns i arbetsgruppens årliga rapport

2 Introduction

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 at least 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, and is a part of the Data Collection Framework as stipulated by the European Council and the Commission (Council Regulation (EC) No 199/2008 and the Commission Data Collection Framework (DCF) web page[1]).
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 DCF and surveys in 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 are co-ordinated and managed by the ICES working group WGBIFS. The main objective of BIAS is to assess herring and sprat resources in the Baltic Sea. The survey will provide data to the ICES Baltic Fisheries Assessment Working Group (WGBFAS).

[1] https://datacollection.jrc.ec.europa.eu/dcf-legislation

3 Methods

3.1 Narrative

Since R/V Argos was taken out of service in 2011, Sweden has chartered R/V Dana for the BIAS survey. The scientific staff was Swedish and the ship crew was Danish. This year's calibration of the SIMRAD EK60[2] sounder was made at Gullmarsfjorden on the Swedish west coast, the location change occurred 2011 because the normal calibration site at Högön is inaccessible for Dana due to deeper draft. The first part of the cruise started 2018-10-02 between Sweden and Bornholm at the border between ICES subdivision (SD) 24 and SD 25, and ended 2018-10-14 close to where it started. The total cruise covered SD 27 and parts of 25, 26, 28 and 29[3].

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 (figure 1). The areas of all strata are limited by the 10 m depth line[4]. The aim is to use parallel transects spaced on regular rectangle basis normally 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. The total area covered was 20832 square nautical miles and the distance used for acoustic estimates was 1247 nautical miles. The cruise track and positions of trawl hauls are shown in figure 2.

3.3 Calibration

The SIMRAD EK60 echo sounder with the transducer ES38B was calibrated at Bornö in Gullmarssfjorden 2018-10-02 according to the BIAS manual [3]. Values from the calibration were within required accuracy. The change of calibration site was decided after correspondance with Simrad. Due to the distance between the calibration site and the survey area the gain was recalculated using the equation: $G = G_0 + 10 * log10(c_0^2/c^2)$ (Bodholt 2002)

3.4 Acoustic data collection

The acoustic sampling was performed around the clock. SIMRAD EK60[2] 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 settings of the hydroacoustic equipment were as described in the BIAS manual[3]. The post processing of the stored raw data was made using the software LSSS[5]. The mean volume back scattering values (Sv) were integrated over 1 nautical mile elementary sampling distance 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 using 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

[2] http://www.simrad.com/ek60
[3] see figure 1
[4] ICES CM 2011/SSGESST:05 Addendum 2
[5] www.marec.no/english/products.htm

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 found in table 1.

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.		

Table 1: Target strength-length (TS) relationships

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.

3.6 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 can be seen in table 2

Jernberg, Carina	IMR, Lysekil, Sweden	Fish sampling
Johannesson, Per	IMR, Lysekil, Sweden	Technician at calibration
Johansson, Marianne	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
Svensson, Matilda	IMR, Lysekil, Sweden	Fish sampling
Tell, Anna-Kerstin	SMHI, Gothenburg	Oceanography

Table 2: Participating scientific crew

4 Results

4.1 Biological data

In total 46 trawl hauls were carried out, 15 in SD 25, 2 in SD 26, 14 in SD 27, 9 in SD 28 and 6 hauls in SD 29. In total 2010 herrings and 1473 sprats were aged. Catch compositions by trawl haul is presented in Table 8. Length distributions for herring and sprat by ICES subdivision are shown in figures 3 to 12.

4.2 Acoustic data

The survey statistics concerning the survey area, the mean backscatter [SA], the mean scattering cross section [SIGMA], the estimated total number of fish, the percentages of herring, sprat and cod per Sub-division/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 should be considered as representative for the abundance of the pelagic species during the BIAS in 2018 for SD 25 to 29 and thus can be used in the assessment work done by WGBFAS.

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Commission DCF web page:
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7 Tables, map and figures

SD	RECT	AREA	SA	SIGMA	NTOT	HHer	HSpr	HCod
25	39G4	287.3	791.8	2.740	830.17	39.80	47.48	0.627
25	39G5	979.0	355.2	1.798	1934.04	15.67	84.18	0.121
25	40G4	677.2	938.6	2.503	2539.82	42.08	55.40	0.419
25	40G5	1012.9	457.8	1.765	2627.68	14.19	83.97	0.046
25	40G6	1013.0	645.3	2.029	3221.14	43.46	45.19	0.007
25	40G7	1013.0	301.1	2.083	1464.29	46.01	53.97	0.000
25	41G6	764.4	779.6	2.440	2442.44	67.85	30.32	0.010
25	41G7	1000.0	718.0	1.407	5101.19	15.95	65.16	0.011
26	41G8	1000.0	728.5	1.820	4002.81	38.33	55.27	0.029
27	42G6	266.0	593.5	0.347	4549.02	0.22	0.76	0.000
27	42G7	986.9	390.5	0.844	4567.30	4.31	45.40	0.000
27	43G7	913.8	922.9	1.301	6479.86	41.47	7.46	0.000
27	44G7	960.5	351.3	1.284	2627.19	27.80	38.20	0.006
27	44G8	456.6	575.2	0.879	2988.47	23.01	2.59	0.000
27	45G7	908.7	374.7	0.483	7056.85	4.48	5.95	0.000
27	45G8	947.2	547.1	0.477	10865.99	2.87	7.03	0.000
27	46G8	884.8	652.8	0.412	14009.62	2.69	0.92	0.001
28	42G8	945.4	306.9	1.243	2335.00	25.44	36.60	0.000
28	43G8	296.2	1057.7	0.535	5853.36	1.95	16.44	0.000
28	43G9	973.7	3211.8	0.802	38983.71	16.70	5.99	0.000
28	44G9	876.6	294.3	1.227	2102.21	22.76	49.64	0.003
28	45G9	924.5	1500.3	1.461	9491.81	35.22	45.28	0.007
29	46G9	933.8	526.1	0.625	7861.60	9.78	11.84	0.001
29	46H0	933.8	744.2	1.034	6722.13	0.49	84.22	0.000
29	47G9	876.2	685.8	0.638	9418.19	3.50	29.63	0.000

Table 3: Survey statistics, see chapter 4.2 for more info

SD	RECT	NSprTOT	NSpr0	NSpr1	NSpr2	NSpr3	NSpr4	NSpr5	NSpr6	NSpr7	NSpr8
25	39G4	394.20	2.15	6.46	58.59	15.51	235.66	50.41	0.00	25.42	0.00
25	39G5	1628.09	157.92	118.54	76.97	258.07	645.60	158.47	89.22	8.48	114.81
25	40G4	1407.15	73.83	60.88	33.53	254.06	699.50	93.74	163.38	0.00	28.23
25	40G5	2206.37	12.11	137.77	266.61	839.70	372.26	11.99	334.27	185.86	45.79
25	40G6	1455.62	98.33	22.78	113.02	141.60	767.02	103.48	127.40	82.00	0.00
25	40G7	790.32	157.49	62.55	43.40	71.70	366.84	32.35	48.15	7.85	0.00
25	41G6	740.64	140.45	24.27	22.58	129.76	352.69	51.08	6.60	13.21	0.00
25	41G7	3324.11	360.86	175.86	197.67	773.13	1353.05	336.34	68.43	29.38	29.38
26	41G8	2212.21	665.50	200.51	149.76	136.03	935.44	43.60	48.22	22.70	10.45
27	42G6	34.46	5.74	2.15	0.00	10.41	10.62	2.44	0.86	1.54	0.68
27	42G7	2073.53	499.27	154.33	158.75	277.11	906.60	45.56	0.00	9.76	22.18
28	42G8	854.58	245.47	241.60	0.00	50.09	277.19	32.34	6.20	0.00	1.68
27	43G7	483.24	115.97	8.00	23.89	92.38	197.61	5.42	32.46	0.00	7.51
28	43G8	962.49	84.51	136.16	32.87	146.49	511.76	29.11	0.00	0.00	21.60
28	43G9	2335.88	374.45	314.64	0.00	195.96	1123.09	199.73	22.88	40.38	64.76
27	44G7	1003.65	128.66	154.76	183.00	43.59	484.09	9.55	0.00	0.00	0.00
27	44G8	77.26	24.88	6.55	0.00	1.57	20.69	8.38	0.00	9.17	6.02
28	44G9	1043.51	600.07	47.70	99.51	58.68	225.36	6.21	2.74	2.74	0.51
27	45G7	419.61	209.16	58.55	13.54	6.98	125.99	1.51	1.98	0.95	0.95
27	45G8	763.66	116.21	145.68	73.57	67.25	258.33	44.24	37.91	18.92	1.56
28	45G9	4297.98	430.66	376.25	73.74	802.83	2069.23	391.06	81.62	50.39	22.21
27	46G8	128.33	56.17	14.22	1.85	7.25	28.90	9.88	4.09	2.31	3.66
29	46G9	930.62	441.14	122.39	77.70	134.20	125.95	13.58	3.28	10.30	2.07
29	46H0	5661.10	1390.75	1705.63	187.53	693.19	1449.91	86.94	60.22	20.07	66.86
29	47G9	2790.66	941.20	233.44	70.36	375.59	738.99	333.07	8.46	0.00	89.55

Table 4: Estimated number (millions) of sprat (Nspr0 stands for number of 0 year old sprat)

SD	RECT	WSpr0	WSpr1	WSpr2	WSpr3	WSpr4	WSpr5	WSpr6	WSpr7	WSpr8
25	39G4	4.00	10.67	12.33	14.33	15.42	17.00		13.50	
25	39G5	4.80	9.67	10.00	12.43	13.77	14.80	15.25	18.00	16.50
25	40G4	3.31	9.50	10.50	13.60	13.86	17.00	17.00		16.00
25	40G5	3.50	10.00	13.00	13.00	13.50	16.00	15.67	15.33	16.50
25	40G6	3.52	7.50	11.00	11.00	12.95	15.25	15.20	15.00	
25	40G7	3.85	8.42	10.67	12.67	12.45	12.00	14.25	17.33	
25	41G6	3.33	8.43	13.00	11.83	12.16	12.50	15.00	16.00	
25	41G7	3.57	7.62	9.67	11.29	11.58	13.00	14.00	14.00	15.00
26	41G8	3.76	8.12	9.67	10.67	11.07	14.33	13.75	12.00	13.00
27	42G6	3.32	7.80		10.75	11.42	12.00	12.00	12.67	14.33
27	42G7	3.71	8.10	9.67	10.80	11.29	12.50		15.00	13.33
28	42G8	4.00	7.47		9.00	11.11	12.25	14.00		12.00
27	43G7	3.21	6.75	10.00	10.33	11.41	13.50	12.40		13.67
28	43G8	3.92	7.56	8.00	10.60	10.88	12.00			12.33
28	43G9	3.88	7.55		9.50	10.76	12.25	12.00	13.50	12.50
27	44G7	3.73	8.86	10.60	10.50	10.94	12.00			
27	44G8	3.79	8.80		10.00	10.70	10.67		12.43	11.33
28	44G9	4.17	6.71	8.62	11.00	10.08	11.00	10.00	12.00	12.00
27	45G7	3.59	7.62	9.00	9.00	10.56	13.00	12.50	13.00	13.50
27	45G8	3.96	7.86	9.67	11.67	11.60	12.60	12.83	12.00	13.00
28	45G9	3.87	7.80	7.00	8.60	9.85	12.33	13.67	14.00	12.00
27	46G8	4.09	8.71	12.00	10.33	10.00	11.50	13.00	14.00	11.00
29	46G9	3.96	8.50	8.20	9.57	11.11	12.00	13.00	12.00	13.50
29	46H0	3.95	8.08	8.50	10.40	9.88	11.50	12.00	12.00	12.00
29	47G9	3.84	7.88	10.00	9.83	10.09	10.33	13.00		12.67

Table 5: Estimated mean weights (g) of sprat
(Wspr1 stands for average weight of the 1 year old sprat)

SD	RECT	NHerTOT	NHer0	NHer1	NHer2	NHer3	NHer4	NHer5	NHer6	NHer7	NHer8
25	39G4	330.40	11.20	24.19	51.97	19.49	135.07	51.52	23.07	10.98	2.91
25	39G5	303.09	20.43	33.71	34.59	41.91	149.32	11.00	6.02	4.23	1.89
25	40G4	1068.84	37.87	88.93	155.12	124.34	469.88	94.92	93.65	4.11	0.00
25	40G5	372.91	37.17	58.78	63.25	30.54	152.93	10.65	12.50	3.83	3.27
25	40G6	1399.93	6.66	99.84	159.31	118.80	821.80	96.35	89.86	7.33	0.00
25	40G7	673.74	0.00	10.06	28.96	116.41	355.80	136.08	23.14	0.00	3.29
25	41G6	1657.10	1.68	22.78	65.31	151.91	1115.52	224.72	36.35	35.43	3.41
25	41G7	813.43	16.79	28.76	92.59	129.23	412.40	112.45	11.09	2.95	7.16
26	41G8	1534.44	0.00	7.38	57.08	249.66	747.15	283.13	132.84	53.48	3.72
27	42G6	9.92	7.06	2.86	0.00	0.00	0.00	0.00	0.00	0.00	0.00
27	42G7	197.04	0.71	10.06	14.02	29.78	107.26	29.91	4.48	0.82	0.00
28	42G8	594.00	2.74	23.84	111.88	91.64	340.65	8.08	9.52	4.32	1.33
27	43G7	2687.49	32.73	169.04	431.62	519.23	1327.42	173.60	13.59	20.26	0.00
28	43G8	113.88	5.13	32.01	18.26	13.95	39.60	3.90	1.03	0.00	0.00
28	43G9	6508.81	197.91	53.08	843.39	566.41	3360.02	532.22	644.46	311.31	0.00
27	44G7	730.39	36.97	32.14	191.12	145.00	267.15	51.91	4.06	2.03	0.00
27	44G8	687.67	2.63	34.37	220.86	65.07	351.91	10.54	0.00	2.29	0.00
28	44G9	478.40	2.86	1.63	42.03	40.08	198.08	151.33	16.42	8.47	17.48
27	45G7	315.98	57.62	24.83	72.03	68.26	63.73	26.68	0.00	2.83	0.00
27	45G8	311.61	63.52	25.68	50.47	40.69	120.15	8.95	1.08	1.08	0.00
28	45G9	3343.48	223.84	365.13	662.42	283.60	1498.54	282.59	0.00	27.35	0.00
27	46G8	377.34	6.58	21.77	32.80	40.05	212.62	52.93	7.71	2.89	0.00
29	46G9	768.95	24.69	113.85	167.20	25.81	336.93	94.77	2.85	0.00	2.85
29	46H0	32.89	16.46	8.05	4.79	0.00	3.59	0.00	0.00	0.00	0.00
29	47G9	329.92	156.28	47.91	69.51	12.47	42.82	0.92	0.00	0.00	0.00

Table 6: Estimated number (millions) of herring

SD	RECT	WHer0	WHer1	WHer2	WHer3	WHer4	WHer5	WHer6	WHer7	WHer8
25	39G4	13.30	37.80	46.00	62.71	46.24	73.88	61.56	74.80	48.00
25	39G5	11.21	19.86	32.70	44.00	35.53	54.44	61.40	47.00	63.00
25	40G4	11.84	21.80	44.33	70.82	45.05	77.85	55.14	86.50	
25	40G5	12.37	26.36	22.69	38.75	36.46	50.00	45.67	51.00	51.00
25	40G6	6.80	19.08	23.57	40.14	35.83	52.00	47.88	56.00	
25	40G7		18.50	22.00	35.78	32.54	42.77	44.67		40.00
25	41G6	5.50	17.17	20.71	29.40	33.74	43.69	52.43	56.80	74.00
25	41G7	5.27	18.67	22.43	28.00	33.29	41.50	51.20	58.00	47.00
26	41G8		15.00	23.20	28.30	30.76	33.88	45.50	44.33	47.00
27	42G6	4.42	6.30							
27	42G7	4.00	15.72	19.83	24.50	30.75	34.11	38.33	38.00	
28	42G8	4.17	14.53	20.92	26.14	29.50	41.25	40.00	50.33	47.00
27	43G7	4.35	14.75	19.44	25.00	26.75	32.88	34.50	40.00	
28	43G8	5.40	14.82	20.00	26.83	25.12	28.50	44.00		
28	43G9	3.79	13.00	19.67	26.00	27.33	33.17	33.33	34.67	
27	44G7	4.64	14.06	21.00	26.60	26.91	34.57	37.50	46.00	
27	44G8	4.50	14.82	20.17	26.33	26.96	34.75		34.00	
28	44G9	4.64	15.33	19.82	26.00	26.75	33.40	36.25	39.67	35.00
27	45G7	4.71	14.00	19.55	23.56	24.42	27.20		36.50	
27	45G8	4.06	13.93	19.09	23.83	26.22	29.75	39.00	35.00	
28	45G9	4.47	14.71	20.14	22.50	25.50	28.83		25.00	
27	46G8	3.70	14.73	20.75	23.40	25.83	30.89	35.33	33.50	
29	46G9	4.07	14.69	19.45	25.33	26.50	32.11	34.00		38.00
29	46H0	3.38	12.43	17.75		20.00				
29	47G9	4.12	13.27	18.00	22.00	23.36	28.00			

Table 7: Estimated mean weights (g) of herring

	Species	2	4	6	8	10	12	14	16
1	Ammodytidae								
2	Clupea harengus	39.37	52.58	19.03	260.96	825.02	55.48	354.43	0.75
3	Cyclopterus lumpus			0.16	0.38	0.52		0.25	
4	Gadus morhua	6.29	0.63		2.52	0.55	0.51		
5	Gasterosteus aculeatus	0.00	0.04	0.13	4.90	0.60	3.33	32.09	108.00
6	Hyperoplus lanceolatus								0.01
7	Lampetra fluviatilis								
8	Liparis liparis	0.00							
9	Merlangius merlangus	3.22							
10	Myoxocephalus scorpius					0.78		0.52	
11	Nerophis ophidion								0.00
12	Pholis gunnellus					0.01			
13	Platichthys flesus	1.07		0.09		0.10			
14	Pleuronectes platessa	0.15							
15	Pomatoschistus	0.12	0.01	0.11					
16	Pungitius pungitius				0.02	0.04	0.02	0.17	0.64
17	Salmo salar								
18	Scophthalmus maximus								
19	Sprattus sprattus	14.21	24.16	79.28	256.28	21.42	42.60	450.99	4.92
20	Trachurus trachurus								

Table 8: Catch composition per haul.

	Species	18	20	22	24	26	28	30	32
1	Ammodytidae								
2	Clupea harengus	56.17	397.29	112.50	515.03	7.26	177.42	74.39	16.91
3	Cyclopterus lumpus		0.09	0.08		0.24	2.53	0.17	
4	Gadus morhua				0.51				
5	Gasterosteus aculeatus	28.41	26.16	17.60	42.68	23.67	49.05	120.93	14.41
6	Hyperoplus lanceolatus								
7	Lampetra fluviatilis								
8	Liparis liparis								
9	Merlangius merlangus								
10	Myoxocephalus scorpius				0.08				
11	Nerophis ophidion								
12	Pholis gunnellus								
13	Platichthys flesus	0.25							
14	Pleuronectes platessa								
15	Pomatoschistus								
16	Pungitius pungitius	0.10	0.04	0.04	0.06	0.01	0.17	0.06	0.01
17	Salmo salar								
18	Scophthalmus maximus								
19	Sprattus sprattus	43.32	18.26	12.92	4.94	387.35	7.58	69.42	7.56
20	Trachurus trachurus								

Table 8 (continued): Catch composition per haul

	Species	34	36	38	40	42	44	47	49
1	Ammodytidae								
2	Clupea harengus	0.57	3.73	42.19	47.03	138.58	18.85	7.12	3.83
3	Cyclopterus lumpus		0.09	0.36		0.27	0.13	0.61	0.33
4	Gadus morhua				0.09	0.55			
5	Gasterosteus aculeatus	27.97	85.75	120.06	121.83	57.35	66.67	43.80	7.11
6	Hyperoplus lanceolatus			0.12	0.05				
7	Lampetra fluviatilis							0.06	
8	Liparis liparis								
9	Merlangius merlangus								
10	Myoxocephalus scorpius								
11	Nerophis ophidion	0.00	0.00	0.01	0.00	0.01	0.00	0.03	
12	Pholis gunnellus								
13	Platichthys flesus								
14	Pleuronectes platessa								
15	Pomatoschistus								
16	Pungitius pungitius	0.02	0.06	0.01	0.01	0.02	0.08	0.19	
17	Salmo salar								0.27
18	Scophthalmus maximus				0.27	0.02			
19	Sprattus sprattus	1.07	18.62	7.91	2.07	11.49	97.22	555.42	1671.03
20	Trachurus trachurus								

Table 8 (continued): Catch composition per haul

	Species	51	53	55	57	59	61	63	65
1	Ammodytidae						0.00		
2	Clupea harengus	12.90	40.68	224.29	3.96	39.24	76.82	162.34	87.06
3	Cyclopterus lumpus	0.08	0.63		0.30			0.83	0.13
4	Gadus morhua			0.24		0.72			
5	Gasterosteus aculeatus	35.26	73.62	4.91	8.97	2.15	6.94	42.37	48.43
6	Hyperoplus lanceolatus							0.01	
7	Lampetra fluviatilis								
8	Liparis liparis								
9	Merlangius merlangus								
10	Myoxocephalus scorpius								
11	Nerophis ophidion	0.00	0.03						
12	Pholis gunnellus								
13	Platichthys flesus				0.05	0.10			
14	Pleuronectes platessa								
15	Pomatoschistus								
16	Pungitius pungitius	0.04			0.03	0.02	0.00		
17	Salmo salar								
18	Scophthalmus maximus								
19	Sprattus sprattus	88.59	85.67	18.55	191.20	383.23	2.02	23.50	9.75
20	Trachurus trachurus								

Table 8 (continued): Catch composition per haul

	Species	67	69	71	73	75	77	79	81
1	Ammodytidae								
2	Clupea harengus	2.47	337.68	236.32	495.27	100.38	57.99	281.66	145.70
3	Cyclopterus lumpus		0.56	1.64			0.27	0.36	0.96
4	Gadus morhua				5.55				
5	Gasterosteus aculeatus	8.04	26.22	48.14	3.31	1.09	1.47		
6	Hyperoplus lanceolatus								
7	Lampetra fluviatilis							0.13	
8	Liparis liparis								
9	Merlangius merlangus								
10	Myoxocephalus scorpius								
11	Nerophis ophidion	0.00							
12	Pholis gunnellus								
13	Platichthys flesus				1.01				
14	Pleuronectes platessa								
15	Pomatoschistus				0.02				
16	Pungitius pungitius	0.01							
17	Salmo salar								
18	Scophthalmus maximus					0.31			
19	Sprattus sprattus	9.18	81.16	227.93	222.56	35.35	153.29	52.49	136.94
20	Trachurus trachurus								

Table 8 (continued): Catch composition per haul

	Species	83	85	87	89	91
1	Ammodytidae					
2	Clupea harengus	243.35	1247.80	46.54	35.39	63.65
3	Cyclopterus lumpus	0.58	0.73		0.55	0.73
4	Gadus morhua	0.74		0.95	3.67	1.86
5	Gasterosteus aculeatus	0.52	12.85	0.30		
6	Hyperoplus lanceolatus					
7	Lampetra fluviatilis					
8	Liparis liparis					
9	Merlangius merlangus					
10	Myoxocephalus scorpius					
11	Nerophis ophidion					
12	Pholis gunnellus					
13	Platichthys flesus	0.14	0.56		0.18	0.15
14	Pleuronectes platessa					
15	Pomatoschistus					
16	Pungitius pungitius	0.04	0.12	0.05		
17	Salmo salar					
18	Scophthalmus maximus					
19	Sprattus sprattus	94.77	245.99	93.99	55.80	191.72
20	Trachurus trachurus					

Table 8 (continued): Catch composition per haul

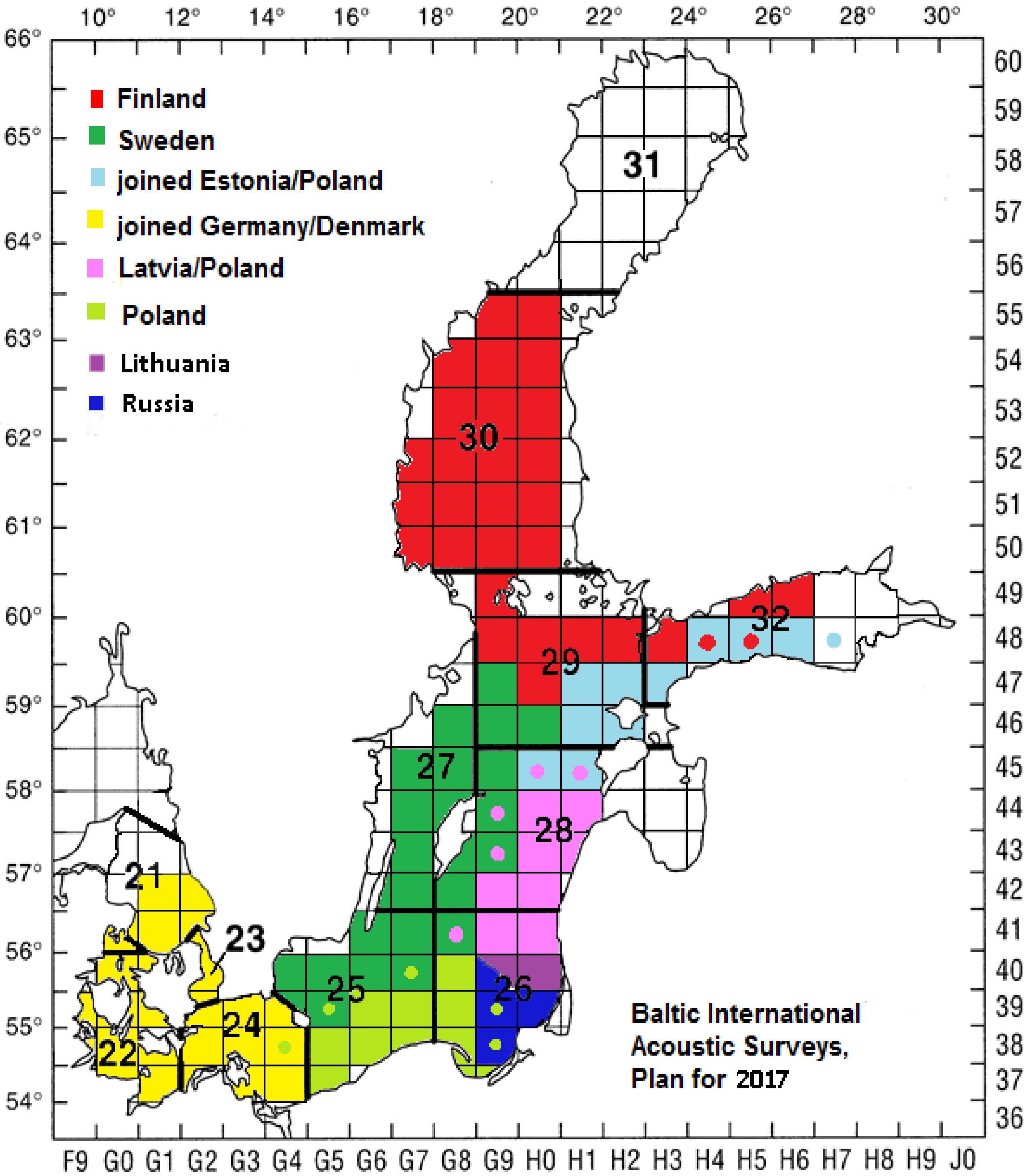

Figure 1: Map over which ICES square are allocated to each country (On axes: longitude, latitude and ICES name of square eg:41G8)

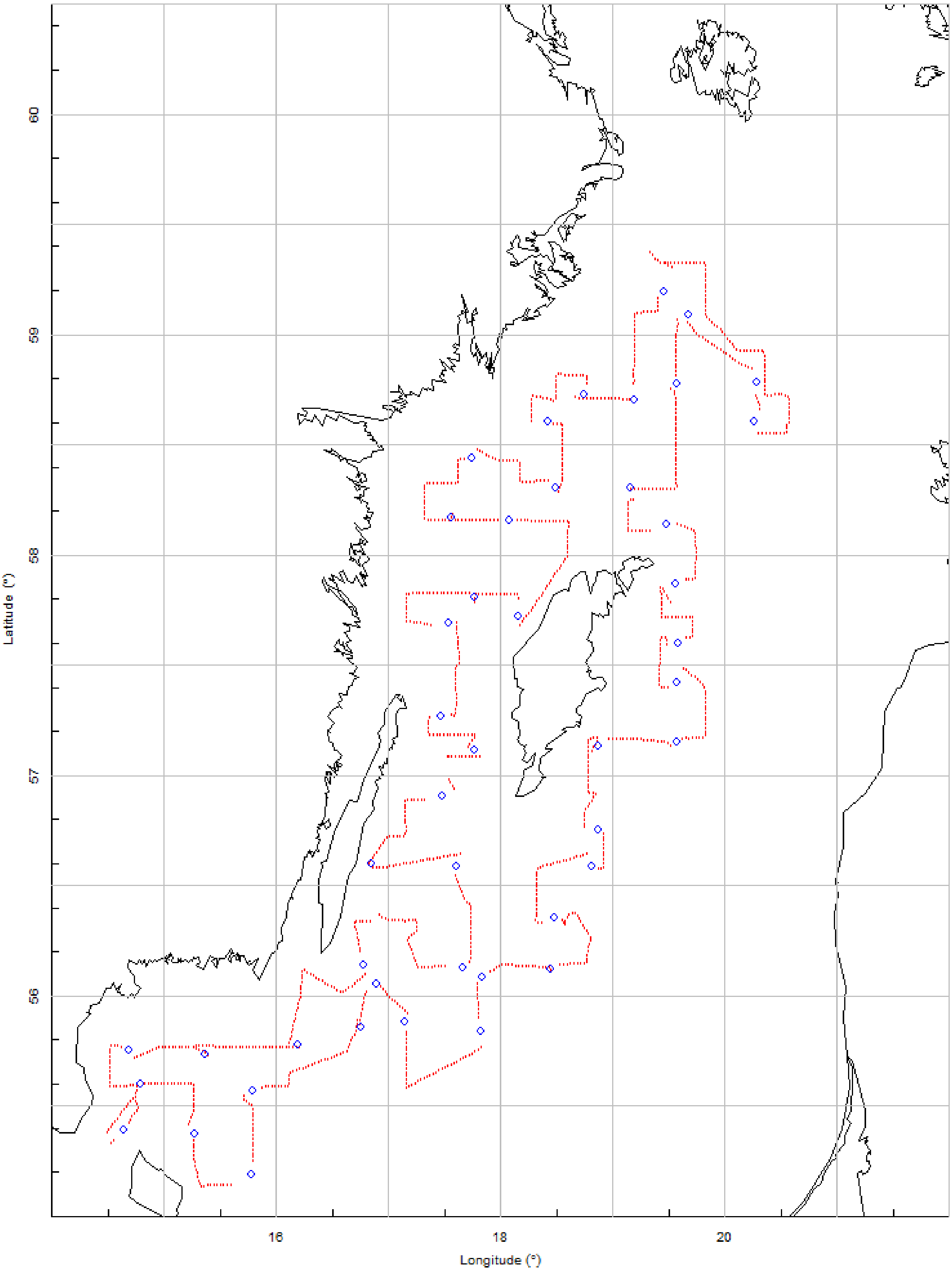

Figure 2: Cruise track(red), positions of trawl hauls (blue) and survey grid (ICES squares)(grey)

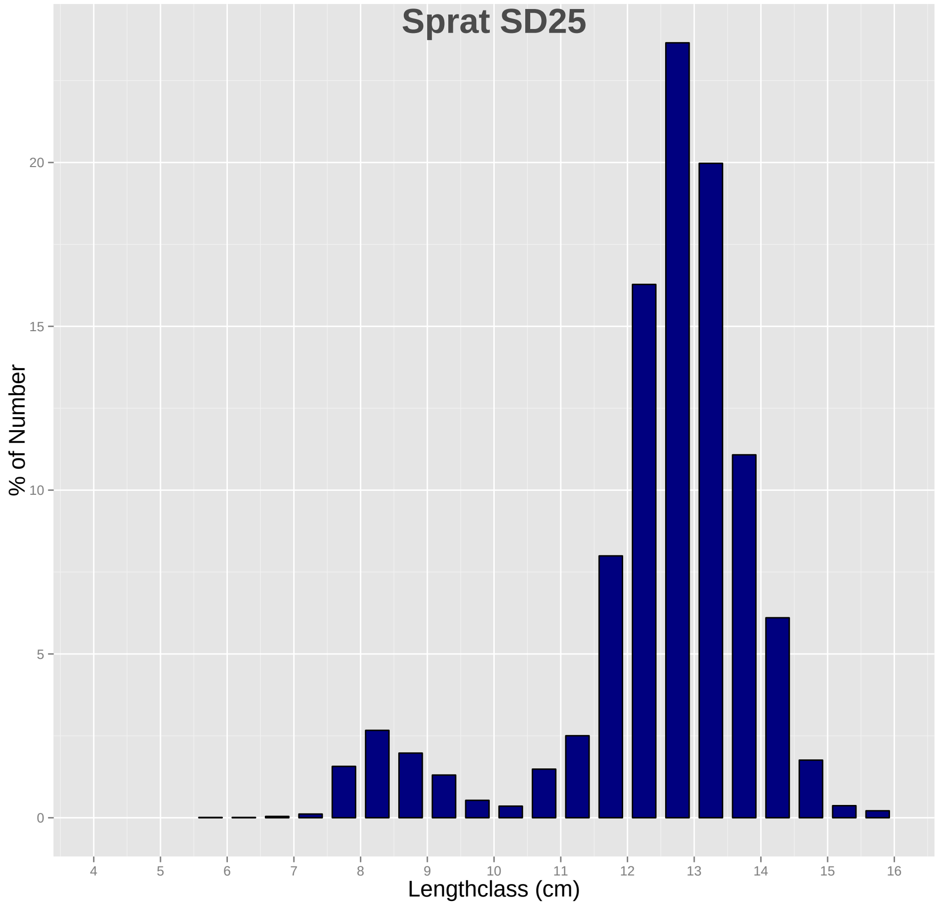

Figure 3: Length distribution of sprat from subdivision 25

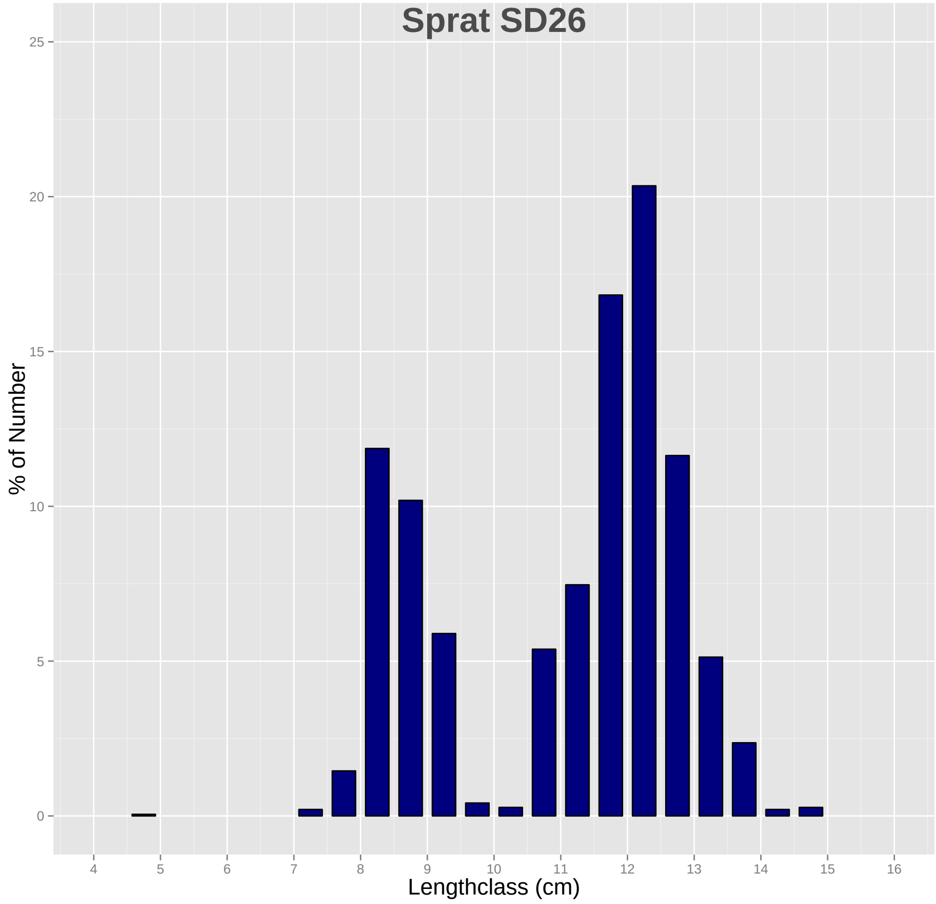

Figure 4: Length distribution of sprat from subdivision 26

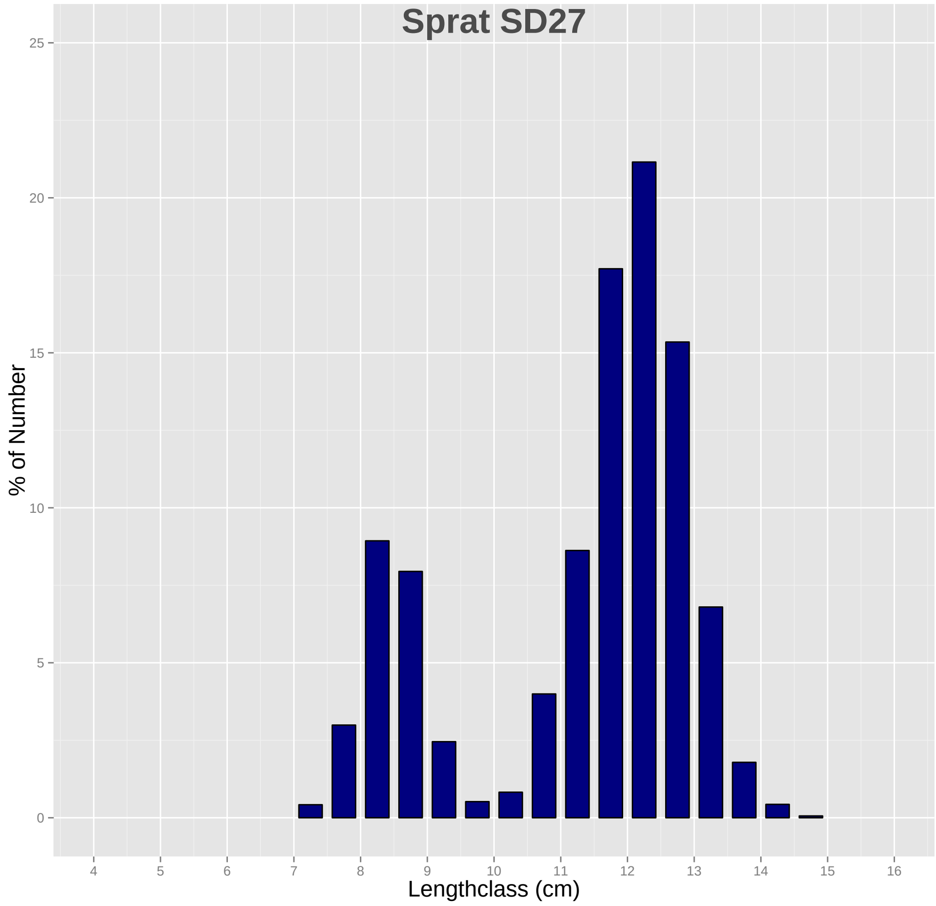

Figure 5: Length distribution of sprat from subdivision 27

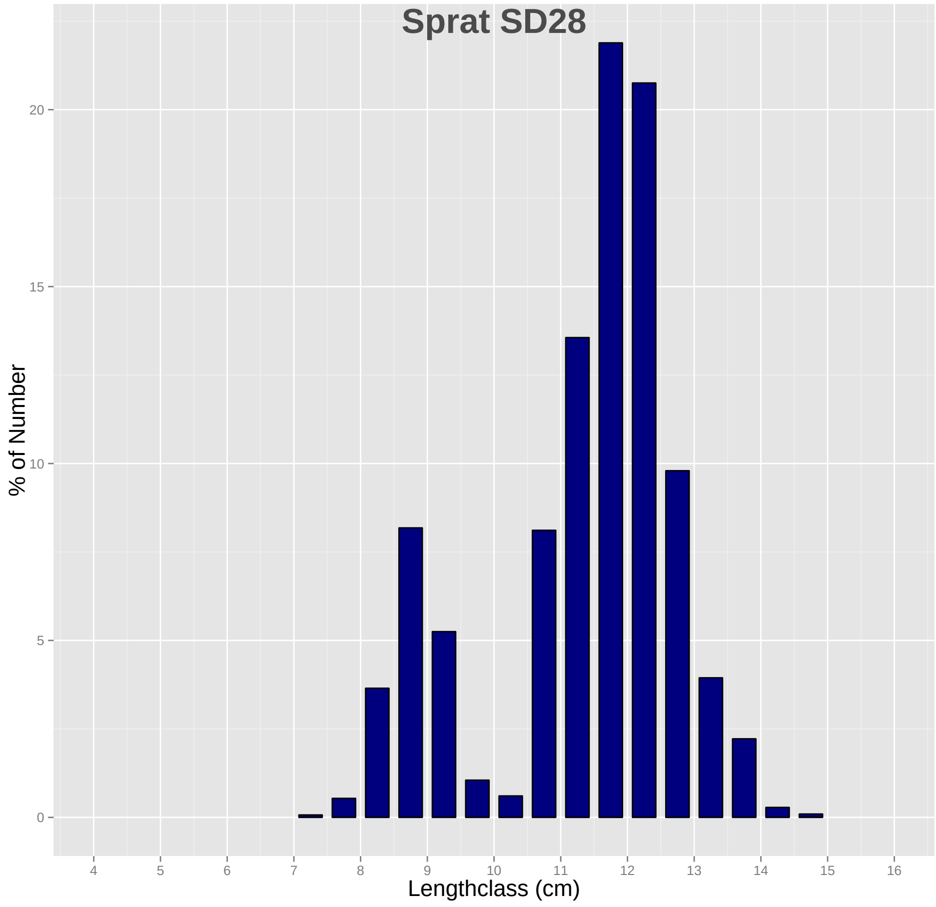

Figure 6: Length distribution of sprat from subdivision 28

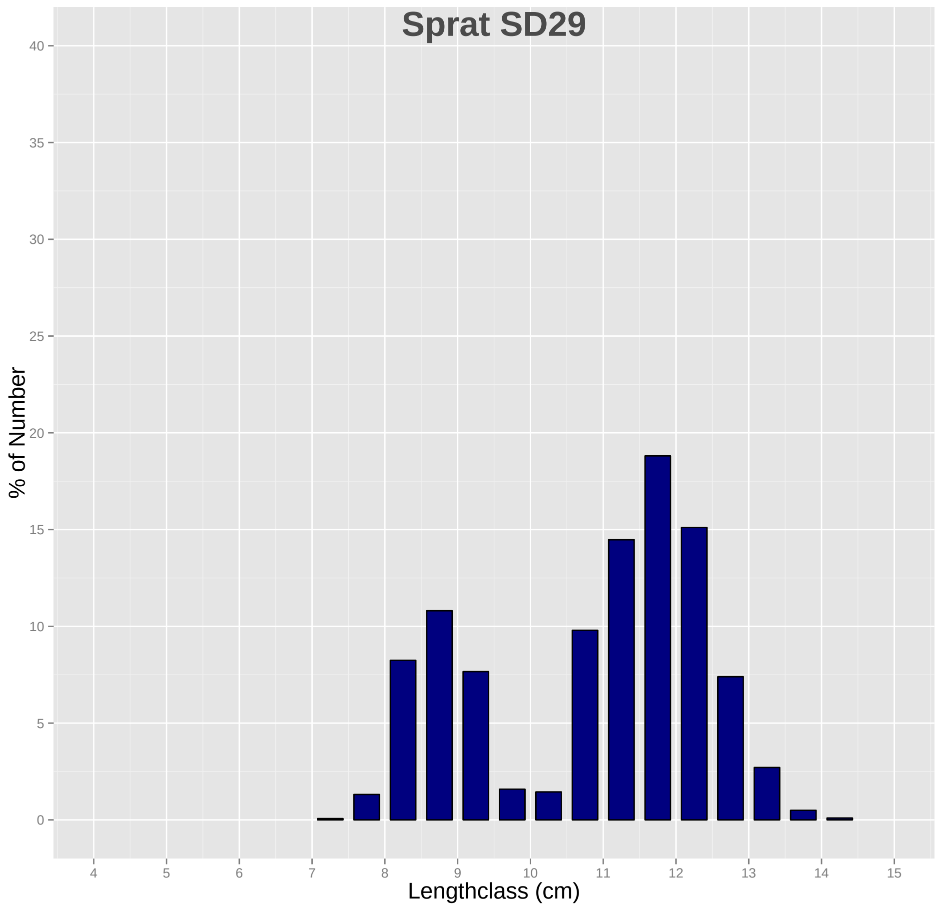

Figure 7: Length distribution of sprat from subdivision 29

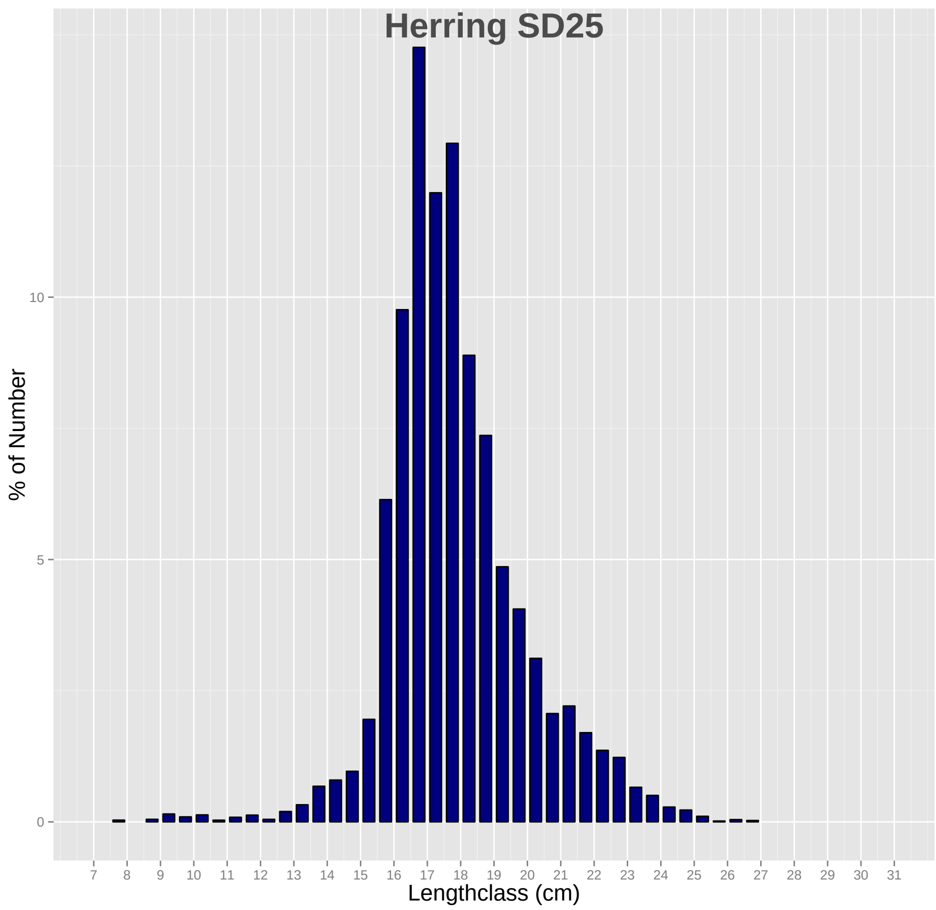

Figure 8: Length distribution of herring from subdivision 25

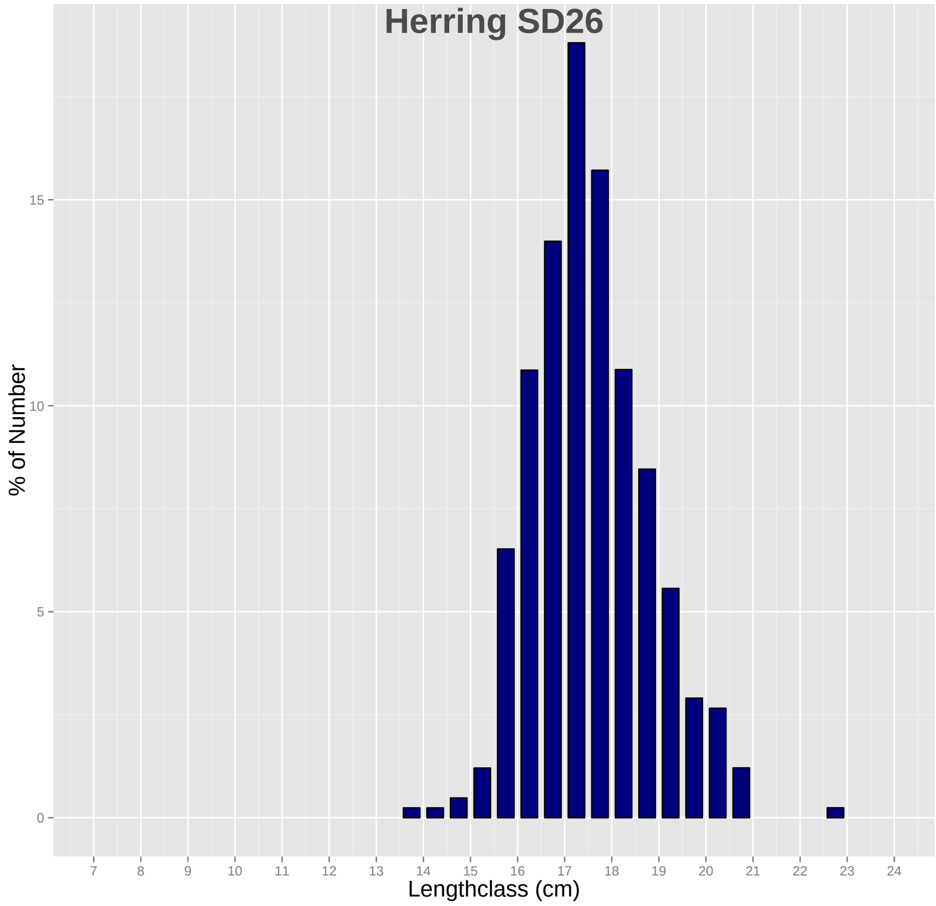

Figure 9: Length distribution of herring from subdivision 26

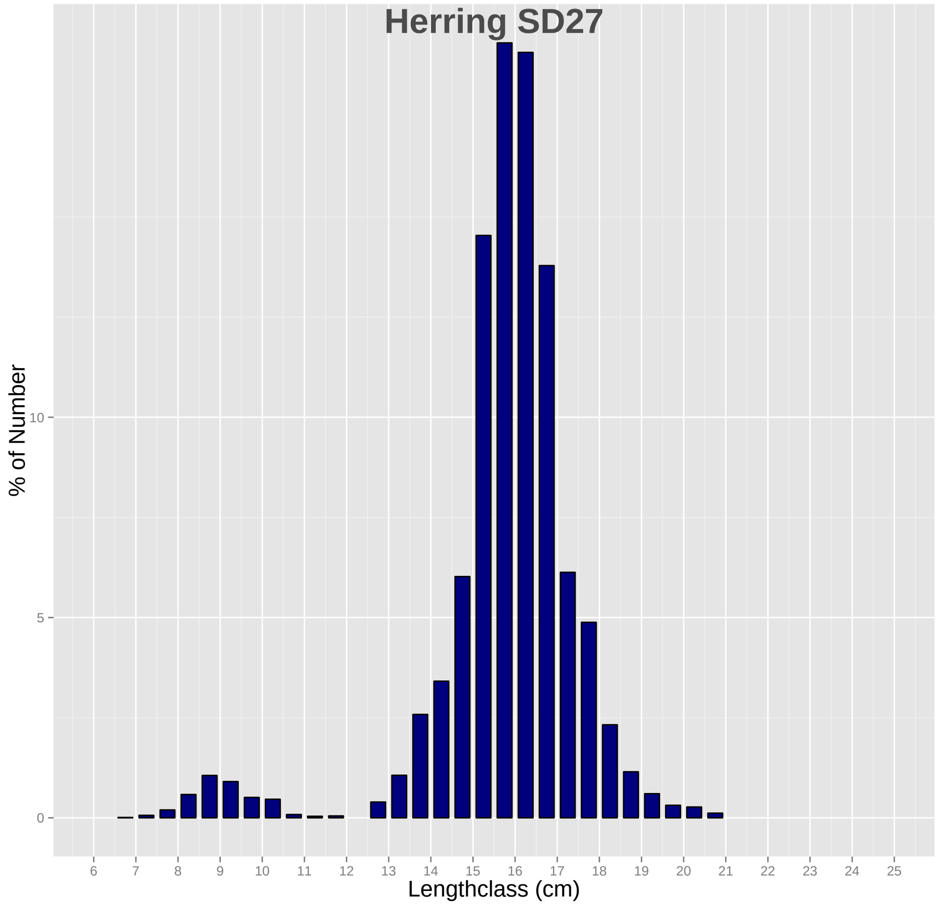

Figure 10: Length distribution of herring from subdivision 27

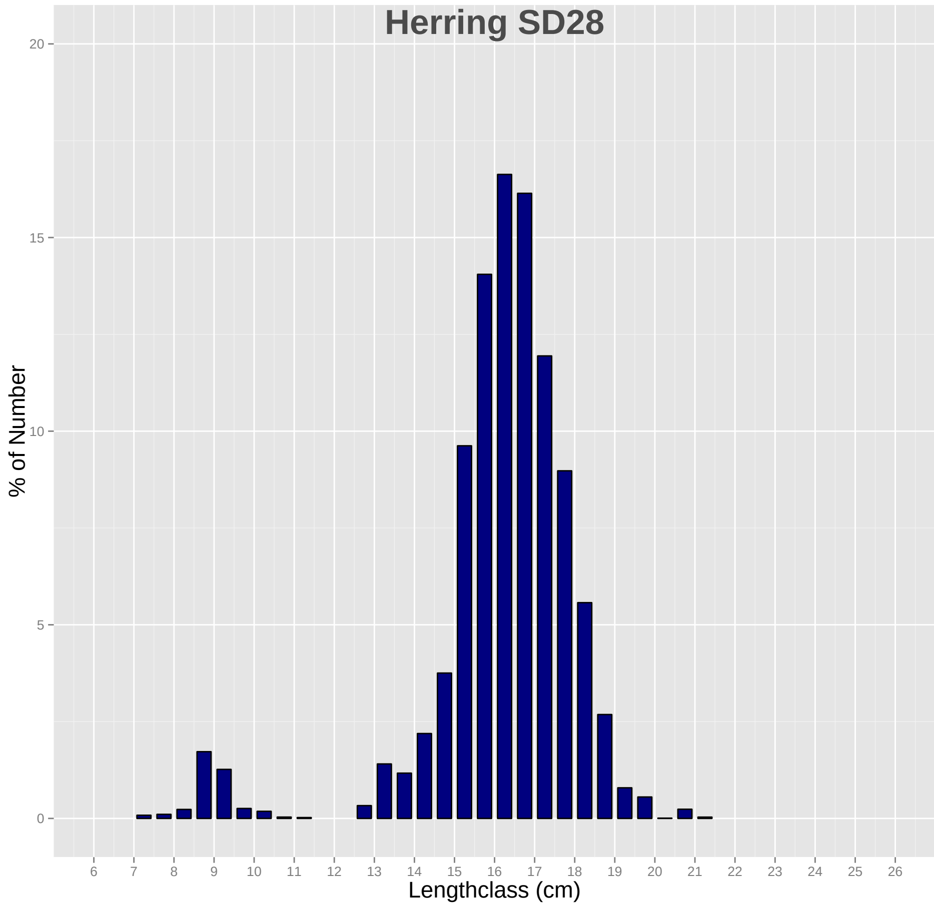

Figure 11: Length distribution of herring from subdivision 28

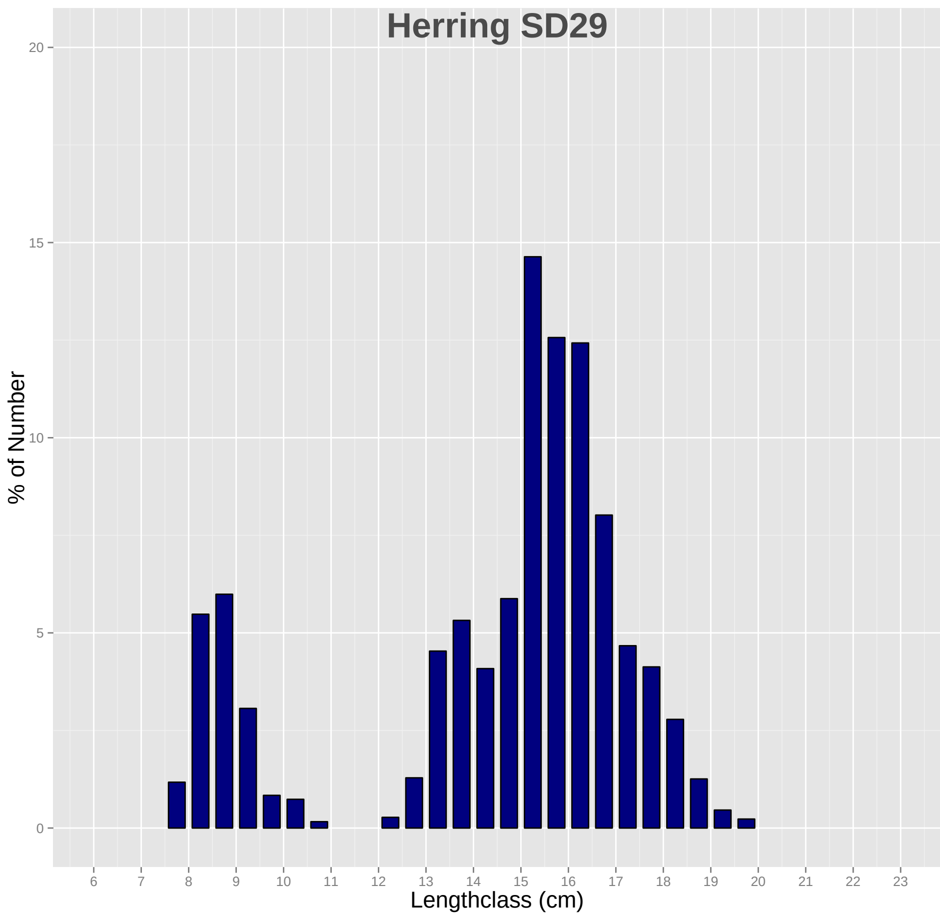

Figure 12: Length distribution of herring from subdivision 29