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Baltic International Acoustic Survey Report, October 2024, R/V Svea, Sweden

Survey 2024-10-02–2024-10-16

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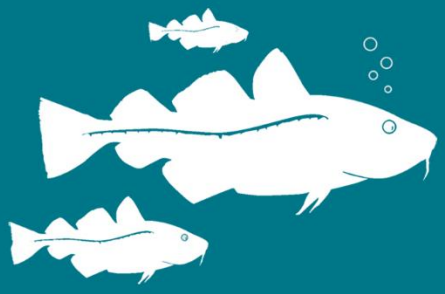

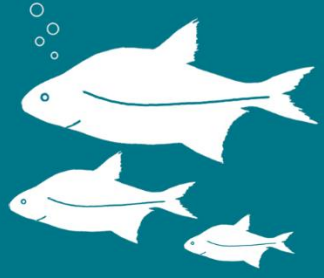

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Baltic International Acoustic Survey Report, R/V Svea, Sweden – Survey 2024-10-02–2024-10-16

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Summary

Internationally coordinated hydroacoustic surveys in the Baltic Sea have been operated by the Institute of Marine Research in Lysekil since 1978. The Baltic International Acoustic Survey (BIAS) is performed annually in October. The survey is mandatory for each EU member state around the Baltic Sea, and is regulated under the European Commission's Data Collection Framework (DCF). Sweden is responsible for collecting data from subdivision (SD) 27 as well as parts of SD 25, 26, 28, and 29. The purpose of the expedition is to assess the stock status of herring and sprat, and this is done by producing an index of abundance each year. The results are reported annually to the International Council for the Exploration of the Sea (ICES) working groups Baltic International Fish Survey (WGBIFS) and the Baltic Fisheries Assessment (WGBFAS).

The 2024 survey was carried out with R/V Svea and commenced with echo sounder calibration on October 2, in Gåsfjärden (57°34.5 N, 16°35.0 E), after which the vessel headed eastward to SD 27 where the data collection started. The survey finished on October 16, in Kalmar (56°40.0 N, 16° 21.0 E). Through the survey, acoustic raw data was continuously collected using a scientific echo sounder (EK80 38 kHz). Biological data was collected through pelagic trawling to obtain information on species composition and length distribution. Acoustic raw data were post-processed using the Large Scale Survey System (LSSS) software. The trawl catches were analysed for species composition and length distribution, and the target species herring, sprat, and cod were also analysed to determine the age structure of each stock. The information on species and lengths from the trawl catches was integrated with the acoustic data to calculate an index of abundance of the fish species.

Guidelines and manuals are managed by WGBIFS and results from each country are compiled into a database. The results are used as an index of abundance by WGBFAS in the estimation of the total stock status of herring and sprat in the Baltic Sea. The results for BIAS were accepted by the WGBIFS and added to the index. Previous results and more information about BIAS and WGBIFS work can be found in the annual reports of the WGBIFS working group.

Sammanfattning

Internationellt koordinerade hydroakustiska expeditioner i Östersjön har regelbundet genomförts av Havsfiskelaboratoriet i Lysekil sedan 1978. 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 datainsamlingen i subdivision (SD) 27 samt delar av SD 25, 26, 28 samt 29. Syftet med expeditionen är att ta fram underlag för bedömning av beståndsstatus för sill och skarpsill. Resultaten rapporteras årligen till Havsforskningsrådets (International Council for the Exploration of the Sea, ICES) arbetsgrupper Baltic International Fish Survey (WGBIFS) och Baltic Fisheries Assessment (WGBFAS).

Expeditionen 2024 genomfördes med R/V Svea och inleddes med kalibrering av ekolod 2024-10-02 i Gåsfjärden (57°34.5 N, 16°35.0 O) och därefter tog sig fartyget österut till SD 27 där datainsamlingen startade. Expeditionen avslutades 2024-10-16 i Kalmar (56°40.0N, 16°21.0 O). Under expeditionen samlades akustiska rådata in med ett vetenskapligt ekolod (Simrad 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 artsammansättning och längdfördelning, målarterna sill, och skarpsill provtogs även för åldersbestämning för att ta fram åldersstruktur för respektive bestånd. Informationen om arter och längder från trålfångsterna integrerades med akustiska data för att räkna fram ett index för biomassan av fiskarterna.

WGBIFS har tagit fram gemensamma riktlinjer och manualer för deltagarna i BIAS och resultaten från varje land sammanställs i en gemensam databas. Resultaten utgör underlag för WGBFAS uppskattning de totala bestånden av sill respektive skarpsill i Östersjön. Resultatet från 2024 års BIAS har godkänts och förts in i WGBIFS gemensamma databas. Tidigare års resultat samt mer information kring BIAS och WGBIFS arbete finns i WGBIFS arbetsgruppens årliga rapporter.

Content

1. 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 commercially used fish stocks and the marine ecosystems, develops and provides biological advice 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 abundance in the Baltic Sea. The survey provides data to the ICES working group Baltic Fisheries Assessment (WGBFAS).

2. Methods

2.1. Narrative

The survey was carried out using the Fisheries Research Vessel, Svea that that has been used for this survey since 2019. The total cruise covered subdivision (SD) 27 and parts of SDs 25, 26, 28 and 29 (Figure 1). The calibration of the SIMRAD EK80 echo sounder was performed in Gåsfjärden (57°34.5 N, 16°35.0 E) on the Swedish east coast. The survey started 2024-10-02 east of Gåsfjärden, and ended 2024-10-16, between mainland Sweden and Öland, close to Kalmar (Figure 2).

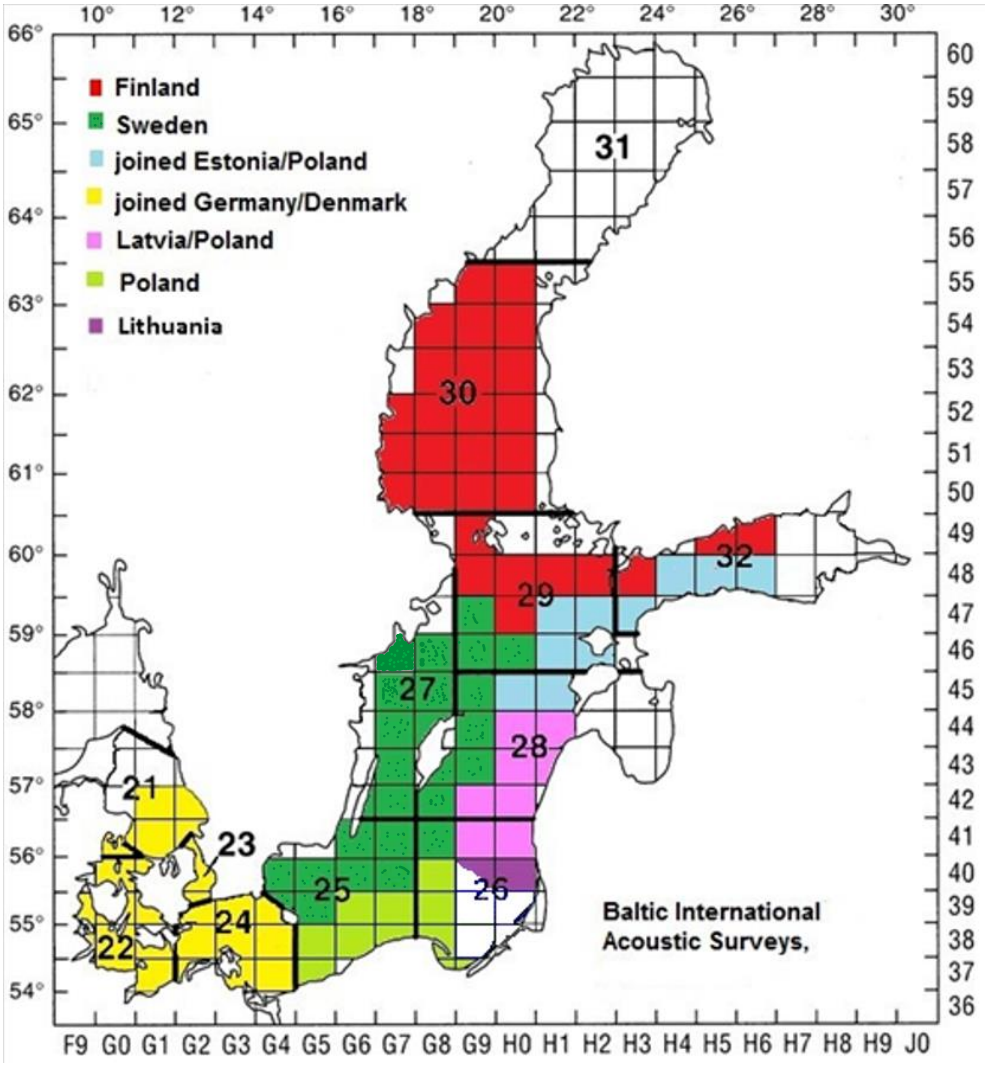

Figure 1. Allocation of ICES squares to each country in the BIAS survey 2024 (On axes: longitude, latitude and ICES name of square eg: 41G8).

2.2. 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 occasional bad weather conditions during surveys the design may in parts be difficult to fulfil. The total area covered in 2024 was 21887 square nautical miles and the distance used for acoustic estimates was 1609 nautical miles. The cruise track and positions of trawl hauls are shown in Figure 2.

2.3. Calibration

The SIMRAD EK80 echo sounder with the 38 kHz transducer was calibrated in Gåsfjärden 2024-10-02, according to manuals (ICES, 2017; Demer *et al.*, 2015). Values from the calibration were within required accuracy.

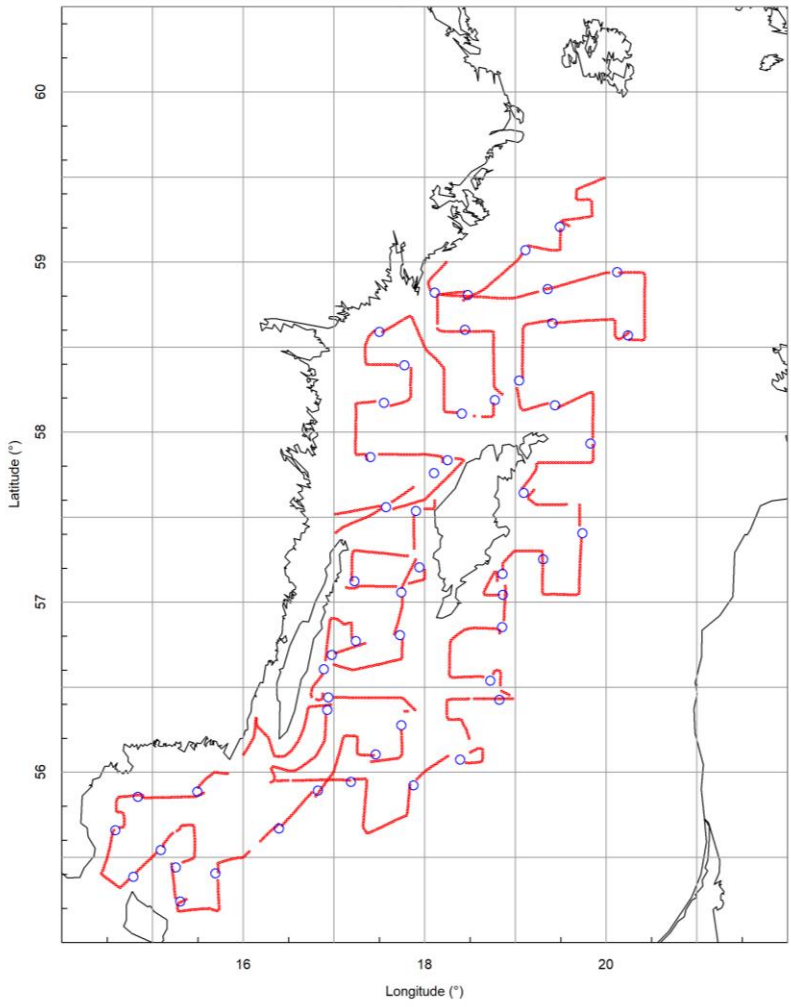

Figure 2. Cruise track (red), positions of trawl hauls (blue) and survey grid of ICES squares (grey) for BIAS 2024.

2.4. 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 hydroacoustic 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 (S_v) were integrated over 1 nautical mile (elementary distance sampling units, EDSUs) from 10 m below the surface to the bottom. Contributions from air bubbles, bottom structures and irrelevant scattering were removed.

2.5. Data analysis

The data analysis was carried out according to ICES 2017. The pelagic target species sprat and herring are usually distributed in mixed layers together with other species so that it was 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 sA and the rectangle area, divided by the corresponding backscattering cross section σ_{bs}. The total number was separated into different fish species according to the mean catch composition in the rectangle.

Table 1. Target strength (TS) relationships.

Type of fish	**Target strength**	**Reference**
Clupeids	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)
Stickleback and salmonids	TS = 20 log L (cm) - 71.2	(ICES, 2017)

2.6. Hydrographic data

CTD (Conductivity, Temperature, Depth) 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.

2.7. Personnel

The participating scientific crew are listed in Table 2.

Table 2. Participating scientific crew.

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

3. Results

3.1. Biological data

In total 53 trawl hauls were carried out, 16 hauls in SD 25, 2 in SD 26, 19 in SD 27, 10 in SD 28 and 6 in SD 29. In total 1454 herring and 1014 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.

3.2. Acoustic data

The survey statistics concerning the survey area [NM^2], the mean nautical area scattering coefficient (SA[m^2/nmi^2]), the mean backscattering cross section (SIGMA[cm^2]), the estimated total number of fish (NTOT[10^6]), the percentages of herring (Hher[%]), sprat (HSpr[%]) and cod (HCod[%]) per SD/rectangle are shown in Table 3.

3.3. Abundance estimates

The estimated 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.

4. Discussion

This year marked the sixth year of using R/V Svea for BIAS. The overall evaluation determined that the survey was accomplished as planned. Some bad weather occurred and thus the planned survey track had to be changed in some parts according to the situation. The data collected during the survey was reviewed and accepted at the WGBIFS meeting and was considered representative for the index of abundance of the pelagic species in 2024 for the covered area (Figure 2). For further information regarding the procedures of WGBIFS see the WGBIFS report (ICES, 2021).

5. Acknowledgements

Special thanks to the participating personnel from the Institute of Marine Research, Department of Aquatic Resources, at the Swedish University of Agricultural Sciences for their invaluable competence and dedication to quality data collection during the BIAS survey. We are also grateful to the crew of R/V Svea for their assistance. This survey is funded by the Swedish Agency for Marine and Water Management, ID: SLU.aqua.2023.5.4-408. Additionally, we extend our appreciation to Thomas Axenrot and Yvette Heimbrand from the Swedish University of Agricultural Sciences, Department of Aquatic Resources, for their insightful reviews, which contributed to enhancing the quality of this work.

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ICES 2017. Manual for the International Baltic Acoustic Surveys (IBAS). Version 2. Series of ICES Survey Protocols (SISP) 8. 47 pp. https://doi.org/10.17895/ices.pub.3368

Tables and figures

Table 3. Survey statistics, see chapter 3.2 for more information.

SD	RECT	AREA	SA	SIGMA	NTOT	HHer	HSpr	HCod
25	39G4	287.3	593.0	1.777	958.69	6.61	93.30	0.081
25	39G5	979.0	109.5	2.469	433.97	50.35	41.07	3.659
25	40G4	677.2	786.5	2.824	1886.46	69.79	29.07	1.103
25	40G5	1012.9	345.0	1.917	1822.96	23.72	76.28	0.000
25	40G6	1013.0	421.4	2.571	1660.29	49.85	49.49	0.294
25	40G7	1013.0	187.9	3.419	556.75	93.06	2.81	1.867
25	41G6	764.4	367.3	1.353	2075.61	32.20	1.38	0.021
25	41G7	1000.0	219.2	2.905	754.47	77.23	20.50	0.651
26	41G8	1000.0	394.2	0.532	7408.98	3.41	2.50	1.837
27	42G6	266.0	163.9	0.466	936.02	4.62	0.50	0.132
27	42G7	986.9	402.4	1.182	3358.38	27.57	2.65	0.379
27	43G7	913.8	242.4	1.132	1956.77	24.17	31.90	0.195
27	44G7	960.5	274.3	0.392	6724.47	0.25	1.27	1.346
27	44G8	456.6	272.9	0.504	2470.58	4.57	13.67	0.065
27	45G7	908.7	515.2	1.156	4050.70	31.68	9.59	0.381
27	45G8	947.2	320.9	0.555	5480.26	2.49	22.02	0.004
27	46G7	452.6	1503.8	1.018	6688.91	44.20	55.60	0.000
27	46G8	884.8	682.0	1.077	5602.63	27.30	67.67	0.000
28	42G8	945.4	647.6	1.044	5864.15	6.66	42.73	0.540
28	43G8	296.2	925.9	1.170	2344.56	25.74	44.98	0.054
28	43G9	973.7	380.1	0.421	8788.47	0.58	0.31	0.060
28	44G9	876.6	374.2	0.716	4580.55	1.62	48.21	0.000
28	45G9	924.5	431.9	0.528	7556.72	1.06	41.26	0.053
29	46G9	933.8	290.2	0.820	3306.92	13.87	36.20	0.015
29	46H0	933.8	256.1	0.406	5889.91	0.30	5.86	0.000
29	47G9	876.2	1066.3	1.925	4852.49	61.96	34.14	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	894	12	30	96	110	301	187	77	0	83
25	39G5	178	16	1	3	43	11	47	24	27	7
25	40G4	548	128	0	40	51	81	207	42	0	0
25	40G5	1391	29	60	77	379	628	159	0	0	58
25	40G6	822	21	22	155	171	238	72	4	70	68
25	40G7	16	0	1	0	0	4	7	1	2	1
25	41G6	29	2	1	5	6	9	2	1	0	2
25	41G7	155	44	2	1	9	47	16	14	12	10
26	41G8	185	10	18	13	5	39	31	16	30	23
27	42G6	5	2	0	0	0	1	0	0	0	0
27	42G7	89	2	13	3	6	34	23	0	0	8
28	42G8	2506	400	0	0	247	1082	393	141	102	141
27	43G7	624	581	6	11	1	14	5	4	0	1
28	43G8	1055	980	0	3	3	16	21	11	10	11
28	43G9	27	24	0	1	0	1	0	0	0	1
27	44G7	85	41	2	1	2	21	15	1	1	2
27	44G8	338	315	3	0	3	13	2	0	0	2
28	44G9	2208	1196	63	112	204	366	120	0	0	148
27	45G7	389	350	3	7	3	5	17	3	0	0
27	45G8	1207	753	4	41	91	129	144	5	0	40
28	45G9	3118	2931	0	60	16	75	34	0	0	1
27	46G7	3719	3702	0	0	0	17	0	0	0	0
27	46G8	3791	3628	27	39	0	32	65	0	0	0
29	46G9	1197	1155	7	0	10	8	8	0	0	8
29	46H0	345	261	2	14	17	19	16	0	5	12
29	47G9	1656	1366	60	59	0	97	47	27	0	0

Table 5. Estimated mean weights (g) of sprat per age group and area (Weight sprat two year old (WS2)).

SD	RECT	WS0	WS1	WS2	WS3	WS4	WS5	WS6	WS7	WS8+
25	39G4	4	12	13	16	16	15	18		17
25	39G5	3	11	10	15	13	16	17	17	18
25	40G4	3		14	18	14	16	17		
25	40G5	3	14	12	16	16	15			18
25	40G6	4	11	12	14	16	17	20	17	14
25	40G7		17			15	17	17	18	17
25	41G6	5	10	12	14	16	16	16		18
25	41G7	5	10	12	14	14	16	16	17	17
26	41G8	4	13	18	11	15	17	17	16	19
27	42G6	5	12	12	15	14	17		17	
27	42G7	3	11	10	14	16	16			16
28	42G8	4			13	14	17	16	15	17
27	43G7	4	11	12	17	16	16	16		18
28	43G8	3		10	18	13	15	13	14	14
28	43G9	3		11		15	14			13
27	44G7	3	10	9	14	14	17	19	19	18
27	44G8	4	12		14	14	16			14
28	44G9	4	10	11	15	13	12			15
27	45G7	4	10	12	13	15	14	16		
27	45G8	4	9	13	14	15	16	18		17
28	45G9	3		12	12	13	13			16
27	46G7	3				10				
27	46G8	4	11	11		15	14			
29	46G9	4	10		13	14	17			13
29	46H0	3	5	11	12	13	15	18	13	15
29	47G9	3	10	10		14	13	14		

Table 6. Estimated number (millions) of herring per age group and area (Number herring two year old (NH2)).

SD	RECT	NHTOT	NH0	NH1	NH2	NH3	NH4	NH5	NH6	NH7	NH8+
25	39G4	63	37	9	8	6	1	1	2	0	0
25	39G5	218	49	6	36	38	36	33	9	8	3
25	40G4	1316	253	252	233	39	128	281	123	8	0
25	40G5	432	195	100	62	24	13	25	5	3	5
25	40G6	828	14	71	333	3	71	275	37	23	0
25	40G7	518	2	0	49	58	73	100	176	19	42
25	41G6	668	0	0	124	133	73	225	54	7	52
25	41G7	583	0	0	70	28	58	34	255	69	68
26	41G8	253	3	0	59	41	43	52	40	14	0
27	42G6	43	0	0	16	0	4	14	9	0	0
27	42G7	926	0	6	33	252	89	260	179	64	43
28	42G8	391	11	0	57	46	96	40	103	34	4
27	43G7	473	17	0	199	56	5	119	67	3	5
28	43G8	603	35	1	286	0	26	41	182	3	29
28	43G9	51	0	0	13	5	7	17	8	1	1
27	44G7	17	3	0	4	0	1	5	2	0	1
27	44G8	113	16	0	16	3	4	22	40	2	9
28	44G9	74	46	7	21	0	0	0	0	0	0
27	45G7	1283	18	16	605	64	447	95	39	0	0
27	45G8	136	32	4	39	2	9	40	10	0	0
28	45G9	80	62	1	5	1	3	4	2	1	1
27	46G7	2957	1803	83	743	144	29	126	29	0	0
27	46G8	1530	331	76	496	110	237	195	83	0	1
29	46G9	459	27	1	98	19	135	94	37	48	0
29	46H0	17	13	0	1	2	1	1	0	0	0
29	47G9	3007	59	167	21	1363	228	515	617	36	0

Table 7. Estimated mean weights (g) of herring per age group and area. (Weight herring two year old (WH2))

SD	RECT	WH0	WH1	WH2	WH3	WH4	WH5	WH6	WH7	WH8+
25	39G4	15	28	46	60	48	41	70		
25	39G5	15	31	36	59	63	48	45	71	55
25	40G4	15	33	37	66	65	59	60	77	
25	40G5	16	33	43	51	58	58	56	54	68
25	40G6	17	47	39	67	52	53	59	61	
25	40G7	19		34	42	48	50	57	65	53
25	41G6			34	48	49	46	52	56	43
25	41G7			34	36	43	40	47	54	62
26	41G8	8		35	51	43	48	48	55	
27	42G6			35		42	45	48		
27	42G7		24	40	34	48	48	48	52	52
28	42G8	5		33	32	45	36	47	52	53
27	43G7	7		36	33	38	45	46	63	47
28	43G8	5	22	33		34	42	48	56	46
28	43G9	4		32	40	31	40	46	55	43
27	44G7	5	23	30	31	39	38	44		55
27	44G8	5		32	30	35	38	46	42	43
28	44G9	5	24	33		35	38			
27	45G7	5	24	32	38	33	45	44		
27	45G8	5	26	31	31	39	37	47		
28	45G9	5	13	31	34	30	38	42	42	42
27	46G7	6	21	28	33	40	37	44		
27	46G8	6	21	30	27	31	32	44		54
29	46G9	5	27	28	28	34	36	45	39	
29	46H0	5	21	34	27	31	35			39
29	47G9	6	25	22	30	29	34	36	40	

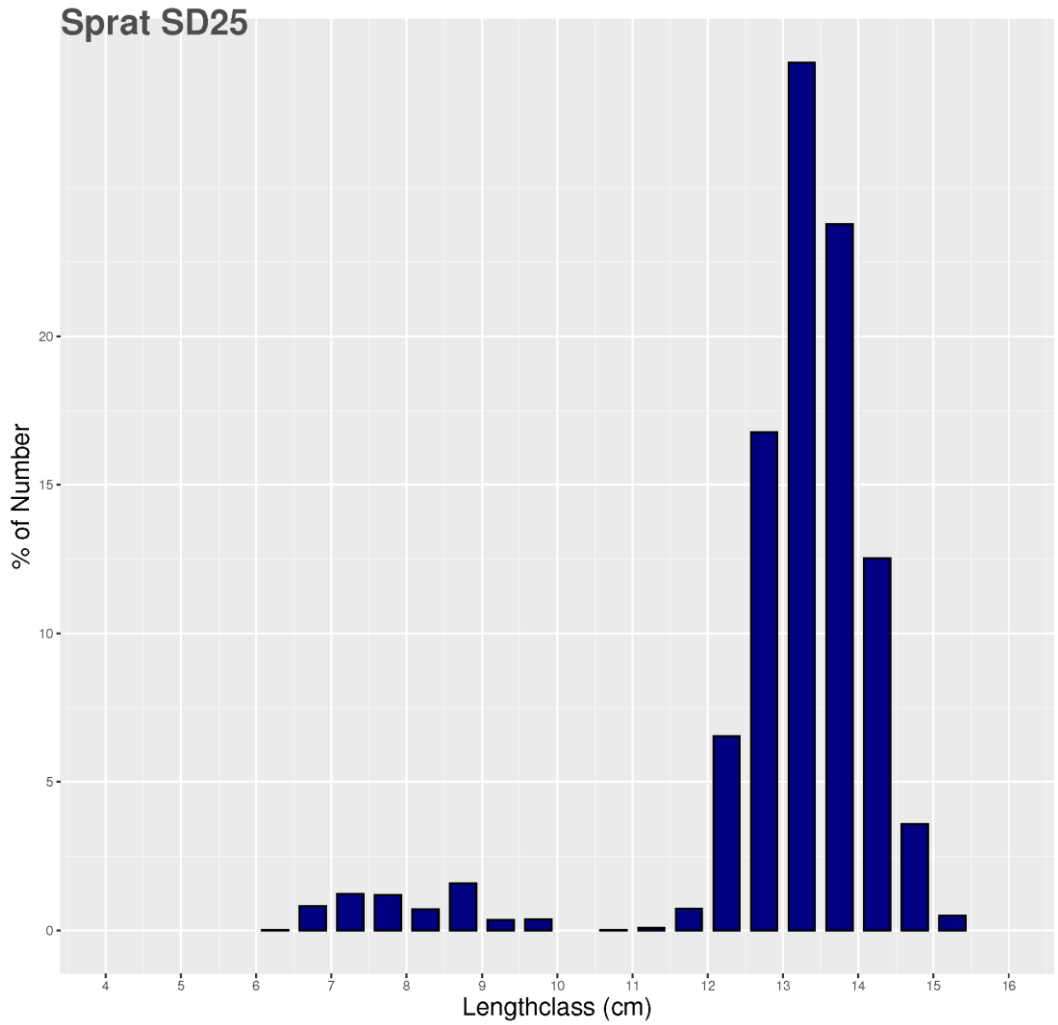

Figure 3. Length distribution of sprat from subdivision 25 for BIAS 2024.

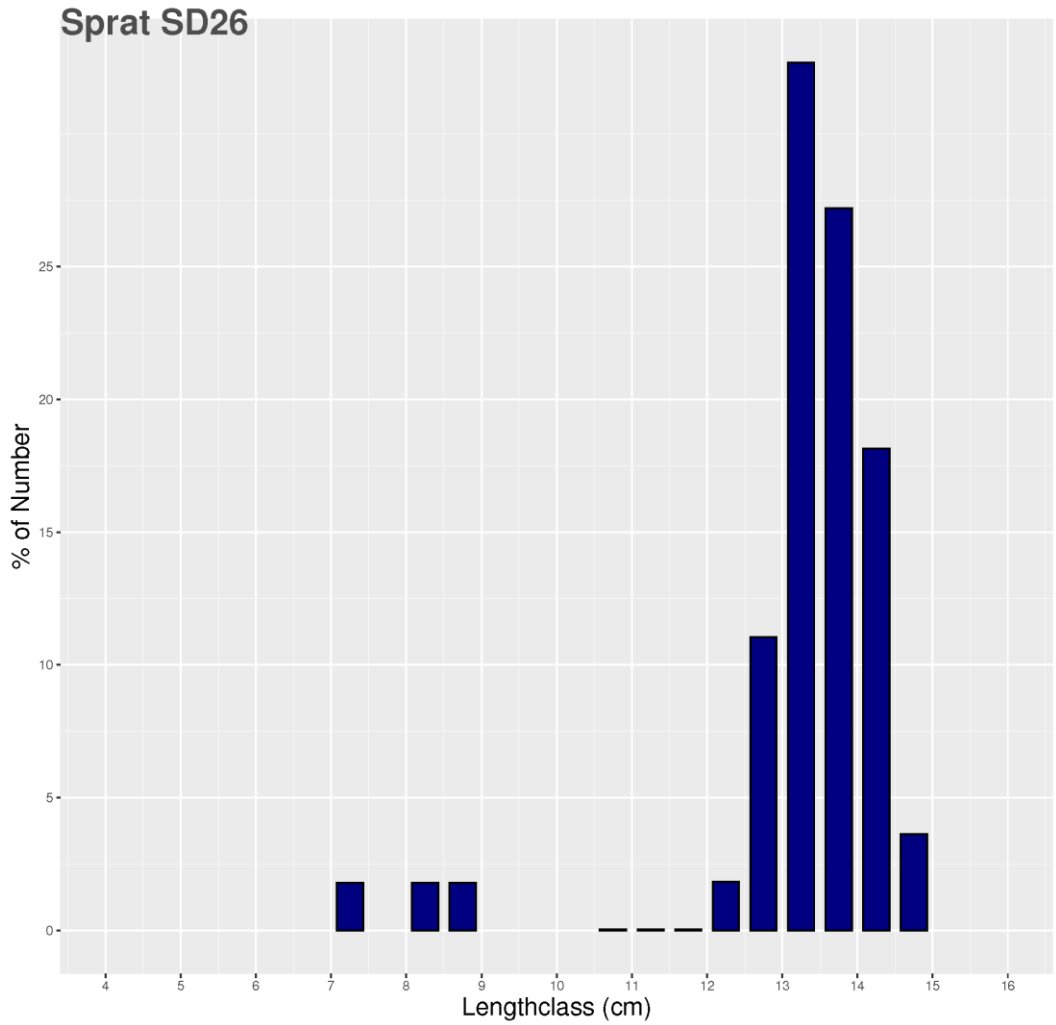

Figure 4. Length distribution of sprat from subdivision 26 for BIAS 2024.

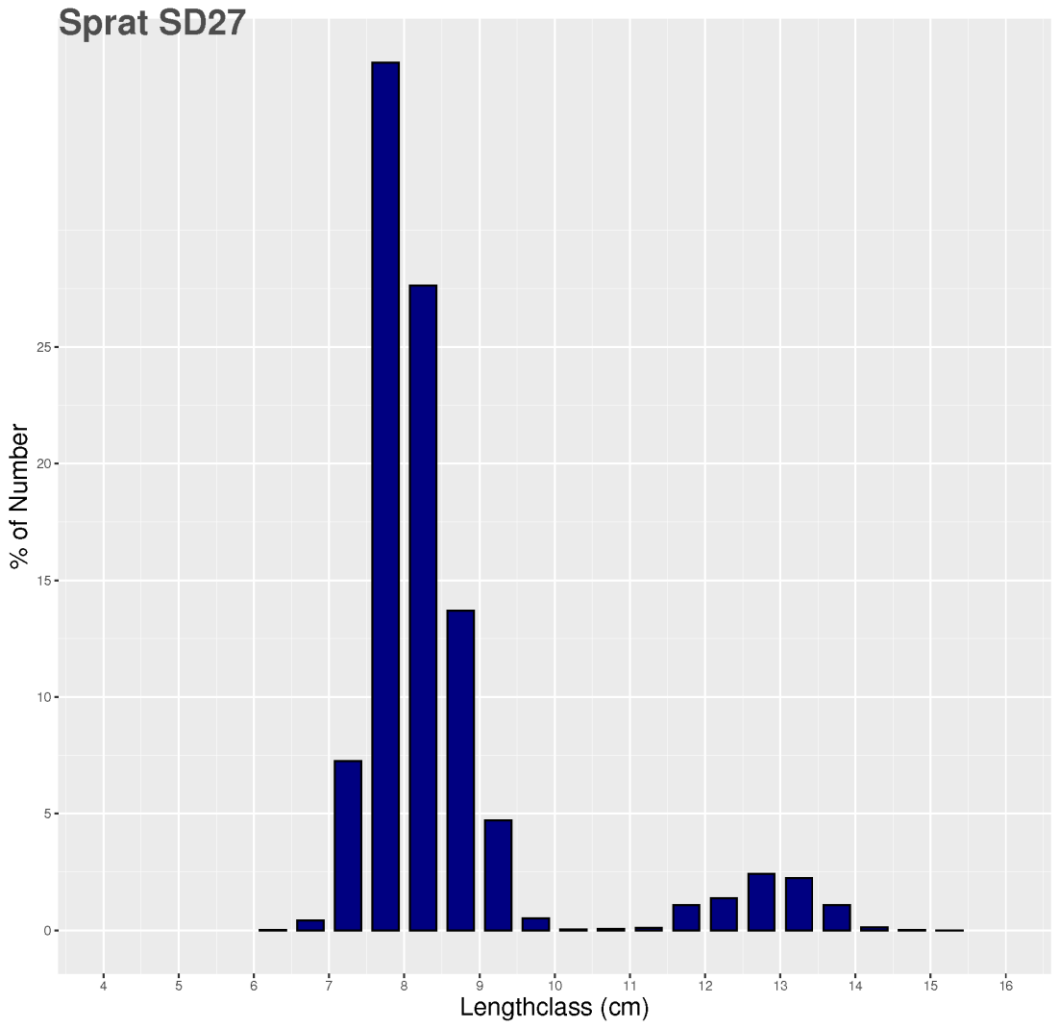

Figure 5. Length distribution of sprat from subdivision 27 for BIAS 2024.

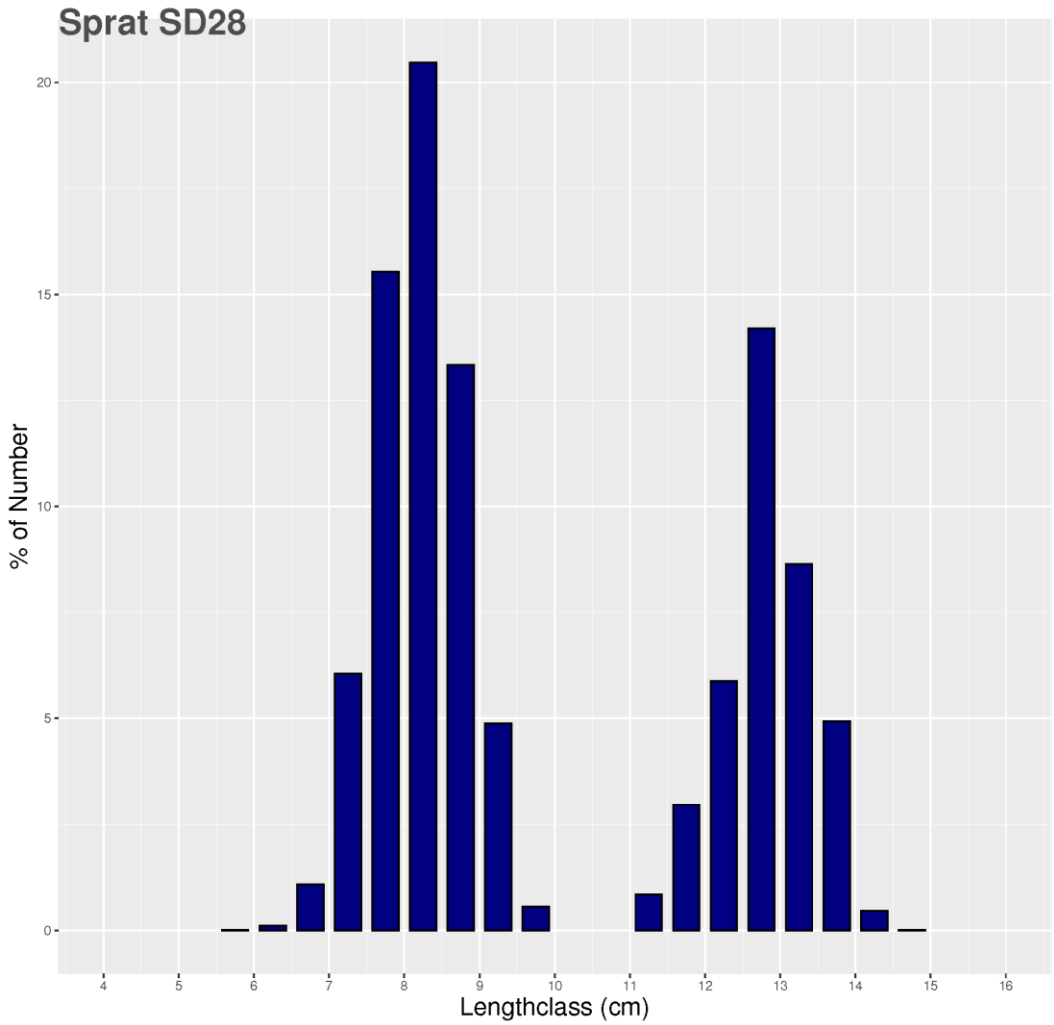

Figure 6. Length distribution of sprat from subdivision 28 for BIAS 2024.

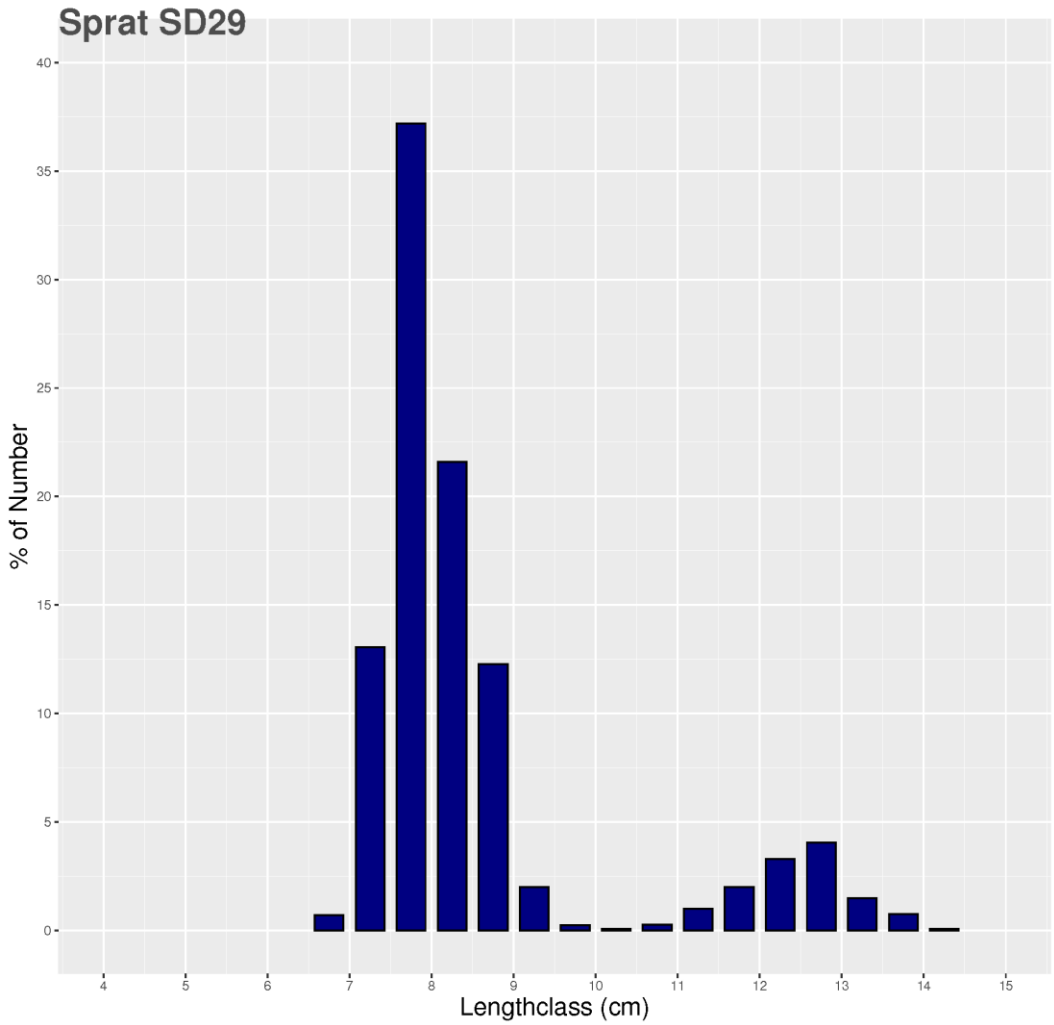

Figure 7. Length distribution of sprat from subdivision 29 for BIAS 2024.

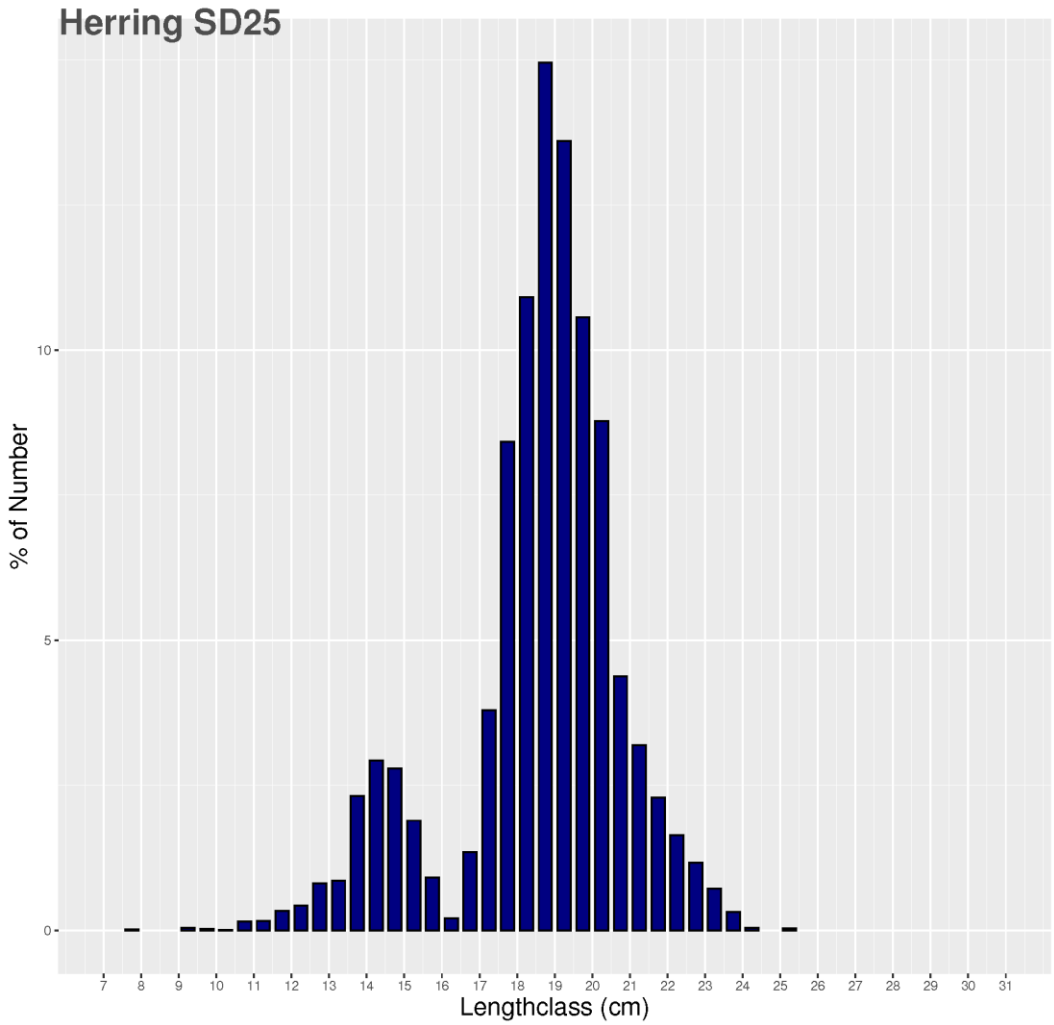

Figure 8. Length distribution of herring from subdivision 25 for BIAS 2024.

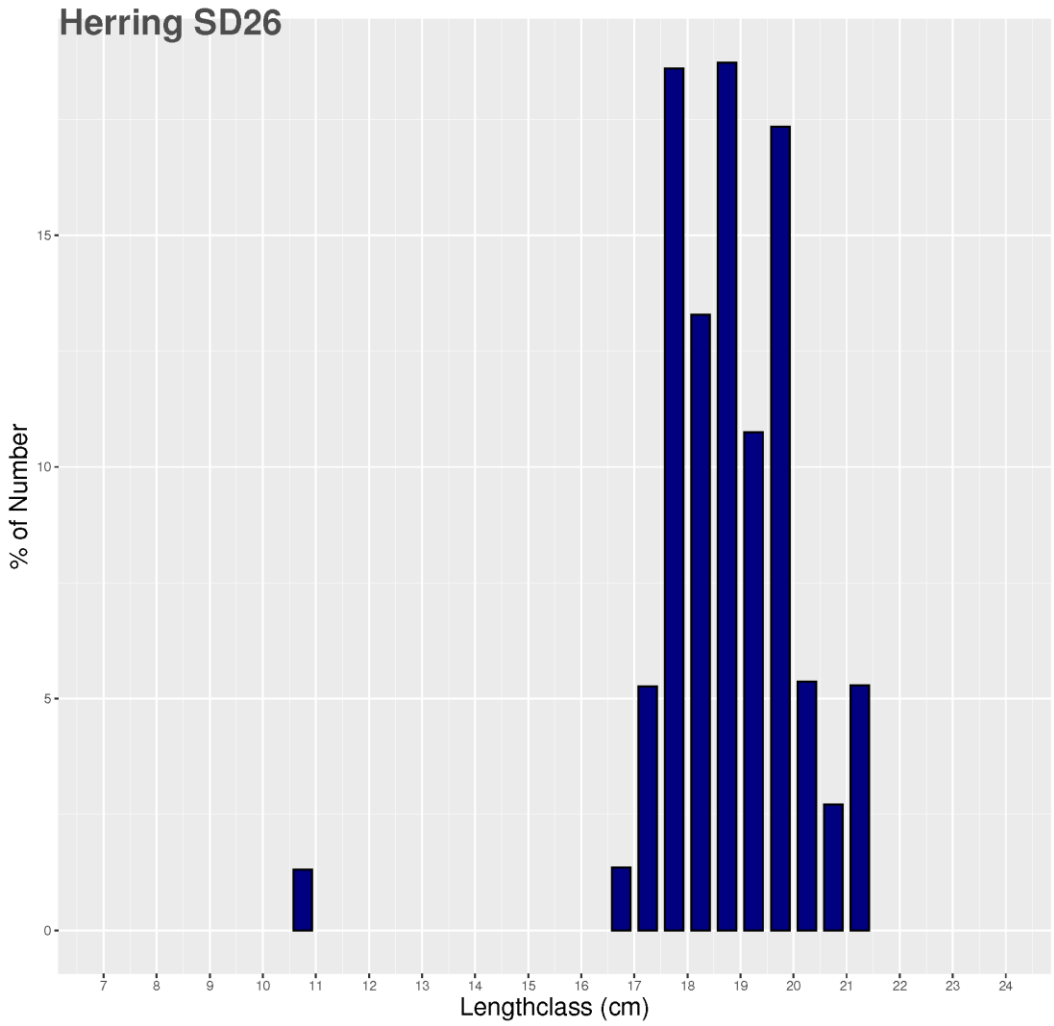

Figure 9. Length distribution of herring from subdivision 26 for BIAS 2024.

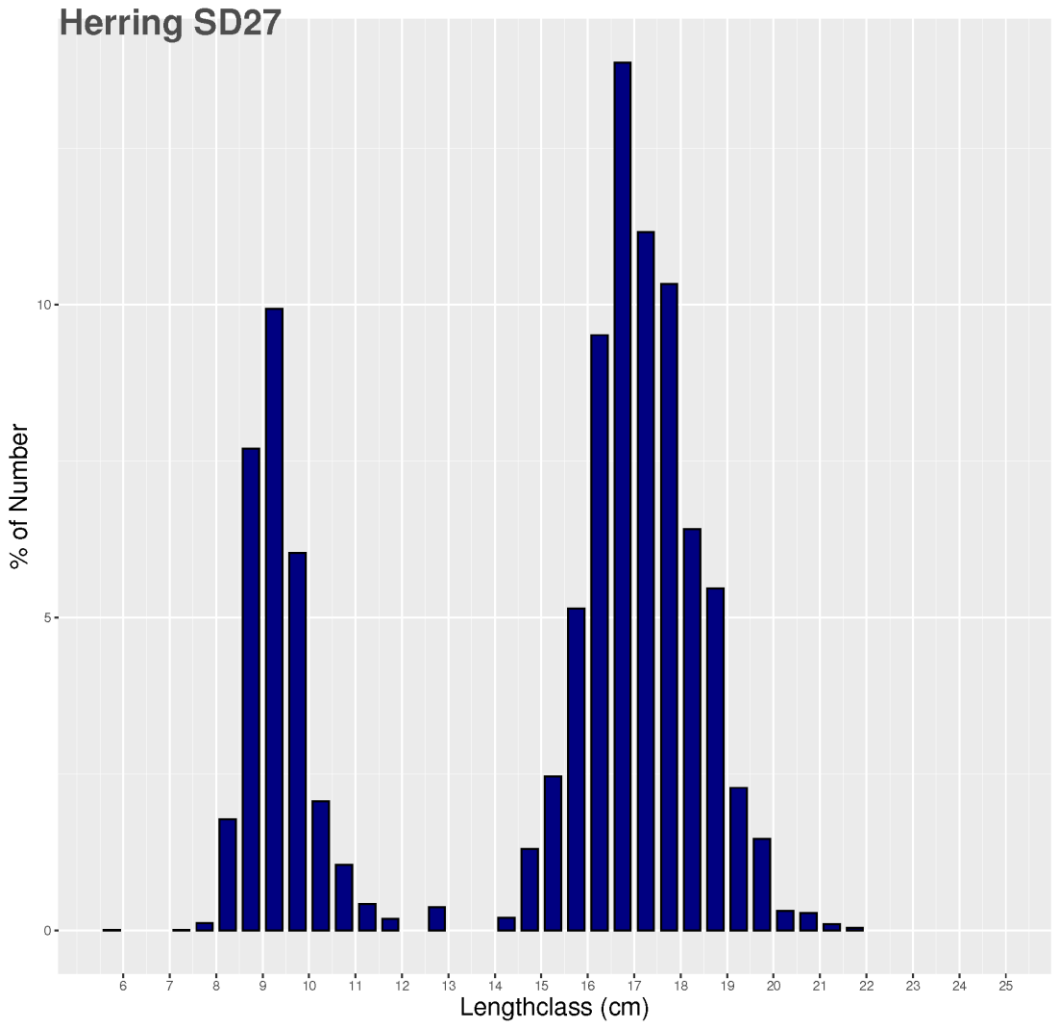

Figure 10. Length distribution of herring from subdivision 27 for BIAS 2024.

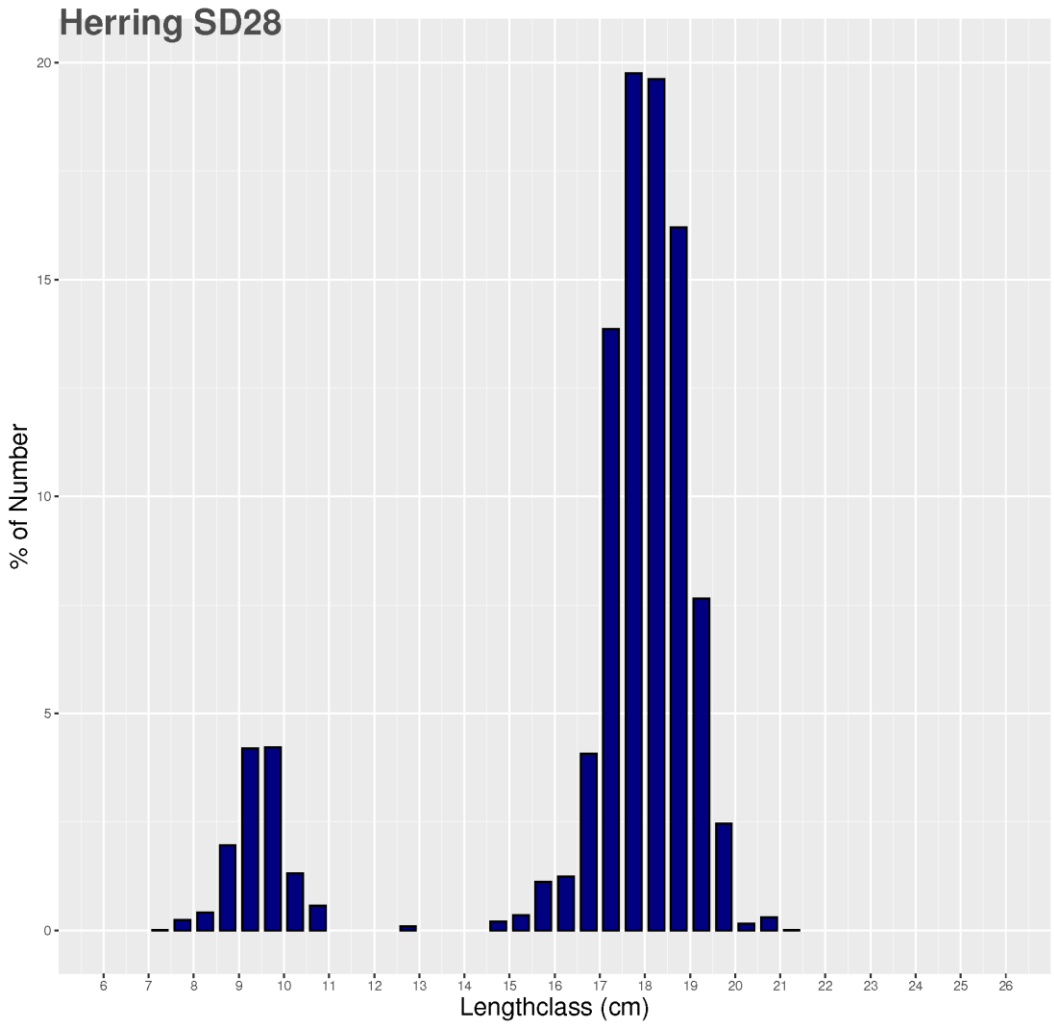

Figure 11. Length distribution of herring from subdivision 28 for BIAS 2024.

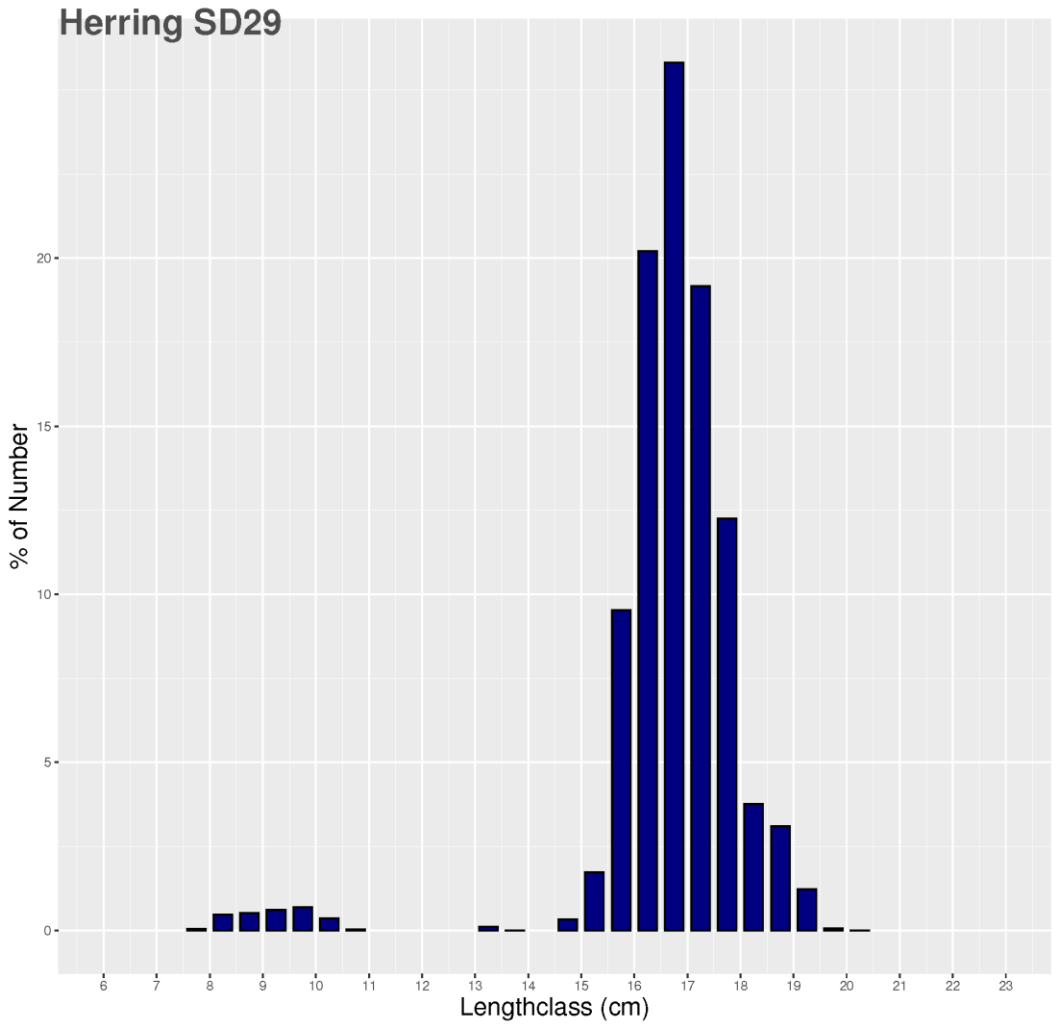

Figure 12. Length distribution of herring from subdivision 29 for BIAS 2024.