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Baltic International Acoustic Survey, October 2021

-Report, R/V Svea, Sweden

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Datainsamling inom DCF finansieras till 60% av medel från Europeiska havs-, fiskeri- och vattenbruksfonden (EHFVF).

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Baltic International Acoustic Survey Report, R/V Svea, Sweden

Survey 2021-09-25 - 2021-10-08

Niklas Larson
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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 Kommissionens Data Collection Framework (DCF) och är obligatorisk för varje medlemsland i EU runt Östersjön. Sverige ansvarar för subdivision(SD) 27 samt för delar av subdivisionerna 25, 26, 28 samt 29. Syftet med expeditionen är att bedöma beståndstatus för sill och skarpsill. Resultaten rapporteras årligen till Baltic International Fish Survey Working Group (WGBIFS) och Baltic Fisheries Assessment Working Group (WGBFAS), som båda är arbetsgrupper inom International Council for the Exploration of the Sea (ICES).
Expeditionen 2021 genomfördes med R/V Svea och inleddes med kalibrering av ekolod 2021-09-26 i Gåsöfjärden och därefter tog sig Svea österut till SD27 där datainsamlingen startade. Expeditionen avslutades 2021-10-08 i Västervik. Under expeditionen samlas akustiska rådata in med ett vetenskapligt ekolod (EK80 38kHz) och biologiska data med hjälp av pelagisk trålning för information om art och längfördelning. Akustiska rådata efterbehandlas i programvaran Large Scale Survey System LSSS. Trålfångsterna analyseras avseende art- och längdfördelning, Målarterna - sill, skarpsill och torsk - provtas även för åldersbestämning för att ta fram åldersstruktur för respektive bestånd. Informationen om arter och längder från trålfångsterna används tillsammans med akustiska data för att räkna fram ett index för biomassan av fiskarterna. WGBIFS tar fram gemensamma riktlinjer och manualer och resultaten från varje land kan sammanställas i en gemensam databas.

Resultaten utgör underlag för WGBFAS uppskattning de totala bestånden av sill respektive skarpsill i Östersjön. Resultatet från 2021 års svenska BIAS bedömdes av WGBIFS vara representativt för mängden sill och skarpsill i Östersjön. WGBIFS möte hölls, via videokonferans, i april 2022. Tidigare års resultat samt mer information kring BIAS och WGBIFS arbete finns i arbetsgruppens årliga rapporter.

2 Introduction

International hydroacoustic surveys have been conducted in the Baltic Sea since 1978. The starting point was the cooperation between the Institute of Marine Research (IMR) in Lysekil, Sweden, and the Institut für Hochseefisherei und Fishverarbeitung in Rostock, German Democratic Republic, in October 1978, which produced the first acoustic estimates of the 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 in the Baltic Sea and results have been reported to the International Council for the Exploration of the Sea (ICES).

The Baltic International Acoustic Survey (BIAS), is mandatory for the countries that have Exclusive Economic Zone (EEZ) in the Baltic Sea, and is part of the Data Collection Framework(DCF) as stipulated by the European Council and the Commission (European Council, 2017) and the Commission Data Collection Framework (The Commission, 2021).

The IMR in Lysekil is part of the Department of Aquatic Resources at the Swedish University of Agricultural Sciences and responsible for the Swedish part of the DCF and surveys in the marine environment. The IMR assesses the status of the marine ecosystems, develops and provides biological advices for the sustainable use of the aquatic resources.

The BIAS survey is coordinated and managed by the ICES working group for the Baltic International Fish Survey (WGBIFS). The main objective of BIAS is to assess herring and sprat resources in the Baltic Sea. The survey provides data to the ICES Baltic Fisheries Assessment Working Group (WGBFAS).

3 Methods

3.1 Narrative

The survey was conducted onboard the Fisheries Research Vessel, Svea that was delivered in July 2019. The total cruise covered SD 27 and parts of 25, 26, 28 and 29 (Figure 1). The calibration of the SIMRAD EK80 echo sounder was made in Gåsöfjärden on the Swedish east coast. The survey started 2021-09-25 east of Gåsöfjärden, and ended 2021-10-08 between Sweden and Bornholm at the border between ICES subdivision (SD) 24 and 25 (Figure 2).

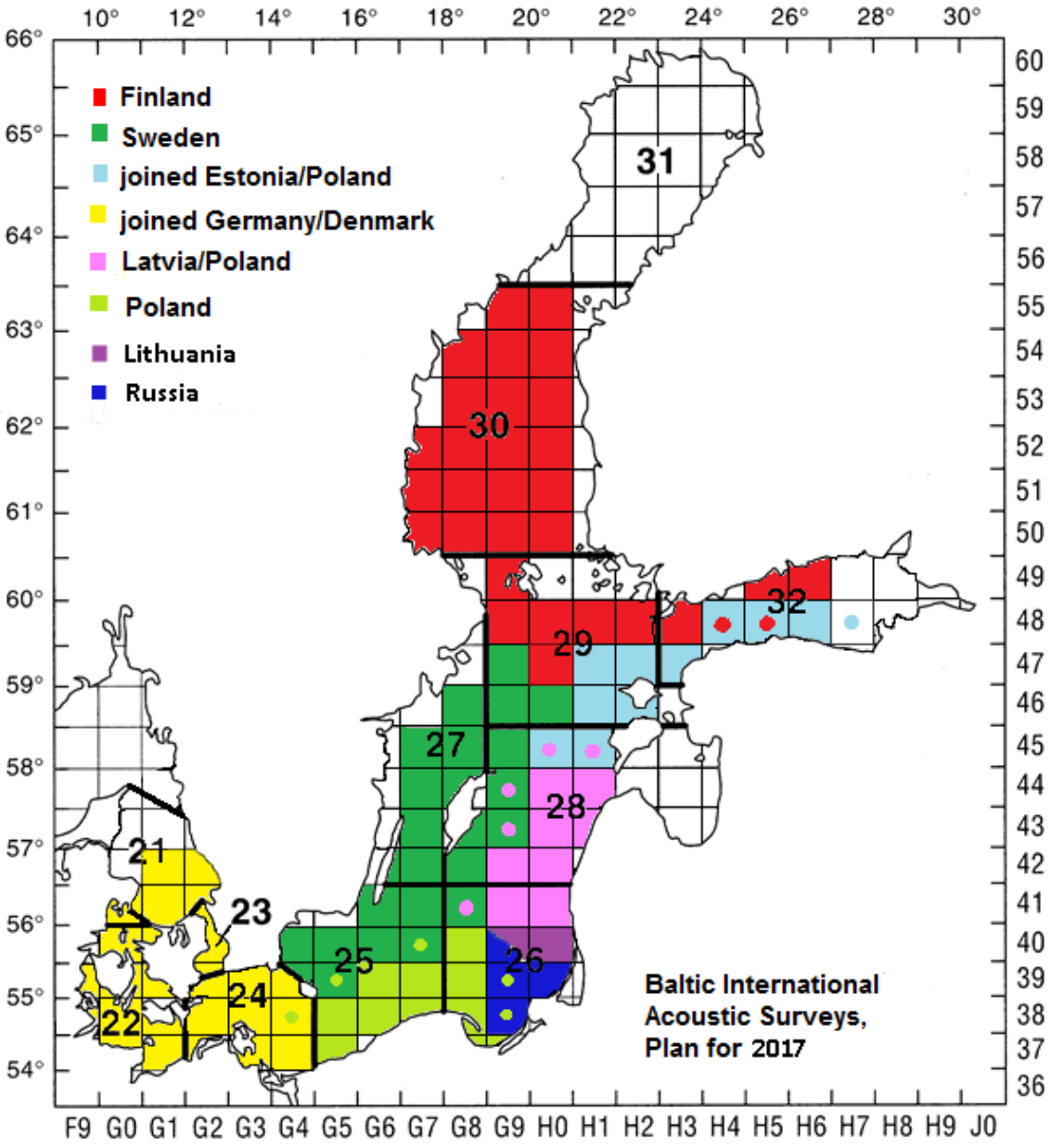

Figure 1. Allocation of ICES squares to each country in the BIAS survey 2021 (On axes: longitude, latitude and ICES name of square eg:41G8).

3.2 Survey design

The survey design is based on ICES statistical rectangles (0.5 degrees in latitude and 1 degree in longitude) (Figure 1). The 10 m depth line (ICES, 2017) limits the areas of all strata. The aim (ICES, 2017) is to use parallel transects spaced out 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. Due to the irregular shape of the survey area assigned to Sweden and occational bad weather conditions during surveys the design is difficult to fulfill. The total area covered in 2021 was 20832 square nautical miles and the distance used for acoustic estimates was 1304 nautical miles. The cruise track and positions of trawl hauls are shown in Figure 2.

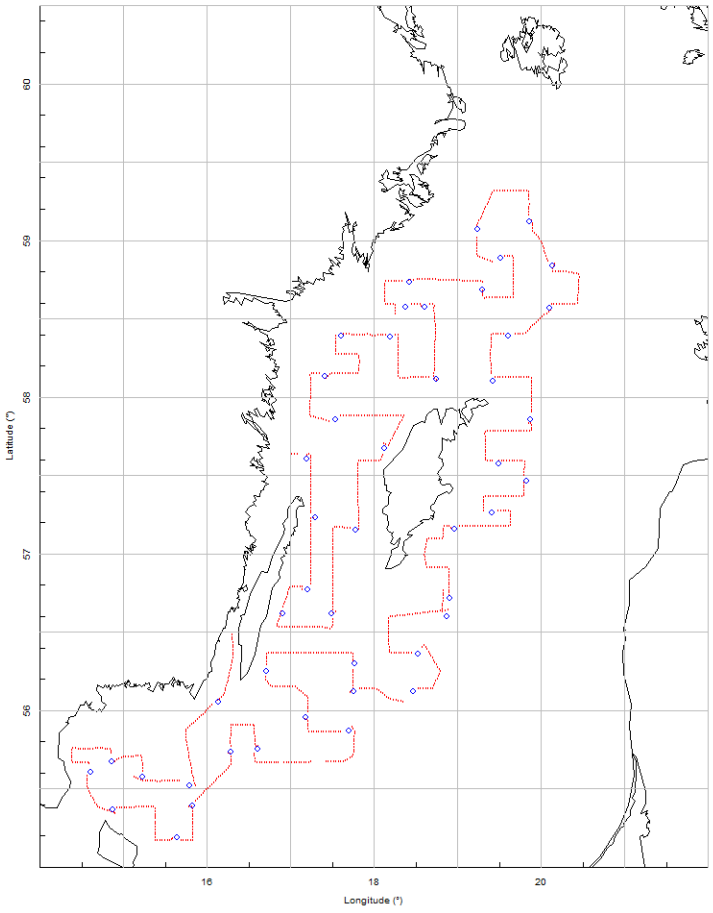

Figure 2. Cruise track(red), positions of trawl hauls (blue) and survey grid of ICES squares (grey) for BIAS 2021.

3.3 Calibration

The SIMRAD EK80 echo sounder with the 38kHz transducer was calibrated in Gåsöfjärden 2021-09-26, according to the IBAS manual (ICES, 2017). Values from the calibration were within required accuracy.

3.4 Acoustic data collection and processing

The acoustic data sampling was performed around the clock. SIMRAD EK80 (simrad.com/ek80) echo sounder with the 38 kHz transducer mounted on a drop keel was used for the acoustic data collection. The hydro-acoustic equipment was set in accordance with the IBAS manual (ICES, 2017). The post processing of the stored raw data was made using the software LSSS (Large Scale Survey System, marec.no/products.htm). 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 and irrelevant scattering 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 acoustic integrator readings to a single species. Therefore the species composition was based on the catch results from the executed hauls. For each rectangle the species composition and length distribution were determined as the unweighted mean of all trawl results in this rectangle. From these data, the mean acoustic cross-section was calculated according to the target strength(TS) relationships (Table 1).

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

Table 1. Target strength (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)
Fish without swim bladder	TS = 20 log L (cm) - 84.9	(ICES, 2017)
Salmonids and 3-spined stickleback were given the same acoustic properties as Clupeoids.		

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 the stations.

3.7 Personnel

The participating scientific crew are listed in Table 2.

Table 2. Participating scientific crew.

Björklund, Emilia	IMR, Lysekil	Fish sampling
Jernberg, Carina	IMR, Lysekil	Fish sampling
Larson, Niklas	IMR, Lysekil	Scientific & Exp. leader, Acoustics
Nilsson, Hans	IMR, Lysekil	Acoustics
Sjöberg, Rajlie	IMR, Lysekil	Fish sampling
Svenson, Anders	IMR, Lysekil	Acoustics
Risberg, Ronja	IMR, Lysekil	Fish sampling
Tell, Anna-Kerstin	SMHI, Gothenburg	Oceanography

4 Results

4.1 Biological data

In total 47 trawl hauls were carried out, 15 in SD 25, 2 in SD 26, 15 in SD 27, 9 in SD 28 and 6 hauls in SD 29. In total 1683 herring and 1172 sprat were sampled for age analyses. Length distributions by ICES subdivision are shown for sprat in Figures 3-7 and for herring in Figures 8 to 12.

4.2 Acoustic data

The survey statistics concerning the survey area, the mean nautical area scattering coefficient (SA), the mean backscattering cross section (SIGMA), the estimated total number of fish (NTOT), the percentages of herring (HHer), sprat (HSpr) and cod (HCod) per SD/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

This year was the third year that R/V Svea was used for BIAS. As a whole the evaluation was that the survey was accomplished as planned. Some bad weather occurred and thus in some parts the planned survey track had to be changed according to the situation. The data collected during the survey was reviewed and accepted at the WGBIFS meeting and thus representative for the index of abundance of the pelagic species during the BIAS in 2021 for the covered area (Figure 2). For further information regarding the procedures of WGBIFS see the WGBIFS report (ICES, 2021).

6 References

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7 Tables and figures

Table 3. Survey statistics, see chapter 4.2 for more information.

SD	RECT	AREA	SA	SIGMA	NTOT	HHer	HSpr	HCod
25	39G4	287.3	455.8	1.796	729.10	4.36	95.63	0.000
25	39G5	979.0	183.8	1.766	1018.49	22.68	77.20	0.114
25	40G4	677.2	214.8	2.496	582.65	56.26	42.76	0.269
25	40G5	1012.9	141.4	1.860	769.99	37.36	59.04	0.070
25	40G6	1013.0	384.3	1.613	2413.90	12.46	83.90	0.264
25	40G7	1013.0	415.3	2.103	2000.12	63.15	33.60	0.005
25	41G6	764.4	562.9	1.433	3002.17	32.17	62.00	0.005
25	41G7	1000.0	794.8	1.584	5016.24	25.78	64.41	0.000
26	41G8	1000.0	906.8	1.844	4916.08	44.68	52.36	0.058
27	42G6	266.0	1450.5	1.387	2782.73	29.28	56.63	0.000
27	42G7	986.9	726.3	1.520	4716.77	43.90	23.39	0.000
27	43G7	913.8	655.1	1.157	5175.92	9.49	83.85	0.000
27	44G7	960.5	346.9	1.073	3106.73	23.26	41.14	0.000
27	44G8	456.6	429.5	1.131	1734.61	23.80	39.44	0.000
27	45G7	908.7	770.5	1.249	5607.77	30.19	63.87	0.000
27	45G8	947.2	466.1	1.229	3591.92	25.24	54.68	0.000
27	46G8	884.8	441.0	0.933	4182.18	12.99	45.22	0.000
28	42G8	945.4	359.5	1.637	2076.26	35.13	50.31	0.000
28	43G8	296.2	370.4	1.213	904.22	0.10	99.42	0.000
28	43G9	973.7	652.3	1.192	5327.53	17.73	41.01	0.000
28	44G9	876.6	855.1	0.864	8671.89	0.54	49.43	0.000
28	45G9	924.5	584.8	1.255	4307.78	38.32	11.79	0.004
29	46G9	933.8	327.0	0.654	4671.47	5.80	20.02	0.000
29	46H0	933.8	343.3	0.991	3236.81	10.03	47.87	0.000
29	47G9	876.2	990.3	1.244	6972.22	22.85	49.72	0.000

Table 4. Estimated number (millions) of sprat per age group and area (Number sprat two year old (NS2)).

SD	RECT	NSTOT	NS0	NS1	NS2	NS3	NS4	NS5	NS6	NS7	NS8+
25	39G4	697	6	0	94	164	134	8	131	84	76
25	39G5	786	2	38	110	157	196	88	152	7	36
25	40G4	249	4	1	16	43	26	48	59	48	1
25	40G5	455	12	38	57	144	54	56	27	55	11
25	40G6	2025	10	102	334	590	672	85	95	109	27
25	40G7	672	6	82	162	172	109	106	4	19	12
25	41G6	1861	1332	178	86	82	57	22	37	56	11
25	41G7	3231	26	726	322	782	342	207	310	500	16
26	41G8	2574	7	338	396	731	526	253	46	259	17
27	42G6	1576	14	770	402	197	7	37	14	134	0
27	42G7	1103	0	235	438	88	75	100	26	123	18
28	42G8	1044	0	120	312	268	170	18	63	77	16
27	43G7	4340	21	2431	385	1224	68	152	7	45	7
28	43G8	899	5	256	441	117	9	18	18	27	9
28	43G9	2185	17	227	209	747	424	97	127	223	114
27	44G7	1278	21	637	208	174	55	46	26	89	23
27	44G8	684	3	187	74	130	132	53	15	90	0
28	44G9	4287	2	443	1500	928	375	133	574	215	116
27	45G7	3582	277	2107	302	430	181	72	139	56	18
27	45G8	1964	68	1126	295	187	32	199	51	0	6
28	45G9	508	1	224	40	83	65	43	27	18	8
27	46G8	1891	28	643	490	76	316	3	224	109	3
29	46G9	935	10	231	193	144	240	18	49	48	2
29	46H0	1550	10	376	459	231	334	44	91	2	2
29	47G9	3467	29	614	904	849	691	99	148	99	33

Table 5. Estimated mean weights (g) of sprat per age group and area (Weight sprat (WS)).

SD	RECT	WS0	WS1	WS2	WS3	WS4	WS5	WS6	WS7	WS8+
25	39G4	4		13	14	16	20	16	16	20
25	39G5	5	8	12	11	13	15	13	15	13
25	40G4	4	9	10	13	14	15	15	16	18
25	40G5	4	8	10	12	15	13	16	13	16
25	40G6	3	8	10	13	13	12	12	14	13
25	40G7	4	8	10	11	12	13	14	14	16
25	41G6	3	7	9	9	12	11	13	13	14
25	41G7	3	8	10	11	12	11	14	12	15
26	41G8	4	8	10	12	12	12	13	12	15
27	42G6	3	7	11	11	15	12	13	10	
27	42G7		7	9	11	12	11	9	11	13
28	42G8		7	9	11	11	13	13	13	14
27	43G7	4	7	10	9	11	11	13	10	13
28	43G8	4	8	10	11	13	11	12	13	13
28	43G9	5	8	10	11	12	11	14	14	14
27	44G7	4	6	9	9	11	11	11	11	10
27	44G8	4	7	9	10	11	11	12	12	
28	44G9	4	7	10	10	12	13	12	9	11
27	45G7	4	7	9	10	10	11	10	11	13
27	45G8	4	7	9	9	12	10	12		12
28	45G9	3	7	9	10	11	11	12	9	12
27	46G8	4	7	10	9	10	13	11	11	13
29	46G9	4	7	10	10	10	13	10	12	13
29	46H0	4	7	10	11	10	12	12	13	15
29	47G9	4	7	8	9	10	10	12	10	12

Table 6. Estimated number (millions) of herring per age group and area (Number herring (NH)).

SD	RECT	NHTOT	NH0	NH1	NH2	NH3	NH4	NH5	NH6	NH7	NH8+
25	39G4	32	1	2	4	10	5	6	3	1	0
25	39G5	231	4	9	89	45	28	33	13	10	0
25	40G4	328	7	10	59	89	82	37	18	26	0
25	40G5	288	2	44	77	65	45	14	22	17	2
25	40G6	301	3	10	98	28	59	58	23	21	0
25	40G7	1263	0	45	433	225	263	82	128	87	0
25	41G6	966	7	40	155	180	150	187	98	145	4
25	41G7	1293	4	13	541	168	188	240	83	43	14
26	41G8	2196	0	23	673	411	488	291	154	150	6
27	42G6	815	17	88	341	81	87	119	56	23	3
27	42G7	2071	13	72	684	345	466	260	116	102	12
28	42G8	729	0	4	147	102	176	149	152	0	0
27	43G7	491	11	100	242	48	52	11	23	4	0
28	43G8	1	0	0	0	0	0	0	0	0	0
28	43G9	944	0	4	207	167	164	191	127	85	0
27	44G7	723	13	171	297	41	82	42	73	4	0
27	44G8	413	10	71	222	33	38	15	17	6	0
28	44G9	46	9	1	17	12	4	1	1	0	0
27	45G7	1693	438	401	451	129	101	94	42	39	0
27	45G8	906	57	90	363	122	122	98	29	22	3
28	45G9	1651	10	35	563	198	225	313	85	213	8
27	46G8	543	141	104	148	46	69	22	9	2	1
29	46G9	271	2	19	128	23	24	21	27	27	0
29	46H0	325	1	5	142	83	36	23	21	11	2
29	47G9	1593	12	121	740	253	270	116	81	0	0

Table 7. Estimated mean weights (g) of herring per age group and area. (Weight herring (NS))

SD	RECT	WH0	WH1	WH2	WH3	WH4	WH5	WH6	WH7	WH8+
25	39G4	7	32	33	37	34	30	36	28	
25	39G5	13	16	20	29	31	34	35	32	
25	40G4	13	18	26	50	52	56	46	36	
25	40G5	12	18	25	30	36	41	39	37	29
25	40G6	14	29	22	32	37	31	39	40	
25	40G7		14	22	23	30	38	38	39	
25	41G6	7	16	20	25	30	30	32	38	32
25	41G7	11	14	19	27	30	37	37	43	33
26	41G8		13	19	23	28	34	32	35	38
27	42G6	5	14	19	23	29	28	30	32	53
27	42G7	4	13	19	24	26	28	26	30	35
28	42G8		14	19	21	26	26	32		
27	43G7	4	12	17	21	24	26	25	32	
28	43G8			15	21	70				
28	43G9		15	19	23	27	26	35	30	
27	44G7	4	12	18	23	21	29	24	23	
27	44G8	4	12	18	21	24	21	27	28	
28	44G9	4	13	18	24	24	25	24		
27	45G7	5	12	17	21	22	25	22	27	
27	45G8	5	12	17	21	24	23	25	25	19
28	45G9	4	14	17	23	27	27	32	26	36
27	46G8	4	11	18	22	24	23	32	30	30
29	46G9	4	12	17	19	25	24	24	24	
29	46H0	6	13	16	22	23	27	27	26	25
29	47G9	5	13	17	20	22	24	24		

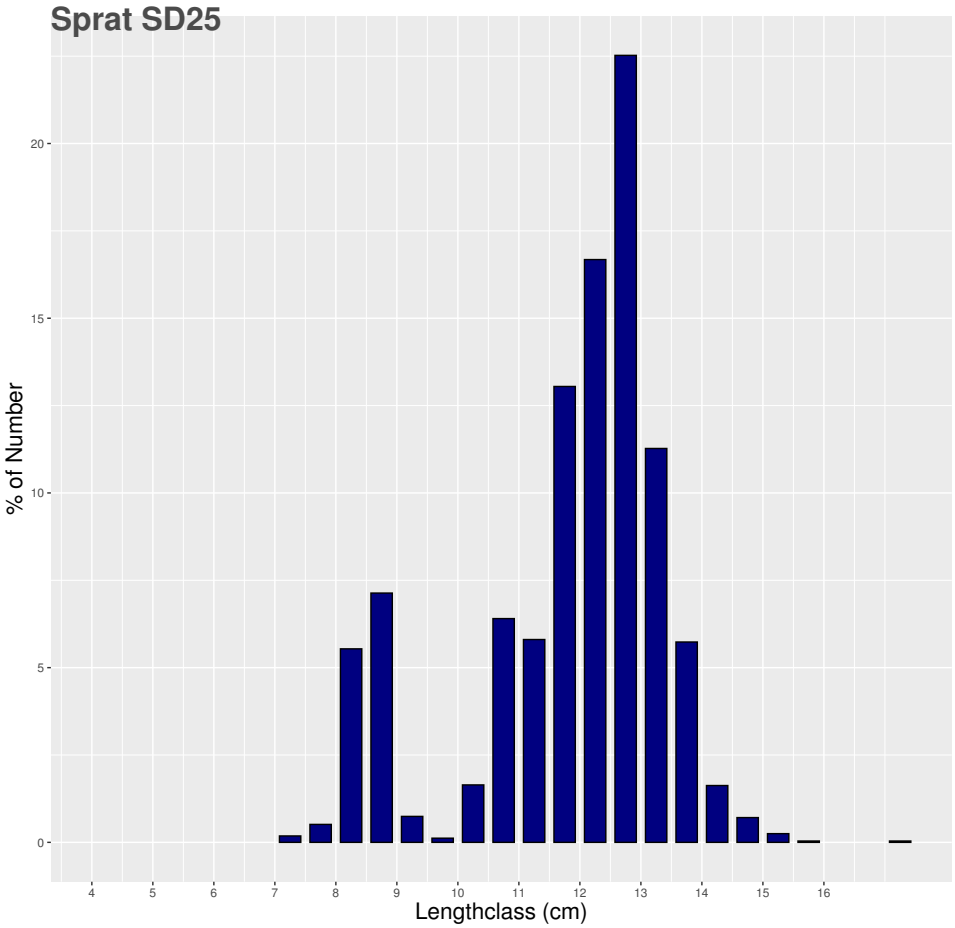

Figure 3. Length distribution of sprat from subdivision 25 for BIAS 2021.

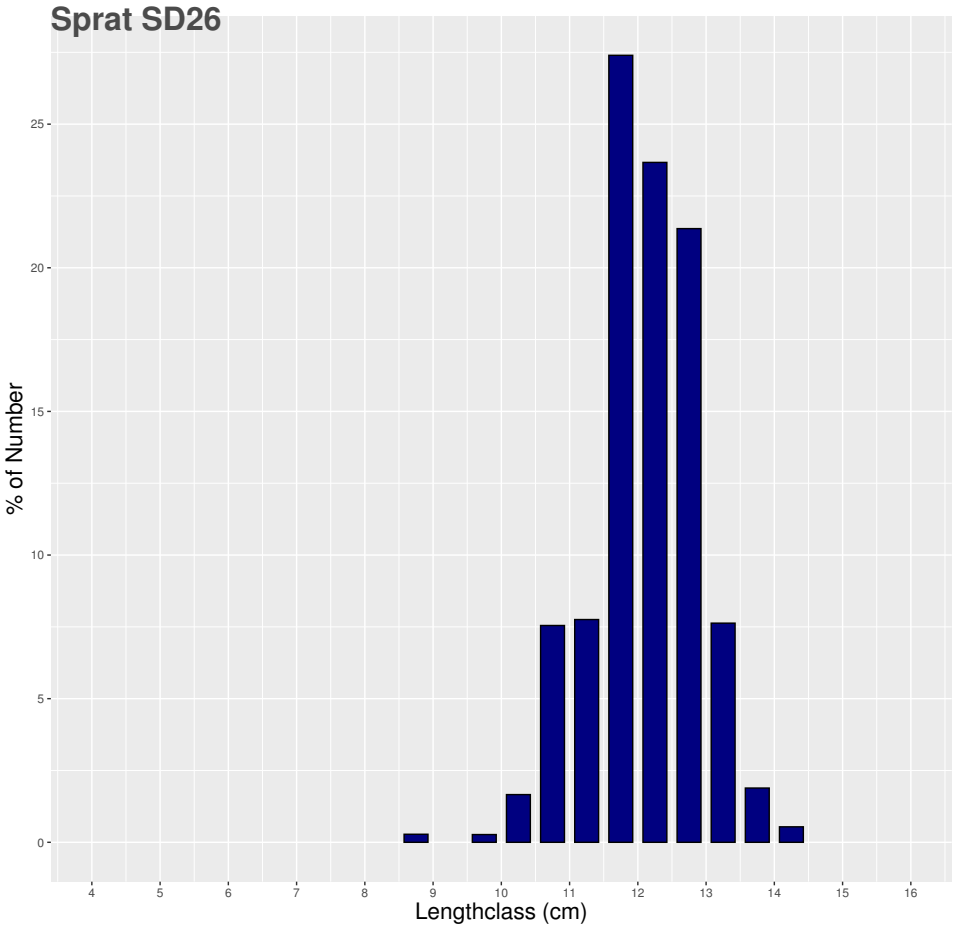

Figure 4. Length distribution of sprat from subdivision 26 for BIAS 2021.

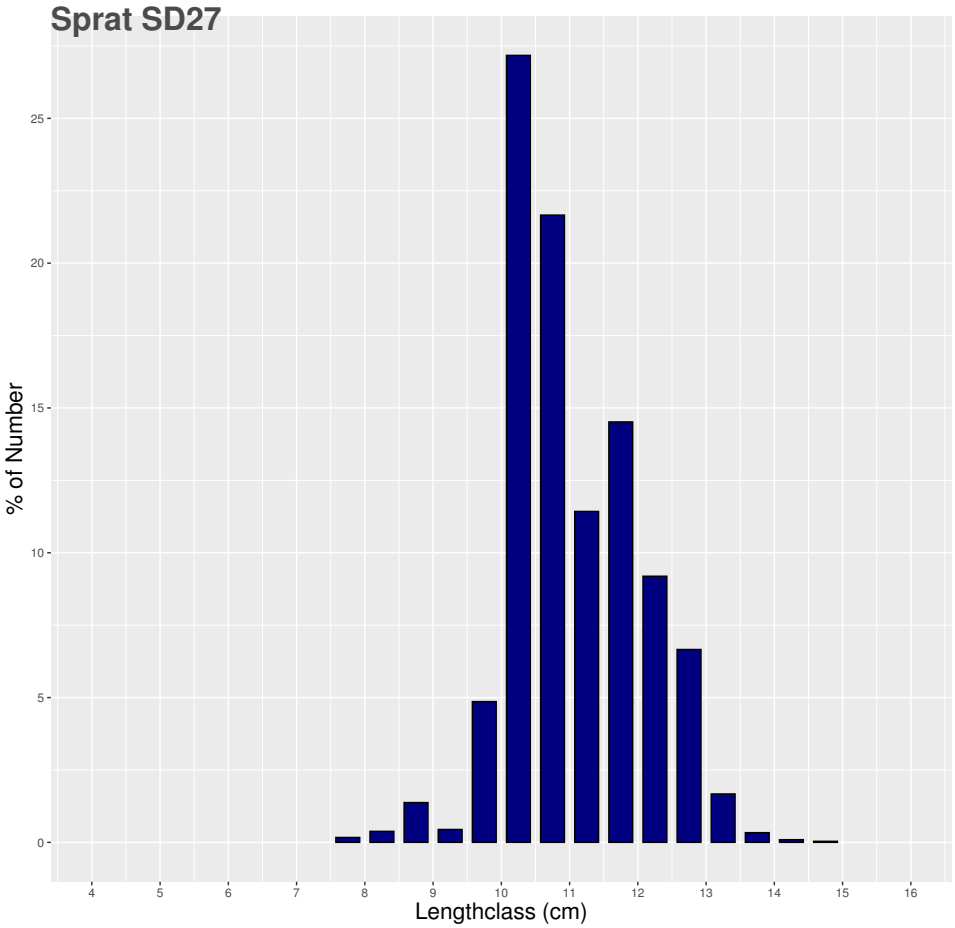

Figure 5. Length distribution of sprat from subdivision 27 for BIAS 2021.

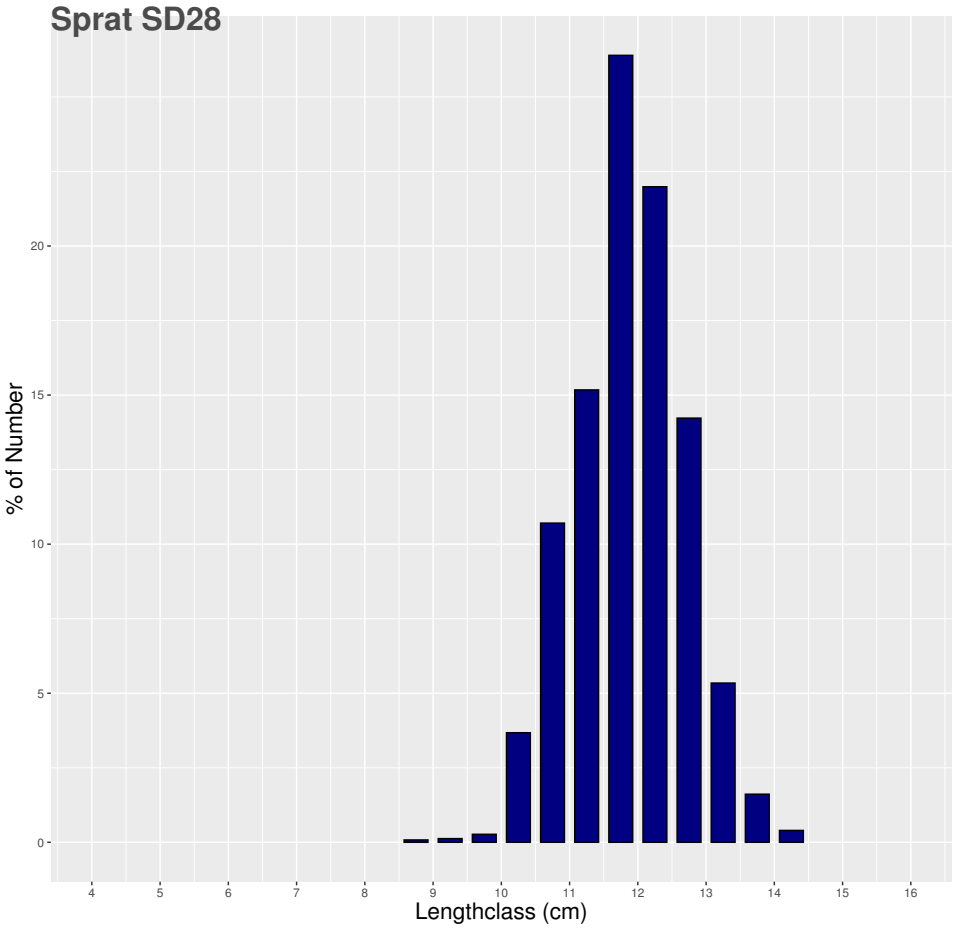

Figure 6. Length distribution of sprat from subdivision 28 for BIAS 2021.

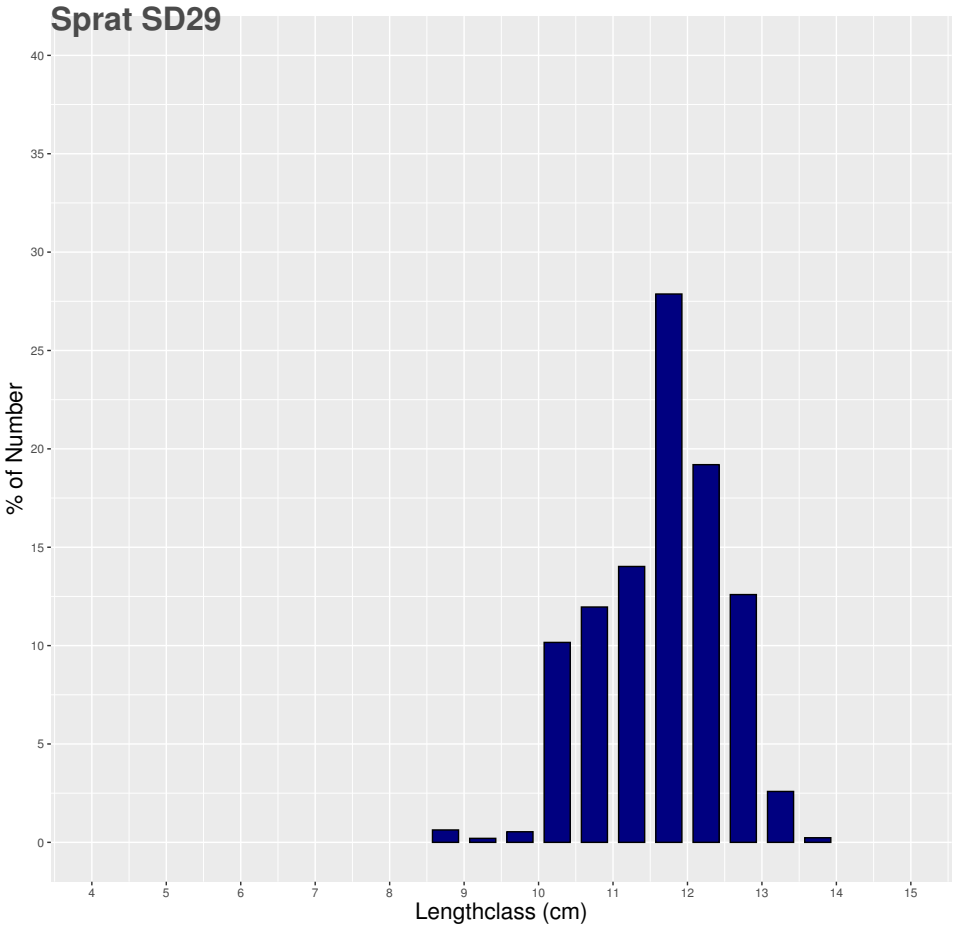

Figure 7. Length distribution of sprat from subdivision 29 for BIAS 2021.

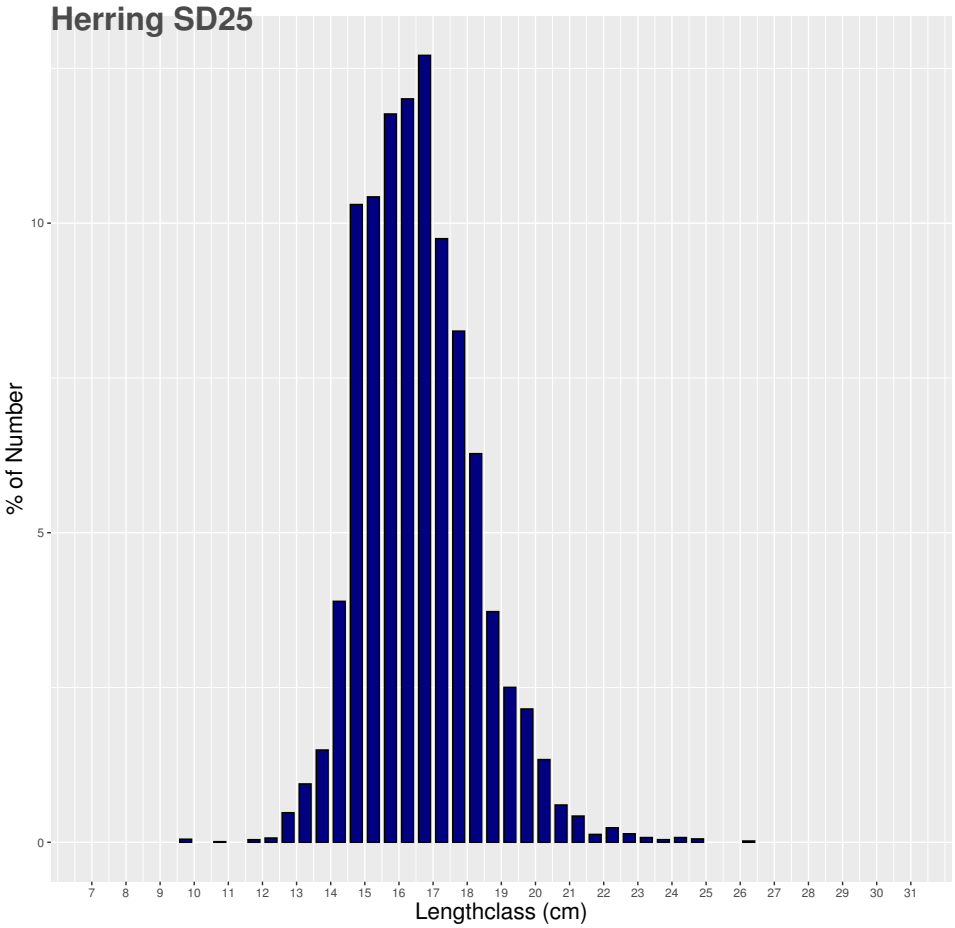

Figure 8. Length distribution of herring from subdivision 25 for BIAS 2021.

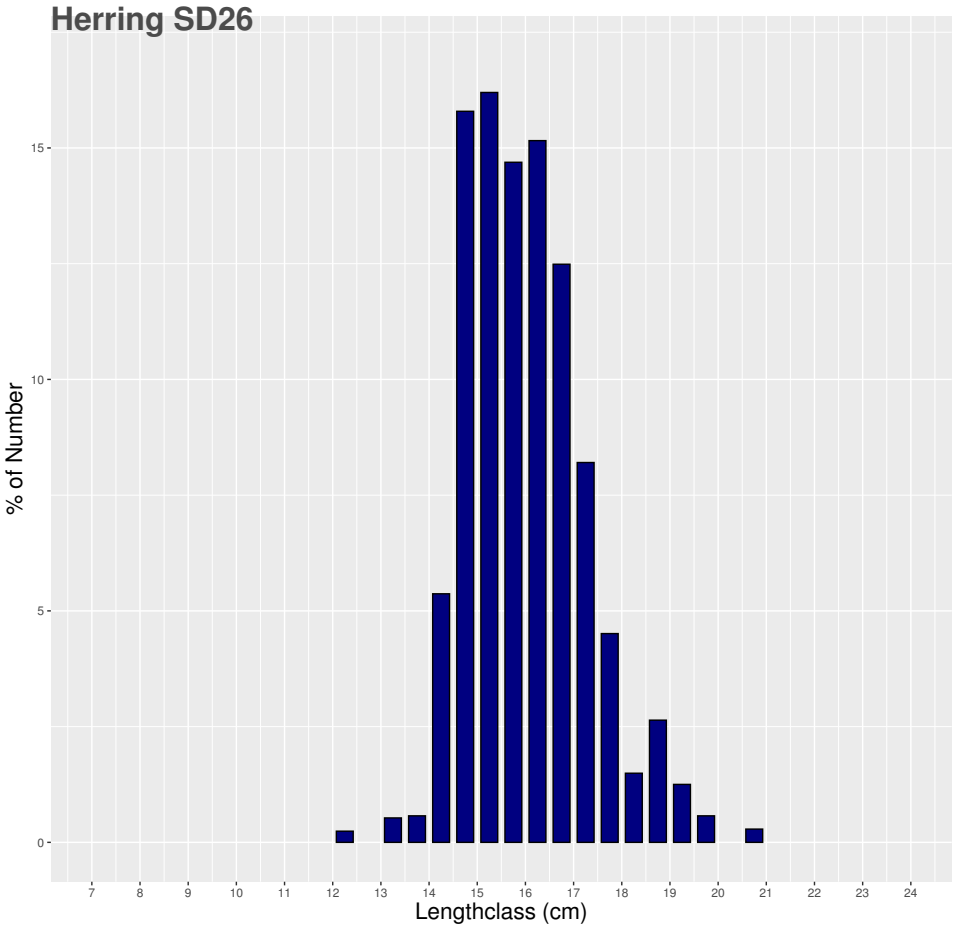

Figure 9. Length distribution of herring from subdivision 26 for BIAS 2021.

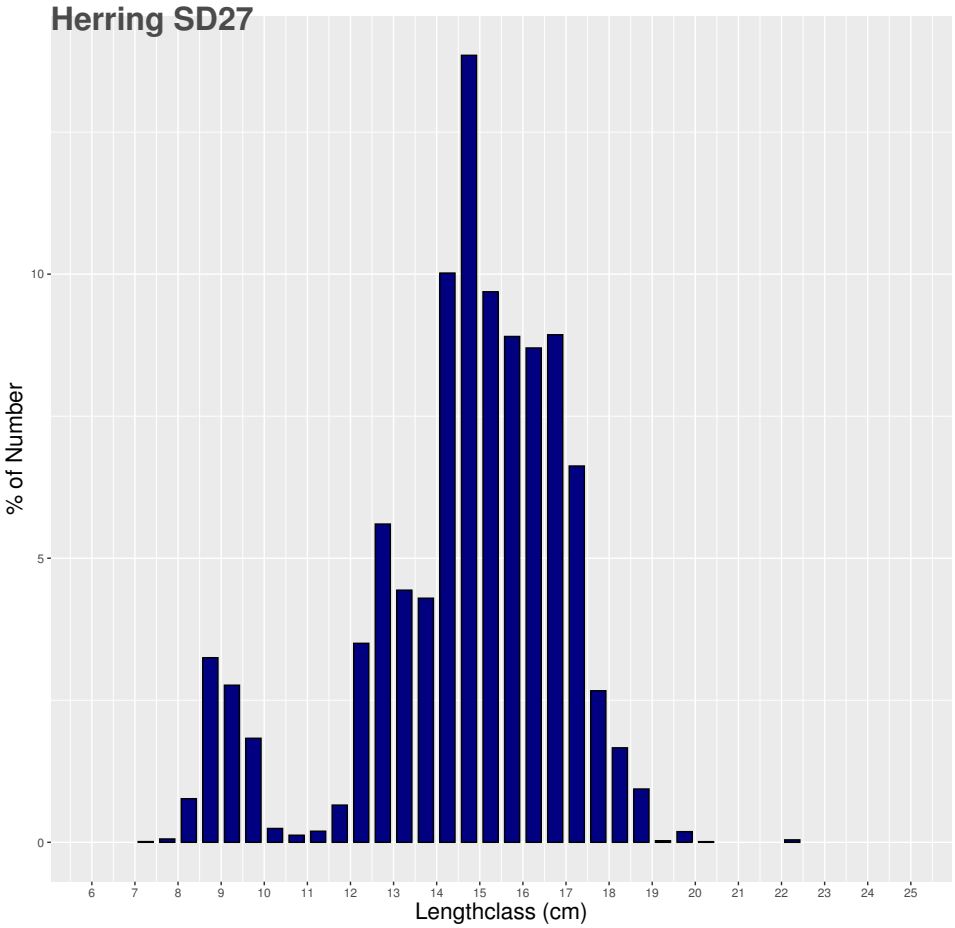

Figure 10. Length distribution of herring from subdivision 27 for BIAS 2021.

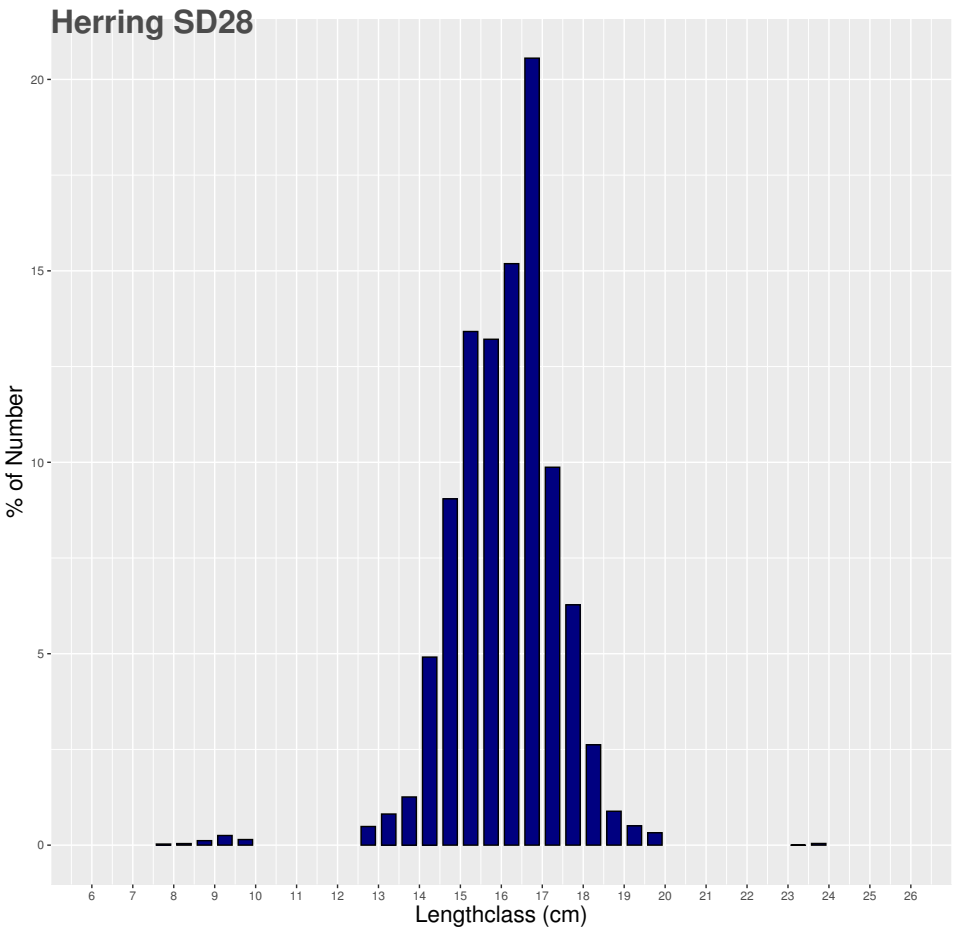

Figure 11. Length distribution of herring from subdivision 28 for BIAS 2021.

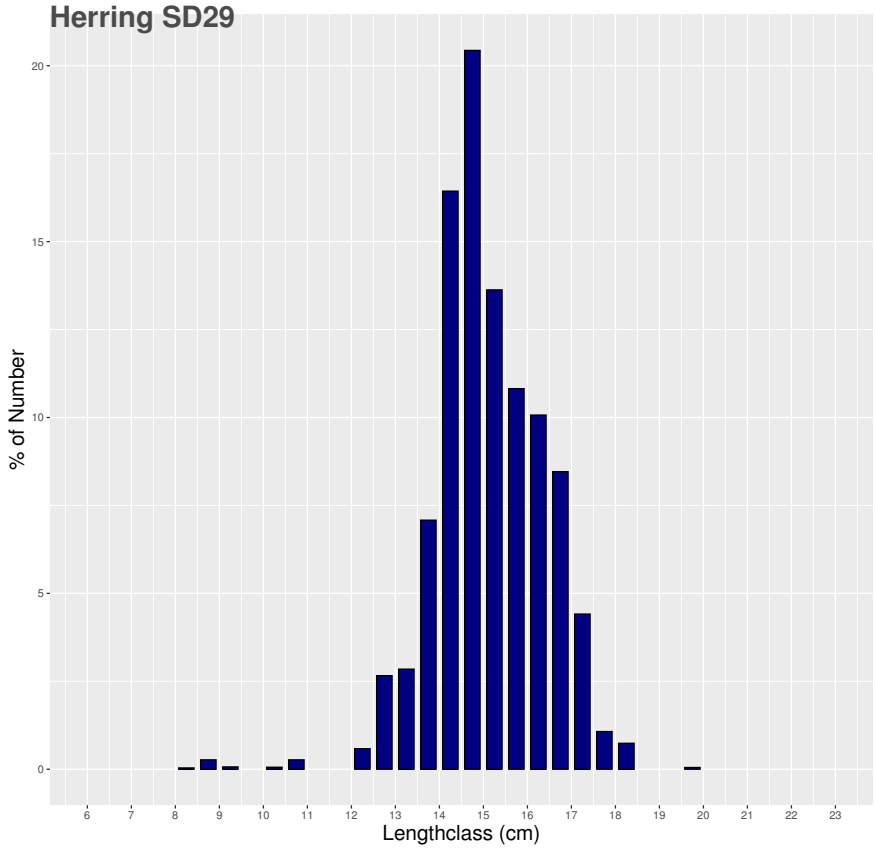

Figure 12. Length distribution of herring from subdivision 29 for BIAS 2021.