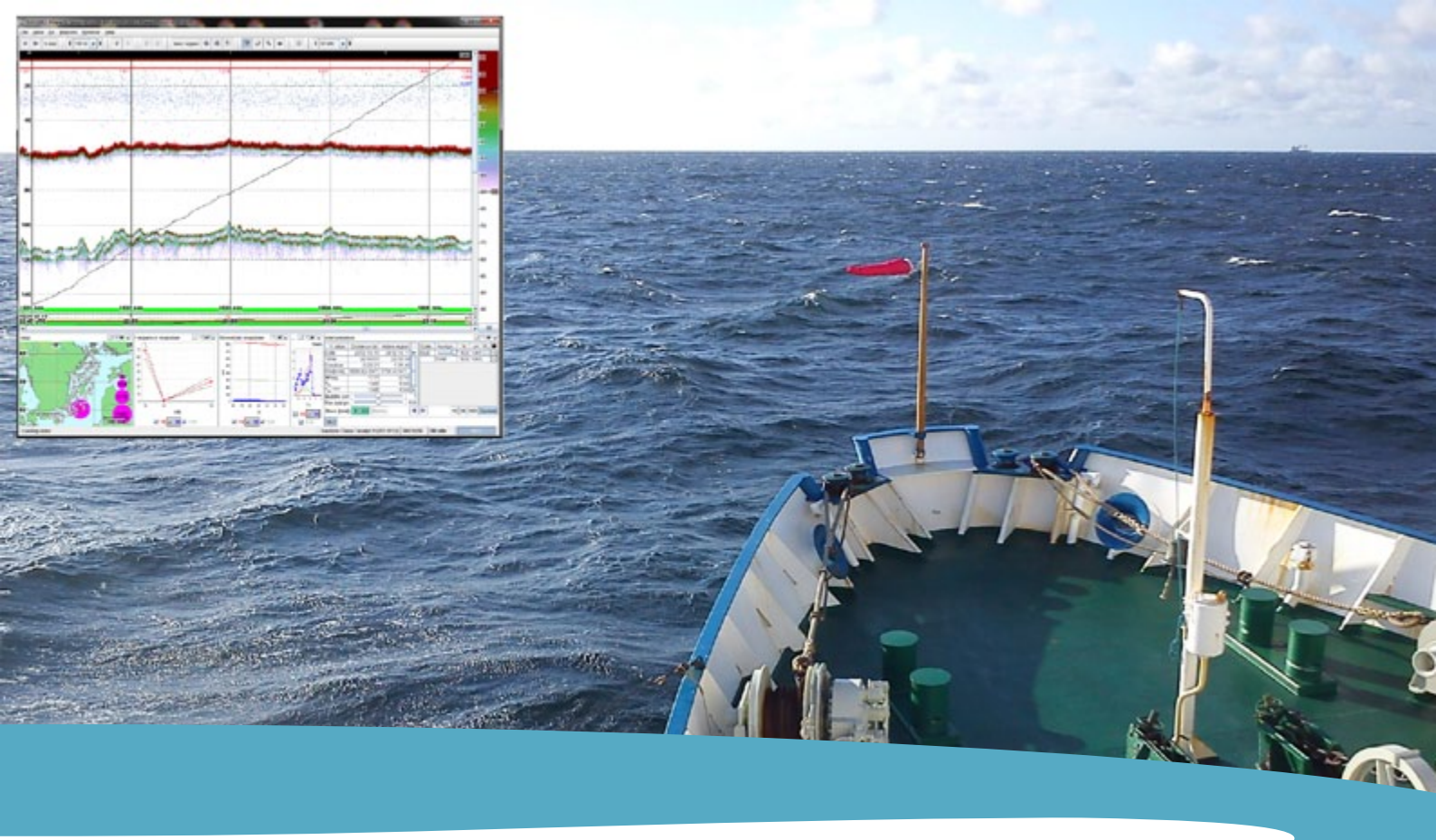

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Baltic International Acoustic Survey report, October 2015

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Baltic International Acoustic Survey report, October 2015

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Baltic International Acoustic Survey Report for R/V Dana

Survey 2015-09-30 - 2015-10-12

Calibration 2015-09-14 - 2015-09-15

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

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 subdivision(SD) 27 och för delar av 25, 26, 28 samt 29. Dessutom har Sverige 2007-2012 tillsammans med Finland täckt SD 30. 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).
I år utfördes kalibrering den 2015-09-14 och 2015-09-15 i Gullmarsfjorden och därefter startade expeditionen den 2015-09-30 och slutade 2015-10-12 i Köpenhamn. Under surveyen samlas akustisk rådata in från ett kalibrerat vetenskapligt ekolod[1] och pelagisk trålning utförs för att få information om art och längfördelning. Den akustiska rådatan efterbehandlas i en mjukvara som 2011 byttes till en nyare programvara, 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 av trålfångsterna.
De deltagande länderna skickar årligen de som är vetenskapligt ansvariga för surveyen och/eller expeditionsledarna, till arbetsgruppen WGBIFS. Där tas gemensamma riktlinjer och manualer fram och resultaten från varje land 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 2015 års svenska BIAS survey bedömdes av WGBIFS vara representativt för mängden sill och skarpsill i Östersjön. Tidigare års resultat samt mer information kring BIAS samt WGBIFS arbete finns i arbetsgruppens årliga rapport[3]

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 DCF web page[4]).
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 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] simrad.com
[2] Marec.no
[3] ICES CM 2014/SSGESST:13
[4] 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 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 2015-09-30 inbetween Sweden and Bornholm at the border between ICES subdivision (SD) 24 and SD 25, and ended 2015-10-12 a few nautical miles east from where it had started. The total cruise covered SD 27 and parts of 25, 26, 28 and 29.

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[5]. 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 21752 square nautical miles and the distance used for acoustic estimates was 1379 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 2015-09-14 and 2015-09-15 according to the BIAS manual.[6] 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[7] 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[8]. The post processing of the stored raw data was made using the software LSSS[9]. 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

[5] ICES CM 2011/SSGESST:05 Addendum 2
[6] See footnote 5
[7] http://www.simrad.com/ek60
[8] See footnote 5
[9] 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

Hilvarsson, Anneli	IMR, Lysekil, Sweden	Fish sampling
Jernberg, Carina	IMR, Lysekil, Sweden	Fish sampling
Larson, Niklas	IMR, Lysekil, Sweden	Scientific & Expedition leader, Acoustics
Lövgren, Olof	IMR, Lysekil, Sweden	Acoustics
Öman, Cristin	IMR, Lysekil, Sweden	Fish sampling
Palmen-Bratt, Anne-Marie	IMR, Lysekil, Sweden	Fish sampling
Sjöberg, Rajlie	IMR, Lysekil, Sweden	Fish sampling
Svenson, Anders	IMR, Lysekil, Sweden	Expedition leader, Acoustics
Tell, Anna-Kerstin	SMHI, Gothenburg	Oceanography

Table 2: Participating scientific crew

4 Results

4.1 Biological data

In total 49 trawl hauls were carried out, 16 in SD 25, 2 in SD 26, 15 in SD 27, 9 in SD 28 and 7 hauls in SD 29. 2609 herrings and 1493 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 [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 should be considered as representative for the abundance of the pelagic species during the BIAS in 2015 for SD25 to 29 and thus can be used in the assessment work done by WGBFAS.

6 References

Bodholt, H. The effect of water temperature and salinity on echo sounder measurments. ICES Symposium on Acoustics in Fisheries, Montpellier June 2002, paper no 123.

Foote, K.G., Aglen, A. and Nakken, O. 1986. Measurement of fish target strength with a split-beam echosounder. J.Acoust.Soc.Am. 80(2):612-621.

Håkansson, N.; Kollberg, S.; Falk, U.; Götze, E., Rechlin, O. 1979. A hydroacoustic and trawl survey of herring and sprat stocks of the Baltic proper in October 1978. Fischerei-Forschung, Wissenschaftliche Schriftenreihe 17(2):7-2

ICES. 2012. Report of the Baltic International Fish Survey Working Group (WGBIFS) March 2012, Helsinki, Finland. ICES CM 2012/SSGESST:02. 531 pp.

ICES. 2012. Report of the Baltic Fisheries Assessment Working Group 2012 (WGBFAS), 12 - 19 April 2012, ICES Headquarters, Copenhagen. ICES CM 2012/ACOM:10. 859 pp.

Misund, O. A., Beltestad, A. K., Castillo, J., Knudsen, H. P., and Skagen, D. 1997. Distribution and acoustic abundance estimation of horse mackerel, and mackerel in the northern North Sea, October 1996. ICES WG on the assessment of anchovy, horse mackerel, mackerel and sardine, Copenhagen, 9/9-18/9, 1997.

Peña, H. 2008. In situ target-strength measurements of Chilean jack mackerel (Trachurus symmetricus murphyi) collected with a scientific echosounder installed on a fishing vessel. - ICES Journal of Marine Science 65: 594-604.

Council Regulation (EC) No 199/2008:
http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2008:060:0001:0012:EN:PDF

Commission DCF web page:
http://datacollection.jrc.ec.europa.eu/dcf-legislation

7 Tables, map and figures

SD	RECT	AREA	SA	SIGMA	NTOT	HHer	HSpr	HCod
25	39G4	287.3	534.4	2.788	550.76	35.55	63.40	0.764
25	39G5	979.0	422.4	1.897	2180.19	14.78	85.16	0.033
25	40G4	677.2	514.3	4.094	850.69	44.03	50.84	4.506
25	40G5	1012.9	931.3	4.036	2337.28	82.92	15.52	1.326
25	40G6	1013.0	565.8	2.748	2085.75	44.16	53.52	0.815
25	40G7	1013.0	278.1	1.417	1988.51	0.85	99.15	0.000
25	41G6	764.4	1328.2	2.138	4747.77	44.98	53.16	0.005
25	41G7	1000.0	1153.0	2.139	5391.20	51.21	34.88	0.010
26	41G8	1000.0	1570.5	1.165	13480.47	18.92	37.13	0.000
27	42G6	266.0	860.2	1.642	1393.48	34.40	40.32	0.000
27	42G7	986.9	1540.6	1.377	11042.91	36.82	10.31	0.000
27	43G7	913.8	2152.6	1.433	13722.74	40.59	9.42	0.000
27	44G7	960.5	498.2	0.904	5292.54	14.57	29.03	0.000
27	44G8	456.6	1145.3	1.480	3532.44	54.38	14.66	0.000
27	45G7	908.7	617.0	0.863	6496.65	15.31	27.06	0.000
27	45G8	947.2	828.7	0.603	13007.36	3.85	23.86	0.000
27	46G8	884.8	936.7	0.773	10727.39	17.02	51.02	0.000
28	42G8	945.4	1419.1	1.472	9113.50	36.16	25.86	0.000
28	43G8	296.2	2774.1	0.845	9720.46	9.36	33.27	0.000
28	43G9	973.7	1143.5	0.988	11267.13	14.60	43.34	0.000
28	44G9	876.6	1382.8	0.686	17665.62	8.45	23.23	0.000
28	45G9	924.5	850.5	0.657	11968.09	8.95	26.65	0.000
29	46G9	933.8	1159.1	0.810	13355.85	3.12	65.53	0.000
29	46H0	933.8	675.7	0.896	7043.15	4.66	71.22	0.000
29	47G9	876.2	1818.0	1.235	12898.74	46.27	30.22	0.000
29	47H0	920.3	2158.6	1.138	17459.83	34.99	55.60	0.000

Table 3: Survey statistics

SD	RECT	NSprTOT	NSpr0	NSpr1	NSpr2	NSpr3	NSpr4	NSpr5	NSpr6	NSpr7	NSpr8
25	39G4	349.19	0.00	94.08	44.76	112.15	70.20	20.08	2.13	0.00	5.79
25	39G5	1856.73	0.00	244.31	136.65	624.46	448.92	64.97	271.82	34.13	31.47
25	40G4	432.53	0.00	58.66	82.59	103.26	99.43	10.30	60.59	0.00	17.69
25	40G5	362.83	0.00	101.97	29.52	93.67	49.29	25.35	16.59	27.82	18.63
25	40G6	1116.24	0.00	218.07	230.31	379.24	156.23	68.44	47.26	16.69	0.00
25	40G7	1971.53	0.00	1066.59	219.39	426.57	203.42	0.00	3.99	47.47	4.11
25	41G6	2523.78	0.00	530.82	232.45	360.74	715.55	429.33	190.24	44.03	20.64
25	41G7	1880.23	25.76	601.67	93.07	454.76	390.95	6.20	216.62	76.45	14.73
26	41G8	5005.53	0.00	3487.54	534.82	215.06	382.38	81.73	172.21	95.80	36.00
27	42G6	561.84	28.61	226.30	85.32	110.29	24.97	13.01	62.95	10.40	0.00
27	42G7	1138.30	7.25	349.30	56.68	306.30	171.85	32.26	88.13	82.45	44.08
28	42G8	2357.01	161.55	1155.90	308.49	421.78	98.84	0.00	188.82	10.82	10.82
27	43G7	1292.48	11.00	439.57	107.33	286.86	48.24	26.68	132.81	239.98	0.00
28	43G8	3233.78	176.64	2146.80	323.38	402.18	130.44	27.17	27.17	0.00	0.00
28	43G9	4882.72	219.17	2775.20	374.48	825.88	435.69	33.58	43.71	114.98	60.04
27	44G7	1536.35	24.25	553.03	332.29	384.04	146.20	0.00	26.55	69.99	0.00
27	44G8	517.71	11.59	187.77	103.16	93.88	76.50	0.00	6.95	37.86	0.00
28	44G9	4104.23	537.75	1570.65	539.36	800.85	108.14	24.80	126.97	204.79	190.92
27	45G7	1757.94	31.12	1225.20	71.74	108.17	143.42	60.32	52.46	20.34	45.17
27	45G8	3103.15	118.19	2077.49	282.65	326.83	111.92	11.13	39.42	109.78	25.73
28	45G9	3189.37	1073.99	1453.10	172.57	310.65	52.49	6.02	95.60	0.00	24.95
27	46G8	5473.26	3454.07	1849.27	31.61	79.24	54.21	0.00	0.00	4.86	0.00
29	46G9	8752.25	435.78	7188.48	114.24	453.73	421.35	0.00	120.07	18.61	0.00
29	46H0	5016.44	186.33	3852.19	246.81	328.33	169.97	76.82	123.41	32.59	0.00
29	47G9	3897.88	1228.10	2531.00	9.35	93.62	0.00	13.23	0.00	0.00	22.58
29	47H0	9707.56	2619.50	5290.36	503.35	832.08	154.09	51.36	0.00	51.36	205.45

Table 4: Estimated number (millions) of sprat

SD	RECT	WSpr0	WSpr1	WSpr2	WSpr3	WSpr4	WSpr5	WSpr6	WSpr7	WSpr8
25	39G4		11.42	14.33	15.09	16.60	16.00	19.00		16.00
25	39G5		9.86	11.00	14.22	14.25	17.00	15.20	21.00	16.00
25	40G4		11.56	12.29	15.75	18.62	19.00	16.20		15.00
25	40G5		12.17	15.00	14.00	16.86	17.50	18.00	16.00	17.00
25	40G6		10.40	12.00	13.67	16.75	16.00	18.14	17.00	
25	40G7		9.16	13.00	13.60	13.60		17.00	15.67	13.00
25	41G6		7.44	11.60	11.00	13.20	16.12	14.60	17.50	18.00
25	41G7	2.00	7.65	10.00	11.12	13.11	16.00	15.30	13.00	15.00
26	41G8		6.96	11.00	11.50	12.62	11.00	13.00	15.00	13.50
27	42G6	2.14	7.86	10.33	11.44	12.50	14.50	14.38	11.00	
27	42G7	2.00	7.33	8.75	12.11	11.60	15.50	14.00	15.50	15.50
28	42G8	2.60	6.42	9.50	10.78	12.25		12.29	12.00	13.00
27	43G7	2.00	7.13	11.00	10.71	12.50	14.67	13.40	12.88	
28	43G8	2.30	6.27	9.43	11.09	12.00	10.00	13.00		
28	43G9	2.53	6.65	9.50	10.70	11.50	13.00	15.00	12.50	12.00
27	44G7	2.00	6.32	10.00	11.12	12.20		12.75	12.83	
27	44G8	2.00	6.74	9.67	11.57	11.17		14.00	11.20	
28	44G9	2.27	6.22	9.33	10.89	12.00	13.50	13.17	11.67	10.00
27	45G7	2.50	6.03	9.33	11.50	11.88	11.67	12.83	14.00	12.00
27	45G8	2.27	5.95	9.86	9.91	11.25	13.00	13.00	11.33	10.00
28	45G9	2.20	6.48	10.00	11.08	11.00	14.00	11.00		8.00
27	46G8	2.20	5.59	9.33	9.44	10.80			12.00	
29	46G9	2.08	6.46	10.00	10.20	10.33		12.33	13.00	
29	46H0	2.07	5.83	8.75	10.43	11.14	10.50	11.00	11.50	
29	47G9	2.14	6.00	10.00	10.11		11.00			10.00
29	47H0	2.05	5.94	8.80	9.70	11.50	13.00		11.00	9.50

Table 5: Estimated mean weights (g) of sprat

SD	RECT	NHerTOT	NHer0	NHer1	NHer2	NHer3	NHer4	NHer5	NHer6	NHer7	NHer8
25	39G4	195.82	6.15	4.75	38.60	65.89	50.17	11.39	13.91	3.47	1.49
25	39G5	322.16	53.97	12.28	24.15	43.39	85.75	27.41	46.04	13.79	15.38
25	40G4	374.52	8.26	5.93	30.35	116.45	53.83	34.40	35.96	58.79	30.55
25	40G5	1938.18	20.86	54.04	405.83	575.94	299.76	160.44	264.65	151.48	5.19
25	40G6	921.15	5.53	82.15	16.96	216.44	251.83	55.12	180.48	75.48	37.15
25	40G7	16.98	0.23	1.70	4.18	4.48	3.47	1.01	0.82	0.85	0.23
25	41G6	2135.58	69.95	293.01	308.11	582.59	665.53	52.37	74.19	71.38	18.44
25	41G7	2761.09	0.00	68.33	344.45	942.09	715.42	330.02	143.67	166.06	51.04
26	41G8	2550.34	1.26	142.31	142.21	522.69	626.59	253.92	311.66	495.73	53.97
27	42G6	479.42	0.00	29.06	26.47	92.98	174.66	77.80	31.96	43.26	3.23
27	42G7	4066.12	0.00	294.43	828.24	1195.22	797.66	318.55	356.78	216.62	58.61
28	42G8	3295.69	10.85	224.69	164.68	1269.31	1023.56	476.94	37.13	84.16	4.37
27	43G7	5570.53	0.00	636.95	418.99	887.73	2158.43	541.59	680.30	171.72	74.82
28	43G8	910.28	0.00	67.04	16.94	184.17	434.67	89.62	82.56	35.28	0.00
28	43G9	1644.98	0.00	739.42	44.23	340.80	313.18	102.57	43.90	45.09	15.79
27	44G7	771.13	2.02	199.59	196.01	158.70	114.71	58.40	23.77	14.11	3.81
27	44G8	1920.96	5.11	353.54	705.03	197.20	392.37	217.64	39.85	10.22	0.00
28	44G9	1492.88	0.00	609.55	177.70	155.99	320.17	127.09	73.84	24.05	4.48
27	45G7	994.39	0.34	225.77	221.11	224.49	173.91	81.56	46.00	12.16	9.05
27	45G8	500.69	9.82	79.01	80.06	92.26	117.30	61.94	31.30	25.70	3.29
28	45G9	1071.64	3.45	294.87	151.18	174.07	313.76	95.75	30.69	1.46	6.41
27	46G8	1825.81	414.99	291.73	234.40	174.33	324.68	224.02	101.45	47.32	12.89
29	46G9	416.81	264.76	102.08	21.18	9.68	14.87	1.04	1.08	1.58	0.54
29	46H0	328.05	82.01	188.81	6.94	7.23	30.38	7.75	4.36	0.00	0.56
29	47G9	5968.38	269.88	2685.56	491.01	1242.69	606.25	494.38	75.82	49.28	53.51
29	47H0	6108.78	140.30	4292.40	654.08	461.94	449.68	20.44	69.50	20.44	0.00

Table 6: Estimated number (millions) of herring

SD	RECT	WHer0	WHer1	WHer2	WHer3	WHer4	WHer5	WHer6	WHer7	WHer8
25	39G4	11.43	25.00	43.80	57.40	77.03	92.77	104.00	69.00	29.00
25	39G5	10.27	19.67	27.78	31.88	37.50	47.50	48.62	53.20	47.40
25	40G4	10.50	30.67	35.00	51.25	59.85	75.22	53.50	53.69	58.14
25	40G5	13.00	29.00	49.22	48.89	68.71	60.22	52.08	53.20	93.00
25	40G6	12.00	26.73	18.89	45.08	49.30	51.00	48.43	45.20	71.25
25	40G7	12.00	21.17	26.86	28.07	33.54	36.75	39.50	34.00	91.00
25	41G6	11.50	15.58	35.00	30.40	37.60	42.75	51.83	48.71	53.00
25	41G7		12.87	20.29	25.87	36.71	38.67	47.00	49.33	52.40
26	41G8	3.00	12.46	20.00	22.12	26.46	31.00	42.45	40.32	48.50
27	42G6		12.67	17.33	24.87	31.57	33.80	43.62	43.33	52.00
27	42G7		12.37	20.06	26.16	30.67	35.17	43.92	48.78	41.50
28	42G8	11.00	11.23	16.33	28.04	30.59	40.29	34.00	46.75	58.00
27	43G7		12.36	17.30	21.64	32.50	30.67	35.25	30.00	47.67
28	43G8		11.79	20.50	21.93	29.67	30.43	40.67	43.25	
28	43G9		11.79	17.67	21.94	26.47	36.36	34.20	37.00	32.50
27	44G7	4.50	10.40	17.31	22.57	26.54	26.88	37.17	33.67	36.00
27	44G8	2.00	10.52	16.55	24.29	25.50	22.43	28.80	34.50	
28	44G9		11.17	18.44	24.67	25.94	28.89	32.71	30.00	42.00
27	45G7	3.67	10.52	19.00	25.71	28.69	30.70	30.29	52.75	32.00
27	45G8	2.50	10.86	16.17	19.80	24.88	28.75	30.33	28.50	45.50
28	45G9	3.00	11.30	16.50	25.47	26.18	34.10	37.00	46.00	37.75
27	46G8	2.19	10.50	18.69	20.44	28.35	27.83	26.33	45.60	46.00
29	46G9	2.52	10.67	18.62	19.67	23.67	18.00	41.00	30.00	32.00
29	46H0	2.43	11.03	14.67	19.25	20.37	24.12	25.60		30.00
29	47G9	2.41	9.91	16.73	22.68	31.44	30.85	38.25	30.00	42.67
29	47H0	2.27	10.03	15.69	22.89	21.50	19.00	20.50	23.00	

Table 7: Estimated mean weights (g) of herring

	Species	2	4	6	8	10	12	14	16
1	Ammodytes	0.00							
2	Ammodytidae								
3	Clupea harengus	67.27	179.61	44.98	178.69	170.69	314.93	83.15	290.04
4	Cyclopterus lumpus	0.44		0.67	0.83	0.48			
5	Gadus morhua	12.18	112.84		20.66	6.06	0.56		
6	Gasterosteus aculeatus				0.00	0.00	0.07	0.51	13.36
7	Hyperoplus lanceolatus								
8	Limanda limanda		0.10						
9	Merlangius merlangus	0.31	9.56		0.37	0.14			
10	Myoxocephalus scorpius								0.06
11	Nerophis ophidion								
12	Platichthys flesus		0.58			0.09			
13	Pleuronectes platessa	0.26	0.52						
14	Pomatoschistus	0.00	0.00						
15	Pungitius pungitius								0.06
16	Salmo salar								
17	Sprattus sprattus	10.09	64.80	109.83	3.90	21.81	118.28	51.45	113.93
18	Syngnathus typhle								

Table 8: Catch composition per haul.

	Species	18	20	22	24	26	28	30	32
1	Ammodytes								
2	Ammodytidae								
3	Clupea harengus	0.07	688.41	101.19	397.90	10.46	0.19	477.73	471.87
4	Cyclopterus lumpus	0.40	0.31		0.01	0.37		0.32	0.04
5	Gadus morhua								
6	Gasterosteus aculeatus	40.90	8.77	14.65	14.50	17.45	30.60	50.93	24.01
7	Hyperoplus lanceolatus		0.29						
8	Limanda limanda								
9	Merlangius merlangus								
10	Myoxocephalus scorpius								
11	Nerophis ophidion					0.01	0.00	0.00	
12	Platichthys flesus								
13	Pleuronectes platessa								
14	Pomatoschistus								
15	Pungitius pungitius	0.00	0.03		0.02	0.07	0.03	0.03	0.02
16	Salmo salar								
17	Sprattus sprattus	21.70	46.11	30.77	42.00	252.21	5.80	70.92	62.67
18	Syngnathus typhle								

Table 8 (continued): Catch composition per haul

	Species	34	36	38	40	42	44	46	48
1	Ammodytes								
2	Ammodytidae								
3	Clupea harengus	39.60	122.56	1.14	0.23	104.72	84.16	4.90	8.96
4	Cyclopterus lumpus	0.40		0.17	0.09	0.07			
5	Gadus morhua								
6	Gasterosteus aculeatus	29.34	7.76	45.28	75.08	20.23	9.42	48.63	15.06
7	Hyperoplus lanceolatus	0.08				0.17			
8	Limanda limanda								
9	Merlangius merlangus								
10	Myoxocephalus scorpius								
11	Nerophis ophidion			0.00				0.06	0.00
12	Platichthys flesus						0.17		
13	Pleuronectes platessa								
14	Pomatoschistus								
15	Pungitius pungitius	0.04	0.02	0.04	0.06	0.11	0.04	0.06	0.02
16	Salmo salar								0.33
17	Sprattus sprattus	38.96	66.15	23.16	136.47	49.99	99.75	768.39	88.60
18	Syngnathus typhle					0.00			

Table 8 (continued): Catch composition per haul

	Species	50	52	54	56	58	60	62	64
1	Ammodytes								
2	Ammodytidae								
3	Clupea harengus	212.96	88.97	262.15	6.10	19.52	44.42	124.37	115.85
4	Cyclopterus lumpus	0.05		0.18	0.38		0.10	0.10	0.17
5	Gadus morhua								
6	Gasterosteus aculeatus	25.40	1.47	7.62	7.33	10.39	31.00	52.91	45.65
7	Hyperoplus lanceolatus								0.01
8	Limanda limanda								
9	Merlangius merlangus								
10	Myoxocephalus scorpius								
11	Nerophis ophidion			0.03		0.00			
12	Platichthys flesus								0.30
13	Pleuronectes platessa								
14	Pomatoschistus								
15	Pungitius pungitius		0.01	0.03	0.01	0.12	0.15	0.12	0.11
16	Salmo salar								
17	Sprattus sprattus	124.83	5.66	194.98	118.60	132.85	46.11	99.28	50.11
18	Syngnathus typhle								

Table 8 (continued): Catch composition per haul

	Species	66	68	70	72	74	76	78	80
1	Ammodytes								
2	Ammodytidae								
3	Clupea harengus	41.13	99.79	234.00	319.30	873.00	130.19	49.83	255.32
4	Cyclopterus lumpus	0.19	0.22	0.17	0.75	0.40	0.36	2.12	1.61
5	Gadus morhua								
6	Gasterosteus aculeatus	64.10	30.18	47.27	111.67	28.59	32.42	22.26	25.43
7	Hyperoplus lanceolatus			0.01					
8	Limanda limanda								
9	Merlangius merlangus								
10	Myoxocephalus scorpius								
11	Nerophis ophidion								
12	Platichthys flesus								
13	Pleuronectes platessa								
14	Pomatoschistus								
15	Pungitius pungitius	0.01	0.04	0.04	0.26	0.17	0.10		
16	Salmo salar							0.26	3.72
17	Sprattus sprattus	174.03	233.24	180.27	315.81	50.27	142.00	116.04	57.16
18	Syngnathus typhle								

Table 8 (continued): Catch composition per haul

	Species	82	84	86	88	90	92	94	96
1	Ammodytes								
2	Ammodytidae					0.01			
3	Clupea harengus	435.32	243.36	0.21	9.06	76.13	235.06	129.56	33.67
4	Cyclopterus lumpus						0.38	0.77	0.25
5	Gadus morhua	0.23				27.50	22.00	0.90	
6	Gasterosteus aculeatus	11.13	0.86			0.38	0.01		
7	Hyperoplus lanceolatus								
8	Limanda limanda								
9	Merlangius merlangus								
10	Myoxocephalus scorpius								
11	Nerophis ophidion								
12	Platichthys flesus					0.20			
13	Pleuronectes platessa								
14	Pomatoschistus		0.01						
15	Pungitius pungitius	0.01							
16	Salmo salar								
17	Sprattus sprattus	26.59	145.62	323.33	188.32	180.54	13.54	45.79	139.96
18	Syngnathus typhle								

Table 8 (continued): Catch composition per haul

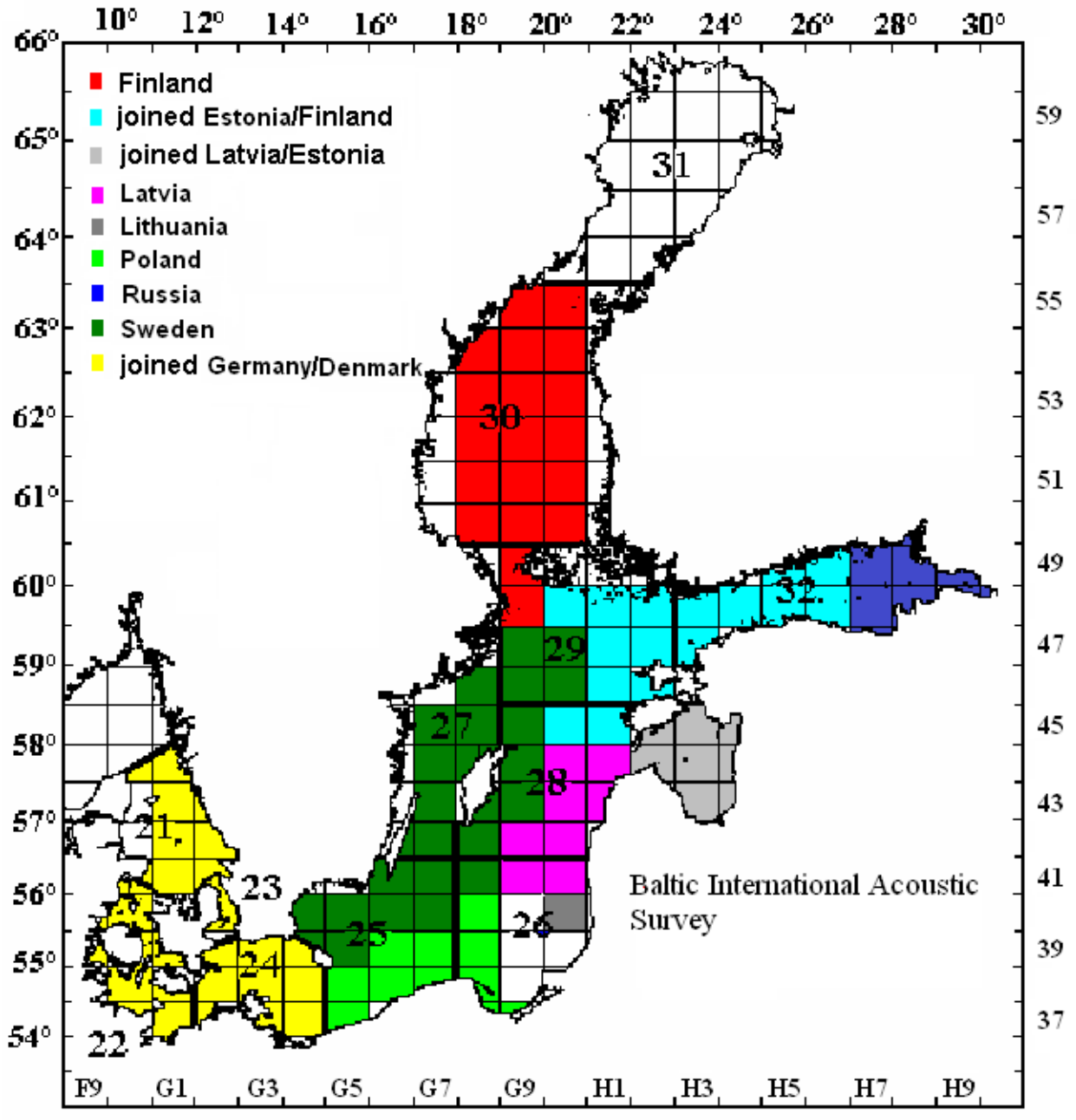

Figure 1: Map over which ICES square are allocated to each country (On axes: longitude, latitude and ICES name of square eg:41G8)

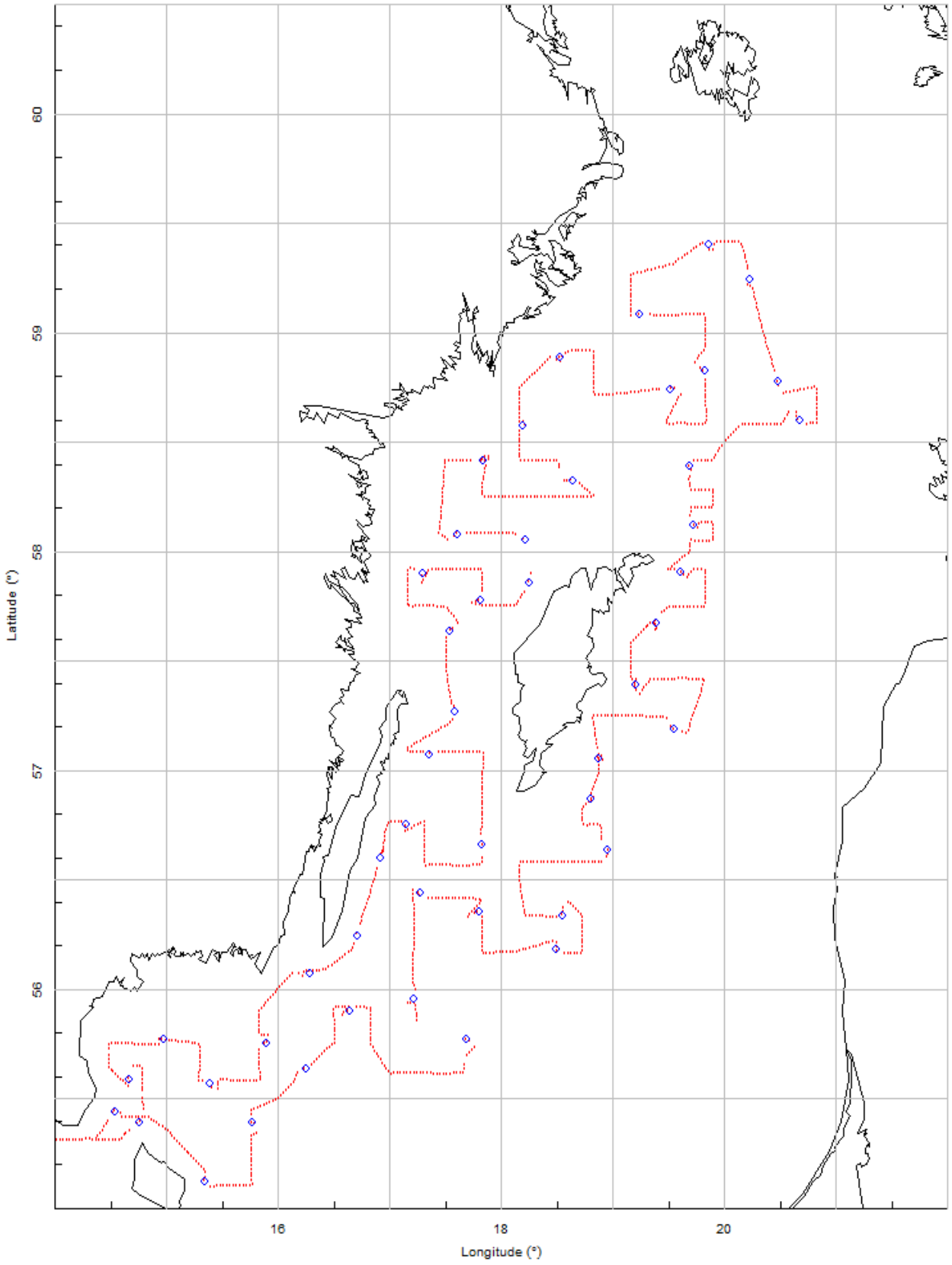

Figure 2: cruise track(red), positions of trawl hauls (blue) and survey grid (ICES squares)(grey)

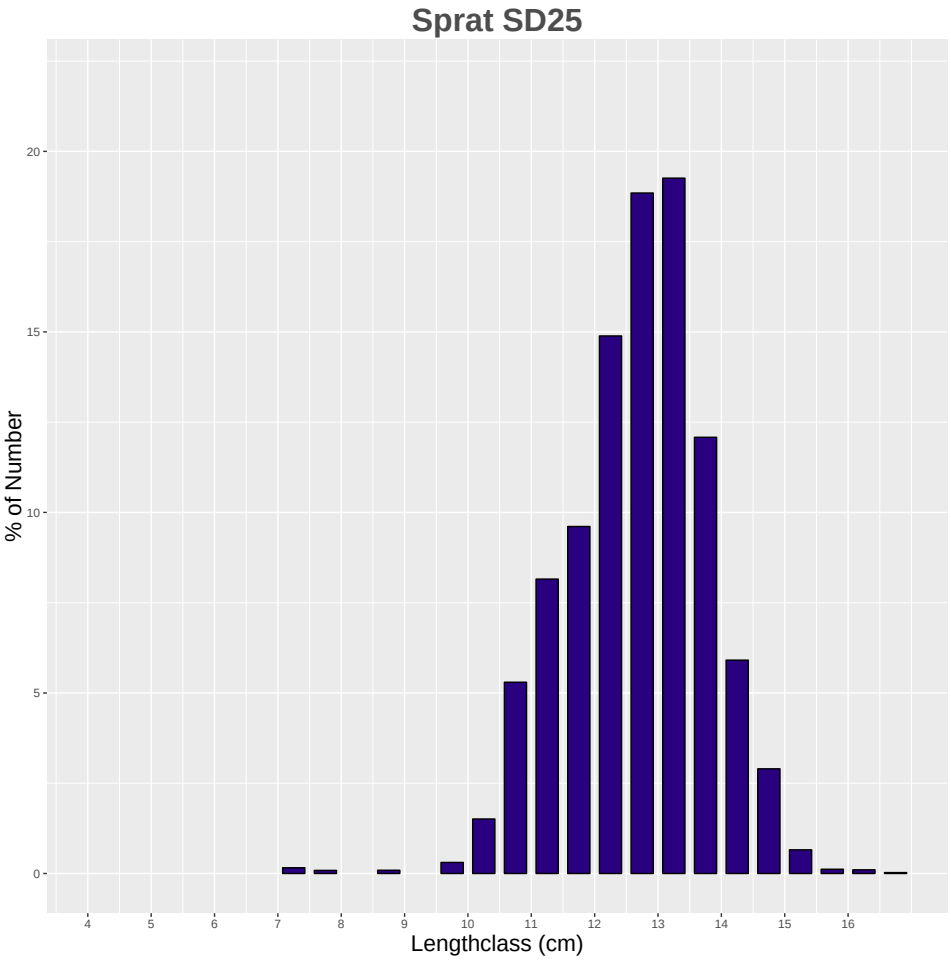

Figure 3: Length distribution of sprat from subdivision 25

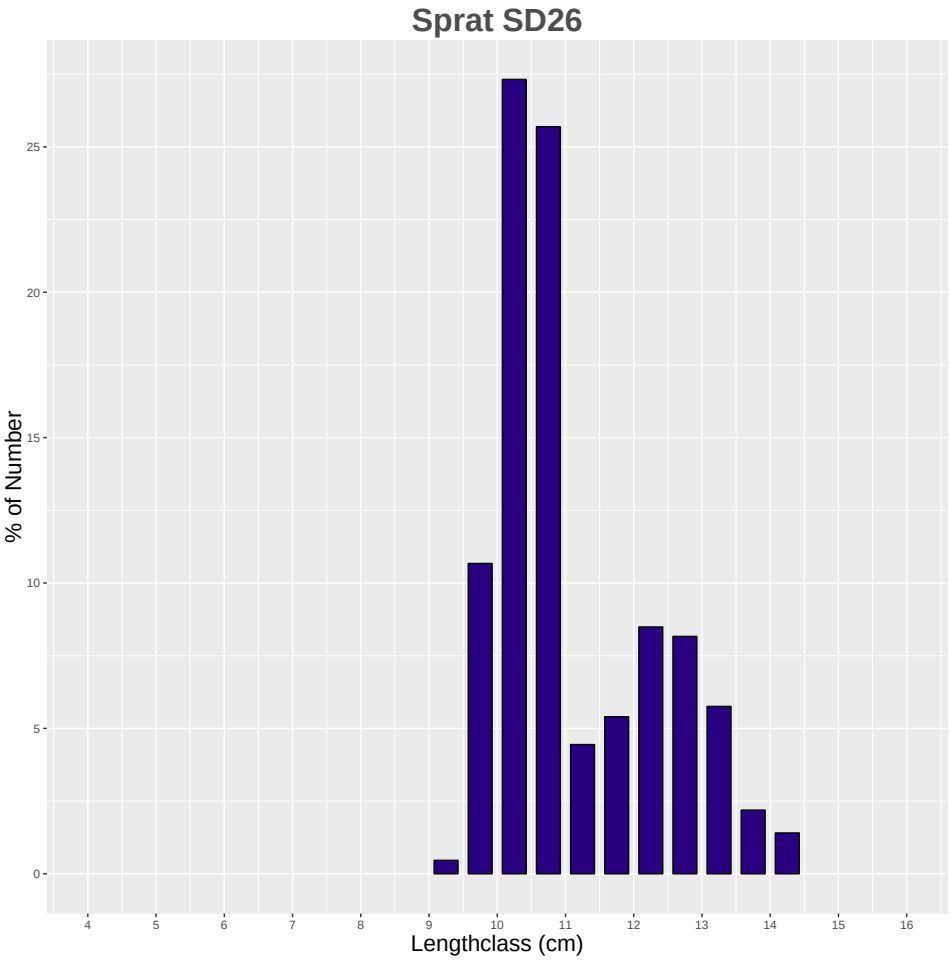

Figure 4: Length distribution of sprat from subdivision 26

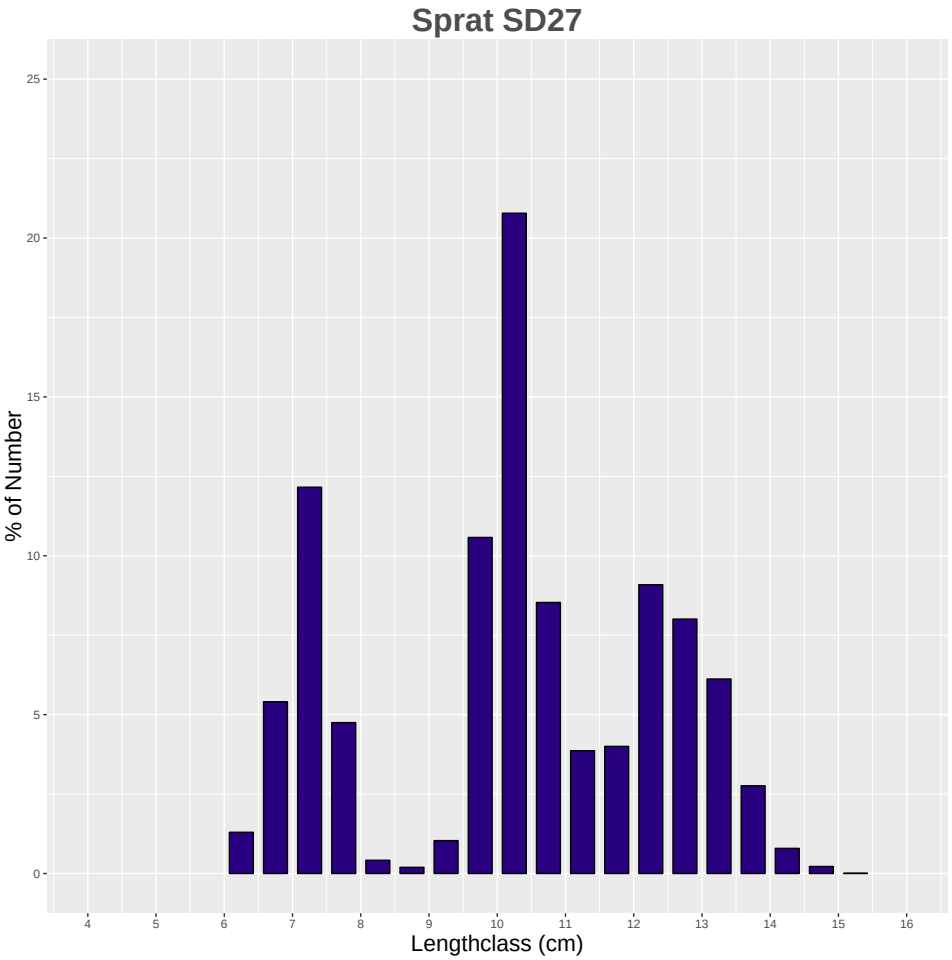

Figure 5: Length distribution of sprat from subdivision 27

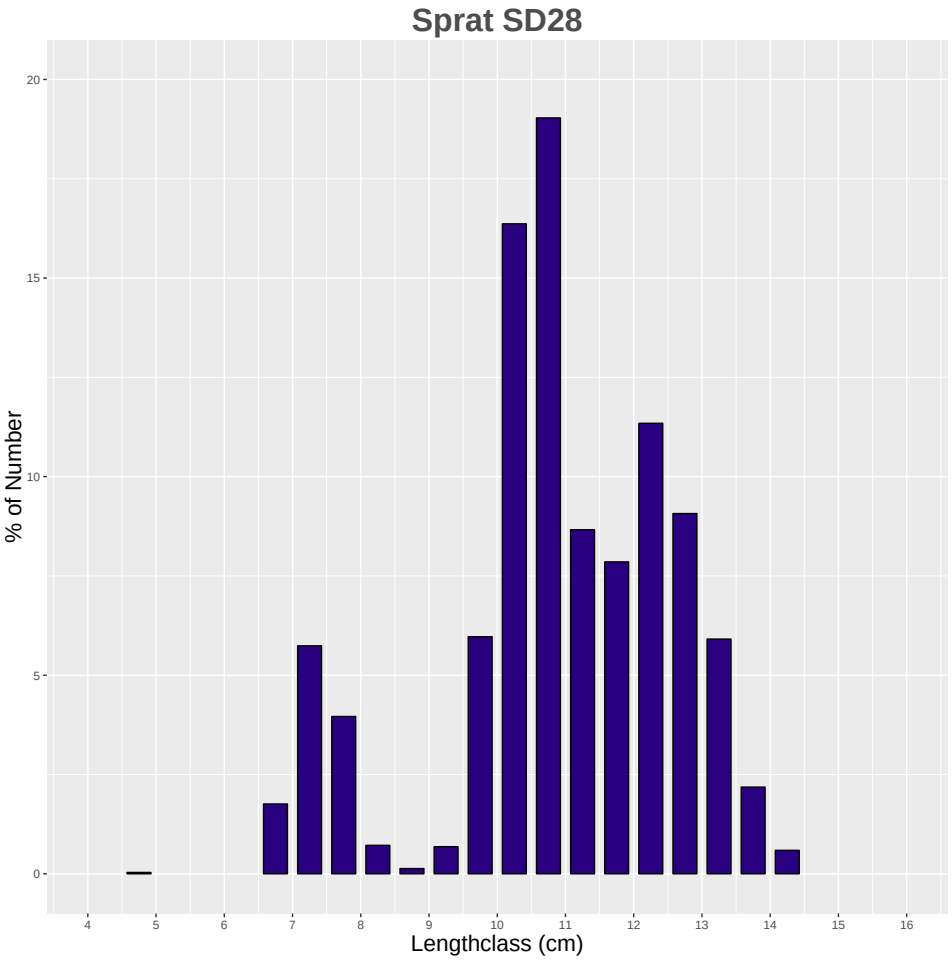

Figure 6: Length distribution of sprat from subdivision 28

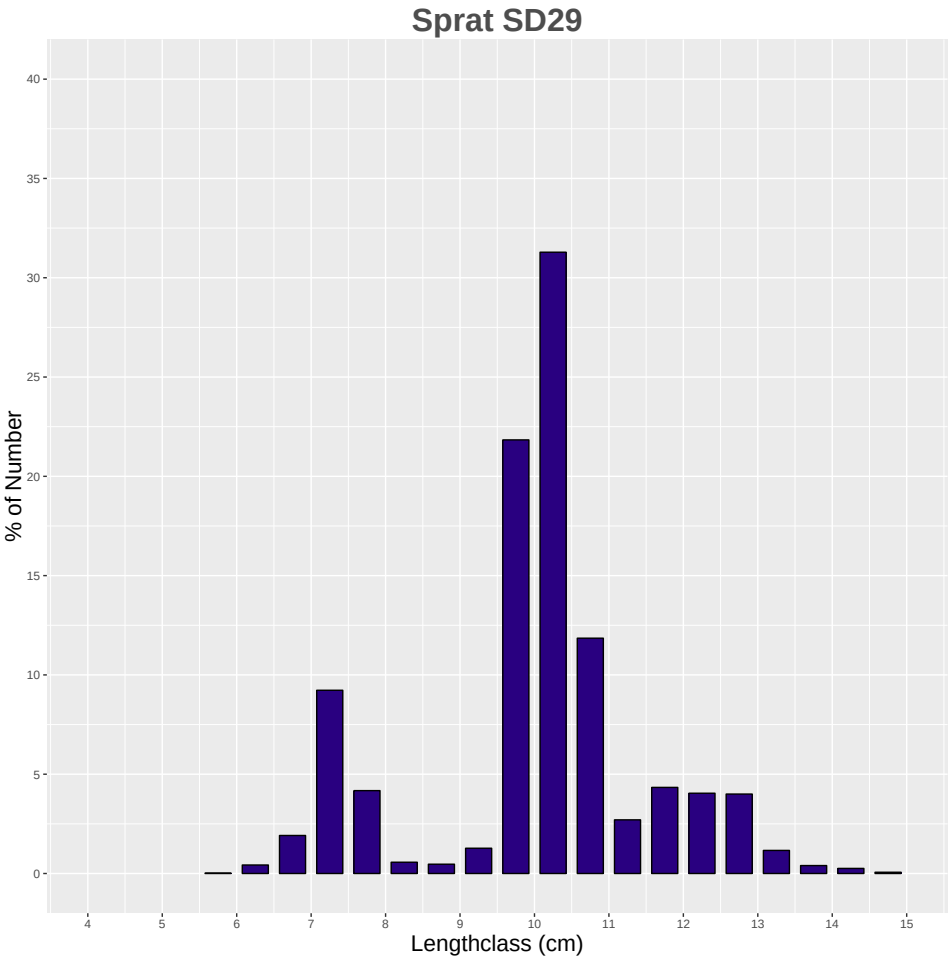

Figure 7: Length distribution of sprat from subdivision 29

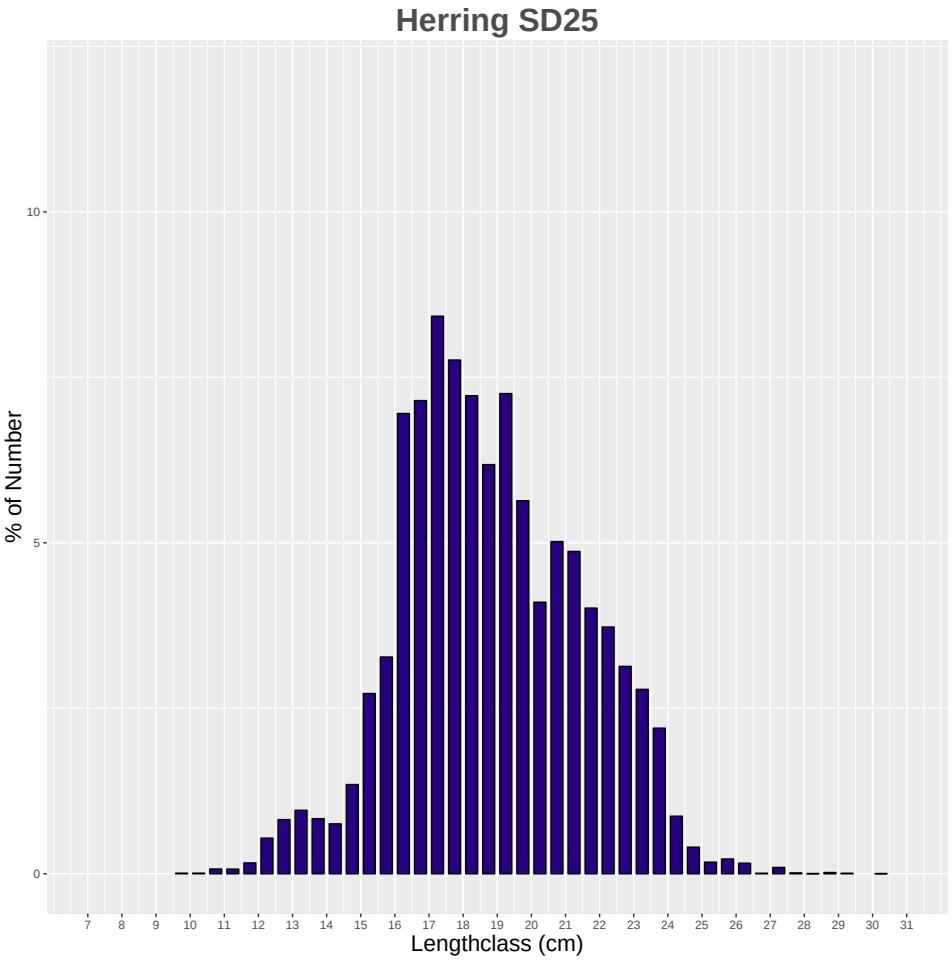

Figure 8: Length distribution of herring from subdivision 25

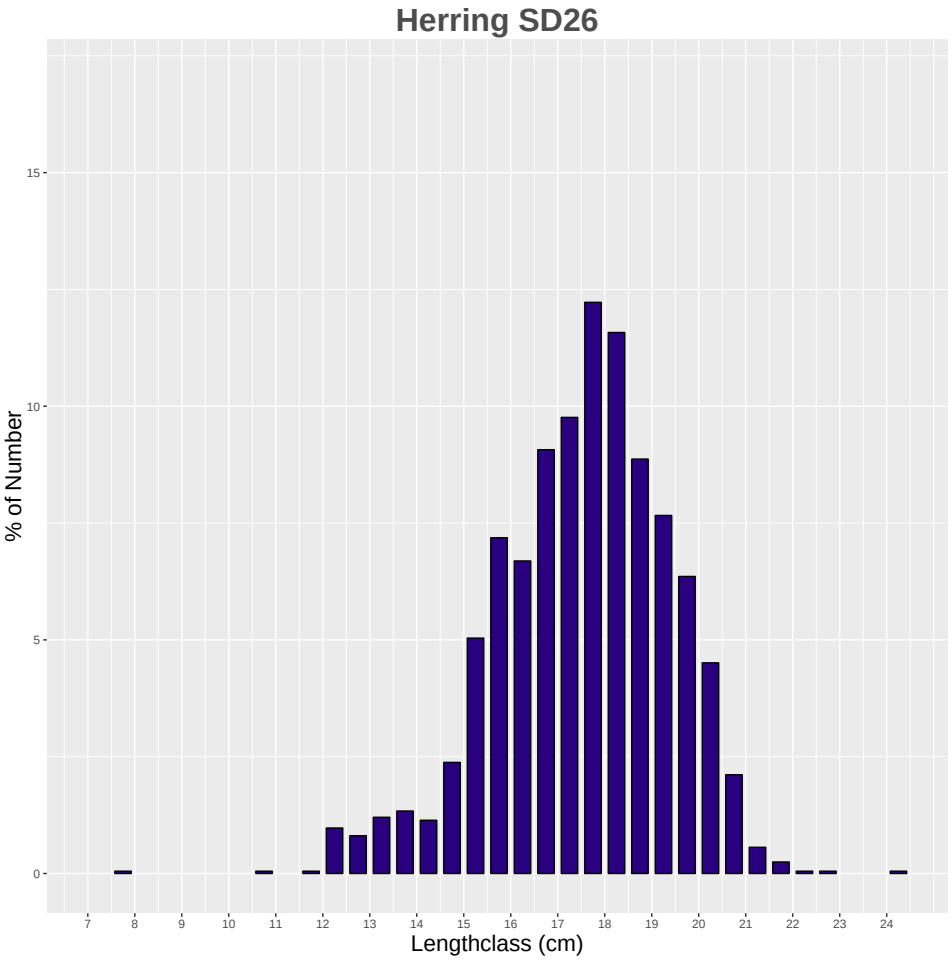

Figure 9: Length distribution of herring from subdivision 26

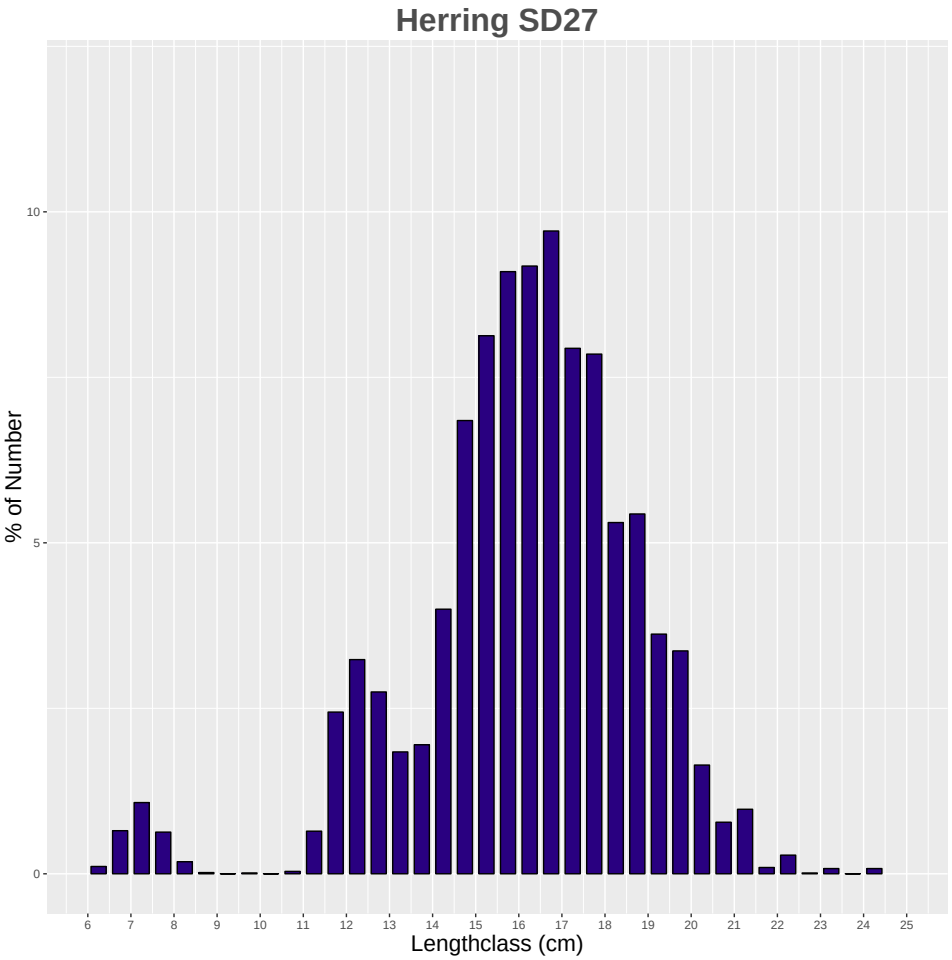

Figure 10: Length distribution of herring from subdivision 27

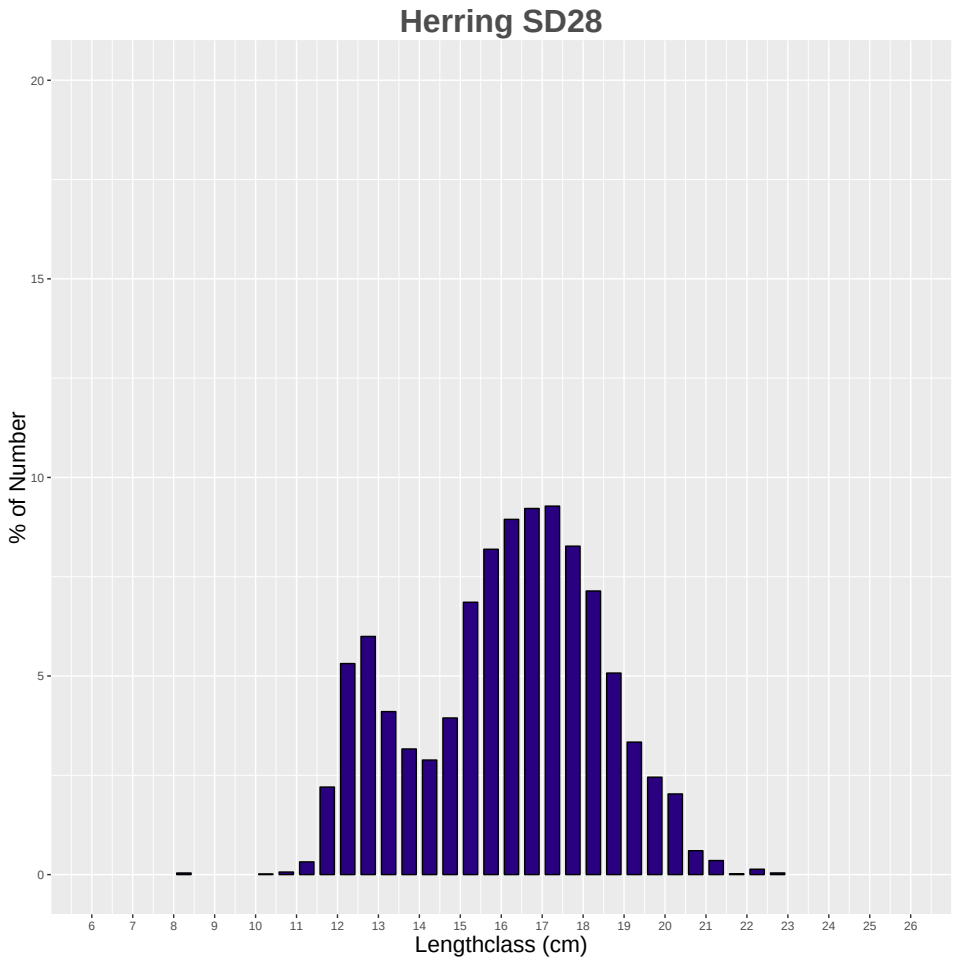

Figure 11: Length distribution of herring from subdivision 28

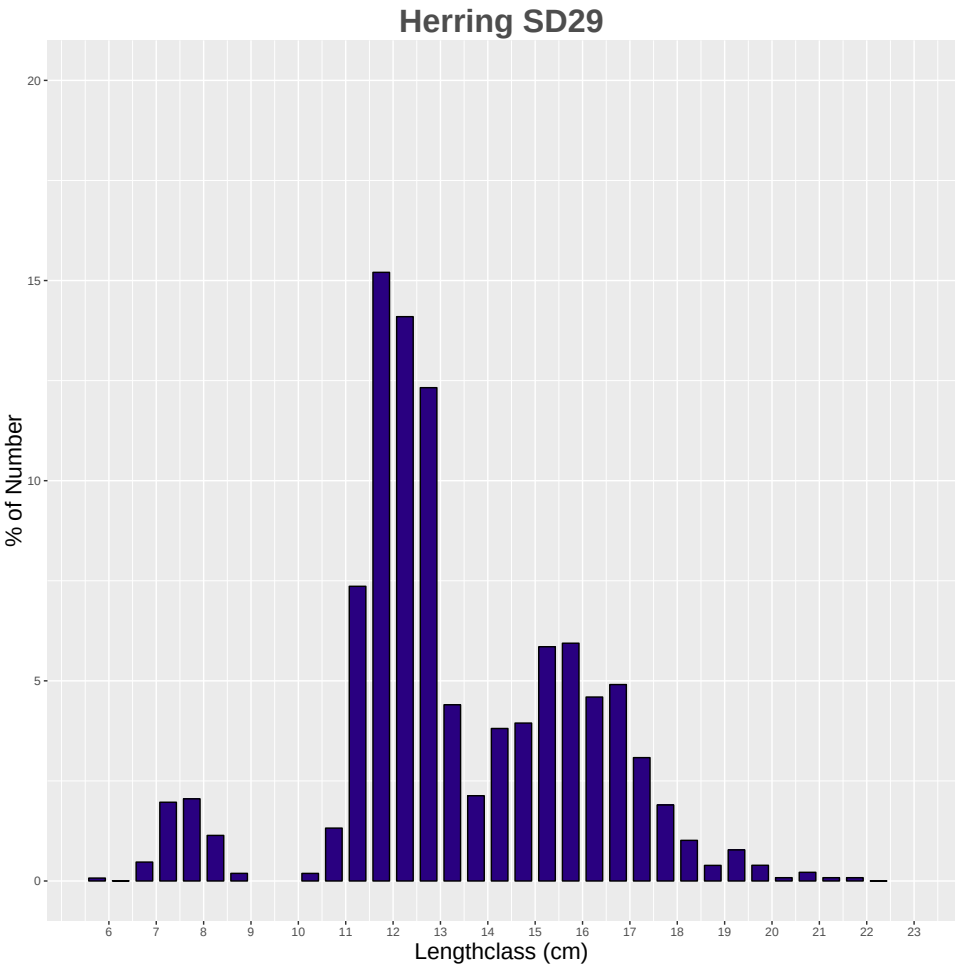

Figure 12: Length distribution of herring from subdivision 29