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ICES WORKING GROUP ON BALTIC INTERNATIONAL FISH SURVEY (WGBIFS; outputs from 2020 meeting)

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Contents

i Executive summary

The Baltic International Fish Survey Working Group (WGBIFS) plans, coordinates, and implements demersal trawl surveys and hydroacoustic surveys in the Baltic Sea including the Baltic International Acoustic Survey (BIAS), the Baltic Acoustic Spring Survey (BASS), and the Baltic International Trawl Surveys (BITS) in the 1st and 4th quarter on an annual basis. The group compiles results from these surveys and provides the herring, sprat, cod and flatfish abundance indices for the Baltic Fisheries Assessment Working Group (WGBFAS) to use as tuning fleets.

In 2020, WGBIFS completed the following tasks: (1) compiled survey results from 2019 and the first half of 2020, (2) planned and coordinated all Baltic fish stocks assessment relevant surveys for the second half of 2020 and the first half of 2021, (3) updated the common survey manuals according to decisions made during the annual WGBIFS meeting. Data from the recent BITS was added to the ICES Database of Trawl Surveys (DATRAS). The Tow-Database, which allows planning the spatial distribution of hauls in the areas where the seabed is suitable for safety trawling, was corrected and updated. The Access-databases for aggregated acoustic data and the ICES database of acoustic-trawl surveys for disaggregated data were also updated. All countries also registered collected litter materials to DATRAS.

The area coverage and the number of control hauls in the BASS and in the BIAS in 2019 were considered to be appropriate to the calculation of tuning indices and the data can be used for the assessment of Baltic herring and sprat stocks. The number of valid hauls accomplished during the 4th quarter 2019 and 1st quarter 2020 BITS were considered by the group as appropriate to tuning series and the data can be used for the assessment of Baltic and Kattegat cod and flatfish stocks. Survey sampling variance calculations were also conducted for the BIAS and BASS surveys from 2012 to 2019.

A comparison exercise between the StoX and traditional BIAS calculation methods was performed for the SD 30 herring. It was found that the StoX project, developed for the WGBIFS, has small methodological differences compared to the standard calculation method used by the group, as specified in the Manual for the International Baltic Acoustic Surveys, (IBAS) and is thereby causing a small difference in the total number of herring. Nevertheless, WGBIFS decided to recommend for the assessment purpose that the herring abundance time-series is calculated with StoX.

WGBIFS is planning to perform in the coming years analogical comparison exercises between the StoX and IBAS calculation methods also for all other acoustic index series before the final transition to StoX and to a transparent reproducible pathway into the ICES Transparent Assessment Framework (TAF) can be done.

ii Expert group information

Expert group name	Baltic International Fish Survey Working Group (WGBIFS)
Expert group cycle	Multiannual fixed term
Year cycle started	2018
Reporting year in cycle	3/3
Chair(s)	Olavi Kaljuste, Sweden
Meeting venue(s) and dates	24–28 March 2018, Lyngby-Copenhagen, Denmark, (24 participants)
	25–29 March 2019, Klaipeda, Lithuania, (21 participants)
	30 March – 3 April 2020, web meeting, (22 participants)
	1–3 December 2020, web meeting, (13 participants)

1 Terms of Reference

TOR	Description	Background	Science plan codes	Duration	Expected deliverables
a	Combine and analyse the results of spring and autumn acoustic surveys and experiments	Acoustic surveys provide important fishery-independent stock estimates for Baltic herring and sprat stocks	3.1	Annually Year 1, 2 and 3	Updated acoustic tuning index for WGBFAS
b	Update the BIAS and BASS hydroacoustic databases and ICES database for acoustic-trawl surveys	The aim of BIAS and BASS databases is to store the aggregated data. The aim of ICES database is to ensure that the standardized and quality-controlled scrutinized data from the acoustic-trawl surveys will be stored centrally in a safe way and enables easy access to the data, which will facilitate usage for many different analyses by a wider range of users.	3.1	Annually Year 1, 2 and 3	Updated databases with acoustic and biotic data for WGBIFS
c	Coordinate and plan acoustic surveys including any experiments to be conducted	Acoustic surveys provide important fishery-independent stock estimates for Baltic herring and sprat stocks	3.1	Annually Year 1, 2 and 3	Finalized planning for the surveys for WGBIFS
d	Discuss the BITS surveys results and evaluate the characteristics of TVL and TVS standard gears used in BITS	Demersal trawl surveys provide important fishery-independent stock estimates for Baltic cod and flatfish stocks	3.1	Annually Year 1, 2 and 3	Updated BITS data in DATRAS database for ICES Data Centre and WGBFAS
e	Coordinate and plan demersal trawl surveys and experiments to be conducted, and update and correct the Tow Database	Demersal trawl surveys provide important fishery-independent stock estimates for Baltic cod and flatfish stocks	3.1	Annually Year 1, 2 and 3	Finalized planning for the surveys for WGBIFS, updated and corrected Tow Database
f	Conduct analyses related to the improvement of quality of acoustic indices and estimation of the uncertainty in the BIAS and BASS surveys	Acoustic surveys provide important fishery-independent stock estimates for Baltic herring and sprat stocks	3.1, 3.2, 3.3	Year 1-3	Improved quality of acoustic indices with estimates of the uncertainty for WGBFAS
g	Update on progress in development of the StoX software and implementation of it for the calculation of WGBIFS acoustic stock estimates, based on the IBAS methodology and data from ICES acoustic-trawl survey database	StoX software produces fish abundance estimations in a transparent and reproducible way. Planned development of the StoX post-processing program should allow implication this software by WGBIFS using the acoustic and biotic data from ICES database for acoustic-trawl surveys.	3.1, 3.2	Year 1-3	Improved transparency and reproducibility of acoustic indices, improved pace of work on the level of national data compilation and verification

		Comparisons will be performed to validate whether the StoX software provides us similar results as the current IBAS calculation method in order to allow WGBIFS to use it as a new standard tool for the calculation of annual BIAS and BASS survey estimates.			
h	Define methods for the appropriate processing of the survey data and output products from the BITS survey to deliver input-data for calculation of the Baltic LFI and MML indicators.	The ground trawl surveys provide important fishery-independent stock estimates for baltic cod and flatfish stocks and can be a source of the ecosystem indicators, recently requested by different scientific organizations	3.1, 3.2	Year 1, 2 and 3	Improvement the scientific knowledge about the demersal/benthic components (mostly fish) in the Baltic Sea
i	Coordinate the marine litter-sampling programme within the Baltic International Trawl Survey and registering the data in the ICES database.	Collected and registered information about the marine litter (mostly anthropogenic origin), occasionally appeared in the ground trawl fish control-catches, are additional source of data about present ecological status of marine seabed in investigated areas of the baltic.	3.1	Annually Year 1, 2 and 3	Coordinated the marine litter sampling programme in the Baltic International Trawl Survey (BITS).
j	Agree a standard pelagic trawl gear used in BIAS and BASS surveys	Acoustic surveys provide important fishery-independent estimates for baltic herring and sprat stocks size and possible uncertainties, which result from, e.g. different type of fishing gears applied for fish control-catches, should be eliminated.	3.1, 3.2	Year 1-3	Agreement on the standard pelagic fishing gear which will be used in the BIAS and BASS surveys
k	Review and update the International Baltic Acoustic Surveys (IBAS) manual and address methodological question raised at the last review of the SISP	Acoustic surveys provide important fishery-independent stock estimates for baltic herring and sprat stocks	3.1, 3.2	Year 3	Updated IBAS manual for WGBIFS (SISP 8)
l	Review and update the Baltic International Trawl Survey (BITS) manual and address methodological question raised at the last review of the SISP	Demersal trawl surveys provide important fishery-independent stock estimates for baltic cod and flatfish stocks	3.1, 3.2	Year 3	Updated BITS manual for WGBIFS (SISP 7)

2 Summary of the Work Plan for Year 3

- Combined survey results from 2019 and the first quarter of 2020 and updated tuning indices for WGBFAS (ToR a and d).
- Updated databases with acoustic and biotic data (ToR b).
- Finalized coordination and planning for the BASS, BIAS and BITS surveys in 2020 and first half of 2021, updated and corrected Tow Database (ToR c and e).
- Uncertainties were estimated in the BIAS and BASS surveys from 2012 to 2019 (ToR f).
- Progress towards to validate the StoX software in order to allow WGBIFS to use it as a new standard tool for the calculation of annual BIAS and BASS survey estimates (ToR g).
- Progress in delivering input-data for the calculation of the Baltic LFI and MML indicators (ToRh).
- Coordinated marine litter sampling programme in the BITS surveys and registered data in the ICES database (ToR i).
- Progress towards an agreement in the standard pelagic fishing gear to be used in the BIAS and BASS surveys (ToR j).
- Final review and update of the IBAS and BITS manuals (ToR k and l).

3 Summary of outcomes and achievements of the WG during 3-year term

Indices for the pelagic and demersal fish stocks in the Baltic Sea from annual surveys as fishery-independent data for analytical assessment purposes in WGBFAS:

- Calculated BASS tuning fleet index for Baltic sprat in SDs 24–26 and 28.2 (abundance per age in the age groups 1-8+).
- Calculated BIAS tuning fleet index for Baltic sprat in SDs 22–29 (abundance per age in the age groups 1-8+).
- Calculated BIAS tuning fleet index for Baltic sprat recruitment in SDs 22–29 (abundance at age 0).
- Calculated BIAS tuning fleet index for Baltic herring in SDs 25–29 (abundance per age in the age groups 1-8+).
- Calculated BIAS tuning fleet index for Baltic herring recruitment in SDs 25–29 (abundance at age 0).
- Calculated BIAS tuning fleet index (in StoX) for Baltic herring in SD 30 (abundance per age in the age-groups 0-15+).
- Uploaded data from the 1st and 4th quarter BITS surveys to the DATRAS database to be used for the calculation of survey indices for the relevant cod and flatfish stocks.

Other survey-derived products:

- Annual maps of BASS and BIAS area coverage.
- Annual geographical distribution maps of sprat abundance in the Baltic Sea (May-June; BASS surveys).
- Annual geographical distribution maps of sprat, herring and cod abundance in the Baltic Sea (September-October; BIAS surveys).
- Updated Access-databases for aggregated acoustic data (BASS_DB.mdb and BIAS_DB.mdb).
- Updated ICES database of acoustic-trawl surveys for disaggregated data.
- Updated and corrected the Tow-Database which allows planning the spatial distribution of hauls in the areas, where the seabed is suitable for safety trawling.
- Estimated uncertainties for the BIAS and BASS surveys from 2012 to 2019.

Other outcomes and achievements:

- Agreed plans (time and spatial coverage by countries) for the next standard acoustic surveys.
- Agreed plans (time and number of planned stations by countries) for the next standard BITS surveys.
- Performed comparison exercise between the StoX and traditional BIAS calculation methods for the SD 30 herring.
- 6 recommendations (Annex 4) was made to ICES Data Centre and to other ICES Working Groups.
- Updated action list (Annex 5) for WGBIFS members.

4 Final report on ToRs and Work Plan

4.1 ToR a) Combine and analyse the results of spring (BASS) and autumn (BIAS) 2019 acoustic surveys and report to WGBFAS

4.1.1 Combined results of the Baltic International Acoustic Survey (BIAS)

In September - October 2019, the following acoustic surveys were conducted in the ICES Subdivisions 21-32 (excl. ICES SD 31) however, in some subdivisions only in parts:

Country	Data	Vessel	ICES SDs	Length of acoustic transects [NM]	Number of hauls	Number of hydrological stations
Finland	25.09-05.10.2019	Aranda	30, parts of 29 and 32	1600	43	43
Poland	15-30.09.2019	Baltica	Parts of 25 and 26	777	27	37
Latvia-Poland	11-20.10.2019	Baltica	Parts of 26 and 28	611	19	24
Estonia-Poland	21-31.10.2019	Baltica	Parts of 28.2, 29 and 32	468	21	21
Sweden	08-20.10.2019	Svea	27, parts of 25, 26, 28 and 29	1358	46	46
Lithuania	30-31.10.2019	Atlant	Part of 26	123	5	5
Germany	01-21.10.2019	Solea	22, 23, 24 and parts of 21	1124	45	76

4.1.1.1 Area under investigation and overlapping areas

Each the ICES statistical rectangle of the area under investigation was allocated to one country during the WGBIFS meeting in 2005. Thus each country has a mandatory responsible area, where the acoustic transects of length about 60 NM per 1000 NM^2 area and at least two fish catch-stations should be performed. However, it is allowed for all nations to cover also other areas, the results from the responsible country are used if these data are available.

The Figure 4.1.1.1.1 illustrates that the coverage of the Baltic Sea during the BIAS-2019 survey, was exactly as it was planned during the WGBIFS 2019 meeting. Overall, 117 statistical ICES rectangles were inspected and reported, therein 115 ICES rectangles investigated by one country and two ICES rectangles inspected and reported by two countries, namely 40G9 by Latvian and Russian and 48H4 by Estonian and Finland. Also, four ICES rectangles were inspected additionally by another country, namely 38G9 and 39G9 by Poland, 43G9 by Latvia and 48H5 by Finland, however, its data were not included into the final analysis. Investigations in the eastern part of the ICES SD 32 (the Russian zone) were not planned and remain not realized.

Additionally, the Estonian-Latvian acoustic survey in the Gulf of Riga was conducted in July-August 2019, as was planned during WGBIFS 2019 meeting. The survey results from the recent years are accessible at the national level, however, were not uploaded to the WGBIFS database.

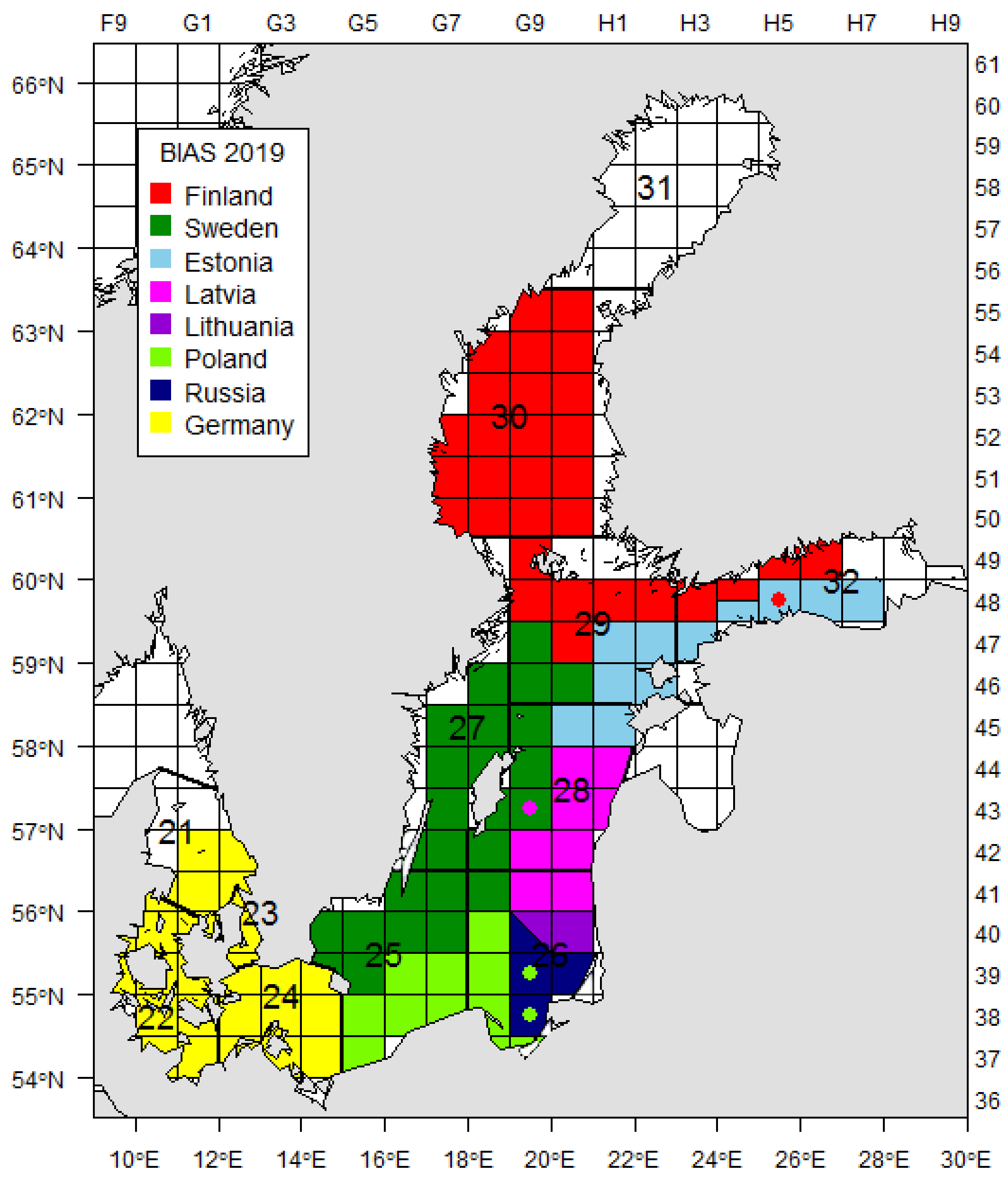


Figure 4.1.1.1.1. Map of the BIAS survey conducted in September-October 2019. Various colours indicate the countries, which covered specific ICES rectangles or its part and delivered data to BIAS-database, thus was responsible for this rectangle. Dot with different colour within a rectangle explain additional data in BIAS-database partly or totally covered by other countries (not included into final analysis).

4.1.1.2 Total results

Geographical distribution of herring, sprat and cod abundance in the Baltic Sea, accordingly to the ICES rectangles inspected in September-October 2019 is illustrated in Figures 4.1.1.2.1 - 4.1.1.2.5.

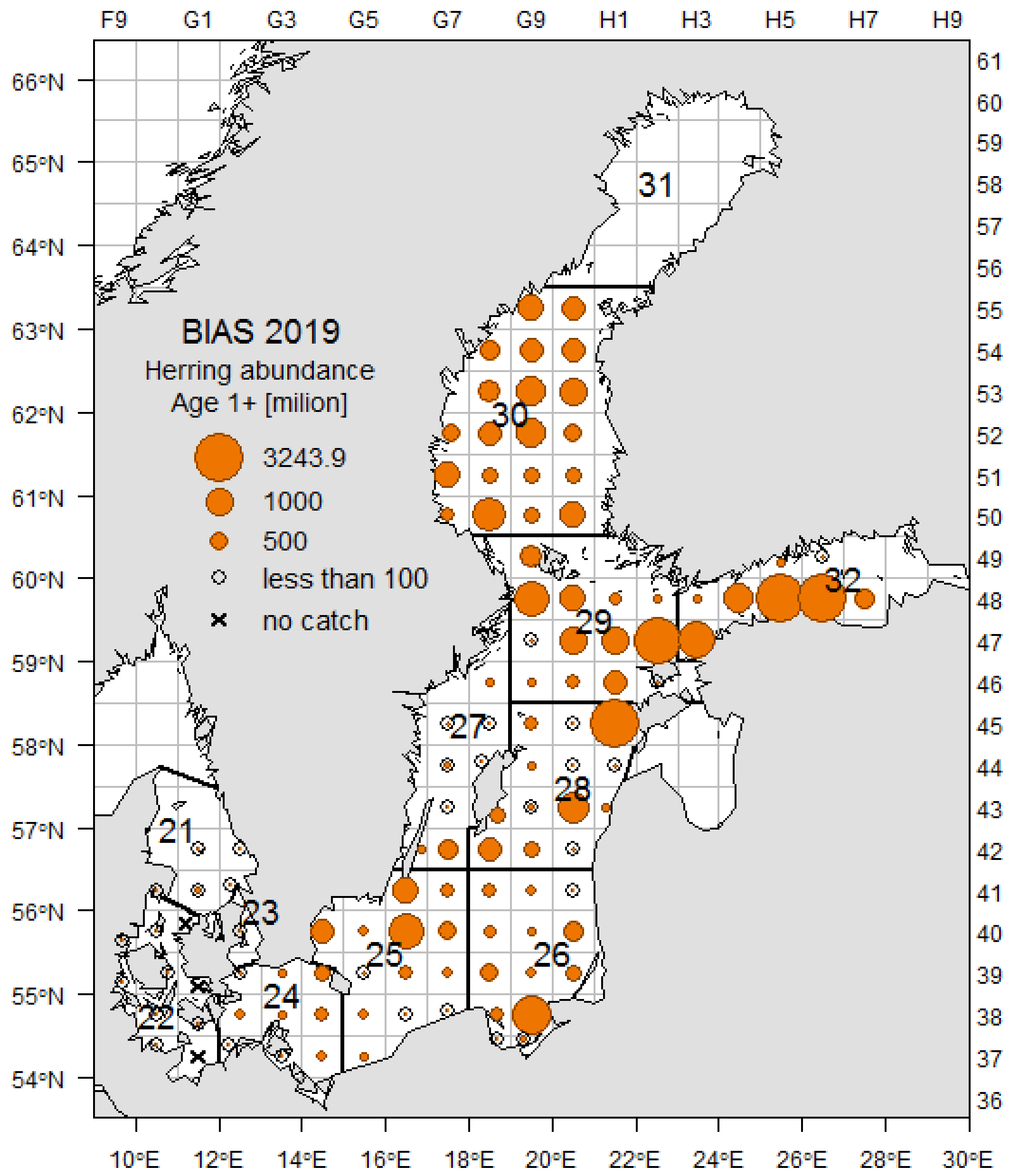


Figure 4.1.1.2.1. The abundance of herring (age 1+) per ICES rectangles monitored in September-October 2019 (the area of circles indicates estimated numbers of specimens x10^6 in given rectangle).

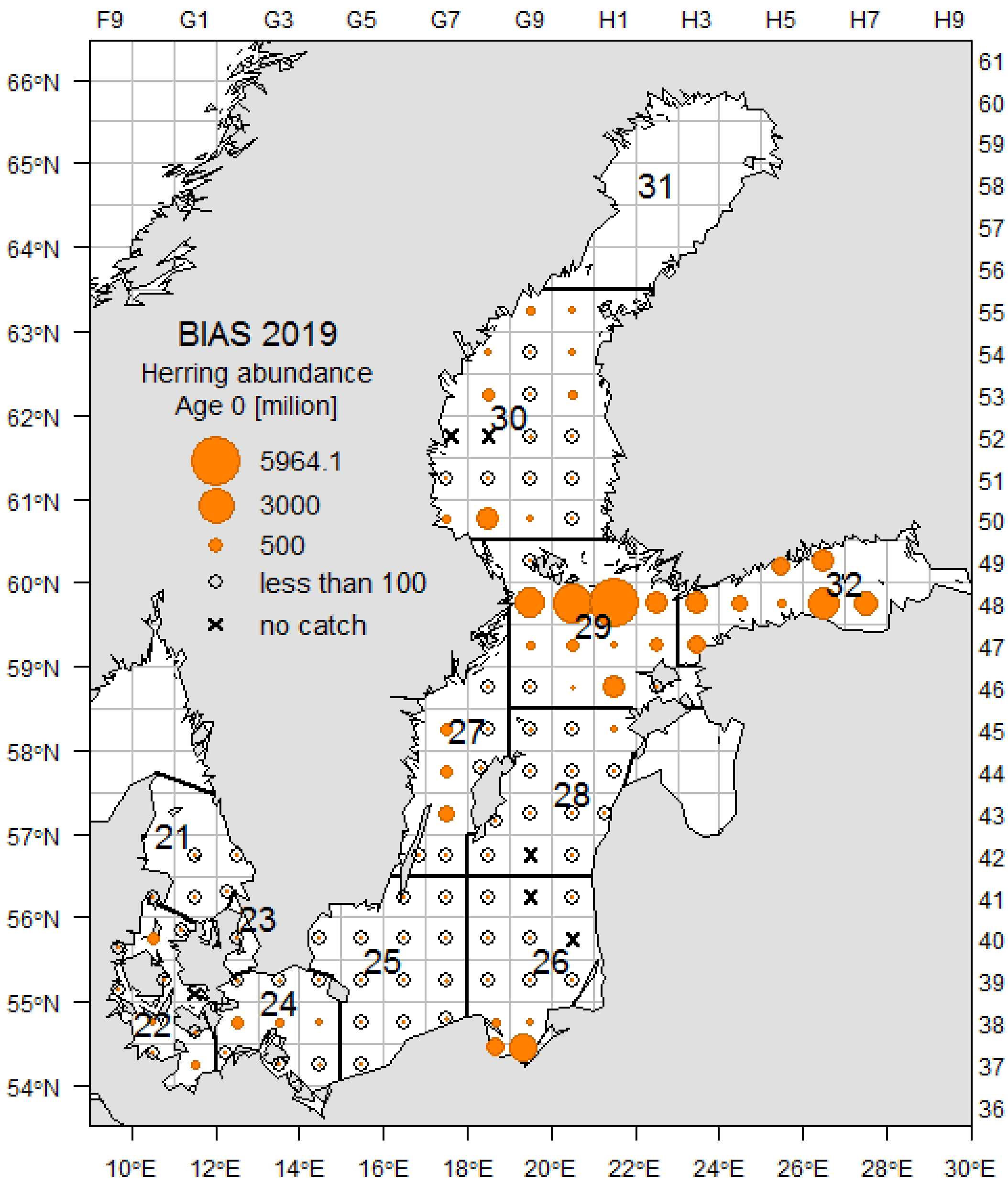


Figure 4.1.1.2.2. The abundance of herring (age 0) per ICES rectangles monitored in September-October 2019 (the area of circles indicates estimated numbers of specimens x10^6 in given rectangle).

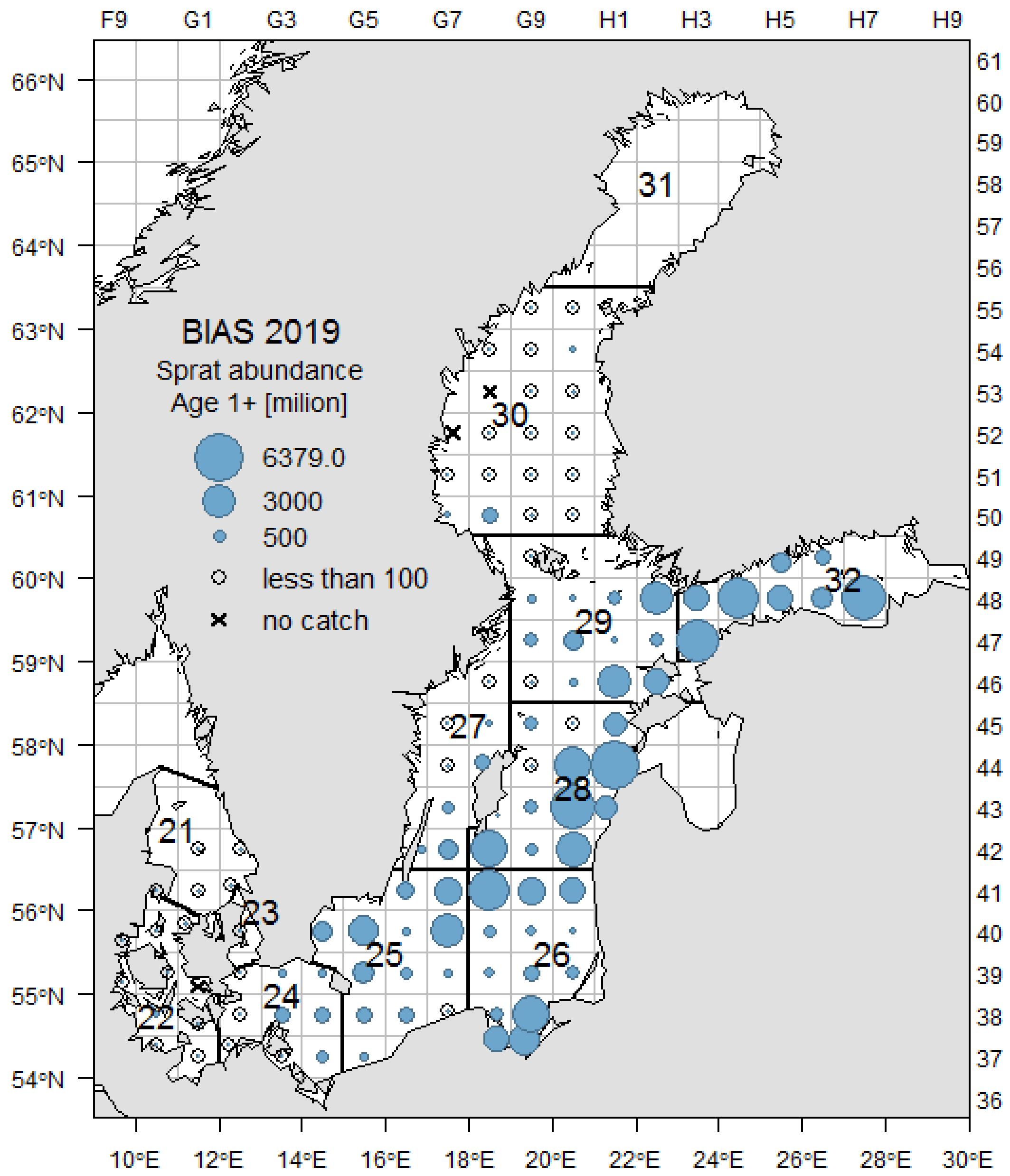


Figure 4.1.1.2.3. The abundance of sprat (age 1+) per ICES rectangles monitored in September-October 2019 (the area of circles indicates estimated numbers of specimens x10^6 in given rectangle).

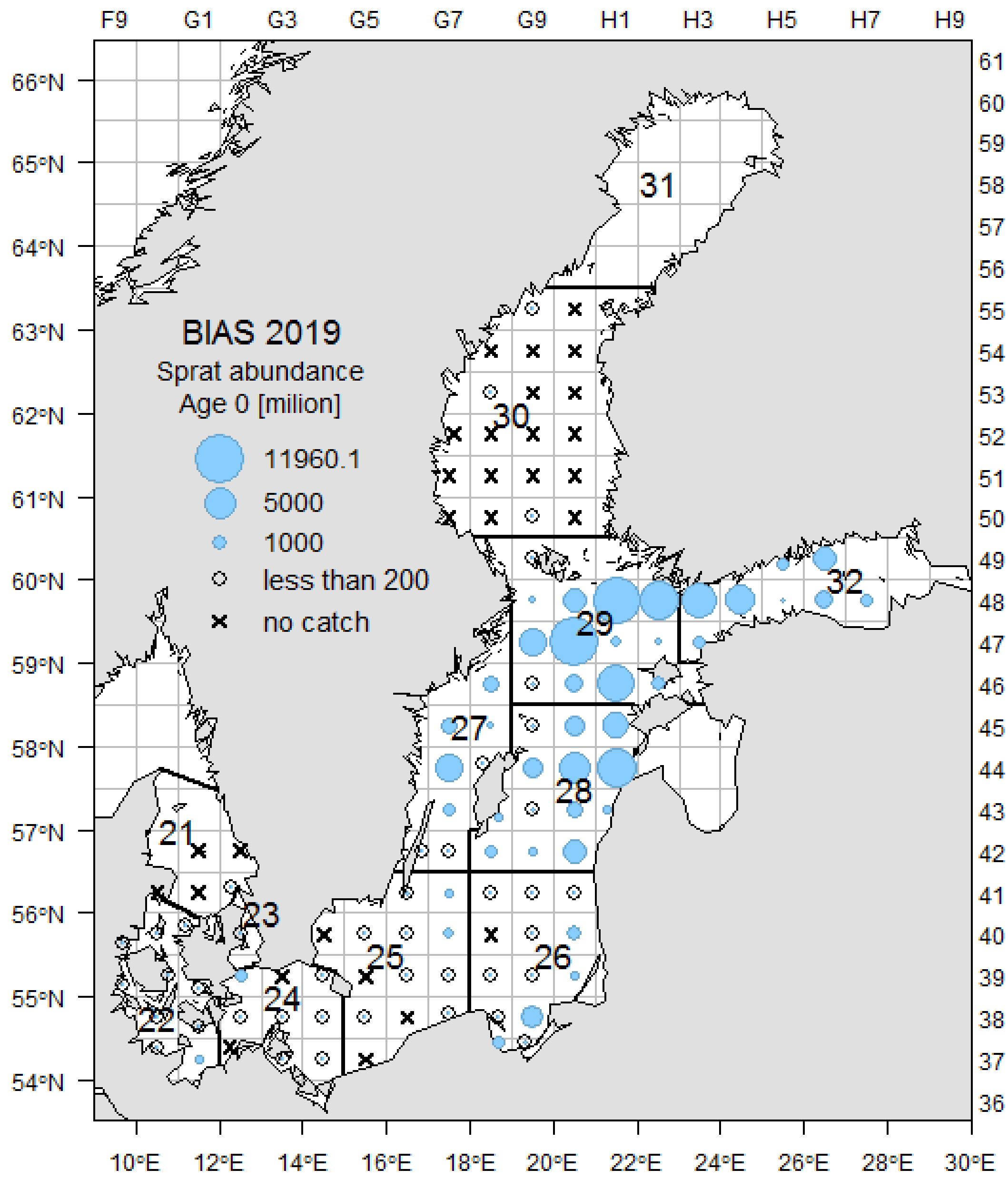


Figure 4.1.1.2.4. The abundance of sprat (age 0) per ICES rectangles monitored in September-October 2019 (the area of circles indicates estimated numbers of specimens x10^6 in given rectangle).

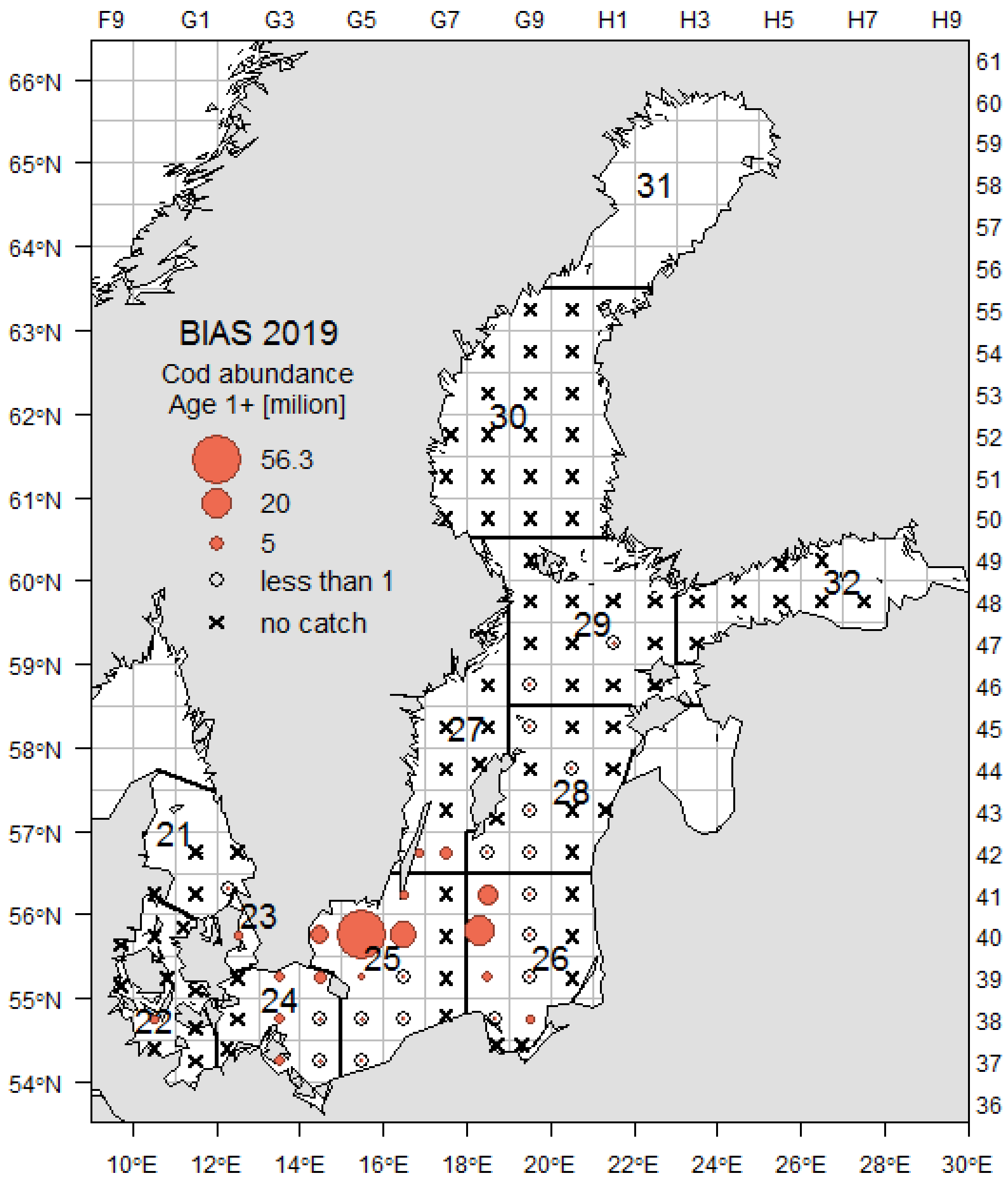


Figure 4.1.1.2.5. The abundance of cod (age 1+) per ICES rectangles monitored in September-October 2019 (the area of circles indicates estimated numbers of specimens x10^6 in given rectangle).

The fish abundance estimates, which are based on the BIAS survey in September-October 2019, are presented per the ICES rectangles and age-groups and are specified in Tables 4.1.1.2.1, 4.1.1.2.2 and 4.1.1.2.3 for herring, sprat and cod, respectively. In addition, the abundance estimates for herring and sprat aggregated per ICES Subdivisions and fish age-groups are presented in Tables 4.1.1.2.4 and 4.1.1.2.5.

The highest herring (age 1+) stock abundance was observed in the ICES SD 32 (the Gulf of Finland) and in the eastern part of the ICES SD 29, Figure 4.1.1.2.1. Somewhat lower, however also significant abundance of herring stock was assessed in the ICES SD 30. Herring (age 1+) was distributed in all except three (the ICES rec. 37G9, 39G9 and 40G1) inspected areas of the Baltic, however with various abundances. The highest concentration of YOY herring (age-group 0, year class 2019) was detected in the ICES rectangle 48H1 (ICES SD 29; Figure 4.1.1.2.2). Somewhat smaller 0-age-group herring concentration was detected in the ICES SD 32 (the Gulf of Finland) and in the south part of the ICES SD 26 (the Gulf of Gdansk). YOY herring occurred also in others inspected waters of the Baltic, however on the very low level (Figure 4.1.1.2.2).

The highest sprat (age 1+) stock abundance was observed in the eastern Baltic, particularly in the eastern part of the ICES SD 28 (the Latvian inshore waters) and in the ICS SD 32 (the Gulf of Finland) (Figure 4.1.1.2.3). The highest concentration of YOY sprat (year class 2019) was detected in the ICES SDs 29, 28 and 32. YOY sprat was distributed in all ICES subdivions except the ICES SD 30, where occurred only in three ICES rectangles (50G9, 53G8 and 55G9) on the very low level (Figure 4.1.1.2.4).

The highest cod stock abundance (age 1+) was detected in the ICES rectangle 40G5 (the Sweden inshore waters), Figure 4.1.1.2.5. Cod with low abundance was detected in many others areas of the Baltic, with exception of the ICES SDs 31 and 32. It should be underlined that cod stock abundance was several times lower than herring and sprat stocks abundance.

Table 4.1.1.2.1. Estimated numbers (millions) of herring in September-October 2019, by ICES rectangles, accordingly to age-groups.

YEAR	SD	RECT	total	age 0	age 1	age 2	age 3	age 4	age 5	age 6	age 7	age 8+
2019	21	41G0	13.55	11.16	1.71	0.23	0.21	0.12	0.11	0.01	0.00	0.00
2019	21	41G1	109.25	21.38	56.89	14.73	6.94	2.47	5.24	1.60	0.00	0.00
2019	21	41G2	15.70	8.31	5.34	0.89	0.51	0.13	0.40	0.12	0.00	0.00
2019	21	42G1	40.71	38.05	2.11	0.08	0.30	0.11	0.06	0.00	0.00	0.00
2019	21	42G2	16.12	2.35	10.64	0.65	0.92	0.34	0.90	0.32	0.00	0.00
2019	22	37G0	30.16	21.77	7.22	0.00	0.37	0.24	0.56	0.00	0.00	0.00
2019	22	37G1	190.90	190.90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2019	22	38G0	155.23	137.41	10.67	1.72	1.24	2.85	0.77	0.57	0.00	0.00
2019	22	38G1	66.61	62.17	2.64	0.37	0.65	0.41	0.00	0.37	0.00	0.00
2019	22	39F9	15.73	8.66	3.33	0.98	2.14	0.52	0.10	0.00	0.00	0.00
2019	22	39G0	9.62	5.29	2.04	0.60	1.31	0.32	0.06	0.00	0.00	0.00
2019	22	39G1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2019	22	40F9	15.48	14.41	0.95	0.00	0.03	0.01	0.08	0.00	0.00	0.00
2019	22	40G0	410.27	381.77	25.15	0.00	0.79	0.31	2.25	0.00	0.00	0.00
2019	22	40G1	6.40	6.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2019	22	41G0	0.34	0.00	0.30	0.00	0.02	0.00	0.02	0.00	0.00	0.00
2019	23	39G2	49.21	30.69	2.37	3.53	2.51	2.67	5.85	0.90	0.60	0.09
2019	23	40G2	14.48	11.19	2.44	0.41	0.13	0.16	0.09	0.00	0.00	0.06
2019	23	41G2	29.38	19.06	7.39	1.44	0.47	0.56	0.46	0.00	0.00	0.00
2019	24	37G2	14.50	9.67	0.81	0.48	0.97	0.48	1.61	0.48	0.00	0.00
2019	24	37G3	26.89	5.73	1.29	4.44	3.56	3.09	5.71	1.80	0.82	0.45
2019	24	37G4	223.93	69.58	20.20	28.74	25.15	24.37	42.64	7.19	4.82	1.24
2019	24	38G2	519.04	376.21	26.93	22.87	21.00	23.24	41.23	3.12	4.40	0.04
2019	24	38G3	322.34	190.53	13.85	25.57	17.61	21.70	41.12	5.56	5.06	1.34
2019	24	38G4	408.11	126.81	36.82	52.39	45.83	44.42	77.71	13.10	8.78	2.25
2019	24	39G2	91.40	57.00	4.41	6.56	4.66	4.96	10.86	1.68	1.11	0.16
2019	24	39G3	193.76	70.08	11.52	25.70	17.91	19.06	39.06	5.59	4.01	0.83
2019	24	39G4	275.57	15.31	12.40	46.16	41.49	46.19	70.53	27.01	10.94	5.54
2019	25	37G5	152.80	30.10	4.78	21.14	19.67	16.32	42.79	8.79	7.04	2.17
2019	25	38G5	190.97	41.66	4.16	21.40	21.24	20.37	47.21	12.61	11.25	11.06
2019	25	38G6	39.22	23.12	1.03	2.71	2.07	1.97	5.49	1.33	1.02	0.48
2019	25	38G7	79.85	71.30	0.56	1.30	1.63	0.98	2.83	0.79	0.37	0.10
2019	25	39G4	107.21	2.54	10.94	31.94	23.43	20.56	14.81	1.88	0.00	1.11
2019	25	39G5	38.85	5.79	5.60	8.28	2.56	3.32	10.72	1.47	1.13	0.00
2019	25	39G6	365.51	31.69	18.37	58.37	54.98	44.17	112.23	22.01	17.80	5.89
2019	25	39G7	273.84	95.64	4.98	27.33	24.23	23.29	67.19	16.99	11.03	3.17
2019	25	40G4	780.39	21.77	103.16	151.18	115.69	56.55	220.27	91.83	19.95	0.00
2019	25	40G5	204.11	29.66	28.43	16.14	19.12	25.82	75.22	7.17	0.52	2.02
2019	25	40G6	1 781.52	9.26	83.92	122.15	309.62	173.34	973.20	63.40	44.15	2.46
2019	25	40G7	465.91	1.48	2.61	92.71	40.35	162.29	151.86	5.22	9.39	0.00
2019	25	41G6	978.97	11.73	111.89	114.87	170.82	270.36	285.43	9.60	1.06	3.21
2019	25	41G7	319.83	5.18	1.44	29.63	55.69	44.76	170.66	8.50	3.10	0.86
2019	26	37G8	841.30	837.45	3.85	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2019	26	37G9	2 128.09	2 040.94	46.78	9.49	8.67	4.69	11.60	3.22	1.10	1.59
2019	26	38G8	489.73	204.51	30.45	35.08	24.75	33.15	75.62	36.04	24.56	25.58
2019	26	38G9	2 126.50	116.81	53.52	363.72	230.68	399.65	391.14	319.16	164.16	87.68
2019	26	39G8	474.04	45.11	18.01	52.38	33.87	52.40	126.84	62.61	37.82	44.99
2019	26	39G9	143.33	0.66	1.70	17.44	13.23	15.59	40.21	21.41	18.36	14.72
2019	26	39H0	454.83	44.87	1.15	57.89	63.54	85.67	95.49	40.18	29.24	36.80
2019	26	40G8	256.04	47.89	6.58	28.76	18.29	25.41	65.93	27.59	17.87	17.73
2019	26	40G9	121.94	0.79	1.19	5.84	9.67	24.40	35.69	23.98	15.94	4.43
2019	26	40H0	597.86	0.00	10.30	69.20	97.27	207.55	128.88	43.61	41.07	0.00
2019	26	41G8	336.16	7.86	3.05	42.44	20.19	49.25	186.39	10.41	16.58	0.00
2019	26	41G9	156.46	0.00	1.48	16.19	22.52	19.93	75.98	3.18	8.97	8.21
2019	26	41H0	22.64	0.85	0.67	3.38	6.00	4.65	6.05	0.67	0.38	0.00
2019	27	42G6	124.59	13.65	4.55	19.57	16.04	16.61	51.88	1.71	0.00	0.57
2019	27	42G7	564.83	17.66	20.91	76.17	30.18	139.22	274.20	0.00	6.49	0.00
2019	27	43G7	656.54	635.61	1.40	3.54	5.95	2.23	5.86	1.95	0.00	0.00
2019	27	44G7	505.86	423.07	22.82	24.67	5.94	8.96	19.02	1.38	0.00	0.00
2019	27	44G8	62.26	55.71	0.00	0.00	0.00	6.55	0.00	0.00	0.00	0.00
2019	27	45G7	448.42	392.72	10.68	21.10	3.37	2.25	11.88	6.42	0.00	0.00
2019	27	45G8	55.08	48.37	1.34	0.90	0.00	1.65	2.83	0.00	0.00	0.00
2019	27	46G8	132.47	22.73	9.50	24.03	14.33	25.91	23.34	12.62	0.00	0.00

Table 4.1.1.2.1. Continues

YEAR	SD	RECT	total	age 0	age 1	age 2	age 3	age 4	age 5	age 6	age 7	age 8+
2019	28_2	42G8	787.76	20.04	0.00	189.85	161.85	180.57	223.72	7.65	0.00	4.07
2019	28_2	42G9	355.24	0.00	1.75	27.89	38.42	45.22	177.06	17.68	17.04	30.18
2019	28_2	42H0	84.55	28.07	2.98	9.10	15.59	11.34	14.72	1.71	1.04	0.00
2019	28_2	43G8	421.25	5.05	22.20	35.82	56.00	66.59	211.38	19.17	5.04	0.00
2019	28_2	43G9	70.64	1.21	0.60	20.89	9.78	12.80	22.58	2.78	0.00	0.00
2019	28_2	43H0	1 321.94	6.10	10.66	140.62	159.54	164.22	641.87	75.52	76.65	46.74
2019	28_2	43H1	116.51	3.63	1.86	22.16	17.33	8.88	45.34	6.91	4.99	5.42
2019	28_2	44G9	135.76	25.81	3.86	11.15	34.35	17.35	42.47	0.00	0.77	0.00
2019	28_2	44H0	26.34	0.83	0.23	1.20	2.39	3.47	11.92	2.03	2.39	1.88
2019	28_2	44H1	52.78	1.87	2.80	15.93	7.75	11.77	6.17	0.93	4.39	1.17
2019	28_2	45G9	384.28	71.24	31.98	43.75	71.37	69.51	82.27	14.16	0.00	0.00
2019	28_2	45H0	1.73	1.51	0.22	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2019	28_2	45H1	3 350.74	106.80	123.16	383.03	671.79	437.58	1 154.30	80.24	210.29	183.54
2019	29	46G9	157.19	30.93	2.64	20.12	20.50	13.61	61.40	5.27	0.00	2.72
2019	29	46H0	380.85	102.71	16.46	19.11	52.13	47.91	102.34	38.05	2.13	0.00
2019	29	46H1	1 997.35	1 222.62	183.76	76.74	104.84	74.82	242.94	13.87	54.22	23.54
2019	29	46H2	84.43	52.91	14.29	6.42	4.65	0.81	4.10	0.37	0.59	0.29
2019	29	47G9	244.11	201.48	1.15	15.90	9.97	4.45	6.74	2.93	0.00	1.49
2019	29	47H0	1 515.24	438.22	109.97	343.12	262.27	100.69	197.77	23.70	17.74	21.75
2019	29	47H1	1 232.97	128.95	76.59	129.67	163.84	124.91	392.07	50.55	106.50	59.88
2019	29	47H2	3 411.76	500.29	442.03	687.38	576.72	194.89	835.51	33.36	99.13	42.44
2019	29	48G9	3 949.73	2 246.96	801.89	385.14	233.95	86.12	154.44	14.23	11.76	15.25
2019	29	48H0	4 694.50	3 720.30	403.89	239.58	148.05	56.26	98.97	9.69	7.55	10.21
2019	29	48H1	6 210.62	5 964.12	31.73	85.31	55.69	23.21	38.66	4.44	2.96	4.50
2019	29	48H2	1 455.73	1 329.21	28.02	49.67	24.40	8.93	13.50	1.54	0.23	0.23
2019	29	49G9	717.10	10.97	139.29	176.99	148.11	63.00	126.28	17.95	15.17	19.33
2019	30	50G7	581.98	253.19	274.48	38.32	11.71	2.31	1.28	0.50	0.07	0.12
2019	30	50G8	2 728.62	1 160.06	1 301.77	186.12	58.17	11.77	6.83	2.64	0.45	0.82
2019	30	50G9	512.48	127.10	172.23	95.82	60.12	22.92	20.12	6.94	2.62	4.61
2019	30	50H0	960.03	12.23	449.51	232.81	132.79	44.51	43.88	14.34	6.23	23.73
2019	30	51G7	956.63	7.57	153.73	218.26	202.60	99.53	132.09	44.34	27.00	71.50
2019	30	51G8	394.68	1.40	87.55	96.42	82.17	37.89	46.11	15.06	7.92	20.14
2019	30	51G9	386.66	11.34	23.69	95.88	104.10	50.89	56.78	18.15	8.15	17.68
2019	30	51H0	394.90	42.64	86.20	100.06	75.81	30.86	32.11	10.45	5.09	11.67
2019	30	52G7	464.66	0.00	15.54	70.44	112.47	64.24	106.07	33.05	19.49	43.36
2019	30	52G8	837.84	0.00	40.04	125.49	198.94	117.30	186.61	58.68	33.21	77.57
2019	30	52G9	1 277.00	85.18	82.63	197.70	288.37	163.40	244.50	77.96	43.71	93.54
2019	30	52H0	503.33	24.41	58.29	111.83	116.59	56.34	69.75	22.37	12.19	31.56
2019	30	53G8	1 024.98	400.24	20.80	90.96	153.55	92.74	132.88	43.82	24.55	65.44
2019	30	53G9	1 248.44	12.45	110.33	195.82	287.37	161.76	246.92	78.42	45.61	109.75
2019	30	53H0	1 176.21	184.90	141.31	228.42	226.18	107.78	134.69	42.91	27.09	82.91
2019	30	54G8	651.74	116.47	19.62	66.94	121.61	73.47	125.81	40.22	26.41	61.20
2019	30	54G9	822.50	35.55	37.98	111.88	181.46	107.98	175.78	56.90	34.84	80.12
2019	30	54H0	860.44	112.42	145.37	182.84	162.50	72.42	91.87	29.48	18.52	45.01
2019	30	55G9	1 081.51	222.37	153.98	149.38	183.31	95.78	145.31	44.71	26.55	60.13
2019	30	55H0	966.16	110.74	118.86	192.59	206.52	106.65	127.14	42.68	19.56	41.43
2019	32	47H3	2 741.98	905.21	14.55	178.51	831.08	412.78	253.35	104.60	35.92	5.98
2019	32	48H3	1 341.28	1 237.71	14.33	28.97	17.60	4.73	26.77	5.26	4.60	1.31
2019	32	48H4	1 940.08	766.84	45.21	210.45	565.52	207.58	105.46	34.38	3.99	0.65
2019	32	48H5	3 321.20	184.43	64.12	598.13	1 369.40	635.96	343.18	110.82	14.57	0.59
2019	32	48H6	5 607.00	2 450.32	117.41	546.32	1 085.78	761.78	438.03	161.59	26.42	19.37
2019	32	48H7	1 913.90	1 351.95	66.78	248.34	223.76	14.31	6.54	2.22	0.00	0.00
2019	32	49H5	903.82	781.51	27.85	46.93	15.27	3.37	20.28	3.28	2.05	3.28
2019	32	49H6	1 251.51	1 213.97	8.34	17.02	3.78	1.81	3.81	1.39	0.00	1.39

Table 4.1.1.2.2. Estimated numbers (millions) of sprat in September-October 2019, by ICES rectangles, accordingly to age-groups.

YEAR	SD	RECT	total	age 0	age 1	age 2	age 3	age 4	age 5	age 6	age 7	age 8+
2019	21	41G0	56.93	0.00	25.17	24.71	5.10	1.92	0.00	0.03	0.00	0.00
2019	21	41G1	84.49	0.00	27.33	41.41	8.52	7.00	0.00	0.23	0.00	0.00
2019	21	41G2	66.44	0.00	28.27	29.20	5.75	3.10	0.00	0.12	0.00	0.00
2019	21	42G1	22.02	0.00	3.76	11.45	3.46	3.18	0.00	0.17	0.00	0.00
2019	21	42G2	85.92	0.00	37.58	39.23	7.85	1.26	0.00	0.00	0.00	0.00
2019	22	37G0	22.12	0.67	4.81	9.39	3.36	3.29	0.60	0.00	0.00	0.00
2019	22	37G1	397.30	395.81	1.49	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2019	22	38G0	203.53	84.79	53.66	38.99	12.28	10.94	2.87	0.00	0.00	0.00
2019	22	38G1	22.94	12.58	2.24	5.02	1.37	1.51	0.22	0.00	0.00	0.00
2019	22	39F9	13.90	5.79	1.07	4.19	1.24	1.26	0.35	0.00	0.00	0.00
2019	22	39G0	8.49	3.54	0.65	2.56	0.76	0.77	0.21	0.00	0.00	0.00
2019	22	39G1	1.85	1.85	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2019	22	40F9	3.21	1.95	0.92	0.21	0.07	0.05	0.01	0.00	0.00	0.00
2019	22	40G0	84.94	51.70	24.42	5.44	1.94	1.22	0.22	0.00	0.00	0.00
2019	22	40G1	89.66	8.72	44.17	21.92	7.23	6.66	0.96	0.00	0.00	0.00
2019	22	41G0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2019	23	39G2	308.59	289.70	8.78	3.02	3.21	2.88	0.90	0.10	0.00	0.00
2019	23	40G2	69.96	68.20	0.82	0.53	0.19	0.13	0.06	0.02	0.01	0.00
2019	23	41G2	2.37	0.10	0.59	0.77	0.44	0.25	0.10	0.07	0.04	0.01
2019	24	37G2	2.42	0.00	0.00	0.36	0.85	1.21	0.00	0.00	0.00	0.00
2019	24	37G3	43.66	13.73	15.71	4.41	4.41	4.33	1.02	0.05	0.00	0.00
2019	24	37G4	424.87	13.28	50.48	68.27	115.61	132.47	32.35	9.57	2.84	0.00
2019	24	38G2	73.84	72.11	0.63	0.33	0.39	0.22	0.14	0.02	0.00	0.00
2019	24	38G3	793.26	92.53	362.59	97.43	109.05	101.10	26.62	3.80	0.14	0.00
2019	24	38G4	774.34	24.21	92.00	124.42	210.70	241.43	58.96	17.44	5.18	0.00
2019	24	39G2	573.01	537.95	16.30	5.60	5.96	5.35	1.66	0.19	0.00	0.00
2019	24	39G3	247.00	0.00	24.18	40.43	72.69	82.24	19.99	6.41	1.06	0.00
2019	24	39G4	25.57	0.30	3.84	3.99	6.63	7.48	2.36	0.80	0.17	0.00
2019	25	37G5	222.18	0.00	7.28	16.25	35.80	90.22	53.54	16.51	0.48	2.11
2019	25	38G5	691.67	1.34	28.16	58.20	115.43	284.17	161.62	38.83	0.89	3.03
2019	25	38G6	736.65	0.00	36.34	71.52	123.55	298.49	164.33	39.15	0.96	2.31
2019	25	38G7	105.04	10.60	14.69	16.01	16.63	30.28	15.70	1.04	0.00	0.08
2019	25	39G4	165.65	0.00	5.03	25.13	38.34	36.48	41.13	2.23	8.19	9.12
2019	25	39G5	1 282.79	0.00	173.78	0.00	186.60	153.89	670.32	38.70	59.50	0.00
2019	25	39G6	513.77	15.49	51.83	71.53	87.02	177.26	95.06	15.17	0.14	0.27
2019	25	39G7	278.01	15.98	44.57	48.13	45.37	80.27	40.20	2.95	0.13	0.41
2019	25	40G4	1 046.94	0.00	149.56	60.26	139.92	219.61	316.21	60.80	95.74	4.83
2019	25	40G5	2 347.45	5.70	185.58	344.86	354.58	463.21	595.57	307.51	85.98	4.47
2019	25	40G6	277.58	9.10	37.17	72.47	54.95	20.64	70.29	8.09	0.00	4.87
2019	25	40G7	3 754.97	717.26	374.29	269.28	527.11	734.70	956.34	75.05	92.76	8.17
2019	25	41G6	1 085.88	167.75	168.67	48.32	328.83	159.74	129.01	13.11	9.90	60.53
2019	25	41G7	2 491.19	378.06	289.23	148.30	250.15	616.50	803.75	0.00	5.19	0.00
2019	26	37G8	2 682.46	834.98	1 035.60	460.10	153.90	163.39	33.11	1.38	0.00	0.00
2019	26	37G9	2 855.92	173.70	879.20	811.54	429.52	457.10	99.92	4.95	0.00	0.00
2019	26	38G8	703.19	80.65	148.14	152.32	133.51	150.64	36.61	1.34	0.00	0.00
2019	26	38G9	6 378.53	2 518.86	397.15	1 277.50	997.42	617.93	457.54	83.99	28.15	0.00
2019	26	39G8	346.45	2.36	23.12	61.05	94.41	120.08	39.38	4.21	0.99	0.84
2019	26	39G9	800.53	17.15	94.33	259.65	142.57	145.32	133.18	5.19	3.15	0.00
2019	26	39H0	1 099.60	466.90	150.26	271.39	107.34	53.46	44.47	3.40	2.39	0.00
2019	26	40G8	511.70	0.00	14.89	49.94	136.60	216.05	85.89	7.76	0.00	0.57
2019	26	40G9	396.28	11.04	10.89	59.82	106.83	142.47	58.24	2.74	3.48	0.78
2019	26	40H0	1 143.92	977.16	19.20	17.83	63.91	58.60	4.99	2.24	0.00	0.00
2019	26	41G8	4 588.65	30.27	835.12	499.17	1 340.12	539.38	950.77	52.84	202.27	138.70
2019	26	41G9	2 266.25	81.24	99.17	623.31	429.83	250.32	702.58	32.70	27.12	19.99
2019	26	41H0	1 767.70	53.52	144.65	556.12	370.29	164.77	425.72	52.62	0.00	0.00
2019	27	42G6	236.90	34.95	22.52	28.74	22.01	24.60	76.12	16.83	1.29	9.84
2019	27	42G7	1 087.19	22.95	25.62	96.52	93.08	235.57	490.61	34.35	12.94	75.54
2019	27	43G7	1 188.69	760.54	125.02	37.89	71.85	48.40	114.41	15.14	11.80	3.62
2019	27	44G7	3 784.41	3 711.42	20.35	10.17	0.00	0.00	21.23	11.95	9.29	0.00
2019	27	44G8	779.82	104.85	95.02	122.54	96.99	134.99	169.07	30.80	25.56	0.00
2019	27	45G7	1 467.13	1 435.64	13.71	0.00	4.11	4.11	9.57	0.00	0.00	0.00
2019	27	45G8	384.20	238.13	28.46	48.72	19.23	18.43	27.34	1.27	1.27	1.36
2019	27	46G8	1 296.51	1 276.67	7.44	0.00	2.48	0.00	9.92	0.00	0.00	0.00

Table 4.1.1.2.2. Continues

YEAR	SD	RECT	total	age 0	age 1	age 2	age 3	age 4	age 5	age 6	age 7	age 8+
2019	28_2	42G8	4 705.98	852.23	738.35	346.67	841.38	306.47	1 464.06	78.87	20.81	57.14
2019	28_2	42G9	786.23	382.42	49.08	71.03	70.97	42.61	150.55	6.53	8.77	4.25
2019	28_2	42H0	6 180.56	2 901.25	479.64	845.58	602.83	352.33	848.76	36.00	112.72	1.46
2019	28_2	43G8	458.26	354.78	0.00	4.14	23.06	27.79	48.49	0.00	0.00	0.00
2019	28_2	43G9	728.37	189.20	187.99	121.86	70.70	103.42	55.19	0.00	0.00	0.00
2019	28_2	43H0	6 729.15	1 457.55	619.65	1 300.55	500.44	547.40	2 075.38	64.38	39.40	124.39
2019	28_2	43H1	1 900.40	371.87	206.31	441.99	212.70	73.82	546.78	24.05	11.63	11.25
2019	28_2	44G9	2 070.87	1 975.55	7.34	14.23	16.38	36.52	19.51	1.34	0.00	0.00
2019	28_2	44H0	8 529.42	4 981.17	611.06	1 026.20	618.32	312.56	876.50	45.17	56.86	1.59
2019	28_2	44H1	14 156.27	7 777.28	1 182.79	1 935.90	1 136.82	531.21	1 441.16	72.47	78.64	0.00
2019	28_2	45G9	747.67	129.47	130.09	115.56	49.23	76.35	167.49	62.61	5.62	11.24
2019	28_2	45H0	1 967.00	1 949.11	3.58	7.64	2.60	0.81	3.25	0.00	0.00	0.00
2019	28_2	45H1	4 791.69	3 257.62	642.96	589.42	161.51	28.01	96.50	11.74	3.91	0.00
2019	29	46G9	205.08	139.23	4.41	4.37	23.03	8.04	20.48	4.00	1.52	0.00
2019	29	46H0	1 831.06	1 617.19	55.49	9.94	37.26	40.09	48.64	5.20	0.00	17.27
2019	29	46H1	9 891.92	6 951.70	328.32	1 048.80	170.71	224.64	1 001.31	92.44	18.49	55.52
2019	29	46H2	2 976.55	1 078.24	326.70	840.61	87.71	117.01	500.57	14.02	0.00	11.68
2019	29	47G9	4 721.43	4 150.74	83.94	59.29	71.06	0.00	334.94	0.00	21.47	0.00
2019	29	47H0	13 057.41	11 960.06	170.57	380.53	95.28	116.38	270.21	28.91	0.00	35.47
2019	29	47H1	822.71	668.57	17.09	49.00	6.49	15.39	58.72	2.96	0.00	4.49
2019	29	47H2	858.73	334.30	37.89	159.89	26.76	49.49	208.12	16.55	4.93	20.81
2019	29	48G9	463.89	253.42	26.90	59.75	18.47	23.92	61.83	9.96	0.00	9.64
2019	29	48H0	2 866.64	2 707.59	22.63	47.39	13.45	16.97	45.08	6.58	0.00	6.96
2019	29	48H1	11 821.15	11 234.51	146.67	243.61	33.45	29.00	111.33	9.22	0.00	13.36
2019	29	48H2	10 925.49	7 926.50	651.64	1 227.92	191.44	217.16	583.62	66.45	0.00	60.76
2019	29	49G9	11.37	5.99	0.19	1.03	0.50	0.73	2.14	0.43	0.00	0.36
2019	30	50G7	159.96	0.00	7.79	30.32	12.29	14.08	76.39	8.37	2.90	7.82
2019	30	50G8	764.52	0.00	36.68	141.58	58.28	67.73	367.63	40.33	14.37	37.91
2019	30	50G9	72.93	0.28	2.24	6.38	4.57	7.33	40.33	4.51	2.49	4.80
2019	30	50H0	7.18	0.00	0.07	0.42	0.41	0.72	4.07	0.45	0.34	0.71
2019	30	51G7	13.95	0.00	0.00	1.66	0.92	1.39	7.86	0.87	0.48	0.76
2019	30	51G8	2.80	0.00	0.00	0.30	0.18	0.26	1.57	0.18	0.11	0.20
2019	30	51G9	4.55	0.00	0.00	0.16	0.25	0.41	2.66	0.32	0.25	0.50
2019	30	51H0	3.45	0.00	0.00	0.13	0.16	0.30	1.87	0.20	0.23	0.55
2019	30	52G7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2019	30	52G8	2.12	0.00	0.23	0.30	0.30	0.00	0.64	0.30	0.04	0.30
2019	30	52G9	25.05	0.00	0.12	0.52	1.08	2.16	15.03	1.59	1.71	2.85
2019	30	52H0	5.16	0.00	0.05	0.61	0.31	0.46	2.86	0.30	0.23	0.35
2019	30	53G8	1.37	1.37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2019	30	53G9	6.99	0.00	0.40	0.69	0.35	0.60	3.80	0.39	0.33	0.42
2019	30	53H0	59.13	0.00	1.80	7.30	4.00	5.60	31.67	3.53	1.76	3.47
2019	30	54G8	1.56	0.00	0.00	0.00	0.07	0.07	0.85	0.10	0.14	0.34
2019	30	54G9	2.00	0.00	0.06	0.16	0.08	0.13	0.94	0.09	0.16	0.38
2019	30	54H0	164.73	0.00	5.86	21.01	10.63	15.10	87.47	9.31	5.42	9.92
2019	30	55G9	57.49	0.74	1.28	8.60	4.17	5.48	29.69	3.25	1.23	3.06
2019	30	55H0	11.24	0.00	0.12	1.77	0.72	0.95	6.05	0.60	0.43	0.61
2019	32	47H3	5 704.74	899.53	577.09	1 585.80	385.94	191.22	1 327.56	411.90	74.95	250.74
2019	32	48H3	7 772.91	6 012.16	398.80	672.02	135.27	63.06	431.31	17.96	16.84	25.49
2019	32	48H4	8 916.23	4 349.75	523.78	1 404.31	435.58	231.61	1 485.09	196.87	100.00	189.24
2019	32	48H5	2 127.26	205.81	207.32	649.50	156.00	79.19	542.17	158.53	25.97	102.77
2019	32	48H6	2 903.26	1 578.68	148.61	446.84	107.90	51.24	373.80	112.84	15.32	68.03
2019	32	48H7	6 307.41	843.07	413.73	1 714.76	442.35	268.01	1 598.71	575.58	95.76	355.44
2019	32	49H5	1 857.38	737.62	132.37	318.71	116.38	67.72	373.13	37.10	29.88	44.48
2019	32	49H6	3 666.14	2 980.39	100.97	229.82	75.42	32.18	212.91	12.32	9.02	13.10

Table 4.1.1.2.3. Estimated numbers (millions) of cod in September-October 2005-2019, by ICES rectangles.

Sub_Div	RECT	Area	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
24	37G2	192.40	2.17	0.00	1.82	0.00	0.00	0.00	0.00	0.00	6.01	0.00	0.00	1.26	0.00	0.27	0.00
24	37G3	167.70	0.00	4.14	0.87	1.18	0.72	4.26	0.00	1.99	1.09	0.91	0.25	2.26	11.35	2.46	2.86
24	37G4	875.10	9.50	0.13	4.27	5.16	1.41	2.60	0.02	0.00	19.73	0.31	3.32	0.88	4.57	0.45	0.52
24	38G2	832.90	10.86	0.00	1.95	0.00	0.00	1.93	1.07	5.97	0.46	0.00	0.00	22.78	0.00	15.89	0.00
24	38G3	865.70	0.28	0.00	1.61	1.07	1.97	3.57	0.40	4.39	0.94	25.85	1.22	2.12	4.50	16.28	2.96
24	38G4	1034.80	6.20	0.54	9.73	13.71	0.96	4.35	0.40	2.05	1.66	0.58	14.08	1.94	20.13	5.63	0.95
24	39G2	406.10	1.49	3.89	1.76	0.41	1.26	3.77	0.05	0.87	0.04	1.69	0.13	2.31	2.51	0.40	0.00
24	39G3	765.00	17.92	3.78	13.93	2.76	0.55	3.80	0.35	2.08	5.09	18.75	2.19	1.12	1.71	9.11	2.80
24	39G4	524.80	2.70	1.82	2.44	1.19	1.58	7.09	0.21	0.38	1.18	4.19	1.07	7.93	3.03	1.44	1.91
25	37G5	642.20	17.83	0.25	1.31	0.00	0.38	0.21	0.00	0.00	0.00	0.03	0.00	0.00	1.95	0.00	0.12
25	38G5	1035.70	57.28	2.06	5.20	0.74	2.92	4.54	18.40	19.88	4.98	3.37	2.95	0.99	1.72	9.95	0.52
25	38G6	940.20	9.54	3.00	17.12	2.52	0.27	0.23	0.00	15.48	0.00	0.00	0.00	0.38	0.00	0.28	0.14
25	38G7	471.70	0.00	0.13	0.04	0.92	0.37	0.85	0.00	0.21	0.00	0.00	0.00		0.00	0.00	0.00
25	39G4	287.30	2.67	28.46	0.22	4.36	0.35	0.29	0.22	0.57	0.49	2.90	4.21	0.00	1.16	5.20	1.97
25	39G5	979.00	1.50	3.60	1.79	3.15	2.49	6.21	71.33	8.93	4.09	5.76	0.71	3.39	0.75	2.34	1.65
25	39G6	1026.00	0.86	6.50	0.69	4.05	0.48	16.71	3.48	0.04	0.00	0.16	0.12	0.10	0.85	0.91	0.15
25	39G7	1026.00	47.40	0.52	0.44	5.78	0.26	0.18	2.18	0.00	0.00	0.51	0.06	0.04	0.66	7.63	0.00
25	40G4	677.20	1.38	5.54	15.86	0.22	19.19	0.33	25.27	15.24	2.06	31.02	38.33	7.44	8.42	10.65	8.78
25	40G5	1012.90	2.40	7.60	4.89	25.09	1.81	0.81	14.00	5.45	1.24	7.96	31.00	3.14	0.28	1.20	56.27
25	40G6	1013.00	1.13	6.53	0.24	5.94	6.54	7.03	30.84	5.66	0.22	53.62	17.00	1.76	4.27	0.24	16.06
25	40G7	1013.00	5.70	5.78	0.00	6.26	3.50	0.49	18.62	42.73	0.29	7.81	0.00	3.07	2.66	0.00	0.00
25	41G6	764.40	2.69	14.80	0.00	2.53	0.63	0.36	0.00	1.03	0.00	0.84	0.23	18.94	0.00	0.24	2.20
25	41G7	1000.00	0.08	1.90	8.71	0.25	4.40	1.12	61.89	29.81	35.29	0.00	0.53	0.71	0.87	0.56	0.00
26	37G8	86.00	0.46	3.25	0.00	0.23	0.00	0.03	0.00	0.08	0.00	0.54	0.00	0.00	0.05	0.00	0.00
26	37G9	151.60	37.64	0.89	1.59	0.99	0.32	0.21	0.51	0.59	0.00	0.16	0.15	0.12	2.52	0.00	0.00
26	38G8	624.60	37.05	4.97	1.68	3.39	2.01	1.43	1.29	7.19	0.00	1.05	7.11	0.10	2.01	15.12	0.02
26	38G9	918.20	0.00	0.00	0.00	0.00	0.51	0.00	2.61	4.53	49.20	6.52	0.25	0.56	0.51	0.09	1.75
26	39G8	1026.00	32.28	22.10	1.63	0.83	4.33	9.43	19.88	5.18	0.00	0.50	0.42	0.22	0.55	1.44	2.51
26	39G9	1026.00	0.00	0.00	0.00	0.00	0.71	0.00	1.83	0.00	3.12	4.66	7.30	0.35	1.17	0.43	0.16
26	39H0	881.60					0.00	0.00	0.02					0.30	0.09		0.00
26	40G8	1013.00	17.82	4.57	0.54	0.21	0.55	13.53	3.96	3.18	0.00	0.10	2.75	0.06	0.56	1.47	21.83
26	40G9	1013.00	0.00		0.00	0.00	3.02	0.00	0.43	5.86	9.07	0.79		0.82	1.42	0.13	0.12
26	40H0	1012.10	5.10		0.00	0.71	34.59	51.72	1.12	0.23	0.13	0.14		5.13	0.00	107.78	0.00
26	41G8	1000.00	0.00	2.62		0.04	2.31	3.17	21.93	19.24	0.92	1.30	0.00	1.52	0.69	1.17	9.06
26	41G9	1000.00	10.00	0.07	3.21	0.18	0.00	1.05	0.00	0.00	0.27	195.80	1.59	0.00	0.00		0.00
26	41H0	953.30	54.47	0.24	3.39	1.92	0.00	0.09	0.00	0.00	0.30	0.00	0.01	0.00	0.00		0.00
27	42G6	266.00		2.23	0.04	0.00	1.14	0.02	0.00	0.26	0.01	0.00	0.00	0.00	0.00	0.00	1.69
27	42G7	986.90	1.02	1.14	0.49	0.02	0.88	0.00	1.57	0.61	0.69	0.92	0.00	2.68	0.00	0.00	3.97
27	43G6	269.80				0.00											
27	43G7	913.80	0.00	22.02	0.00	0.08	0.00	0.50	0.09	0.00	1.87	2.70	0.00	3.21	0.00	0.00	0.00
27	44G7	960.50	0.00	1.19	1.25	0.42	0.00	0.23	0.00	0.00	0.00	0.07	0.00	0.47	0.06	0.16	0.00
27	44G8	456.60	0.00	0.00	0.00	0.03	0.51	0.23	0.09	0.00	0.19	0.00	0.00	0.00	0.46	0.00	0.00
27	45G7	908.70	0.00	0.00	0.00	1.57	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.93	0.00	0.00	0.00
27	45G8	947.20	0.00	2.22	0.23	0.00	0.00	0.00	0.00	0.00	1.14	0.32	0.00	0.00	0.04	0.00	0.00
27	46G8	884.80	0.00	0.21	0.00	0.00	0.00	0.00	0.07	0.00	0.00	0.37	0.00	0.00	0.16	0.10	0.00
28_2	42G8	945.40	4.70	0.00	3.73	3.30	0.48	1.29	0.00	1.63	4.73	1.79	0.00	0.79	0.47	0.00	0.07
28_2	42G9	986.90	0.00	0.23	0.56	1.33	0.00	0.00	0.00	0.00	4.94	293.83	0.00	0.00	0.20		0.00
28_2	42H0	968.50	0.00	0.37	10.37	2.89	0.00	0.14	0.00	0.00	0.32	1.23	0.13	0.00	0.05		0.00
28_2	43G8	296.20	0.32	0.00	0.00	0.19	0.00	0.00	0.00	5.57	0.10	0.40	0.00	0.00	0.00	0.00	0.00
28_2	43G9	973.70	0.00	0.16	12.71	2.07	1.39	0.00	0.00	8.25	11.76	0.00	0.00	0.00	3.90	0.00	0.02
28_2	43H0	973.70	0.00	0.12	3.57	0.00	0.00	0.07	0.00	0.00	0.61	3.59	0.32	0.00	0.08		0.00
28_2	43H1	412.70	0.00	0.05	0.00	0.00	0.00	0.14	0.00	0.00	0.06	0.00		0.00			0.00
28_2	44G9	876.60	0.00	0.00	0.47	0.61	0.00	0.91	2.28	2.60	2.69	2.91	0.00	3.33	0.06	0.07	0.00
28_2	44H0	960.50	0.00	0.47	0.00	0.00	0.00	0.00	0.00	0.00	0.00	238.71	11.70	0.00	0.22		0.01
28_2	44H1	824.60	0.00	0.00	0.00	0.00	0.00	0.07	0.00	0.00	0.38	0.00	0.00	0.00			0.00
28_2	45G9	924.50	0.27	0.00	0.10	0.00	0.36	0.00	0.00	0.63	0.64	0.00	0.00	0.90	0.05	0.63	0.31
28_2	45H0	947.20	0.00	0.00	0.16	0.15	0.00	0.04	0.00	0.00	0.00	0.00	0.04	0.00	0.33	13.17	0.00
28_2	45H1	827.10	0.00	0.00	0.14	0.00	0.00	0.09	0.00	0.00	0.00	0.00	1.67	0.56	0.00	0.00	0.00
29	46G9	933.80	0.03	0.00	0.48	0.18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.66	0.00	0.10	0.30
29	46H0	933.80	0.00	0.00	0.00	0.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.66	0.24	0.00	0.00
29	46H1	921.50	0.00	0.00	0.00	0.00	0.00	0.42	0.00	0.70	0.09	0.00	0.03	0.00	0.00	0.00	0.00
29	46H2	258.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
29	47G9	876.20	2.82	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.98	0.00	0.00
29	47H0	920.30	0.00	0.00	1.26	0.29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.42	0.00	0.00
29	47H1	920.30	0.00	0.00	0.00	0.00	0.00	0.00	8.77	0.00	0.00	0.00	0.00	0.00	1.06	0.00	0.81
29	47H2	793.90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.67	0.05	0.00	0.00	0.00	0.06	0.00
29	48G9	772.80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
29	48H0	730.30			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.97	0.00	0.00
29	48H1	544.00			0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.21	0.00	0.00
29	48H2	597.00			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.21	0.20	0.00
29	49G9	564.20			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Note: The numbers for the year 2016 have changed in 9 rectangles as the corrected POL BIAS 2016 data were included into BIAS_db during WGBIFS meeting in 2020 - red coloured numbers.

Table 4.1.1.2.4. Estimated numbers (millions) of herring by ICES Subdivisions, accordingly to age-groups; September-October 2019.

YEAR	Sub_Div	0	1	2	3	4	5	6	7	8
2019	21	81.25	76.69	16.58	8.88	3.17	6.71	2.05	0.00	0.00
2019	22	828.78	52.30	3.67	6.55	4.66	3.84	0.94	0.00	0.00
2019	23	60.94	12.20	5.38	3.11	3.39	6.40	0.90	0.60	0.15
2019	24	920.92	128.23	212.91	178.18	187.51	330.47	65.53	39.94	11.85
2019	25	380.90	381.89	699.16	861.11	864.11	2 179.90	251.59	127.80	32.53
2019	26	3 347.75	178.71	701.79	548.68	922.33	1 239.82	592.04	376.04	241.74
2019	27	1 609.53	71.20	169.96	75.82	203.38	389.01	24.09	6.49	0.57
2019	28_2	272.16	202.30	901.41	1 246.17	1 029.30	2 633.80	228.79	322.61	273.00
2019	29	15 949.68	2 251.71	2 235.16	1 805.13	799.59	2 274.74	215.95	318.00	201.62
2019	30	2 920.27	3 493.91	2 787.99	2 966.35	1 520.53	2 126.52	683.64	389.30	942.30
2019	32	8 891.94	358.59	1 874.67	4 112.20	2 042.32	1 197.41	423.54	87.55	32.58

Table 4.1.1.2.5. Estimated numbers (millions) of sprat by ICES Subdivisions, accordingly to age-groups; September-October 2019.

YEAR	Sub_Div	0	1	2	3	4	5	6	7	8
2019	21	0.00	122.11	146.00	30.68	16.46	0.00	0.55	0.00	0.00
2019	22	567.40	133.43	87.72	28.25	25.70	5.44	0.00	0.00	0.00
2019	23	358.00	10.19	4.32	3.84	3.26	1.06	0.19	0.05	0.01
2019	24	754.11	565.73	345.24	526.29	575.83	143.10	38.28	9.39	0.00
2019	25	1 321.28	1 566.17	1 250.25	2 304.29	3 365.45	4 113.10	619.16	359.87	100.20
2019	26	5 247.82	3 851.74	5 099.72	4 506.24	3 079.50	3 072.39	255.36	267.55	160.88
2019	27	7 585.15	338.15	344.59	309.74	466.10	918.27	110.34	62.15	90.36
2019	28_2	26 579.51	4 858.85	6 820.77	4 306.95	2 439.30	7 793.62	403.16	338.38	211.33
2019	29	49 028.02	1 872.45	4 132.11	775.62	858.81	3 246.98	256.73	46.42	236.31
2019	30	2.39	56.70	221.90	98.77	122.76	681.39	74.69	32.60	74.95
2019	32	17 607.00	2 502.67	7 021.77	1 854.84	984.24	6 344.69	1 523.08	367.73	1 049.29

4.1.1.3 Area corrected data

During WGBIFS meeting in 2006 possible improvement of presenting the results from acoustic surveys was discussed, and correction factor for each ICES Subdivision and year was introduced because of the coverage of the investigated area differed in the years. This factor is the proportion between the total area of the ICES Subdivision that are presented in the IBAS Manual and the area of the ICES rectangles, which was covered during the survey. Some disagreements appeared about appropriate area of the ICES Subdivision 28. It was agreed that the Gulf of Riga (the ICES Subdivision 28_1) must be excluded from the total area. All other ICES Subdivisions kept their areas as specified in the IBAS manual.

The area corrected abundance estimates for herring and sprat per the ICES Subdivisions and age-groups are summarized in Tables 4.1.1.3.1 and 4.1.1.3.2, respectively. Biomass for herring and sprat per the ICES Subdivisions and age-groups are summarized in Tables 4.1.1.3.3 and 4.1.1.3.4, respectively.

Table 4.1.1.3.1. Area corrected numbers (millions) of herring by ICES Subdivisions and age-groups (September-October 2019).

YEAR	Sub_Div	AREA_CORR_FACTOR	AGE 0	AGE 1	AGE 2	AGE 3	AGE 4	AGE 5	AGE 6	AGE 7	AGE 8+
2019	21	1.55	125.62	118.57	25.63	13.73	4.90	10.37	3.17	0.00	0.00
2019	22	1.02	845.87	53.38	3.75	6.69	4.76	3.92	0.96	0.00	0.00
2019	23	1.00	60.94	12.20	5.38	3.11	3.39	6.40	0.90	0.60	0.15
2019	24	1.00	920.92	128.23	212.91	178.18	187.51	330.47	65.53	39.94	11.85
2019	25	1.03	393.09	394.10	721.53	888.65	891.75	2 249.63	259.64	131.89	33.57
2019	26	1.01	3 386.37	180.78	709.89	555.01	932.97	1 254.12	598.87	380.38	244.53
2019	27	1.23	1 980.91	87.62	209.18	93.32	250.31	478.77	29.65	7.99	0.70
2019	28_2	1.01	275.72	204.95	913.22	1 262.50	1 042.79	2 668.32	231.79	326.84	276.58
2019	29	1.04	16 583.51	2 341.19	2 323.98	1 876.87	831.37	2 365.14	224.53	330.63	209.63
2019	30	1.08	3 156.36	3 776.37	3 013.38	3 206.16	1 643.46	2 298.43	738.91	420.78	1 018.48
2019	32	1.42	12 637.60	509.64	2 664.36	5 844.43	2 902.63	1 701.81	601.95	124.43	46.31

Table 4.1.1.3.2. Area corrected numbers (millions) of sprat by ICES Subdivisions and age-groups (September-October 2019).

YEAR	Sub_Div	AREA_CORR_FACTOR	AGE 0	AGE 1	AGE 2	AGE 3	AGE 4	AGE 5	AGE 6	AGE 7	AGE 8+
2019	21	1.55	0.00	188.79	225.73	47.43	25.45	0.00	0.85	0.00	0.00
2019	22	1.02	579.10	136.18	89.53	28.83	26.23	5.55	0.00	0.00	0.00
2019	23	1.00	358.00	10.19	4.32	3.84	3.26	1.06	0.19	0.05	0.01
2019	24	1.00	754.11	565.73	345.24	526.29	575.83	143.10	38.28	9.39	0.00
2019	25	1.03	1 363.55	1 616.27	1 290.25	2 378.00	3 473.11	4 244.68	638.97	371.38	103.41
2019	26	1.01	5 308.36	3 896.17	5 158.55	4 558.23	3 115.03	3 107.83	258.31	270.64	162.73
2019	27	1.23	9 335.33	416.17	424.10	381.21	573.64	1 130.15	135.80	76.49	111.21
2019	28_2	1.01	26 927.89	4 922.53	6 910.17	4 363.40	2 471.27	7 895.77	408.45	342.81	214.10
2019	29	1.04	50 976.37	1 946.86	4 296.31	806.44	892.93	3 376.02	266.93	48.26	245.71
2019	30	1.08	2.59	61.29	239.84	106.76	132.69	736.48	80.72	35.24	81.01
2019	32	1.42	25 023.83	3 556.90	9 979.64	2 636.18	1 398.85	9 017.35	2 164.67	522.64	1 491.30

Table 4.1.1.3.3. Estimated biomass (in tons) of herring in September-October 2019.

YEAR	Sub_Div	AREA_CORR_FACTOR	AGE 0	AGE 1	AGE 2	AGE 3	AGE 4	AGE 5	AGE 6	AGE 7	AGE 8+
2019	21	1.55	2 848.19	5 466.87	1 674.49	858.45	362.99	663.62	251.78		
2019	22	1.02	11 486.54	2 030.47	232.13	388.80	245.59	151.91	51.33		
2019	23	1.00	897.37	468.25	225.36	124.30	134.71	257.97	44.88	27.25	9.00
2019	24	1.00	10 716.22	4 303.98	9 422.55	8 201.02	9 132.20	15 304.99	5 300.86	2 092.20	825.64
2019	25	1.03	4 213.83	8 017.03	23 556.72	28 849.71	31 130.38	84 545.57	11 910.73	6 148.52	2 238.65
2019	26	1.01	26 417.06	4 463.70	25 539.01	20 651.02	36 482.32	47 436.65	28 053.47	17 854.12	13 715.23
2019	27	1.23	9 913.31	1 541.81	5 038.83	2 330.96	7 473.01	14 963.74	932.24	265.15	22.47
2019	28_2	1.01	1 511.30	3 484.73	21 500.54	32 395.44	29 585.65	79 021.40	7 143.26	10 821.76	9 857.46
2019	29	1.04	81 260.19	37 934.34	52 468.84	46 371.30	22 304.42	62 986.33	6 637.94	9 736.09	6 350.83
2019	30	1.08	18 556.39	60 370.29	71 676.12	91 803.18	50 509.31	78 283.44	25 153.34	15 866.04	44 232.18
2019	32	1.42	60 363.82	8 578.79	49 017.79	126 385.08	70 197.36	44 567.89	16 253.09	3 933.10	1 677.93

Table 4.1.1.3.4. Estimated biomass (in tons) of sprat in September-October 2019.

YEAR	Sub_Div	AREA_CORR_FACTOR	AGE 0	AGE 1	AGE 2	AGE 3	AGE 4	AGE 5	AGE 6	AGE 7	AGE 8+
2019	21	1.55		2 879.13	4 028.15	889.85	533.61		19.33		
2019	22	1.02	3 481.28	1 834.23	1 548.45	515.38	480.78	104.40			
2019	23	1.00	1 629.84	110.00	63.00	58.80	49.94	16.86	3.67	1.05	0.25
2019	24	1.00	3 618.35	6 475.60	5 076.94	8 223.29	9 252.37	2 330.89	680.12	193.64	
2019	25	1.03	4 806.13	13 944.02	13 509.10	28 034.47	42 211.67	56 593.92	9 217.16	5 356.27	1 585.70
2019	26	1.01	17 255.08	31 708.50	49 417.67	47 692.16	35 165.86	36 102.47	3 193.97	3 168.23	2 205.83
2019	27	1.23	25 243.24	3 696.88	4 523.02	3 921.82	6 623.73	13 509.39	1 818.98	931.69	1 548.95
2019	28_2	1.01	78 198.70	42 095.06	64 766.67	43 750.90	25 755.66	83 827.51	5 194.56	3 885.35	2 560.54
2019	29	1.04	136 488.38	17 027.22	40 408.50	8 314.78	9 404.15	34 895.64	3 111.96	670.94	2 860.90
2019	30	1.08	7.86	646.82	2 917.11	1 404.12	1 842.75	10 283.51	1 135.66	534.70	1 201.37
2019	32	1.42	75 810.35	32 525.40	98 309.11	27 206.49	15 486.35	94 000.44	24 626.78	6 433.46	16 937.21

4.1.1.4 Tuning fleets for WGBFAS

4.1.1.4.1 Herring in the ICES Subdivisions 25–29

The tuning fleet for assessment of the Central Baltic herring (CBH) abundance in the ICES Subdivisions 25-29 per age-groups and years 1991-2019 (BIAS) is presented in Figure 4.1.1.4.1.1, with inclusion of the data from the ICES SD 29N. The area corrected combined results (for age 1+ CBH) of the above-mentioned ICES Subdivisions are presented in Table 4.1.1.4.1.1. The recruitment index for herring (age 0) in the ICES Subdivisions 25-29 is presented in Table 4.1.1.4.1.2.

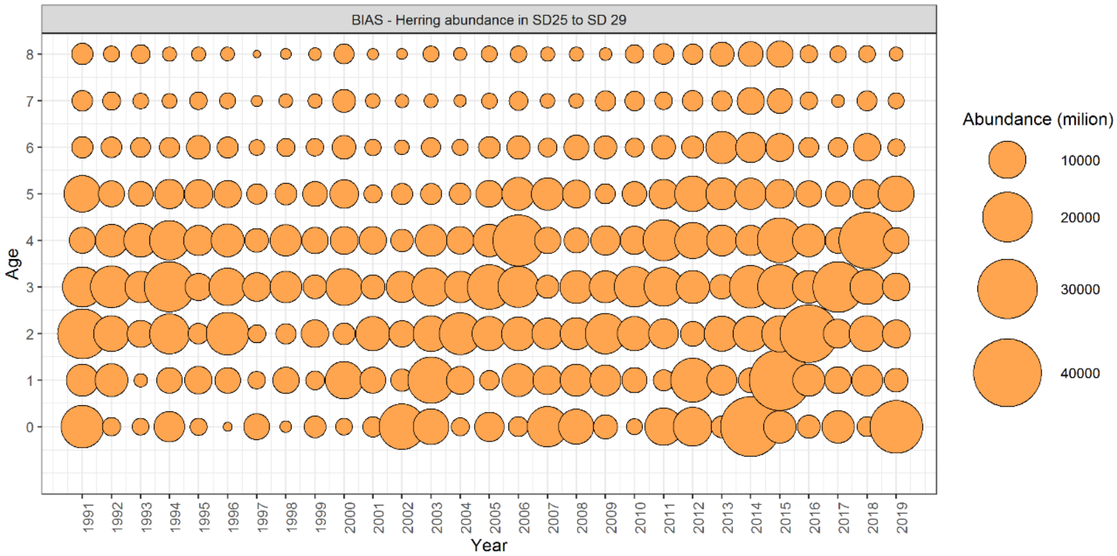


Figure 4.1.1.4.1.1. Autumn (BIAS) tuning fleet index (abundance per age-groups and years 1991-2019) for herring in the ICES Subdivisions 25-29.

Table 4.1.1.4.1.1. ***Whole time-series of tuning indices*****. Autumn acoustic (BIAS) tuning fleet index (numbers in millions) for the Central Baltic herring (the ICES Subdivisions 25–27, 28.2 and 29, including the existing data of the ICES SD 29 North).**

YEAR	HER_TOTAL_age1_8	HER_AGE1	HER_AGE2	HER_AGE3	HER_AGE4	HER_AGE5	HER_AGE6	HER_AGE	HER_AGE8+
1991	59 944.22	6 942.71	20 002.43	11 963.95	4 148.43	9 642.76	2 511.21	2280.026	2452.70551
1992	45 994.83	7 416.92	9 155.99	13 177.55	7 156.18	4 107.91	2 273.74	1539.516	1167.03327
1993	28 396.39	709.95	4 539.70	6 809.39	7 830.70	3 619.01	2 054.43	1089.658	1743.56156
1994	57 157.97	3 924.41	11 881.25	20 303.84	11 526.53	5 653.24	2 098.90	940.7476	829.044754
1995	28 048.83	4 663.87	2 235.90	4 464.12	5 908.27	5 286.76	3 156.91	1503.952	829.060363
1996	43 944.57	3 985.13	13 761.96	9 989.35	7 360.96	4 532.76	2 358.59	1178.874	776.941929
1997	15 438.37	1 447.81	1 544.65	5 182.71	3 237.17	2 156.86	1 091.16	466.7082	311.317259
1998	24 922.96	4 285.08	2 170.72	6 617.17	6 520.67	2 584.07	1 523.58	791.2695	430.406127
1999	20 511.87	1 754.15	4 741.92	3 193.65	4 251.46	3 679.73	1 427.81	833.1969	629.962205
2000	40 924.36	10 151.18	2 560.04	9 873.66	4 837.59	5 200.35	3 234.04	3006.827	2060.66843
2001	24 300.57	4 028.51	8 194.34	3 286.15	4 660.79	1 567.36	1 238.05	861.2559	464.120753
2002	20 672.28	2 686.92	4 242.02	6 508.41	2 842.26	2 326.29	869.78	741.2812	455.303611
2003	49 161.77	16 704.18	9 115.70	10 643.33	6 689.95	2 319.57	1 777.96	755.0704	1156.00491
2004	34 519.87	4 913.56	13 229.49	6 788.89	4 672.24	2 500.08	1 132.10	603.519	679.983069
2005	41 760.33	1 920.24	8 250.78	15 344.88	7 123.19	4 355.80	2 540.70	1095.946	1128.80324
2006	62 514.29	7 316.60	8 059.84	12 700.27	21 120.77	7 336.31	3 068.12	1700.65	1211.72271
2007	29 634.05	5 400.70	6 587.26	2 974.88	4 191.03	7 092.91	1 696.87	882.9258	807.458579
2008	35 039.19	6 841.54	6 822.40	7 588.80	3 612.67	4 926.52	3 563.14	877.0712	807.045303
2009	38 653.24	6 408.78	12 141.39	6 820.28	5 551.44	2 058.64	2 969.48	2089.219	614.001646
2010	37 891.76	3 829.47	8 278.75	12 047.60	5 006.24	3 542.80	1 684.71	1901.9	1600.29885
2011	44 141.66	2 338.71	5 667.81	10 992.95	12 668.94	5 525.30	3 257.40	1448.433	2242.12108
2012	51 695.69	14 947.97	3 630.05	7 544.67	9 345.39	9 199.52	2 684.65	2 261.89	2 081.55
2013	43 899.02	5 749.38	8 664.02	3 552.75	6 384.38	6 987.04	7 039.66	2 126.88	3 394.91
2014	52 626.21	3 675.26	8 562.66	13 769.67	5 860.66	6 584.71	5 993.28	4 619.10	3 560.88
2015	89 037.51	31 108.39	9 401.50	15 005.57	15 429.65	5 440.33	4 799.20	3 600.45	4 252.43
2016	58 134.62	6 884.89	27 704.64	7 260.46	7 311.38	4 046.38	2 003.00	1 459.86	1 464.01
2017	41 451.96	4 453.61	5 361.84	20 366.65	3 944.99	3 662.63	1 823.71	628.36	1 210.17
2018	64 020.47	6 305.87	9 085.50	8 407.90	26 662.65	5 605.86	4 625.38	2 016.15	1 311.18
2019	29 015.18	3 208.64	4 877.81	4 676.35	3 949.19	9 015.99	1 344.48	1 177.73	765.00

Note: The coverage of the ICES Subdivision 29N was very inconsistent until 2007. In the years, 1993, 1995 and 1997 the total coverage was very poor. It is recommended that these data should not be used. Also the numbers for years 2013-2016 have changed as the corrected FIN BIAS 2013-2015 data and POL BIAS 2016 data were included into BIAS_DB during WGBIFS meeting in 2020.

Table 4.1.1.4.1.2. Autumn acoustic (BIAS) recruitment index (age 0; numbers in millions) for the Central Baltic herring (the ICES Subdivisions 25-27, 28.2 and 29, including the existing data of the ICES SD 29 North).

YEAR	HER_AGE0
1991	13 732.73
1992	1 607.67
1993	1 297.73
1994	6 122.03
1995	1 356.71
1996	336.39
1997	4 050.41
1998	507.52
1999	2 591.05
2000	1 318.96
2001	2 122.76
2002	16 046.38
2003	9 066.54
2004	1 586.72
2005	5 567.63
2006	1 990.13
2007	12 197.22
2008	8 673.16
2009	3 365.99
2010	1 177.97
2011	10 098.28
2012	11 140.63
2013	2 582.46
2014	30 301.41
2015	7 174.81
2016	2 956.01
2017	7 183.88
2018	2 052.46
2019	22 619.61

Note: The coverage of the ICES Subdivision 29N has been very inconsistent until 2007. In the years, 1993, 1995 and 1997 the total coverage was very poor. It is recommended that these data should not be used. Also the numbers for years 2013-2016 have changed as the corrected FIN BIAS 2013-2015 data and POL BIAS 2016 data were included into BIAS_DB during WGBIFS meeting in 2020.

4.1.1.4.2 Sprat in the ICES Subdivisions 22–29

The tuning fleet for assessment of sprat abundance in the ICES Subdivisions 22-29 per age-groups and years 1991-2019 (BIAS) is presented in Figure 4.1.1.4.2.1. The area corrected combined results (for age 1+ sprat) of the above-mentioned ICES Subdivisions are presented in Table 4.1.1.4.2.1. The recruitment index for sprat (age 0) in the ICES Subdivisions 22-29 is presented in Table 4.1.1.4.2.2.

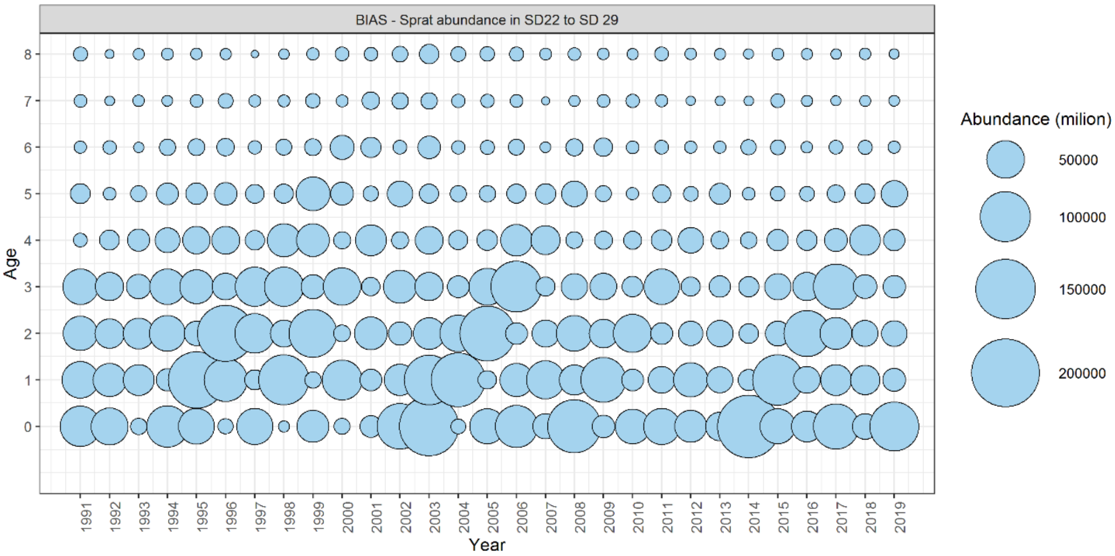


Figure 5.1.1.4.2.1. Autumn (BIAS) tuning fleet index (abundance per age-groups and years 1991-2018) for sprat in the ICES Subdivisions 22-29.

Table 4.1.1.4.2.1. *Whole time-series of tuning indices*. Autumn acoustic (BIAS) tuning fleet index (numbers in millions) for Baltic sprat (the ICES Subdivisions 22–29).

YEAR	SPR_TOTAL_age 1_8	SPR_AGE1	SPR_AGE2	SPR_AGE3	SPR_AGE4	SPR_AGE5	SPR_AGE6	SPR_AGE7	SPR_AGE8
1991	149 058.78	46 487.55	40 298.51	43 681.07	2 743.40	8 923.78	1 850.70	1 956.55	3117.22
1992	102 482.10	36 519.48	26 991.22	24 050.54	9 289.37	1 920.67	2 436.59	714.03	560.20
1993	98 533.51	30 598.67	30 890.12	16 143.51	12 681.94	4 602.94	989.26	1 451.80	1175.27
1994	137 290.10	12 531.57	44 587.69	43 274.48	17 271.54	11 924.82	5 111.65	1 028.95	1559.41
1995	231 515.93	133 193.30	16 471.15	39 297.74	22 146.93	11 336.09	5 565.78	2 104.11	1400.83
1996	268 983.16	69 994.44	130 760.26	20 797.14	23 240.90	12 777.76	6 405.11	3 696.69	1310.87
1997	143 508.24	9 279.48	57 189.82	56 067.88	8 711.23	7 627.08	2 577.01	1 638.94	416.80
1998	229 727.74	100 615.48	21 975.06	55 422.01	36 291.46	8 055.62	4 734.54	1 623.02	1010.56
1999	195 727.24	4 892.39	90 049.98	15 989.26	35 716.70	38 820.46	5 230.64	3 289.62	1738.19
2000	153 298.39	58 702.70	5 284.94	49 634.73	5 676.06	13 932.76	15 834.60	1 554.39	2678.20
2001	107 308.72	12 047.44	35 686.65	6 927.47	30 236.94	4 028.43	9 605.64	6 369.57	2406.58
2002	118 874.55	31 208.71	14 414.86	36 762.80	5 733.13	18 735.12	2 638.09	5 036.99	4344.84
2003	213 176.56	99 128.90	32 269.59	24 035.40	23 198.49	8 015.62	13 163.37	4 830.62	8534.58
2004	199 357.55	119 497.31	47 026.76	11 638.43	7 928.99	4 875.78	2 449.65	2 388.71	3551.91
2005	204 805.07	7 082.11	125 148.06	48 723.56	10 035.20	5 115.68	3 010.70	2 364.40	3325.36
2006	201 584.17	36 531.26	11 773.53	103 289.44	32 411.85	7 937.24	4 582.91	2 110.57	2947.37
2007	120 744.73	51 888.04	21 665.20	8 174.53	26 102.00	9 800.35	1 066.69	470.39	1577.52
2008	127 064.04	28 804.63	45 117.75	20 134.34	5 350.44	18 819.87	5 678.43	1 241.37	1917.21
2009	145 140.98	77 342.78	25 333.42	20 839.86	6 546.99	4 667.38	7 023.48	2 011.35	1375.72
2010	88 295.36	12 048.42	51 771.79	10 275.01	6 594.51	1 880.19	1 951.11	2 591.36	1182.97
2011	99 587.07	20 620.08	11 656.53	43 356.67	9 989.74	6 746.61	2 614.83	1 794.67	2807.94
2012	90 590.08	40 515.77	16 525.13	7 935.32	18 412.56	3 494.33	1 732.67	606.20	1368.12
2013	72 073.19	19 702.86	20 486.34	11 242.82	6 040.50	10 792.27	1 882.27	765.63	1160.51
2014	41 224.08	10 665.29	8 623.21	9 735.00	4 933.43	2 033.89	3 778.55	681.04	773.67
2015	162 095.71	102 246.65	17 405.51	19 931.64	11 138.29	3 456.30	3 574.47	2 795.32	1547.51
2016	143 002.18	20 629.17	81 156.57	24 160.82	9 343.43	3 771.45	1 492.22	1 195.37	1253.15
2017	166 670.25	30 170.75	33 936.85	78 088.23	13 673.42	6 371.96	2 680.92	822.75	925.38
2018	105 294.21	26 878.92	19 204.34	14 849.34	29 574.50	9 134.61	3 134.31	1 182.26	1335.94
2019	79 813.38	13 510.10	18 518.47	13 046.25	11 131.30	19 904.16	1 746.92	1 119.01	837.17

__Note:__ In the years, 1993, 1995 and 1997 the coverage was very poor. It is recommended that these data should not be used. Also the numbers for years 2013-2016 have changed as the corrected FIN BIAS 2013-2015 data and POL BIAS 2016 data were included into BIAS_DB during WGBIFS meeting in 2020.

Table 4.1.1.4.2.2. Autumn acoustic (BIAS) recruitment index (age 0; numbers in millions) for sprat (the ICES Subdivisions 22-29).

YEAR	SPR_AGE0
1991	59 472.84
1992	48 035.33
1993	5 173.57
1994	64 092.10
1995	44 364.82
1996	3 841.55
1997	45 947.64
1998	1 279.14
1999	33 320.45
2000	4 601.26
2001	12 000.66
2002	79 550.86
2003	146 334.99
2004	3 562.32
2005	41 862.94
2006	66 125.22
2007	17 821.04
2008	115 698.22
2009	12 798.16
2010	41 158.22
2011	45 186.05
2012	33 653.39
2013	24 921.17
2014	168 124.77
2015	42 251.07
2016	30 848.28
2017	78 166.60
2018	18 541.96
2019	95 602.70

Note: In the years, 1993, 1995 and 1997 the coverage was very poor. It is recommended that these data should not be used. Also the numbers for years 2013-2016 have changed as the corrected FIN BIAS 2013-2015 data and POL BIAS 2016 data were included into BIAS_DB during WGBIFS meeting in 2020.

4.1.1.4.3 Herring in the ICES Subdivision 30

The results from 2012 survey are not consistent with the results from other years due to lower area coverage than normally. In 2012, Sweden could not support the funding for the BIAS survey in the Bothnian Sea and therefore the coverage of the ICES SD 30 was based on the Finnish data only, which resulted in half of the normal effort. In 2013, Finland installed fishing equipment and the Simrad EK-60 echosounder into the R/V "Aranda" and used the vessel in order to cover all required ICES rectangles in the Bothnian Sea. In 2014-2018, the distance of the acoustic transects and the numbers of realized fish control-hauls were done almost as planned. In 2019, the Finnish BIAS survey was realized on board of the r/v "Aranda".

Estimates from the standard BIAS calculations for the 1999, 2000, 2007-2019 surveys are presented in Table 4.1.1.4.3.1 and Figure 4.1.1.4.3.1.

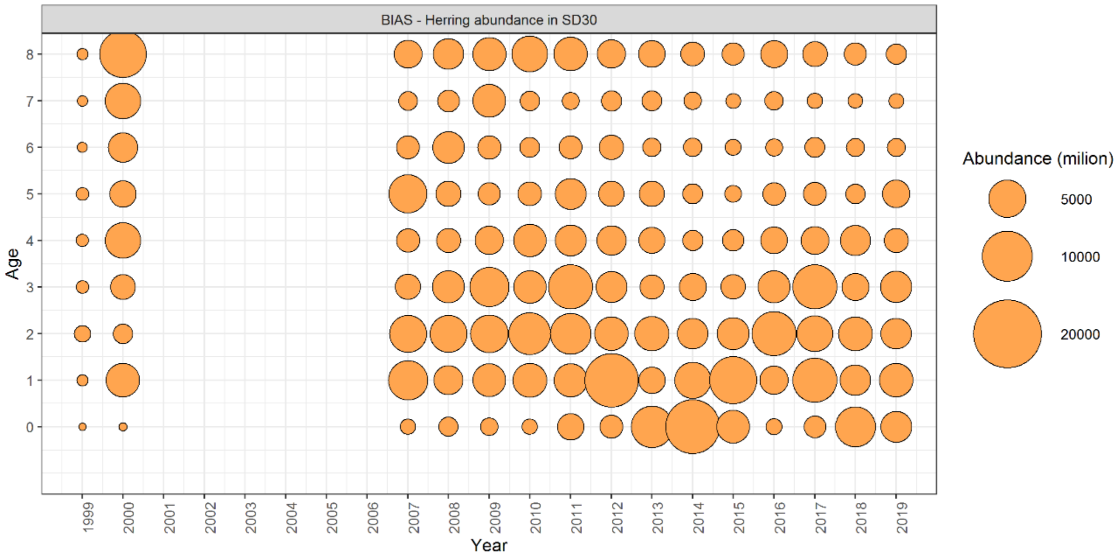


Figure 4.1.1.4.3.1. Autumn (BIAS) tuning fleet index (abundance per age-groups and years 1999-2000 and 2007-2018) for herring in the ICES Subdivision 30.

Table 4.1.1.4.3.1. Correction factor and area corrected numbers (millions) of herring per age-groups in the ICES Subdivision 30 (1999, 2000, 2007-2019) based on the standard BIAS calculations.

YEAR	AREA_CORR_FACTOR	age 0	age 1	age 2	age 3	age 4	age 5	age 6	age 7	age 8+
1999	1.28	100.45	187.68	561.32	252.25	228.34	252.55	140.65	156.24	188.65
2000	1.06	104.19	3 846.00	928.57	1 794.16	4 429.95	2 048.50	2 704.11	4 361.30	8 552.91
2007	1.06	442.53	5 670.78	4 916.19	1 845.69	1 507.59	5 254.43	1 441.11	826.08	2 347.95
2008	1.20	859.15	2 669.79	4 846.31	3 386.30	1 649.49	1 825.30	3 344.39	1 265.96	3 049.00
2009	1.06	679.46	3 573.39	5 089.63	5 558.51	2 438.03	1 282.91	1 518.46	3 615.98	3 757.41
2010	1.06	452.73	3 989.84	6 534.82	3 500.95	3 535.59	1 576.84	982.35	891.26	4 479.00
2011	1.06	2 041.68	3 699.81	6 100.51	7 384.00	3 086.23	3 133.75	1 442.21	641.73	3 870.69
2012	1.08	1 402.04	11 647.55	3 841.53	3 108.94	2 733.63	1 868.14	1 693.16	987.30	2 494.57
2013	1.11	6 417.65	2 031.62	4 014.04	1 650.38	1 958.76	1 865.32	771.88	957.54	2 103.03
2014	1.08	11 917.90	4 666.69	3 019.16	2 206.86	1 009.47	961.19	759.97	691.42	1 587.03
2015	1.21	3 643.91	8 661.26	3 402.28	1 713.24	1 192.99	583.79	531.72	429.78	1 321.77
2016	1.07	516.11	2461.71	7523.15	3435.98	2143.38	1348.59	656.18	754.88	2257.24
2017	1.08	1210.64	7469.92	4502.78	7473.83	2398.53	1427.02	940.46	446.82	1765.08
2018	1.08	5 817.77	2 994.51	3 937.75	2 243.29	2 878.45	886.53	719.35	388.13	1 326.35
2019	1.08	3 156.36	3 776.37	3 013.38	3 206.16	1 643.46	2 298.43	738.91	420.78	1 018.48

Note: The numbers for years 2013-2015 have changed as the corrected FIN BIAS 2013-2015 data were included into BIAS_DB during WGBIFS meeting in 2020.

An additional 3-day long meeting was agreed to be organized at the beginning of December 2020 to evaluate StoX estimates compared to BIAS calculations and the to find out the possible reasons behind the differences. Directly after the WGBIFS 2020 meeting in March it revealed that the SD3031 herring benchmark WG outcomes became invalid, because the wrong acoustic index figures were used in the assessment models. A new benchmark for the Gulf of Bothnia herring assessment was planned for the beginning of the 2021 and WGBIFS got the following request: "WGBGFAS recommends WGBIFS to thoroughly scrutinize the acoustic survey index calculation for herring in SDs 30-31. Ultimately, the relevant survey data must be uploaded into the ICES database for acoustic trawl surveys and the StoX software should be applied for the calculation of estimates for a transparent reproducible pathway in TAF". WGBFAS was forced to drop some of their recommendations (including this one) in the final version of their report, because the maximum limit of recommendations was exceeded, but ACOM still expected from WGBIFS to address that recommendation during the planned December meeting.

A web meeting was held 1–3 December 2020 to calculate the herring abundance indices in SD 30 using the StoX software and to perform a comparison exercise between the StoX and traditional BIAS calculation methods. Before the meeting were the data for the years 2007-2019 available for that purpose. Comparison revealed that in general the differences in total number of herring between the two methods were below 4%, but in some rectangles in certain years the differences were observed to be up to 35%. The reason of these differences appeared to be the small methodological differences between the StoX and the standard BIAS calculation method (the StoX project, developed for the WGBIFS, is for various reasons actually not following 100% the standard method used by WGBIFS). As some new mistakes were discovered in the standard BIAS calculations for some years, WGBIFS decided to recommend for the assessment purpose the herring abundance time-series calculated with StoX. Tuning fleet data from the October 2007-2019 BIAS surveys for the assessment of the Gulf of Bothnian herring stock (the ICES Subdivisions 30-31) are presented in Table 4.1.1.4.3.2.

Table 4.1.1.4.3.2. Correction factor and area corrected numbers (millions) of herring per age-groups in the ICES Subdivision 30 (2007-2019) based on the StoX calculations.

YEAR	Area correction factor	Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11	Age 12	Age 13	Age 14	Age 15+
2007	1.03920	480	6346	5228	1902	1492	5449	1420	786	536	490	322	253	139	145	75	260
2008	1.21349	1069	3074	5105	3478	1649	1707	3285	1235	987	630	396	292	173	155	145	147
2009	1.05543	819	4667	5074	5358	2491	1259	1458	3525	1210	544	575	316	336	172	152	221
2010	1.05543	712	4465	7189	3611	3424	1669	1055	931	2145	505	519	261	184	128	72	173
2011	1.05543	2504	4412	6285	7406	2942	3127	1360	587	497	1949	379	288	202	164	133	149
2012	1.08205	1398	11389	3905	3271	2902	1695	1627	962	382	504	817	344	140	104	103	178
2013	1.08205	5567	1849	3889	1503	1717	1597	711	884	408	172	260	477	188	92	49	104
2014	1.07634	11845	4839	2637	2193	1012	687	554	626	322	180	102	204	237	52	50	81
2015	1.21947	3446	8863	3462	1912	1334	763	764	458	472	284	156	121	176	129	109	65
2016	1.07634	1502	2003	6118	2778	1544	956	499	540	438	276	263	138	138	223	173	171
2017	1.08205	1287	7732	5065	8105	2444	1595	927	449	426	368	294	238	62	82	148	207
2018	1.07634	6174	2882	3937	2087	3158	869	767	412	262	275	245	137	161	68	48	190
2019	1.08205	2798	3538	3682	3780	1834	2333	838	492	440	261	148	125	50	84	47	94

*** The abundance indices for age-groups 0 and 1 is underestimated in the survey and should therefore not be used for the assessment.**

4.1.2 Combined results of the Baltic Acoustic Spring Survey (BASS)

In May 2019, the following acoustic surveys were conducted:

Country	Data	Vessel	ICES SDs	Length of acoustic transects [NM]	Number of hauls	Number of hydrological stations
Latvia-Poland	18-25.05.2019	Baltica	Parts of 26, 28,	611	19	22
Estonia-Poland	26-31.05.2019	Baltica	Parts of 28, 29, 32	380	14	14
Lithuania	02-03.06.2019	169	Part of 26	125	7	7
Poland	03-15.05.2019	Baltica	Parts of 25, 26	774	31	39
Germany	03-28.05.2019	Solea	Part of 24, 25, 26, 27, 28, 29	1845	68	152

4.1.2.1 Area under investigation and overlapping areas

The BASS surveys were realized in May 2019 by the above-mentioned five countries in the ICES Subdivisions 24-32 (excl. ICES SD 30, 31) however, in some ICES Subdivisions only fragmentary (Figure 4.1.2.1.1). The area coverage of the Baltic Sea with the BASS/2019 survey was very broad and 99% of planned area was monitored with acoustic and trawling. The part of ICES SD 26 (the ICES rct.39H0) was not investigated as Russia did not take part in BASS 2019 cruises and rectangles 38G9, 39G9 and 40G9 were inspected only partly, i.e. inside the Polish and Lithuanian EEZ. The ICES SD 29 was monitored with acoustic-trawl investigations in the southern and middle parts moreover, only one the ICES rectangle 47H3 was inspected in the ICES Subdivision 32. In May 2019, overall 59 the ICES rectangles were covered with acoustic-biotic monitoring. Four ICES rectangles were inspected by two countries (i.e. 42G9, 43G9, 44G9 and 46H0). Echointegration was recorded at totally of 3735 NM linear distance moreover, 139 and 234 catch and hydrological stations, respectively were inspected too. Because of relatively small portion of herring (<10%) compared with sprat (>90%) in most of areas monitored during the BASS 2019 surveys only the distribution of sprat is further examined.

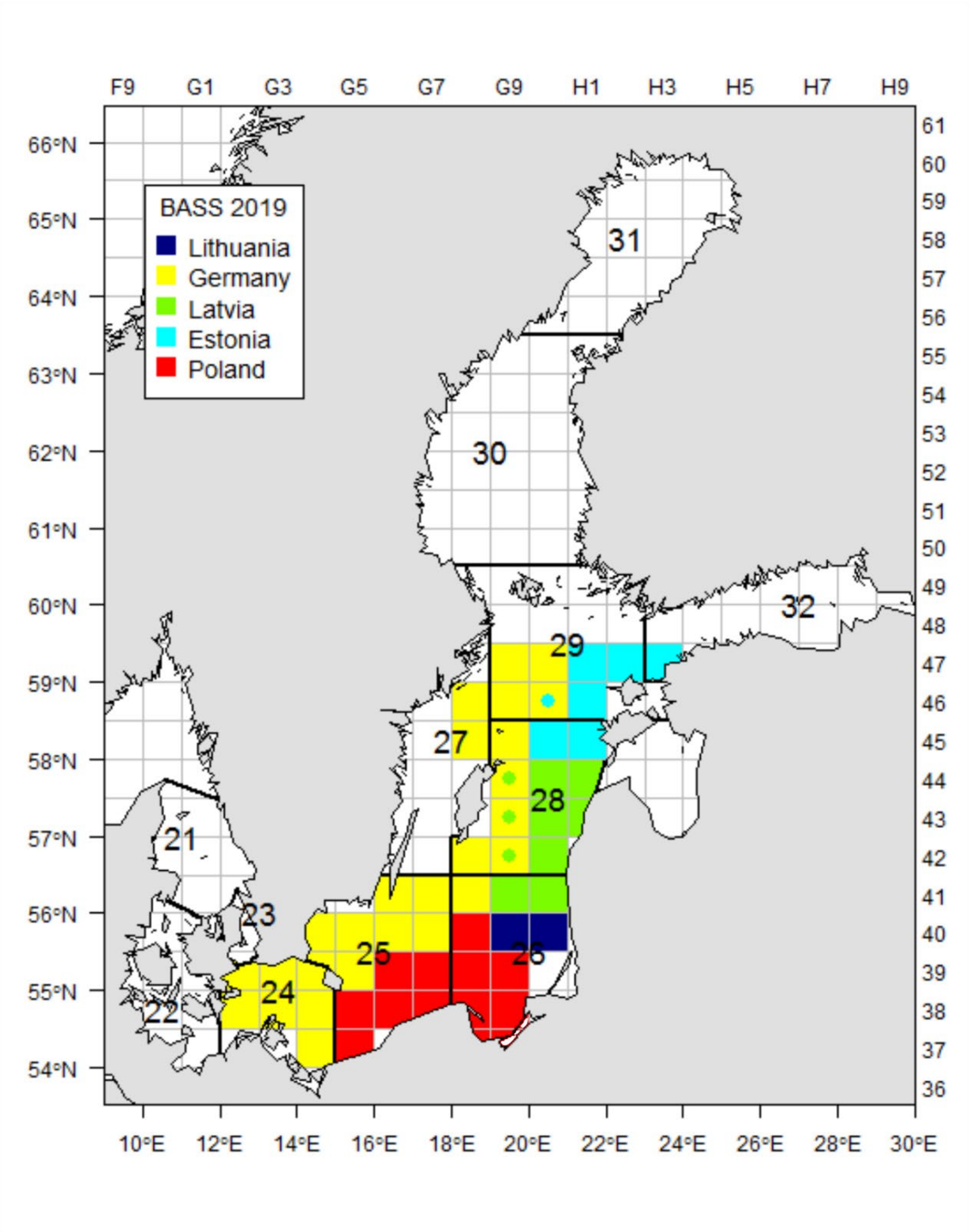


Figure 4.1.2.1.1. Map of the BASS survey conducted in May 2019. Various colours indicate the countries, which covered specific ICES rectangles and delivered data to the BASS-database, thus was responsible for this rectangle. Dot with different colour within a rectangle explain additional data in the BASS-database partly or totally covered by other countries (not included into final analysis).

4.1.2.2 Combined results and area corrected data

The geographical distribution of the sprat abundance per ICES rectangles monitored in May 2019 is demonstrated in Figure 4.1.2.2.1. The Baltic sprat stock abundance estimates per ICES rectangles and ICES Subdivisions according to age-groups are presented in Tables 4.1.2.2.1 and 4.1.2.2.2. During the WGBIFS 2006 meeting possible improvement of the results from acoustic surveys was discussed, and a correction factor for each ICES Subdivision and year was introduced because of the coverage of the investigated areas differed in the years. This factor is the proportion to the total area of the ICES Subdivision (see the IBAS Manual) and the area of rectangles covered during the survey. The correction factors, calculated by ICES Subdivisions for 2019 are included.

In May 2019 sprat was very widely distributed in the Baltic Sea, it occurred in the each monitored ICES rectangle (Figure 4.1.2.2.1). The highest sprat (age 1+) stock abundance was observed in the ICES SD 26 (the Gdansk Basin) and in the ICES SD 25.

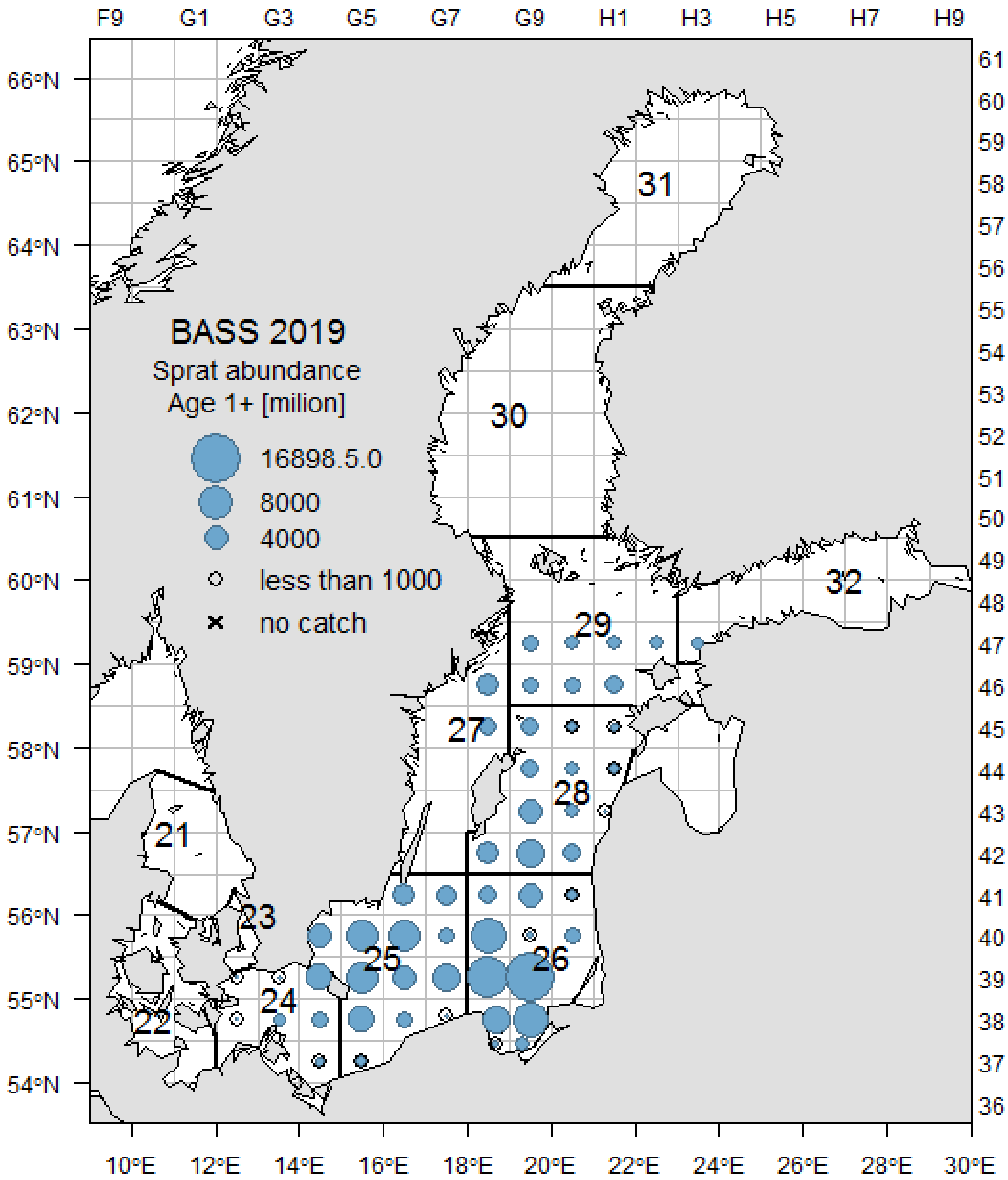


Figure 4.1.2.2.1. The abundance of sprat per ICES rectangles monitored in May 2019 (the area of circles indicates estimated numbers of specimens x10^6 in given rectangle).

Table 4.1.2.2.1. Estimated abundance (millions) of sprat in May 2019 per age-groups and the ICES-rectangles in given ICES Subdivisions.

ANNUS	SD	RECT	total	age 1	age 2	age 3	age 4	age 5	age 6	age 7	age 8+
2019	24	37G4	700.51	138.25	68.32	173.85	158.17	138.00	9.83		14.09
2019	24	38G2	76.63	20.63	2.02	15.28	18.77	17.36	1.32		1.25
2019	24	38G3	1 126.94	236.31	141.42	274.77	228.40	210.52	11.88		23.64
2019	24	38G4	1 977.63	359.37	251.01	488.51	423.64	391.15	27.48		36.47
2019	24	39G2	14.00	3.77	0.37	2.79	3.43	3.17	0.24		0.23
2019	24	39G3	185.82	15.04	18.41	38.19	54.39	32.18	15.71		11.90
2019	24	39G4	1 655.66	234.80	382.54	413.56	264.81	321.54	11.35		27.06
2019	25	37G5	968.52	3.37	34.38	176.04	296.45	348.09	63.15	32.05	15.01
2019	25	38G5	5 132.61	52.01	242.31	1 304.76	1 547.01	1 663.87	194.09	78.85	49.69
2019	25	38G6	1 793.08	12.81	68.93	335.95	560.65	640.52	101.81	46.46	25.96
2019	25	38G7	156.80	0.33	6.62	38.56	51.90	53.05	4.48	0.68	1.18
2019	25	39G4	3 026.90	376.54	419.76	326.92	1 116.47	671.25	106.72		9.24
2019	25	39G5	7 405.30	845.95	1 695.73	900.63	2 379.88	1 428.06	145.96		9.09
2019	25	39G6	4 215.52	73.23	224.57	1 420.25	1 209.25	1 154.91	83.74	29.72	19.85
2019	25	39G7	5 184.04	332.23	407.61	2 107.02	1 181.85	1 075.20	57.18	7.46	15.49
2019	25	40G4	4 436.23	397.23	602.36	482.89	1 742.88	1 036.59	165.94		8.34
2019	25	40G5	7 257.18	2 124.03	2 070.99	800.12	1 451.54	779.01	31.49		
2019	25	40G6	7 216.25	1 958.31	1 376.98	708.56	1 928.67	1 115.48	128.25		
2019	25	40G7	2 067.64	354.82	568.58	260.33	539.49	327.86	16.56		
2019	25	41G6	3 489.46	792.47	988.80	373.77	851.37	447.72	35.33		
2019	25	41G7	2 715.92	204.38	418.99	370.38	998.13	663.02	59.64		1.38
2019	26	37G8	339.65	22.83	42.38	80.10	124.90	55.53	12.40	0.61	0.91
2019	26	37G9	1 566.68	55.89	202.59	443.07	570.64	242.95	50.64	0.91	
2019	26	38G8	5 555.82	159.36	875.79	1 621.71	1 989.87	761.94	140.23	0.99	5.94
2019	26	38G9	9 245.96	275.35	1 508.77	2 960.36	3 034.42	1 230.47	234.68	1.92	
2019	26	39G8	11 810.20	837.21	1 466.72	2 919.80	4 349.99	1 857.70	355.19	7.80	15.79
2019	26	39G9	16 898.49	1 047.37	2 304.88	4 488.14	6 168.55	2 450.45	432.11	6.99	
2019	26	40G8	9 065.35	751.23	1 211.81	2 370.73	3 075.50	1 393.38	247.76	9.28	5.67
2019	26	40G9	492.52	12.92	44.01	48.26	242.28	132.15	12.19	0.72	
2019	26	40H0	1 805.74	481.77	288.44	283.53	425.73	278.81	47.45		
2019	26	41G8	2 440.69	65.49	485.03	322.99	1 069.12	441.55	16.81	4.20	35.50
2019	26	41G9	4 189.65	305.85	1 129.83	388.23	554.75	1 610.82	65.18	98.70	36.29
2019	26	41H0	924.86	315.81	206.55	48.07	96.78	231.69	5.74	18.54	1.68
2019	27	45G8	2 661.86	1 091.02	802.88	224.91	395.90	145.71	0.72		0.72
2019	27	46G8	3 657.25	1 338.48	984.94	372.28	703.43	252.26	2.93		2.93
2019	28_2	42G8	3 769.94	135.19	734.09	667.18	1 655.86	535.52	26.05		16.05
2019	28_2	42G9	5 179.30	210.90	1 497.87	738.03	1 921.07	774.06	15.97		21.40
2019	28_2	42H0	2 210.05	181.88	824.23	207.95	192.72	700.85	50.87	9.90	41.65
2019	28_2	43G9	4 058.19	255.93	1 355.36	541.86	1 345.00	549.81	3.41		6.82
2019	28_2	43H0	1 636.21	319.71	407.62	103.27	188.25	521.09	27.33	44.14	24.80
2019	28_2	43H1	251.01	61.20	57.91	13.72	24.78	75.09	6.45	6.08	5.78
2019	28_2	44G9	2 671.27	173.77	867.88	351.60	891.27	372.13	4.87		9.75
2019	28_2	44H0	1 722.52	95.06	400.18	192.39	290.72	638.14	37.68	32.70	35.65
2019	28_2	44H1	862.36	374.89	144.51	68.72	60.89	191.28	19.30	1.80	0.97
2019	28_2	45G9	2 565.57	148.13	667.66	366.14	972.01	391.27	9.50		10.86
2019	28_2	45H0	793.34	59.54	221.38	72.30	75.62	267.02	40.99	13.64	42.85
2019	28_2	45H1	726.34	229.53	187.40	44.44	44.29	160.28	28.31	6.23	25.85
2019	29	46G9	1 955.90	97.77	426.80	218.38	889.85	302.69	5.38	13.69	1.34
2019	29	46H0	2 184.05	259.47	523.80	211.09	903.87	268.87	4.98	10.73	1.24
2019	29	46H1	2 358.92	329.95	934.32	98.75	134.76	689.84	111.72	7.28	52.30
2019	29	47G9	2 110.20	52.16	273.85	223.05	1 097.31	420.75	1.58	41.10	0.40
2019	29	47H0	1 544.43	375.51	242.27	132.04	558.26	211.69	6.22	16.89	1.55
2019	29	47H1	1 552.89	205.50	587.57	64.88	89.53	469.68	80.22	7.86	47.65
2019	29	47H2	1 726.36	77.03	596.72	101.07	137.46	617.37	123.07	6.05	67.60
2019	32	47H3	1 078.56	77.48	309.53	55.13	62.65	471.68	20.18	35.23	46.67

Table 4.1.2.2.2. Estimated numbers of sprat (millions) by ICES Subdivisions, according to age-groups (May 2019).

ANNUS	Sub_Div	AGE1	AGE2	AGE3	AGE4	AGE5	AGE6	AGE7	AGE8
2019	24	1 008.17	864.09	1 406.95	1 151.61	1 113.92	77.81		114.64
2019	25	7 527.70	9 126.60	9 606.19	15 855.54	11 404.63	1 194.33	195.23	155.22
2019	26	4 331.08	9 766.78	15 975.00	21 702.54	10 687.42	1 620.39	150.63	101.77
2019	27	2 429.50	1 787.82	597.19	1 099.33	397.97	3.65		3.65
2019	28_2	2 245.72	7 366.08	3 367.60	7 662.49	5 176.55	270.72	114.49	242.43
2019	29	1 397.39	3 585.32	1 049.26	3 811.04	2 980.89	333.17	103.60	172.08
2019	32	77.48	309.53	55.13	62.65	471.68	20.18	35.23	46.67

4.1.2.2.1 Sprat in the ICES Subdivisions 24 – 28

Tuning Fleets for WGBFAS

The area corrected abundance estimates for sprat per ICES Subdivision are summarized in Table 4.1.2.2.1.1. The corresponding biomass estimates of sprat are given in the Table 4.1.2.2.1.2. The complete time-series (2001 - 2019) of the area-corrected sprat abundance in the ICES Subdivisions 24, 25 26 and 28_2 is given in the Table 4.1.2.2.1.3.

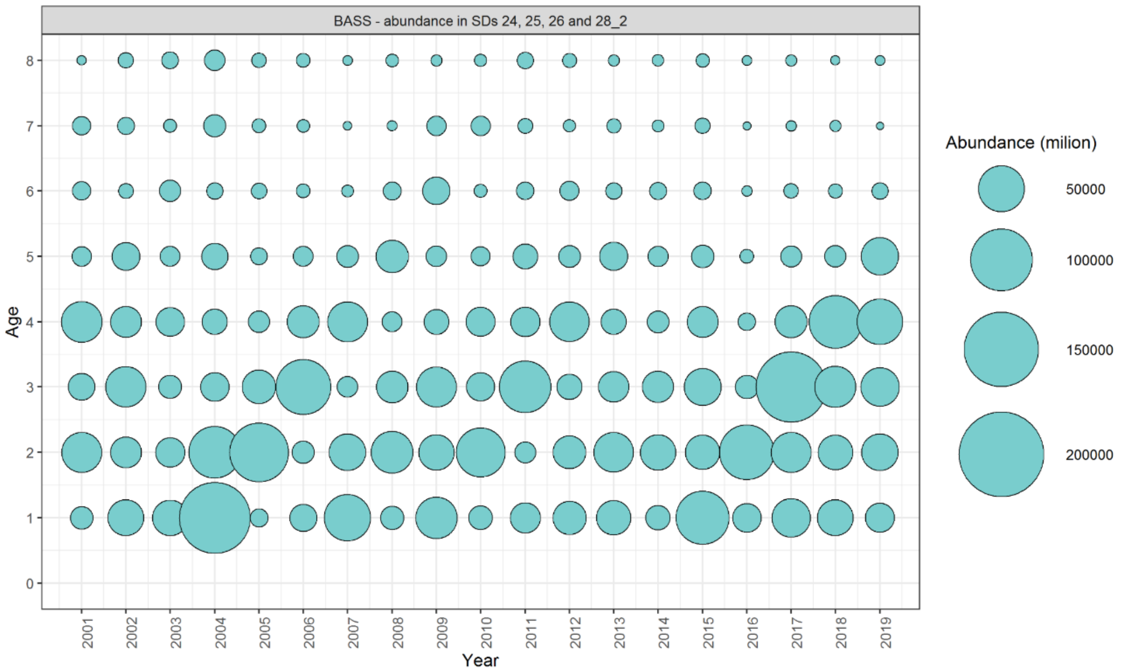


Figure 4.1.2.2.1.1. Spring (BASS) tuning fleet index (abundance per age-groups and years 2001-2019) for sprat in the ICES Subdivisions 24, 25, 26 and 28_2.

Table 4.1.2.2.1.1. Area corrected numbers (millions) of sprat by ICES Subdivisions and age-groups (May 2019).

ANNUS	Sub_Div	AREA_CORR_FACTOR	AGE1	AGE2	AGE3	AGE4	AGE5	AGE6	AGE7	AGE8+
2019	24	1.07	1 076.61	922.75	1 502.46	1 229.79	1 189.54	83.09		122.42
2019	25	1.03	7 768.50	9 418.55	9 913.48	16 362.74	11 769.45	1 232.54	201.48	160.19
2019	26	1.10	4 774.21	10 766.05	17 609.44	23 922.99	11 780.88	1 786.18	166.05	112.18
2019	27	4.25	10 322.46	7 596.09	2 537.34	4 670.83	1 690.89	15.51		15.51
2019	28_2	1.04	2 338.60	7 670.74	3 506.89	7 979.41	5 390.65	281.92	119.23	252.46
2019	29	1.61	2 252.36	5 778.93	1 691.22	6 142.74	4 804.68	537.02	166.98	277.36
2019	32	13.98	1 083.35	4 327.87	770.81	876.03	6 595.12	282.23	492.66	652.52

Table 4.1.2.2.1.2. Corrected sprat biomass (in tonnes) according to ICES Subdivisions and age-groups (May 2019).

ANNUS	Sub_Div	AREA_CORR_FACTOR	AGE1	AGE2	AGE3	AGE4	AGE5	AGE6	AGE7	AGE8+
2019	24	1.07	9089.05	11323.35	23590.37	21772.70	19925.56	1955.43		2236.98
2019	25	1.03	52324.11	84978.31	99375.68	193971.46	144195.51	18172.22	3363.85	2491.67
2019	26	1.10	22838.32	80664.66	144965.30	232009.19	116300.01	18072.61	2090.18	1519.41
2019	27	4.25	45471.38	53719.81	22438.33	43406.75	15778.72	201.61		201.61
2019	28_2	1.04	11201.37	59602.37	33236.77	77896.11	51652.77	3249.28	1431.83	2975.58
2019	29	1.61	9643.33	41193.97	15190.96	56536.55	44459.09	5126.37	1960.67	2969.75
2019	32	13.98	4053.73	27837.43	5830.01	6986.98	54899.49	2642.54	4425.71	6605.87

Table 4.1.2.2.1.3. *Whole time-series of tuning indices*. Spring acoustic (BASS) tuning fleet index (numbers in millions) for Baltic sprat (the ICES Subdivisions 24, 25, 26 and 28_2).

ANNUS	SPR_TOTAL	SPR_AGE1	SPR_AGE2	SPR_AGE3	SPR_AGE4	SPR_AGE5	SPR_AGE6	SPR_AGE7	SPR_AGE8
2001	109 404.16	8 225.02	35 734.86	12 970.86	37 327.77	5 384.44	4 635.49	4 526.01	599.71
2002	125 782.95	27 412.11	18 982.00	36 813.57	19 044.89	14 758.59	2 517.12	3 669.81	2 584.85
2003	84 986.61	26 468.98	16 471.45	8 422.95	15 532.70	5 653.45	7 169.73	1 660.01	3 607.34
2004	258 606.73	136 162.06	65 565.92	15 783.74	11 042.29	12 655.24	3 270.65	7 805.79	6 321.05
2005	134 373.52	4 358.61	88 829.99	23 556.64	7 258.25	3 516.63	2 780.51	1 829.96	2 242.94
2006	130 287.13	13 416.63	7 980.49	76 703.20	21 045.81	5 701.71	1 970.41	1 525.76	1 943.11
2007	132 637.19	51 568.74	28 713.21	6 377.16	36 006.21	7 480.56	1 261.14	532.65	697.52
2008	102 722.51	9 029.20	40 269.65	20 164.14	5 627.08	21 187.94	4 209.97	757.16	1 477.38
2009	139 641.22	39 412.17	26 701.03	36 255.42	10 548.51	6 312.12	14 106.27	5 341.22	964.48
2010	112 784.60	9 387.20	58 680.01	15 199.18	15 963.48	5 061.93	1 653.59	5 566.35	1 272.87
2011	128 153.97	18 091.69	6 790.99	66 159.99	16 689.00	10 564.65	4 076.69	2 399.13	3 381.83
2012	107 660.52	22 699.62	22 079.78	11 274.09	35 541.24	7 515.42	5 024.69	1 367.20	2 158.48
2013	111 418.65	24 876.63	35 333.30	18 392.57	11 357.94	14 959.37	3 385.50	2 163.71	949.62
2014	76 549.35	10 144.65	26 906.62	19 857.10	7 457.71	6 098.20	3 810.12	1 217.38	1 057.57
2015	160 548.72	70 752.42	24 659.60	29 744.21	18 934.79	8 080.81	4 074.30	2 581.47	1 721.12
2016	108 392.40	15 554.71	75 824.12	9 121.48	3 989.53	1 894.54	791.08	513.72	703.20
2017	233 353.41	32 701.04	36 291.63	132 939.42	20 629.89	6 790.33	2 249.57	809.40	942.12
2018	171 723.01	27 208.85	25 641.68	38 632.38	69 259.39	7 250.77	2 086.13	1 025.15	618.66
2019	161 411.46	15 957.92	28 778.09	32 532.27	49 494.92	30 130.52	3 383.73	486.76	647.25

Note: **In year 2016, the coverage was very poor. It is recommended that these data should not be used.**

4.2 ToR b) Update the BIAS and BASS hydroacoustic databases and ICES database for acoustic-trawl surveys

After validation, the international data from the Baltic International Acoustic Survey (BIAS) and the Baltic Acoustic Spring Survey (BASS) curried out in 2019 were added to the BIAS_DB.mdb and the BASS_DB.mdb access-databases, respectively. These databases also include queries with the used algorithms for creation of report tables and calculation of the different tuning fleets. The updated versions of the databases are located in the folder "Data" of the ICES WGBIFS 2020 SharePoint.

Before the WGBIFS 2020 meeting the errors in the Finnish BIAS data for years 2013-2015 and the Polish BIAS data for 2016 were found. The BIAS_DB.mdb access-database has been corrected for those years just before the meeting.

During WGBIFS 2020 meeting the errors in reported the herring and sprat mean weight data in both BASS_DB.mdb and BIAS_DB.mdb access-databases were found. The group decided that each country will check both species mean weight data quality and provide the missing and corrected values to Beata Schmidt – this work will be done within the ToR b tasks during the next 3 years.

Also, during WGBIFS-2020 meeting the group decided to create additional BIAS_SD30_DB.mdl access-database for SD 30 herring with expanded age-group up to 15+. Finland and Sweden will provide B. Schmidt with the BIAS data for SD 30 herring and she will create it before the next WGBIFS meeting in March 2021.

The results of the next international acoustic surveys (BIAS, BASS) should be summarized in table format according the IBAS Manual and latest one month before the next year meeting uploaded to the ICES WGBIFS-SharePoint. O. Kaljuste from Sweden and B Schmidt from Poland were assigned as the above-mentioned (BAD1) acoustic-trawl data coordinators, responsible to control that the acoustic survey results are uploaded in the right format to the SharePoint of WGBIFS. Moreover, B. Schmidt was assigned as the manager of the BIAS and BASS databases for aggregated data (BIAS_DB.mdb and BASS_DB.mdb). B. Schmidt in cooperation with particular national submitters will check the integrated data for errors and preliminary analysis will be performed in order to present the data to the WGBIFS meeting for further evaluations and discussion. If the countries do not submit the data to database manager in the agreed time, this work cannot be done during the WGBIFS annual meeting with the required quality.

Additionally, the latest disaggregated acoustic and biotic data from national BASS and BIAS surveys should also be uploaded at least 15 days before the beginning of the annual WGBIFS meeting to the new database for acoustic trawl surveys at the ICES Data Centre (http://ices.dk/marine-data/data-portals/Pages/acoustic.aspx), using the ICES acoustic data format.

4.3 ToR c) Plan and decide on acoustic surveys to be conducted in autumn 2020 and spring 2020-2021

All the Baltic Sea countries except of Russia intend to take part in the BASS and BIAS acoustic surveys and experiments in 2020 and 2021 (Figures 4.3.1, 4.3.3 and 4.3.4). There is also an intention to conduct a Latvian/Estonian survey in the Gulf of Riga (GRAHS) in July-August 2020 and 2021 (Figures 4.3.2 and 4.3.5). The list of participating research vessels and initially planned periods of particular surveys are given in the following tables:

BASS/2020 surveys

Vessel	Country	Area of Investigation (ICES Subdivisions)	(Preliminary) Period of Investigations	Duration (Days)
Svea	Sweden	27	30/4-6/5 2020	7
Baltica	Estonia/Poland	28,29	27.5 – 01.06.2020	6
Walther Herwig III	Germany	24, 25, 26, 27, 28, 29 (for all SD: only part monitored)	07/05-29/05	22
Baltica	Latvia	26 partly, 28 partly	19-26/5 2020	8
Commercial Vessel	Lithuania	Part of 26	18-19.05.2020	2
Baltica	Poland	Parts of 25 and 26	02-15.05.2020	14

GRAHS/2020 survey

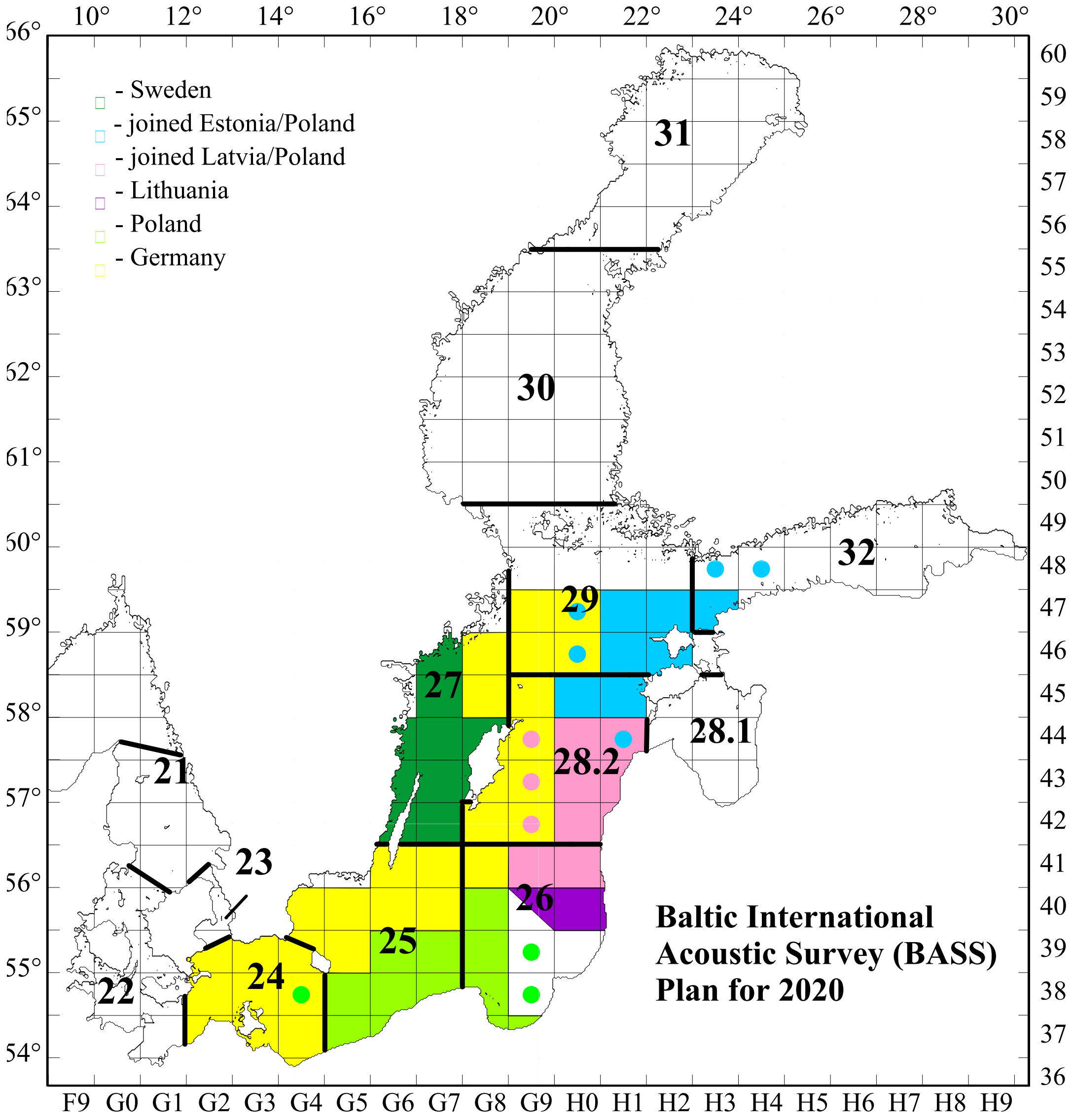
Vessel	Country	Area of Investigation (ICES Subdivisions)	(Preliminary) Period of Investigations	Duration (Days)
Ulrika	Latvia	28.1	28/7-3/8 2020	7
Ulrika	Estonia	28.1	28/7-3/8 2020	7

BIAS/2020 surveys

Vessel	Country	Area of Investigation (ICES Subdivisions)	(Preliminary) Period of Investigations	Duration (Days)
Svea	Sweden	27 and parts of 25,26,28,29	28/9 – 15/10 2020	18
Baltica	Estonia/Poland	28,29,32	18.10 – 28.10.2020	11
Aranda	Finland	29N, 30 and 32N	22.9.-6.10.2020	15
Baltica	Latvia	26 partly, 28 partly	8-17/10 2020	10
Commercial Vessel	Lithuania	Part of 26	01-02.10.2020	2
Baltica	Poland	Parts of 25 and 26	15-30.09.2020	16
Atlantida or AtlantNIRO	Russia	26 partly (the Russian EEZ)	02-17.10.2020	15

BASS/2021 surveys

Vessel	Country	Area of Investigation (ICES Subdivisions)	(Preliminary) Period of Investigations	Duration (Days)
Baltica	Estonia/Poland	28,29	05 – 06.2020	6
Baltica	Latvia	26 partly, 28 partly	19-26/5 2021	8
Commercial Vessel	Lithuania	Part of 26	15-16.05.2020	2
Baltica	Poland	Parts of 25 and 26	02-15.05.2020	14
Svea	Sweden	27	1-7/5 2021	7
Walther Herwig III	Germany	24, 25, 26, 27, 28, 29 (for all SD: only part monitored)	3.-28.05.2021	26



- Sweden
- joined Estonia/Poland
- joined Latvia/Poland
- Lithuania
- Poland
- Germany
Baltic International Acoustic Survey (BASS) Plan for 2020
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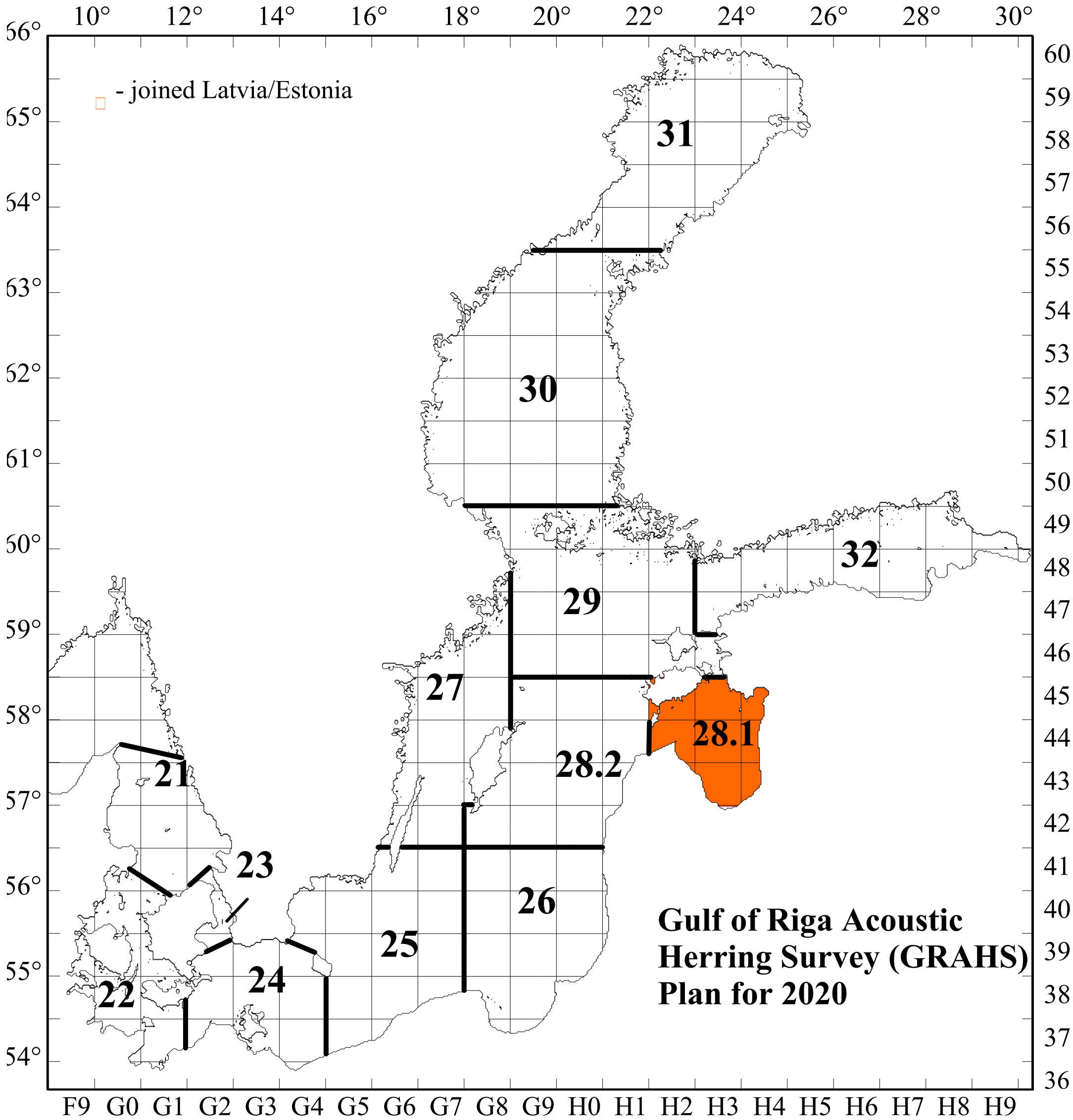
10° 12° 14° 16° 18° 20° 22° 24° 26° 28° 30°
56° 65° 64° 63° 62° 61° 60° 59° 58° 57° 56° 55° 54°
F9 G0 G1 G2 G3 G4 G5 G6 G7 G8 G9 H0 H1 H2 H3 H4 H5 H6 H7 H8 H9
60 59 58 57 56 55 54 53 52 51 50 49 48 47 46 45 44 43 42 41 40 39 38 37 36



10° 12° 14° 16° 18° 20° 22° 24° 26° 28° 30°
66° 65° 64° 63° 62° 61° 60° 59° 58° 57° 56° 55° 54°
60 59 58 57 56 55 54 53 52 51 50 49 48 47 46 45 44 43 42 41 40 39 38 37 36
F9 G0 G1 G2 G3 G4 G5 G6 G7 G8 G9 H0 H1 H2 H3 H4 H5 H6 H7 H8 H9
- joined Latvia/Estonia
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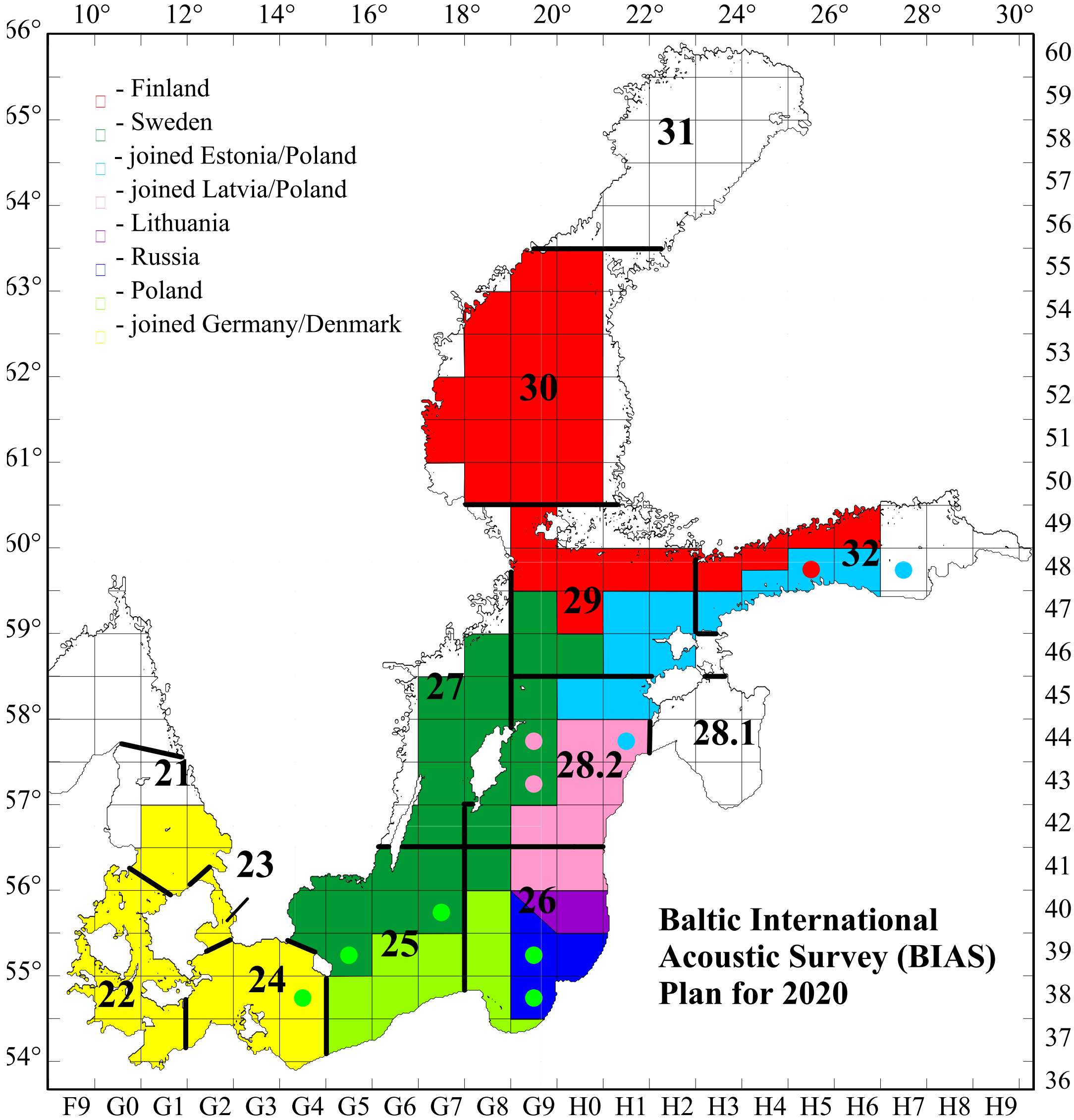
Gulf of Riga Acoustic
Herring Survey (GRAHS)
Plan for 2020


- Finland
- Sweden
- joined Estonia/Poland
- joined Latvia/Poland
- Lithuania
- Russia
- Poland
- joined Germany/Denmark
Baltic International Acoustic Survey (BIAS) Plan for 2020
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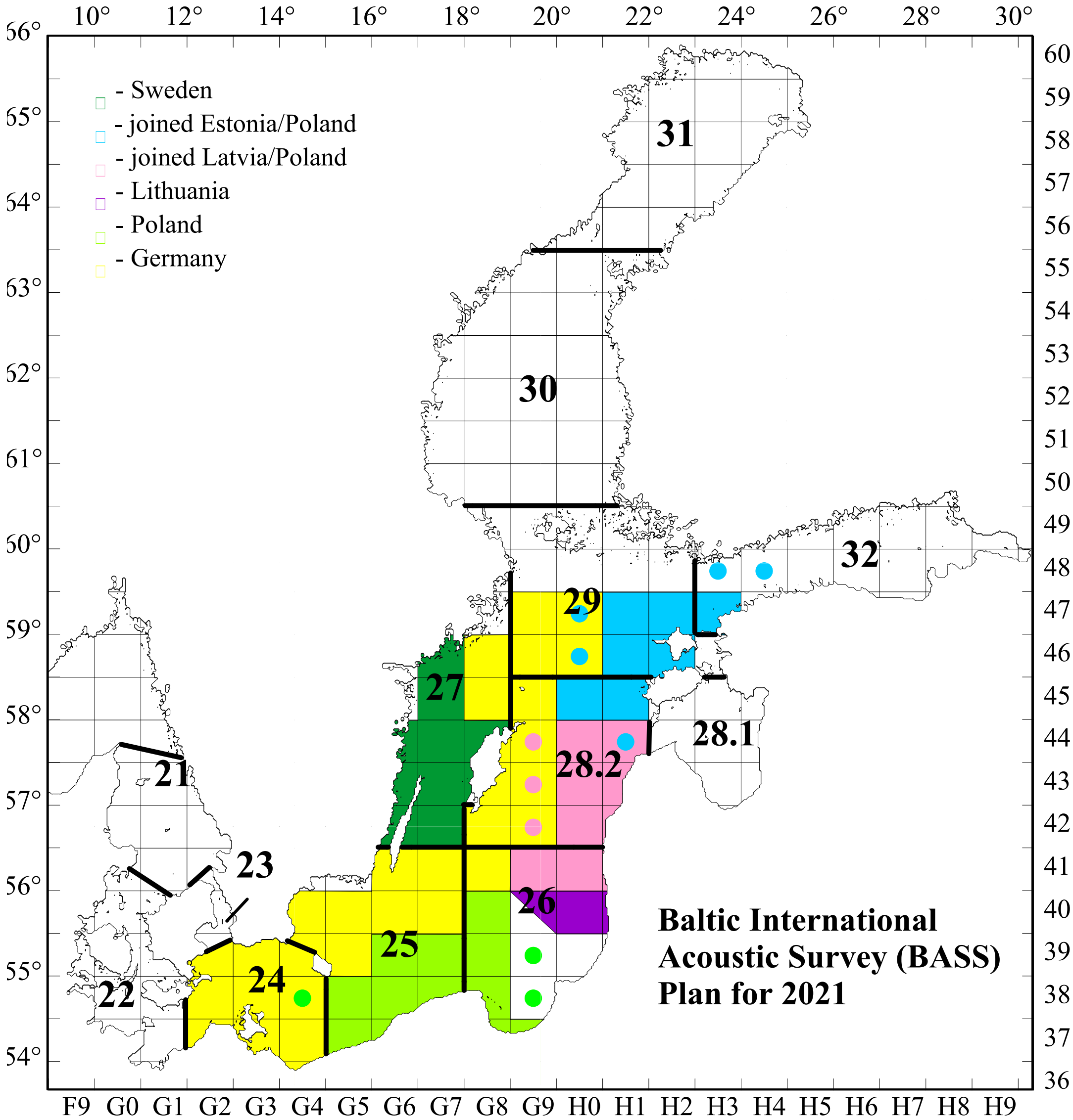
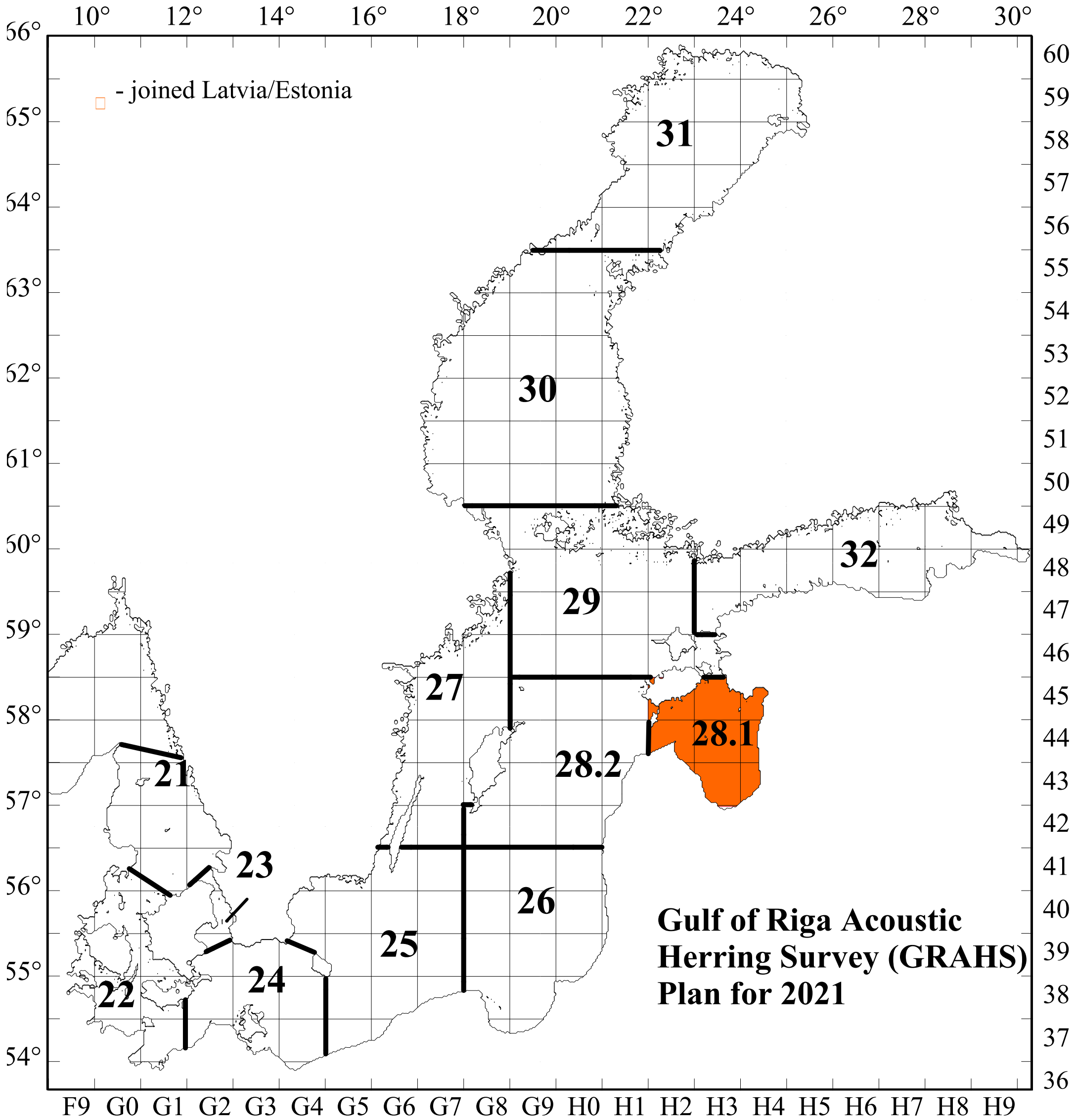
60 59 58 57 56 55 54 53 52 51 50 49 48 47 46 45 44 43 42 41 40 39 38 37 36
F9 G0 G1 G2 G3 G4 G5 G6 G7 G8 G9 H0 H1 H2 H3 H4 H5 H6 H7 H8 H9



- Sweden
- joined Estonia/Poland
- joined Latvia/Poland
- Lithuania
- Poland
- Germany
Baltic International Acoustic Survey (BASS) Plan for 2021
10° 12° 14° 16° 18° 20° 22° 24° 26° 28° 30°
56° 65° 64° 63° 62° 61° 60° 59° 58° 57° 56° 55° 54°
60 59 58 57 56 55 54 53 52 51 50 49 48 47 46 45 44 43 42 41 40 39 38 37 36
F9 G0 G1 G2 G3 G4 G5 G6 G7 G8 G9 H0 H1 H2 H3 H4 H5 H6 H7 H8 H9
21 22 23 24 25 26 27 28.1 28.2 29 30 31 32



Figures 4.3.1–4.3.5. The planned coverage of the Baltic Sea and the assignment of the national/joint acoustic surveys to the ICES rectangles during the May 2020, July/August 2020, September/October-2020 and May 2021 surveys (from top to bottom). Base colours of rectangles indicate the country or joint survey, which is responsible for given ICES-rectangle. Coloured dots indicate overlapping coverage by other countries (sometimes only parts of rectangle are covered).

4.4 ToR d) Discuss the results from BITS surveys performed in autumn 2019 and spring 2020 and evaluate the characteristics of TVL and TVS standard gears used in BITS

4.4.1 4th quarter 2019 BITS.

During quarter 4th BITS in 2019, the level of realized valid hauls represented 96.2% of the total planned stations. The number of realized valid hauls is above the mean historical level. In SD 24 the sampling was influenced by the restrictions enforced by the Swedish military.

The coverage by depth stratum is as follows (depth stratum, coverage in %): 1, 97.5; 2, 93.8; 3, 86.9; 4, 115.4; 5, 100 and 6, 86.7). Again, the low coverage in depth stratum 3 was induced by the restrictions by the Swedish military preventing sampling in southeastern part of Swedish waters.

Russia did not perform neither autumn survey 2019 nor spring survey 2020 in the Russian EEZ of the ICES Subdivision 26 due to problems with financing research vessel.

The number of valid hauls was considered by WGBIFS as appropriate for tuning series and it is recommended that the data are used for the assessment of the Baltic and Kattegat cod and flatfish stocks.

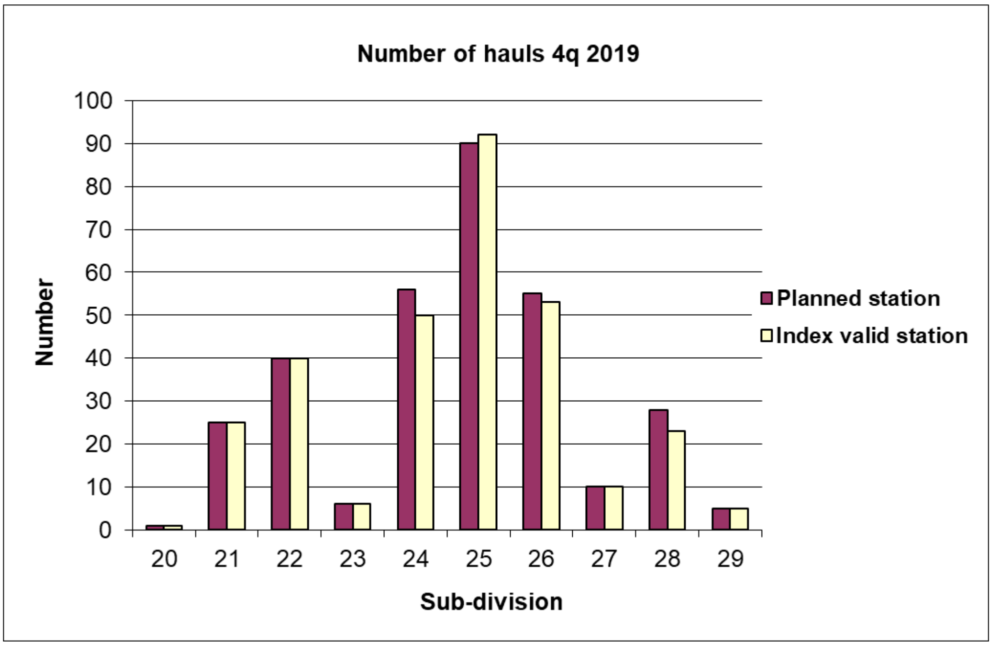


Figure 4.4.1.1. Comparison of the planned and the index-valid fishing stations by ICES Subdivisions and depth layers during BITS 4th quarter 2019.

4.4.2 1st quarter 2020 BITS.

The overall coverage in this quarter was 98%. The coverage by depth stratum is (depth stratum, coverage %): 1, 89.7; 2, 92.9; 3, 91.6; 4, 112; 5, 97.2; 6, 108.3.

The number of valid hauls accomplished during the BITS-Q1/2020 was considered by WGBIFS 2020 as appropriate for tuning series (e.g. CPUE indices) and the data can be used for the assessment of Baltic and Kattegat cod and flatfish stocks.

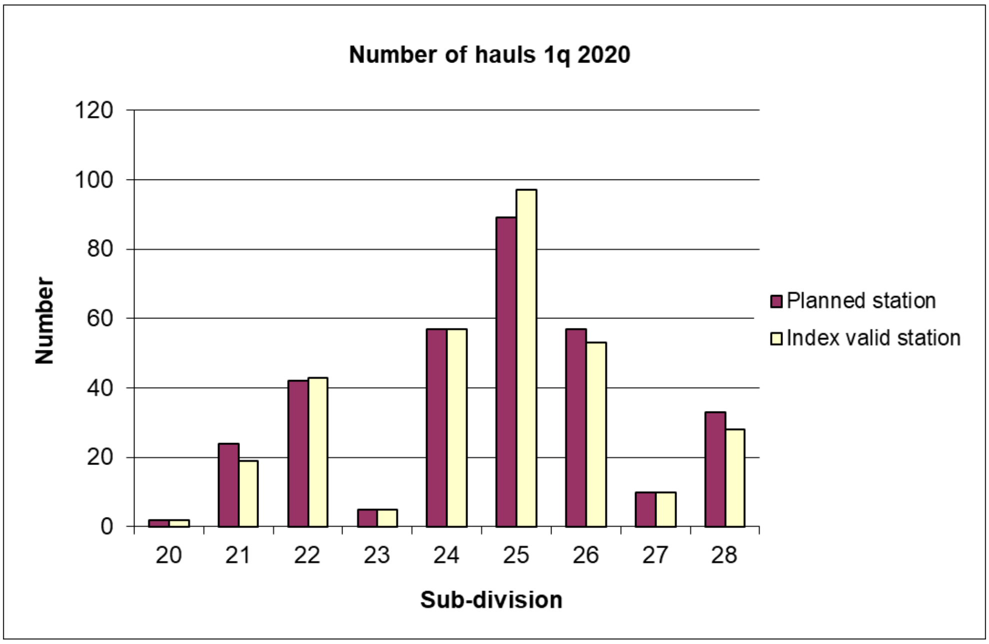
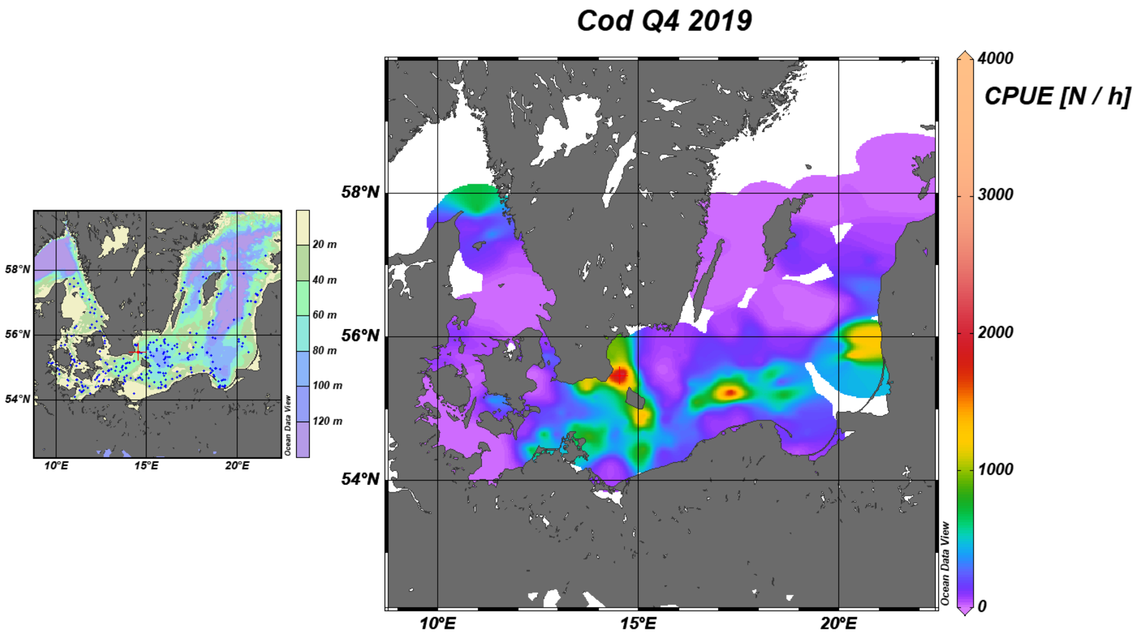


Figure 4.4.2.1. Comparison of the planned and the index-valid fishing stations by ICES Subdivisions and depth layers during BITS 1st quarter 2020.

4.4.3 CPUE in 4th quarter 2019 and 1st quarter 2020 BITS.

Figures 4.4.3.1 to 4.4.3.6 show the concentrations of cod, flounder, plaice, dab, turbot and brill during the BITS surveys in Autumn 2019 and Spring 2020.

Some concentrations of cod were observed in SD 25 and 26 in Q4 2019 with hot spots southeast of Sweden and north of Poland. In Q1 2020 cod was concentrated in the Mecklenburger Bay in SD 22, around of Bornholm in SD 24 and in 25 with a big hot spot north of Poland (Słupsk Furrow). Flounder was concentrated in SD 25 and 26 in Q4 2019 southwest of Sweden, north of Poland and in front of Lithuania with hot spots in Q1 2020 east of Bornholm, north of Poland and in the Gulf of Gdańsk. Plaice showed hot spots south of Sweden in SD24 and 25 in Q4 2019 and in the Belt Sea in SD22 in Q1 2020. Hot spots of dab were observed in Q4 2019 in Samsø Belt and in Q1 2020 in the Great Belt in SD22. Turbot was concentrated in Q4 2019 and in Q1 2020 southeast of Sweden in SD25 and around of the Isle of Rügen in SD24. Finally, brill concentrations were observed in Q4 2019 and in Q1 2020 in Kattegat in SD21.



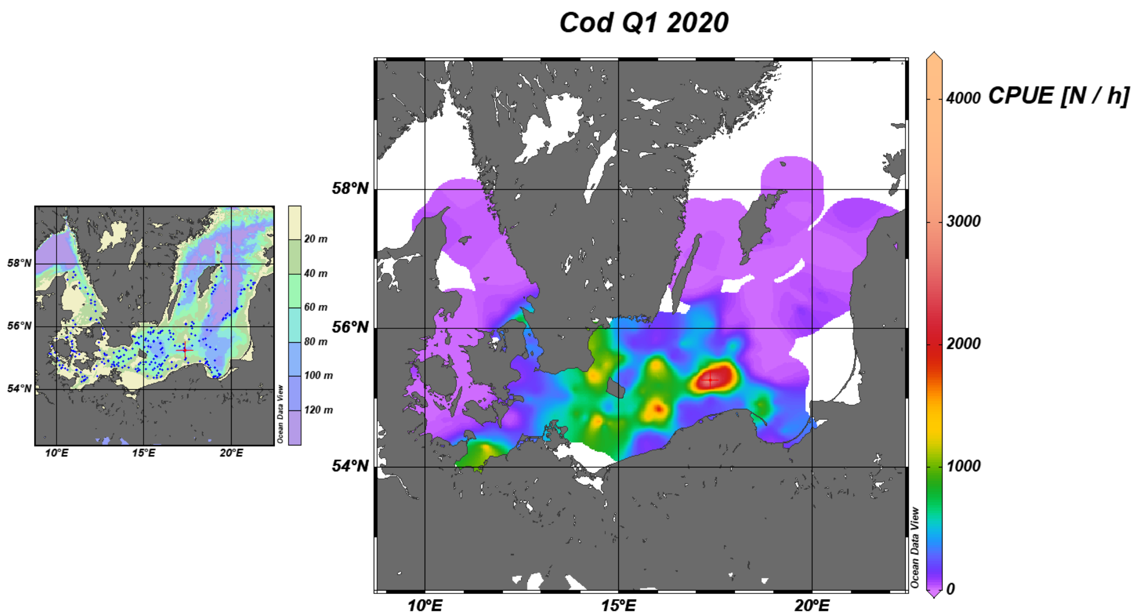


Figure 4.4.3.1. CPUE (N/per hour) for cod during BITS 4th quarter 2019 and 1st quarter 2020.

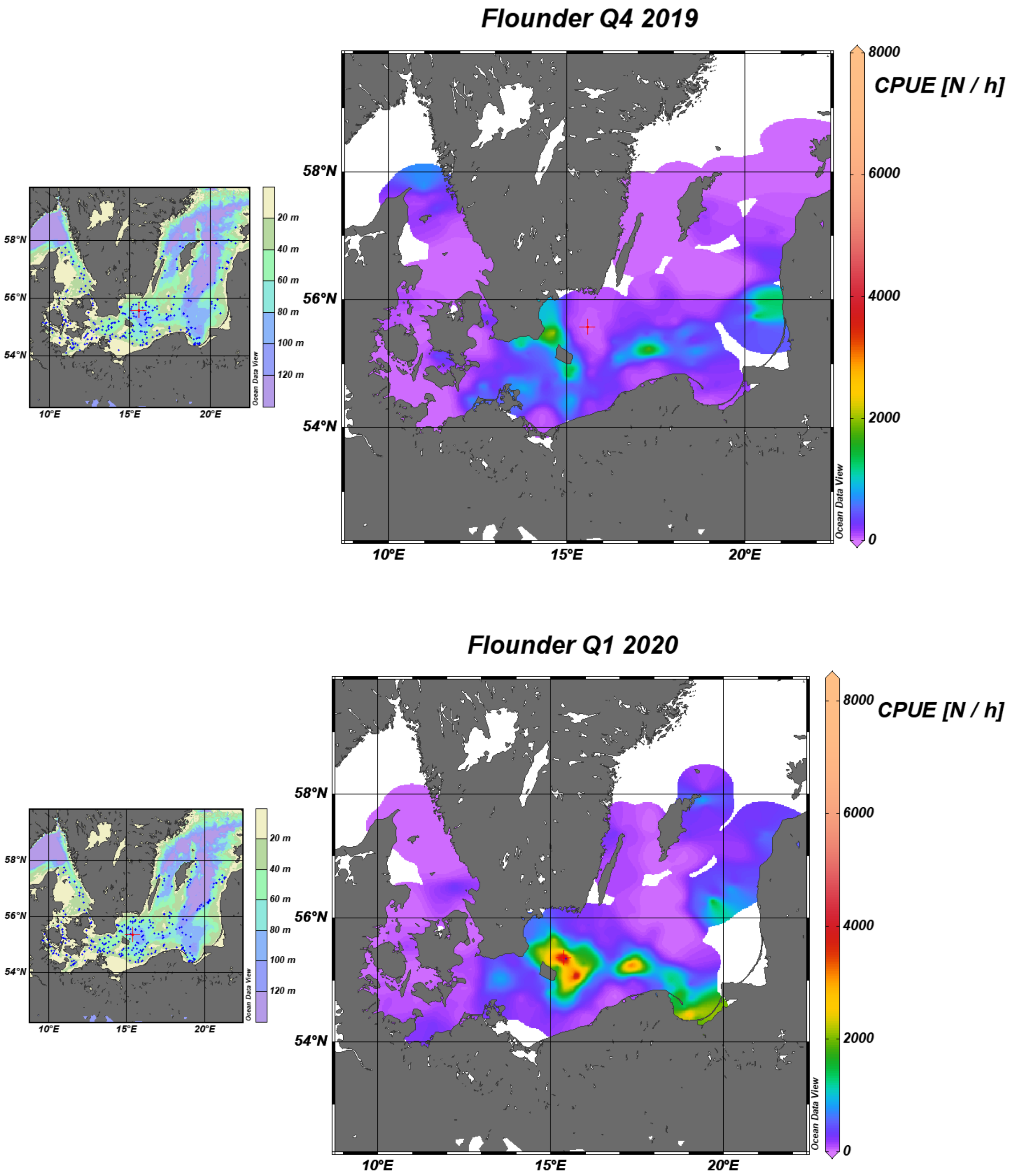
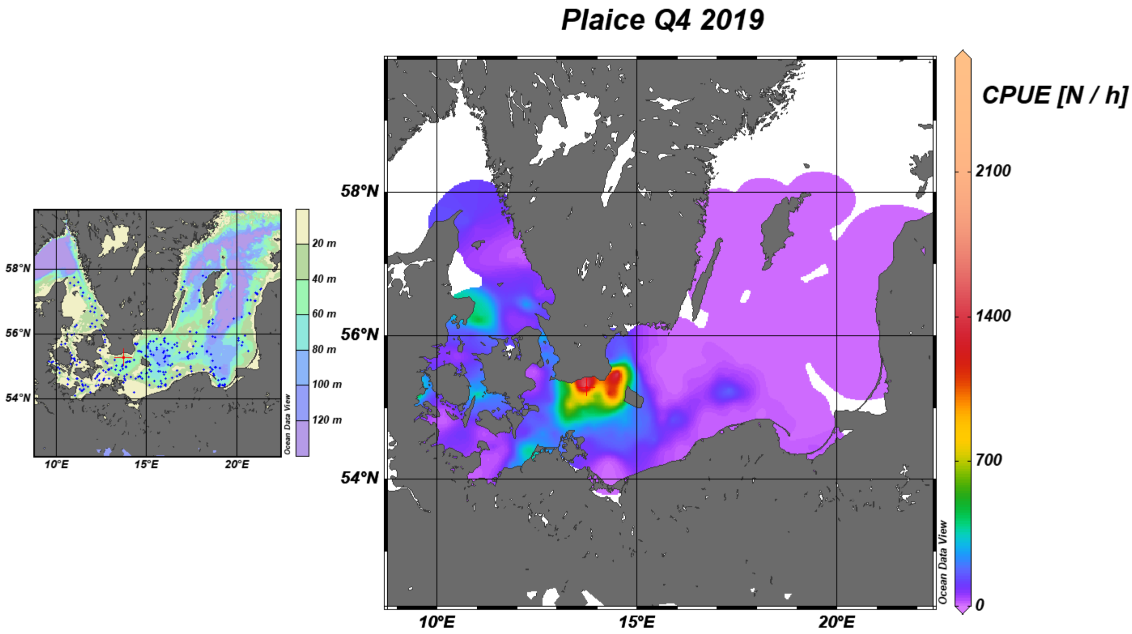


Figure 4.4.3.2. CPUE (N/per hour) for flounder during BITS 4th quarter 2019 and 1st quarter 2020.



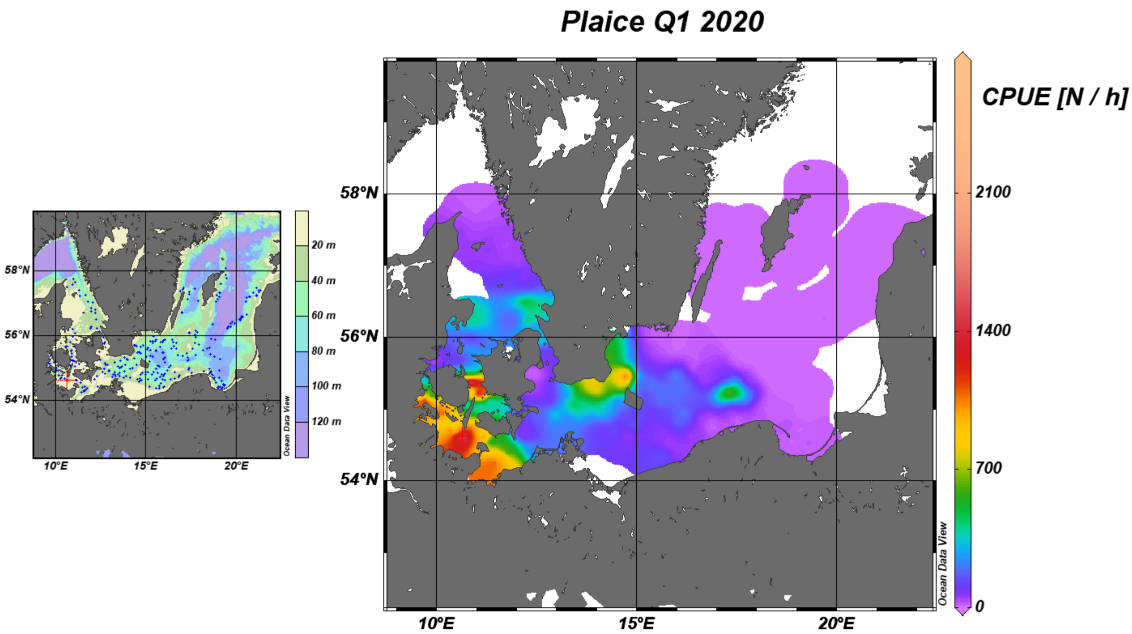


Figure 4.4.3.3. CPUE (N/per hour) for plaice during BITS 4th quarter 2019 and 1st quarter 2020.

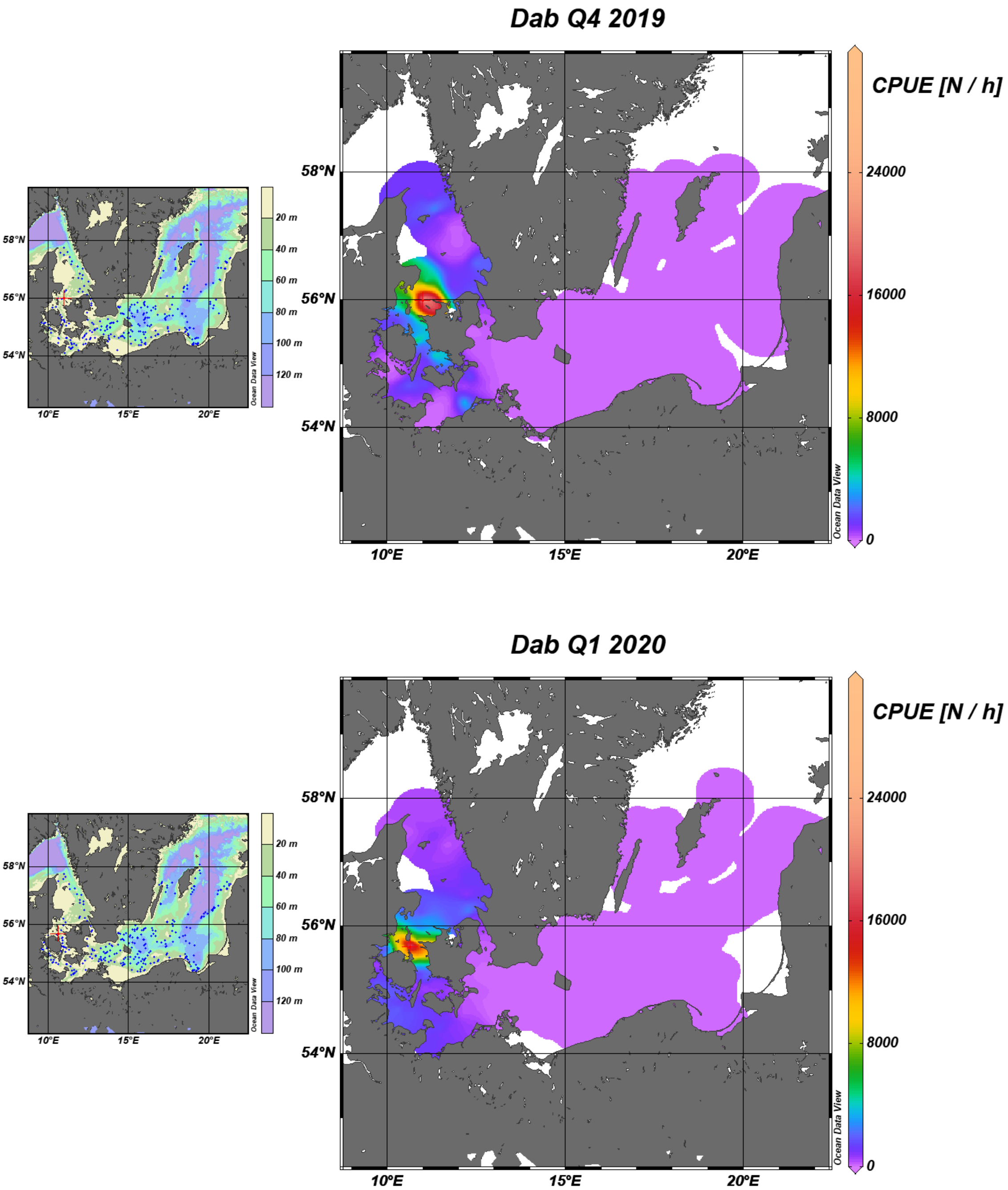


Figure 4.4.3.4. CPUE (N/per hour) for dab during BITS 4th quarter 2019 and 1st quarter 2020.

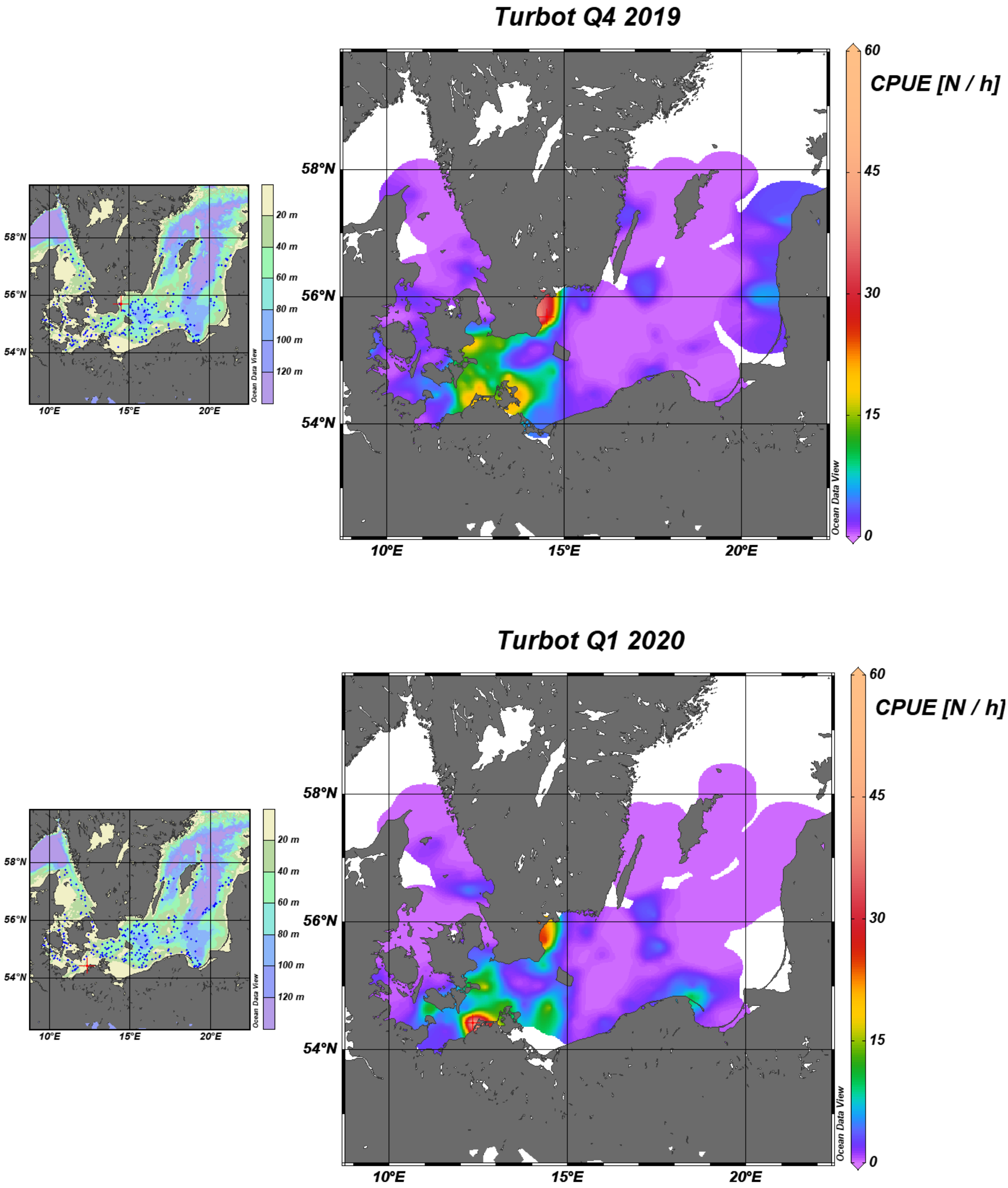


Figure 4.4.3.5. CPUE (N/per hour) for turbot during BITS 4th quarter 2019 and 1st quarter 2020.

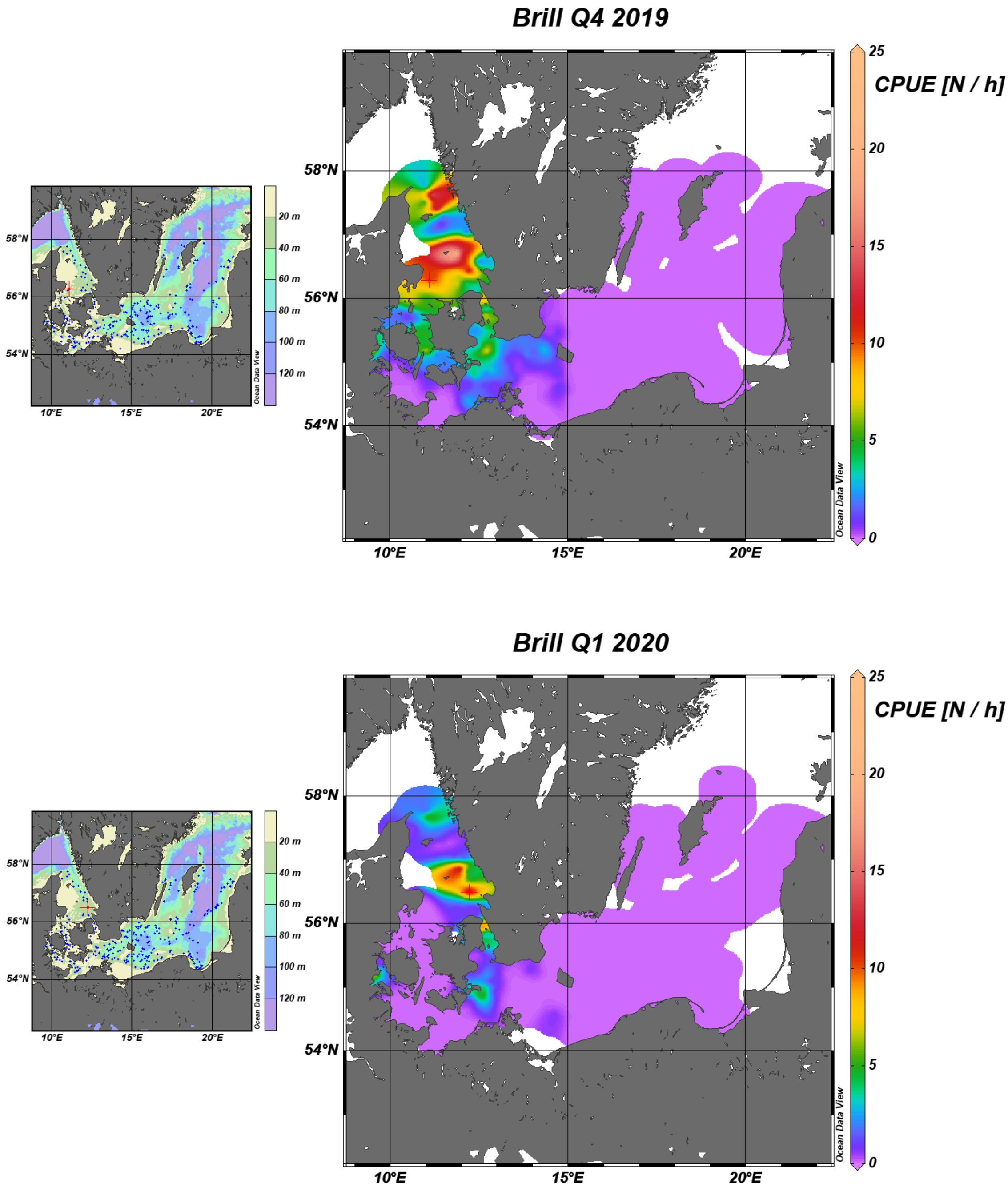


Figure 4.4.3.6. CPUE (N/per hour) for brill during BITS 4th quarter 2019 and 1st quarter 2020.

4.4.4 Standard fishing-gear checking.

WGBIFS has implemented a complete and accurate measurement of technical parameters (the geometry, mesh sizes, rope lengths of the trawl, etc.) of the exploited demersal trawls (type TV-3L and TV-3S) as a standard procedure. This procedure has to be performed at least once a year for each gear used during the survey by each country involved in the BITS surveys realization. In addition, prior to each BITS survey, also a smaller scale measurement of the trawl should be made. All the measurements should follow the Manual of the construction and use of the International Standard Trawl for the Baltic Demersal Surveys. It is recommended that the measurements of TV-3L and TV-3S trawl technical parameters is done by professional experts in fishing gear technology or experienced crew members. Results of the measurements must be uploaded to the WGBIFS SharePoint using the standard protocols. Four reports, covering the trawls type TV-3S and TV-3L, were submitted by national laboratories to WGBIFS 2020. Latvia has not made measurements of standard gear parameters due to chartering vessel and the fishing gear by the Latvian Institute BIOR. Presented reports of the fishing gear measurements did not show any values, which were outside the acceptable percentage deviation from the standard reference values of the two trawls. The reports can be found in the Annex 6. One example of filled report of the standard bottom fishing gear-checking is given below.

Table 4.4.4.1. Results of the Polish (RV "Baltica") bottom, standard fishing gear-checking exercise.

Table 2. Check list for trawl and for frame ropes of trawl Tag no. TV3-930 #	Country:	Year:	Quarter:	Date:	Remarks:
Trawl no./name No 1	POL	2020	1	20200123	

Check list for trawl TV3-930#

Section	Manual TV3-930 # page 57	Standard			Tag no. TV3-930 # -				Relative error [%]		Remarks
		Measured distance [m]	Mesh size [mm]	Number of meshes	Measured distance [m]	Mesh size [mm]	Mesh size mean	Number of meshes	Mesh size [mm]	Number of meshes	
1	1B1	22,10	200	111	21,93	200	200	109,7	0,0	-0,8	
	1A1	22,10	200	111	23,33	200	200	116,7	0,0	5,6	
	1A2	22,10	200	111	21,97	200	200	109,9	0,0	-0,6	
	1B2	22,10	200	111	21,94	200	200	109,7	0,0	-0,7	
	1C1	22,10	120	184	22,52	120	120	187,7	0,0	1,9	
	1C2	22,10	120	184	22,57	120	120	188,1	0,0	2,1	
2	2B1	2,96	160	19	2,87	160	160	17,9	0,0	-3,0	
	2A	2,96	160	19	2,65	160	160	16,6	0,0	-10,5	
	2B2	2,96	160	19	2,89	160	160	18,1	0,0	-2,4	
	2C1	3,00	120	25	2,89	120	120	24,1	0,0	-3,7	
	2C2	3,00	120	25	2,9	120	120	24,2	0,0	-3,3	
3	3B1	2,94	120	25	2,85	120	120	23,8	0,0	-3,1	
	3A	2,94	120	25	2,77	120	120	23,1	0,0	-5,8	
	3B2	2,94	120	25	2,85	120	120	23,8	0,0	-3,1	
	3C	3,00	120	25	2,8	120	120	23,3	0,0	-6,7	
4	4B1	7,92	80	99	7,75	80	80	96,9	0,0	-2,1	
	4A	7,92	80	99	7,83	80	80	97,9	0,0	-1,1	
	4B2	7,92	80	99	7,77	80	80	97,1	0,0	-1,9	
	4C	8,00	80	100	7,56	80	80	94,5	0,0	-5,5	
5	5B1	5,94	60	99	5,81	60	60	96,8	0,0	-2,2	
	5A	5,94	60	99	5,88	60	60	98,0	0,0	-1,0	
	5B2	5,94	60	99	5,81	60	60	96,8	0,0	-2,2	
	5C	6,00	60	100	5,87	60	60	97,8	0,0	-2,2	
6	6B1	11,92	40	298	11,25	40	40	281,3	0,0	-5,6	
	6A	11,92	40	298	11,35	40	40	283,8	0,0	-4,8	
	6B2	11,92	40	298	11,45	40	40	286,3	0,0	-3,9	
	6C	12,00	40	300	11,28	40	40	282,0	0,0	-6,0	
Codend			20			20					
			20			20					

Mean mesh opening in codend (OMEGA mesh gauge): mm (n, n, n, n, n, n, n, n, n, n)

Check list for frame ropes of trawl TV3-930 #

Manual TV3-930 # page 59	Measured distance [m] Standard	TV3-930 #	Remarks
Head line extension Port.	4,00	4,00	
Head line wing section Port.	28,50	28,50	
Head line bosom section	2,50	2,6	
Head line wing section Stbd.	28,50	28,50	
Head line extension Stbd.	4,00	4	
Fishing line extension Port.	0,95	0,95	
Fishing line wing section Port.	29,94	29,94	
Fishing line bosom section	1,68	1,68	
Fishing line wing section Stbd.	29,94	29,94	
Fishing line extension Stbd.	0,95	0,95	
Upper wing line Port.	2,70	2,7	
Upper wing line Stbd.	2,70	2,7	
Upper wing side Port.	2,15	2,15	
Upper wing side Stbd.	2,15	2,15	
Lower wing line Port.	2,75	2,75	
Lower wing line Stbd.	2,75	2,75	
Lower wing side Port.	2,20	2,2	
Lower wing side Stbd.	2,20	2,2	

Type of fishing gear:	TV3-930 #
Nation:	POL
Date of measurements:	23.01.2020
Name of operators:	Krzysztof Radtke
Number of realized hauls:	250
Comments concerning the use:	

4.5 ToR e) Plan and decide on demersal trawl surveys and experiments to be conducted in autumn 2020 and spring 2021, and update, and correct the Tow-Database and DATRAS

The most of the participating institutes plan the same numbers of hauls during BITS surveys in autumn 2020 and spring 2021 as in the year before.

The total number of stations committed by the countries and available is given in Table 4.5.1.

Table 4.5.1. Total numbers of catch-stations planned by particular country during BITS in autumn 2020 and spring 2021.

Country	Vessel	Number of planned stations in autumn 2020	Number of planned stations in spring 2021
Germany	Solea	57	60
Denmark	Havfisken	27+30*	27+30*
	Total in SD 20 - 24	**84**	**87**
Denmark	Dana	55	55
Estonia	Commercial vessel	10**	0
Latvia	Chartered vessel	25	25
Lithuania	Commercial vessel	6	6
Poland	Baltica	61	69
Russia	Atlantniro/Atlantida	0	0
Sweden	Svea	30	50
	Total in SD 25 - 28	**187**	**205**
	Total in SD 20 - 28	**271**	**292**

* Including hauls in Kattegat

** Only in Estonian EEZ

According to preliminary information, the participation of Russia in the BITS surveys in 2021 cannot be confirmed yet. Since other ICES Member Countries will not be able to get permission to work in the EEZ of Russia, these potential gaps in the dataset can affect the quality of survey results based on the BITS survey.

During the period of 2018-2020 no any essential changes of the data in the ICES Database of Trawl Surveys (DATRAS) was made. Adriana Villamor presented an overview of the new DATRAS data mining shiny app during the WGBIFS 2020 meeting.

Data from the recent BITS surveys was added to the DATRAS. The Tow-Database, which allows planning the spatial distribution of hauls in the areas where the seabed is suitable for safety trawling, was corrected and updated.

4.6 ToR f) Conduct analyses related to the improvement of quality of acoustic indices and estimation of the uncertainty in the BIAS and BASS surveys

At earlier WGBIFS meetings, a decision was made to follow the recommendations given at the workshop WKSDO "Workshop on Sampling Design and Optimization" in Lysekil, Sweden. That method was to bootstrap over the survey results in each square from the whole survey area. Further discussion on the topic can be found in previous WGBIFS reports.

Discussions at WGBIFS have led to a bootstrap method over the sampling variability, which has been conducted aiming to estimate a confidence interval. This has been done and presented in earlier WGBIFS reports. Due to the survey result always being close to the bootstrapped mean in the histogram of the bootstrapped results and far away from the 95% confidence intervals, a standard deviation over the resampled results is now presented. This method aims to derivate an estimation of the variation of the results by resampling the calculated index results, thus we are looking at both the internal errors as well as the natural fluctuation in what we are measuring

This year the survey sampling variance calculations have been conducted for the BIAS and BASS surveys from 2012 to 2019 and are presented in figures 4.6.1.1- 4.6.1.6, 4.6.2.1- 4.6.2.6 and in tables 4.6.1.1 and 4.6.2.1 here below.

4.6.1 Estimation of sampling variance in BIAS survey

Herring in 2019 BIAS survey

Mean of bootstrapped numbers of herring : 95493

Standard deviation of bootstrapped numbers of herring: 11868

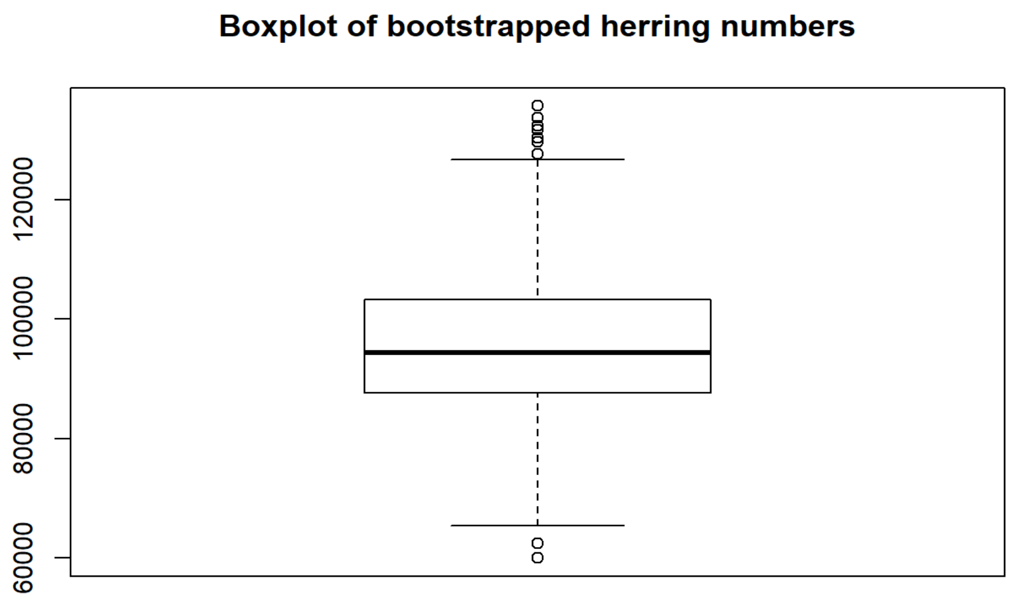


Figure 4.6.1.1. Boxplot of herring numbers in 2019 BIAS survey.

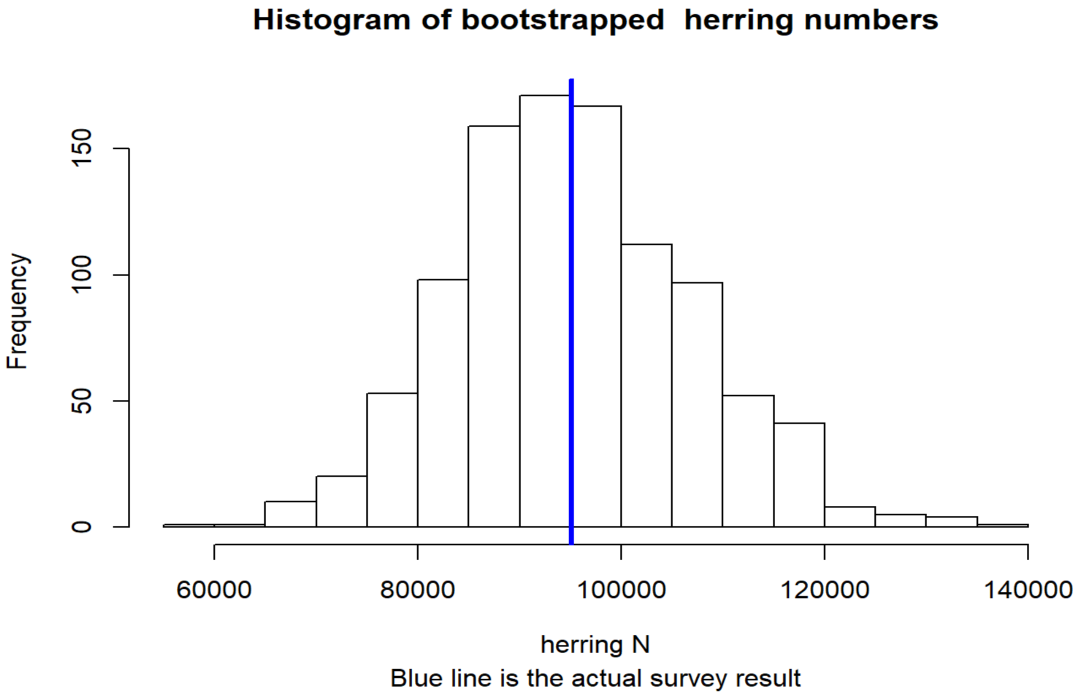


Figure 4.6.1.2. Histogram of bootstrap of herring numbers in 2019 BIAS survey.

Sprat in 2019 BIAS survey

Mean of bootstrapped numbers of sprat: 226427

Standard deviation of bootstrapped numbers of sprat: 32505

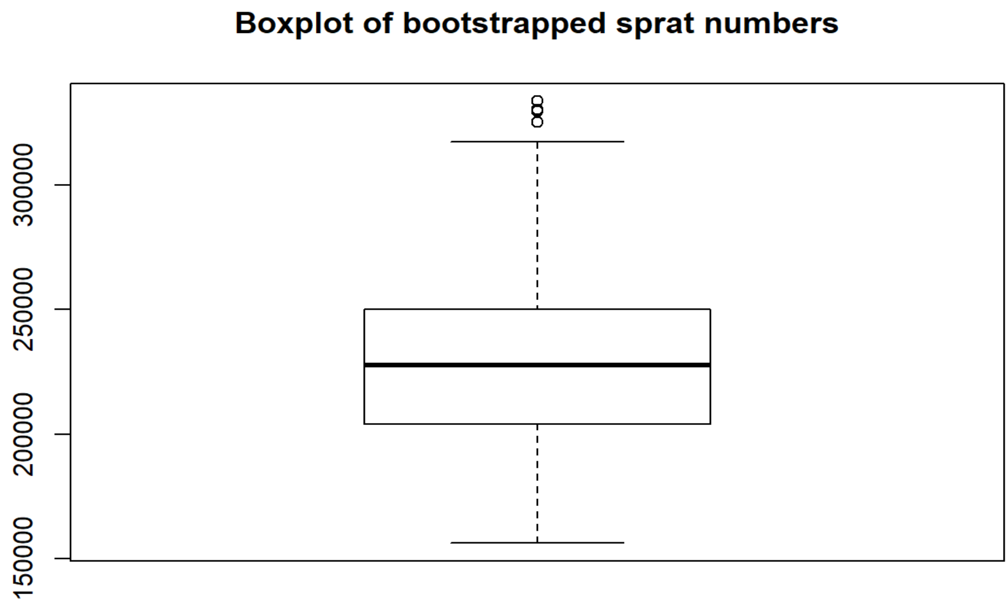


Figure 4.6.1.3. Boxplot of sprat numbers in 2019 BIAS survey.

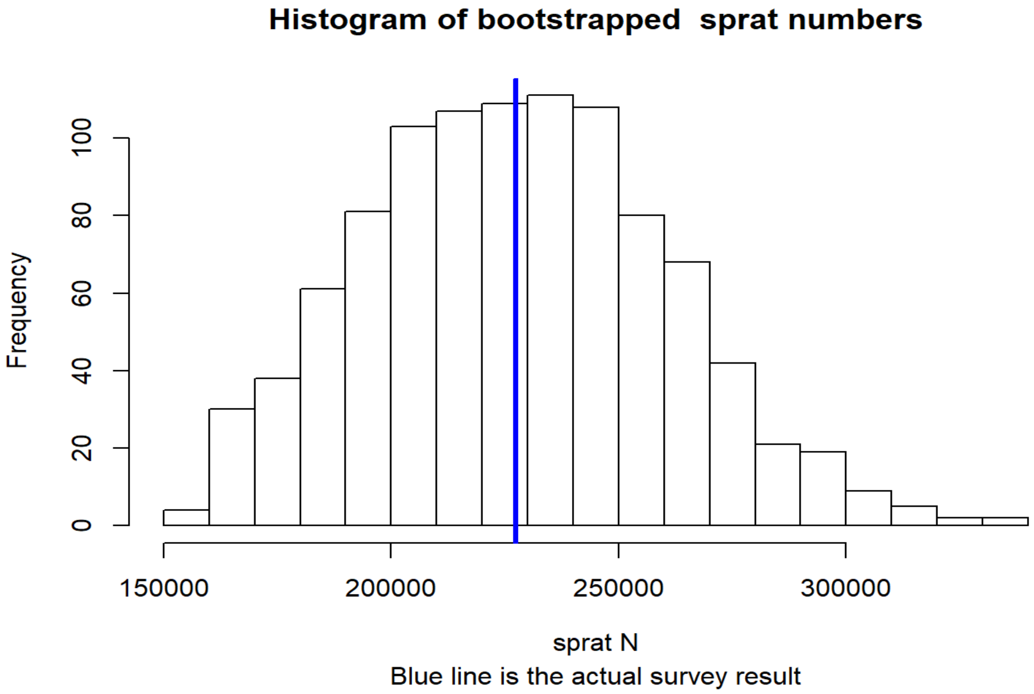


Figure 4.6.1.4. Histogram of bootstrap of sprat numbers in 2019 BIAS survey.

Sampling variance in BIAS surveys

Table 4.6.1.1. Mean and standard deviation of the bootstrapped numbers per year in BIAS surveys.

Years	2012	2013	2014	2015	2016	2017	2018	2019
Mean herring	95344	101007	202337	142651	130661	106480	103189	95493
SD herring	11824	10284	27231	19650	23987	11090	14322	11868
Mean sprat	196685	138953	196758	266511	234879	354014	142343	226427
SD sprat	37654	17605	29283	38974	33531	83446	22474	32505

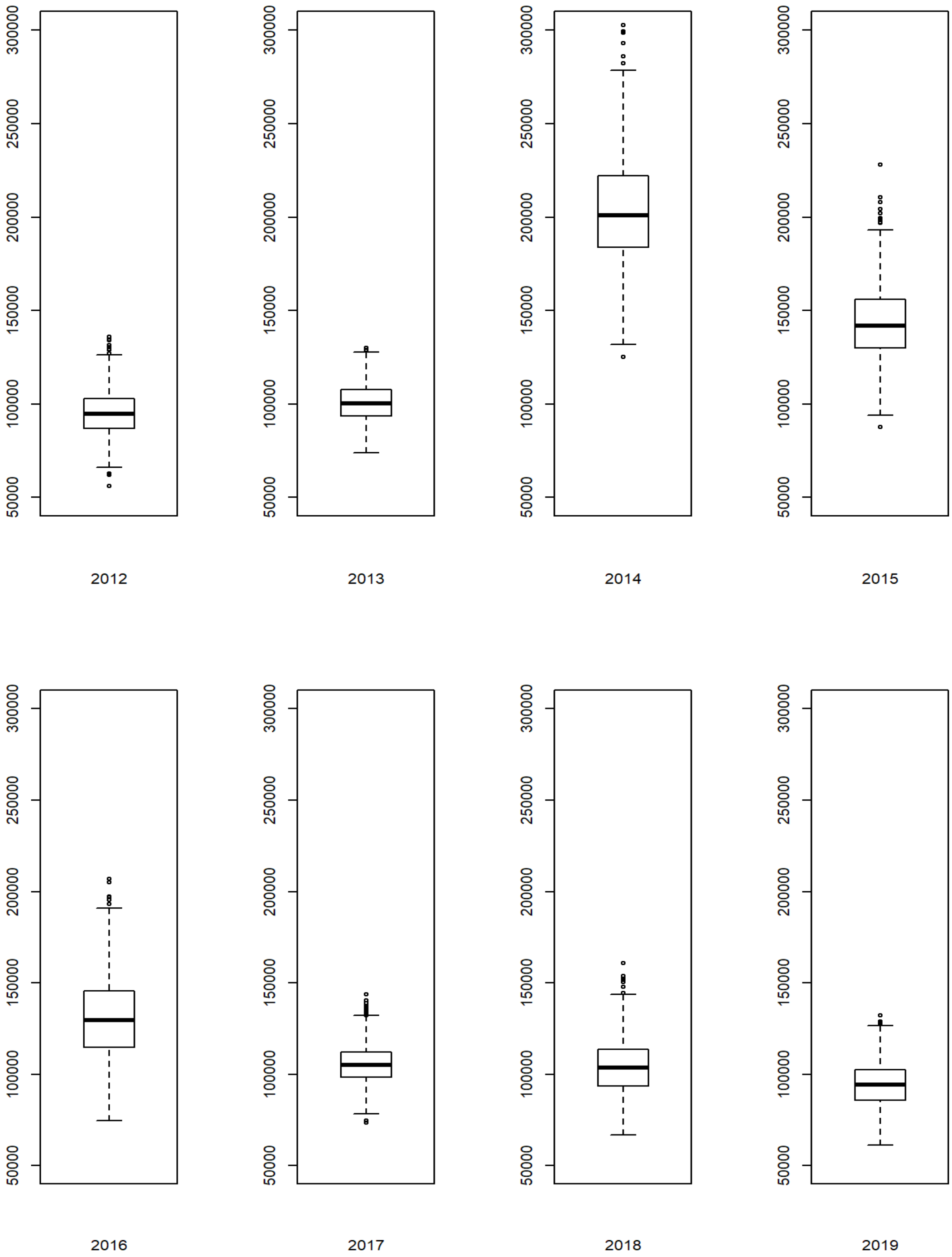


Figure 4.6.1.5. Boxplot of herring numbers per year in BIAS surveys.

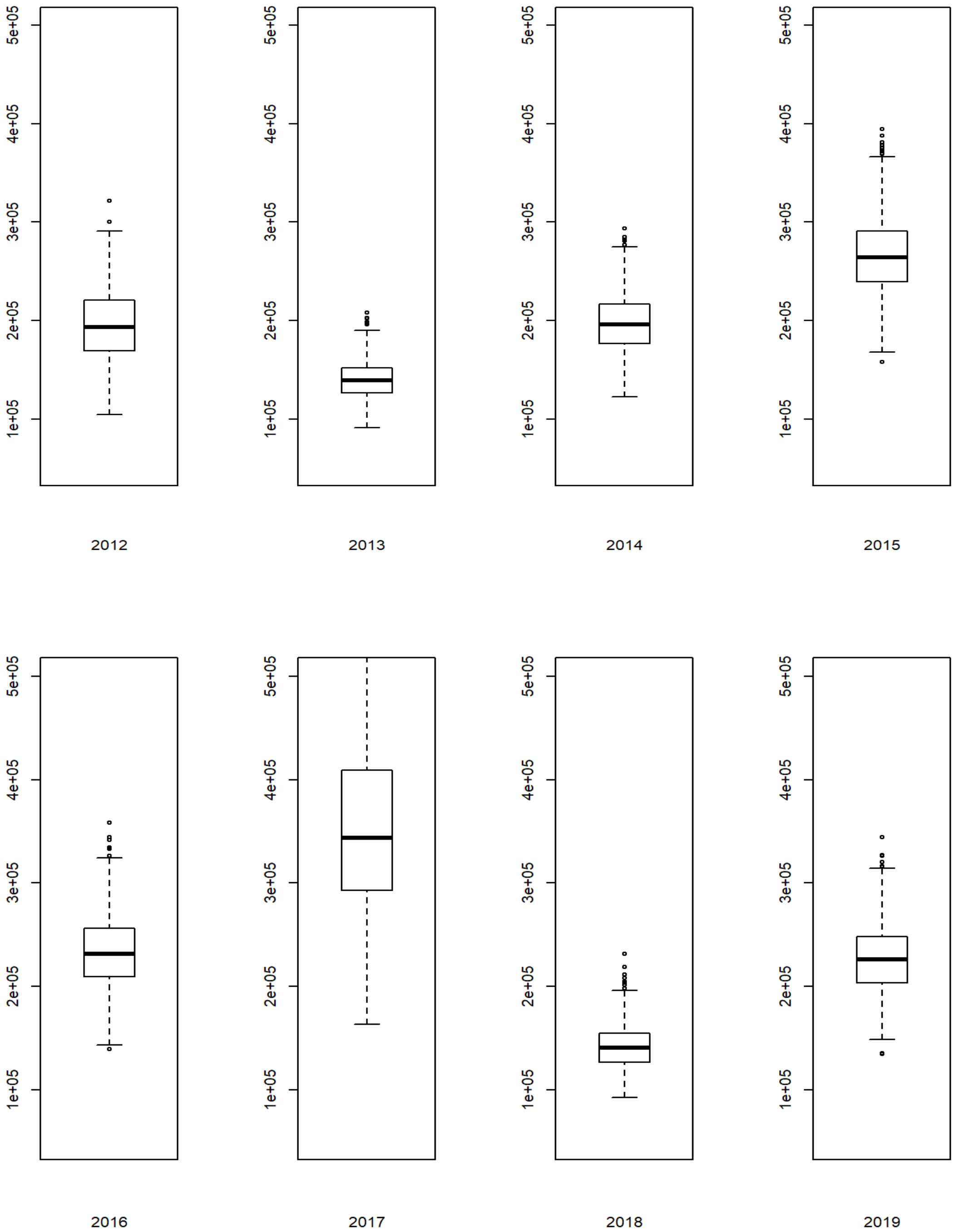


Figure 4.6.1.5. Boxplot of sprat numbers per year in BIAS surveys.

Herring numbers in 2019 BASS survey

Mean of bootstrapped numbers of herring: 12908

Standard deviation of bootstrapped numbers of herring: 2156

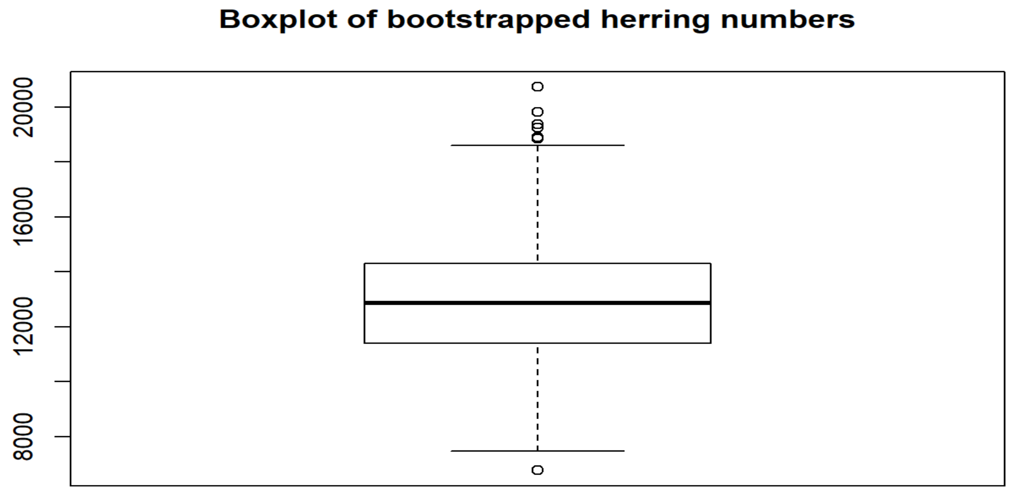


Figure 4.6.2.1. Boxplot of herring numbers in 2019 BASS survey.

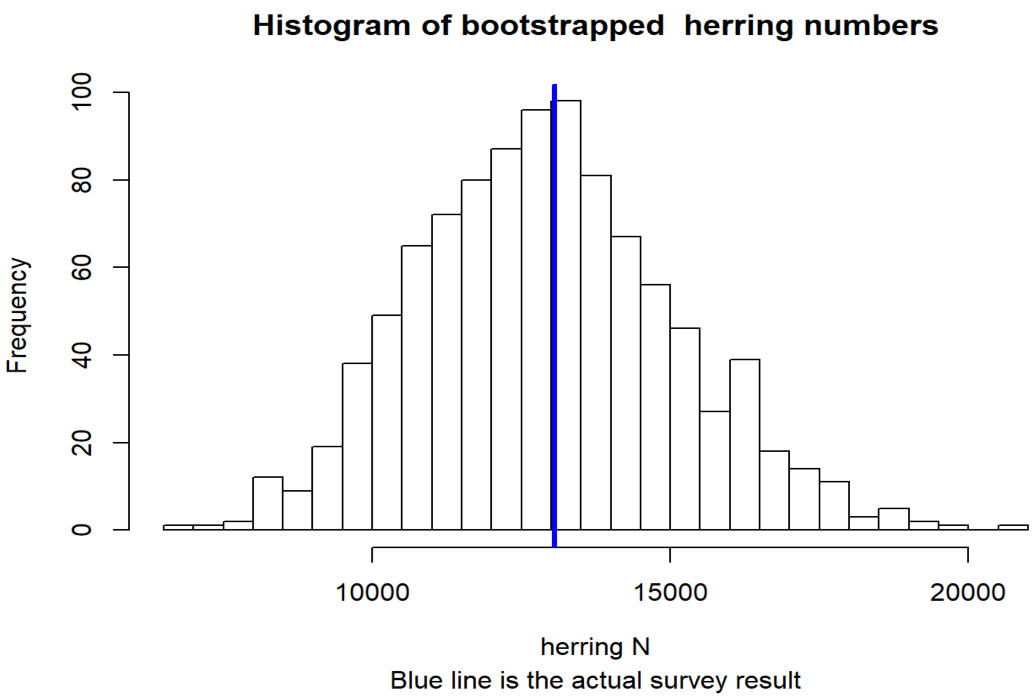


Figure 4.6.2.2. Histogram of bootstrap of herring numbers in 2019 BASS survey.

Sprat numbers in 2019 BASS survey

Mean of bootstrapped numbers of sprat: 179187

Standard deviation of bootstrapped numbers of sprat: 23626

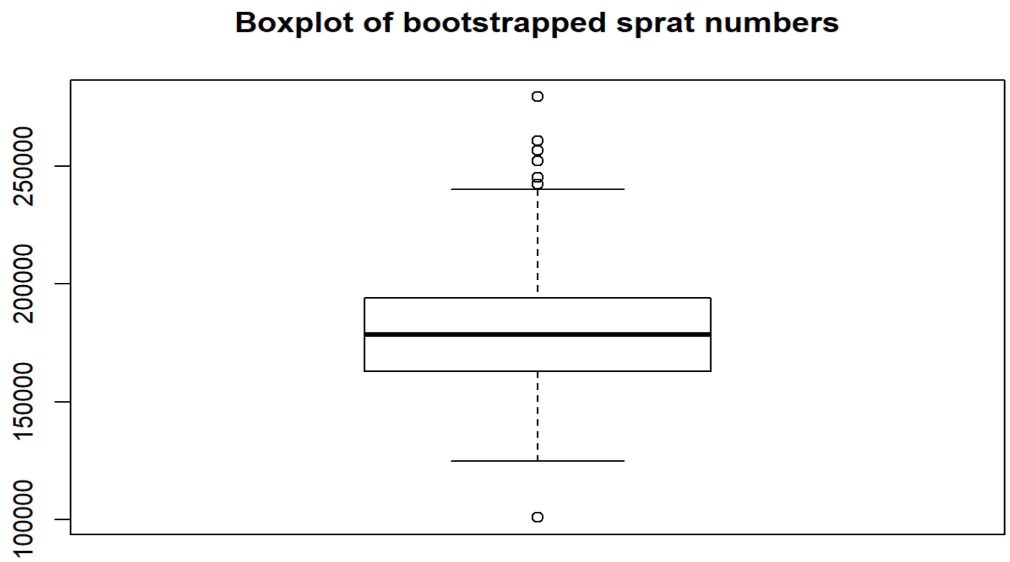


Figure 4.6.2.3. Boxplot of sprat numbers in 2019 BASS survey.

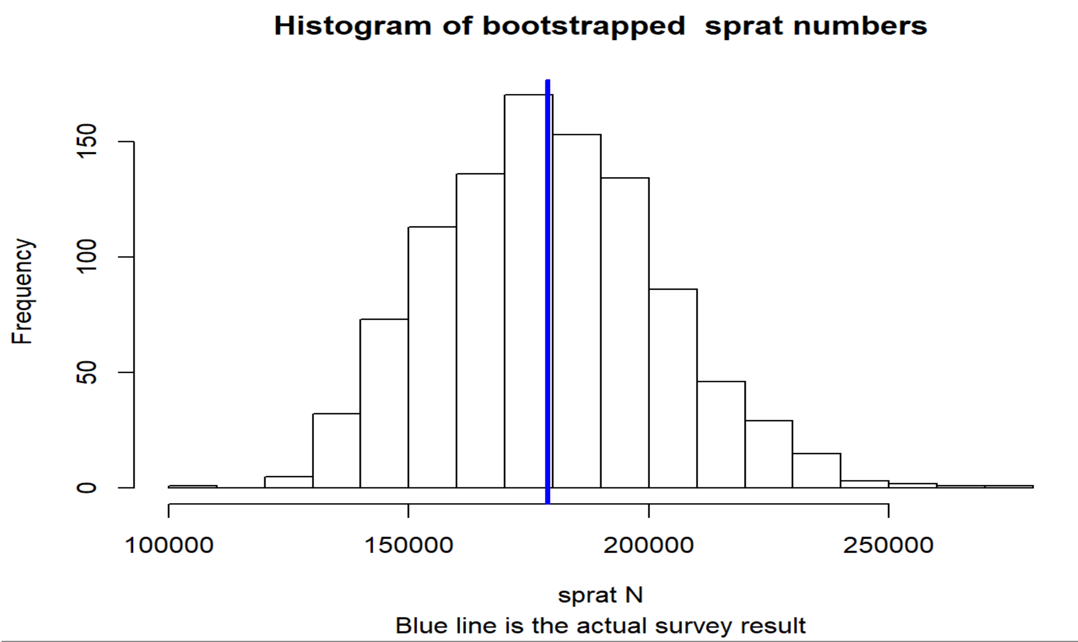


Figure 4.6.2.4. Histogram of bootstrap of sprat numbers in 2019 BASS survey.

Sampling variance in BASS surveys

Table 4.6.2.1. Mean and standard deviation of the bootstrapped numbers per year in BASS surveys.

Year	2012	2013	2014	2015	2016	2017	2018	2019
Mean herring	3230	4926	47433	30081	65167	14672	9636	12908
SD herring	769	1029	10400	6860	12109	2355	1444	2156
Mean sprat	94617	119729	95144	212829	33709	281273	191891	179187
SD sprat	10661	14725	29625	19227	10781	40964	26263	23626

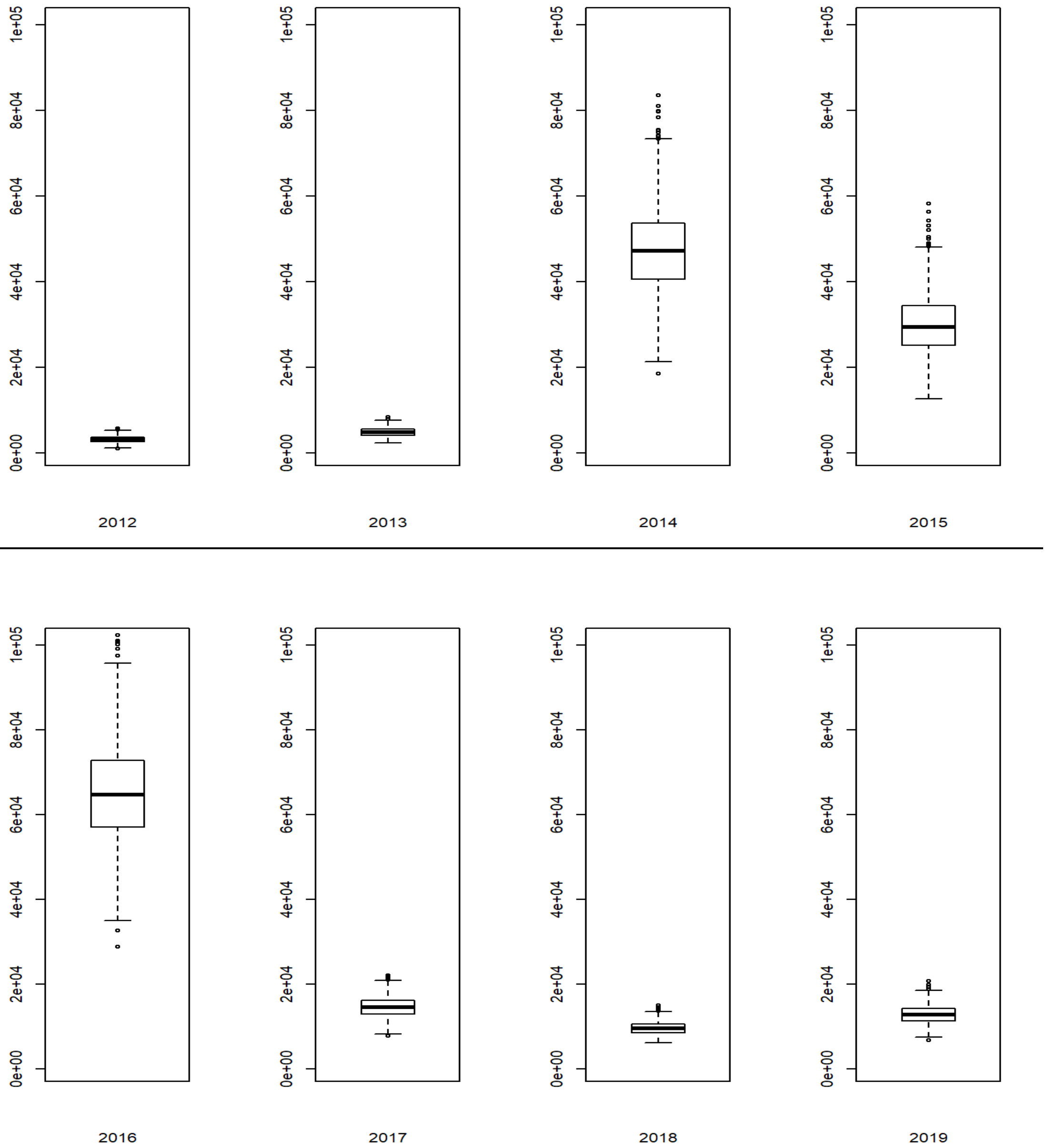


Figure 4.6.2.5. Boxplot of herring numbers per year in BASS surveys.

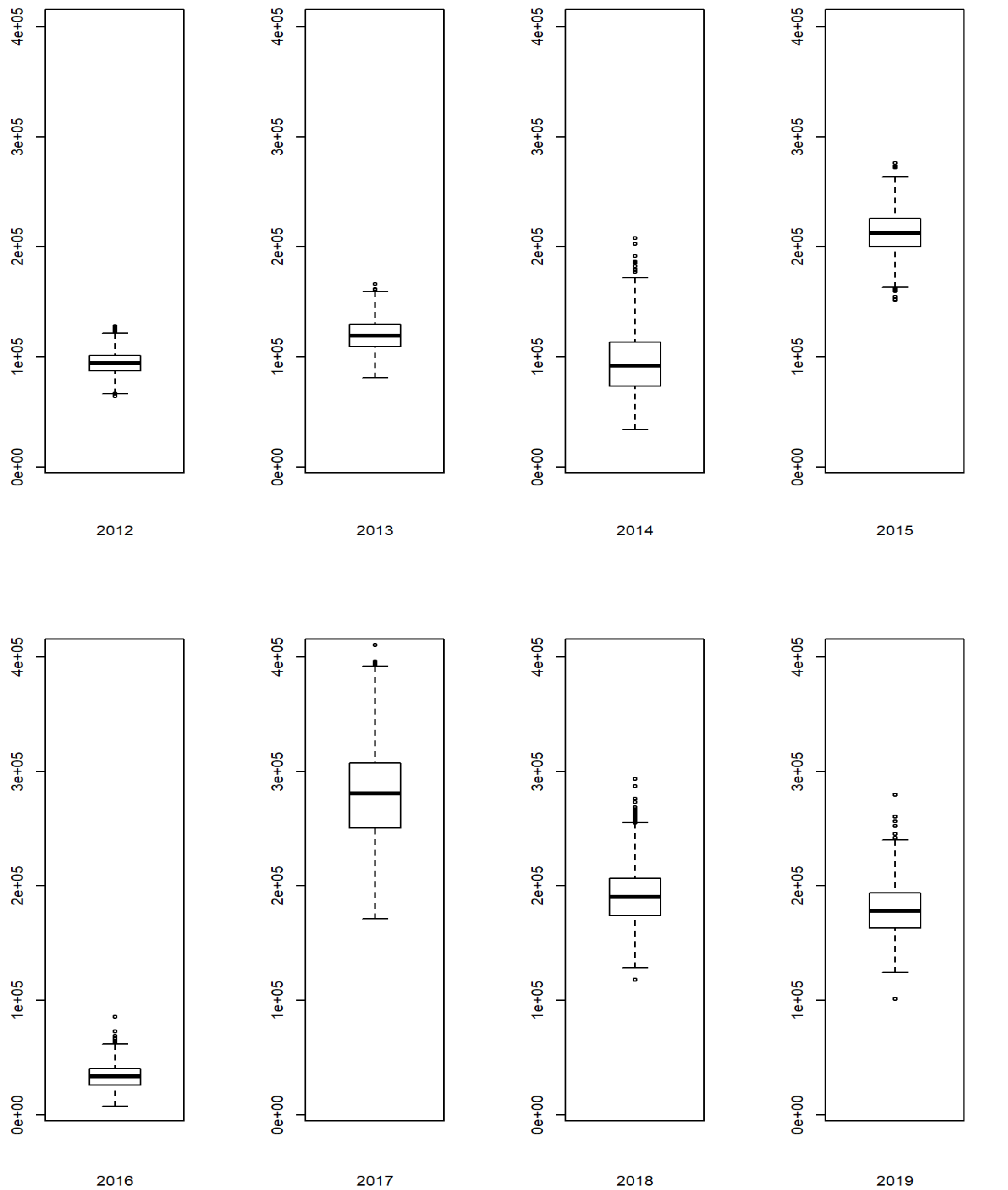


Figure 4.6.2.6. Boxplot of sprat numbers per year in BASS surveys.

4.7 ToR g) Update on progress in development of the StoX software and implementation of it for the calculation of WGBIFS acoustic stock estimates, based on the IBAS methodology and data from ICES acoustic-trawl survey database

Initial objective of that ToR was that WGBIFS would reach an agreement about the possibility to implement StoX as a new standard tool for the calculation of WGBIFS acoustic stock estimates. The following steps were planned for that purpose:

1) cooperation with StoX developers to enable StoX to perform the fish abundance calculations following the IBAS standard methodology,
2) testing and fine tuning of the StoX project developed for the WGBIFS,
3) realization of the comparison exercises to validate whether the StoX software provides similar results as the current IBAS calculation method.

A StoX task subgroup was created during the WGBIFS 2018 meeting containing Juha Lilja (Finland), Olavi Kaljuste (Sweden), Elor Sepp (Estonia), Niklas Larson (Sweden), Paco Rodriguez-Tress (Germany) and Beata Schmidt (Poland) as contact persons for the implementation of the StoX software for the calculation of WGBIFS acoustic stock estimates. This subgroup had the following tasks:

- WGBIFS subgroup will control that the acoustic survey results from 2017 are uploaded in the right format to the ICES acoustic data portal in April 2018 as latest.
- WGBIFS subgroup will contact the developers of StoX to solve the problems with installation of the StoX software.
- WGBIFS subgroup will organize a net-meeting together with StoX developers in the end of August/beginning of September 2018 to go through the fish abundance index calculation procedure in the StoX software using the BIAS and BASS data from 2017.
- WGBIFS subgroup will organize a meeting together with StoX developers in January 2019 to set up the final herring and sprat abundance index calculation procedures in the StoX software using the BIAS and BASS data from 2017.

StoX task subgroup organized a net-meeting together with StoX developers on 13th of September 2018 to go through the fish abundance index calculation procedure in the StoX software using the BIAS data from 2017. The main goal for this net-meeting was to learn the standard analysis procedure in StoX (using IBAS calculation standards). Some issues with the BIAS 2017 data (uploaded to the ICES database for acoustic trawl surveys) were discovered before that meeting. Several of them were solved due to the meeting time and the rest was solved afterwards. There were also some issues with data uploading, deletion and downloading in the ICES database for acoustic trawl surveys. These were solved by ICES Data Centre. Additionally, it was discovered that StoX software did not allow to use data from 9 surveys in one project. StoX developers promised to solve that problem with the next version of StoX software.

During the WGBIFS 2019 meeting a WebEx-meeting was held with Espen Johnsen and Atle Totland to discuss the issues related to the progress in development of the StoX software and implementation of it for the calculation of WGBIFS acoustic stock estimates, based on the IBAS methodology and data from ICES acoustic-trawl survey database. During this meeting it was demonstrated that the latest version of StoX software is able to perform the calculation procedure using the WGBIFS coordinated survey data (based on the BIAS 2017 data downloaded from the ICES database for acoustic trawl surveys). During the discussions an additional problem was raised that some countries perform biological sampling during the surveys and are unable to measure fish individual weights with sufficient accuracy. Therefore, they are measuring mean weights for all length-classes in each haul instead. In the standard IBAS calculation procedure these mean weights are then used instead of the individual weights. The current biotic data format of ICES database for acoustic trawl surveys does not allow to upload these values and therefore they are also not incorporated into StoX calculations. WGBIFS recommended to ICES Data Centre to add a new field into the biotic data format of ICES database for acoustic survey data. This new field would specify whether the values given in the “BiologyIndividualWeight” field are measured as individual weights or as mean weights of current length-class.

It was decided that StoX task subgroup members will analyse their national survey data with StoX software using the BIAS data from 2017, compare the results with their official results and contact the developers of StoX if necessary to solve the problems with abundance index calculation procedure in the StoX software. StoX task subgroup decided additionally to organize a meeting together with StoX developers in beginning of November 2019 to set up the final herring and sprat abundance index calculation procedures in the StoX software using the BIAS and BASS data from 2017. (Later on it emerged that the meeting was not necessary and the final settings for the StoX were agreed via correspondence.)

Before the WGBIFS meeting, in March 2020, there were 2 StoX calculations done by WGBIFS StoX subgroup members based on the data that were available in the ICES database for the acoustic trawl surveys:

a) estimates of herring and sprat abundance by rectangles based on the BIAS 2019 data (German biotic data were missing in the ICES database and were therefore not included in this exercise) made by E. Sepp,
b) estimates of herring abundance in SD 30 in 2013-2019 made by J. Lilja.

Comparison of these StoX estimates and standard BIAS estimates revealed that in general the difference was rather small. Only in certain rectangles the differences were observed to be larger. The members of WGBIFS were encouraged before the WGBIFS 2020 meeting by the correspondence to evaluate their own BIAS calculations and the StoX estimates to find out the possible reasons behind these differences. Unfortunately, no such exercises were done by the meeting time in March. Therefore, an additional 3-day long meeting was agreed to be organized at the beginning of December 2020 to make some progress in this question. Directly after the WGBIFS 2020 meeting in March it revealed that the SD3031 herring benchmark workshop (WKCLUB) outcomes became invalid, because the wrong acoustic index figures were used in the assessment models. A new benchmark for the Gulf of Bothnia herring assessment was planned for the beginning of the 2021 and WGBIFS got the following request: "WGBGFAS recommends WGBIFS to thoroughly scrutinize the acoustic survey index calculation for herring in SDs 30-31. Ultimately, the relevant survey data must be uploaded into the ICES database for acoustic trawl surveys and the StoX software should be applied for the calculation of estimates for a transparent reproducible pathway in TAF". WGBFAS was forced to drop some of their recommendations (including this one) in the final version of their report, because the maximum limit of recommendations was exceeded, but ACOM still expected from WGBIFS to address that recommendation during the planned December meeting.

A web meeting was held 1–3 December 2020 to calculate the herring abundance indices in SD 30 using the StoX software and to perform a comparison exercise between the StoX and traditional BIAS calculation methods. Michael O'Malley Chair of WGIPS (Working Group of International Pelagic Surveys) was participating in this meeting and acted as an additional reviewer as it was recommended by the ACOM. Before the meeting, there were the data for the years 2007-2019 available for that purpose. Comparison revealed that in general the differences in total number of herring between the two methods were below 4%, but in some years (2013-2019) the differences were much larger (Table 4.7.1, Figure 4.7.1). A thorough scrutinization was performed on the input data to rule out possible errors there. Comparison of NASC values showed that with some few exeptions the differences in the data were marginal (Table 4.7.2.). Larger differences in NASC values were explained with the fact that in the case of BIAS standard calculations sometimes NASC values from the coastal rectangles, which were left out from the calculations because of the low coverage, were incorporated into the calculations of the neighboring rectangles. Smaller differences were usually explained by the different definition of the EDSU positions (beginning/middle/end) used in in the input data of the StoX and standard BIAS calculations – so that the NASC values of the EDSUs close to the rectangle border may have ended up in the different rectangles. Examination of the input data did not explain the larger differences in the total number of herring between the two methods in 2013-2019. A verification of the BIAS calculations revealed a number of errors made in those years. Biggest change is in the 2016 estimates (Figure 4.7.1), where a systematic error was found in the original BIAS calulations - wrong (low) mean weight for herring length samples was used, which gave higher abundance estimates. Also in 2019 BIAS calculations were errors discovered in some rectangles, where the combining of different hauls was done in the wrong way (not given the equal weight for all hauls). In years 2007-2012, where no errors were found in the BIAS calculations, in some rectangles in certain years the differences between the 2 methods were still observed to be up to 34% (Table 4.7.1). The reason of these differences appeared to be the small methodological differences between the StoX and the standard BIAS calculation method (the StoX project, developed for the WGBIFS, is for various reasons actually not following 100% the standard method used by WGBIFS). Because of the mistakes, that were discovered in the standard BIAS calculations for some years, WGBIFS decided to recommend for the assessment purpose the herring abundance time-series calculated with StoX (Table 4.1.1.4.3). WGBIFS decided additionally that analogical exercises must be done also with all other abundance index series before the transition to StoX can be done. The StoX analyses showed that the current software version cannot handle in a good way a situation, where the data from different nations is combined in one calculation project and the different fish species have been measured using different accuracy (in WGBIFS coordinated surveys different species are measured by 1 mm, half cm or 1 cm accuracy). If this situation occurs in the data, the length measurements must be converted to the same accuracy level (the lowest common level), but unfortunately it will affect in this case all fish species. Fortunately, this issue did not affect the results of SD 30 analyses, because only one country is performing the survey there. But before the analogical comparison exercise between the StoX and traditional BIAS calculation methods can be done with Baltic sprat and Central Baltic herring abundance index series, this issue in the StoX software must be solved. The Chair of WGBIFS contacted the StoX developers during the WGBIFS 2020 meeting in December in this matter and received the information that the next version of the StoX software, which will be released in spring 2021, will solve that problem.

Table 4.7.1. **Difference (in %) of StoX herring abundance estimates relative to the values in BIAS database.**

Rectangle	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
50G7	0		0	0	8	0		-64	0	-3	-6	-59	-62
50G8	-3	0	2	2	-1	0	2	-46	10	-28	4	-1	-34
50G9	0	1	3	-3	4	0	-6	100	-7	12	0	-1	13
50H0	0	-4	0	0	0	0	6	17	-1	-28	0	9	0
51G7	0		0	0	0	0	-24	-46	0	-21	0	4	0
51G8	-1	-5	8	2	16	0	-37	7	131	-15	-1	-50	320
51G9	1	3	0	-1	12	0	0	-3	-15	-17	1	305	143
51H0	1	1	1	2	1	0	-1	-16	-12	-15	13	50	16
52G7	0		0	0	0	0	-19	4	-3	-5	0	2	0
52G8	0	2	0	18	0	1	0	3	-14	-7	44	0	3
52G9	0	6	14	12	0	0	-6	4	0	-91	-1	20	2
52H0	-2	34	0	11	21	0	-12	-3	0	-1	13	-12	20
52H1									-1				
53G7	0		0	0	0								
53G8	20	1	14	0	1	0	-3	-14	0	-38	0	16	0
53G9	15	8	0	2	0	0	-24	72	0	-7	67	-3	0
53H0	2	19	0	0	0	0	-6	2	1	-30	24	-12	-5
53H1										13			
54G8	4	0	0	0	0	1	0	-52	-16	-2	0	0	0
54G9	0	0	0	28	2	1	-19	-36	0	3	1	2	-2
54H0	1	-2	0	2	0	2	0	-5		-36	0	0	-1
55G9	0	0	0	0	0	0	-14	-66		-6	0	0	0
55H0	1	1	1	0	-1	0	-26	-46		-2	9	-1	0
Total	**2**	**3**	**2**	**3**	**3**	**0**	**-11**	**-21**	**3**	**-17**	**7**	**-2**	**4**

Table 4.7.2. Difference (in %) of NASC values used in StoX relative to the values in BIAS database. "OK"means no difference. "?" means that there is no value in the BIAS database.

Rectangle	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
50G7	0	?	OK	OK	OK	OK	OK	0	OK	OK	OK	OK	OK
50G8	0	0	OK	OK	OK	OK	1	OK	OK	0	OK	1	OK
50G9	0	OK	OK	OK	OK	OK	-8	OK	OK	0	OK	OK	OK
50H0	0	0	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK
51G7	0	?	OK	OK	OK	OK	OK	OK	OK	OK	0	0	OK
51G8	0	0	OK	OK	OK	OK	OK	OK	0	-2	OK	OK	OK
51G9	0	0	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK
51H0	0	OK	OK	OK	OK	OK	OK	4	OK	OK	0	OK	OK
52G7	0	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK
52G8	0	0	OK	OK	OK	OK	OK	0	OK	OK	OK	OK	OK
52G9	0	OK	OK	OK	OK	OK	OK	0	OK	OK	OK	OK	OK
52H0	0	0	OK	OK	OK	OK	OK	OK	0	OK	0	OK	OK
52H1	?	OK	OK	OK	OK	OK	OK	OK	3	?	OK	OK	OK
53G7	0	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK
53G8	0	OK	OK	OK	OK	OK	OK	OK	0	-29	0	0	OK
53G9	0	0	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK
53H0	0	OK	OK	OK	OK	OK	-7	3	OK	-16	OK	1	OK
53H1	OK	OK	OK	OK	OK	OK	?	?	17	38	OK	?	OK
54G8	0	0	OK	OK	OK	OK	OK	OK	OK	OK	0	OK	0
54G9	0	0	OK	OK	OK	OK	OK	OK	OK	0	OK	OK	OK
54H0	0	0	OK	OK	OK	OK	OK	OK	OK	-33	OK	OK	OK
55G9	0	OK	OK	OK	OK	OK	OK	OK	OK	0	OK	OK	OK
55H0	0	0	OK	OK	OK	OK	OK	OK	OK	OK	0	OK	OK

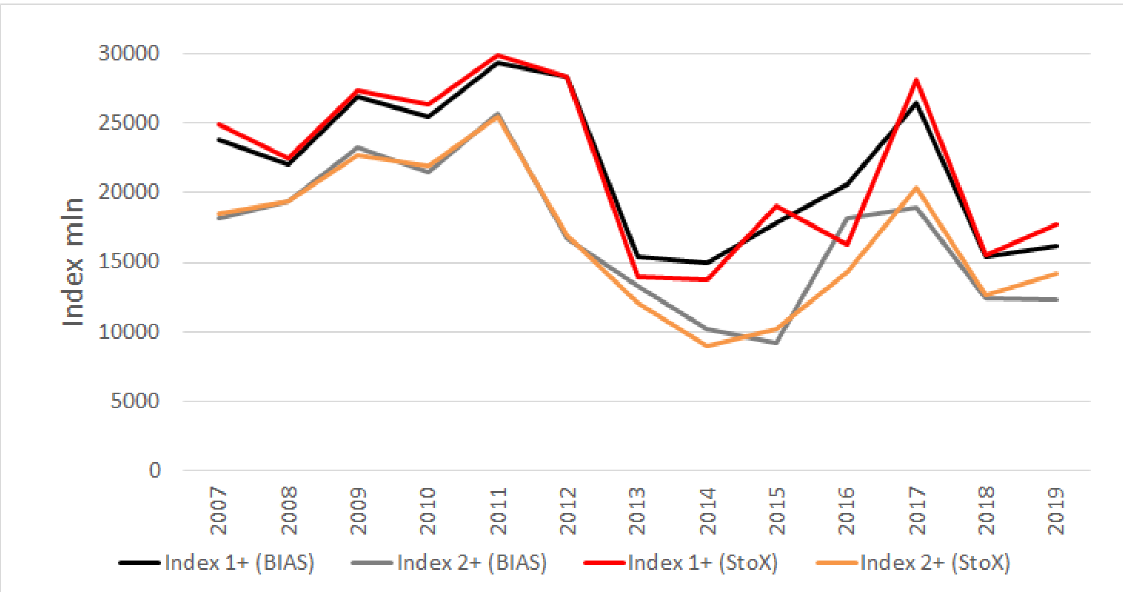


Figure 4.7.1. Herring abundance index based on the StoX estimates and the values in BIAS database. "1+" means summed abundance of 1 year old and older individuals. "2+" means summed abundance of 1 year old and older individuals.

One of the outcomes of the WKClub 2020 workshop was that the SS3 model doesn't provide a very good fit to the trend of the acoustic survey (Figure 4.7.2). Especially the years 2011, 2012 and 2017 look like a outliers. Coincidentally, these are the years in which the Danish research vessel "Dana" was used. In years 2007-2010 the Swedish research vessel "Argos" and in other years Finnish r/v "Aranda" was used to perform the survey in SD 30. This raises a suspicion that there may be a vessel effect involved. Unfortunately, no inter-calibration between these 3 research vessels has been done. The only way to study the possible vessel effect is to use an indirect method where the estimates of r/v "Dana" are compare with the other research vessels.

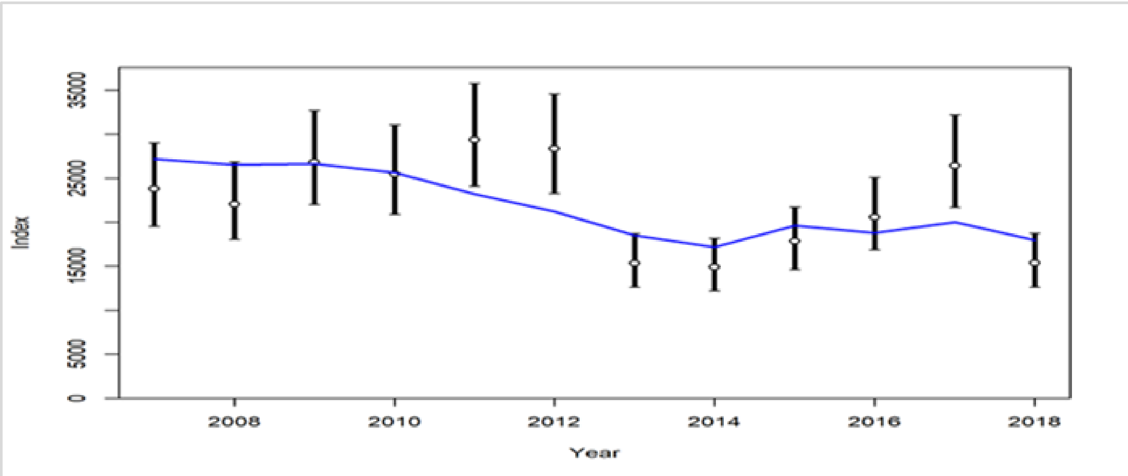


Figure 4.7.2. **Herring abundance index based on the BIAS database (summed abundance of 1 year old and older individuals) vs. model fit (from WKClub 2020 outcomes).**

In 2011-2018 r/v "Dana" was used by Sweden to cover their EEZ in the Baltic proper (ICES SD 27 and smaller parts of SD 25, 26, 28 and 29). Sprat and herring abundance density estimates in SD 27 are in good agreement with the similar estimates in neighbouring SDs and also with the sprat and herring index density values, and show no obvious signs of a possible vessel effect (overestimation by "Dana") in 2011-2018 (Figure 4.7.3). In Figure 4.7.4 the NASC values from the SDs 25, 28 and 29 are given by countries. In these SDs Sweden covers at least 4 rectangles, although there is no overlap in the coverage with other countries (research vessels). In SD 28 and 29, there are no obvious signs of a possible vessel effect in 2011-2018, but in SD 25 happened a big jump in the NASC values since 2011. By looking at the age compositions of sprat and herring in the ICES SD 25 by year and country (Figure 4.7.5 and 4.7.6), it reveals that this big change in the Swedish NASC values coincides with the change in the age composition. While until 2010 the age compositions of Sweden and Poland were similar, from 2011 onwards younger age-groups dominated in Polish waters, while in Swedish waters older individuals predominated. This indicates that the change in Swedish NASC values in SD 25 can more likely be explained by the change in fish distribution, than by the vessel effect.

Figure 4.7.3. Sprat and herring abundance denity estimates (summed abundance of 1 year old and older individuals) based on the BIAS estimates. SD 26 is mainly covered by r/v "Baltica" and additionally by "Darius" and "Atlantida" or "AtlantNIRO". SD 27 is covered by by "Argos" until 2010, by "Dana" in 2011-2018 and by "Svea" since 2019. SD 28 is mainly covered by r/v "Baltica" and additionally by "Argos" until 2010, or "Dana" in 2011-2018 or "Svea since 2019.

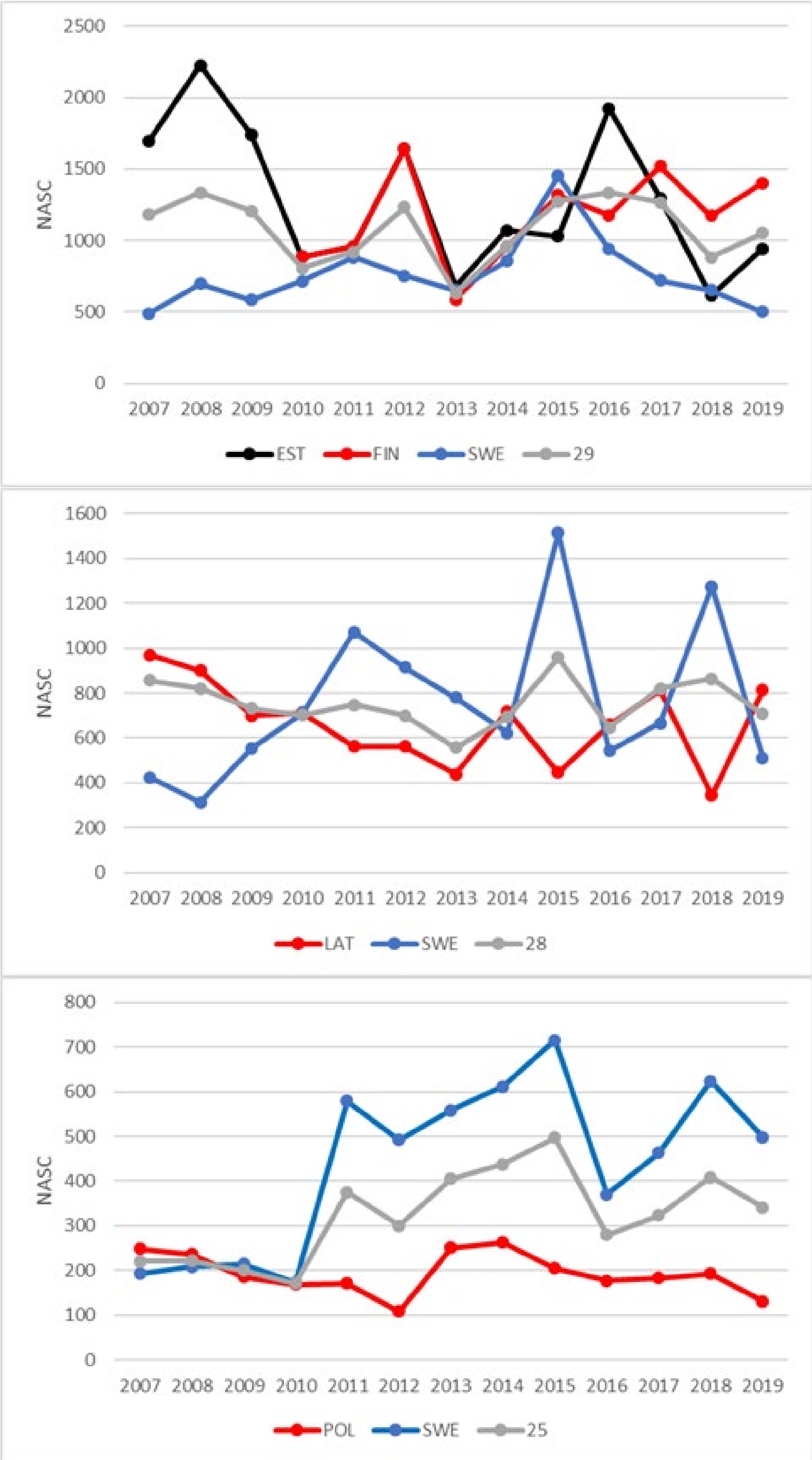


Figure 4.7.4. Mean NASC estimates based on the BIAS data. Estonia, Latvia and Poland have used r/v "Baltica". Finland has used r/v "Dana" in 2010, 2011 and 2017, and "Aranda" in 2012-2016 and since 2018. Sweden has used "Argos" until 2010, "Dana" in 2011-2018 and "Svea" since 2019.

Figure 4.7.5. Sprat **age composition (in %) by countries based on the BIAS estimates in SD 25. Poland has used r/v "Baltica". Sweden has used "Argos" until 2010, "Dana" in 2011-2018 and "Svea" since 2019.**

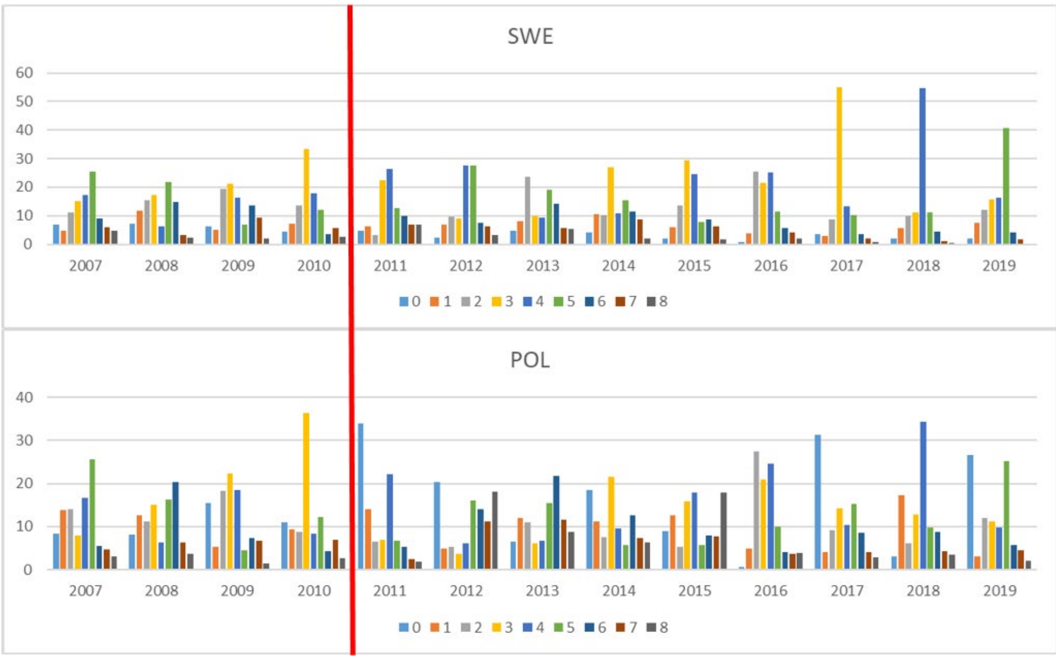


Figure 4.7.6. Herring **age composition (in %) by countries based on the BIAS estimates in SD 25. Poland has used r/v "Baltica". Sweden has used "Argos" until 2010, "Dana" in 2011-2018 and "Svea" since 2019.**

Additionally, the SD 30 herring indices were compared with the mean NASC values and the mean CPUE of herring in the BIAS control catches (Figure 4.7.7 and 4.7.8). I general there is a good correlation between them (~0.8). The correlation should be better, if herring biomass estimates would be used instead of the abundance. As the same trawl gear model was used with all different research vessels in SD 30, then the herring CPUE time-series cannot have any vessel effect. Good correlation between the SD 30 herring indices and the mean CPUE of herring in the BIAS control catches indicates therefore that there is no serious issues with the possible vessel effect.

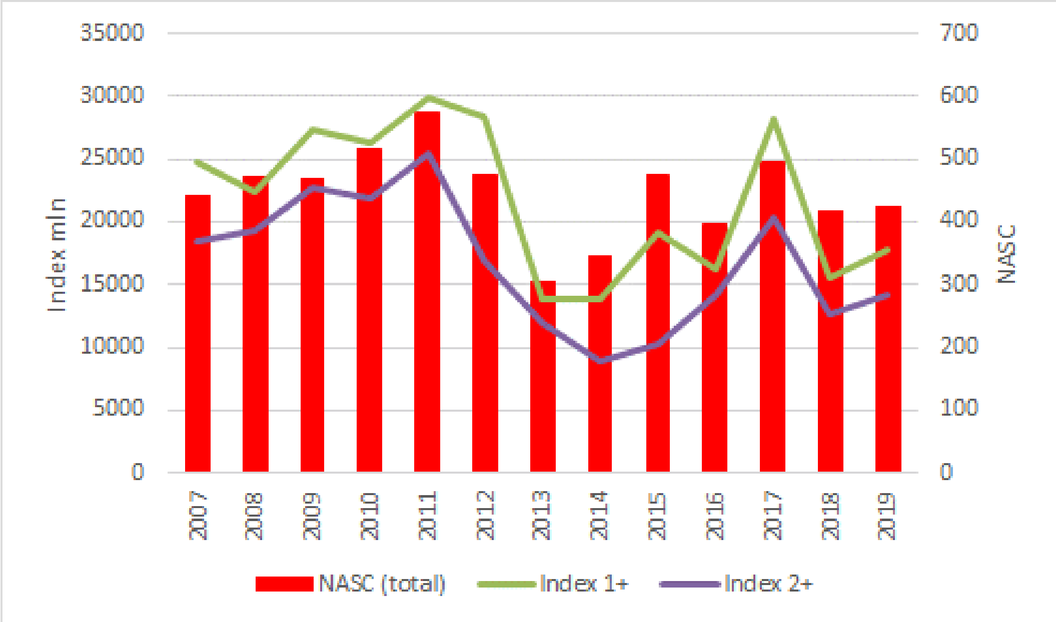


Figure 4.7.7. Herring abundance index based on the StoX estimates vs. mean total NASC values used in StoX. "1+" means summed abundance of 1 year old and older individuals. "2+" means summed abundance of 1 year old and older individuals.

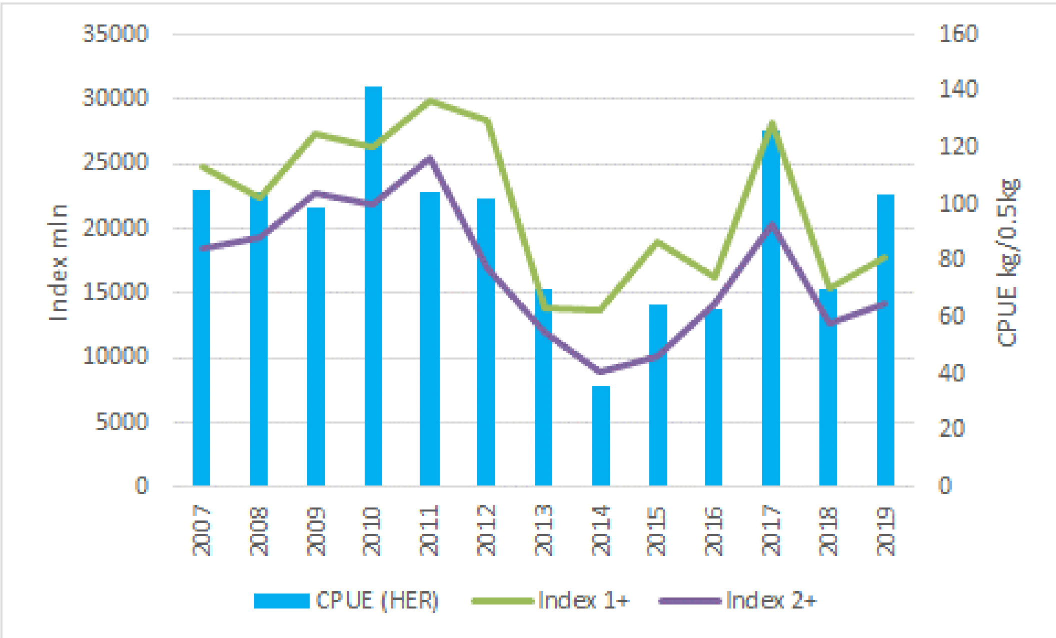


Figure 4.7.8. Herring abundance index based on the StoX estimates vs. mean CPUE of herring in the BIAS control catches. "1+" means summed abundance of 1 year old and older individuals. "2+" means summed abundance of 1 year old and older individuals.

Figure 4.7.9. shows the survey transects and haul positions in different years. One could say that there are some issues with the survey coverage in some years (for example 2012, 2014 and 2015) and also with uneven distribution of the survey hauls (2013-2016). The survey design has been the same for 2007-2011 (the Swedish way). In 2012 it was reduced to 50% because Sweden refused

to pay for the half costs of the survey. Since 2013 there has been slightly different design (the Finnish way). In 2014 and 2015 bad weather and unexpected problems with the trawling equipment has caused remarkable changes into the survy performance (transect layout and number/distribution of hauls) compared to the plan. Survey design issue was discussed during the WGBIFS meeting in December and the conclusion was, that it would be much better to cover the Bothnian Sea by parallel transects from coast to coast and also the hauls should be distributed more evenly. This change would probably add an extra day for the survey. There is an additional problem involved - trawling in shallow (coastal) areas. Namely the fish is too close to the bottom there during the daytime. So, the trawling is possible only during the dark hours, when the fish migrates upwards. This will make the planning and realization of the survey much more complicated. Ideally the survey in SD30 should be done only during the dark hours, but this would increase the survey time and cost to double.

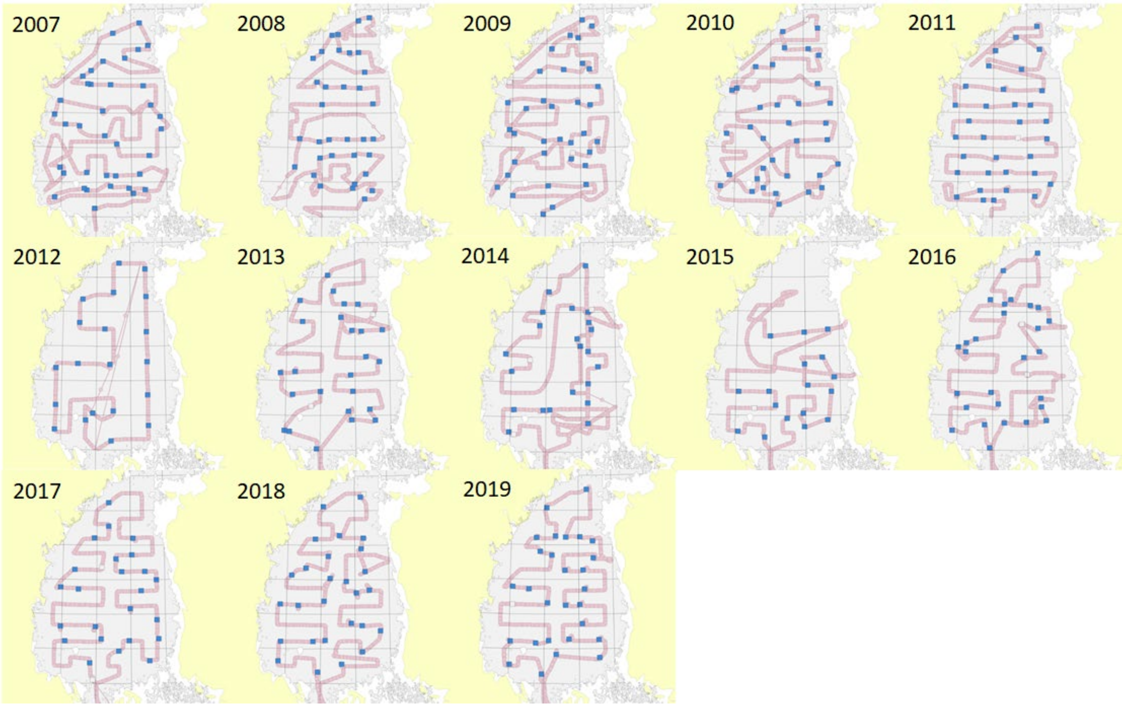


Figure 4.7.9. **Acoustic transects (line) and position of control hauls (blue squares = valid, white squares = invalid hauls) in the Bothnian Sea (SD 30) BIAS surveys.**

4.8 ToR h) Define methods for the appropriate processing of the survey data and output products from the BITS survey to deliver input-data for calculation of the Baltic LFI and MML indicators

The large fish indicator (LFI) is an important community indicator that integrates different stocks in a unique regional indicator. The LFI is one of the DCF indicators and is used by OSPAR in the Ecological Quality Objective (EcoQO), by HELCOM as a useful indicator of biodiversity, related to the foodwebs MSFD descriptor D4 and used in ICES Advice. LFIs may also be used in the future as a standard product in the ICES Ecosystem Overviews and will be calculated every year. ICES Data Centre request of the outlier-rechecking in DATRAS was addressed by the national data submitters of BITS in 2018 as the first step in the process of developing Large Fish Indicator (LFI) for the Baltic Sea.

The processing of the LFI Maximum Mean Length (MML) and the Large Fish Index (LFI) is dependent of the possibility to calculate the swept area for each fishing station. Only Germany Denmark and Sweden have gear geometry measuring devises available during the BITS, which is a precondition for obtaining the distance between either the doors and/or the wings of the demersal trawl, which is one of the key parameter calculating the swept area. The ICES WKSABI meeting (Workshop on method to develop a swept-area based effort index) in 2019 revealed some problems in the data submitted as several countries have submitted the theoretical non-measured values instead of actual measured values for door spread and vertical opening of the gear. As both the door spread and the vertical opening are highly variable, dependent on depth, current and local conditions of the bottom, the theoretic value is not a valid value for calculating the swept area. In most cases, only the door spread is measured, but as it was demonstrated and agreed during the WKSABI that it is possible to convert the door spread to wingspread and vice versa by using regression. The countries, which have uploaded erroneous data, have been requested to correct the data in DATRAS for the whole time-series and it has been agreed that this should be done centrally without the necessity to re-upload all data. A data download by 14/1 2021 (Table 4.8.1) shows that only few of the invalid data still are present in the database.

Table 4.8.1. The number of hauls realized by country and year compared with number of observations of swept area relevant variables. Be aware of that no countries, except Germany, Denmark and Sweden, have the possibility to measure gear geometry, which means that the values uploaded by those countries are theoretical values, which should be deleted from the DATRAS.

Year	Germany						Denmark						Estonia						Lithuana					
	Number of hauls	HaulDur	Distance	GroundSpeed	DoorSpread	Netopening	Number of hauls	HaulDur	Distance	GroundSpeed	DoorSpread	Netopening	Number of hauls	HaulDur	Distance	GroundSpeed	DoorSpread	Netopening	Number of hauls	HaulDur	Distance	GroundSpeed	DoorSpread	Netopening
1991	175	175	170	127			69	69	66			64												
1992	166	166	162	121			64	64	64			61												
1993	147	147	145	147			71	71	71			69												
1994	150	150	138	150			69	69																
1995	122	122	121	74			68	68	68		64		39	39										
1996	130	130	129	71			100	100	100	98		55	68	68										
1997	99	99	99	99			92	92	92	92		47												
1998	136	136	134	136			89	89	89	89		59												
1999	113	113	113	112			190	190	107	107		55												
2000	98	98	98	98			190	190	153	143	17	92	25	25	25	25		25						
2001	120	120	120	120			182	182	145	143	100	55												
2002	119	119	119	119			153	153	114	113	67	67												
2003	113	113	113	113			159	159	159	157	75	76												
2004	112	112	112	112			151	151	151	151	70	72							5	5	5	5		
2005	117	117	117	117		63	165	165	165	165	82	82	10	10						10		10		
2006	111	111	111	111		55	152	152	152	152	68	69	4	4					7	12		12		
2007	112	112	112	112			155	155	155	155	72	65	10	10					16	16		16		
2008	110	110	110	110			162	162	162	159	50	46	6	6					16	16		16		
2009	119	119	119	119			173	173	173	172	80	83	10	10					15	15		7		
2010	102	102	102	102	44	44	168	168	168	168	72	71	10	10					15	15				
2011	114	114	114	114	100	100	186	186	186	186	76	76	9	9					13	13				
2012	108	108	108	108	100	108	203	203	203	203	86	91	9	9					14	14				
2013	104	104	104	104	96	102	177	177	177	177	81	79	9	9					12	12	12			
2014	149	149	149	148	111	149	142	142	49	142	89	88	10	10					11	11	11			
2015	108	108	108	108	103	108	192	192	98	192	109	109	9	9	5				9	9	9			
2016	116	116	116	115	116	56	221	221	52	221	221	216	10	10	5				10	10				
2017	109	109	109	109	105	109	215	215	165	215	214	204	10	10	5				11	11				
2018	111	111	111	111	111	111	204	204	204	204	204	197	10	10	7				12	12	6	6		
2019	98	98	98	98	98	95	223	223	223	222	220	221	5	5	5				12	12	12	12		
2020	59	59	59	59	59	56	102	102	102	102	102	101							6	6	6	6		

Year	Latvia						Poland						Russia						Sweden					
	Number of hauls	HaulDur	Distance	GroundSpeed	DoorSpread	Netopening	Number of hauls	HaulDur	Distance	GroundSpeed	DoorSpread	Netopening	Number of hauls	HaulDur	Distance	GroundSpeed	DoorSpread	Netopening	Number of hauls	HaulDur	Distance	GroundSpeed	DoorSpread	Netopening
1991	112	112					72	72											65	95	95	65	95	95
1992							33	33											39	70	66	70	66	54
1993	36	36					50	50					27	27		27			94	110	110	110	110	15
1994	45	45					72	72					31	31					88	88	88	88	88	85
1995	23	23					47	47						44		44	44		101	124	124	101	118	116
1996	28	28					89	89						57		57	57		83	83	83	83	69	83
1997	35	35					141	141						45		45	45	45	89	89	89	89	86	87
1998	16	16					121	121						50		50	50	50	81	81	81	81	70	77
1999	51	51					59	59						40		40	40	40	79	79	79	79	76	75
2000	59	59						52						37		37	37	37	81	81	81	81	81	80
2001	53	53					57	68						52		52	52	52	75	75	75	75	73	75
2002	50	50					23	28						44		44		44	73	73	73	73	70	73
2003	50	50						51						64		64		64	68	68	68	68	67	68
2004	54	54					41	71						64		64		64	43	43	43	42	43	43
2005	63	63					40	79					21	75		75		75	64	64	64	64	64	59
2006	47	47					61	66					14	51		51		51	52	52	52	52	52	50
2007	45	45					69	69					50	50		50		50	53	53	53	53	53	52
2008	48	48					57	58	26	26	26	26	45	45		45		45	60	60	60	60	60	59
2009	41	41					58	64	63	63	64	64	37	37		37		37	59	59	59	59	59	55
2010	44	44					64	64	64	64	64	64	54	54		54		54	67	67	67	67	67	67
2011	32	32					65	66	64	36	66	66	55	55		55		55	55	55	55	55	55	54
2012	37	37					79	81	81	2	81	81							60	60	60	60	60	60
2013	40	40					74	77	77		77	77	36	36		36		36	64	64	64	64	64	63
2014	38	38					83	84	84		84	84							54	54	54	54	54	54
2015	39	39					81	81	81	32	81	81							54	54	54	54	54	54
2016	41	41		27			95	95	95	94	95	95	15	15		15		15	53	53	53	53	53	53
2017	48	48					136	136	136	136	81	136	15	15		15		15	39	39	39	39	39	39
2018	38	38					118	118	118	118		117	16	16		16		16	56	56	56	56	56	56
2019	33	33					127	127	127	127		127							66	66	66	66	66	65
2020	17	17					57	57	57	57		57							65	65	65	65	65	63

In addition, an amount of swept area related variables contain outliers were demonstrated by the WKSABI. Most of those are corrected, but some are still left in the database and should be corrected.

WGBIFS has been requested to develop methods for calculating the input data for estimating the LFI indices and MML. The most essential tool needed for providing the data for LFI indices and MML is the conversion factors between door spread and wing spread. As this factor will be estimated based on historical data, the correction of the outliers is a precondition for correct estimation and will be done as soon as each country have checked the outliers indicated by WKSABI. The correction of the data involves a re-upload of all years where corrections are made and one reason for the late update might be that each country is awaiting the possibility to upload data in the new unified format, which from 2021 have been made the standard. Each country, which have already made the corrections are requested to check the outliers specified during the WKSABI 2019.

4.9 ToR i) Coordinate the marine litter-sampling programme within the Baltic International Trawl Survey and registering the data in the ICES database

Collected and registered information about marine litter is an important source of knowledge regarding current ecological status of marine seabed in investigated areas of the Baltic. All countries, who realized the recent BITS surveys, have also submitted the collected litter materials into the DATRAS Litter database.

A manual for the marine litter-sampling program will be made by the Marine Litter Working Group (MLWG) and it will be incorporated into the BITS manual in 2021-2023. WGBIFS has reviewed the draft manual for the marine litter-sampling and left the comments for MLWG. In addition to the manual there will be a guideline that will provide the user with information and help to upload data in a correct manner. This guideline has been developed for data suppliers submitting seafloor litter data originating in bottom trawls during fisheries (DATRAS) and environmental (DOME) surveys in the ICES Areas.

The marine litter sampling program continues as before and uses the latest litter format that was decided by WGBIFS 2017 (see in the Table 5.2.1 in the BITS manual http://www.ices.dk/sites/pub/Publication%20Reports/ICES%20Survey%20Protocols%20(SISP)/2017/SISP7%20BITS%202017.pdf).

The DATRAS excel worksheet with information on the database field descriptions and how to fill in the database can be found here:

https://www.ices.dk/marine-data/data-portals/Pages/DATRAS-Docs.aspx

4.10 ToR j) Agree a standard pelagic trawl gear used in BIAS and BASS surveys

In 2016, WGBIFS requested support from WGFTFB to standardize the pelagic trawl for the international Baltic acoustic surveys (BASS and BIAS).

Prior to the discussions held during the WGBIFS 2018 meeting, there were two short meetings between Olavi Kaljuste (Chair of WGBIFS), Haraldur Einarsson (Chair of WGFTFB) and Daniel Stepputtis (Thünen-Institute, Germany and member of WGFTFB) to discuss the basic needs related to the WGBIFS request. During the second meeting (in 25.01.2018 in Copenhagen) of these three above mentioned persons, it was agreed to have a wider discussion during the WGBIFS 2018 meeting.

As it was planned, a WebEX-meeting was held with two representatives of WGFTFB (Haraldur Einarsson and Daniel Stepputtis) to discuss the issues related to survey gear standardization during the WGBIFS 2018 meeting. Based on the discussions, the needs for the possible standard pelagic trawl gear where identified and the next steps in the gear standardization process were agreed. It was decided that Haraldur Einarsson and Daniel Stepputtis will present the topic briefly at WGFTFB meeting in June 2018 to ask gear technologists for their participation.

Until the WGBIFS 2019 meeting, there was no new information from WGFTFB about this ToR available and therefore this issue was not discussed there. WGBIFS decided to wait the response from the WGFTFB to make a final decision about the survey gear standardization in 2020.

After the WGCHAIRS meeting in January 2020 there was a short meeting between Olavi Kaljuste (Chair of WGBIFS), and the 2 new Chairs of WGFTFB (Daniel Stepputtis and Antonello Sala) to discuss the gear standardization topic. It revealed that WGFTFB has changed their position on this issue and are no longer planning to assist WGBIFS in gear standardization process. Chairs of WGFTFB recommended instead WGBIFS to launch a new EU project for the development of a new standard survey gear (as it was for example done for the TV3 type of demersal trawl for BITS surveys) and advised to search partners for cooperation within other ICES survey groups, who might have similar needs.

During the WGBIFS 2020 meeting in March this new information was discussed and the Group found that there is a lack of knowledge within our WG for launching such project alone. At the same time majority of the WG members still supported the continued search for possible solutions in this topic. Therefore, it was decided to take contact with WGIPS in this question. After the meeting the Chair of WGBIFS contacted the Chairs of WGIPS (Bram Couperus and Michael O'Malley) for possible cooperation in this matter and got a response that WGIPS will raise this question at their meeting in January 2021. Then they will see, whether there are members in their group that would be interested in this issue and are willing to take it forward with the potential of getting involved in a more formal project, and will get back to WGBIFS.

Therefore, the Group was not able to reach any final decisions during the 2018-2020 in this question about the standard pelagic fishing gear to be used in the BIAS and BASS surveys.

4.11 ToR k) Review and update the International Baltic Acoustic Surveys (IBAS) manual and address methodological question raised at the last review of the SISP

The International Baltic Acoustic Surveys (IBAS) manual was reviewed during the WGBIFS 2018-2020 meetings and several changes and corrections were implemented. The updated manual will be published in the ICES publication series Techniques in Marine Environmental Science (TIMES) in 2021.

4.12 ToR l) Review and update the Baltic International Trawl Survey (BITS) manual and address methodological question raised at the last review of the SISP

The Baltic International Trawl Survey (BITS) manual was reviewed during the WGBIFS 2018-2020 meetings and several changes and corrections were implemented. The updated manual will be published in the ICES publication series Techniques in Marine Environmental Science (TIMES) in 2021.

5 Inquiries Besides of the Fixed ToRs

5.1 Investigate whether the sprat and herring length distribution data from the BITS survey is representative for these stocks and can be used as input in the assessment. (WGBFAS request)

On a request from WGBFAS, who wants WGBIFS to explore whether the sprat and herring length distribution data from the BITS demersal trawl survey is representative for these stocks and can be used as input in the assessment, the length distributions obtained during the BITS were compared with the length distributions obtained during the BIAS and BASS surveys.

Due to limited access to acoustic length distributions, only data from 2017, 2018 and 2019 were readily available. In order to avoid interference of different herring stocks only data from Subdivision 26. 27 and 28 were included. This means, that only the central Baltic herring stock and part of the sprat stock is considered.

The BASS and the BIAS is carried out in May and September/October respectively while the BITS is carried out in March and October/November. The comparison is made between each survey by quarter although the season does not match exactly between BASS and 1st quarter BITS.

Several issues, which make the assumption of the BITS length distributions representativeness for the length distribution in the stock problematic, can be listed:

- The demersal trawl used in BITS only fish the water volume 4-6 meter above the bottom, which covers the vertical distribution of neither sprat nor herring.
- The BITS hauls are only carried out during daytime where sprat and herring are aggregated in schools. This would normally introduce a high variance in the estimate.
- The BITS survey does not cover the complete spatial area of the sprat or the Central Baltic herring stock.

The comparison of the length distributions is made by year (2017-2019) in order to see any annual changes, which is important in the stock assessment context and by ICES Subdivision in order to eliminate any effects of the different coverage of the surveys. In the length-frequency diagrams below (figure 5.1.1 – 5.1.4) are the surveys showed pairwise by survey type, species and year for spring and autumn surveys.

The preliminary results are indicating that the compared length-distributions are not formally similar (Kolmogorov test) but a working document giving a comprehensive overview of this topic is planned to be presented during the next WGBIFS meeting in 2021.

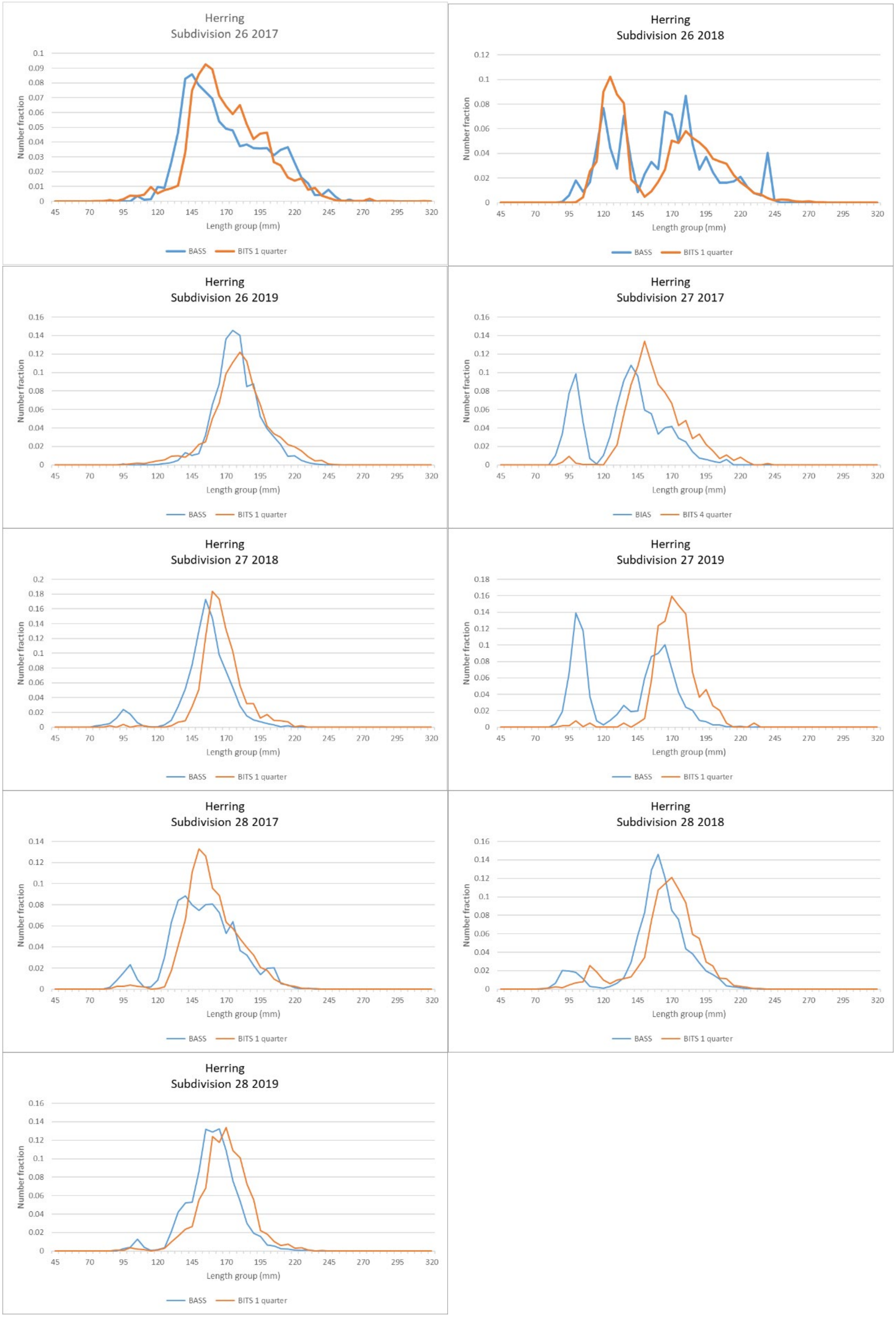


Figure 5.1.1. Herring length frequencies compared between spring surveys (BASS and 1st quarter BITS).

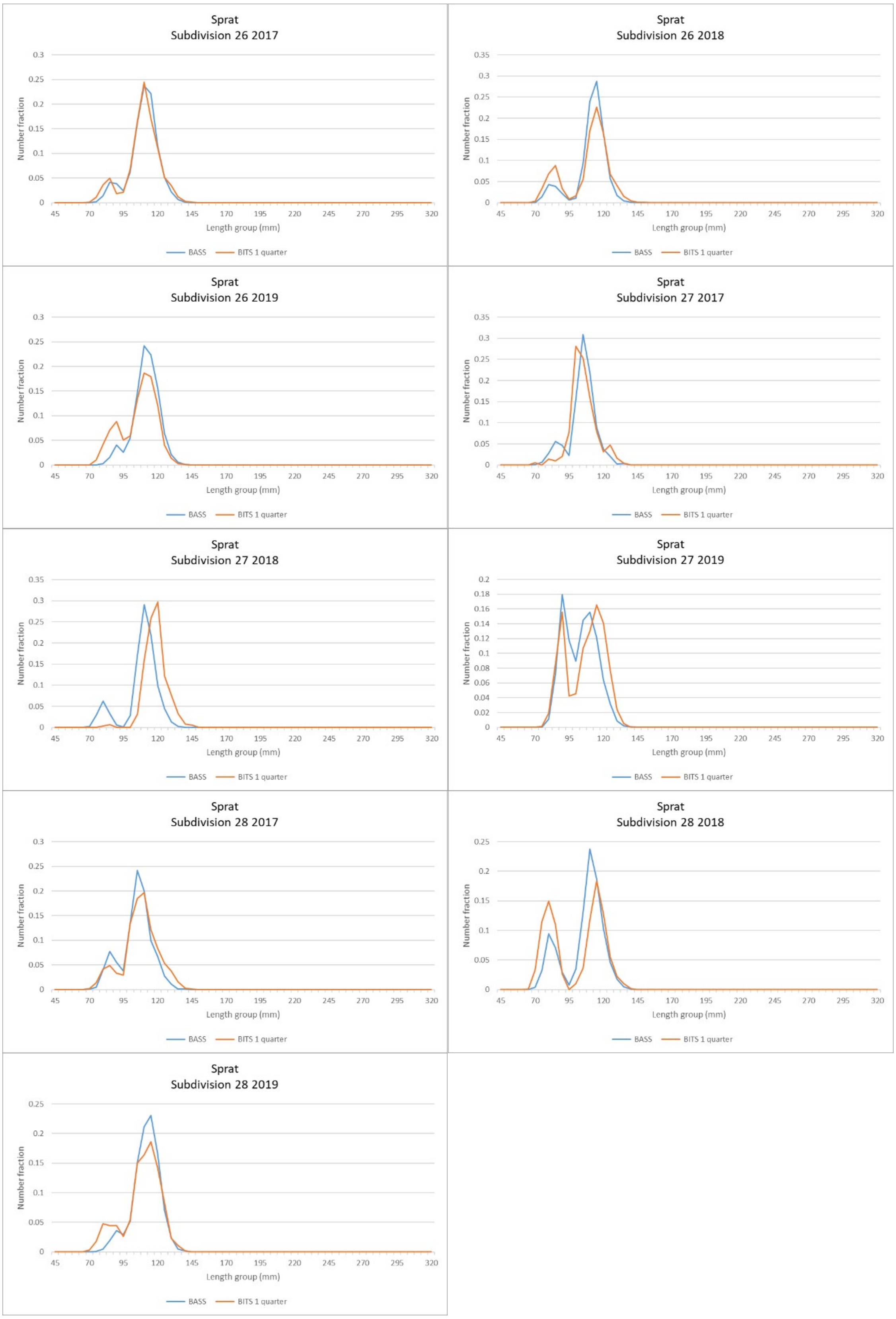


Figure 5.1.2. Sprat length frequencies compared between spring surveys (BASS and 1st quarter BITS).

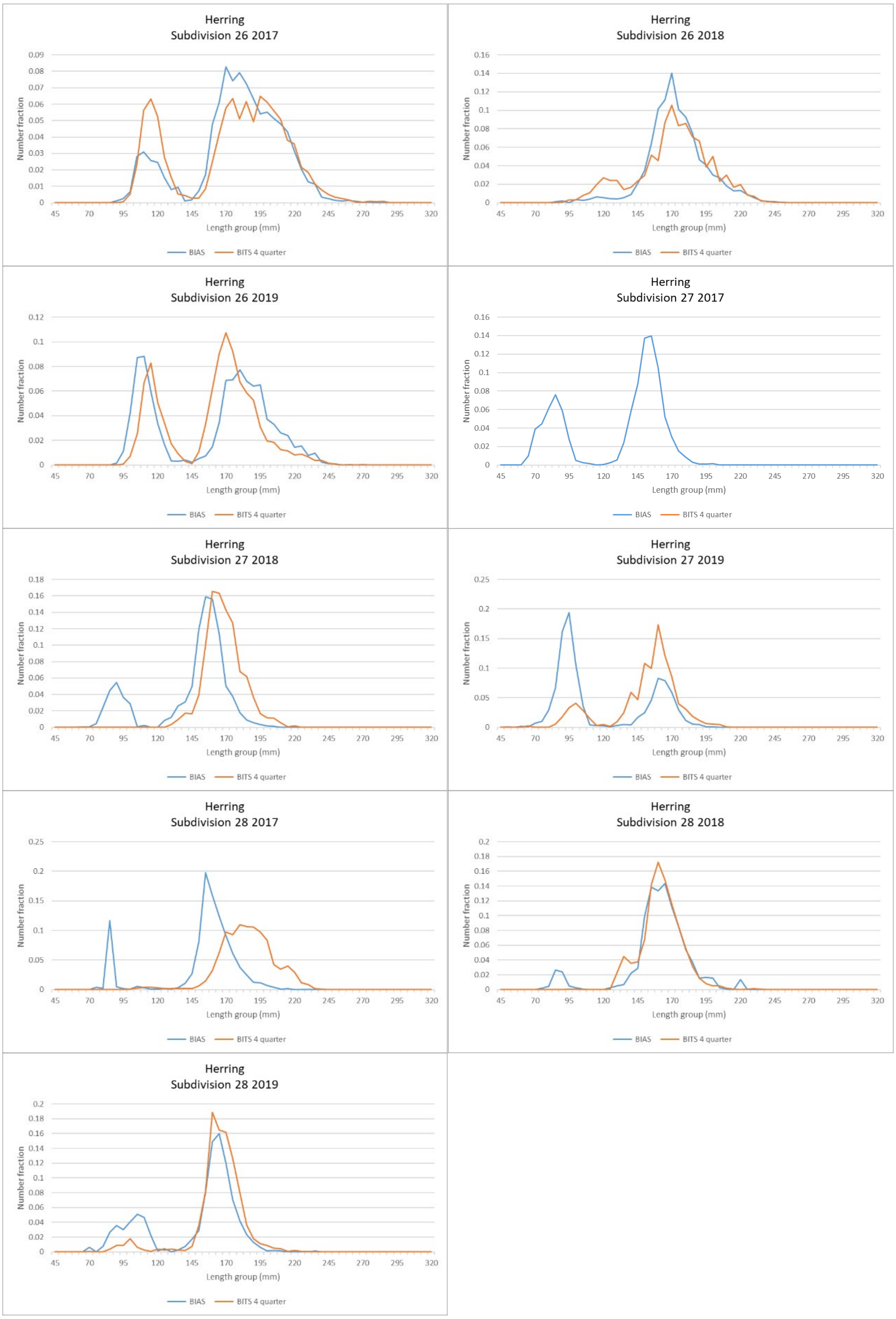


Figure 5.1.3. Herring length frequencies compared between autumns surveys (BIAS and 4th quarter BITS).

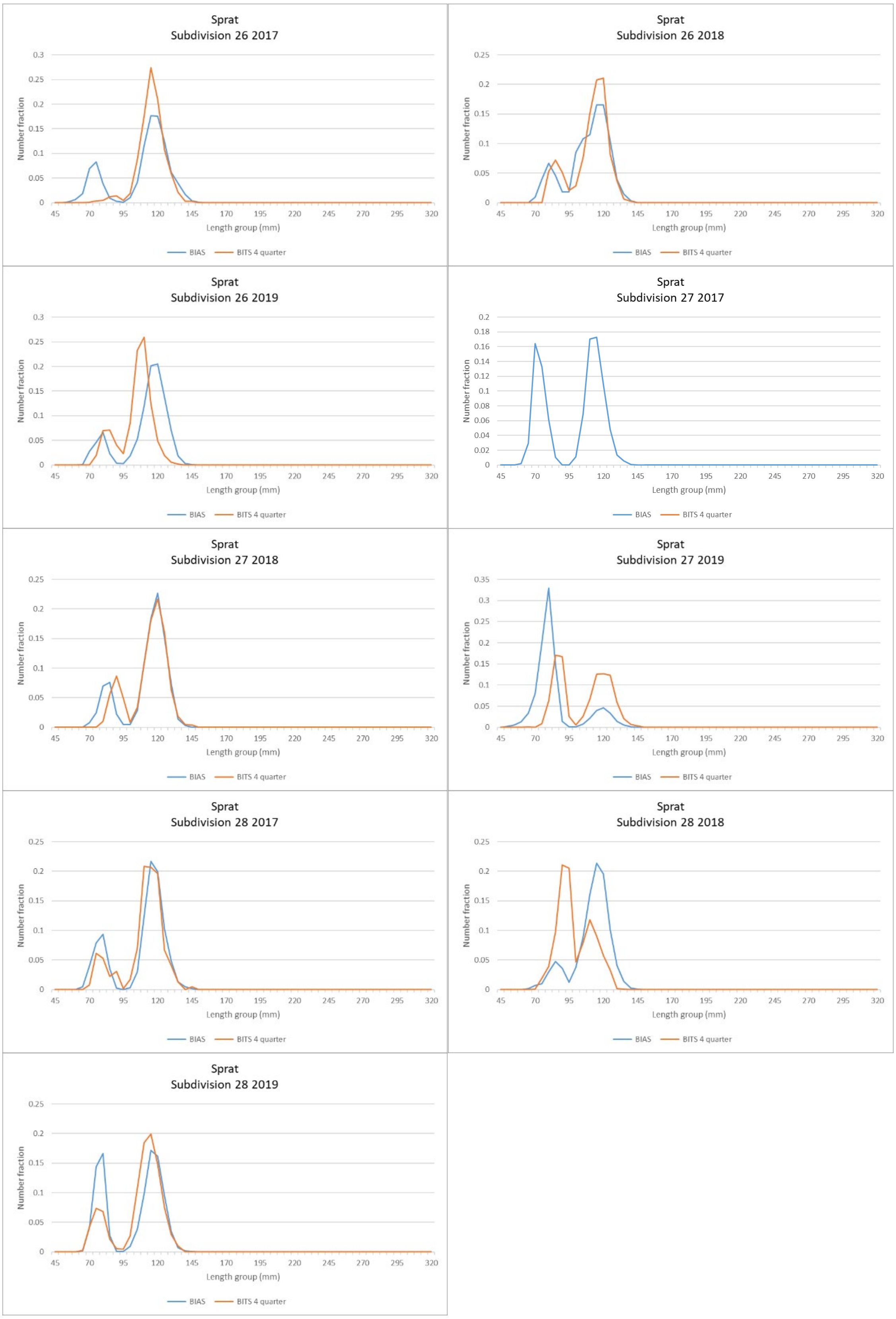


Figure 5.1.4. Sprat length frequencies compared between au-tumns surveys (BIAS and 4th quarter BITS).

5.2 Analyse the results of Gulf of Riga acoustic herring survey in order to provide fishery- independent stock estimates of Gulf of Riga herring and evaluate the usage of that information for stock assessment purposes. (WGBFAS request)

Until now, the preparation of the Gulf of Riga Acoustic Herring Survey (GRAHS) data for the stock assessment of Gulf of Riga herring has been the responsibility of the Latvian and Estonian national laboratories. If the methodology and consistency of results of this survey should be evaluated by the WGBIFS, as WGBFAS requested, all the data from GRAHS should be made available. Therefore, WGBIFS has requested that all available data from the GRAHS surveys will be uploaded into the ICES database for acoustic trawl surveys before the next WGBIFS meeting in March 2021. Once the survey data are made available, WGBIFS can perform the analyses and evaluations that WGBFAS requested. WGBIFS has added a special ToR for the next 3-year term for that purpose: **l**) Conduct analyses related to the uncertainties in the Gulf of Riga Acoustic Herring Survey (GRAHS) in order to improve the quality of the GRAHS and subsequent indices.

5.3 Conduct analyses related to the uncertainties in the Gulf of Riga acoustic herring survey in order to improve the quality of the GRAHS and subsequent indices. (WGBFAS request)

Until now, the preparation of the Gulf of Riga Acoustic Herring Survey (GRAHS) data for the stock assessment of Gulf of Riga herring has been the responsibility of the Latvian and Estonian national laboratories. If the methodology and consistency of results of this survey should be evaluated by the WGBIFS, as WGBFAS requested, all the data from GRAHS should be made available. Therefore, WGBIFS has requested that all available data from the GRAHS surveys will be uploaded into the ICES database for acoustic trawl surveys before the next WGBIFS meeting in March 2021. Once the survey data are made available, WGBIFS can perform the analyses and evaluations that WGBFAS requested. WGBIFS has added a special ToR for the next 3-year term for that purpose: **l**) Conduct analyses related to the uncertainties in the Gulf of Riga Acoustic Herring Survey (GRAHS) in order to improve the quality of the GRAHS and subsequent indices.

5.4 Consider the possibilities of organizing and maintaining a data from the Gulf of Riga acoustic herring survey and incorporate this information in the ICES Acoustic database. (WGBFAS request)

Until now, the preparation of the Gulf of Riga Acoustic Herring Survey (GRAHS) data for the stock assessment of Gulf of Riga herring has been the responsibility of the Latvian and Esto-nian national laboratories. If the methodology and consistency of results of this survey should be evaluated by the WGBIFS, as WGBFAS requested, all the data from GRAHS should be made available. Therefore, WGBIFS has requested that all available data from the GRAHS surveys will be uploaded into the ICES database for acoustic trawl surveys before the next WGBIFS meeting in March 2021. Once the survey data are made available, WGBIFS can per-form the analyses and evaluations that WGBFAS requested. WGBIFS has added a special ToR for the next 3-year term for that purpose: l) Conduct analyses related to the uncertainties in the Gulf of Riga Acoustic Herring Survey (GRAHS) in order to improve the quality of the GRAHS and subsequent indices.

5.5 Due to the high uncertainty of abundance estimates of younger ages from the GRAHS the usefulness of extending the BIAS survey into the Gulf of Riga (SD 28.1) should be considered. (WGBFAS request)

WGBIFS supported the idea. Therefore, WGBIFS communicated this request to Estonia and Latvia with special a recommendion in the WGBIFS Action List that states: if possible, they should consider extending their BIAS surveys into the Gulf of Riga.

5.6 Evaluate if there are methodological and/or environmental reasons for different survey catchabilities (understood as ratio of acoustic estimate of stock size and true stock size in given area/AUs) in former assessment units (subdivisions) and what may be magnitude of these differences. (WGBFAS request)

WGBIFS discussed this request during the meeting. It was considered to be too complex request to be addressed immediately. WGBIFS has added a special ToR for the next 3-year term for that purpose: m) Evaluate if there are methodological and/or environmental reasons for different survey catchabilities in different ICES Subdivisions and what may be magnitude of these differences.

5.7 Support the establishment of a Governance Group for Acoustic ICES DB. (WGIPS request)

WGBIFS recognizes the importance of the establishment of a governance group for the ICES Acoustic Trawl Data Portal needs in order to advise the ICES Data Centre on issues of different matters related to the portal, format, database etc. Therefore, E. Sepp (Estonia) was assigned as a member and B. Schmidt (Poland) as a substitute member to Working Group on Acoustic Trawl Data Portal Governance (WGAcousticGov) to represent WGBIFS.

5.8 Provide ICES Data Centre with some reasonable ranges for the most important variables involved in the calculation of swept area. (ICES Data Centre request)

The workshop on method to develop a swept-area based effort index (WKSABI) in 2019 revealed some problems in DATRAS data as several countries have submitted non-measured values for door spread and vertical opening of the fishing gear. As both the door spread and the vertical opening are highly variable, dependent on depth, current and local conditions of the bottom, the theoretical values are not valid for the calculation of the swept area. In most cases, only the door spread is measured, but it was demonstrated and agreed during the WKSABI, that it is possible to convert the door spread to wingspread and vice versa by using regression. The countries, which have uploaded erroneous data, have been requested to correct the data in DATRAS for the whole time-series. In addition, WKSABI demonstrated that several variables related to the swept area contained outliers. Most of those are corrected by now, but some are still left in the database and should be corrected.

During workshop it was additionally agreed, that the algorithms for the calculation of missing values could only be required from the countries with an adequate equipment measuring the

DoorSpread and/or WingSpread, i.e Denmark, Sweden and Germany. These three countries are obliged to send in the near future the adequate algorithms for these variables: DoorSpread, WingSpread and Distance, which are the most important for the swept-area calculation, to the DATRAS administration. The work done by the IBTSWG can help them with this as a reference http://www.ices.dk/marine-data/Documents/DATRAS/NSIBTS_swept_area_km2_algorithms.pdf

During the WKSABI meeting DATRAS administration agreed on developing a submission tool for these algorithms, in order to facilitate the submission process, the calculations and also to keep record of the different algorithms provided (they can change due to changes in boats, gears, ect).

5.9 Consider the intensity of sampling of maturity in quarter 3 and 4 surveys and possible update the survey manuals. (RCG Baltic request)

The RCG Baltic requested WGBIFS and stock assessors for the clarification if the maturity sampling of the stocks of Baltic cod, plaice and flounder during the surveys conducted in quarter 3 and 4 should be continued.

As a response to that request WGBIFS 2020 found that the collection of maturity data should be carried on as mandatory, although the maturity information from those surveys are not used in the assessments currently. WGBIFS agreed that the maturity data obtained from autumn surveys still has scientific value regardless of their inapplicability in the stock assessment process currently. In addition, the collection of maturity information does not require significant additional effort.

5.10 Consider updating the BITS manual so that two additional parameters, namely 1. „liver weight“ (in gram) and 2. „infestation level of the liver“ (categorical value), become a mandatory part of the routine work during BITS. (Thünen Institute of Baltic Sea Fisheries request)

WGBIFS agreed to the request formulated by the Thünen Institute of Baltic Sea Fisheries in Rostock (Germany) to systematically monitor and report on the level of infestation of Baltic cod livers during the BITS surveys. Data collection on infestation should follow the guidelines given in Annex 14 (Visual assignment of the level of infestation of Baltic cod livers) in the BITS manual. Information obtained during the surveys should also be uploaded to DATRAS database. Therefore, DATRAS should be modified accordingly to include additional mandatory fields (parameters) “Liver weight” (in grams) and “Infestation level of the liver” (stages 0, 1, 2, 3 and 4) in CA records. A corresponding recommendation was also made by WGBIFS to the ICES Data Centre.

6 Revisions to the work plan and justification

No changes in ToRs have been proposed.
Some revision to the work plan was made regarding the ToR g. Significant revision to the work plan was made regarding the ToR j.

6.1 ToR g) Update on progress in development of the StoX software and implementation of it for the calculation of WGBIFS acoustic stock estimates, based on the IBAS methodology and data from ICES acoustic-trawl survey database

Initially it was planned that WGBIFS would reach at the end of the 3-year term period an agreement about the possibility to implement StoX as a new standard tool for the calculation of WGBIFS acoustic stock estimates. The following steps were taken to reach that goal:

1) cooperation with StoX developers to enable StoX to perform the fish abundance calculations following the IBAS standard methodology,
2) testing and fine tuning of the StoX project developed for the WGBIFS,
3) realization of the comparison exercises to validate whether the StoX software provides similar results as the current IBAS calculation method.

Step one was fulfilled in 2018 and step two in 2019. Before the WGBIFS meeting, in March 2020, there were 2 StoX calculations done based on the data that were available in the ICES database for the acoustic trawl surveys:

a) estimates of herring and sprat abundance by rectangles based on the BIAS 2019 data (German biotic data were missing in the ICES database and were therefore not included in this exercise) made by E. Sepp,
b) estimates of herring abundance in SD 30 in 2013-2019 made by J. Lilja.

Comparison of these StoX estimates and standard BIAS estimates revealed that in general the difference was rather small. Only in certain rectangles the differences were observed to be larger. The members of WGBIFS were encouraged before the WGBIFS 2020 meeting by the correspondence to evaluate their own BIAS calculations and the StoX estimates to find out the possible reasons behind these differences. Unfortunately, no such exercises were done by the meeting time in March. Therefore, an additional 3-day long meeting was agreed to be organized at the beginning of December 2020 to make some progress in this question. Directly after the WGBIFS 2020 meeting in March it revealed that the SD3031 herring benchmark workshop (WKCLUB) outcomes became invalid, because the wrong acoustic index figures were used in the assessment models. A new benchmark for the Gulf of Bothnia herring assessment was planned for the beginning of the 2021 and WGBIFS got the following request: "WGBGFAS recommends WGBIFS to thoroughly scrutinize the acoustic survey index calculation for herring in SDs 30-31. Ultimately, the relevant survey data must be uploaded into the ICES database for acoustic trawl surveys and the StoX software should be applied for the calculation of estimates for a transparent reproducible pathway in TAF". WGBFAS was forced to drop some of their recommendations (including this one) in the final version of their report, because the maximum limit of recommendations was exceeded, but ACOM still expected from WGBIFS to address that recommendation during the planned December meeting.

A web meeting was held 1–3 December 2020 to calculate the herring abundance indices in SD 30 using the StoX software and to perform a comparison exercise between the StoX and traditional BIAS calculation methods. Before the meeting were the data for the years 2007-2019 available for that purpose. Comparison revealed that in general the differences in total number of herring between the two methods were below 4%, but in some rectangles in certain years the differences were observed to be up to 35%. The reason of these differences appeared to be the small methodological differences between the StoX and the standard BIAS calculation method (the StoX project, developed for the WGBIFS, is for various reasons actually not following 100% the standard method used by WGBIFS). As some new mistakes were discovered in the standard BIAS calculations for some years, WGBIFS decided to recommend for the assessment purpose the herring abundance time-series calculated with StoX. WGBIFS decided additionally that analogical exercises must be done also with all other abundance index series before the transition to StoX can be done. Therefore, WGBIFS has added a special ToR for the next 3-year term for that purpose: g) Update on progress in development of the StoX software and implementation of it for the calculation of WGBIFS acoustic stock estimates. The StoX analyses showed that the current software version cannot handle in a good way a situation, where the data from different nations is combined in one calculation project and the different fish species have been measured using different accuracy (in WGBIFS coordinated surveys different species are measured by 1 mm, half cm or 1 cm accuracy). If this situation occurs in the data, the length measurements must be converted to the same accuracy level (the lowest common level), but unfortunately it will affect in this case all fish species. Fortunately, this issue did not affect the results of SD 30 analyses, because only one country is performing the survey there. But before the analogical comparison exercise between the StoX and traditional BIAS calculation methods can be done with Baltic sprat and Central Baltic herring abundance index series, this issue in the StoX software must be solved. The Chair of WGBIFS contacted the StoX developers during the WGBIFS 2020 meeting in December in this matter and received the information that the next version of the StoX software, which will be released in spring 2021, will solve that problem.

6.2 ToR j) Agree a standard pelagic trawl gear used in BIAS and BASS surveys.

Initially it was planned that WGBIFS would reach at the end of the 3-year term period an agreement about a standard pelagic fishing gear which will be used in the BIAS and BASS surveys and would eliminate the possible uncertainties, which result from different type of fishing gears that are used so far for fish control-catches. WGBIFS asked help from WGFTFB to address that ToR, who promised in 2018 to come up with a proposal (e.g. by modifying for example an existing pelagic mackerel survey gear to our needs), but then after the change of the Chairs, it revealed that they changed their mind and decided in 2020 that WGFTFB is no longer planning to assist WGBIFS in gear standardization process. Chairs of WGFTFB recommended instead WGBIFS to launch a new EU project for the development of a new standard survey gear (as it was for example done for the TV3 type of demersal trawl for BITS surveys) and advised to search partners for cooperation within other ICES survey groups, who might have similar needs.
During the WGBIFS 2020 meeting in March this new information was discussed and the Group found that there is a lack of knowledge within our WG for launching such project alone. At the same time majority of the WG members still supported the continued search for possible solutions in this topic. Therefore, it was decided to take contact with WGIPS in this question. After the meeting the Chair of WGBIFS contacted the Chairs of WGIPS (Bram Couperus and Michael O'Malley) for possible cooperation in this matter and got a response that WGIPS will raise this question at their meeting in January 2021. Then they will see, whether there are members in their group that would be interested in this issue and are will-ing to take it forward with the potential of getting involved in a more formal project, and will get back to WGBIFS.
Therefore, the Group was not able to reach any final decisions during the 2018-2020 in this question about the standard pelagic fishing gear to be used in the BIAS and BASS surveys and decided to continue addressing that ToR during the next 3-year term period.

7 Next meeting and election of a new Chair

There were two proposals for the venue of the next WGBIFS meeting if there will be no travel restrictions in March 2021: Cadiz, Spain and Kaliningrad, Russia. Majority of WGBIFS members supported the idea to organize the next meeting at the University of Cadiz in the period of 22–26 March 2021.

The group elected Elor Sepp, Estonia and Olavi Kaljuste, Sweden to be the new Chairs of WGBIFS.

Annex 1: List of participants

Name	Institute	Country (of institute)	Email
Amosova Viktoriia	Atlantic Research Institute of Fisheries and Oceanography (AtlantNIRO)	Russia	amosova@atlantniro.ru
Degel Henrik[1]	Danish Technical University, National Institute of Aquatic Resources, Section for Fisheries Advice	Denmark	hd@aqua.dtu.dk
Fedotova Elena[1]	Marine Research Institute, Klaipeda University	Lithuania	jelena.fedotova@apc.ku.lt
Fernandez Ruth[2]	International Council for the Exploration of the Sea		ruth.fernandez@ices.dk
Stefanie Haase[2]	Thünen-Institute of Baltic Sea Fisheries	Germany	stefanie.haase@thuenen.de
Kaljuste Olavi (chair)	Swedish University of Agricultural Sciences, Department of Aquatic Resources, Institute of Coastal Research	Sweden	olavi.kaljuste@slu.se
Karpushevskaia Anastasiia[2]	Atlantic Research Institute of Fisheries and Oceanography (AtlantNIRO)	Russia	anastasia0006@mail.ru
Larson Niklas	Swedish University of Agricultural Sciences, Department of Aquatic Resources, Institute of Marine Research	Sweden	niklas.larson@slu.se
Lilja Juha	Natural Resources Institute Finland (Luke), Natural Resources and Bioproduction	Finland	juha.lilja@luke.fi
Lövgren Olof[1]	Swedish University of Agricultural Sciences, Department of Aquatic Resources, Institute of Marine Research	Sweden	olof.lovgren@slu.se
O'Malley Michael[2]	Marine Institute	Ireland	michael.omalley@marine.ie
Parner Hjalte	International Council for the Exploration of the Sea		hjalte@ices.dk
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Spegys Marijus[1]	Marine Research Institute, Klaipeda University	Lithuania	marijus.spegys@apc.ku.lt
Strods Guntars	Institute of Food Safety, Animal Health and Environment (BIOR), Fish Resources Research Department	Latvia	guntars.strods@bior.lv
Svenson Anders[1]	Swedish University of Agricultural Sciences, Department of Aquatic Resources, Institute of Marine Research	Sweden	anders.svenson@slu.se
Velasco Andrés[1]	Thünen-Institute of Baltic Sea Fisheries	Germany	andres.velasco@thuenen.de
Villamor Adriana[1]	International Council for the Exploration of the Sea		Adriana.villamor@ices.dk

[1] Participated only in the March meeting.

[2] Participated only in the December meeting.

Annex 2: Draft resolutions for the next meeting

The Baltic International Fish Survey Working Group (WGBIFS), chaired by Elor Sepp, Estonia and Olavi Kaljuste, Sweden, will work on ToRs and generate deliverables as listed in the Table below.

	Meeting dates	Venue	Reporting details	Comments (change in Chair, etc.)
Year 2021	22–26 March 2021	Cadiz, Spain/ By Correspond-ence/Webex	Interim report by 15 May 2021 to, SCICOM and ACOM	Elor Sepp and Olavi Kaljuste appointed as chairs
Year 2022			Interim report by 15 May 2022 to, SCICOM and ACOM	
Year 2023			Final report by 15 May 2023 to, SCICOM and ACOM	

ToR descriptors

ToR	Description	Background	Science plan codes	Duration	Expected deliverables
a	Combine and analyse the results of acoustic surveys and experiments	Acoustic surveys provide important fishery-independent stock estimates for Baltic herring and sprat stocks	3.1	Annually Year 1, 2 and 3	Updated acoustic tuning indices for WGBFAS
b	Update the BIAS, BASS and GRAHS hydroacoustic databases and ICES database for acoustic-trawl surveys	The aim of BIAS, BASS and GRAHS databases is to store the aggregated data that are used for the calculation of the survey indices. The aim of ICES database is to ensure that the standardized and quality-controlled scrutinized data from the acoustic-trawl surveys will be stored centrally in a safe way and enables easy access to the data, which will facilitate usage for many different analyses by a wider range of users.	3.1	Annually Year 1, 2 and 3	Updated databases with acoustic and biotic data for WGBIFS
c	Coordinate and plan acoustic surveys including any experiments to be conducted	Acoustic surveys provide important fishery-independent stock estimates for Baltic herring and sprat stocks	3.1	Annually Year 1, 2 and 3	Finalized planning for the surveys for WGBIFS
d	Review the results of BITS surveys and evaluate the characteristics of TVL and TVS standard gears used in BITS	Demersal trawl surveys provide important fishery-independent stock estimates for Baltic cod and flatfish stocks	3.1	Annually Year 1, 2 and 3	Updated BITS data in DATRAS database for ICES Data Centre and WGBFAS
e	Coordinate and plan demersal trawl surveys and experiments to be	Demersal trawl surveys provide important fishery-	3.1	Annually	Finalized planning for the surveys for WGBIFS, updated and corrected Tow Database

	conducted, and update and correct the Tow Database	independent stock estimates for Baltic cod and flatfish stocks		Year 1, 2 and 3	
f	Conduct the analyses related to the improvement of quality of acoustic indices and estimation of the uncertainty in the acoustic surveys coordinated by WGBIFS	Acoustic surveys provide important fishery-independent stock estimates for Baltic herring and sprat stocks	3.1, 3.2, 3.3	Year 1-3	Improved quality of acoustic indices with estimates of the uncertainty for WGBFAS
g	Update on progress in development of the StoX software and implementation of it for the calculation of WGBIFS acoustic stock estimates	StoX post-processing software produces fish abundance estimations in a transparent and reproducible way. Planned development of the StoX should allow implication of this software by WGBIFS using the data from ICES database. Comparisons will be performed to validate whether the StoX software provides us similar results as the current IBAS calculation method in order to allow WGBIFS to use it as a new standard tool for the calculation of annual acoustic survey estimates.	3.1, 3.2	Year 1-3	Improved quality, transparency and reproducibility of acoustic indices, improved pace of work on the level of national data compilation and verification
h	Coordinate the marine litter-sampling programme within the Baltic International Trawl Survey and registering the data in the ICES database.	Collected and registered information about the marine litter (mostly anthropogenic origin), occasionally appeared in the ground trawl fish control-catches, are additional source of data about present ecological status of marine seabed in investigated areas of the Baltic.	3.1	Annually Year 1, 2 and 3	Coordinated marine litter sampling programme within the Baltic International Trawl Survey (BITS).
i	Agree a standard pelagic trawl gear used in the acoustic surveys	Acoustic surveys provide important fishery-independent estimates for Baltic herring and sprat stocks size and possible uncertainties, which result from, e.g. different type of fishing gears applied for fish control-catches, should be eliminated.	3.1, 3.2	Year 1-3	Agreement on the standard pelagic fishing gear which will be used in the BIAS and BASS surveys
j	Review and update the manual for International Baltic Acoustic Surveys (IBAS; former SISP 8) and address methodological question raised at the last review of the SISP	Acoustic surveys provide important fishery-independent stock estimates for Baltic herring and sprat stocks	3.1, 3.2	Year 3	Updated IBAS manual for publication in TIMES
k	Review and update the manual for Baltic International Trawl Survey (BITS; former SISP 7) and address methodological question raised at the last review of the SISP	Demersal trawl surveys provide important fishery-independent stock estimates for Baltic cod and flatfish stocks	3.1, 3.2	Year 3	Updated BITS manual for publication in TIMES

l	Conduct analyses related to the uncertainties in the Gulf of Riga Acoustic Herring Survey (GRAHS) in order to improve the quality of the GRAHS and subsequent indices.	Until now, the preparation of the survey data for stock assessment is the responsibility of the Latvian and Estonian national laboratories. The methodology and consistency of results of this survey should be evaluated by the wider international scientific expertise available.	3.1, 3.2	Year 1-3	Improved quality, transparency and reproducibility of acoustic indices, updated databases with acoustic and biotic data from GRAHS
m	Evaluate if there are methodological and/or environmental reasons for different survey catchabilities in different ICES Subdivisions and what may be magnitude of these differences	Within the INSPIRE project assessments of herring and sprat stocks were conducted by former assessment units (AUs) instead of currently used central Baltic herring (CBH) and sprat in the entire Baltic. It was discovered in these assess-ments that catchabilities (q) (understood as ratio between the acoustically estimated and the model assessed stock sizes in given area/AU) of acoustic surveys estimated by applied assessment models differed by AUs, and usually q's were higher in northern than in southern waters. The question is if these differences may to some extent be caused by "environmental" differences, acoustic methodologies, area coverages etc. in the surveyed areas. This information is important to have if ICES is asked to develop/evaluate a spatial management plan for sprat and herring, as has been suggested for several years in the sprat advice.	3.1, 3.2	Year 1-3	Improved quality and transparency of acoustic indices

	Summary of the Work Plan
Year 1	Compilation the survey results from 2020 and the first quarter of 2021 and reporting to WGBFAS. Coordination and planning the schedule for surveys in 2021 and first half of 2022. Review the development and validation progress of the StoX software. Conduct the analyses related to the improvement of quality of acoustic indices and estimation of the uncertainty in the acoustic surveys coordinated by WGBIFS. Uploading the data from the Gulf of Riga Acoustic Herring Survey into the ICES database for acoustic and trawl surveys and screening of the data. Conduct analyses related to the evaluation of the different survey catchabilities. Coordinate the marine litter-sampling programme in the BITS surveys and registering the data in the ICES database. Cooperate with WGIPS to find, whether there can be a joint approach for designing a standard pelagic fishing gear used in the acoustic surveys.
Year 2	Compilation the survey results from 2021 and first quarter of 2022 and reporting to WGBFAS. Coordination and planning the schedule for surveys in 2022 and first half of 2023. Review the development and validation progress of the StoX software. Conduct the analyses related to the improvement of quality of acoustic indices and estimation of the uncertainty in the acoustic surveys coordinated by WGBIFS. Conduct analyses related to the uncertainties in the Gulf of Riga Acoustic Herring Survey. Conduct analyses related to the evaluation of the different survey catchabilities. Coordinate the marine litter-sampling programme in the BITS surveys and registering the data in the ICES database. Joint approach with WGIPS, if possible, to designing the standard pelagic fishing gear used in acoustic surveys.
Year 3	Compilation the survey results from 2022 and first quarter of 2023 and reporting to WGBFAS. Coordination and planning the schedule for surveys 2023 and first half of 2024. Implementation of the StoX software linked with the ICES acoustic-trawl survey database for the calculation of stock estimates for Baltic herring and sprat. Present the results of the analyses related to the improvement of quality of acoustic indices and estimation of the uncertainty in the acoustic surveys coordinated by WGBIFS. Present the quality checked, transparent and reproducible acoustic indices from the Gulf of Riga Acoustic Herring Survey. Adress results of the analyses related to the evaluation of the different

	survey catchabilities to WGBFAS. Coordinate the marine litter-sampling programme in the BITS surveys and registering the data in the ICES database. Reviewing and updating the BITS and IBAS survey manuals, and publication in TIMES. Final decision concerning the possible implementation of the standard pelagic fishing gear for control-catches in acoustic surveys.

Supporting information	
Priority	The current activities of this Group will lead ICES into issues related to the ecosystem effects of fisheries, especially with regard to the application of the Precautionary Approach. Consequently, these activities are considered to have a very high priority.
Resource requirements	The research programmes which provide the main input to this group are already underway, and resources are already committed. The additional resource required to undertake additional activities in the framework of this group is negligible.
Participants	The Group is normally attended by about 25 members and guests.
Secretariat facilities	None.
Financial	No financial implications.
Linkages to ACOM and groups under ACOM	The survey data are prime inputs to the assessments of Baltic herring, sprat, cod and flatfish stocks carried out by WGBFAS. Linked to ACOM through the quality of stock assessments and management advice.
Linkages to other committees or groups	There is a very close working relationship with WGBFAS. It is also relevant to the HAPSISG, WGFAST and the working group on Marine litter (WGML).
Linkages to other organizations	No direct linkage to other organizations.

Annex 3: Agenda of WGBIFS 2020

Introduction

1. Opening of the meeting
- Welcome and introduction
- Households remarks
2. Adoption of the agenda and organization of the meeting
- Discussion and adoption of the agenda
- Allocation of tasks between participants
- Presentation of time schedule

Acoustic surveys and data

3. Combine and analyse the results of spring and autumn 2019 acoustic surveys and experiments and report to WGBFAS. (ToR a)
• Status of BIAS and BASS standard survey reports.
4. Update the BIAS and BASS hydroacoustic databases and ICES database for acoustic-trawl surveys. (ToR b)
5. Plan and decide on acoustic surveys and experiments to be conducted in autumn 2020 and spring 2021. (ToR c)
6. Analyses related to the improvement of quality of acoustic indices and estimation of the uncertainty in the BIAS and BASS surveys. (ToR f)
7. Review the progress in development of the StoX software and implementation of it for the calculation of WGBIFS acoustic stock estimates, based on the IBAS methodology and data from ICES acoustic-trawl survey database. (ToR g)
8. An attempt to make standardization of the pelagic fishing gear used in BIAS and BASS surveys. (ToR j)
9. Review and update the International Baltic Acoustic Surveys (IBAS) manual and address methodological question raised at the last review of the SISP. (ToR k)

Bottom trawl surveys and data

10. Discuss the results from BITS surveys performed in autumn 2019 and spring 2020 and evaluate the characteristics of TVL and TVS standard gears used in BITS. (ToR d)
• Status of BITS standard and extended survey reports.
11. Plan and decide on demersal trawl surveys and experiments to be conducted in autumn 2020 and spring 2021, and update and correct the Tow Database. (ToR e)
12. Define methods for the appropriate processing of the survey data and output products from the BITS survey to deliver input-data for calculation of the Baltic LFI and MML indicators. (ToR h)
13. Coordinate the marine litter-sampling programme within the Baltic International Trawl Survey and registering the data in the ICES database. (ToR i)
14. Review and update the Baltic International Trawl Survey (BITS) manual and address methodological question raised at the last review of the SISP. (ToR l)

Inquiries besides of the fixed ToRs

15. **Recommendations from other Expert Groups**
15.1. Investigate whether the sprat and herring length distribution data from the BITS survey is representative for these stocks and can be used as input in the assessment. (Rec. by WGBFAS)

15.2. Analyse the results of Gulf of Riga acoustic herring survey in order to provide fishery-independent stock estimates of Gulf of Riga herring and evaluate the usage of that information for stock assessment purposes. (Rec. by WGBFAS)
15.3. Conduct analyses related to the uncertainties in the Gulf of Riga acoustic herring survey in order to improve the quality of the GRAHS and subsequent indices. (Rec. by WGBFAS)
15.4. Consider the possibilities of organizing and maintaining a data from the Gulf of Riga acoustic herring survey and incorporate this information in the ICES Acoustic database. (Rec. by WGBFAS)
15.5. Due to the high uncertainty of abundance estimates of younger ages from the GRAHS the usefulness of extending the BIAS survey into the Gulf of Riga (SD 28.1) should be considered. (Rec. by WGBFAS)
15.6. Evaluate if there are methodological and/or environmental reasons for different survey catchabilities (understood as ratio of acoustic estimate of stock size and true stock size in given area/AUs) in former assessment units (subdivisions) and what may be magnitude of these differences. (Rec. by WGBFAS)
15.7. Support the establishment of a Governance Group for Acoustic ICES DB. (Rec. by WGIPS)
16. **Requests from other organizations**
16.1. Provide ICES Data Centre with some reasonable ranges for the most important variables involved in the calculation of swept area. (Req. by ICES Data Centre)
16.2. Consider the intensity of sampling of maturity in quarter 3 and 4 surveys and possible update the survey manuals. (Req. by RCG Baltic)
16.3. Consider updating the BITS manual so that two additional parameters, namely 1. „liver weight“ (in gram) and 2. „infestation level of the liver“ (categorical value), become a mandatory part of the routine work during BITS. (Req. by Thünen Institute of Baltic Sea Fisheries)

Final issues

17. Selection of the new chair
18. Selection of the venue for the next meeting

Annex 4: Recommendations

Recommendation	Responsible	Deadline	Recipients	Section from report this relates to
WGBIFS recommends that, the updated and corrected BIAS index series can be used in the assessment of the herring (CBH) and sprat stocks in the Baltic Sea with the restriction that the years 1993, 1995 and 1997 are excluded from the index series.	WGBIFS	Before WGBFAS 2020 meeting.	WGBFAS	4.1.1.4.1 and 4.1.1.4.2
WGBIFS recommends that, the BIAS index series calculated by the StoX can be used in assessment of the Gulf of Bothnia herring stock size with the restriction that the age-groups 0 and 1 are excluded from the dataset.	WGBIFS	Before WKCLUB and WGBFAS 2021 meetings.	WGBFAS, WKCLUB	4.1.1.4.3
WGBIFS recommends that, the BASS index series can be used in the assessment of sprat stock in the Baltic Sea with restriction that the year 2016 is excluded from the dataset.	WGBIFS	Before WGBFAS 2020 meeting.	WGBFAS	4.1.2.2.1
WGBIFS recommends that the data obtained and uploaded to DATRAS for both the 4th quarter 2019 and the 1st quarter 2020 BITS are used for calculating survey indices for the relevant cod and flatfish stocks.	WGBIFS	Before WGBFAS 2020 meeting.	WGBFAS	4.4.1 and 4.4.2
WGBIFS recommends that “liver weight” and “infection levels of liver parasites” are included in the DATRAS CA records.	WGBIFS	Before December 2020	WGDG	5.10
WGBIFS recommends that ICES Data Centre will provide WGBIFS with the indices for the assessment of cod and flatfish stocks, which are based on the data from BITS surveys, immediately after their calculation in DATRAS. This would allow WGBIFS to perform a verification of the indices to detect potential irregularities before we are confronted with the demand of an explanation and justification of the indices for the WGBFAS.	WGBIFS	Before March 2021	ICES Data Centre	NA
WGBIFS recommends that SCICOM and ACOM will do every effort to help restore Russian participation in the surveys, as this information is important for stock assessment of Baltic Sea fish stocks.	WGBIFS	Before March 2021	SCICOM and ACOM	4.3, 4.5 and Annex 5

Annex 5: Action List

1. The feedback of the recent catch-stations realized in the framework of BITS surveys should be submitted to Henrik Degel (Denmark; e-mail: hd@aqua.dtu.dk), using the proposed standard format (Annex ToR e, Ch. 5.5.2.2; WGBIFS 2016 Report) not later than 20 December (autumn survey) and immediately after winter-spring survey. The above-mentioned Danish delegate is a coordinator of the reprogrammed Tow-Database, responsible for storage old control-hauls location with remarks concern realization - and for planning new catch-stations distribution for the next BITS surveys. All problems with realization of designated single control-hauls or part (whole) of survey should be promptly transferred (by e-mail or mobile phone) to H. Degel with c/c to the WGBIFS chair. The updated version of the trawl database will be made available after submission the full set of data from the current BITS surveys by all countries.

2. Olavi Kaljuste (Sweden) and Beata Schmidt (Poland) were assigned as coordinators of acoustic-trawl (IBAS) surveys, responsible among-others for controlling that the acoustic surveys results are uploaded in the right format. Beata Schmidt (Poland; e-mail: bschmidt@mir.gdynia.pl) was assigned as the coordinator of BIAS and BASS national databases aggregated data uploading and compilation to international level, moreover she is responsible also for all kind of input data preparation, before and during the ongoing WGBIFS meeting. The recently collected aggregated acoustic-trawl surveys (BASS, BIAS) data (in already agreed Excel format) should be uploaded to the latest WGBIFS SharePoint site at least one month before beginning of the annual WGBIFS meeting. At the same time, the latest disaggregated acoustic and biotic data from national BASS and BIAS surveys should also be uploaded 15 days before beginning of the annual WGBIFS meeting to the new database for acoustic trawl surveys at the ICES Data Centre (http://ices.dk/marine-data/data-portals/Pages/acoustic.aspx), using the ICES acoustic data format.

3. Directly, after each BITS survey finalization, national submitters of data linked with monitoring of the marine litter from seabed should be uploaded to the DATRAS database (the ICES Data Centre). The upload data format is described in the manual accessible at the ICES web page: http://www.ices.dk/marine-data/data-portals/Pages/DATRAS-Docs.aspx.

4. WGBIFS suggested performing in every year, as obligatory - the technical checking of standard parameters, i.e. measurements of the TV-3 ground trawl elements. The measurements results should be reported to next WGBIFS meeting, using the agreed format of protocols.

5. It’s important for precise values of the LFI and MML indicators to inspect that both doors and wingspread indices are included in DATRAS uploads. This should be analysed by all WGBIFS members involved in the BITS surveys accomplishment. This information will facilitate the ability calculate the swept area, one of the much needed parameter in calculation of the a.-m. indicators. Therefore, WGBIFS suggest that all vessels involved in the BITS surveys realization should to have possibly soon suitable equipment (sensors on the trawl wings) for measuring horizontal and vertical trawl opening during fishing.

6. It was suggested to make regular consistency analyses to the age matrixes of the indices produced by the regular research surveys, for the use of WGBFAS.

7. WGBIFS recommends national laboratories to collect, whenever possible, the data requested by WKQUAD:

7.1 Collect data during both calm weather and in inclement weather. Use the opportunity of inclement weather to collect data along a transect in opposite headings (i.e. with and against the seas).

The objectives of collecting data along a transect in inclement weather are to:

a) characterize the vessel motion,

b) characterize the seabed backscatter, and

c) characterize the backscatter by your target species.

One can characterize the vessel motion in a fairly short time, but to characterize the seabed and fish backscatter with enough data to compare to the same stretch of transect in good weather will take longer - i.e. in good weather you can cover 10 nautical mile in an hour, but in inclement weather one may only be able to cover 2-3 nautical mile The safety of the vessel and comfort of crew/scientist should also be taken into consideration.

It is recommended that the data in inclement weather are collected at least during one hour in one heading of the transect. If there is a need to steam longer along a transect, then one should do that.

7.2 Compile seabed substratum maps and data for the survey area. These may be useful for decoupling substrate effects from noise or attenuation effects on data quality when the seabed backscatter is used as a diagnostic.

Any quality information is useful. Even publicly available seabed classification data are useful.

7.3 Compile information on transducer location and vessel trim, and collect vessel motion (pitch, roll, heave) data at a sampling rate of at least twice the frequency of the vessel motion (<1/2 the period), i.e. Nyquist sampling rate. A typical rate is 3 Hz.

7.4 Collect meteorological data, e.g. windspeed and direction, swell, sea state, wave height during the surveys.

7.5 Collect passive data during inclement weather. Transient and impulse noise will appear in passive data. Compare noise values between good and bad data.

The objective is to measure and monitor the background, transient, and impulse noise as weather conditions deteriorate. Ideally this should be done at survey speed, but if that is not possible, then slower speeds can be informative. If the survey protocols specify a minimum speed, then speeds below that are not as useful.

It is recommended that the passive data in inclement weather are collected at least during one hour per one data sample. If there is a need to steam longer along a transect, then one should do that.

8. WGBIFS recommends national laboratories to collect of gonad samples (images of gonads and gonads for histology) during regular sampling; the data requested by WGBIOP.

That's potential importance of the collection gonad samples (images of gonads and gonads for histology) and the benefits the other availability of such a library of samples would have for maturity exchanges and workshops. This will be followed up with an email with a protocol with instructions on how to collect the samples.

9. WGBIFS recommends that all available data from the GRAHS surveys will be uploaded to the ICES database for acoustic trawl surveys before the next WGBIFS meeting in March 2021.

10. WGBIFS recommends that if possible, Estonia and Latvia should consider extending the BIAS survey into the Gulf of Riga due to the high uncertainty of abundance estimates of younger ages from the GRAHS.

11. WGBIFS recommends that all countries that have provided BIAS and BASS data into the Access databases will check the herring and sprat mean weight data quality and provide the missing and corrected values to Beata Schmidt.

12. Beata Schmidt will create before the next WGBIFS meeting in March 2021 a new Access database for the SD 30 herring, where the age span is up to 15+ group. Finland and Sweden will provide her with the BIAS data for SD 30 herring.

13. WGBIFS recommends that cod liver weight" and "infection levels of liver parasites" are introduced as a mandatory task during both the 1st quarter and the 4th quarter BITS.

14. Chair of the WGBIFS will discuss with SCICOM and ACOM chairs the importance of restoring Russian participation in the surveys, as this information is important for stock assessment of Baltic Sea fish stocks.

Annex 6: Standard and Cruise Reports of BITS surveys at the WGBIFS 2020 annual meeting

Note: Authors are fully responsible for quality of the prepared text and all kind of presented data

List of standard reports:

- 1. BITS 2019 Quarter 4 Standard Report of Lithuania;
- 2. BITS 2019 Quarter 4 Standard Report of Germany;
- 3. BITS 2019 Quarter 4 Standard Report of Estonia;
- 4. BITS 2019 Quarter 4 Standard Report of Poland;
- 5. BITS 2019 Quarter 4 Standard Report of Latvia;
- 6. BITS 2019 Quarter 4 Standard Report of Denmark
- 7. BITS 2019 Quarter 4 Standard Report of Sweden;
- 8. BITS 2020 Quarter 1 Standard Report of Germany;
- 9. BITS 2020 Quarter 1 Standard Report of Poland;
- 10. BITS 2020 Quarter 1 Standard Report of Latvia;
- 11. BITS 2020 Quarter 1 Standard Report of Lithuania;
- 12. BITS 2020 Quarter 1 Standard Report of Denmark;
- 13. BITS 2020 Quarter 1 Standard Report of Sweden.

II List of cruise reports:

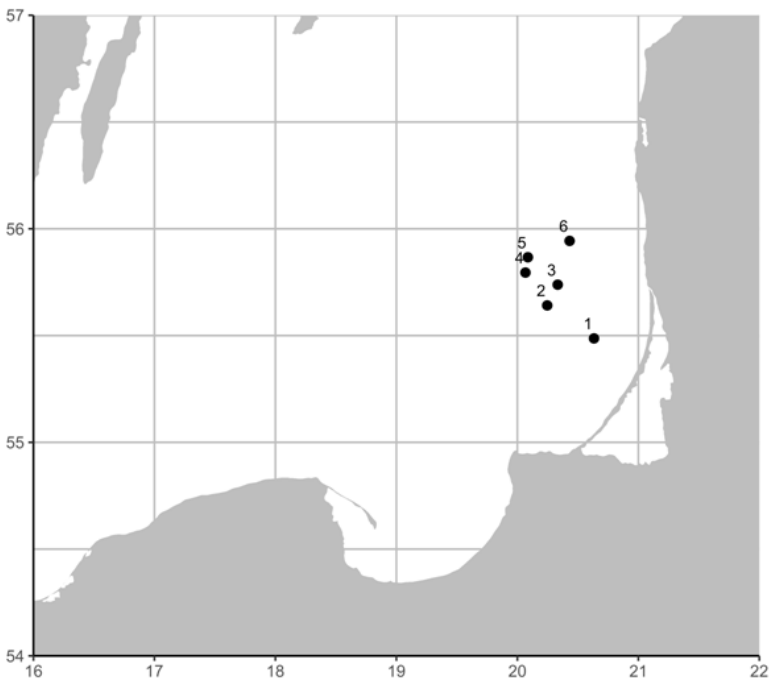
- 1. BITS 2019 Quarter 4 Cruise Report of Denmark;
- 2. BITS 2019 Quarter 4 Cruise Report of Germany;
- 3. BITS 2019 Quarter 4 Cruise Report of Latvia;
- 4. BITS 2019 Quarter 4 Cruise Report of Lithuania;
- 5. BITS 2019 Quarter 4 Cruise Report of Poland;
- 6. BITS 2019 Quarter 4 Cruise Report of Sweden;
- 7. BITS 2020 Quarter 1 Cruise Report of Denmark;
- 8. BITS 2020 Quarter 1 Cruise Report of Germany;
- 9. BITS 2019 Quarter 1 Cruise Report of Latvia;
- 10. BITS 2020 Quarter 1 Cruise Report of Lithuania;
- 11. BITS 2020 Quarter 1 Cruise Report of Poland;
- 12. BITS 2020 Quarter 1 Cruise Report of Sweden.

NATION:	**LITHUANIA**	**VESSEL:**	**LLB-1113**
Survey:	BITS2019Q4	Dates:	21th – 22thNovember 2019

Cruise	
Gear details:	The small (520#) standard TV3 trawl was used.
Notes from survey (e.g. problems, additional work etc.):	Survey made with Lithuania commercial fishery vessel LBB-1113. Total 6 fishing hauls was performed. First three hauls was made November 21 and last three November 22. No hydrological measurements were performed due to weather conditions.
Additional comments:	

ICES SUB-DIVISIONS	GEAR (TVL, TVS)	DEPTH STRATA (2–6)	NUMBER OF HAULS PLANED	NUMBER OF VALID HAULS REALIZED USING "STANDARD" GROUND GEAR	NUMBER OF VALID HAULS REALIZED USING ROCK HOPPERS	NUMBER OF ASSUMED ZERO-CATCH HAULS	NUMBER OF REPLACEMENT HAULS	NUMBER OF INVALID HAULS	% STATIONS FISHED
26	TVS	2	1	1	-	-	-	-	100
26	TVS	3	1	1	-	-	-	-	100
26	TVS	4	4	4	-	-	-	-	100

NUMBER OF BIOLOGICAL SAMPLES (MATURITY AND AGE MATERIAL, *MATURITY ONLY):		
SPECIES	**LENGTH**	**AGE**
Alosa fallax	20	
Clupea harengus	1728	
Gadus morhua	754	286
Hyperoplus lanceolatus	1	
Myoxocephalus scorpius	30	
Osmerus eperlanus	30	
Platichthys flesus	1076	248
Pleuronectes platessa	2	2
Psetta maxima	6	6
Sprattus sprattus	84	

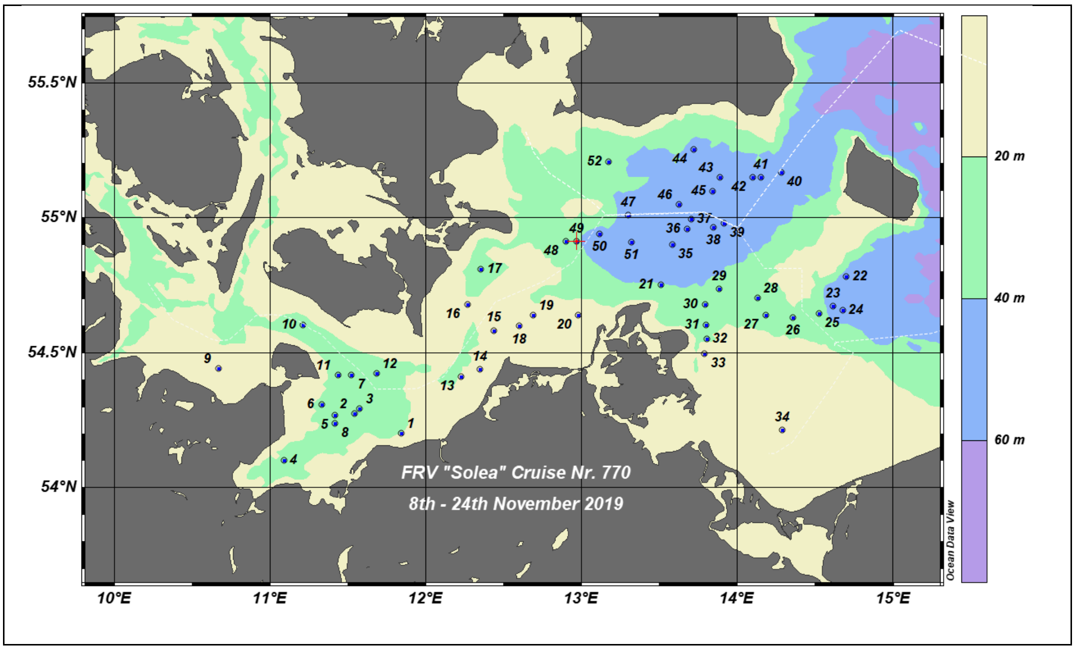


NATION:	GERMANY	VESSEL:	FRV "SOLEA"
Survey:	BITS 2019, quarter 4	Dates:	8th – 24th November 2019

Cruise	
Gear details:	The small (520#) standard TV3 trawl was used. All Tow Database stations were fished without rock-hoppers. The construction of the trawl follows the specifications in the manual.
Notes from survey (e.g. problems, additional work etc.):	A total of 52 fishing hauls and 52 hydrographical stations were performed. 5 stations in Strata 2 in Swedish territorial waters were not allowed to carry out. Bad weather caused three days downtime.
Additional comments:	

ICES SUB-DIVISIONS	GEAR (TVL, TVS)	DEPTH STRATA (1–3)	NUMBER OF HAULS PLANED	NUMBER OF VALID HAULS REALIZED USING "STANDARD" GROUND GEAR	NUMBER OF VALID HAULS REALIZED USING ROCK HOPPERS	NUMBER OF ASSUMED ZERO-CATCH HAULS	NUMBER OF REPLACE-MENT HAULS	NUMBER OF INVALID HAULS	% STATIONS FISHED
22	TVS	1	1	1	-		-	-	100
22	TVS	2	11	11	-		-	-	100
24	TVS	1	10	9	-		-	-	90
24	TVS	2	19	13	-		-	-	68
24	TVS	3	18	18	-		-	-	100

NUMBER OF BIOLOGICAL SAMPLES (MATURITY AND AGE MATERIAL, *MATURITY ONLY):		
SPECIES	LENGTH	AGE
Gadus morhua	4684	756
Platichthys flesus	4058	549
Pleuronectes platessa	5096	618
Limanda limanda	2612	556
Psetta maxima	214	216
Scophthalmus rhombus	27	27
Clupea harengus	5198	-
Sprattus sprattus	3650	-

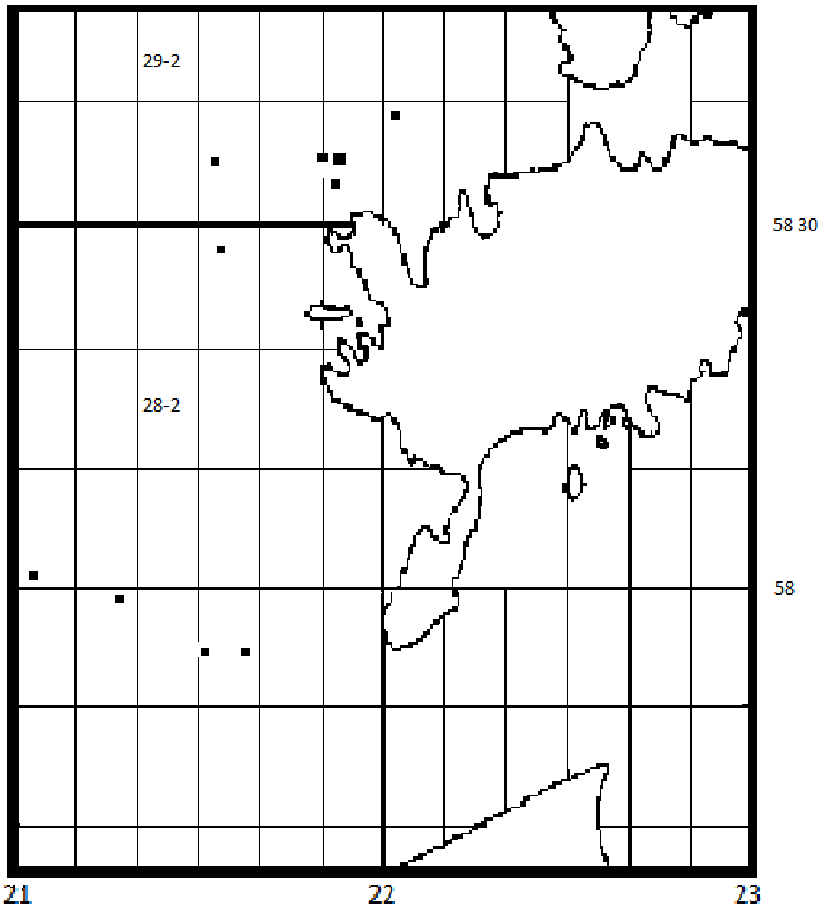


NATION:	ESTONIA	VESSEL:	CEV
Survey:	BITS18IVQRT	Dates:	20th – 22th November 2019

Cruise	
Gear details:	The small (530) standard TV3 trawl was used. The construction of the trawl follows the specifications in the manual.
Notes from survey (e.g. problems, additional work etc.):	The survey was carried out as planned. Survey started late evening of 20 November 2019 from the Port of Haapsalu, steaming to the Sub-division 28-2. The weather conditions wereinitially good: moderate NE-E wind. At the time of commencing hauls, wind speed increased but still, it was possible to carry out all 5 assigned for Estonia trawl hauls as planned. During the survey it was discovered that haul 28061 was assignedtwice so it was decided to replace one with additional haul 28xx. Since the weather forecast for next days was bad, it was decided to continue with the rest of survey in the Sub-division 29 immediately. So, after accomplishing the planned work in Sub-division 28-2, the vessel steamed to Sub-division 29, where all planned additional 5 hauls were performed. The survey was finished in the morning of hours of 22 November 2019 in the Port of Haapsalu. No technical problems were observed during the survey this year. All catches were analysed at the Pärnufield station of the Estonian Marine Institute.

ICES Sub-Divisions	Gear (TVL,TVS)	Depth strata (1–6)	Number of hauls planed	Number of valid hauls realized using "Standard" ground gear	Number of valid hauls realized using Rock hoppers	Number of assumed zero-catch hauls	Number of replacement hauls	Number of invalid hauls	% stations fished
28	TVS	40-59m	1	1	0	0	0	0	100
28	TVS	60-79m	4	4	0	0	0	0	100
28	TVS	80-99m	0	0	0	0	0	0	Na
29	TVS	20-39m	1	1	0	0	0	0	100
29	TVS	40-59m	2	2	0	0	0	0	100
29	TVS	60-79m	1	1	0	0	0	0	100
29	TVS	>80m	1	1	0	0	0	0	100

Number of biological samples (maturity and age material, *maturity only):		
Species	Age	Length
Gadus morhua	14	14
Sprattus sprattus	0	120
Clupea harengus	0	113
Platichthys flesus	408	1156



Approximate positions of realized hauls during Estonian BITS survey in 4 QRT 2019.
Estonian BITS IV Quarter 2019: Overview of catches.

BITS 2019 4. Qrt		Catch composition, kg per 30 min haul									
Haul no.	ID 28029	ID 28030	ID 28061	ID 28192	ID 28xx	ID 2901	ID 2902	ID 2903	ID 2904	ID 2905	
Sd	28_2	28_2	28_2	28_2	28_2	29	29	29	29	29	Total
Depth, m											
Date	21.11.2019	21.11.2019	21.11.2019	21.11.2019	21.11.2019	21.11.2019	21.11.2019	21.11.2019	21.11.2019	21.11.2019	
Catch, kg											
Platichthys flesus	19,859	18,3035	0,4505	7,2415	3,373	13,7155	0,208	16,136	16,85	33,6941	**129,831**
Gadus morhua	1,3569	0,008		1,359		0,0075					**2,731**
Scophthalmus maximus		0,1085								0,0735	**0,182**
Clupea harengus	0,1071	0,1414	5,425	11,85	0,0964	1,436	0,838	0,228	0,717	0,324	**21,163**
Sprattus sprattus	0,1455	0,0556	2,739		0,0277	0,1445	2,428	0,091	0,0894	0,296	**6,017**
Osmerus eperlanus	1,821	0,734			0,0479	0,422	0,0272	0,3186	1,201	5,032	**9,604**
Myxocephalys quadricornis											**0,000**
Myoxocephalus scorpius		0,2267				0,0216		0,0494	0,0233	0,0538	**0,375**
Cyclopterus lumpus											**0,000**
Zoarces viviparus	0,1553	0,1562				0,2392			0,0652	0,7515	**1,367**
Gobius sp.	0,0454	0,382			0,0004	0,492		0,141	10,187	4,96	**16,208**
Pungitius pungitius											**0,000**
Acerina cernua											**0,000**
Gasterosteus aculeatus	0,0017					0,0036		0,0099	0,0021	0,0031	**0,020**
Neogobius melanostomus	0,1001	0,0323				0,054		0,0474	0,1735	0,5337	**0,941**
Triglopsis quadricornis						0,3183		0,0471		0,6553	**1,021**
Pungitius pungitius									0,0009		**0,001**
Lumpenus lampretaeformis									0,0276	0,0213	**0,049**
Gymnocephalus cernuus										0,253	**0,253**
	23,6	**20,1**	**8,6**	**20,5**	**3,5**	**16,9**	**3,5**	**17,1**	**29,3**	**46,7**	**189,8**

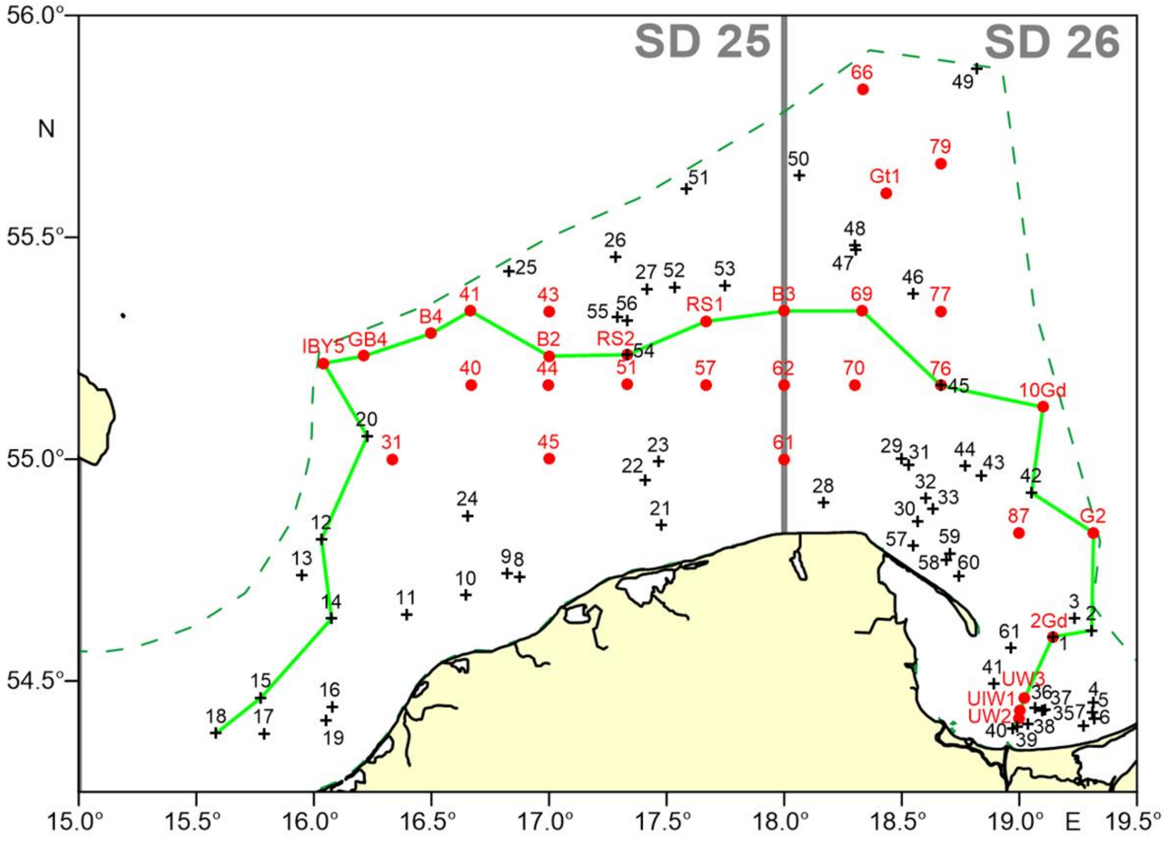
NATION:	**POLAND**	**VESSEL:**	**RV "BALTICA"**
Survey:	BITS-Q4/2019	Dates:	11th – 29th November 2019

Cruise	No. 23/2019/MIR
Gear details:	The standard rigging cod ground trawl type TV-3#930, with 10-mm mesh bar length in the codend was applied for fish control-catches realisation. The construction of the trawl follows the specifications in the manual.
Notes from survey (e.g. problems, additional work etc.):	According to the WGBIFS recent (March 2019) recommendations, the vessel "Baltica" was designated to cover in November/December 2019 survey, the Polish part of ICES Sub-divisions 25 and 26 with 26 and 35, respectively randomly selected bottom fishing hauls. The R/V Baltica realized 61 of the 61 planned hauls for this survey. Realized haul No 26280 is invalid due to by-catch of 500 kg of wooden parts completely damaging fish in the catch. That haul was not repeated in another place. Due to oxygen level on the bottom below 0.5 ml/l, haul No 26104 was not realized. The haul was classified as "no oxygen". In total 60 fish catch-stations can be accepted as representative. Due to stormy weather, rocky bottom and large fish concentrations observed in echosounder – 1, 8, 4 and 2 hauls was shortened to 25, 20, 15 and 10 min, respectively. Every control-haul was preceded by the seawater temperature, salinity and oxygen content measurements, made continuously from the sea-surface to a bottom. Overall, 61 fish catch-stations starting positions and 30 standard hydrographic stations were controlled by the SeaBird SBE 911 CTD-probe combined with the rosette sampler (the bathometer rosette). Oxygen content was determined by the standard Winkler's method.
Additional comments:	

ICES SUB-DIVISIONS	**GEAR (TVL, TVS)**	**DEPTH STRATA (2–6)**	**NUMBER OF HAULS PLANED**	**NUMBER OF VALID HAULS REALIZED USING "STANDARD" GROUND GEAR**	**NUMBER OF VALID HAULS REALIZED USING ROCK HOPPERS**	**NUMBER OF ASSUMED ZERO-CATCH HAULS**	**NUMBER OF REPLACE-MENT HAULS**	**NUMBER OF INVALID HAULS**	**% STATIONS FISHED**
25	TVL	2	13	13	0	0	0	0	100
25	TVL	3	7	6	0	0	0	0	86
25	TVL	4	5	6	0	0	0	0	120
25	TVL	5	1	1	0	0	0	0	100
26	TVL	2	8	8	0	0	0	0	100
26	TVL	3	9	9	0	0	0	0	100
26	TVL	4	7	6	0	0	0	1	86
26	TVL	5	9	8	0	1	0	0	100
26	TVL	6	2	2	0	0	0	0	100

NUMBER OF BIOLOGICAL SAMPLES (MATURITY AND AGE MATERIAL, *MATURITY ONLY):		
SPECIES (LATIN NAME)	**Length**	**Ageandmaturity**
Gadus morhua	7930	363
Clupea harengus	9121	971
Sprattus sprattus	8292	498
Platichthys flesus	4896	682
Pleuronectes platessa	638	366
Agonus cataphractus	1	

Zoarces viviparus	13	1
Enchelyopus cimbrius	115	29
Perca fluviatilis	46	4
Gasterosteus aculeatus	12	
Cyclopterus lumpus	4	
Myoxocephalus scorpius	146	19
Neogobius melanostomus	3	
Pomatoschistus minutus	1	
Osmerus eperlanus	33	9
Alosa fallax	10	3
Scophthalmus maximus	11	10
Merlangius merlangus	29	14
Hyperoplus lanceolatus	143	9
Sander lucioperca	6	4
Engraulis encrasicolus	16	2
Lampetra fluviatilis	3	



Crosses – fish stations, red dots – hydrological stations, green line – hydrological profile.

NATION:	**LATVIA**	**VESSEL:**	**RV "BALTICA"**
Survey:	BITS-Q4/2019	Dates:	08-18/12/2019

Cruise	No. 2/2019
Gear details:	The hard bottom ground-rope (rockhopper) trawl, type TV-3#930 (with 10-mm mesh bar length in the codend) was applied for fish catches. The construction of the trawl follows the specifications in the manual.
Notes from survey (e.g. problems, additional work etc.):	The original surveys plan provided that 24 control-hauls will be realized in the Latvian EEZ (18 trawls in SD 28 and 6 trawls in SD 26). Five additional trawls were planned in the SD 26, in the Lithuanian EEZ. One track selected for Latvia was in Polish EEZ (track 26269). Polish colleagues realized this track during Polish 4Q BITS survey. The r.v. "Baltica" realized 14 bottom trawl control-hauls including the Latvian territorial waters (Fig). Three catch-stations were only initiated by hydrological parameters measurement and due to very low oxygen concentration (below 0.5 ml/l) near bottom, fishing was omitted. All trawl catches were performed in the daylight. The hard-bottom ground-rope (rockhopper) trawl, type TV-3#930 (with 10-mm mesh bar length in the codend) was applied for fish catches. The mean speed of vessel while trawling was 3.0 knots. For the all realized trawls, their duration was shortened to 15-20 minutes, due to dense clupeids concentrations observed on the echosounder or bad weather for trawling. The length measurements in the 1.0-cm classes were realised for 178 cod and 1555 flounder. Length measurements in the 0.5-cm classes were realized for 1111 herring and 1156 sprat. In total, 263 cod and 326 flounder individuals were taken for biological analysis. Stomachs from the 187 cod were taken for investigation of cod feeding. Acoustic data, i.e. the echo-integration records (SA = NASCs; Nautical Area Scattering (Strength) Coefficient) were collected with the EK-60 scientific echosounder during fishing operations and on the distances between consecutive hauls. Echo-sounding data collected during the BITS survey were delivered to the Latvian researchers for further analysis. Directly before every haul, the seawater temperature, salinity and oxygen content were measured continuously from the sea surface to a bottom. The seawater samples were taken also at the standard HELCOM stations. Totally, 20 hydrological stations were inspected with the Neil-Brown CTD-probe combined with the rosette sampler (the bathometer rosette). Oxygen content was determined by the standard Winkler's method. Meteorological observations of wind velocity and directions and the sea state were realized at the actual geographic position of each control-haul.
Additional comments:	**During the survey 6 working days were lost due to the bad weather.**

ICES SUB-DIVISIONS	**GEAR (TVL, TVS)**	**DEPTH STRATA (2–6)**	**NUMBER OF HAULS PLANED**	**NUMBER OF VALID HAULS REALIZED USING "STANDARD" GROUND GEAR**	**NUMBER OF VALID HAULS REALIZED USING ROCK HOPPERS**	**NUMBER OF ASSUMED ZERO-CATCH HAULS**	**NUMBER OF REPLACE-MENT HAULS**	**NUMBER OF INVALID HAULS**	**% STATIONS FISHED**
26	TVL	3	1	0	0	0	0	0	0
26	TVL	4	0	0	0	0	0	0	0
26	TVL	5	1	0	0	0	0	0	0
26	TVL	6	4	0	0	1	0	0	25
28	TVL	2	6	0	5	0	0	0	83
28	TVL	3	6	0	4	0	0	0	67
28	TVL	4	2	0	2	0	0	0	100
28	TVL	5	2	0	0	2	0	0	100
28	TVL	6	2	0	0	0	0	0	0

Number of biological samples (maturity and age material, *maturity only):		
Species	**Length**	**Age**
Gadus morhua	441	261
Platichthys flesus	1881	326
Clupea harengus	1111	0
Sprattus sprattus	1156	0
Scophthalmus maximus	10	0
Zoarces viviparus	23	0
Cyclopterus lumpus	2	0
Engraulis encrasicholus	3	0
Pomatoschistus minutus	12	0
Myoxocephalus scorpius	137	0
Osmerus eperlanus	66	0
Enchelyopus cimbrius	1	0
Neogobius melanostomus	7	0

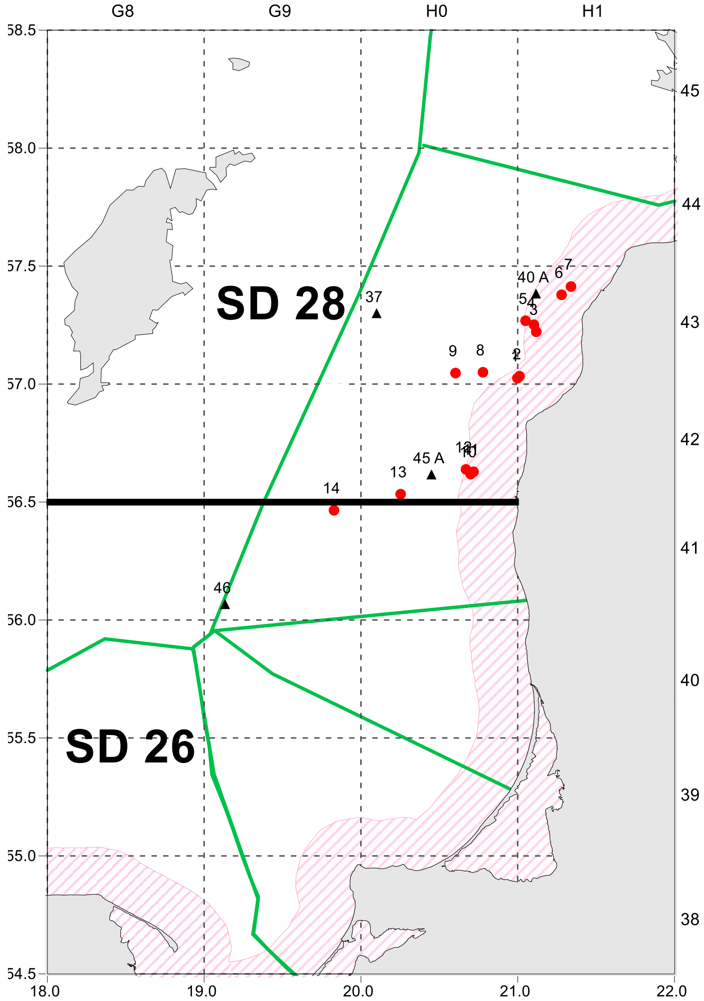


Figure. Location of the realized fish control-hauls (marked with red dots) and the HELCOM standard hydrological stations (marked with black triangles), green lines - national fishing zone borders.

Nation:	**Denmark**	Vessel:	Havfisken
Survey:	KASU	Dates:	21/10-10/11

Cruise	Kasu 2-2019
Gear details:	The small (#520) standard TV3 trawl is used. The construction of the trawl follows the specifications in the manual.
Notes from survey (e.g. problems, additional work etc.):	4 stations in division 22 were moved due to problems with stones or other problems at the stations.

ICES Sub-Divisions	Gear (TVL,TVS)	Depth strata (1 -6)	Number of hauls planed	Number of valid hauls realized using "Standard" ground gear	Number of valid hauls realized using Rockhoppers	Number of assumed zero-catch hauls	Number of replacement hauls	Number of invalid hauls	% stations fished
20	TVS	2(20-39m)	1	1					100%
21	TVS	1(0-19m)	6	6					100%
21	TVS	2(20-39m)	12	12					100%
21	TVS	3(40-59m)	5	5					100%
21	TVS	4(60-89m)	2	2					100%
22	TVS	1(0-19m)	13	13					100%
22	TVS	2(20-39m)	15	15					100%
23	TVS	1(0-19m)	5	5					100%
23	TVS	1(20-39m)	1	1					100%
24	TVS	1(0-19m)	5	5					100%
24	TVS	2(20-39)	3	3					100%
				68 St. i alt					100%

Number of biological samples (maturity and age material, *age and sex only):

Species	**Number of otoliths**	**Species**	**Number of otoliths**
Sole *	147	Saith *	0
Cod	335	Dab *	310
Withing *	249	Haddok *	7
Witch *	28	Turbot *	71
Hake *	20	Brill *	148
Plaice *	811	I alt	2126

Nation:	Denmark	Vessel:	år
Survey:	BITS	Dates:	7-24/11 - 2019

Cruise	
Gear details:	The big (#920) standard TV3 trawl is used. The construction of the trawl follows the specifications in the manual. No rock hopper was used
Notes from survey (e.g. problems, additional work etc.):	Liver sampling from cod, plankton fishing during night.

ICES Sub-Divisions and Depth stratum	Gear (TVL,TVS)	Number of hauls planed	Number of valid hauls realized using "Standard" ground gear	Number of valid hauls realized using Rock-hoppers	Number of assumed zero-catch hauls	Number of replacement hauls	Number of invalid hauls	Coverage (%)
25	TVL							
2	TVL	1	2	0	0	0	0	200,0
3	TVL	21	15	0	0	0	1	71,4
4	TVL	20	23	0	2	0	0	125,0
5	TVL	12	11	0	2	0	0	108,3
24	TVL							
3	TVL	1	1					100,0
4	TVL		1					
Total		55	53	0	4	0	1	105,5

Number of biological samples (maturity and age			
Species	Age	Species	Age
Clupea harengus			
Gadus morhua			
Sprattus sprattus			

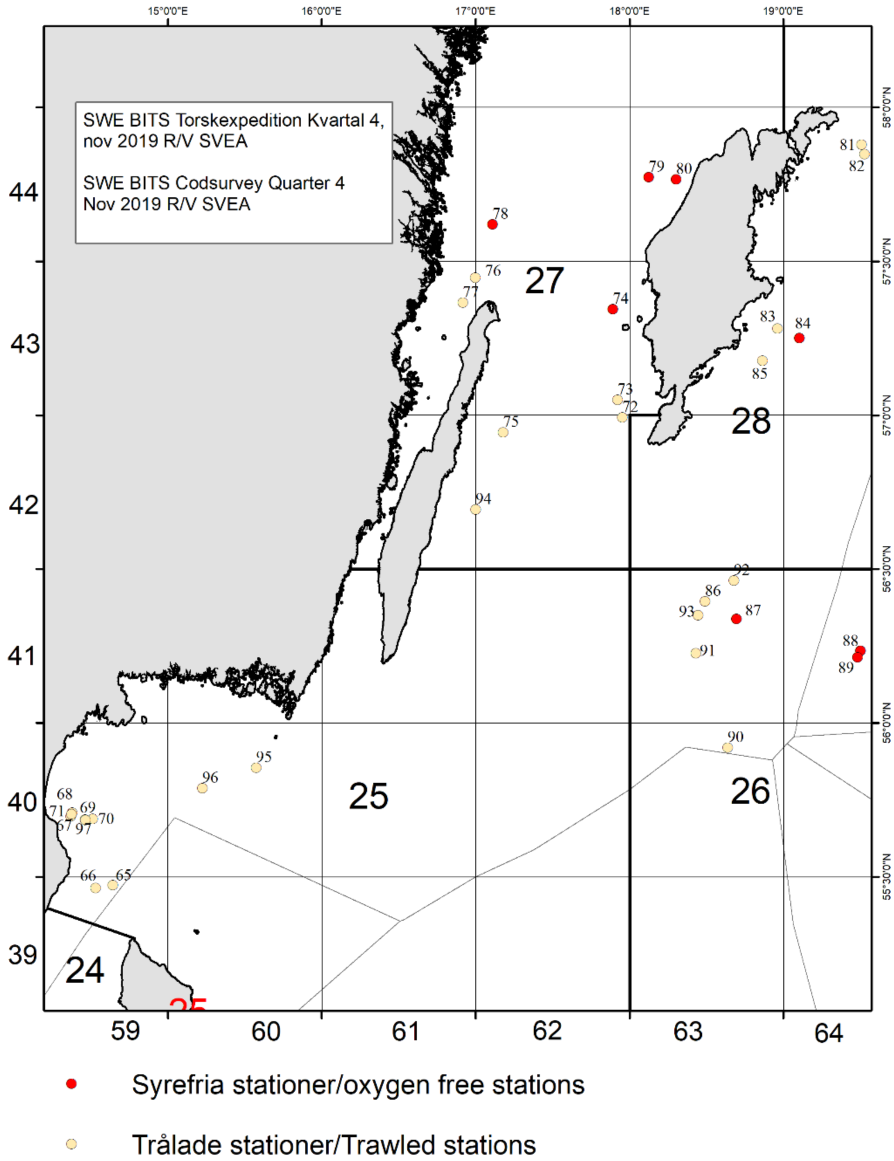
NATION:	**SWEDEN**	**VESSEL:**	**RV "DANA"**
Survey:	BITSQ4 2019	Dates:	18th-28th November2019

Cruise	
Gear details:	The large (930#) standard TV3 trawl was used. No tows are done with the rockhopper groundgear on harder ground stations. The trawl construction is according to the specification in the BITS manual.
Notes from survey (e.g. problems, additional work etc.):	33 stations were allocated, 33 of these were trawled. Two hauls were replaced due to weather conditions. Three hauls in SD 26, four in SD 27 and one in SD 28 had oxygen deficiency.
Additional comments:	Depth strata5 SD 26 we planned 1 haul but none where made due to close proximity to next depthstrata, thus 2 were made in depthstrata 4 but only one were planned. Depth strata 3 and 4 in SD 27 deviates because one haul is randomized as depth layer 3 but in reality is in dl 4.

ICES Sub-Divisions	Gear (TVL, TVS)	Depth strata (2–6)	Number of hauls planned	Number of valid hauls realized using "Standard" ground gear	Number of valid hauls realized using Rock hoppers	Number of assumed zero-catch hauls	Number of replace-ment hauls	Number of invalid hauls	Stations fished %
25	TVL	2	3	2	-	0	1	0	100
25	TVL	3	6	6	-	0	0	0	100
25	TVL	4	1	1		0	0	0	100
26	TVL	2	1	1		0	0	0	100
26	TVL	3	1	1		0	0	0	100
26	TVL	4	1	2		0	0	0	200
26	TVL	5	1	0		0	0	0	0
26	TVL	6	4	1		3	0	0	100
27	TVL	3	3	2	-	0	0	0	67
27	TVL	4	3	4	-	0	0	0	125
27	TVL	5	1	0	-	1	0	0	100
27	TVL	6	3	0		3	0	0	100
28	TVL	3	2	2	-	0	0	0	100
28	TVL	4	2	2	-	0	0	0	100
28	TVL	5	1	0	-	1	0	0	100

Remark.The %number deviates from 100 because the depth varied from before.

Number of biological samples (maturity and age material, *maturity			
Specnamesci.	***Lenght***	***Age***	***Stomachs***
Alosa fallax	1		
Clupea harengus	5 016		
Cyclopterus lumpus	15		
Enchelyopus cimbrius	11		
Engraulis encrasicolus	1		
Gadus morhua	5 853	380	380
Gasterosteus aculeatus	559		
Hyperoplus lanceolatus	6		
Limanda limanda	44		
Lumpenus lampretaeformis	6		
Merlangius merlangus	699		
Myoxocephalus quadricornis	131		
Myoxocephalus scorpius	370		
Neogobius melanostomus	1		
Osmerus eperlanus	6		
Platichthys flesus	2 811	1127	1127
Pleuronectes platessa	644		
Pollachius virens	2		
Pomatoschistus	20		
Pungitius pungitius	10		
Scomber scombrus	1		
Scophthalmus maximus	118		
Scophthalmus rhombus	1		
Sprattus sprattus	3 559		
Trachurus trachurus	5		
Zoarces viviparus	50		

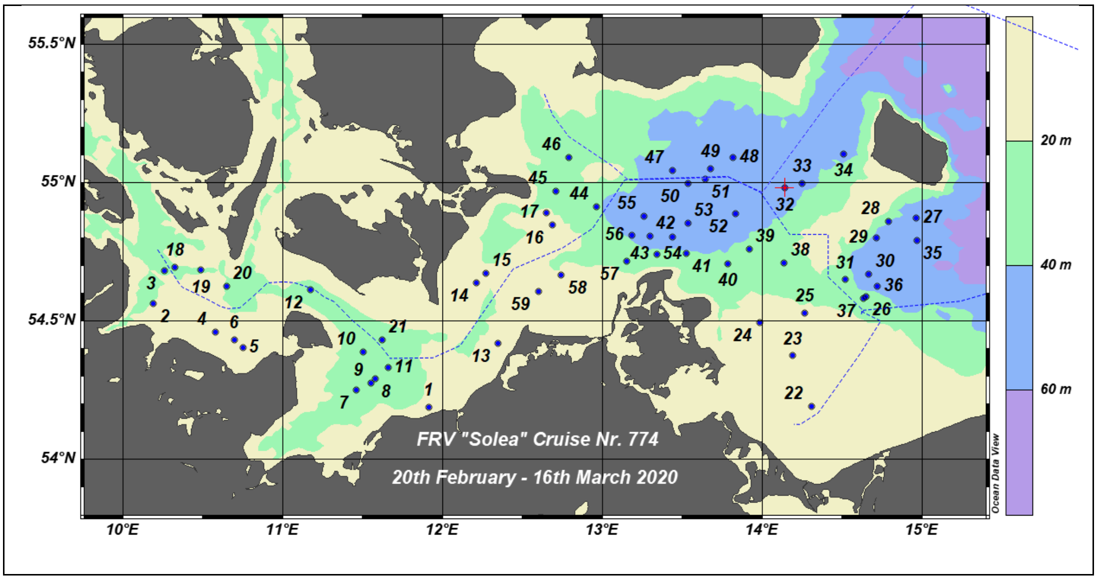

SWE BITS Torskexpedition Kvartal 4, nov 2019 R/V SVEA
SWE BITS Codsurvey Quarter 4 Nov 2019 R/V SVEA
15°0'0"E
16°0'0"E
17°0'0"E
18°0'0"E
19°0'0"E
58°0'0"N
57°30'0"N
57°0'0"N
56°30'0"N
56°0'0"N
55°30'0"N
44
43
42
41
40
39
59
60
61
62
63
64
24
25
26
27
28
Syrefria stationer/oxygen free stations
Trålade stationer/Trawled stations

Nation:	**Germany**	**Vessel:**	**FRV "Solea"**
Survey:	BITS 2020, quarter 1	Dates:	20th February to 6st March, 9th to 16th March 2020

Cruise	
Gear details:	The small (520#) standard TV3 trawl was used. All Tow Database stations wre fished without rock-hoppers. The construction of the trawl follows the specifications in the manual.
Notes from survey (e.g. problems, additional work etc.):	A total 59 fishing hauls and 59 hydrographical stations were performed. Bad weather caused 3 days downtime. Due of the restrictions for fishing in territorial Swedish waters last times; Germany is fishing currently in Swedish waters only outside of the 12 nm.
Additional comments:	

ICES Sub-Divisions	**Gear (TVL, TVS)**	**Depth strata (1–3)**	**Number of hauls planed**	**Number of valid hauls realized using "standard" ground gear**	**Number of valid hauls realized using Rock hoppers**	**Number of assumed zero-catch hauls**	**Number of replace-ment hauls**	**Number of invalid hauls**	**% stations fished**
22	TVS	1	5	4	-		-	-	80
22	TVS	2	10	12	-		-	-	120
24	TVS	1	9	10	-		-	-	111
24	TVS	2	12	11	-		-	-	92
24	TVS	3	22	22	-		-	-	100

Number of biological samples (maturity and age material, *maturity only):		
Species	**Length**	**Age**
Gadus morhua	8891	1071
Platichthys flesus	4815	778
Pleuronectes platessa	5985	934
Limanda limanda	3444	712
Psetta maxima	202	199
Scophthalmus rhombus	12	13
Clupea harengus	2624	-
Sprattus sprattus	5093	-



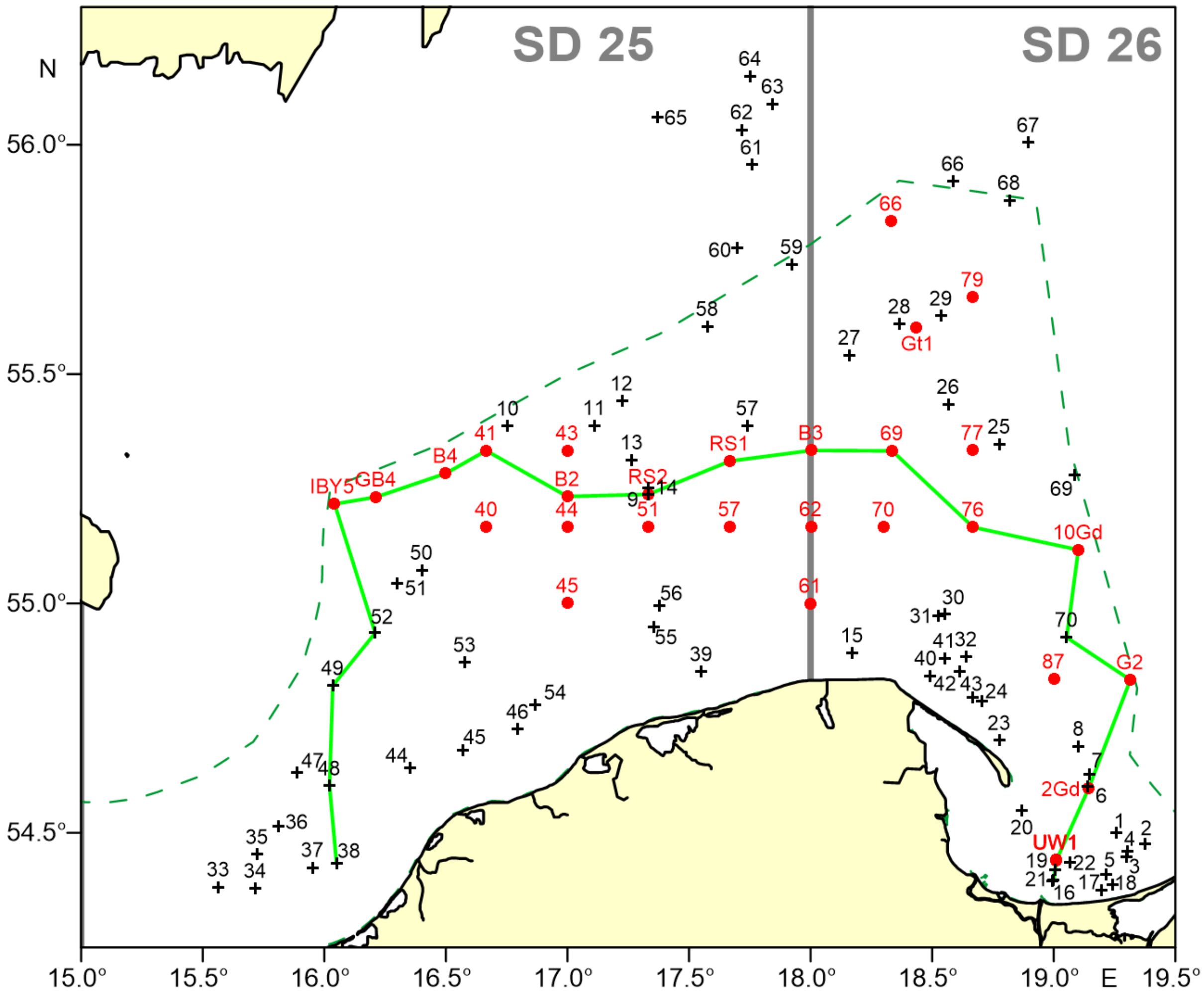
NATION:	POLAND	VESSEL:	RV "BALTICA"
Survey:	BITS-Q1/2020	Dates:	04/02-03/03/2020

Cruise	No. 3/2020/MIR
Gear details:	The standard rigging cod ground trawl type TV-3#930, with 10-mm mesh bar length in the codend was applied for fish control-catches realisation. The construction of the trawl follows the specifications in the manual.
Notes from survey (e.g. problems, additional work etc.):	According to the WGBIFS recent (March 2019) recommendations, the vessel "Baltica" was designated to cover parts of the ICES Sub-divisions 25 and 26 with 29 and 32, respectively randomly selected bottom fishing hauls, and also in Swedish EEZ to cover Swedish part of ICES Sub-divisions 25 and 26 with 6 and 2 fishing hauls, respectively. The R/V Baltica realized 70 of the 69 planned hauls for this survey. One haul (ICES no 26270) was considered as „Invalid" due to technical problems associated with gear performance observed during trawling. The haul No. 26270 was repeated successfully in the place as assigned in the survey plan. In total 12 hauls (ICES no 26165, 26172, 26236, 26284, 25162, 25311, 25512, 25038, 26221, 26140, 26138 and 26257) were not realized due to oxygen level on the bottom below 0.5 ml/l. They were classified as "no oxygen" hauls. In total, all the 69 fish catch-stations can be accepted as representative. Due to stormy weather, rocky bottom and large fish concentrations observed in echosounder – 1, 10 and 15 fishing hauls were shortened to 25 min, 20 min and 15 min, respectively. Every control-haul was preceded by the seawater temperature, salinity and oxygen content measurements, made continuously from the sea-surface to a bottom. Overall, 70 fish catch-stations starting positions and 28 standard hydrographic stations were controlled by the SeaBird SBE 911 CTD-probe combined with the rosette sampler (the bathometer rosette). Oxygen content was determined by the standard Winkler's method.
Additional comments:	

ICES SUB-DIVISIONS	GEAR (TVL, TVS)	DEPTH STRATA (2–6)	NUMBER OF HAULS PLANED	NUMBER OF VALID HAULS REALIZED USING "STANDARD" GROUND GEAR	NUMBER OF VALID HAULS REALIZED USING ROCK HOPPERS	NUMBER OF ASSUMED ZERO-CATCH HAULS	NUMBER OF REPLACE-MENT HAULS	NUMBER OF INVALID HAULS	% STATIONS FISHED
25	TVL	2	13	13	0	0	0	0	100
25	TVL	3	13	12	0	1	0	0	100
25	TVL	4	7	5	0	3	0	0	114
25	TVL	5	2	2	0	0	0	0	100
26	TVL	2	9	9	0	0	0	0	100
26	TVL	3	6	6	0	0	0	0	100
26	TVL	4	8	8	0	0	0	1	100
26	TVL	5	7	3	0	4	0	0	100
26	TVL	6	4	0	0	4	0	0	100

NUMBER OF BIOLOGICAL SAMPLES (MATURITY AND AGE MATERIAL, *MATURITY ONLY):		
SPECIES (LATIN NAME)	Length	Ageandmaturity
Gadus morhua	12212	539
Clupea harengus	8920	904
Sprattus sprattus	7499	522
Platichthys flesus	6241	756
Pleuronectes platessa	1109	433
Agonus cataphractus	2	

Zoarces viviparus	38	7
Enchelyopus cimbrius	287	26
Perca fluviatilis	75	5
Gasterosteus aculeatus	150	
Cyclopterus lumpus	5	1
Myoxocephalus scorpius	289	23
Neogobius melanostomus	13	2
Pomatoschistus minutus	5	
Osmerus eperlanus	40	5
Alosa fallax	115	9
Scophthalmus maximus	52	52
Merlangius merlangus	98	25
Engraulis encrasicolus	5	2
Gymnocephalus cernua	2	2
Hyperoplusl anceolatus	290	
Ammodytes tobianus	1	



Crosses – fish control stations, red dots – hydrological stations, green line – hydrological profile.

Nation:	**Latvia**	**Vessel:**	**RV "Baltica"**
Survey:	BITS-Q1/2020	Dates:	07-15/03/2020

Cruise	No. 1/2020
Gear details:	The hard bottom ground-rope (rockhopper) trawl, type TV-3#930 (with 10-mm mesh bar length in the codend) was applied for fish catches.The construction of the trawl follows the specifications in the manual.
Notes from survey (e.g. problems, additional work etc.):	The original surveys plan provided that 25 control-hauls will be realized in the Latvian EEZ (24 trawls in SD 28 and one trawl in SD 26). Five additional trawls were planned in the SD 26, in the Latvian EEZ. The r.v. "Baltica" realized 17 bottom control-hauls including the Latvian territorial waters (Fig.). Trawls with track number 28194, 28033, 28167 and 28017 were not in the correct depth zone as it was indicated in track database. These tracks were realized. Information about correct depths for these trawls will be sent to track database administrator. All trawl catches were performed in the daylight. The hard bottom ground-rope (rockhopper) trawl, type TV-3#930 (with 10-mm mesh bar length in the codend) was applied for fish catches. The standard trawling duration was 30 minutes. The mean speed of vessel while trawling was 3.0 knots. However, in the case of 4 hauls, their duration was shortened to 20 minutes, due to dense clupeids concentrations observed on the echosounder or poor ground for trawling. The length measurements in the 1.0-cm classes were realised for all 124 cod and 2068 flounder. Length measurements in the 0.5-cm classes were realized for 1236 herring and 1830 sprat. In total, 124 cod and 344 flounder individuals were taken for biological analysis. Stomachs from the 101 cod were taken for investigation of cod feeding. Acoustic data, i.e. the echo-integration records (SA = NASCs; Nautical Area Scattering (Strength) Coefficient) were collected with the EK-60 scientific echosounder during fishing operations and on the distances between consecutive hauls. Echo-sounding data collected during the BITS survey were delivered to the Latvian researchers for further analysis. Directly before every haul, the seawater temperature, salinity and oxygen content were measured continuously from the sea surface to a bottom. The seawater samples were taken also at the standard HELCOM stations. Totally, 22 hydrological stations were inspected with the Neil-Brown CTD-probe combined with the rosette sampler (the bathometer rosette). Oxygen content was determined by the standard Winkler's method. Meteorological observations of wind velocity and directions and the sea state were realized at the actual geographic position of each control-haul. Ichthyoplankton samples were collected in 10 stations.
Additional comments:	**During the survey 3 working days were lost due to the bad weather.**

ICES Sub-Divisions	**Gear (TVL, TVS)**	**Depth strata (2–6)**	**Number of hauls planed**	**Number of valid hauls realized using "Standard" ground gear**	**Number of valid hauls realized using Rock hoppers**	**Number of assumed zero-catch hauls**	**Number of replace-ment hauls**	**Number of invalid hauls**	**% stations fished**
26	TVL	5	1	0	1	0	0	0	100
26	TVL	6	0	0	0	0	0	0	0
28	TVL	2	6	0	1	0	0	0	17
28	TVL	3	7	0	4	0	0	0	57
28	TVL	4	5	0	6	0	0	0	120
28	TVL	5	4	0	5	0	0	0	125
28	TVL	6	0	0	0	0	0	0	0

Number of biological samples (maturity and age material, *maturity only):		
Species	Length	Age
Gadus morhua	124	124
Platichthys flesus	2068	344
Clupea harengus	1236	0
Sprattus sprattus	1830	0
Pleuronectes platessa	1	0
Zoarces viviparus	17	0
Triglopsis quadricornis	1	0
Myoxocephalus scorpius	68	0
Osmerus eperlanus	6	0
Gasterosteus aculeatus	8	0
Enchelyopus cimbrius	2	0
Hyperoplus lanceolatus	4	0

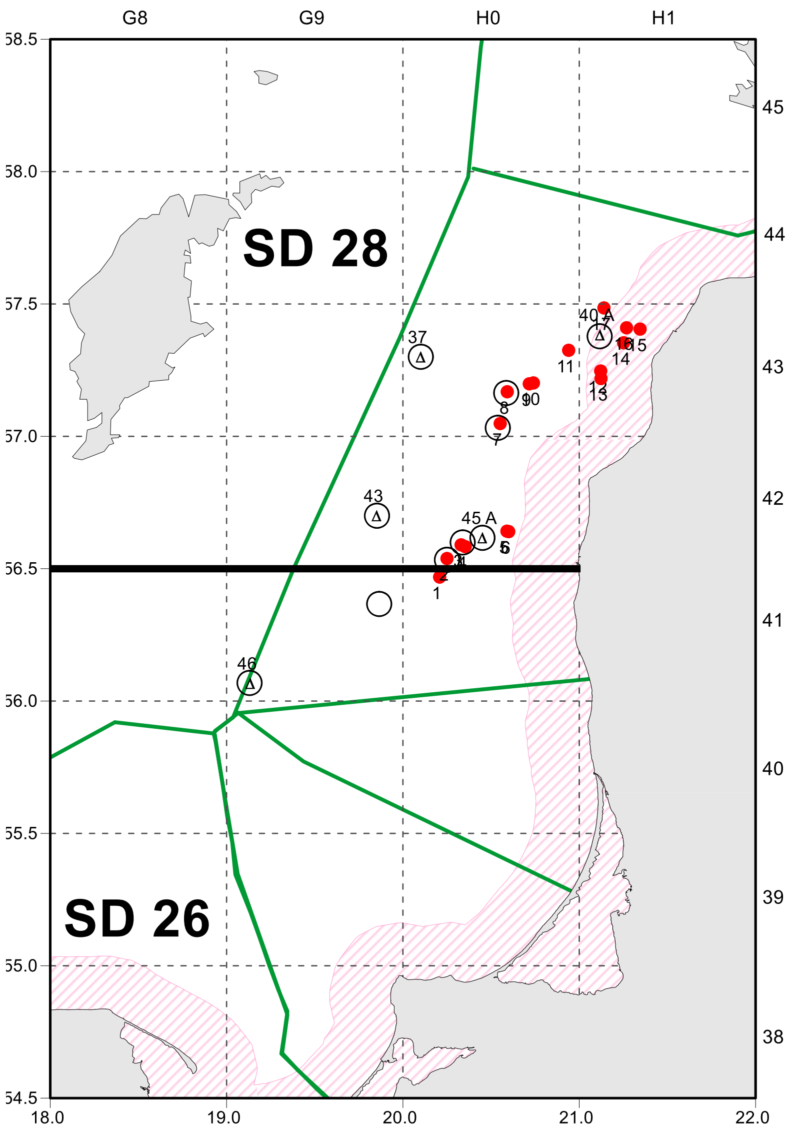


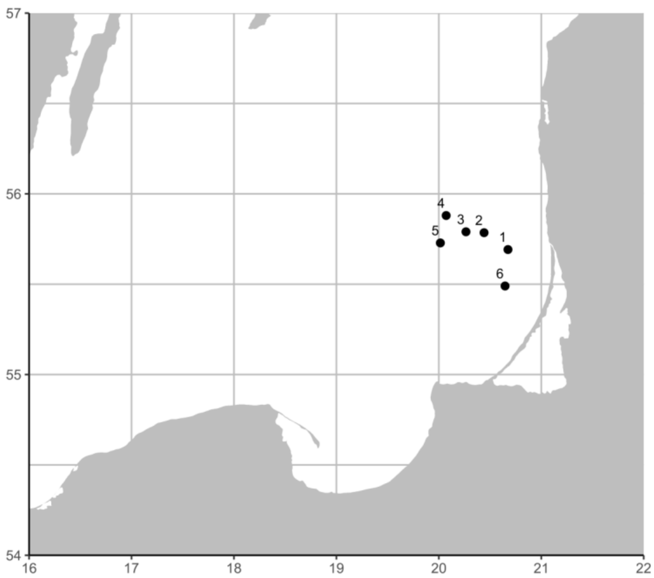
Figure. Location of the realized fish control-hauls (marked with red dots) and the HELCOM standard hydrological stations (marked with black triangles), black circles – ichthyoplankton stations, green lines - national fishing zone borders.

Nation:	**Lithuania**	**Vessel:**	**694**
Survey:	BITS2020Q1	Dates:	5th – 6thMarch 2020

Cruise	
Gear details:	The small (520#) standard TV3 trawl was used.
Notes from survey (e.g. problems, additional work etc.):	Survey made with Lithuania commercial fishery vessel 694. Total 6 fishing hauls was performed. Firstfive hauls was made March5 and the last March 6. No hydrological measurements were performed due to weather conditions
Additional comments:	

ICES Sub-Divisions	Gear (TVL, TVS)	Depth strata (2–6)	Number of hauls planed	Number of valid hauls realized using "Standard" ground gear	Number of valid hauls realized using Rock hoppers	Number of assumed zero-catch hauls	Number of replacement hauls	Number of invalid hauls	% stations fished
26	TVS	3	2	2	-	-	-	-	100
26	TVS	4	4	4	-	-	-	-	100

Number of biological samples (maturity and age material, *maturity only):		
Species	**Length**	**Age**
Alosa fallax	3	
Clupea harengus	1316	
Gadus morhua	726	299
Myoxocephalus scorpius	55	
Osmerus eperlanus	97	
Platichthys flesus	1138	288
Pleuronectes platessa	2	2
Pomatoschistus minutus	1	
Psetta maxima	1	1
Sprattus sprattus	76	



Nation:	Denmark	Vessel:	Dana
Survey:	BITS	Dates:	3-19/3 - 2020

Cruise	
Gear details:	The big (#920) standard TV3 trawl is used. The construction of the trawl follows the specifications in the manual. No rock hopper was used
Notes from survey (e.g. problems, additional work etc.):	Stomack sampling from cod, Liver parasites sampling from cod, plankton fishing during night.

ICES Sub-Divisions and Depth stratum	Gear (TVL,TVS)	Number of hauls planed	Number of valid hauls realized using "Standard" ground gear	Number of valid hauls realized using Rock-hoppers	Number of assumed zero-catch hauls	Number of replacement hauls	Number of invalid hauls	Coverage (%)
25	TVL							
2	TVL	1	1	0	0	0	0	100,0
3	TVL	4	5	0	0	0	0	125,0
4	TVL	13	17	0	0	0	0	130,8
5	TVL	12	11	0	0	0	0	91,7
6	TVL	0	1	0	0	0	0	
26								
2	TVL	1	0	0	0	0	1	0,0
3	TVL	3	0	0	0	0	1	0,0
4	TVL	1	1	0	0	0	1	100,0
5	TVL	4	1	2	0	0	2	75,0
6	TVL	7	3	3	2	0	1	114,3
28	TVL							0,0
5	TVL	1	1	0	0	0	0	33,3
6	TVL	3	1	0	1	0	0	66,7
Total	TVL	50	42	5	3	0	6	100,0

Number of biological samples (maturity and age			
Species	Age	Species	Age
Clupea harengus			
Gadus morhua			
Sprattus sprattus			

Nation:	**SWEDEN**	**Vessel:**	**RV "DANA"**
Survey:	BITSQ1 2020	Dates:	24February - 9 Mars2020

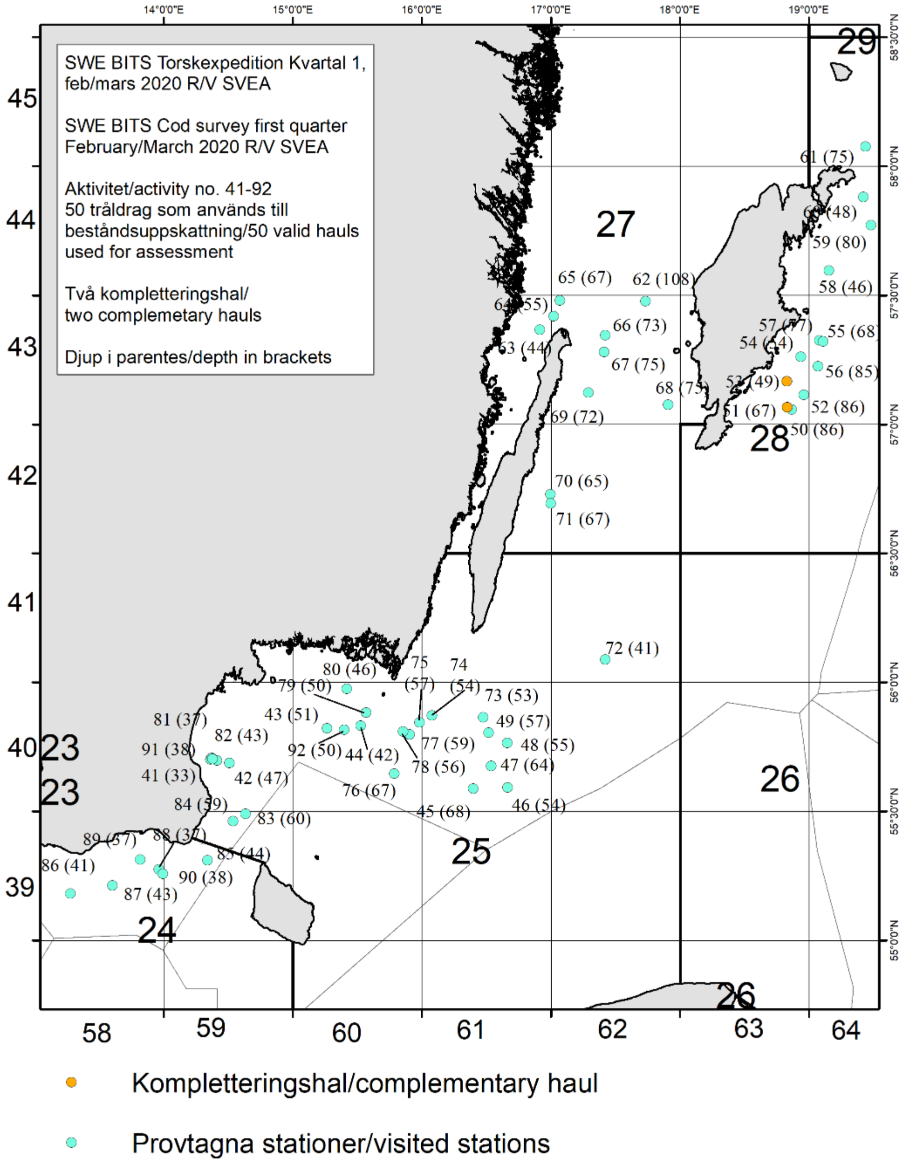
Cruise	
Gear details:	The large (930#) standard TV3 trawl was used. No tows are done with the rockhopper groundgear on harder ground stations. The trawl construction is according to the specification in the BITS manual.
Notes from survey (e.g. problems, additional work etc.):	50 stations were randomly allocated, whereof41 were trawled. Two hauls in SD 27 and four in SD 28had oxygen deficiency.
Additional comments:	Two complementary hauls where made in SD28

ICES Sub-Divisions	Gear (TVL, TVS)	Depth strata (2–6)	Number of hauls planned	Number of valid hauls realized using "Standard" ground gear	Number of valid hauls realized using Rock hoppers	Number of assumed zero-catch hauls	Number of replace-ment hauls	Number of invalid hauls	Stations fished %
24	TVL	2	3	3	-	0	0	0	100
24	TVL	3	3	3	-	0	0	0	100
25	TVL	2	5	4	-	0	0	0	80
25	TVL	3	14	12	-	0	3	1	107
25	TVL	4	5	3	-	0	2	0	100
27	TVL	3	2	2	-	0	0	0	100
27	TVL	4	7	5	-	1	1	0	100
27	TVL	6	1	0		1	0	0	100
28	TVL	3	3	2	-	0	1	0	100
28	TVL	4	2	3	-	0	0	0	133
28	TVL	5	5	4	-	4	0	0	80

Remark. Stations fished shows a low percentage mostly because the number of stations are few in shallow waters.

Number of biological samples (maturity and age material, *maturity only):			
Specname sci.	***Lenght***	***Age***	***Stomachs***
Agonus cataphractus	1	0	
Aphia minuta	34	0	
Clupea harengus	9871	0	
Cyclopterus lumpus	7	0	
Enchelyopus cimbrius	14	0	
Engraulis encrasicolus	8	0	
Eutrigla gurnardus	6	0	
Gadus morhua	6861	939	939
Gasterosteus aculeatus	436	0	
Hyperoplus lanceolatus	25	0	
Limanda limanda	276	0	
Lumpenus lampretaeformis	8	0	

Melanogrammus aeglefinus	1	0	
Merlangius merlangus	539	0	
Myoxocephalus quadricornis	277	0	
Myoxocephalus scorpius	1053	0	
Osmerus eperlanus	1	0	
Platichthys flesus	5331	2141	2141
Pleuronectes platessa	1606	0	
Pomatoschistus	22	0	
Pungitius pungitius	6	0	
Scomber scombrus	1	0	
Scophthalmus maximus	94	0	
Scophthalmus rhombus	1	0	
Sprattus sprattus	6382	0	
Trachurus trachurus	67	0	
Trisopterus minutus	1	0	
Zoarces viviparus	134	0	



Technical
University of
Denmark

DTU Aqua - Cruise report

BITS 4Q 2019

Baltic International Trawl Survey

R/V DANA DENMARK

Cruise no. 12/19

07-11-2019 to 24-11-2019

DTU Aqua
Kemitorvet, Building 202
2800 Kgs. Lyngby
Denmark

DTU Aqua
National Institute of Aquatic Resources

Contents

Cruise summary

Cruise	BITS
Cruise number	12/19
Reseach vessel(s)	R/V DANA
Year and quarter	4Q 2019
Country	Denmark

Location and time

Participants

Leg	Name	Institute	Function and tasks
Leg 1			
	Marie Storr Paulsen	DTU-Aqua	Cruise leader
	Louise Scherffenberg Lundgaard	DTU-Aqua	Assistant cruise leader
	Nina Fuglsang	DTU-Aqua	Individual fish measurements
	Jeppe Olsen	DTU-Aqua	Length measurements
	Micha? Szyma?ski	MIR, Gdynia, Poland	Length measurements
	Heli Einberg	Estonian Fisheries Institute	Length measurements
	Bastian Huwer	DTU-Aqua	Night assistant cruise leader
	Svend-Erik Levinsky	DTU-Aqua	Night assistant
Leg 2			
	Hans Jakob Olesen	DTU-Aqua	Cruise-leader
	Jane Gudmansen	DTU-Aqua	Assistant cruise-leader
	Stina Bjørk Stenersen Hansen	DTU-Aqua	Individual fish measurements
	Anne-Mette Kroner	DTU-Aqua	Individual fish measurements
	Dennis Andersen	DTU-Aqua	Length measurements

Introduction

The Danish research vessel Dana R/V was built in 1980-81 and is a versatile multipurpose vessel with five large laboratories and 38 cabins. The Baltic cod stock has been monitored annually since 1982 through bottom trawl surveys carried out by most countries surrounding the Baltic. The national research vessels have each surveyed part of the area with some overlap in coverage and applied a depth stratified sampling design. However, different gears and design were applied and in 1985 ICES established a Study Group on Young Fish Surveys in the Baltic in order to standardize the surveys. After agreement a common standard trawl gear and standard sampling procedures were implemented in 2000 resulting in the consistent coverage of the western and central Baltic Sea.

To calibrate the national surveys from before 2000 with the TV3 gear used from 2000, a set of conversion factors are produced by making comparative hauls. The work with standardizing gear and creating conversion factors for old data was done under the EU project ISDBITS and gear specifications and conversion factors can be found in the report (ISDBITS 2001).

The type of trawl is called “TV3L” with 930 meshes in the opening. The design and construction of the standard trawls are given in ICES (1997) and can also be found in the BITS manual (Anon. 2000). Until November 2007 Denmark was still using the rock hopper gear on hard fishing ground but since 2008 only the standard TV3L has been used.

The BITS is conducted as a depth-stratified survey. The strata are based on Sub divisions and depth layers. Each year the necessary stations are randomly selected before the beginning of the international trawl surveys from a list of clear haul data. These stations are a stratified random selected sub-sample of the possible trawl tracks. The standard haul is a 30 minute haul with a towing speed of 3 knots. Trawling is only taking place during daylight, defined as the time between 15 minutes past sunrise until 15 minutes before sunset.

Objectives

Daytime

- To estimate the abundance and the year class strength of the Baltic cod and flatfish stocks in ICES Sub-divisions 21-32. The 4st quarter survey is together with the spring survey the Danish contribution to the "Baltic International Trawl Survey"(BITS) and takes place mainly in Sub-division 25 and 26. The main goal of the surveys is to provide the Baltic assessment working group fishery independent data to use for assessment in ICES the working group in April. Furthermore, all fish species are species determination, measured and weighted.
- To measure temperature, salinity and oxygen at the fishing location. The measurements are conducted with a CTD. Calibration of the CTD is conducted before the survey.
- To take individual samples of cod to analyses of age determination, sex, weight and liver condition. Data is used to produce maturity ogive, mean weights per age and condition which is used for Eastern Baltic stock assessment.

Nighttime

- To investigate the abundance and distribution of zooplankton in the central Baltic Sea. The analysis is conducted with a bongo net were the stations are allocated in accordance to the Kiel grid net covering most of SD 25. Trawling speed is 3 kn and the three nets are 150, 335 and 500 μm in cod end.
- To investigate the distribution of juvenile cod caught in a IKMT.
- To catch live zooplankton with a WP2 net.

This Survey

During the cruise, apart from recording a complete set of factual information concerning haul information, gear performance, catch results, hydrographic information etc., the cruise leader keeps a logbook taking notes about circumstances (unusual gear performance, special catches, non-conformities etc. during the survey. The haul summary below is the overview from this logbook.

Haul summary

Number of planned hauls: 54

	Index qualified	Non-index qualified
Number of succesfull trawl hauls:	49	
Number of invalid trawl hauls:		0
Number of "No oxygen trawl hauls" (assumed zero-catch):	4	
SUM	53	0

Number of trawl related CTD stations performed:	53
Number of NON-trawl related CTD stations performed:	15
Number of successful BONGO hauls carried out:	45
Number of successful IKMT hauls carried out:	0
Number of successful Appi hauls carried out:	3
Number of successful WP2 hauls carried out:	3
Number of successful BOM hauls carried out:	0
Number of successful Multi-NET hauls carried out:	0

Cruise leaders and assistants

A cruise leader and an assistant cruise leader are appointed for each leg of the cruise. The Cruise leader is responsible for all matters which are connected to scientific issues during the cruise. The assistant cruise leader assists this task and should be able to take over the responsibilities of the cruise leader if necessary.

Cruise leaders and assistants on the survey

Leg 1 Cruise leader: *Marie Storr-Paulsen* - Assistant: *Louise Scherffenberg Lundgaard*

Leg 2 Cruise leader: *Hans Jacob Olesen* - Assistant: *Jane Gudmansen*

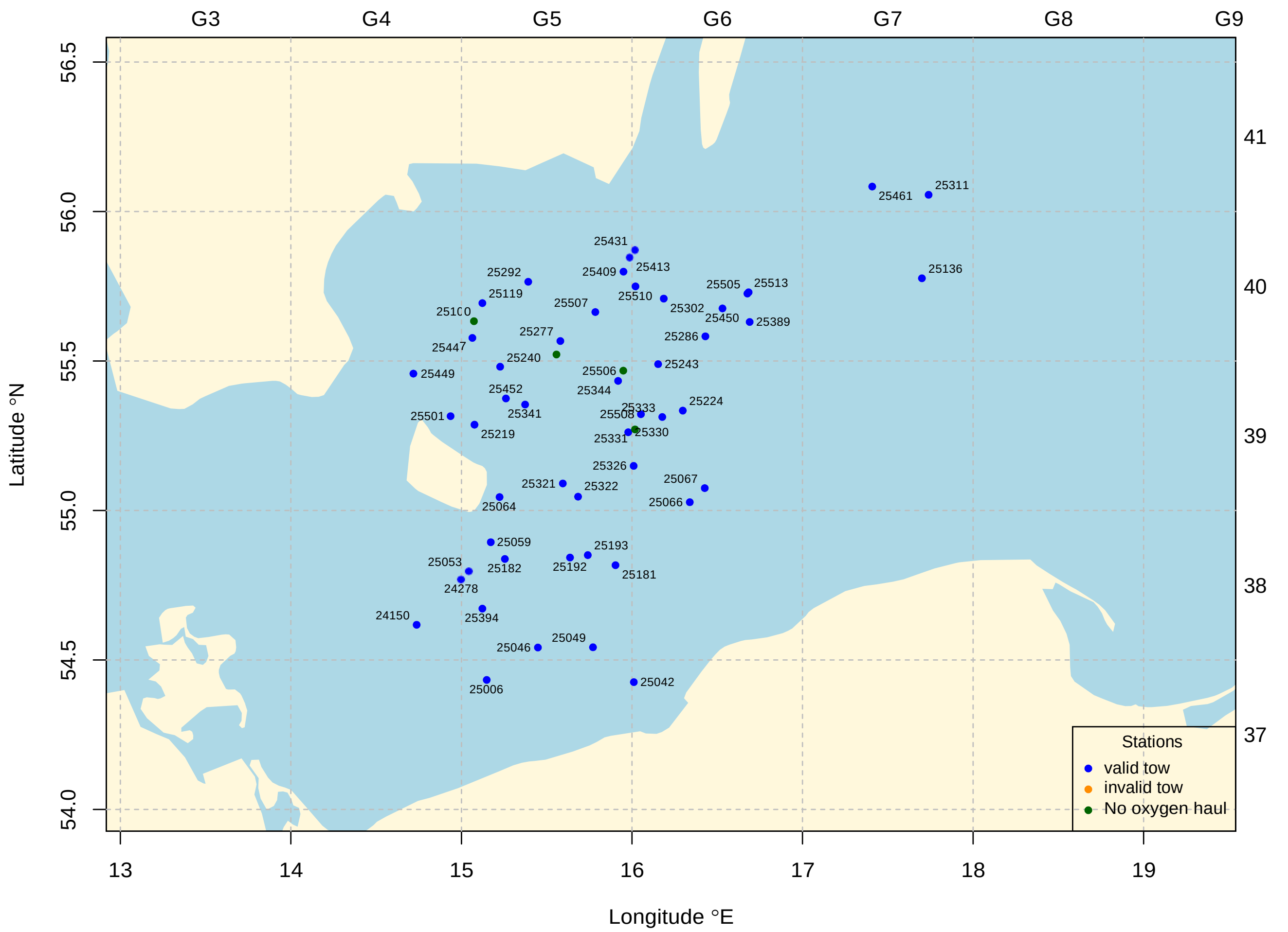


Figure 1: Survey map with trawl stations. During the cruise 49 hauls were conducted, 0 invalid and 4 with low oxygen. R/V DANA Denmark, BITS 4Q 2019.

Itinerary

A survey map with allocated trawl stations is shown in Fig. 1 and in Fig. 2 a map of allocated bongo stations is presented.

Gear performance

The gear performance is monitored during any trawl station. All relevant parameters describing the gear geometry during the fishing is logged to verify that the observed trawl geometry values are within the defined ranges for acceptance.

Nothing to remark

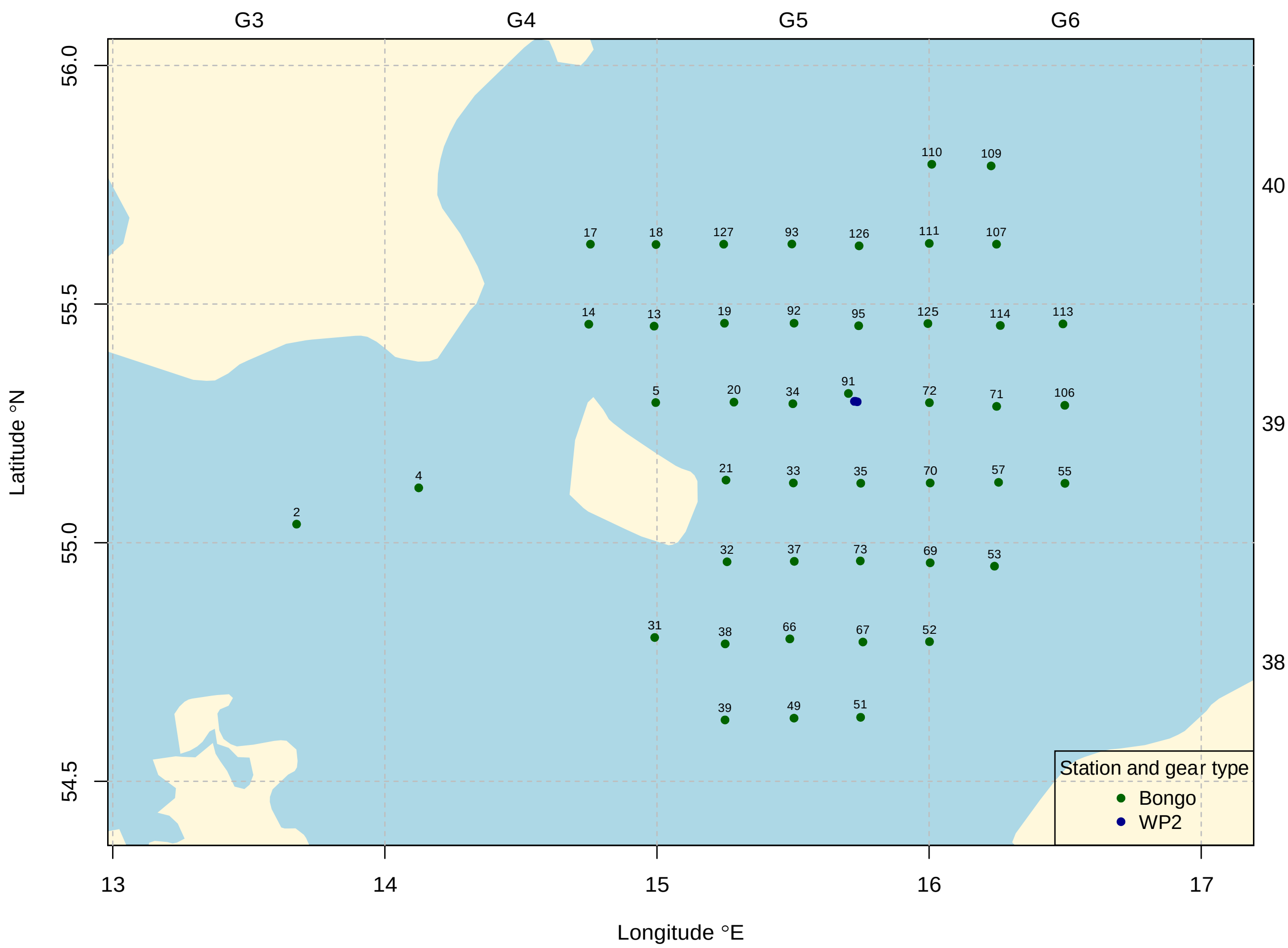


Figure 2: Allocated bongo, IKMT, Aptstein und WP2 stations. Bongo stations are assigned with station numbers but other hauls types are not. R/V DANA Denmark, BITS 4Q 2019.

Oxygen Conditions

Oxygen conditions are monitored in connection with each trawl haul. If the oxygen contend is below 1.5 ml/l it can be decided not to carry out any trawling procedure if it previous under the cruise has been verified by trawling that no fish is staying in this water mass (same Sub-division and same depth strata). The station is then recorded as an assumed zero-catch station. If the cruise leader has any reason to trawl anyway, normal trawling is carried out at the station.

Rather poor oxygen conditions (< 5ml/l) in areas where this normally isn’t any problem. Particularly north and northeast of Bornholm deep was unusual poor oxygen conditions experienced.

Weather conditions

The weather was quite nice with not too strong winds and did not influence the planned program.

Wind speed and direction are presented in Fig. 3.

Number of days with an average wind speed larger than 15 m/s: 0.

Guests on board

There is a long and strong tradition to have scientific colleagues from other countries onboard in exchange during the survey. The reason for that is the facilitating of cooperation and standardization of procedures across participating countries. Guests on this survey: Michal Szymanski from MIR in Poland as national observer and Heli Einberg from Estonia for training.

Other

No.

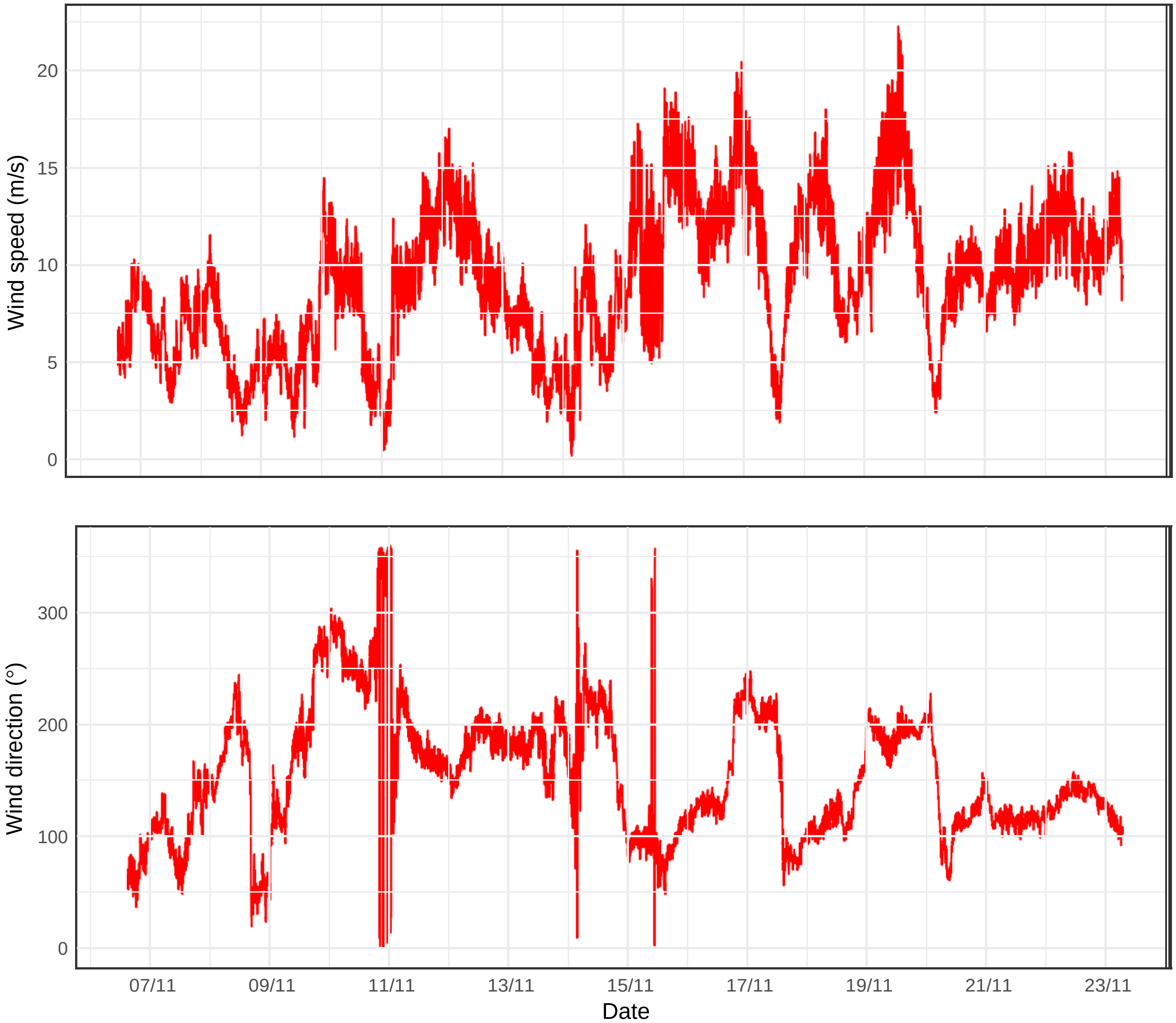


Figure 3: Wind speed and wind direction along the cruise track, R/V DANA Denmark, BITS 4Q 2019.

Catch on survey

Compelete list of species

	Latin name	English name	Danish name	Number	Weight (kg)
1	Agonus cataphractus	Pogge	Panser ulk	8	0.08
2	Clupea harengus	Herring	Sild	178337	5994.72
3	Cyclopterus lumpus	Lumpfish	Stenbider	6	2.47
4	Enchelyopus cimbrius	Four-bearded rockling	Firetrådet havkvabbe	21	0.96
5	Engraulis encrasicolus	Anchovy	Ansjos	6	0.11
6	Gadus morhua	Cod	Torsk	8242	1975.3
7	Gasterosteus aculeatus	Three-spined stickleback	Trepigget hundestejle	6524	14.8
8	Hyperoplus lanceolatus	Greater sandeel	Tobiskonge	7	0.32
9	Limanda limanda	Common dab	Ising	2	0.22
10	Merlangius merlangus	Whiting	Hvilling	1207	192.28
11	Myoxocephalus scorpius	Sculpin	Ulk	320	46.91
12	Mytilus edulis	Blue mussel	Blåmusling	-	125.86
13	Platichthys flesus	Flounder	Skrubbe	1274	293.16
14	Pleuronectes platessa	Plaice	Rødspætte	1503	244.9
15	Pomatoschistus	Sand gobies	Sand kutlinger	145	0.12
16	Saduria entomon	Saduria	Saduria	234	0.45
17	Scomber scombrus	Mackerel	Makrel	1	0.33
18	Scophthalmus maximus	Turbot	Pighvarre	8	3.09
19	Scophthalmus rhombus	Brill	Slethvarre	2	1.41
20	Scyphozoa	Scyphozoans	Storgopler	-	45.08
21	Sprattus sprattus	Sprat	Brisling	421511	5100.17
22	Trachurus trachurus	Horsemackerel	Hestemakrel	4	0.01
23	Zoarces viviparus	Eelpout	Ålekvabbe	1	0.04

Table 1: Species caught on the survey R/V DANA Denmark, BITS 4Q 2019.

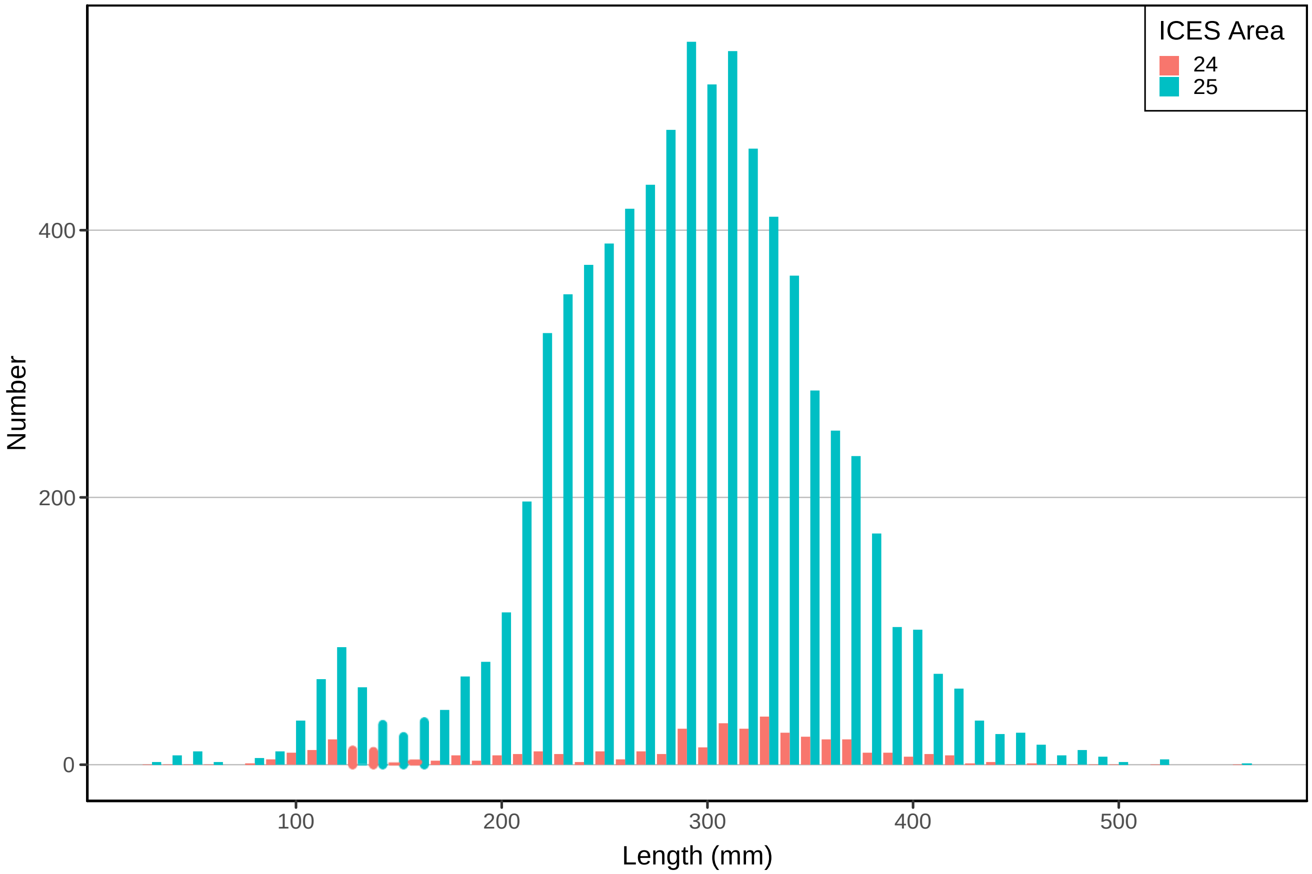


Figure 4: Cod length distribution per area for R/V DANA Denmark, BITS 4Q 2019.

Cod catch and length distribution

Total kgs of cod catched:	1975
Total number of cod measured:	8156
Total number of cod otoliths collected:	1018

In Fig. 4 the length distributions of cod per ICES statiscal area are presented.

Institute of
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Cruise report
Cruise number 770 FRV „SOLEA"
08/11/ - 24/11/2019

Baltic International Trawl Autumn Survey (BITS) in the Arkona Sea, Mecklenburg- and Kiel Bight (ICES SD 24+22)

Scientist in charge: **Dr. A. Velasco**

1. Summary

The 770th cruise of the FRV "SOLEA" is the 38st November survey since 1981. It was part of the Baltic International Trawl Survey (BITS) which was coordinated by ICES WGBIFS. The main objective of the survey was the estimation of fishery independent stock indices for both Baltic cod stocks, flounder and other flat fish.

In total 52 fishery and 52 hydrography stations were carried out.

A preliminary analysis of the survey results suggests a better year class of cod in 2019 as compared with the previous weak year class 2018 (recruits at length range 10-25 cm). The proportion of cod between 26-40 cm was lower in all depth layers as compared to the previous year.

The abundance of flounder as compared to the previous year decreased in SD 22 and in SD 24, with exception of the depth layer of 10–39 m in SD 24.

The oxygen concentration close to the bottom was between 0.1-7.9 ml/l exceptionally low specially in SD 22 (0.1-4.6 m).

Verteiler:
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BMELV, Ref. 614
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Landesverband der Kutter- und Küstenfischer
Sassnitzer Seefischer
Deutsche Fischfang Union Cuxhaven

2. Research programme

The cruise took place from 08th until 24th November 2019. Corresponding to the recommendations of the WGBIFS in 2007, the survey of the FRV "SOLEA" covered the subdivisions 22 and 24 (Figure 1).

The following stock assessment objectives were covered during the survey:

- Collecting data for assessing stock indices, the structure and recruitment of the stocks, especially for cod and flatfish
- Monitoring the composition of fish species in the western Baltic Sea
- Collecting samples of cod, flounder, plaice, dab and turbot for biological investigations (i.e. sex, maturity, fecundity, age)
- Monitoring the actual hydrographical situation in the survey area

3. Narrative

The internationally coordinated trawl survey is planned as a Stratified Random Survey where ICES subdivisions and depth layers are used as strata. A total of 57 stations (45 in subdivision 24 and 12 in subdivision 22) were planned for the German part of the survey which covered the southern part of ICES subdivision 22 and subdivision 24 in total. The haul positions were selected from the TOW Database by the coordinator of the BITS surveys (ICES 2008, WGBIFS report as reference). 52 fishing stations were realized and can be used for stock assessment. The fishing hauls were carried out between 7:00 and 15:00 UTC (8:00 and 16:00 local time).

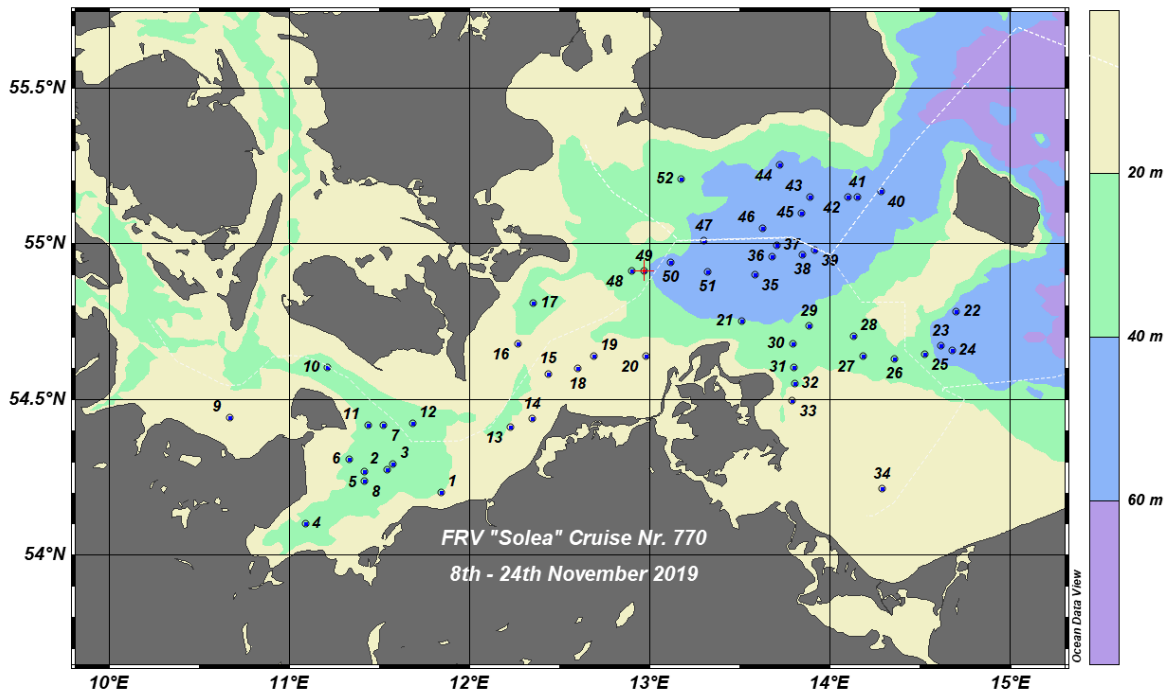

Fig. 1 Stations of the 770th FRV "SOLEA" cruise (Ocean Data View, R. Schlitzer, www.awi-bremerhaven.de/GEO/ODV)

The positions of the trawl hauls are shown in Figure 1. 12 fishing hauls and 12 hydrographic stations were done in subdivision 22, and 40 fishing hauls and 40 hydrographical stations were realized in subdivision 24.
The numbers of fishing hauls and hydrographic stations by subdivision and 10 m depth layers are given in Table 1. The 12 hauls in subdivision 22 were located at depths from 10 m to 29 m and 18 of 40 hauls in subdivision 24 between 40 and 59 m.

Tab. 1 Sampling intensity (evaluated fishing stations)

Area		Stations		
Subdivision	**Stratum Depth [m]**	**Total trawl distance [sm]**	**Fishing [n]**	**Hydrography [n]**
22	**1 [10-19]**	1.5	1	1
	2 [20-29]	16.8	11	11
24	**1 [10-19]**	13.7	9	9
	2 [20-39]	6.7	4	5
		13.0	8	8
	3 [40-59]	27.9	18	18
		-	-	-

Trawling was done with the standard BITS trawl "TV3 520 #". The stretched mesh size in the codend was 20 mm. The duration of each haul was 30 minutes at a velocity of 3 kn as required in the BITS manual. The total catch of a haul was analysed to determine species composition in weight and number as well as the length distribution of all species. Subsamples of cod, flounder, plaice, dab and turbot were investigated concerning sex, maturity and age.
Vertical profiles of the hydrographical parameters temperature, salinity and oxygen were sampled from the surface to the bottom immediately before every fishing haul with a CTDO probe (Sea Bird 19 + 4603).

4. Preliminary results

4.1. Biological data

In total 756 cod, 549 flounder, 618 plaice, 556 dab, 216 turbot and 27 brill were collected for measuring length, weight, sex, maturity and age. The total catches and numbers of length samples of cod and flounder are given in Table 2 by subdivision and depth stratum.

Tab. 2 Numbers of length measurements of cod, flounder, plaice and dab by ICES subdivision and depth stratum

Area		Sample			
		Cod		Flounder	
Subdivision	**Depth [m]**	**Weight [kg]**	**Number [n]**	**Weight [kg]**	**Number [n]**
22	**10-29**	12.8	17	45.6	191
24	**10-19**	131.2	1569	267.0	940
	20-39	876.4	1888	754.0	3242
	40-59	1028.5	2817	469.6	2025

Area		Sample			
		Plaice		Dab	
Subdivision	Depth [m]	Weight [kg]	Number [n]	Weight [kg]	Number [n]
22	10-29	32.8	306	66.5	592
24	10-19	151.5	900	390.0	4095
	20-39	289.4	1171	209.1	1583
	40-59	1296.0	6092	22.3	162

The mean catch per hour (CPUE) was 51,5 kg of cod and 38,6 kg of flounder. In general the catch composition was dominated by cod and flounder. However, plaice and dab were also abundant in the catches. The mean fraction of cod biomass in the hauls was 23,6 % and mean fraction of flounder, plaice and dab was 17,7 %, 20,3 % and 7, 9 %, respectively. sprat and herring represented 18.5 % of the total biomass in mean.
The highest abundances in weight and number of cod, flounder and plaice were observed in subdivision 24 in depths between 20 - 59 m and of dab between 10-39 m.
Mean CPUE are given in Table 3 by subdivision and depth stratum.

Tab. 3 Mean CPUE of cod, flounder, plaice and dab and average individual weights by ICES sub-division and depth stratum

Area		Catch							
		Cod				Flounder			
Subdivision	Depth [m]	Weight [kg/sm]	Number [n/sm]	Average Weight [g]	Stations [n]	Weight [kg/sm]	Number [n/sm]	Average Weight [g]	Stations [n]
22	10-29	0.7	1	752.6	12	2.5	10	238.6	12
24	10-19	9.6	115	83.6	9	19.5	69	284.0	9
	20-39	44.6	96	464.2	12	38.4	165	232.6	12
	40-59	36.8	101	365.1	18	16.8	72	231.9	18

Area		Catch							
		Plaice				Dab			
Subdivision	Depth [m]	Weight [kg/sm]	Number [n/sm]	Average Weight [g]	Stations [n]	Weight [kg/sm]	Number [n/sm]	Average Weight [g]	Stations [n]
22	10-29	1.8	17	107.0	12	3.6	32	112.4	12
24	10-19	11.1	66	168.4	9	28.5	300	95.2	9
	20-39	14.7	60	247.1	12	10.6	81	132.1	12
	40-59	46.4	218	212.7	18	0.8	6	137.6	18

The frequencies of cod grouped by subdivision and depth strata are presented in Figures 2 to 4. Noteworthy is the high abundance of young cod ranging in length from 10 to 25 cm in the subdivisions 24. The length range 26–40 cm of cod recruits compared to the previous year has significantly decreased in all depths layers in the subdivisions 24 and 22 Table 4 and Figures 2 to 4).

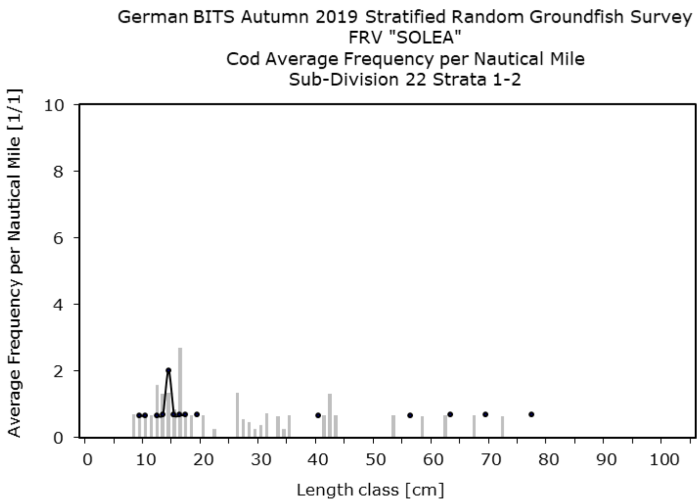

Fig. 2 Length frequencies of cod in number per mile in depth strata 10 m to 29 m in SD 22 2019 (line) and 2018 (bars), (12 Hauls)

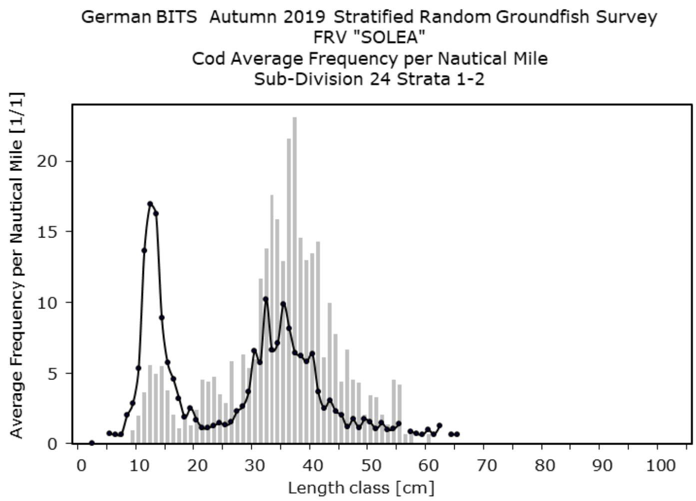

Fig. 3 Length frequencies of cod in number per mile in depth strata 10 m to 39 m in SD 24 2019 (line) and 2018 (bars), (22 Hauls)

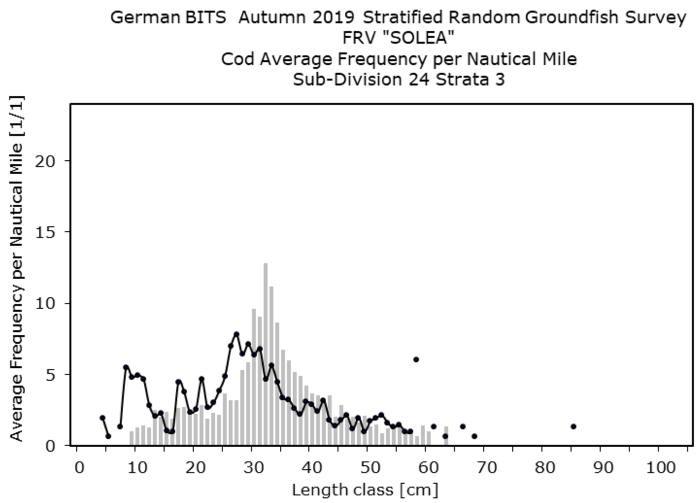

Fig. 4 Length frequencies of cod in number per mile in depth strata 40 m to 59 m in SD 24 2019 (line) and 2018 (bars), (18 Hauls)

Tab. 4 Recruitment of length groups of the year 2019 in comparison to the previous year

Area		Catch	2019		
Subdivision	**Depth [m]**	**Length range [cm]**	**Number [n]**	**Number/ Mile [n/sm]**	**Trawl distance [sm]**
22	**10-29**	**26 - 40**	-	-	18.3
24	**10-19**		95	7	13.7
	20-39		1235	63	19.6
	40-59		1904	68	27.9
22 - 24	**10-59**		3234	41	79.6
22	**10-29**	**10 - 25**	12	1	18.3
24	**10-19**		1424	104	13.7
	20-39		291	15	19.6
	40-59		475	17	27.9
22 - 24	**10-59**		2202	28	79.6

Area		Catch	2018		
Subdivision	**Depth [m]**	**Length range [cm]**	**Number [n]**	**Number/ Mile [n/sm]**	**Trawl distance [sm]**
22	**10-29**	**26 - 40**	21	1	23,7
24	**10-19**		396	32	12.2
	20-39		2448	178	13.7
	40-59		2951	94	31.4
22 - 24	**10-59**		5816	72	81.1
22	**10-29**	**10 - 25**	48	2	23.7
24	**10-19**		209	17	12.2
	20-39		150	11	13.7
	40-59		571	18	31.4
22 - 24	**10-59**		978	12	81.1

Under the assumption that the survey covered all nursery grounds of cod, a weak year class 2019 (table above) compared to the year class 2018 (table below) can be assumed.

4.2 Hydrographical data

Figure 5 shows the distribution of temperature, salinity and oxygen near the bottom and at the surface in the covered area.
The hydrography was characterised by typical autumn conditions with surface temperatures between 8.9 °C and 11.3 °C. The salinity of the surface water decreased from 17.1 to 7.5 from west to east. The lowest temperature value was found in Oderbank at 8.9 °C. The lowest salinity value was also in Oderbank at a water depth of 11.4 m 7.5 The salinity increased below the halocline at a depth of 22.2 m East of Fehmarn up to 23.3
The oxygen concentration close to the bottom was between 0.1-7.3 ml/l.

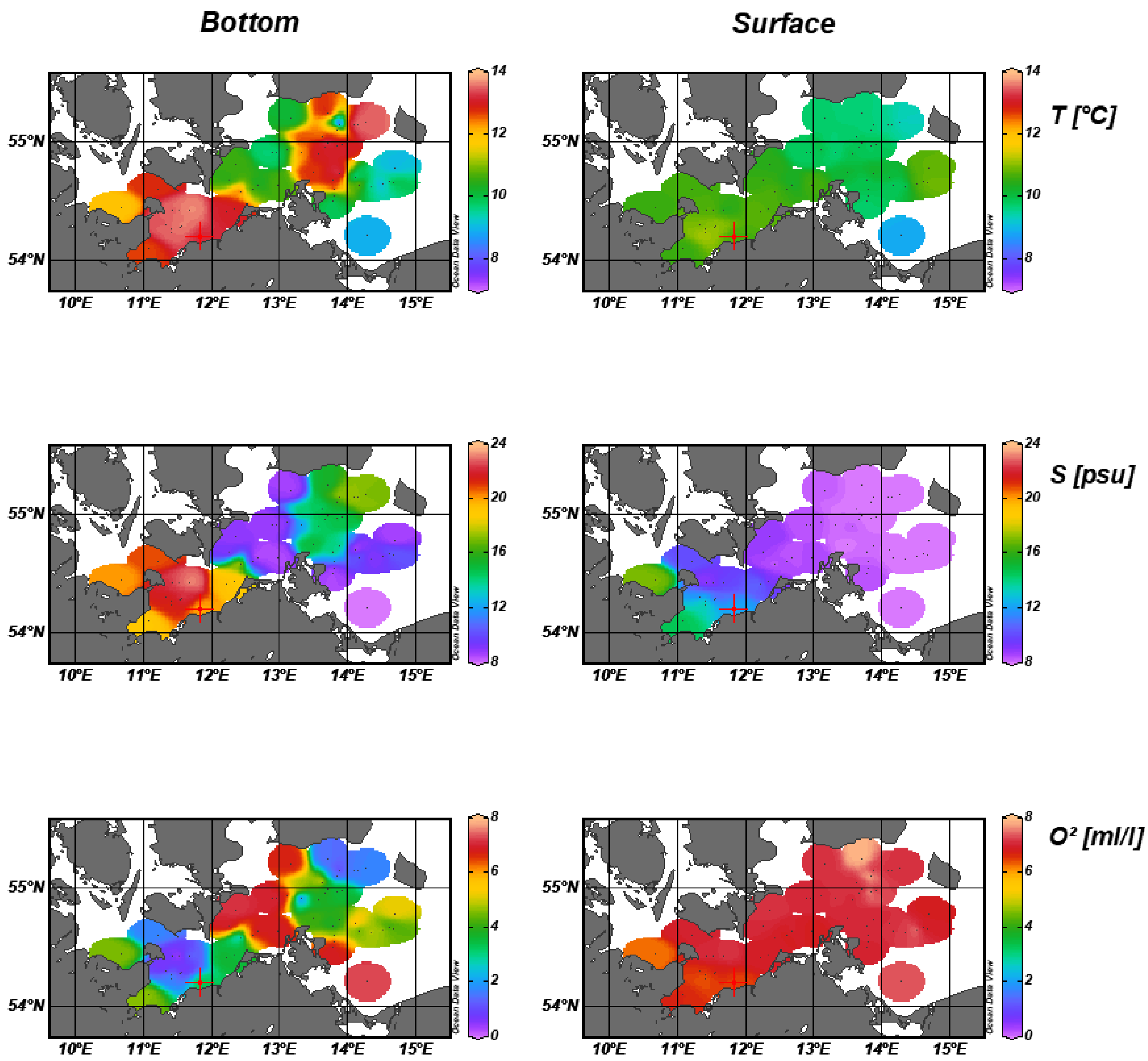

Fig. 5 Hydrography of the survey near the bottom (left) and at the surface (right)

5. Participants

A. Velasco	TI-OF	Scientist in charge
C. Albrecht	TI-OF	Technician
T. Jankiewicz	TI-OF	Technician
S. Dressler	TI-OF	Technician
R. Wiechert	TI-OF	Technician
F.-M. Conrad	TI-OF	Technician
S. Niemann	TI-OF	Technician
S. Winning	Uni Rostock	Student helper
M. Bächtiger	Uni Hamburg	Student helper

6. Acknowledgements

I would like to express my gratitude to Captain Schwegmann and his crew on the FRV "Solea" for their good cooperation.

sgd. Scientist in charge

Institute of Food Safety, Animal Health and Environment (BIOR), Riga (Latvia)
National Marine Fisheries Research Institute (NMFRI), Gdynia (Poland)

THE CRUISE REPORT

FROM THE JOINT LATVIAN-POLISH BITS 4Q SURVEY ON THE POLISH R.V. "BALTICA"
IN THE CENTRAL-EASTERN BALTIC (08-18 December 2019)

by
Ivo Sics*, Radosław Zaporowski** and Tycjan Wodzinowski **

* Institute of Food Safety, Animal Health and Environment (BIOR), Riga (Latvia),
** National Marine Fisheries Research Institute (NMFRI), Gdynia (Poland)

Gdynia - Riga, January 2020

Introduction

The joint Latvian-Polish BITS survey, conducted in the period of 08-18.12.2019 on the r/v. “Baltica”, was based on the agreement between the Institute of Food Safety, Animal Health and Environment (BIOR) in Riga and the National Marine Fisheries Research Institute (NMFRI) in Gdynia. The joint Latvian-Polish BITS 4Q survey was conducted in the Latvian EEZs (the ICES Sub-divisions 26 and 28). It was part of the Baltic International Trawl Survey (BITS), which was coordinated by the ICES Baltic International Fish Survey Working Group [WGBIFS] (Anon. 2019).

The main aims of reported cruise were:

1. Collecting materials to investigate the distribution, abundance and biological structure of cod stock.
2. Determine distribution and abundance of cod recruits. Estimates of year – class strength of cod.
3. Collecting materials to investigate the distribution abundance and biological structure of flounder stock.
4. Collect data on cod feeding.
5. Analysis of the hydro-meteorological conditions (seawater temperature, salinity, oxygen content, air temperature, atmospheric pressure, wind velocity and directions) in the ICES Sub-divisions 26N and 28.
6. Acoustical data recording during trawling and on the distance between consecutive catch-stations.
7. A collection of information about marine litter.

MATERIALS AND METHODS

Personnel

The BITS Q4 - 2019 survey scientific staff was composed of nine persons, i.e.:
Radosław Zaporowski, NMFRI, Poland - cruise leader,
Bartlomiej Nurek, NMFRI, Poland - hydrologist,
Władysław Gaweł, NMFRI, Poland - ichthyologist,
Maciej Bielak, NMFRI, Poland - acoustician,
Ivo Sics, BIOR, Latvia - ichthyologist,
Janis Aizups, BIOR, Latvia - ichthyologist,
Vadims Červoncevs, BIOR, Latvia - ichthyologist,
Laura Briekmane, BIOR, Latvia – ichthyologist,
Janis Gruduls, BIOR, Latvia – ichthyologist.

Narrative

The reported survey research tasks realisation took place during the period of 08-18 December 2019 and overall eleven full days was devoted to survey plan accomplishment. The at sea investigations were conducted within the Latvian EEZ (the ICES Sub-divisions 26 and 28) and inside the Latvian territorial waters not shallower than 20 m (the ICES Sub-division 28).

The vessel left the Gdynia port (Poland) on 08.12.2019 and was navigated towards the south-western corner of the Latvian EEZ (Fig. 1). The direct at sea investigations began on 09.12.2019 and were ended on 17.12.2019. On 18.12.2019 r/v “Baltica” returned to the homeport. Investigations were not conducted in 6 days during the very bad weather.

Survey design and realization

The original surveys plan provided that 24 control-hauls will be realized in the Latvian EEZ (18 trawls in SD 28 and 6 trawls in SD 26). Five additional trawls were planned in the SD 26, in the Lithuanian EEZ. One track selected for Latvia was in Polish EEZ (track 26269). This track was conducted during Polish 4Q BITS survey. .

The r.v. “Baltica” realized 14 bottom trawl control-hauls including the Latvian territorial waters (Fig. 1). Three catch-stations were only initiated by hydrological parameters measurement and due to very low oxygen concentration (below 0.5 ml/l) near bottom, fishing was omitted.

All trawl catches were performed in the daylight. The hard-bottom ground-rope (rockhopper) trawl, type TV-3#930 (with 10-mm mesh bar length in the codend) was applied for fish catches. The mean speed of vessel while trawling was 3.0 knots. For the all realized trawls, their duration was shortened to 15-20 minutes, due to dense clupeids concentrations observed on the echosounder or bad weather for trawling.

The length measurements in the 1.0-cm classes were realised for 178 cod and 1555 flounder. Length measurements in the 0.5-cm classes were realized for 1111 herring and 1156 sprat. In total, 263 cod and 326 flounder individuals were taken for biological analysis. Stomachs from the 187 cod were taken for investigation of cod feeding.

Acoustic data, i.e. the echo-integration records (SA = NASCs; Nautical Area Scattering (Strength) Coefficient) were collected with the EK-60 scientific echosounder during fishing operations and on the distances between consecutive hauls. Echo-sounding data collected during the BITS survey were delivered to the Latvian researchers for further analysis.

Directly before every haul, the seawater temperature, salinity and oxygen content were measured continuously from the sea surface to the bottom. The seawater samples were taken also at the standard HELCOM stations. Totally, 18 hydrological stations were inspected with the Neil-Brown CTD-probe combined with the rosette sampler (the bathometer rosette). Oxygen content was determined by the standard Winkler’s method.

Meteorological observations of wind velocity and directions and the sea state were realized at the actual geographic position of each control-haul.

Investigations were not conducted in 6 days during the very bad weather.

Results

Fish catches and biological data

The control-catches basic results collected in December 2019 during the Latvian-Polish BITS-4Q survey are presented in Table 1. Overall, 12 fish species were recognised in hauls performed in the central-eastern Baltic (Table 2.) Sprat dominated by mass in the ICES Sub - division 28 with the average share of 35.6%. Flounder was the next species most frequently represented in terms of mass, i.e. 32%. The share of herring and cod in control-catches made out in the ICES SD 28 was 25.2 and 5.9 %, respectively. By-catch of other fish species was insignificant.

The mean CPUE for all species in SD 28 amounted 78 kg/h, and in this 220.9, 184.7, 152.9 and 36.1 kg/h were for sprat, flounder, herring and cod, respectively.

Total catch of fishes and the number of realized hauls in the Latvian EEZ, during reported BITS survey is presented in the text-table below:

EEZ	Number of hauls	Total catch [kg]				
		Cod	Herring	Sprat	Flounder	Others
Latvian	14	111.8	478.6	676.4	608.5	26.1

The length distribution of cod, flounder, herring and sprat, according to the ICES Sub-division 28 are illustrated in Figures 2-5 and Tables 3-6.

Cod

The total length of cod in scrutinized samples ranged from 6 to 58 cm and specimens from the length classes of 24 - 35 cm dominated in samples from the ICES Sub-division 28 (Fig. 2, Table 3). Totally 441 cod from hauls in Sub-division 28 was measured.

Flounder

The total length of flounder in scrutinized samples ranged from 9 to 34 cm and specimens from the length classes of 17 - 27 cm dominated in samples from the ICES Sub-division 28, respectively (Fig. 3, Table 4).

Herring

The length range of collected herring was 10.5-25.5 cm, and specimens from the length classes of 15.5-21 cm were most frequently represented in samples from the ICES Sub-divisions 28 (Fig. 4, Table 5).

Sprat

The length range of collected sprat was 6.5-13.5 cm in ICES Sub-divisions 28. The length frequency apexes of 7.0-8.5 cm and 10.0-12.5 cm were characteristically for sprat samples from the ICES Sub-division 28 (Fig. 5, Table 6).

Hydrological situation in December 2019

Graphic illustration of the main hydrological parameters are shown on the figures 7-8. Hydrological parameters were measured at each trawling (14) and hydrological stations (4) (Fig. 1). Measurements were conducted with the CTD SeaBird 911-probe combined with the rosette sampler. Oxygen content was determined by the standard Winkler's method. The STD data were aggregated to the 1-m depth strata. The salinity parameter was presented in Practical Salinity Unit (PSU). Meteorological parameters were measured by MicroStep-MIS AMS 111 automatic weather station.

The most frequent winds (Fig. 6) were from direction SW. The average (10 min) wind speed varied from 1.7 m/s to 19.2 m/s (up to 29.5 m/s). The air temperature ranged from -1.3 °C to 9.4 °C, and average temperature was 4.7°C.

The seawater temperature in the surface layer varied from 6.29 to 8.03 °C. The lowest values were observed at the trawl 14, while the warmest surface water was at the station 40A. The average value equalled 7.37 °C. The average surface salinity was 7.37 PSU. The minimum value was 7.15 PSU (station 37) and maximum 7.54 PSU (station 45A). The highest oxygen content in surface water layer was 7.84 ml/l (trawl 14) while the lowest one 7.84 ml/l (trawl 8). Mean value of dissolved oxygen equalled 7.73 ml/l.

Near - bottom layer conditions are presented in the Fig. 7. Water temperature varied from 6.66 °C (station 45A) to 9.73 °C (station 46). The mean value calculated for the whole area covered during the cruise was 7.70 °C. The average salinity in the close-to-the-bottom water layers was 9.13 PSU. The highest value was measured at the hydrological station 37 (13.22 PSU). The lowest one was 7.31 PSU (station 40A). The dissolved oxygen varied from 0.00 ml/l (hydrological station 37) to 7.93 ml/l (trawl 10).The mean value was 5.38 ml/l.

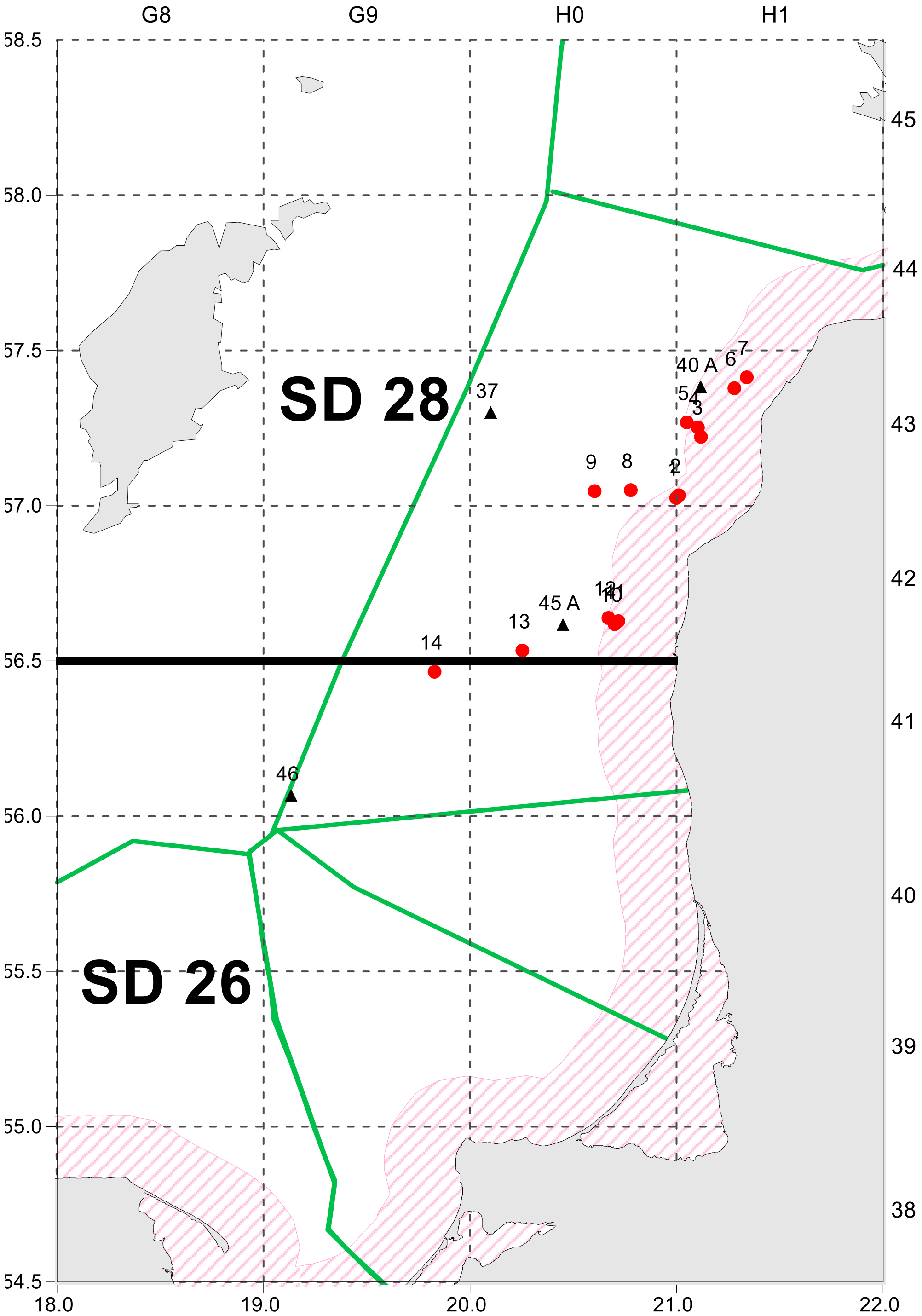

Figure 1. Location of the realized fish control-hauls (marked with red dots) and the HELCOM standard hydrological stations (marked with black triangles), green lines - national fishing zone borders.

Table 1. Catch results from the Latvian-Polish BITS 4Q survey; r/v "Baltica", 08-18 December 2019

Haul number	Date of catch	EEZ	ICES rectangle	ICES SD	Depth to the bottom [m]	The ship's course during fishing [°]	Geographical position of the catch station				Time of		Haul duration [min.]	Total catch	all species CPUE [kg/0.5h]	CATCH of particular fish species [kg]				
							start		end											
							latitude 00°00' N	longitude 00°00' E	latitude 00°00' N	longitude 00°00'E	shutting net	pulling up net				Sprat	Herring	Cod	Flounder	Others
1	2019-12-12	LAT	43H0	28	32	020	57°01.5	20°59.9	57°02.4	21°00.4	10:45	11:05	20	55.205	82.8075	9.917	17.948	1.386	24.12	1.834
2	2019-12-12	LAT	43H1	28	31	025	57°02.0	21°00.7	57°02.8	21°01.4	12:00	12:20	20	47.757	71.6355	8.252	11.235	5.3	21.27	1.7
3	2019-12-12	LAT	43H1	28	47	030	57°13.3	21°07.1	57°14.2	21°07.9	14:00	14:20	20	372.747	559.1205	160.034	59.646	4.14	140.37	8.557
4	2019-12-13	LAT	43H1	28	59	030	57°15.1	21°06.2	57°15.6	21°06.7	08:20	08:35	15	230.402	460.804	66.528	68.112	4.59	90.13	1.042
5	2019-12-13	LAT	43H1	28	62	315	57°16.1	21°03.0	57°16.5	21°02.3	10:10	10:25	15	432.44	864.88	313.971	88.679	2.49	24.86	2.44
6	2019-12-13	LAT	43H1	28	48	020	57°22.7	21°16.8	57°23.7	21°17.3	12:20	12:40	20	192.534	288.801	54.194	32.906	7.31	95.39	2.734
7	2019-12-13	LAT	43H1	28	34	360	57°24.8	21°20.4	57°25.8	21°20.3	13:30	13:50	20	112.593	168.8895	41.141	29.319	4.35	36.6	1.183
8	2019-12-15	LAT	43H0	28	74	350	57°03.0	20°46.7	57°04.0	20°46.7	08:25	08:45	20	197.671	296.5065	2.445	81.855	27.74	84.76	0.871
9	2019-12-15	LAT	43H0	28	88	-9	57°02.8	20°36.2	57°02.8	20°36.2	10:00	10:05	5	0	0	0	0	0	0	0
10	2019-12-17	LAT	42H0	28	39	025	56°37.1	20°42.0	56°37.7	20°42.5	08:25	08:40	15	76.586	153.172	9.606	25.634	10.53	28.81	2.006
11	2019-12-17	LAT	42H0	28	39	025	56°37.7	20°43.1	56°38.3	20°43.7	09:15	09:30	15	64.173	128.346	2.78	15.52	15.6	28.2	2.073
12	2019-12-17	LAT	42H0	28	49	050	56°38.3	20°40.2	56°38.8	20°41.7	10:30	10:45	15	119.313	238.626	7.536	47.784	28.38	33.97	1.643
13	2019-12-17	LAT	42H0	28	92	-9	56°32.0	20°15.2	56°32.0	20°15.2	13:30	13:35	5	0	0	0	0	0	0	0
14	2019-12-17	LAT	41G9	26	111	-9	56°27.9	19°49.7	56°27.9	19°49.7	15:25	15:30	5	0	0	0	0	0	0	0

Table 2. Number of fish biologically analysed during the BITS 4Q survey; r.v. "Baltica" (08-18 December 2019).

Species	Number of samples			Number of fish								
				measured			analyzed			stomach samples		
	SD 26	SD 28	Total	SD 26	SD 28	Total	SD 26	SD 28	Total	SD 26	SD 28	Total
Cod	0	11	11	0	178	178	0	263	263	0	187	187
Flounder	0	11	11	0	1555	1555	0	326	326			
Herring	0	11	11	0	1111	1111						
Sprat	0	11	11	0	1156	1156						
Round Goby	0	3	3	0	7	7						
Turbot	0	5	5	0	10	10						
Four Bearded Rockling	0	1	1	0	1	1						
Eelpout	0	6	6	0	23	23						
Smelt	0	9	9	0	66	66						
Lumpfish	0	1	1	0	2	2						
Sea Scorpion	0	11	11	0	137	137						
Sand Goby	0	3	3	0	12	12						
Total	0	83	83	0	4258	4258	0	589	589	0	187	187

Fig. 2. Length frequency of cod from Sub-Division 28 in the control catches during the r/v "Baltica" BITS survey, 08-18 December 2019

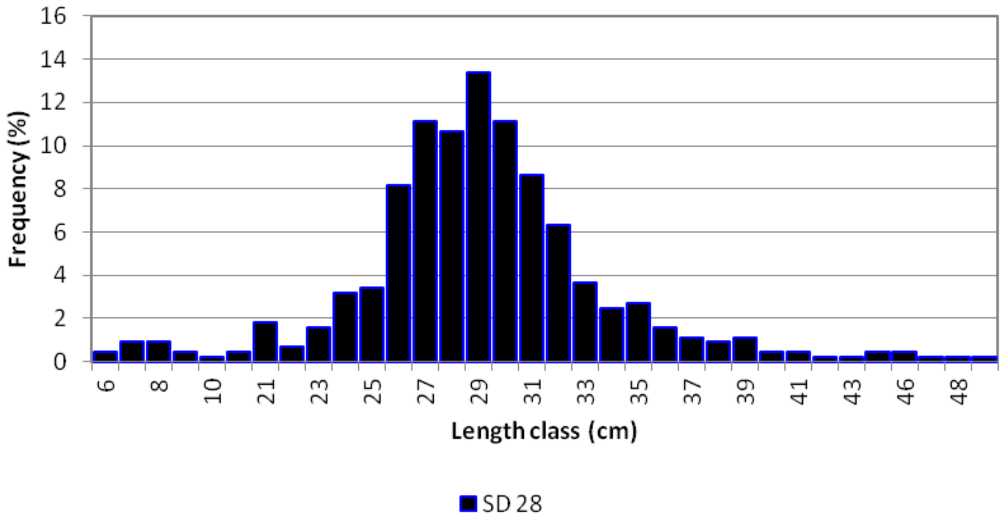

Fig. 3. Length frequency of flounder from Sub-Division 28 in the control catches during the r/v "Baltica" BITS survey, 08-18 December 2019

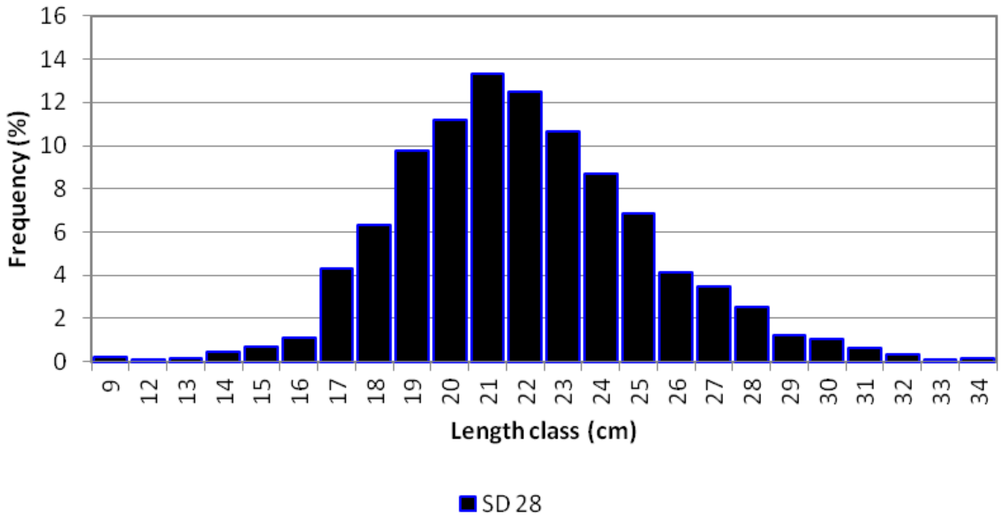

Fig. 4. Length frequency of herring from Sub-Division 28 in the control catches during the r/v "Baltica" BITS survey, 08-18 December 2019

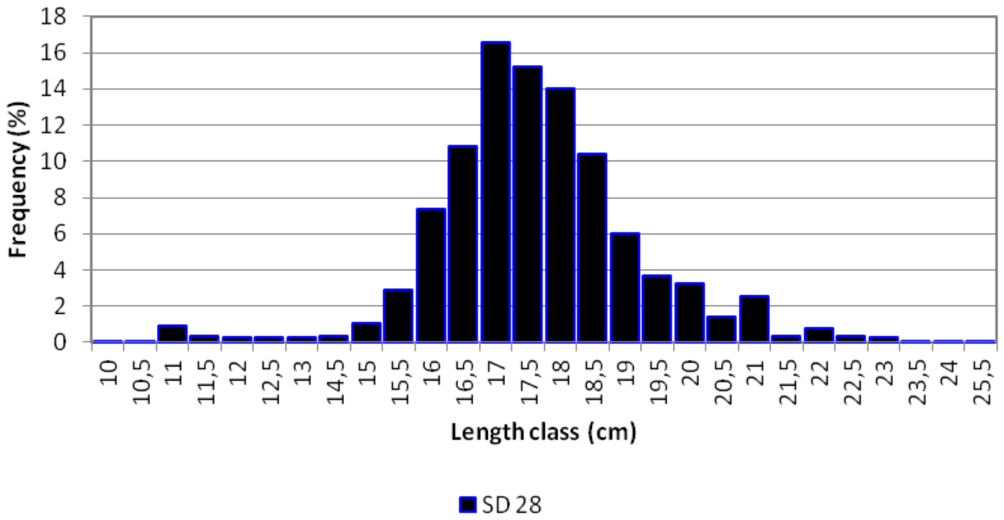

Fig. 5. Length frequency of sprat from Sub-Division 28 in the control catches during the r/v "Baltica" BITS survey, 08-18 December 2019

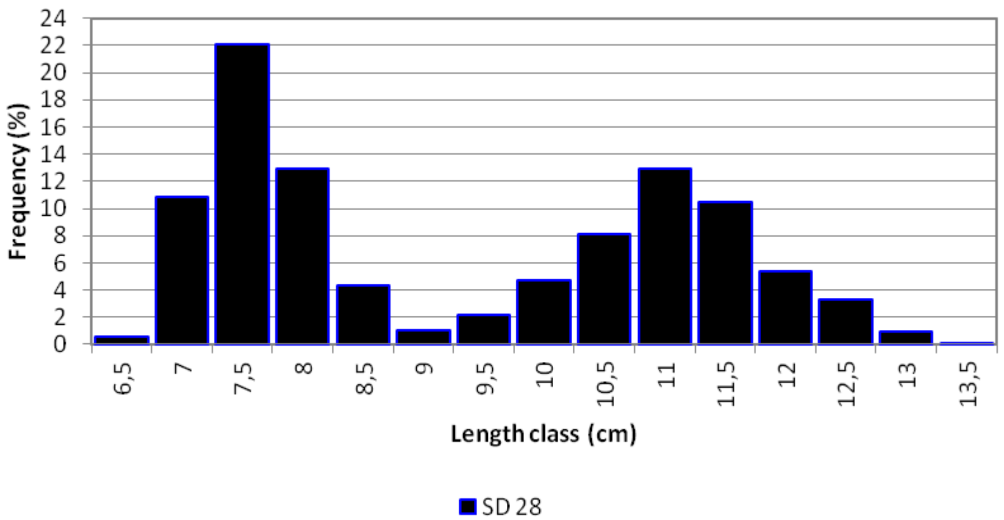

Table 3. Cod length measurements by consecutive hauls in the r/v "Baltica" Latvian - Polish BITS survey (08-18 December 2019); specimens grouped by 1 cm length classes.

		cm_group																																		
Haul no	SD	6	7	8	9	10	18	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	45	46	47	48	58	Sum
1	28			1											1		1		1						1											5
2	28			1							1			3		1	2	3	2	1			1			1					1					17
3	28		2					1					1	1		1	1	3				1		1		1							1			14
4	28		1	1		1	1	1			2	1			1	2	1	2	1			1			1	1	1									19
5	28			1								1	1	1	1	3		1	1				1													11
6	28													1		1	2	2	2		1	1	1		1	1		1							1	15
7	28												1		1	1		1	3	2	1	1	1			1										13
8	28	2	1		1			3		3	6	5	11	17	16	14	17	6	6	4	3	3	1				1			1		2				123
10	28									1			5	2	7	5	5	4	4	3	2	1		2												41
11	28										1	2	1	12	5	11	6	9	2	2	3	1	1	1					1					1		59
12	28				1		1	3	3	3	4	6	16	12	15	20	14	7	6	4	1	3	1	1	1			1			1					124
Total		2	4	4	2	1	2	8	3	7	14	15	36	49	47	59	49	38	28	16	11	12	7	5	4	5	2	2	1	1	2	2	1	1	1	441

Table 4. Flounder length measurements by consecutive hauls in the r/v "Baltica" Latvian - Polish BITS survey (08 - 18 December 2019); specimens grouped by 1 cm length classes.

		cm_group																							
Haul no	SD	9	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	Sum
1	28	2		1	1	2	7	14	26	25	33	33	25	19	20	5	6	3	4	2	2	1				231
2	28				3	3	4	18	19	29	15	32	26	17	19	10	3	1	2	1	1	1				204
3	28	1	1		1	2	2	9	16	19	20	28	28	24	23	15	16	12	3	3	1	2	2	1		229
4	28	1				1		2	8	12	18	20	18	23	14	11	5	7	3	1			1	1		146
5	28			1		1	1	13	15	30	35	39	34	16	12	11	6	6	1	1	1					223
6	28				1	1	1	5	6	7	11	18	16	21	10	9	7	4	9	3	2	2				133
7	28		1		2	2	3	11	15	31	32	22	37	23	12	7	9	3	2		1					213
8	28								2	4	8	12	10	17	20	17	9	9	6	5	6	4	2			131
10	28						1	5	2	9	14	11	14	19	10	17	5	7	6	2	2		1		1	126
11	28			1			1	3	3	5	16	14	11	11	8	12	8	10	6	1	2	1			1	114
12	28					1	1	1	7	13	8	22	16	10	15	15	4	4	6	4	2	1			1	131
Total		4	2	3	8	13	21	81	119	184	210	251	235	200	163	129	78	66	48	23	20	12	6	2	3	1881

Table 5. Herring length measurements by consecutive hauls in the r/v "Baltica" Latvian-Polish BITS survey (08- 18 December 2019); specimens grouped by 0.5 cm length classes.

		cm_group																											
Haul no	SD	10	10.5	11	11.5	12	12.5	13	14.5	15	15.5	16	16.5	17	17.5	18	18.5	19	19.5	20	20.5	21	21.5	22	22.5	23	23.5	24	25.5	Sum
1	28									1	2	7	13	14	13	14	14	12	2	2		3	1	1				1		100
2	28	1		3						1	1	8	10	17	18	14	15	4	3	1	1	2			1					100
3	28								2		7	10	13	13	21	14	9	4	3	2	2									100
4	28								2	3		13	13	14	9	15	13	7	5	4	1	1								100
5	28										2	7	13	18	17	15	12	6	3	2	3			2						100
6	28			1						2	5	7	7	21	19	19	5	4	1	2		1								94
7	28			1	2	1	1				5	6	15	26	17	12	8	5	2	2	2									105
8	28											3	5	13	14	17	13	10	6	6	2	5	3	2		2				101
10	28									2	4	6	9	22	15	9	6	7	5	2	3	6		2			1		1	100
11	28					2	1	2		1	4	6	13	14	11	13	12	2	2	7		5		1	1	1				98
12	28		1	5	2		1	1		2	2	9	9	12	15	14	9	6	9	6	2	5		1	2					113
Total		1	1	10	4	3	3	3	4	12	32	82	120	184	169	156	116	67	41	36	16	28	4	9	4	3	1	1	1	1111

Table 6. Sprat length measurements by consecutive hauls in the r/v “Baltica” Latvian-Polish BITS survey (08- 18 December 2019); specimens grouped by 0.5 cm length classes.

		cm_group															
Haul no	SD	6.5	7	7.5	8	8.5	9	9.5	10	10.5	11	11.5	12	12.5	13	13.5	Sum
1	28	2	9	44	18	7	2	5	9	4	6			3			109
2	28		21	49	15	2	1	2	5	2	3	4	2				106
3	28		2	2	5	1			3	20	29	28	9	4	4		107
4	28			1	5	6			1	14	32	26	13	7	3		108
5	28				4	1	1		5	21	33	26	19	4		1	115
6	28	1	11	23	28		2		1	6	12	10	4	4			102
7	28	2	30	35	14	6	1	1	1	4	6	5	2	1			108
8	28			3	11	11			1	8	16	16	10	8	1		85
10	28	1	11	37	25	7	1	3	11	3	3	2	1				105
11	28	1	20	32	16	5	3	7	9	7	3	1	1	3	1		109
12	28		21	29	9	4	1	7	9	5	7	3	1	4	2		102
Total		7	125	255	150	50	12	25	55	94	150	121	62	38	11	1	1156

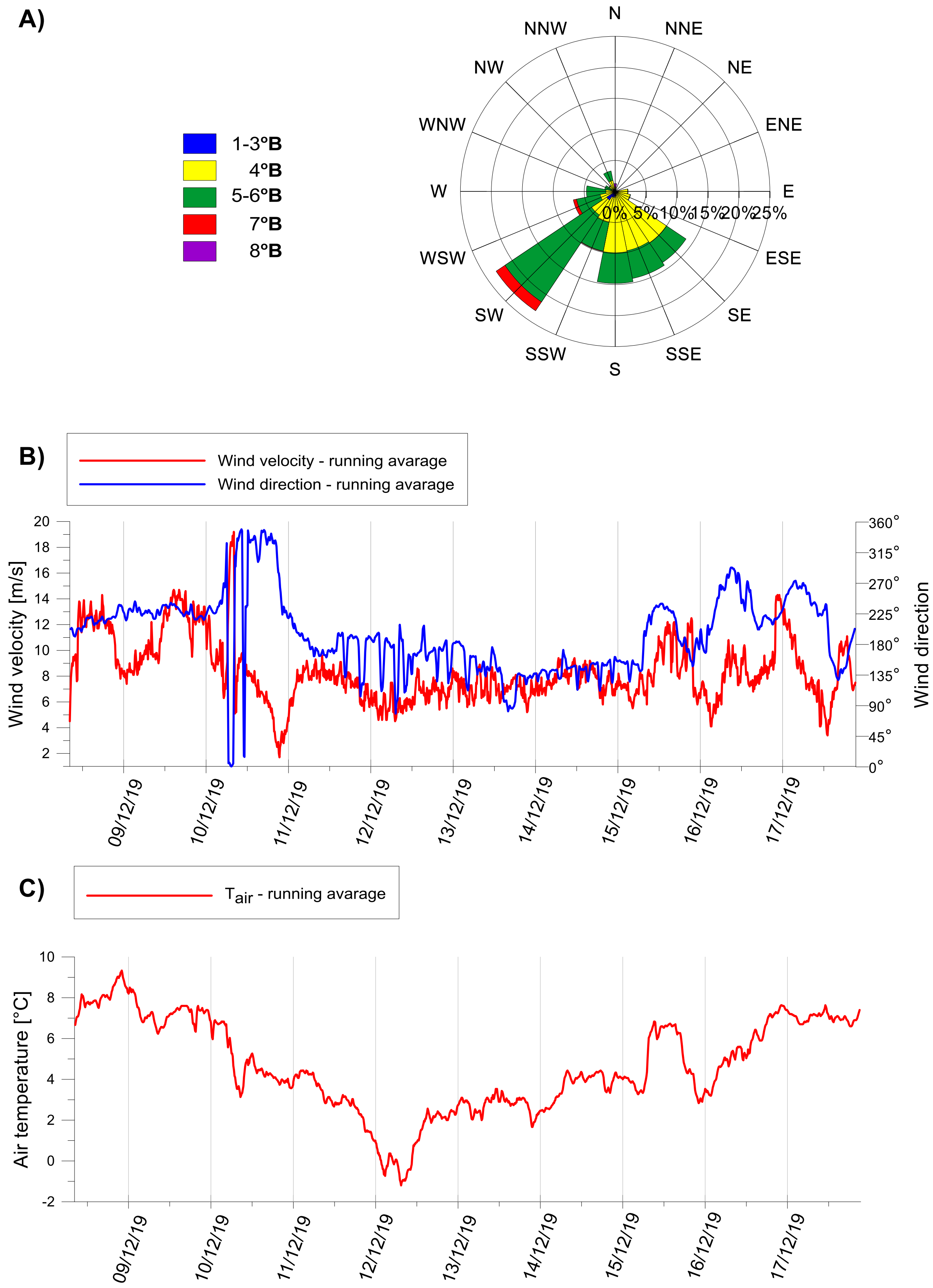

Figure 6. Changes of the main meteorological parameters (December 2019).

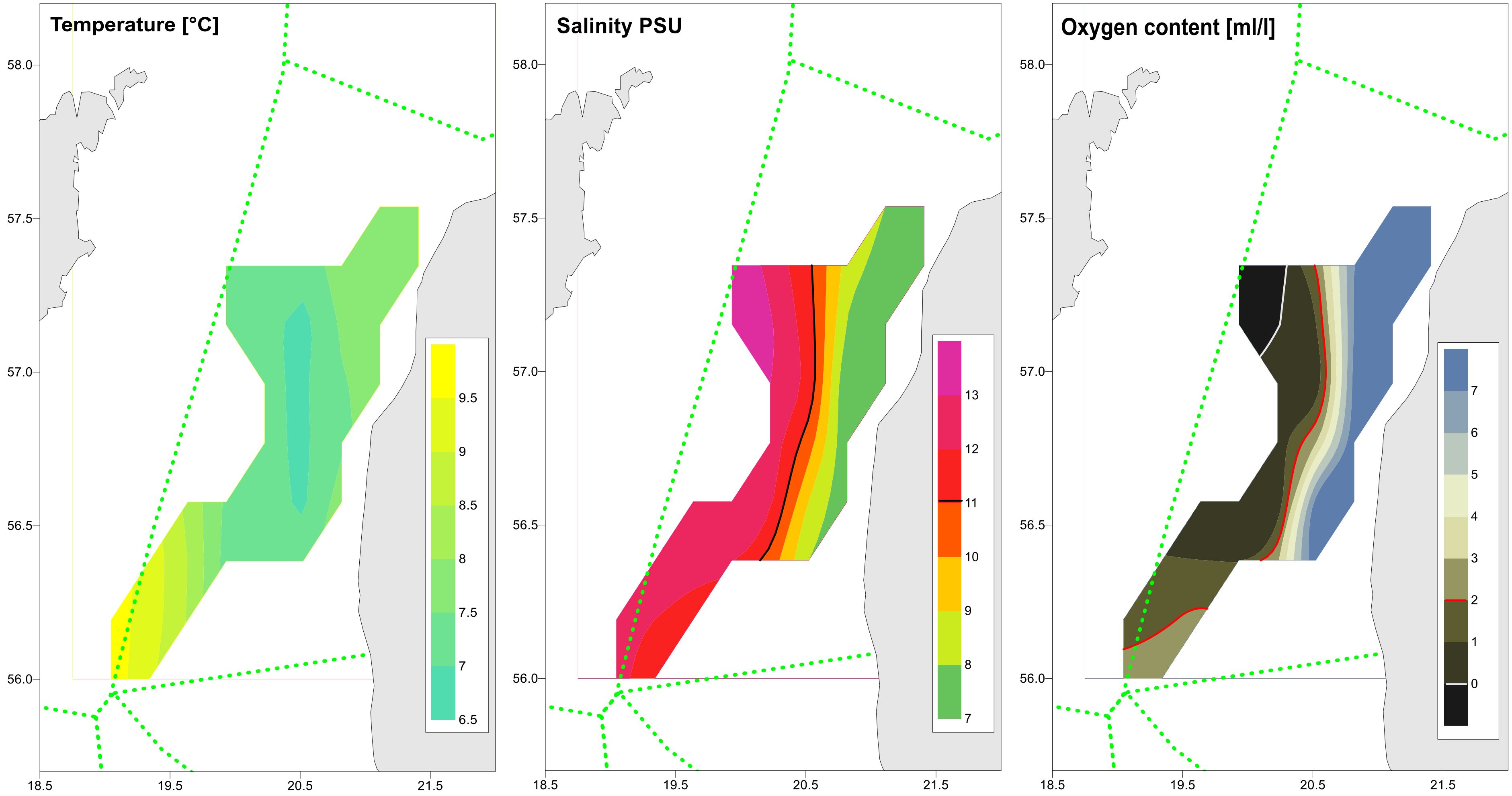

Figure 7. Distribution of the seawater temperature, salinity and oxygen content in the near bottom waters (December 2019).

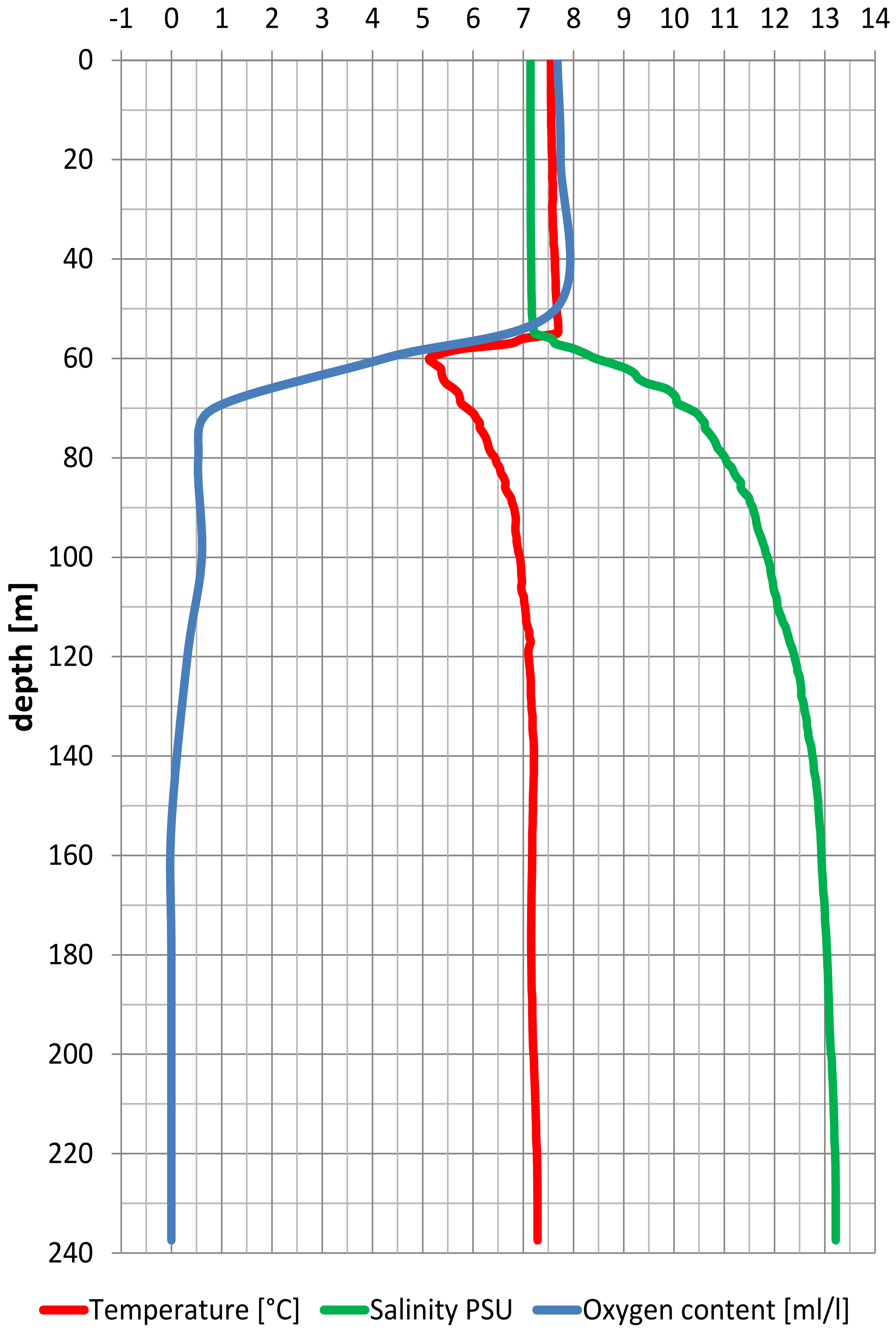

Figure 8.Vertical distribution of the seawater temperature, salinity and oxygen content at the hydrological profile 37 (December 2019).

Klaipeda University
Marine Research Institute

Lithuania BITS Q4 2019 report

Marijus Špėgys

1. INTRODUCTION

The cruise of the FV "LBB – 1113" was part of the Baltic International Trawl Survey (BITS) which is coordinated by ICES WGBIFS. The main objective of the survey is the estimation of fishery independent stock indices of both Baltic cod stocks, of flounder and other flat fish.

The following further objectives were covered during the survey:

Collecting data for assessing stock indices, the structure and recruitment of the stocks especially for cod and flatfish.

Monitoring the composition of fish species in the South-Eastern Baltic Sea

Collecting length samples for all species.

Collecting samples of cod and flounder for biological investigations (i.e., sex, maturity, age).

Collecting litters from trawl.

2 METHODS

2.1 Personnel

Marijus Špegys, Marine research institute, Klaipeda University - cruise leader;
Žilvinas Kregždys, Marine research institute, Klaipeda University –fish sampling.

2.2 Description

The cruise took place two days (21-22 November 2019). FV "LBB – 1113" has covered the Sub-division 26 in Lithuanian EEZ.

2.3 Survey design and realization

The international coordinate trawl survey is planned as Stratified Random Survey where ICES subdivisions and depth layers are used as strata. A total of 6 stations were planned for the Lithuania part of the survey, which realize complete accordance with the agreements of WGBIFS during the meeting in 2019. The hauls' positions were selected from the TOW Database by the coordinator of the BITS surveys (ICES 2019, WGBIFS report as reference). All 6 fishing stations were successfully realized. The fishing hauls were realized in the daylight, between 08:30 and 16:00 local time.

Trawling was done with the standard trawl "TV3/520#". The stretched mesh size in the codend was 20 mm. The duration of the hauls was 30 minutes and the velocity was 3 knots. The total catch of each haul was analysed to determine the species' composition in weight and number as well as the distribution of length among all species. Sub-samples of cod, flounder were investigated concerning sex, maturity and age. Surface temperature and salinity were immediately sampled after every fishing hauls.

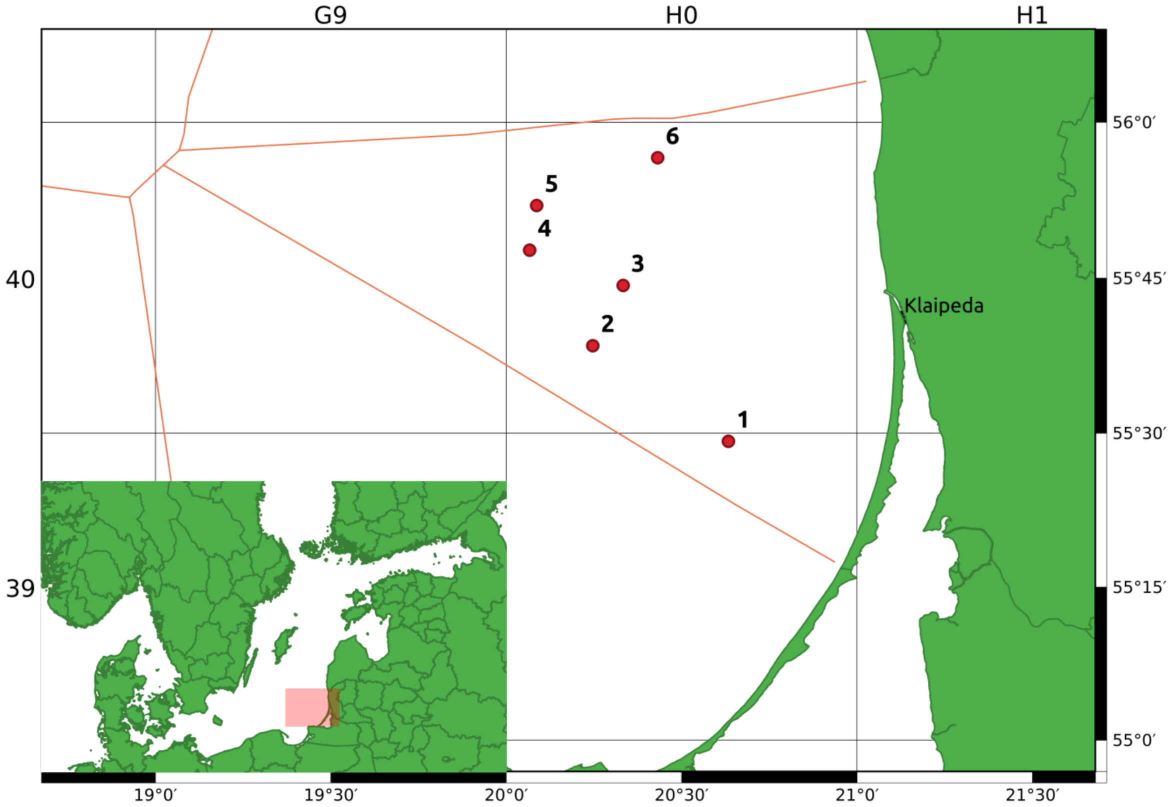

Figure 1. Trawl hauls position of C/V "LBB -1010" in BITS 2019 m. Q4 survey

The length measurements in the 1.0 cm classes was realised for cod, flounder and turbot, subsample were taken for biological analysis to laboratory. The length measurements in the 0.5 cm classes was realised of herring and sprat.

All information about haul and catches are shown in table 1 and table 2.

Table 1. Haul information from the Lithuania BITS Q4 survey with the TV3/520# bottom trawl

Haul number according to TD data	The ICES rectangle (subdivision)	Trawling depth (m)	Geographical position of catch station			
			00.00 N	00.00 E	00.00 E	00.00 N
26052	39H0 (26)	65	55.49	20.63	55.51	20.61
26208	40H0 (26)	71	55.64	20.25	55.65	20.28
26206	40H0 (26)	55	55.74	20.33	55.76	20.33
26197	40H0 (26)	66	55.80	20.07	55.82	20.07
26215	40H0 (26)	61	55.87	20.09	55.86	20.13
26134	40H0 (26)	38	55.94	20.43	55.95	20.48

Table 2 Fish catches results from the Lithuania BITS 2019 4Q survey with the TV3/520# bottom trawl

Haul number according to TD data	Catch date	The ICES rectangle (subdivision)	Trawling depth (m)	Total CPUE (kg/h)	CPUE per species (kg/h)			
					Cod	Flounder	Place	Others
26052	2019-11-21	39H0(26)	65	491.3	85.6	311.5	0.2	94.0
26208	2019-11-21	40H0(26)	71	170.7	3.0	15.5	0	152.2
26206	2019-11-21	40H0(26)	55	670.8	388.4	255.9	0.4	26.1
26197	2018-11-22	40H0(26)	66	88.9	20.8	21.6	0	46.6
26215	2018-11-22	40H0(26)	61	80.3	19.0	53.1	0	8.2
26134	2018-11-22	40H0(26)	38	909.6	287.6	479.9	0	142.1
Mean					81.1	24.4	0.7	17.5

3. RESULTS

In total 754 cods, 1076 flounders, 2 places, 4 turbots 1728 herrings and 167 other species were collected for measuring and from that measurement sample 286 cods and 248 flounders and 2 place and 4 turbot were collected for weight, sex, maturity and age. Numbers of biological samples by haul given in Table 3.

Cod from the length classes range of 25-33 dominated in samples. The fish with this length range constituted about 87.0% of all measured cod. Compared to the 2018 Q4 survey you can see a decrease in cod larger than 35 cm. (Fig. 1).

The total length of flounder ranged from 16 to 35 cm, with dominating length classes of 20-27 cm. The fish with this length range constituted about 81.1% of all measured flounder.

The total length of herring ranged from 8 to 30.0 cm. Herring from the length classes of 16.5-24 was dominated in samples and constituted about 64.5% of all measured herring (Fig. 3).

The length distributions of cod, flounder, herring and sprat, according to the ICES Sub-divisions 26 are shown in Figures 1-3.

Table 3. Biological samples of all hauls from the Lithuania BITS 2019 Q4 survey

Haul number	Catch date	The ICES rectangle and subdivision	Trawling depth (m)	Numbers of biological samples					
				Length				Age, sex, maturity	
				Cod	Flounder	Place	Turbot	Cod	Flounder
1	2019-11-21	39H0(26)	65	162	311	1	1	286	248
2	2019-11-21	40H0(26)	71	4	34				
3	2019-11-21	40H0(26)	55	271	263	1	1		
4	2018-11-22	40H0(26)	66	32	46				
5	2018-11-22	40H0(26)	61	43	143				
6	2018-11-22	40H0(26)	38	242	279		4		
Sum				**754**	**1076**	**2**	**6**		

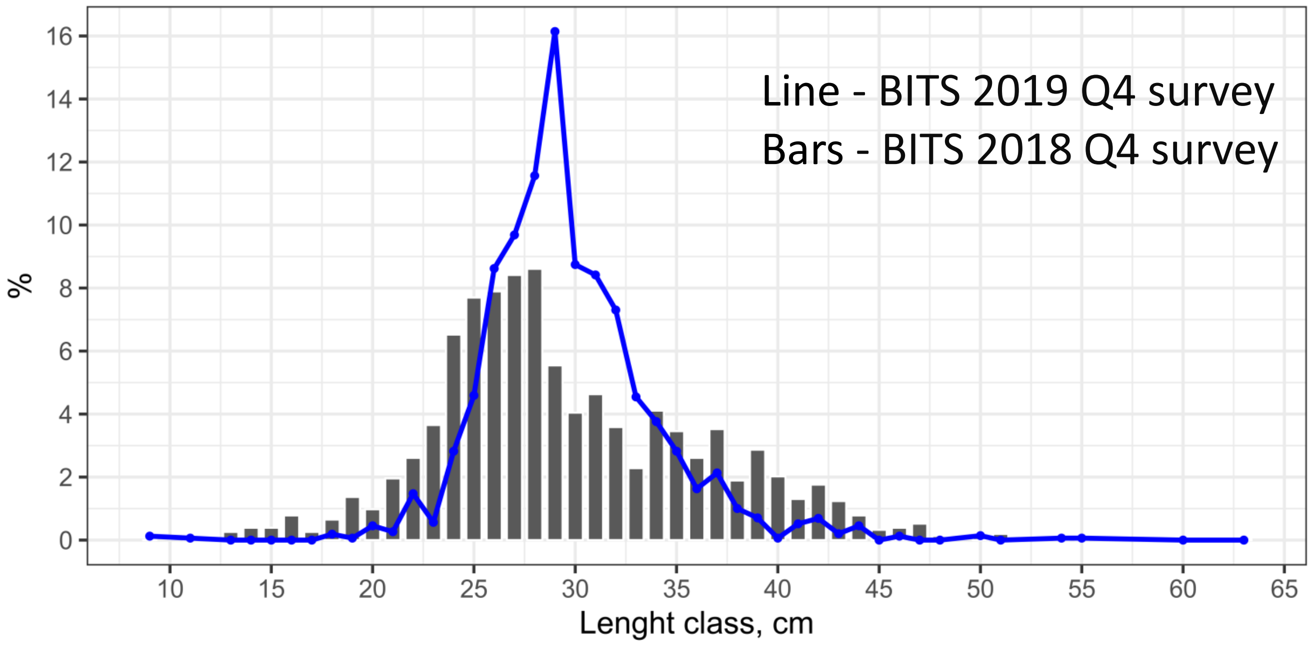

Figure 2. Cod length distribution from Lithuania BITS 2019 and 2018 Q4 surveys.
Line - 2019 Q4 survey; bars – 2018 Q4 survey.

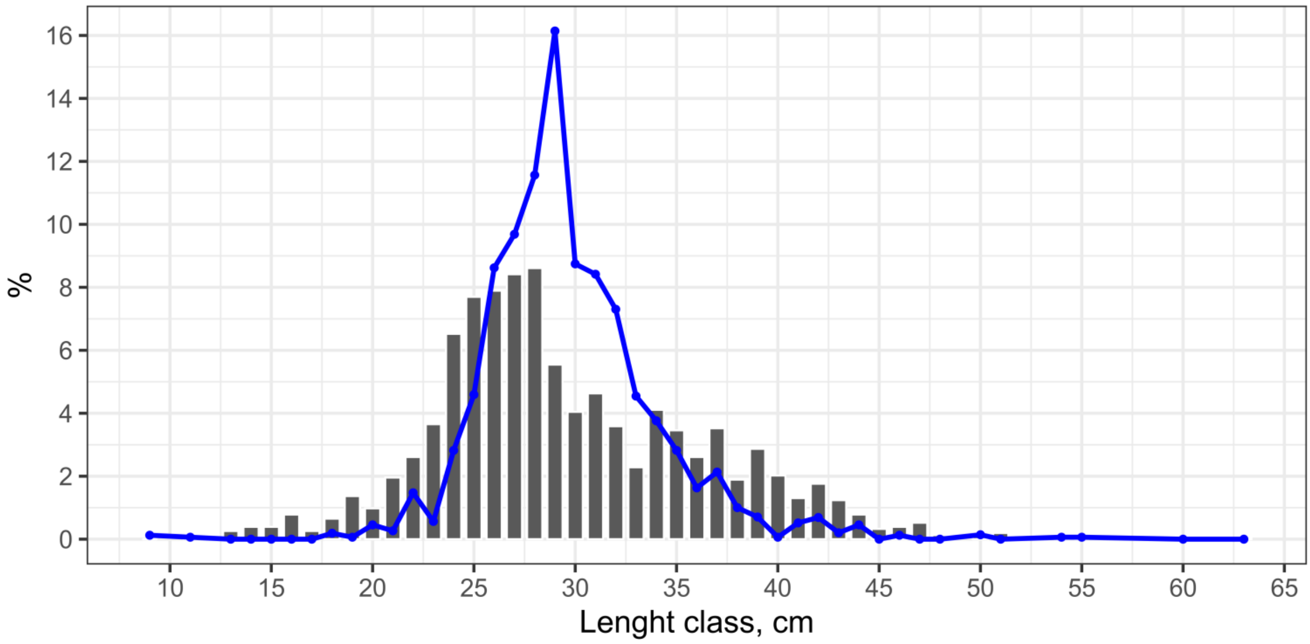

Figure 3. Flounder length distribution from Lithuania BITS 2019 and 2018 Q4 surveys.
Line - 2019 Q4 survey; bars – 2018 Q4 survey.

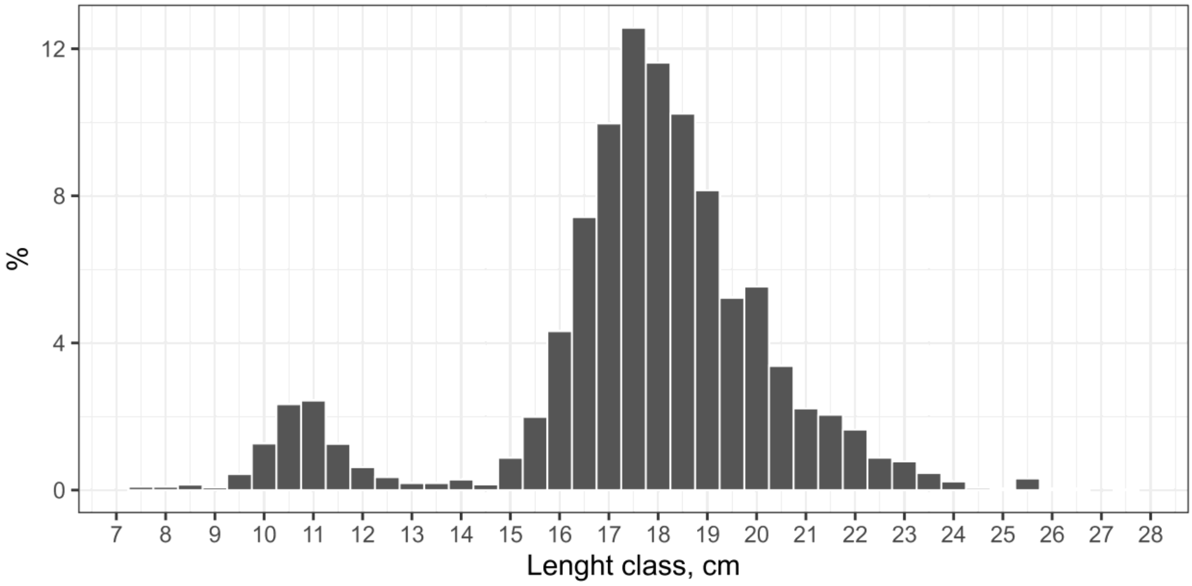

Figure 4. Herring length distribution from Lithuania BITS 2019 m. Q4 survey

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Working paper on the WGBIFS meeting, 30.03-03.04.2020

RESEARCH REPORT

FROM THE POLISH R/V BALTICA BITS 4Q 2019 SURVEY
IN THE SOUTHERN BALTIC
(11-29 November 2019)

by

Krzysztof Radtke and Tycjan Wodzinowski

Gdynia, 02 April 2020

INTRODUCTION

Since 1995, the permanent participation of Polish R/V Baltica operated by the National Marine Fisheries Research Institute (NMFRI) in Gdynia, has taken place in autumn and winter Baltic International Trawl Surveys (BITS-4Q and BITS-1Q) realised in the southern Baltic. In March 2000 when the research standard fishing gear in the Baltic Sea - the cod bottom trawl type TV-3, has been applied by the vessels assigned to the BITS surveys realization, the principal methods of investigations within BITS-4Q ground-trawl surveys designated to particular national laboratories, including the NMFRI were designed and co-ordinated by the Baltic International Fish Survey Working Group (WGBIFS; Anon. 2019). The main aim of the BITS-4Q survey planned in autumn 2019 was to monitor abundance and spatial distribution of the main demersal fish species and to some extent also clupeids in the bottom zone of the Baltic, taking into account hydrological parameters. The R/V Baltica BITS-4Q 2019 survey, which was realized in the Polish part of the ICES Sub-divisions 25 and 26, was aimed at:

- determination of the spatial distribution of cod, flounder, herring and sprat in the near bottom zone of the southern and central Baltic during autumn 2019 applying method of random selection of control-hauls,
- estimation of the fishing efficiency, i.e. catch per unit effort (CPUE), the share of particular species in total mass of bottom control-catches,
- collecting biological samples of dominated fish for the determination of the age-length-mass relationship, sex, sexual maturation, feeding conditions and externally visible diseases,
- analysis of the vertical and horizontal changes of the basic hydrological parameters (temperature, salinity, oxygen content) in the areas of fish catches and in neighbouring standard hydrological stations,
- collect and identify the abundance of marine litter present in the fishing hauls.

MATERIAL AND METHODS

The above purposes of the November 2019 BITS 4Q survey aboard of R/V Baltica were realized by the NMFRI nine members of scientific team, with Krzysztof Radtke as a cruise leader. The scientific team was also composed of seven ichthyologists including technicians, responsible for determination of fish species composition of catches, fish biological analyses and data processing and one hydrologist, responsible for seawater sampling and analysing as well as for meteorogical monitoring.

Narrative

The reported Polish ground-trawl survey on board of R/V Baltica, marked with the number 23/2019/MIR took place during the period of 11-29.11.2019 within the framework of the ICES Baltic International Trawl Surveys (BITS) long-term programme (Anon. 2019) and the Polish Fisheries Data Collection Programme for 2019. The vessel left the port of Gdynia on 11.11.2019 in the morning and at sea investigations began in the eastern part of the Gulf of Gdańsk (Fig. 1, Tab. 1). The survey ended on 29.11.2019 (morning) in Gdynia harbour. The R/V Baltica operated in the Polish EEZ only. Overall, nineteen days were utilized for fulfilling the BITS_4Q survey purposes including time spent for the vessel translocation from the Gdynia port to research area and in the final phase of the survey, a return way to the vessel home-port.

Survey design and realization – sampling description

According to the WGBIFS plan, the Polish vessel was recommended to cover in November 2019 survey, the Polish part of ICES Sub-divisions 25 and 26 with 26 and 35, respectively randomly selected bottom fishing hauls. The R/V Baltica realized all the 61 of the planned fishing hauls for this survey. One haul was considered as “Invalid” due to by-catch of about 500 kg of wooden parts completely damaging the fish in the catch. The haul was not repeated. One haul was assumed as “Non-oxygen” as the oxygen level at the bottom was below 0.5 ml/l and therefore the haul was not conducted but assumed as zero catch. It can be concluded that the remaining 60 hauls realized could be accepted as fully representative from the technical point of view (Fig. 1, Table 1) taking into account gear performance during hauls.

Trawling was done with the standard rigging ground trawl type TV-3#930 (without bobbins and additional chains connected to the footrope), with 10-mm mesh bar length in the codend. A standard vertical fish-sounder monitored the trawling depth. Usually a 6-7 m vertical net opening was achieved, which was monitored by the net echosounder. The catch stations were located on the depth range from 20 to 113 m. Fish control-hauls were conducted at the daylight only, lasting maximum 30 minutes, at on average 3.0 knots vessel speed.

Each fishing haul was sorted out for the determination of the species composition. Mean CPUE of each fish species and their average share in mass of catches were calculated. From each catch station, representative samples of dominated fishes were collected to determine age-length-mass relationships, sex, sexual maturation, feeding conditions, externally visible diseases and additionally stomach samples for food composition estimation of cod were collected for further examinations in the Institute.

In the case of cod, flounder, turbot and plaice all the caught specimens were taken for total length and mass measurements. In the case of clupeids, the representative sub-samples of these fish were investigated. Overall, 7930 cod, 4896 flounder, 638 plaice, 11 turbot, 8292 sprat and 9121 herring were taken for the length and mass determination. In total, 363, 682, 366, 10, 498 and 971, individuals of the above-mentioned species were aged. Biological analyses of fishes were performed directly on board of surveying vessel, according to standard methodological procedures. The length of 35 cm, 23 cm (ICES SD 25) and 21 cm (ICES SD 26), 16 cm and 10 cm was taken into account as a separation (protective) length between juvenile and commercial size of cod, flounder (differed by the ICES Sub-divisions), herring and sprat, respectively.

Externally visible diseases of fish’s skin and their vertebral column anomalies were monitored for 7930 cod, 4896 flounder, 638 plaice, 8292 sprat and 9121 herring. Data on pathological symptoms were registered based on the visual inspection of fish taken to the length measurements.

Every fishing haul was preceded by the measurements of basic hydrological parameters continuously from the sea surface to the bottom. Overall, 91 hydrological stations (including hydrographic standard stations) were inspected with the automatic CTD probe SeaBird 911 combined with the rosette sampler (the bathometer rosette). Oxygen content was determined using the standard Winkler’s method. The seawater temperature and salinity row data was aggregated to the 1-m depth stratum while oxygen content was aggregated to the 10-m intervals. Temperature, salinity and oxygen content was the source of information on abiotic factors potentially influencing fish spatial distribution. Distribution of all hydrological stations inspected by the R/V Baltica in November 2019 is presented in Figure 1.

RESULTS

Fish catches and biological data

Twenty two fish species were recognized in the 61 scrutinized bottom catches (Table 1). Only one of the fish species – European anchovy represented species permanently inhabiting Atlantic Ocean.

Cod, herring, flounder and sprat were the most frequently occurring fish species in the catches - 98%, 98%, 93% and 83% of hauls, respectively (Table 1). Cod, flounder, herring, and sprat dominated also with respect to mass of the catch (kg) and efficiency (CPUE). By-catch of other fish species was insignificant.

The average CPUE of cod in ICES SD 25 (105.1 kg/1h) was markedly lower than herring CPUE (347.4 kg/1h) in this ICES SD, and slightly exceeded sprat CPUE (100.8 kg/1h) and flounder (20.6 kg/1h) (Fig. 2). The average CPUE of cod (93.3 kg/1h) in ICES SD 26 was markedly lower than CPUEs of herring (344.0 kg/1h) and sprat (252.7 kg/1h), and slightly exceeded CPUE of flounder (89.1 kg/1h). In analogous survey from November 2018 the CPUE of cod in ICES SD 25 was 48.0 kg/1h haul and was lower than in November 2019 (105.1 kg/1h). Also lower CPUE of cod in ICES SD 26 in November 2018 was obtained - 30.7 kg/1h, as compared to November 2019 (93.3 kg/1h).

Herring, out of all species dominated markedly in terms of CPUE. The average CPUEs of herring were high in both ICES Sub-divisions and amounted to 347.4 kg/1h in SD 25 and 344.0 kg/1h in SD 26. In the survey from November 2018 the herring CPUEs were considerably lower, 185.0 and 78.2 kg/1h, respectively.

The highest average sprat CPUE was noted in ICES SD 26 – 252.7 kg/1h. Sprat CPUE in ICES SD 25 was by more than half lower - 100.8 kg/1h. In November 2018, sprat CPUE in SD 26 and 25 was 114.3 and 189.2 kg/1h, respectively.

The average CPUE for flounder in ICES SDs 25 and 26 was the lowest as compared to the other three fish species described above. Flounder CPUE in ICES SDs 25 and 26 was 20.6 and 89.1 kg/1h, respectively. The average CPUEs in November 2018 survey were also relatively low and amounted to 14.6 and 100.8 kg/1h, respectively.

Length distributions of main fish species according to the ICES Sub-divisions are illustrated in Figure 3. The length distribution curves for cod in both the ICES SDs were very similar indicating small length variability between lengths of cod inhabiting in ICES SD 25 and 26. Length distribution curves clearly indicated that in both ICES SDs prevailed markedly cod from the length range - 20 cm-46 cm, constituting 98% of the numerical share in each of the ICES SDs. A very low number of small cod (< 19 cm) was observed generally, and they occurred in some hauls only. The curves of cod length distributions clearly indicated individual peaks of cod frequency which amounted 8.1% and corresponded to length class 34 cm in ICES SD 25 and 9.5% in ICES SD 26 and corresponded to length class 32 cm.

Herring length distributions curves in ICES SD 25 and SD 26 indicated the existence of two length fractions. Smaller herring in ICES SD 25 contained fish from smaller length classes - 10.5-13.5 cm. Larger herring, from length classes 14.0-23.5 cm represented second length range. In ICES SD 26 the first fraction of herring contained smaller herring – from length range 8.5-13.5 cm, and the second fraction was of the same size herring like in SD 25 - 14.0-23.5 cm. With regard to herring in ICES SDs 25 and 25 very similar shapes of length distributions were obtained for the fish fraction 14.0-23.5 cm, indicating very homogenous sizes of fish occurring in both of the ICES SDs. In addition in ICES SDs 25 and SD 26 clearly indicated peak of frequency was noted for herring, which in both of the SDs amounted to 15.5% and corresponded to length class 11.5 cm and 7.5% corresponding to length class 11.0 cm.

Sprat length distribution curves in ICES SD 25 and 26 indicated the existence of two length fractions, similarly to herring. First fraction of sprat in ICES SD 25 was created by the smaller size fish - 8.0-10.5 cm, while the second fraction of the larger fish included length classes 11.0-15.0 cm. Sprat of smaller sizes in ICES SD 26 contained fish from length range of 7.0-9.5 cm, while sprat from length range 10.0-14.0 cm were from the second fraction of larger fish. Sprat length distributions indicated quite large variability of sprat length depending on the ICES SD which sprat occupied. Sprat of the most favourable length distribution for commercial fishery was observed in ICES SD 25.

Flounder length distributions indicated large length differences between flounder inhabiting in different ICES SDs. With regard to flounder length distribution from ICES SD 26, clearly smaller flounder was found in that SD. The length range of flounder in ICES SD 26 was from the length classes 11-34 cm, and in ICES SD 25 from higher range - 18-37 cm. In addition, in both of the ICES SDs well distinguished peak of length frequency was observed. In ICES SD 26 the peak amounted 12.2% and corresponded to length class 21 cm, and in ICES SD 25 – 13.0%, and corresponded to higher length class – 26 cm.

Figure 4 shows the numerical shares of the undersized fish fractions of cod, herring, sprat and flounder. In cod catches from ICES SDs 25 and 26 the undersized fraction of cod prevailed markedly. Their numerical share in the above-mentioned ICES SDs was 70.2% and 76.5%, respectively. In the same cruise in November 2018, the share of undersized cod was higher in ICES SD 25 and amounted to 86.4% and in ICES SD 26 it was lower and amounted to 72,5%. The total share of undersized cod from the last survey was very high and amounted to 73.0%. The share of the undersized fraction of herring in ICES SDs 25 and SD 26 amounted to 48.1% and 42.0%, respectively. The largest share of undersized sprat was observed in samples form ICES SD 26 (31.1%). Undersized sprat share in ICES SD 25 amounted to 24.1%. The share of undersized flounder was very low in ICES SDs 25 – 6.6%, while in ICES SD 26 it amounted to 44.4%.

Mean length (l.t.) and mean mass of sprat, herring, cod and flounder calculated for the whole survey and separately for ICES SDs 24, 25 and 26 are presented in the text table below (in parenthesis are shown parameters from November 2018 cruise):

ICES Subdivision	parameter	sprat	herring	cod	flounder
24	Mean length [cm]	(12.1)	(20.2)	(31.6)	(26.3)
25		11.9 (11.5)	15.8 (18.7)	32.1 (29.3)	27.4 (28.0)
26		10.7 (11.4)	16.0 (17.0)	32.2 (31.0)	21.7 (21.0)
Whole survey		11.2 (11.5)	15.9 (18.3)	32.1 (29.8)	23.1 (23.4)
24	Mean weight [g]	(12.1)	(55.6)	(318.0)	(203.8)
25		9.9 (10.1)	30.3 (40.0)	306.4 (232.8)	228.5 (257.2)
26		7.8 (9.3)	32.7 (31.7)	284.1 (277.0)	120.7 (109.9)
Whole survey		8.6 (9.9)	31.5 (38.7)	296.5 (247.3)	147.9 (158.0)

The measurement of the length of the main fish species was accompanied by a macroscopic analysis of the presence of symptoms of visible diseases of fish’s skin, i.e. anatomopathological changes (Fig. 5). The highest prevalence of fish with externally visible pathological changes was recorded for cod (4.4%) and flounder (3.3%). The share of herring with observed pathological symptoms was insignificant and amounted to 0.05%. No pathological changes in sprat were found.

Hydrological situation in the southern Baltic

In the near-bottom water layer (Fig. 6) temperatures in the range from 11.56°C to 5.13°C were noted. The lowest temperature was noted in the control haul no 39, while the highest in hydrological station no 7. The highest salinity was recorded in fishing station no 40 (7.78 on the PSU scale). The lowest salinity measured in fishing haul no 6 amounted to 7.07 in hydrological station (G2). The lowest oxygen content in the water was noted in the fishing station no 39 (6.63 ml/l).

Surface water temperature fluctuated from 11.82°C to 7.83°C (Fig. 7). The lowest temperature was recorded in control haul no 53, and the highest in hydrological station no 76. Mean value of the surface water temperature was 9.32°C. The average salinity of surface water was 7.48 on the PSU scale. The lowest value - 7.04, was recorded in the control haul no 15. The highest salinity was recorded in the haul no 39 (7.85 on the PSU scale). Mean oxygen content was 7.52 ml/l. The highest level of oxygen was registered in control haul no. 45 (7.86 ml/l). The lowest oxygen level was recorded in the control haul no. 12 (7.21 ml/l).

CONCLUSIONS

The data collected during Polish BITS-4Q 2019 survey is considered as representative, taking into account the degree of the survey plan realization, and therefore can be used by the ICES Baltic International Fish Survey Working Group (WGBIFS) and the Baltic Fisheries Assessment Working Group (WGBFAS) for evaluation of fish species abundance and their distribution. The survey data collected during the survey is stored in the international DATRAS database publicly available and managed by the ICES Secretariat.

Rerences:

ICES. 2019. Working Group on Baltic International Fish Survey (WGBIFS).
ICES Scientific Reports. 1:37. 79 pp. http://doi.org/10.17895/ices.pub.5378

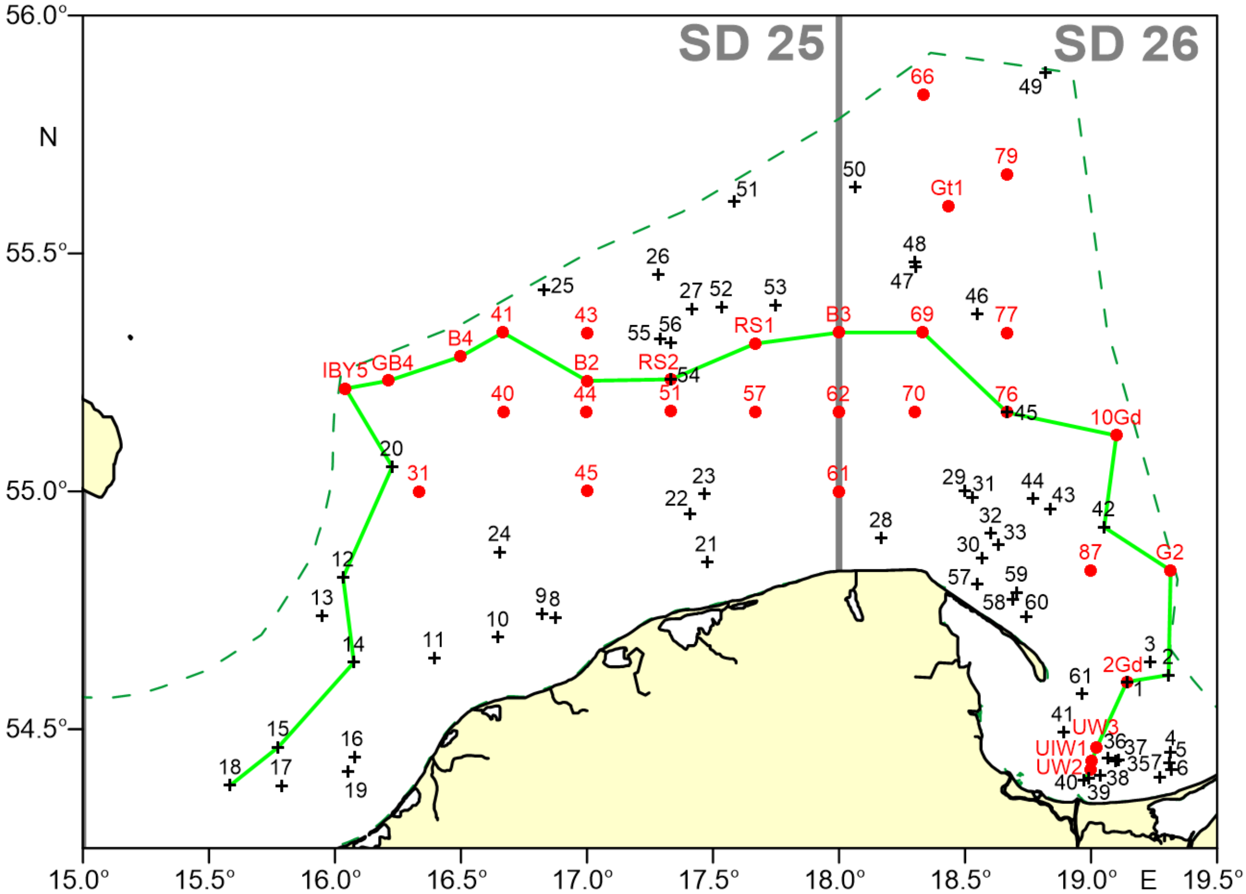

Fig. 1. Location of fish control-hauls (black crosses) and hydrological standard stations (red dots) realised during the r/v Baltica BITS-4Q survey (11-29.11. 2019). (green solid line indicates hydrological research profile).

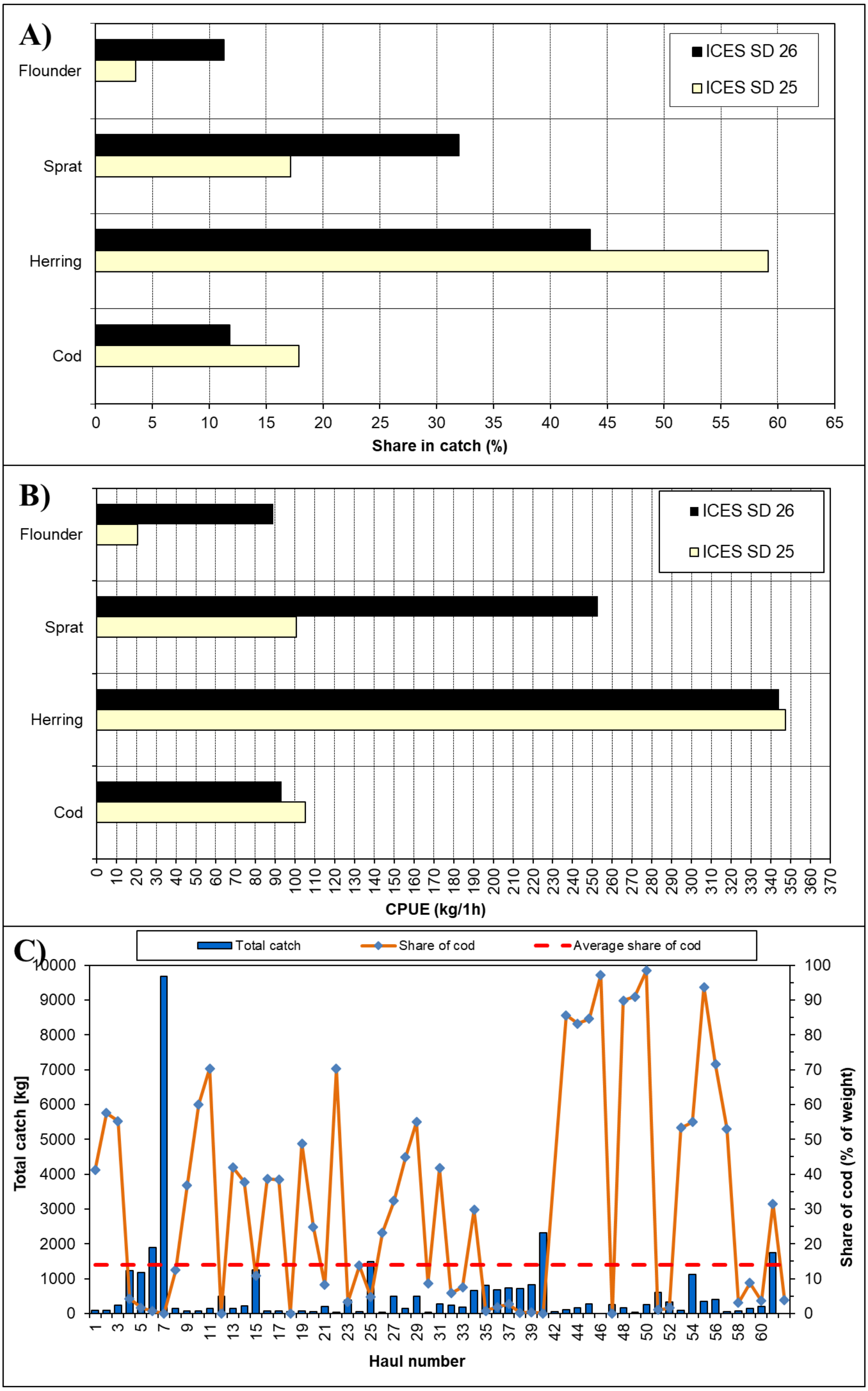

Fig. 2. Mean share in mass of control hauls (A), and mean CPUE (B) of dominant fish species, and share of cod (C) in particular catches conducted during r/v Baltica BITS-4Q survey (11-29.11. 2019).

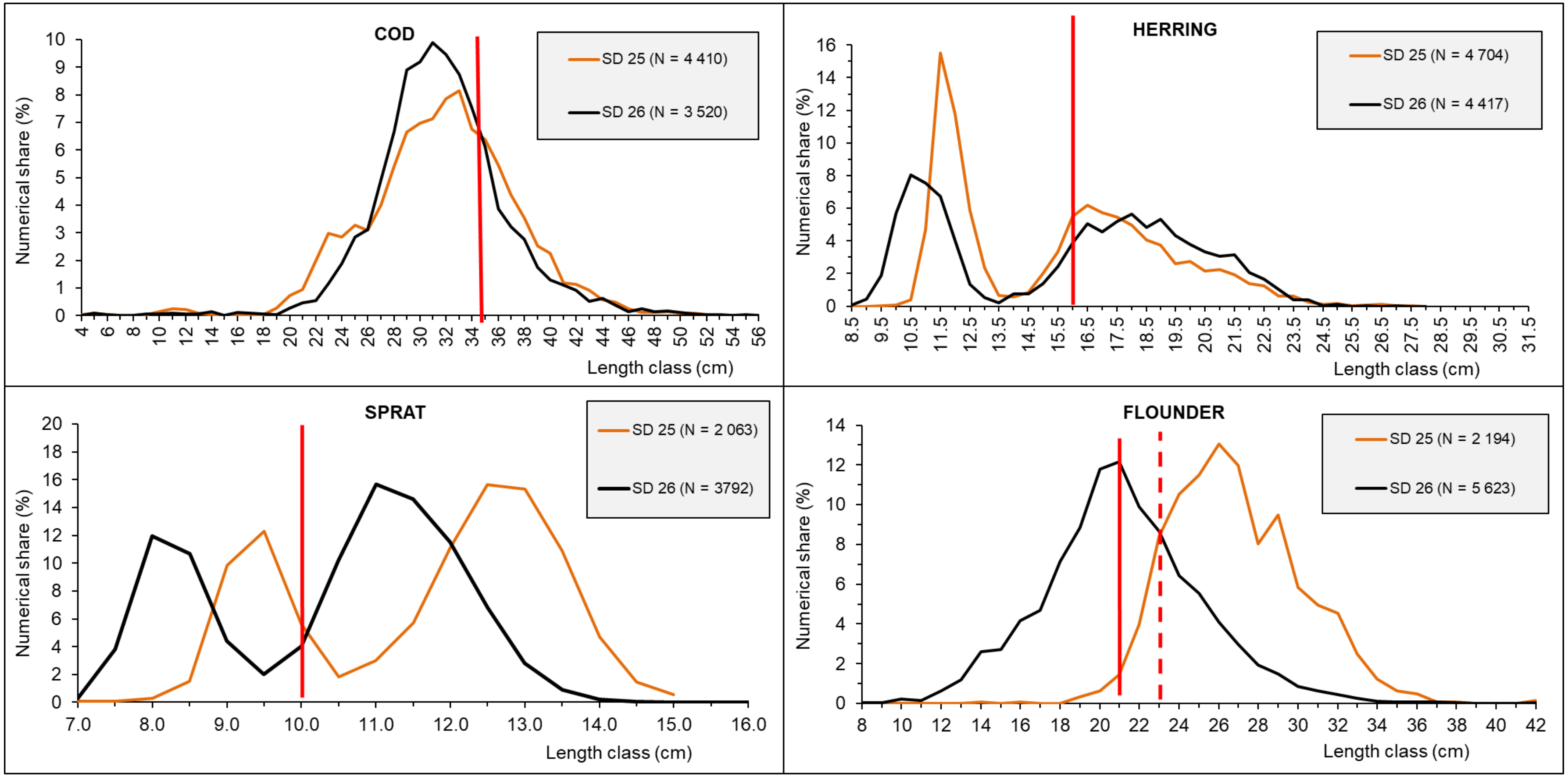

Fig. 3. Length distributions of cod, herring, sprat and flounder in samples from fish control hauls conducted during r/v Baltica BITS-4Q survey (11-29.11. 2019).

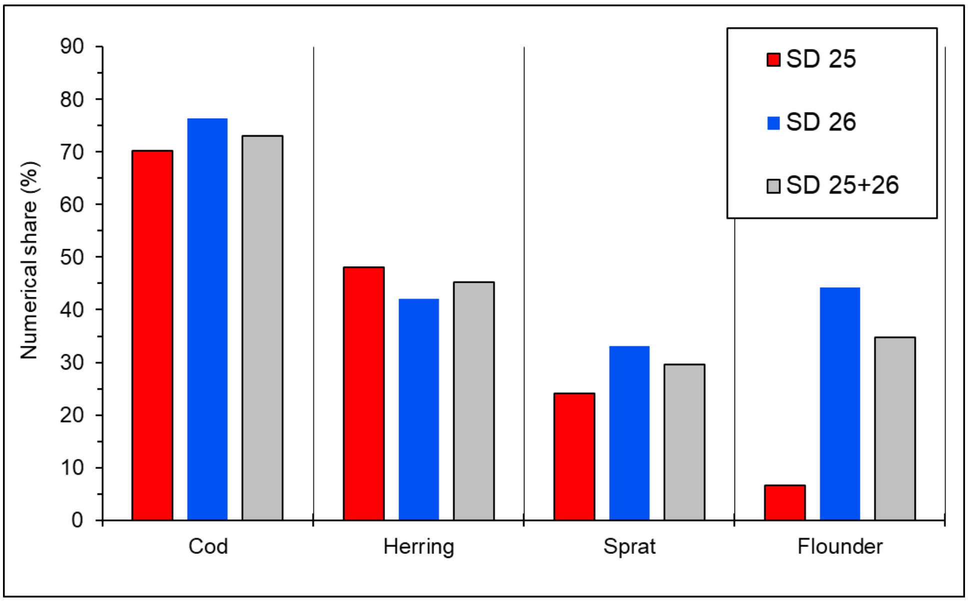

Fig. 4. Mean numerical share (in %) of undersized fish species in samples from fish control hauls conducted during r/v Baltica BITS-4Q survey (11-29.11. 2019).

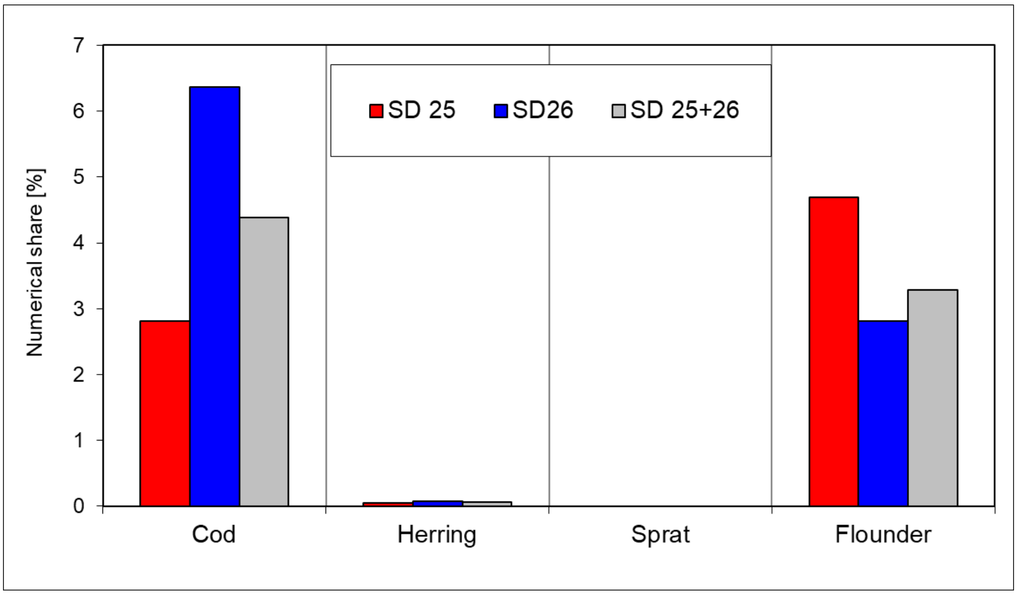

Fig. 5. Mean prevalence (in %-indiv.) of fish with externally visible diseases in samples from fish control hauls conducted during r/v Baltica BITS-4Q survey (11-29.11. 2019).

Tab. 1. Number of fish species individuals measured and aged during r/v Baltica BITS-4Q survey (11-29.11. 2019).

Species name	Number of fish mesured (l.t)			Numer of fish aged and weighed (g)		
	26 ICES Sub-division	25 ICES Sub-division	total	26 ICES Sub-division	25 ICES Sub-division	total
Cod	3520	4410	7930	185	178	363
Baltic herring	4417	4704	9121	529	442	971
Sprat	5046	3246	8292	301	197	498
Flounder	3661	1235	4896	253	429	682
Plaice	135	503	638	232	134	366
Hooknose	0	1	1	0	0	0
Eelpout	13	0	13	1	0	1
Fourbeard rockling	64	51	115	29	0	29
European perch	46	0	46	4	0	4
Three-spined stickleback	3	9	12	0	0	0
Lumpfish	0	4	4	0	0	0
Short-horn scorpion	22	124	146	12	7	19
Round goby	3	0	3	0	0	0
Sand goby	0	1	1	0	0	0
Smelt	33	0	33	9	0	9
Twaite shad	10	0	10	3	0	3
Turbot	4	7	11	3	7	10
Whiting	0	29	29	0	14	14
Greater sandeel	12	131	143	0	9	9
Pike-perch	6	0	6	4	0	4
European anchovy	2	14	16	0	2	2
River lamprey	3	0	3	0	0	0
TOTAL	17000	14469	31469	1565	1419	2984

Tab. 2. Fish control-hauls data obtained during r/v Baltica BITS-4Q survey (11-29.11. 2019).

lack of oxygen in the bottom -> haul not performed (no oxygen haul)

Haul number according to survey order	Haul number according to ICES database	Catch date	ICES rectangle	ICES Sub-division	Trawling depth [m]	Geographical position of the catch-station				Time of		Trawling duration [min]	Total catch [kg]	Weight of the catch by fish species [kg]																					
						start/shoot		end																											
						szerokość (N)	długość (E)	szerokość (N)	długość (E)	shooting net	hauling up net			Cod	Herring	Sprat	Flounder	Plaice	Hooknose	Eelpout	Fourbeard rockling	uropean perc	Three-spined stickleback	Lumpfish	Short-horn scorpion	Round goby	Sand goby	Smelt	Twaite shad	Turbot	Whiting	Greater sandeel	Pike-perch	European anchovy	River
1	26288	2019-11-11	38G9	T5	26	83	54°36'	19°10.1'	54°36.1'	19°12.6'	11:05	11:35	30	17.850	17.920	6.830	0.655					0.083													
2	26191	2019-11-11	38G9	T5	26	87	54°37.6'	19°18.6'	54°39'	19°18.4'	12:45	13:15	30	23.740	14.070	1.773	0.670					1.015													
3	26269	2019-11-11	38G9	T5	26	86	54°38'	19°13.3'	54°37.4'	19°11.4'	14:25	14:55	30	65.190	14.368	37.484	0.604					0.377													
4	26256	2019-11-12	37G9	T4	26	62	54°27'	19°19.7'	54°27.1'	19°17.5'	07:55	08:25	30	26.090	93.043	9.075	482.470	2.204				2.480			0.175			0.250							
5	26261	2019-11-12	37G9	T4	26	52	54°25.7'	19°18.2'	54°25.6'	19°16.6'	10:37	10:57	20	6.732	83.917	242.474	46.430	1.621				0.345			0.589			10.519	0.276						
6	26163	2019-11-12	37G9	T4	26	43	54°25'	19°18.3'	54°24.8'	19°16.5'	12:32	12:57	25	5.004	27.664	686.014	68.650	1.349	0.324		0.015				0.591			1.255					0.292		
7	26216	2019-11-12	37G9	T4	26	32	54°24'	19°17.9'	54°24'	19°17.1'	14:33	14:43	10	0.762	8.436	1592.531	11.110				0.325				0.821							0.215	0.113		0.131
8	25017	2019-11-13	38G6	L6	25	29	54°44.5'	16°53.1'	54°45.5'	16°54.8'	07:30	08:00	30	8.659	38.464	7.552	12.920	1.117	0.219						0.240						0.250				
9	25016	2019-11-13	38G6	L6	25	29	54°44.9'	16°50'	54°45.7'	16°52'	09:00	09:30	30	14.053	10.730	3.413	8.351	1.690																0.030	
10	25014	2019-11-13	38G6	L6	25	29	54°42.1'	16°40.6'	54°41.5'	16°38.3'	11:20	11:50	30	21.433	6.570	1.518	5.074	1.037													0.025			0.056	
11	25013	2019-11-13	38G6	K5	25	32	54°39.4'	16°25.1'	54°38.8'	16°22.9'	13:35	14:05	30	51.890	10.330	1.408	7.381	1.940							0.248					0.516	0.073			0.018	
12	25060	2019-11-14	38G6	J6	25	50	54°49.8'	16°2.7'	54°50.9'	16°4.1'	07:40	08:10	30	53.270	121.280	43.792	17.090	12.610				0.116	0.009		0.081					0.337					
13	25056	2019-11-14	38G5	H6	25	54	54°45'	15°57.3'	54°46.4'	15°56.8'	09:55	10:25	30	30.520	14.750	6.840	13.350	7.050												0.123					
14	25052	2019-11-14	38G6	J5	25	48	54°37.9'	16°4.1'	54°36.7'	16°2.8'	12:15	12:45	30	39.560	38.798	7.652	15.570	2.958												0.297					
15	25040	2019-11-14	37G5	H4	25	47	54°28'	15°49.6'	54°27.7'	15°47.1'	14:30	15:00	30	67.820	411.885	114.975	25.300	3.913	0.401	0.018					1.347					2.058					
16	25010	2019-11-15	37G6	J4	25	27	54°26.3'	16°3.4'	54°25.8'	16°0.8'	07:30	08:00	30	14.518	15.950	0.623	3.289								0.185					0.487	2.474			0.016	
17	25009	2019-11-15	37G5	H4	25	30	54°22.8'	15°46'	54°22.8'	15°43.4'	09:27	09:57	30	15.397	16.080	0.716	4.055	0.650						0.400	2.787						0.045				
18	25008	2019-11-15	37G5	G4	25	29	54°22.9'	15°38.6'	54°22.9'	15°36'	10:31	11:01	30	0.002	8.423		6.082	2.031	0.328					0.703	4.420										
19	25011	2019-11-15	37G6	J4	25	26	54°24.5'	16°2.1'	54°24.2'	15°59.5'	14:26	14:56	30	15.938	11.940	0.815	2.544	0.177							0.104		0.001			0.988	0.161			0.013	
20	25407	2019-11-16	39G6	J8	25	72	55°2.7'	16°12.6'	55°1.7'	16°11'	08:08	08:38	30	6.964	9.650	7.400	1.270	2.675					0.018											0.015	
21	25024	2019-11-17	38G7	N7	25	23	54°51.1'	17°29.5'	54°51.3'	17°32'	07:27	07:57	30	8.041	27.309	16.237	43.280	1.776	0.522												0.260			0.088	
22	25022	2019-11-17	38G7	N7	25	29	54°57.3'	17°25.4'	54°57.7'	17°27.8'	09:24	09:54	30	13.641	0.209		4.719	0.842													0.022				
23	25364	2019-11-17	38G7	N7	25	32	54°59.7'	17°27.2'	54°59.9'	17°24.7'	10:38	11:08	30	6.601	88.331	90.689	8.320	1.367							0.400										
24	25004	2019-11-17	38G6	L7	25	20	54°52.7'	16°42.3'	54°52.4'	16°39.9'	14:32	15:02	30	4.088	0.279		24.860	0.548													0.032				
25	25080	2019-11-18	39G6	L10	25	52	55°25.2'	16°48.2'	55°24.9'	16°47.1'	07:35	07:50	15	17.620	341.418	2.218	3.123	0.390							5.960										
26	25455	2019-11-18	39G7	M10	25	43	55°27.4'	17°16'	55°26.8'	17°13.5'	11:32	12:02	30	4.911	10.520	0.507	2.936							0.386	1.898										
27	25084	2019-11-18	39G7	N10	25	63	55°23.1'	17°23.6'	55°22.9'	17°21.1'	14:03	14:33	30	78.600	153.652	1.944	7.520	1.444				0.276													
28	26274	2019-11-19	38G8	P7	26	23	54°54.1'	18°10.9'	54°54'	18°13.5'	07:32	08:02	30	30.550	25.000	0.374	11.910	0.169													0.079			0.016	
29	26186	2019-11-19	38G8	R7	26	71	54°59.1'	18°32.1'	55°0'	18°30.3'	10:33	11:03	30	133.520	79.341	0.146	28.680	1.236																	
30	26007	2019-11-19	38G8	R7	26	30	54°51.1'	18°34.8'	54°52.6'	18°33.5'	13:38	14:08	30	1.335	0.318		13.330	0.465													0.020				
31	26268	2019-11-20	38G8	R7	26	71	54°58.9'	18°32.5'	54°59.8'	18°30.7'	07:47	08:17	30	55.550	36.860		39.738	0.839				0.128													
32	26267	2019-11-20	38G8	R7	26	45	54°54.8'	18°36'	54°55.9'	18°34.2'	09:57	10:27	30	6.722	84.600		21.143	2.098	0.153						0.732										
33	26019	2019-11-20	38G8	R7	26	46	54°53.3'	18°38.1'	54°54.4'	18°36.6'	11:52	12:22	30	6.610	61.379	4.231	14.544	0.553													0.060				
34	26038	2019-11-20	38G8	R7	26	63	54°53.7'	18°39.3'	54°55'	18°38'	13:34	14:04	30	99.160	178.734	11.830	42.406	1.523											0.045						
35	26289	2019-11-21	37G9	T4	26	56	54°25.9'	19°10.7'	54°26.1'	19°9.1'	08:11	09:31	20	2.037	223.587	27.748	14.460											1.249							0.084
36	26281	2019-11-21	37G9	T4	26	59	54°26.6'	19°3.8'	54°26.6'	19°2.3'	11:06	11:26	20	4.102	74.420	85.160	59.276	1.188			0.050	0.182						0.304							
37	26265	2019-11-21	37G9	T4	26	53	54°26.2'	19°3.7'	54°26.2'	19°2.2'	12:05	12:25	20	6.491	104.472	49.348	79.380	0.684			0.099	0.066						2.272	0.035			0.035			
38	26131	2019-11-22	37G9	T4	26	32	54°24.1'	19°2.5'	54°24.5'	18°59.8'	07:49	08:19	30	0.796	222.277	56.349	70.880	0.544			0.041							2.769			0.079	4.163		0.049	
39	26263	2019-11-22	37G9	T4	26	32	54°24.3'	19°1'	54°24.7'	18°58.3'	10:32	11:02	30	1.706	128.968	229.276	49.200	0.338			0.030				0.475	0.074		0.295			0.044	4.257			
40	26219	2019-11-22	37G8	S4	26	29	54°24.1'	18°59.4'	54°24.5'	18°57.7'	12:34	12:54	20	0.300	11.265	733.575	22.740											1.892							
41	**26280**	**2019-11-22**	**37G8**	**S4**	**26**	**62**	**54°29.1'**	**18°54.5'**	**54°29.7'**	**18°53.9'**	**14:22**	**14:37**	**15**	**Invalid**	**haul**																				
42	26257	2019-11-23	38G9	T7	26	101	54°56.4'	19°2.4'	54°57.6'	19°1.4'	07:40	08:10	30	18.832	2.536	0.447	0.071					0.101													
43	26086	2019-11-23	38G8	S7	26	95	54°58.4'	18°49'	54°59.1'	18°47'	09:43	10:13	30	42.460	2.063	4.850	1.369	0.129				0.153													
44	26278	2019-11-23	38G8	S7	26	95	54°57.9'	18°48'	54°59'	18°46.6'	11:28	11:58	30	66.200	2.755	8.020	0.928	0.235				0.129													
45	26093	2019-11-23	39G8	R9	26	87	55°10.6'	18°38.7'	55°11.5'	18°36.9'	14:04	14:34	30	137.310	0.703	1.636	0.977	0.137	0.445																
46	26104	2019-11-24	39G8	R10	26	83	55°22.4'	18°32.7'			07:21																								
47	26099	2019-11-24	39G8	P10	26	85	55°27.9'	18°19.8'	55°29.1'	18°18.6'	09:26	09:56	30	113.760	5.117	7.570		0.144				0.015													
48	26161	2019-11-24	39G8	P10	26	85	55°27.5'	18°19.5'	55°28.8'	18°18.4'	11:49	12:19	30	75.920	5.760	0.324	0.703	0.802																	
49	26138	2019-11-25	40G8	S13	26	113	55°53.3'	18°46.4'	55°53.4'	18°44.1'	07:53	08:23	30	14.889	0.068	0.095						0.077	0.007												
50	26050	2019-11-25	40G8	P11	26	71	55°37.9'	18°3.2'	55°37.1'	18°2.2'	12:35	12:55	20	0.926	11.174	73.485																			
51	25380	2019-11-26	40G7	N11	25	39	55°37'	17°35.8'	55°38.2'	17°37.3'	07:45	08:15	30	4.839	228.318	69.174	1.498								0.205						0.146				
52	25088	2019-11-26	39G7	N10	25	72	55°23.6'	17°33.2'	55°24.1'	17°35.4'	10:46	11:16	30	85.740	37.445	19.895	15.683	1.454	0.324			0.256													
53	25089	2019-11-26	39G7	O10	25	73	55°23.7'	17°45.6'	55°24.6'	17°47.4'	12:56	13:26	30	26.930	10.110	4.650	4.755	2.151				0.235								0.140					
54	25463	2019-11-27	39G7	M9	25	90	55°14.3'	17°19'	55°14.4'	17°16.5'	08:08	08:38	30	526.790	1.883		9.580	20.690				3.256								0.221					
55	25231	2019-11-27	39G7	M9	25	74	55°18.7'	17°16.6'	55°19.2'	17°14.4'	11:05	11:35	30	124.9	15.4	3.7	23.43	7.110				0.095													
56	25232	2019-11-27	39G7	M9	25	74	55°19.4'	17°18.8'	55°19.7'	17°21.2'	13:14	13:44	30	108.38	43.116	14.074	30.2	7.860				0.708													
57	26266	2019-11-28	38G8	R6	26	20	54°48.8'	18°32.1'	54°49.3'	18°31.4'	07:45	08:00	15	0.379	0.8		9.43	1.650													0.031				
58	26169	2019-11-28	38G8	S6	26	33	54°47.1'	18°40.9'	54°47.8'	18°40.2'	09:22	09:37	15	1.417	4.9	0.322	8.85	0.495													0.020				0.081
59	26020	2019-11-28	38G8	S6	26	46	54°47'	18°42.5'	54°46.1'	18°43.1'	10:22	10:42	20	1.713	28.132	2.193	14.9	0.622																	
60	26133	2019-11-28	38G8	S6	26	52	54°43.9'	18°45'	54°43.1'	18°45.7'	11:35	11:55	20	20.65	0.663		43.23	0.803							0.197						0.051				
61	26132	2019-11-28	38G8	S5	26	70	54°33.9'	18°57.5'	54°33.5'	18°57.1'	14:15	14:25	10	11.34	239.39	20.617	18.34					0.059							0.057						

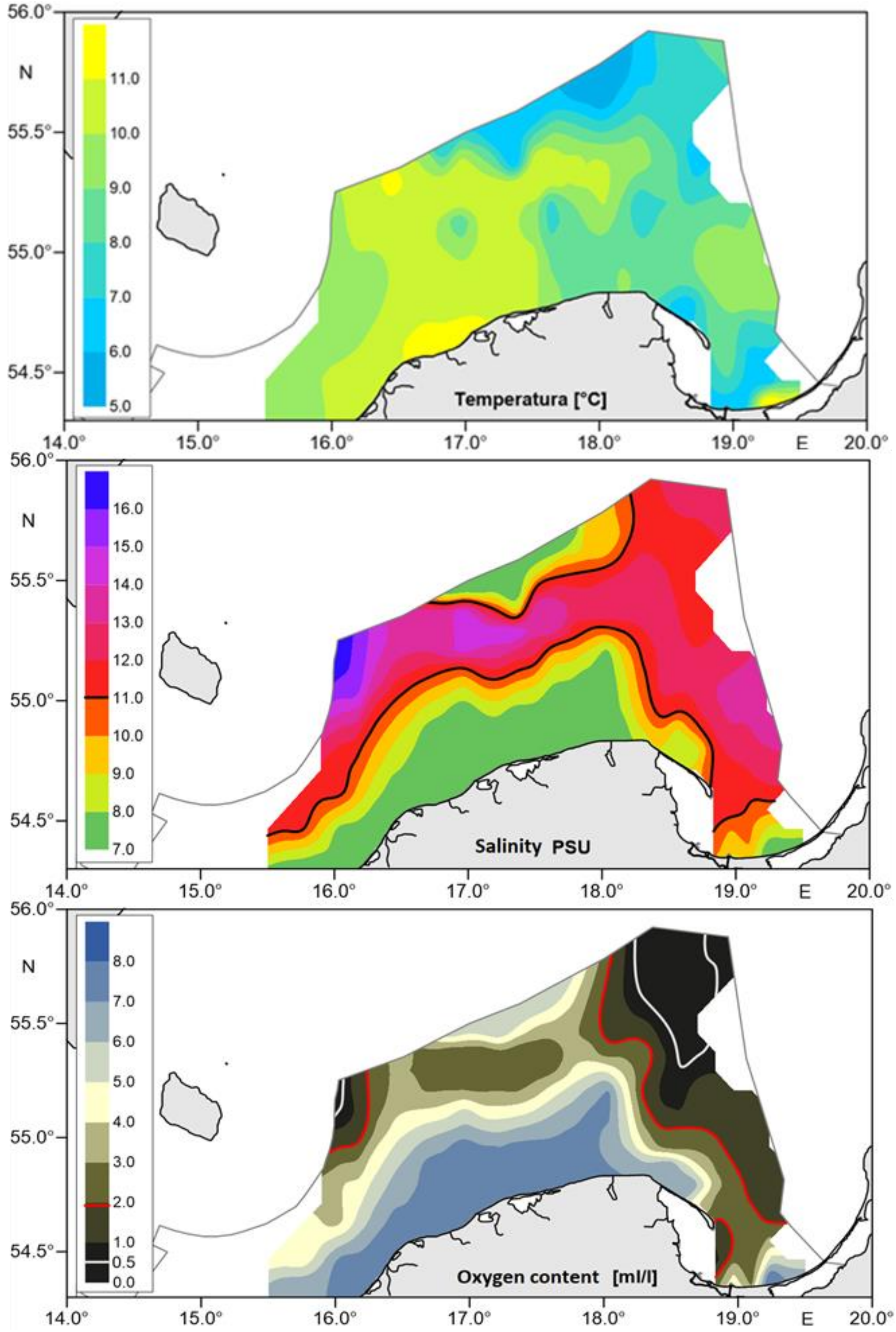

Fig. 6. Horizontal distribution of the seawater temperature, salinity and oxygen content in the near bottom layer during r/v Baltica BITS-4Q survey (11-29.11. 2019).

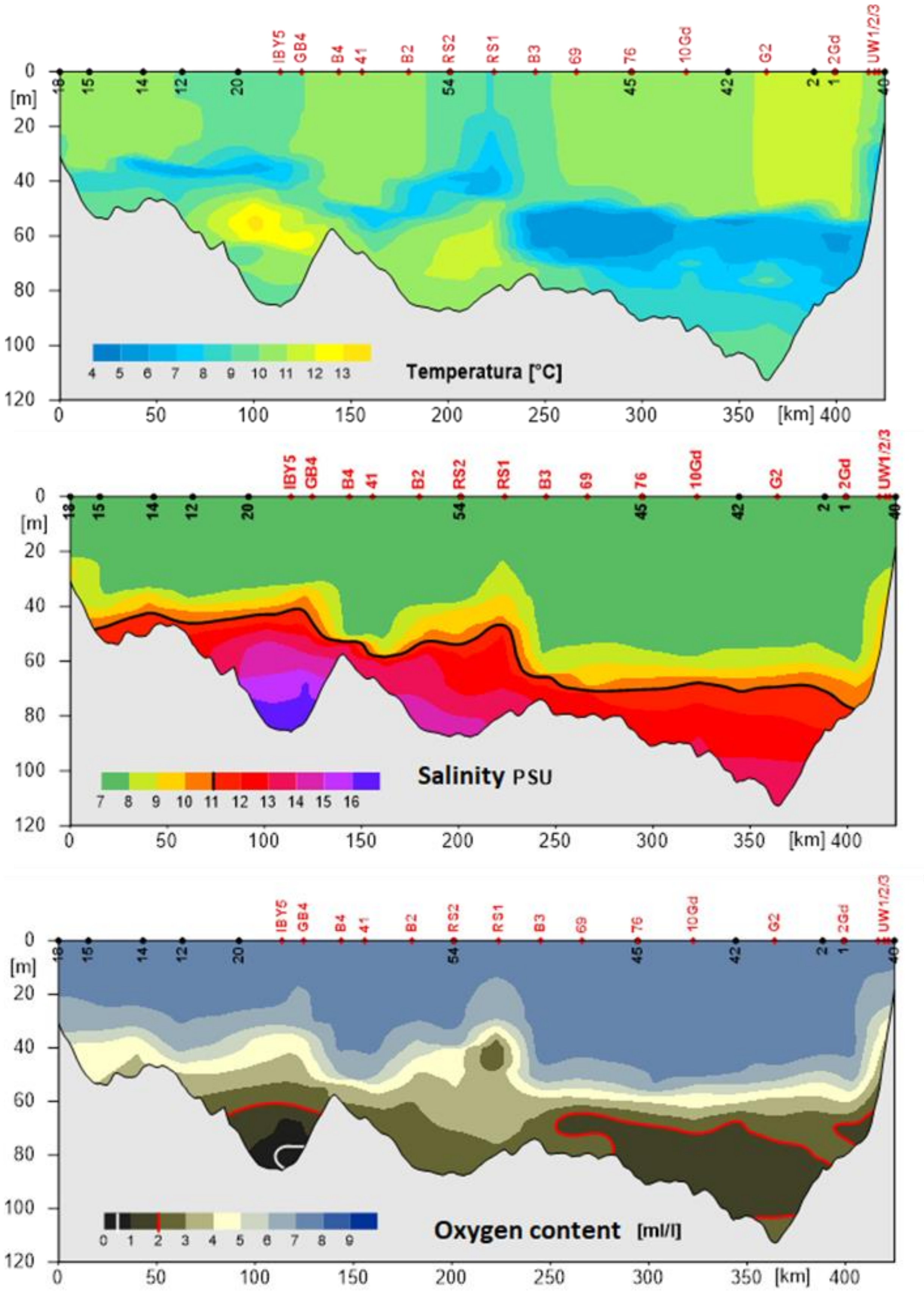

Fig. 7. Vertical distribution of the seawater temperaturę, salinity and oxygen content along the hydrological research profile during r/v Baltica BITS-4Q survey (11-29.11. 2019).

Baltic International Trawl Survey (BITS)
R/V Svea, 18 – 28 November 2019

Cruise leader : Olof Lövgren
Scientific leader : Michele Casini

Summary

The survey was conducted using the TV3L demersal trawl according to the Baltic International Trawl Survey (BITS) manual (ICES. 2017). Sweden was assigned 33 randomly selected hauls. All of the hauls could be trawled because SVEA is a government ship and are allowed to fish in almost all areas in Swedish waters

In total 33 valid hauls were performed with TV3L demersal trawl including eight hauls with oxygen deficiency which were not trawled because the oxygen concentration close to the bottom was <0.5 ml/l (however they are included in stock assessment as zero catch) and covered parts of the areas SD 25, 26, 27 and 28 this year. During the whole survey, acoustic data were continuously recorded.

During this survey a total of 25 fish species were caught. Herring, sprat, cod, flounder, plaice and whiting dominated the total catch, in terms of weight.

The hydrographic conditions were observed and measured on every station. Only the oxygen concentration at the bottom is presented in the report.

Background

The expedition was performed according to the BITS manual (ICES 2017a) and the recommendations from WGBIFS REPORT (ICES 2018. Sweden is one of many countries performing the BITS survey during this period of the year. R/V SVEA is Sweden's new survey vessel and took over after R/V DANA and conducted the BITS expedition for the first time in November 2019. No comparative tests have been done between the two vessels, but all implements are the same as on Dana except that the trawl cable is 4 mm thicker.

The expedition started in Lysekil on Monday 18 November and ended in Åhus on Thursday 28 November. The weather during the expedition varied with strong winds up to 20 m / s between Thursday 21 to Friday afternoon on 22. The wind force gradually subsided and the expedition could be completed without complications.

Sweden was assigned 33 randomly deployed stations: Ten in SD 25, eight in SD 26, ten in SD 27 and five in SD 28 (Fig. 1, Table 1). Of 33 allocated hauls 31 were realized including eight, non-oxygen haul (see table 1). Two stations were replaced for two reasons, one was that the bottom is poor at 8 ENE KÅREHAMN, the other was that YTTERTORPET was not trawled because the time was not enough. YTTERTORPET WEST was taken instead. Sweden is the only country covering SD 27 and the western area of SD 28.

Overall, Svea performed 33 valid trawl hauls (including four non oxygen stations) that can be used in stock assessment. The non-oxygen stations are used in stock assessment as 0-catch stations.

Hydrography

Hydrographical measurements with CTD and oxygen probe were taken at most of the trawl stations (Fig. 2). Oxygen concentrations at approximately one meter from the bottom are presented in Fig. 2.

Fish catches

Overall, 25 species were caught (Table 3). We caught a total of 21 tons of fish, of which 2,2 tons of cod (2 268 individuals), 11,5 tons of herring and 5,5 ton of sprat.

Sampling

Almost all cod were measured. Cod otoliths were collected for age determination with the aim to sample one individual per 1 cm-class and haul. Individuals were sampled in areas 25W, 25C, 26, 27 and 28. Overall, 380 cods were age-estimated.

For flounder, otoliths were collected with the aim to sample three individuals per 1 cm-class and haul. Totally, 1 127 flounder otoliths were sampled.

The other fish species were measured, weighed and total catch recorded.

Ad-hoc studies and sampling were performed:

- Cod and flounder stomachs were collected for further analysis.
- Visual assessment for liver parasites in cod

- Liver and tissue for isotope analysis
- Length distributions and individual measurements (length and weight) of *Saduria entomon*

Other

The results of Swedish BITS expeditions are presented yearly in a report by SLU-Department of Aquatic Resources (SLU Aqua).

All Swedish BITS data are uploaded into FISKDATA 2 database at SLU Aqua and are delivered to ICES database DATRAS for international compilation. The data from this survey are used within the Baltic International Fish Survey Working Group (WGBIFS) and Baltic Fisheries Assessment Working Group (WGBFAS) in ICES.

We thank all the participants, scientists, technicians and crew, which contributed to the accomplishment of the expedition.

Participants

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References

ICES. 2017. Manual for the Baltic International Trawl Surveys (BITS). Series of ICES Survey Protocols SISP 7 - BITS. 95 pp. http://doi.org/10.17895/ices.pub.2883

ICES. 2018. Report of the Baltic International Fish Survey Working Group (WGBIFS). ICES WGBIFS report 2018 24-28 March 2018. Lyngby, Copenhagen, Denmark. 380 pp.

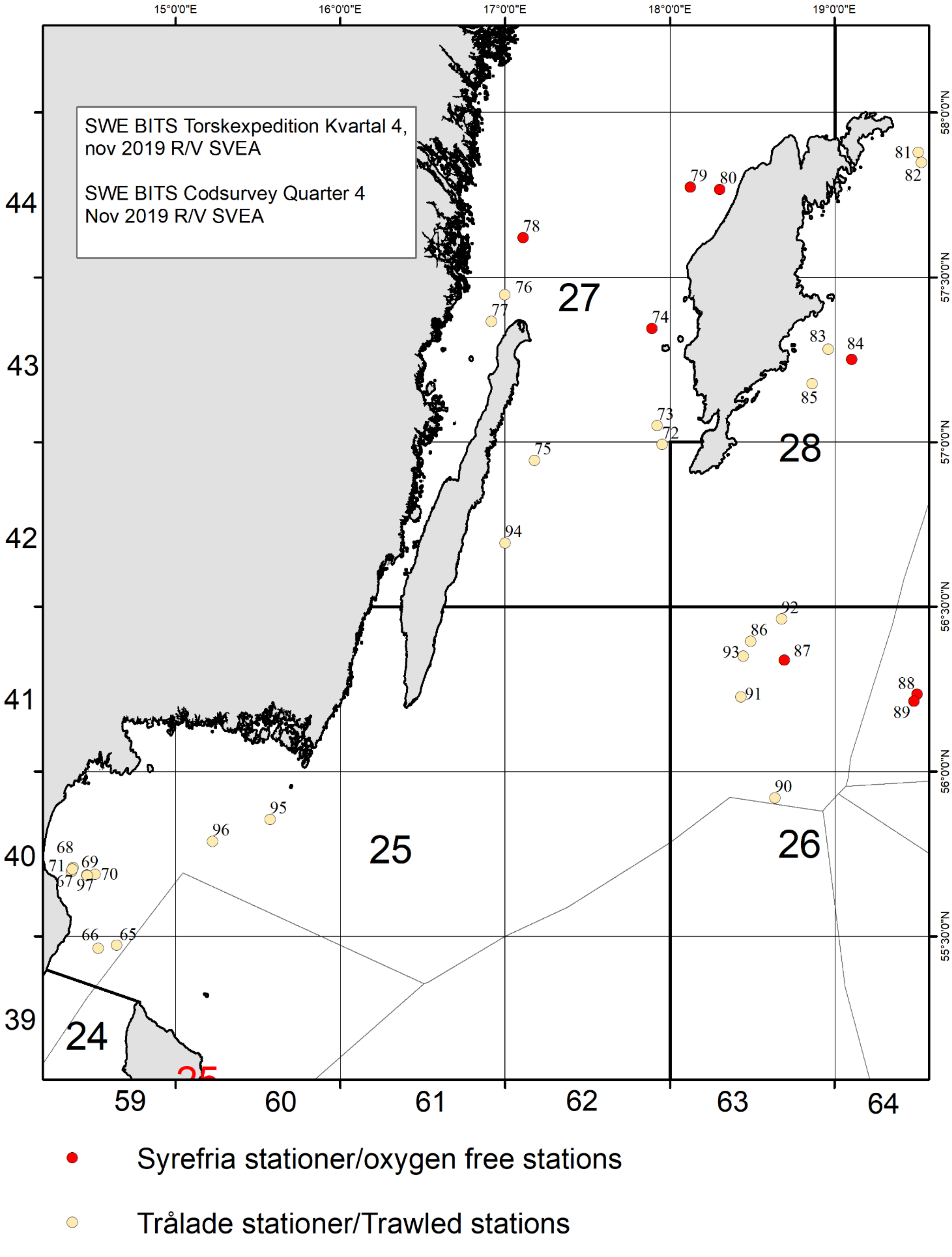

Figure 1. Map of the trawl stations performed during the Swedish BITS Quarter 4 2019. Trawled stations including eight hauls without oxygen.

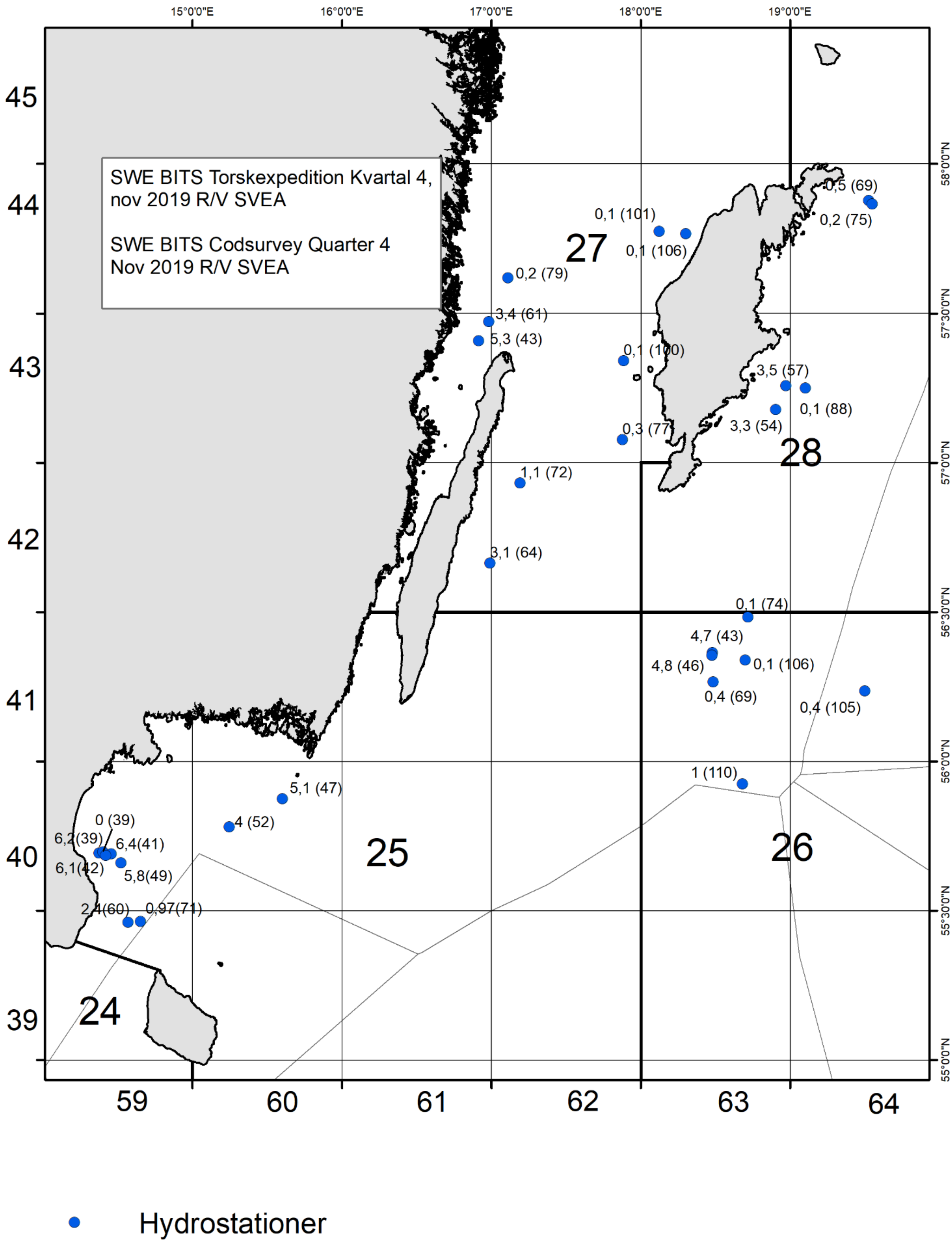

Figure 2. Oxygen concentration (ml/l) at the bottom at the trawl stations. Numbers in brackets indicate bottom depth. Swedish BITS, Quarter 4 2019.

Table 1. Summary of all stations. Swedish BITS quarter 4 2019.

Tråldrag som används för beståndsuppskattning/Valid hauls used for assessment	33	Tråldrag som används för beståndsuppskattning/ Valid hauls used for assessment		
Slumpade trålade stationer/Randomized trawled hauls	31	Slumpade tilldelade drag/ Randomized allocated hauls	SD28	5
Ersättningsdrag/Replacement hauls	2		SD27	10
			SD26	8
Slumpade syrefria drag/Random anoxic hauls	8		SD25	10
Kompletteringsdrag/additional hauls	0	Tråldrag som används för beståndsuppskattning/ Valid hauls used for assessment	SD28	5
Ogiltiga drag/invalid hauls	0		SD27	10
Slumpade stationer, ej trålade/random stations, not trawled	2		SD26	8
			SD25	10

TV3 trawl station
Fictitious haul/oxygen deficiency
Hydrographic station (SEA)

Datum Date	Akt. nr Act. no	Om- råde Area SD	Ruta Rect.	Position N Latitude	Position E Longitude	Stat. nr Haul No	Stationsnamn Station name	Trål- ning Gear	Trål- tid Duration min	Trål- djup Trawldepth	Hydro Djup Depth m	Hydro O2 Oxygen ml/l	Komm entar	Remarks
2019-11-20	64	25	39G4	14 39,054	55 27,799		11 E Skillinge	CTD			71	0,97		
2019-11-20	65	25	39G4	14 38,509	55 28,312	25500	11 E Skillinge	TV3L	00:25	67		1,5		
2019-11-20	65	25	39G4	14 34,059	55 27,633		8 E Skillinge	CTD			60	2,4		
2019-11-20	66	25	39G4	14 31,784	55 27,765	25073	8 E Skillinge	TV3L	00:30	60		2,4		
2019-11-20	66	25	40G4	14 22,395	55 41,512		3,5 NE Stens huvud	CTD			39	6,2		
2019-11-20	67	25	40G4	14 22,039	55 41,745	25419	3,5 NE Stens huvud	TV3L	00:30	38		6,2		
2019-11-21	67	25	40G4	14 24,000	55 41,765		Rackaputt 38	CTD			39	0		
2019-11-21	68	25	40G4	14 22,733	55 42,456	25418	Rackaputt 38	TV3L	00:30	36		0		
2019-11-21	69	25	40G4	14 27,616	55 41,092	25421	Rackaputt Central	TV3L	00:30	48		5,9		
2019-11-21	68	25	40G4	14 31,245	55 39,602		Rackaputt Central	CTD			49	5,8		
2019-11-21	70	25	40G4	14 30,583	55 41,268	25353	Rackaput Nord	TV3L	00:30	49		5,9		
2019-11-21	71	25	40G4	14 22,319	55 42,173	25401	5 NE Stens Huvud	TV3L	00:30	36		6,5		
2019-11-21	69	25	40G4	14 27,317	55 41,401		CTD.00069	CTD			41	6,4		
2019-11-22	72	27	42G7	17 57,075	56 59,514	27007	8 NW Hoburg	TV3L	00:30	64		3,4		
2019-11-22	73	27	43G7	17 55,266	57 02,966	27009	9 NW Hoburg	TV3L	00:25	75		1		
2019-11-22	70	27	43G7	17 52,672	57 04,556		9 NW Hoburg	CTD			77	0,3		
2019-11-22	71	27	43G7	17 53,165	57 20,442		4 NW Stora Karlso	CTD			100	0,1		
2019-11-22	74	27	43G7	17 53,376	57 20,624	27016	4 NW Stora Karlso	TV3L	00:03	104		0,1	Syrefritt	Oxygen free
2019-11-23	72	27	42G7	17 11,429	56 55,881		10 E Karehamn	CTD			72	1,1		
2019-11-23	75	27	42G7	17 10,653	56 56,630	27005	10 E Karehamn	TV3L	00:30	72		1,1		
2019-11-23	76	27	43G6	16 59,798	57 26,762	27003	5 N Byxelkrok	TV3L	00:30	54		5		
2019-11-23	77	27	43G6	16 54,944	57 21,883	27020	4 NW Byxelkrok	TV3L	00:25	43		5,3		
2019-11-23	73	27	43G6	16 54,882	57 24,468		4 NW Byxelkrok	CTD			43	5,3		
2019-11-23	74	27	43G6	16 58,997	57 28,280		5 N Byxelkrok	CTD			61	3,4		
2019-11-23	75	27	44G7	17 06,640	57 37,104		9 SE Kungsgrundet	CTD			79	0,2		
2019-11-23	78	27	44G7	17 06,584	57 37,204	27014	9 SE Kungsgrundet	TV3L	00:04	82		0,2	Syrefritt	Oxygen free
2019-11-23	76	27	44G8	18 07,332	57 46,412		10 NW Visby	CTD			101	0,1		
2019-11-23	79	27	44G8	18 07,428	57 46,350	27027	10 NW Visby	TV3L	00:03	105		0,1	Syrefritt	Oxygen free
2019-11-23	77	27	44G8	18 18,023	57 45,930		6 N Visby	CTD			106	0,1		
2019-11-23	80	27	44G8	18 18,169	57 45,942	27018	6 N Visby	TV3L	00:04	109		0,1	Syrefritt	Oxygen free
2019-11-24	78	28.2	44G9	19 31,539	57 52,624		6.5 SE Faro	CTD			69	0,5		
2019-11-24	81	28	44G9	19 30,471	57 52,716	28104	6.5 SE Faro	TV3L	00:30	70		0,5		
2019-11-24	79	28.2	44G9	19 32,874	57 51,903		8 SE Faro	CTD			75	0,2		
2019-11-24	82	28	44G9	19 31,575	57 50,869	28099	8 SE Faro	TV3L	00:30	76		0,2		
2019-11-24	83	28	43G8	18 57,680	57 16,881	28180	8 ESE Ljugarn	TV3L	00:30	53		4,6		
2019-11-24	80	28.2	43G8	18 58,207	57 15,439		8 ESE Ljugarn	CTD			57	3,5		
2019-11-24	81	28.2	43G9	19 06,109	57 14,984		13 E Ljugarn	CTD			88	0,1		
2019-11-24	84	28	43G9	19 06,105	57 14,973	28072	13 E Ljugarn	TV3L	00:03	91		0,1	Syrefritt	Oxygen free
2019-11-25	82	28.2	43G8	18 54,143	57 10,640		5 SE Nar	CTD			54	3,3		
2019-11-25	85	28	43G8	18 51,821	57 10,585	28016	5 SE Nar	TV3L	00:30	51		4,4		
2019-11-25	86	26	41G8	18 29,393	56 23,648	26013	11 S Hoburgs Bank	TV3L	00:30	36		6,7		
2019-11-25	83	26	41G8	18 28,791	56 21,836		11 S Hoburgs Bank	CTD			43	4,7		
2019-11-25	84	26	41G8	18 41,843	56 20,315		6 NW Bananbanken	CTD			106	0,1		
2019-11-25	87	26	41G8	18 41,633	56 20,223	26141	6 NW Bananbanken	TV3L	00:03	110		0,1	Syrefritt	Oxygen free
2019-11-25	85	26	41G9	19 30,026	56 14,087		20 ENE Bananbanken	CTD			105	0,4		
2019-11-25	88	26	41G9	19 29,963	56 14,005	26071	20 ENE Bananbanken	TV3L	00:03	107		0,4	Syrefritt	Oxygen free
2019-11-25	89	26	41G9	19 28,887	56 12,721	26142	20 E Bananbanken	TV3L	00:03	102		0,4	Syrefritt	Oxygen free
2019-11-26	86	26	40G8	18 40,781	55 55,428		11 SSW Bananbanken	CTD			110	1		
2019-11-26	90	26	40G8	18 38,190	55 55,163	26221	11 SSW Bananbanken	TV3L	00:30	112		1		
2019-11-26	91	26	41G8	18 25,839	56 13,516	26069	20 S hoburg bank	TV3L	00:30	70		0,4		
2019-11-26	87	26	41G8	18 29,004	56 15,927		20 S hoburg bank	CTD			69	0,4		
2019-11-26	92	26	41G8	18 40,576	56 27,690	26125	10 S Hoburgs bank	TV3L	00:30	75		0,1		
2019-11-26	88	26	41G8	18 42,955	56 28,916		10 S Hoburgs bank	CTD			74	0,1		
2019-11-27	89	26	41G8	18 28,590	56 21,231		16 SSW Hoburgs Bank	CTD			46	4,8		
2019-11-27	93	26	41G8	18 26,638	56 20,959	26225	16 SSW Hoburgs Bank	TV3L	00:25	41		5,8		
2019-11-27	94	27	42G6	16 59,909	56 41,591	27028	10 SSE Kapelludden	TV3L	00:30	67		3,1		
2019-11-27	90	27	42G6	16 59,429	56 39,804		10 SSE Kapelludden	CTD			64	3,1		
2019-11-28	91	25	40G5	15 36,021	55 52,458		Klippebank	CTD			47	5,1		
2019-11-28	95	25	40G5	15 34,408	55 51,237	25140	Klippebank	TV3L	00:30	42		5,7		
2019-11-28	92	25	40G5	15 14,742	55 46,809		Yttertorpet väst	CTD			52	4		
2019-11-28	96	25	40G5	15 13,409	55 47,224	25120	Yttertorpet väst	TV3L	00:23	54		4		
2019-11-28	97	25	40G4	14 27,840	55 40,994	25422	Rackaput vast	TV3L	00:30	47		6,1		
2019-11-28	93	25	40G4	14 25,097	55 41,072		Rackaput vast	CTD			42	6,1		

Table 2. Summary of the species in the catches. Swedish BITS, Q4 2019.

Species	SD 25W		SD 25C		SD 26		SD 27		SD 28		Totalt	
	Antal	Vikt	Antal	Vikt	Antal	Vikt	Antal	Vikt	Antal	Vikt	Antal	Vikt
	No.	Weight	No.	Weight	No.	Weight	No.	Weight	No.	Weight	No.	Weight
Gadus morhua	10803	2188,69	83	14,134	75	20,97	33	8,666	168	36,416	11162	2268,876
Clupea harengus	32616,7	1267,426	38895,3	1140,894	74261,6	2325,785	187826,2	4387,186	89111,8	2455,047	422711,6	11576,338
Sprattus sprattus	115444,1	933,906	182310,5	2268,937	44128	441,007	150103,6	1165,88	61300,8	654,163	553287	5463,893
Enchelyopus cimbrius	7	0,544			3	0,148	1	0,001			11	0,693
Pollachius virens	2	1,814									2	1,814
Myoxocephalus quadricornis					1	0,16	130	18,156			131	18,316
Scomber scombrus	1	0,236									1	0,236
Osmerus eperlanus					1	0,088	5	0,16			6	0,248
Scophthalmus maximus	113	58,318	3	0,53			2	0,21			118	59,058
Pleuronectes platessa	2035,8	350,23	33	6,242	3	0,292	2	0,254			2073,8	357,018
Myoxocephalus scorpius	39	3,568	20	3,152	822,5	138,38	27	2,982	31	3,518	939,5	151,6
Limanda limanda	44	9,204									44	9,204
Cyclopterus lumpus	11	4,516	1	0,31	2	0,49			1	0,23	15	5,546
Platichthys flesus	3569,6	757,176	176	31,44	293	51,534	269	41,358	483	73,028	4790,6	954,536
Scophthalmus rhombus	1	0,4									1	0,4
Pungitius pungitius							41,8	0,055	5	0,007	46,8	0,062
Pomatoschistus	8	0,006			3	0,003	7	0,01	2	0,003	20	0,022
Lumpenus lampretaeformis							1	0,026	5	0,11	6	0,136
Alosa fallax	1	0,036									1	0,036
Gasterosteus aculeatus	1	0,001	18	0,034	949,4	2	1166,8	2,202	514	1,053	2649,2	5,29
Neogobius melanostomus	1	0,016									1	0,016
Trachurus trachurus	5	0,034									5	0,034
Hyperoplus lanceolatus			6	0,074							6	0,074
Zoarces viviparus	1	0,048			2	0,162	43	0,788	4	0,088	50	1,086
Merlangius merlangus	1359,1	215,73									1359,1	215,73
	166481,3	5811,568	221662,8	3466,66	120581,5	2986,24	339673,4	5629,138	151628,6	3225,79	1000027,6	21119,396

Table 2. List of the stations not visited Q4 2019.

Stationsnr	SD	Ruta	Stationer	Lat1	Long1	Lat2	Long2	Declat	Declong	Depth	KDL
25404/25125	25	4060	YTTERTORPET	55°49,60	15°26,40	55°48,85	15°23,48	55,82667	15,44	51	3
27031	27	4362	8 ENE KÅREHAMN	57°01,27	17°07,97	57°02,72	17°08,69	57,02108	17,13277	54	3

Technical University of Denmark

DTU Aqua - Cruise report

BITS 1Q 2020

Baltic International Trawl Survey

R/V DANA DENMARK

Cruise no. 3/20

02-03-2020 to 19-03-2020

DTU Aqua
Kemitorvet, Building 202
2800 Kgs. Lyngby
Denmark

DTU Aqua
National Institute of Aquatic Resources

Contents

Cruise summary

Cruise	BITS
Cruise number	3/20
Reseach vessel(s)	R/V DANA
Year and quarter	1Q 2020
Country	Denmark

Location and time

Participants

Leg	Name	Institute	Function and tasks
Leg 1			
	Henrik Degel	DTU-Aqua	Cruise-leader
	Louise Lundgaard	DTU-Aqua	Assistant cruise-leader
	Peter Vingaard	DTU-Aqua	Individual fish measurements
	Jane Gudmandsen	DTU-Aqua	Length measurements
	Ina Hennings	Sea Fisheries, Rostock	Individual fish measurements
	Nele Guttmann	DTU-Aqua	Length measurements
	Christian Skou Petersen	DTU-Aqua	Technisian
Leg 2			
	Henrik Degel	DTU-Aqua	Cruise-leader
	Stina Bjørk Stenersen	DTU-Aqua	Assistant cruise-leader
	Nikolaj Kolding Pedersen	DTU-Aqua	Individual fish measurements
	Laura Diernæs	DTU-Aqua	Individual fish measurements
	Piotr Pankowski	Observer MIR	Length measurements
	Svend-Erik Levinsky	DTU-Aqua	Night assistant cruise leader
	Nele Guttmann	DTU-Aqua	Night assistant
	Christian Skou Petersen	DTU-Aqua	Technisian

Introduction

The Danish research vessel Dana R/V was built in 1980-81 and is a versatile multipurpose vessel with five large laboratories and 38 cabins. The Baltic cod stock has been monitored annually since 1982 through bottom trawl surveys carried out by most countries surrounding the Baltic. The national research vessels have each surveyed part of the area with some overlap in coverage and applied a depth stratified sampling design. However, different gears and design were applied and in 1985 ICES established a Study Group on Young Fish Surveys in the Baltic in order to standardize the surveys. After agreement a common standard trawl gear and standard sampling procedures were implemented in 2000 resulting in the consistent coverage of the western and central Baltic Sea.

To calibrate the national surveys from before 2000 with the TV3 gear used from 2000, a set of conversion factors are produced by making comparative hauls. The work with standardizing gear and creating conversion factors for old data was done under the EU project ISDBITS and gear specifications and conversion factors can be found in the report (ISDBITS 2001).

The type of trawl is called “TV3L” with 930 meshes in the opening. The design and construction of the standard trawls are given in ICES (1997) and can also be found in the BITS manual (Anon. 2000). Until November 2007 Denmark was still using the rock hopper gear on hard fishing ground but since 2008 only the standard TV3L has been used.

The BITS is conducted as a depth-stratified survey. The strata are based on Sub divisions and depth layers. Each year the necessary stations are randomly selected before the beginning of the international trawl surveys from a list of clear haul data. These stations are a stratified random selected sub-sample of the possible trawl tracks. The standard haul is a 30 minute haul with a towing speed of 3 knots. Trawling is only taking place during daylight, defined as the time between 15 minutes past sunrise until 15 minutes before sunset.

Objectives

Daytime

- To estimate the abundance and the year class strength of the Baltic cod and flatfish stocks in ICES Sub-divisions 21-32. The 4st quarter survey is together with the spring survey the Danish contribution to the "Baltic International Trawl Survey"(BITS) and takes place mainly in Sub-division 25 and 26. The main goal of the surveys is to provide the Baltic assessment working group fishery independent data to use for assessment in ICES the working group in April. Furthermore, all fish species are species determination, measured and weighted.
- To measure temperature, salinity and oxygen at the fishing location. The measurements are conducted with a CTD. Calibration of the CTD is conducted before the survey.
- To take individual samples of cod to analyses of age determination, sex, weight and liver condition. Data is used to produce maturity ogive, mean weights per age and condition which is used for Eastern Baltic stock assessment.

Nighttime

- To investigate the abundance and distribution of zooplankton in the central Baltic Sea. The analysis is conducted with a bongo net were the stations are allocated in accordance to the Kiel grid net covering most of SD 25. Trawling speed is 3 kn and the three nets are 150, 335 and 500 μm in cod end.
- To investigate the distribution of juvenile cod caught in a IKMT.
- To catch live zooplankton with a WP2 net.

This Survey

During the cruise, apart from recording a complete set of factual information concerning haul information, gear performance, catch results, hydrographic information etc., the cruise leader keeps a logbook taking notes about circumstances (unusual gear performance, special catches, non-conformities etc. during the survey. The haul summary below is the overview from this logbook.

Haul summary

Number of planned hauls: 50

	Index qualified	Non-index qualified
Number of succesfull trawl hauls:	42	
Number of invalid trawl hauls:		4
Number of "No oxygen trawl hauls" (assumed zero-catch):	6	
SUM	48	4

Number of trawl related CTD stations performed:	47
Number of NON-trawl related CTD stations performed:	12
Number of successful BONGO hauls carried out:	44
Number of successful IKMT hauls carried out:	0
Number of successful Appi hauls carried out:	0
Number of successful WP2 hauls carried out:	3
Number of successful BOM hauls carried out:	0
Number of successful Multi-NET hauls carried out:	0

Cruise leaders and assistants

A cruise leader and an assistant cruise leader are appointed for each leg of the cruise. The Cruise leader is responsible for all matters which are connected to scientific issues during the cruise. The assistant cruise leader assists this task and should be able to take over the responsibilities of the cruise leader if necessary.

Cruise leaders and assistants on the survey

Leg 1 Cruise leader: *Henrik Degel* - Assistant: *Louise Lundgaard*

Leg 2 Cruise leader: *Henrik Degel* - Assistant: *Stina Bjørk Stenersen*

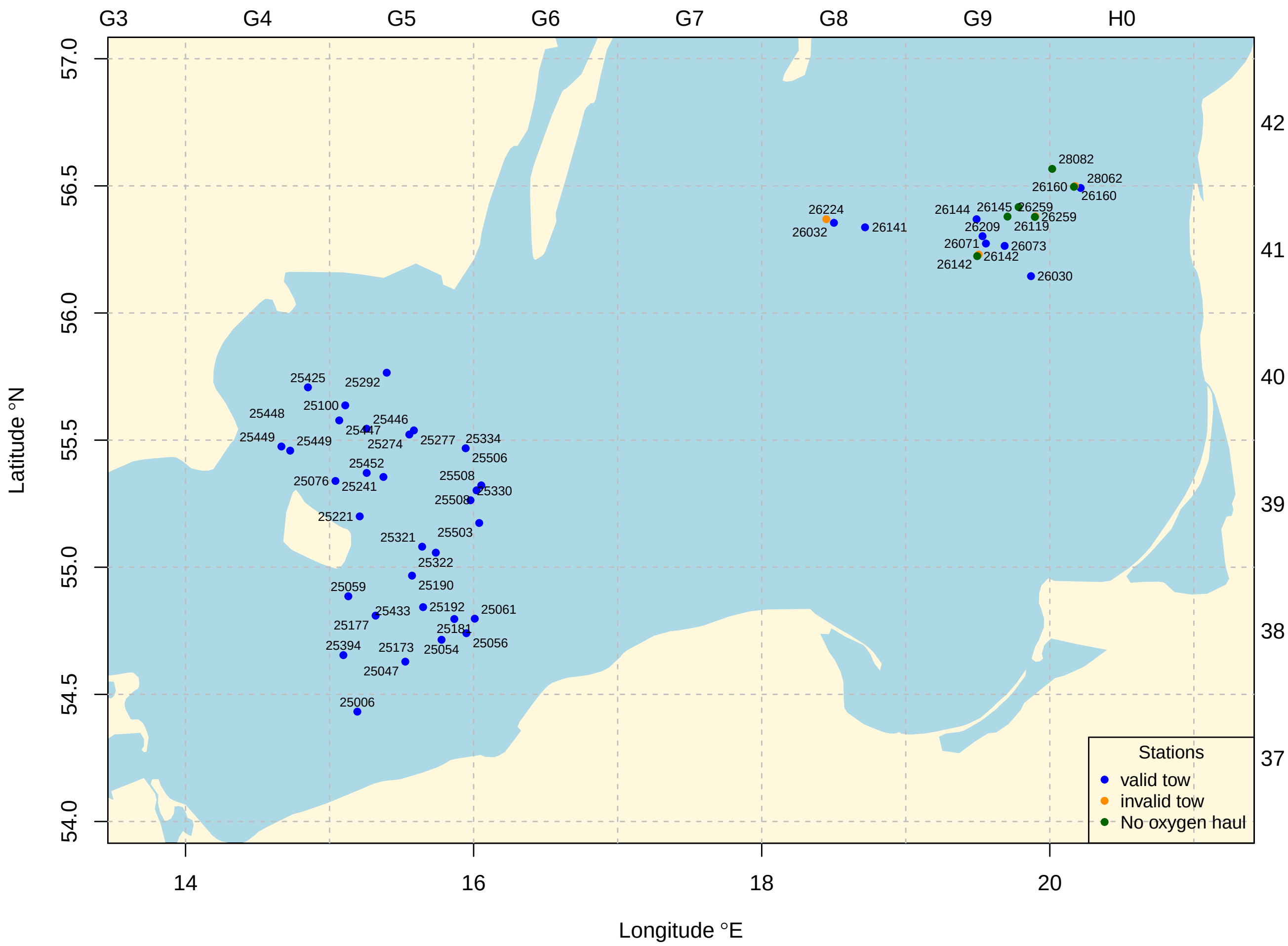

Figure 1: Survey map with trawl stations. During the cruise 42 hauls were conducted, 4 invalid and 6 with low oxygen. R/V DANA Denmark, BITS 1Q 2020.

Itinerary

A survey map with allocated trawl stations is shown in Fig. 1 and in Fig. 2 a map of allocated bongo stations is presented.

Gear performance

The gear performance is monitored during any trawl station. All relevant parameters describing the gear geometry during the fishing is logged to verify that the observed trawl geometry values are within the defined ranges for acceptance.

We damaged 3 trawls in SD 26 but did not otherwise have any trouble with the gear

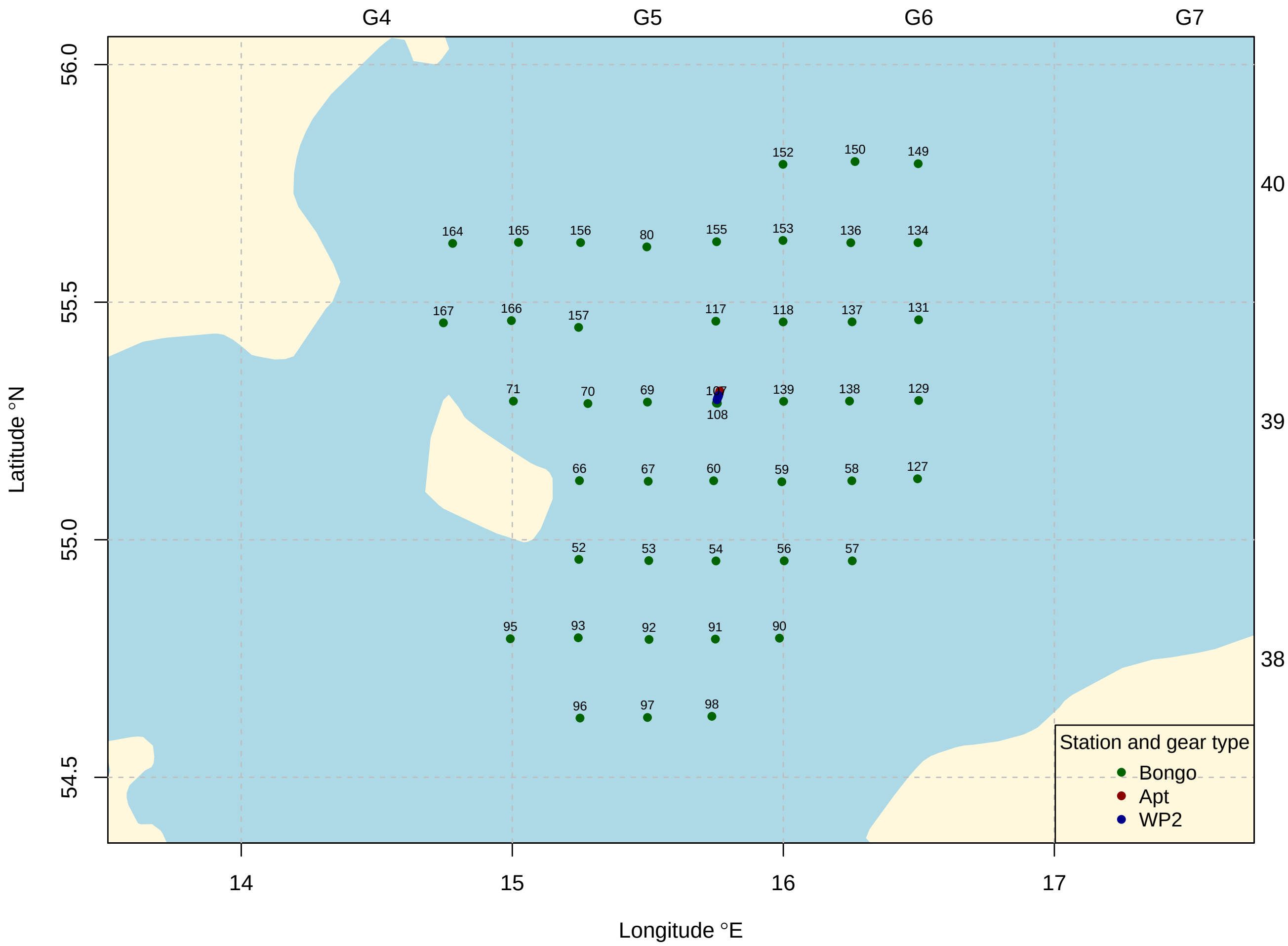

Figure 2: Allocated bongo, IKMT, Aptstein und WP2 stations. Bongo stations are assigned with station numbers but other hauls types are not. R/V DANA Denmark, BITS 1Q 2020.

Oxygen Conditions

Oxygen conditions are monitored in connection with each trawl haul. If the oxygen contend is below 1.5 ml/l it can be decided not to carry out any trawling procedure if it previous under the cruise has been verified by trawling that no fish is staying in this water mass (same Sub-division and same depth strata). The station is then recorded as an assumed zero-catch station. If the cruise leader has any reason to trawl anyway, normal trawling is carried out at the station.

Very few station with oxygen < 0.5 ml/l and only in SD 26 and 28

Weather conditions

The weather was very fine with only moderate vind speeds

Wind speed and direction are presented in Fig. 3.

Number of days with an average wind speed larger than 15 m/s: 2.

Guests on board

There is a long and strong tradition to have scientific colleagues from other countries onboard in exchange during the survey. The reason for that is the facilitating of cooperation and standardization of procedures across participating countries. Guests on this survey: Ina Hennings, Sea Fisheries, Rostock, Germany Piotr Pankowski, Observer, MIR, Poland

Other

The outbreake of the Corona virus had no influence on the cruise.

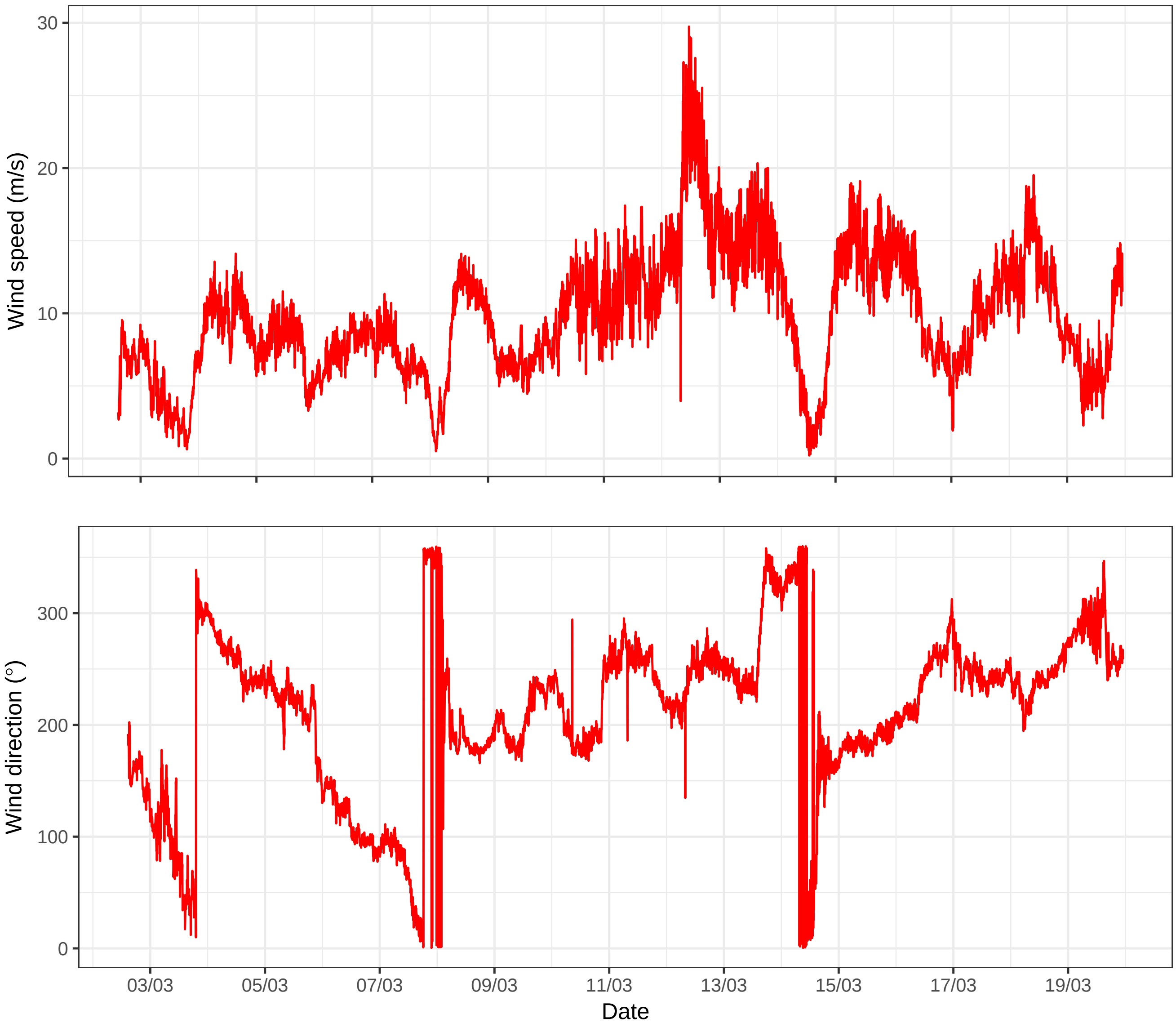

Figure 3: Wind speed and wind direction along the cruise track, R/V DANA Denmark, BITS 1Q 2020.

Catch on survey

Compelete list of species

	Latin name	English name	Danish name	Number	Weight (kg)
1	Alosa fallax	Twaite shad	Stavsild	4	0.16
2	Ammodytes marinus	Sandeel	Tobis-hav	1	0.01
3	Clupea harengus	Herring	Sild	30498	1173.46
4	Crystallogobius linearis	Crystal goby	Krystalkutling	5	0
5	Cyclopterus lumpus	Lumpfish	Stenbider	1	0.19
6	Enchelyopus cimbrius	Four-bearded rockling	Firetrådet havkvabbe	191	10.64
7	Engraulis encrasicolus	Anchovy	Ansjos	69	0.33
8	Gadus morhua	Cod	Torsk	15223	5534.76
9	Gasterosteus aculeatus	Three-spined stickleback	Trepigget hundestejle	462	0.93
10	Hyperoplus lanceolatus	Greater sandeel	Tobiskonge	111	1.75
11	Limanda limanda	Common dab	Ising	7	1.06
12	Merlangius merlangus	Whiting	Hvilling	1047	191.14
13	Merluccius merluccius	Hake	Kulmule	1	0.43
14	Microstomus kitt	Lemon sole	Rødtunge	1	0.24
15	Myoxocephalus scorpius	Sculpin	Ulk	103	13.98
16	Mytilus edulis	Blue mussel	Blåmusling	-	11.91
17	Platichthys flesus	Flounder	Skrubbe	35177	7344.04
18	Pleuronectes platessa	Plaice	Rødspætte	3472	349.62
19	Scomber scombrus	Mackerel	Makrel	40	11.44
20	Scophthalmus maximus	Turbot	Pighvarre	3	1.33
21	Sprattus sprattus	Sprat	Brisling	1837806	18680.31
22	Trachurus trachurus	Horsemackerel	Hestemakrel	127	1.34
23	Zoarces viviparus	Eelpout	Ålekvabbe	1	0.01

Table 1: Species caught on the survey R/V DANA Denmark, BITS 1Q 2020.

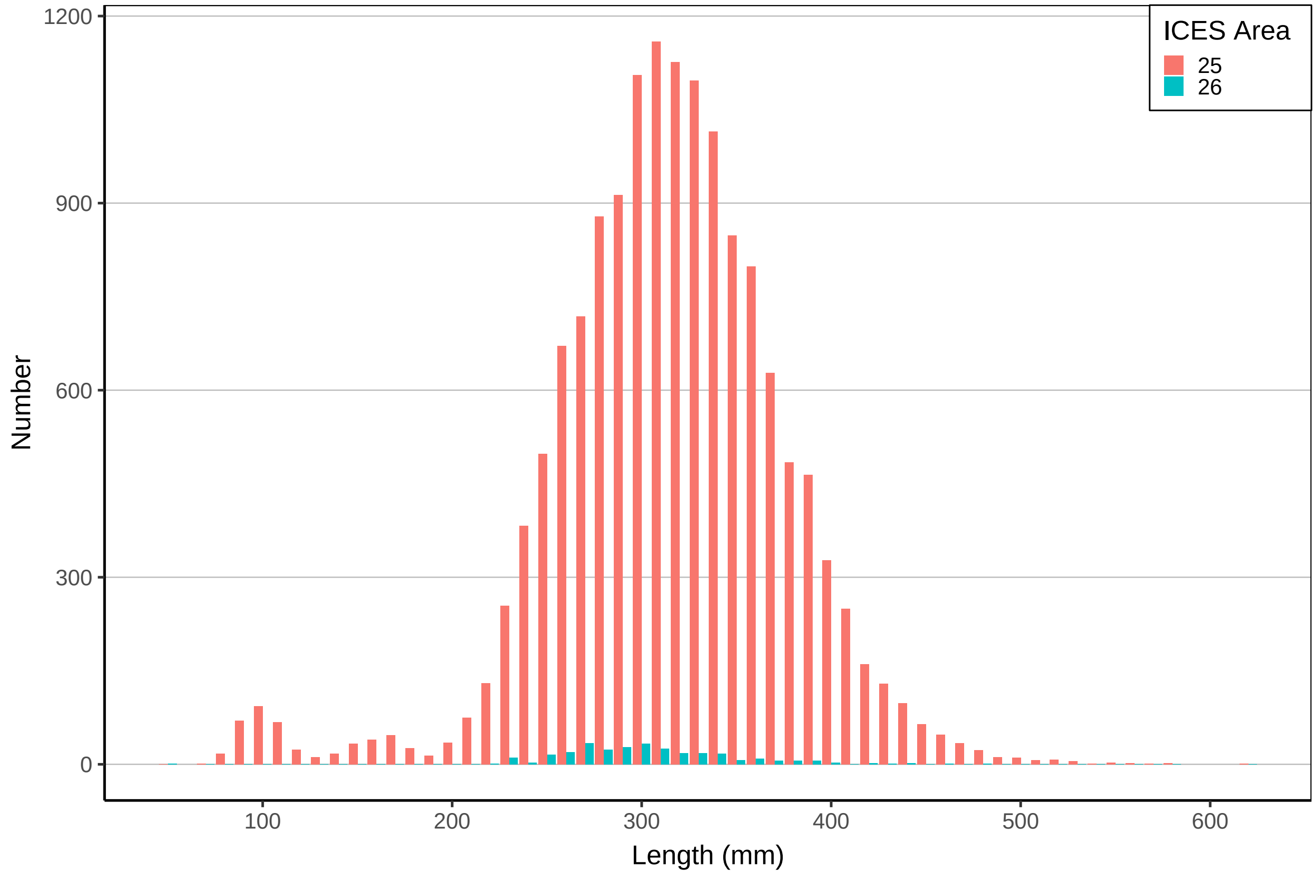

Figure 4: Cod length distribution per area for R/V DANA Denmark, BITS 1Q 2020.

Cod catch and length distribution

Total kgs of cod catched:	5535
Total number of cod measured:	13046
Total number of cod otoliths collected:	1071

In Fig. 4 the length distributions of cod per ICES statiscal area are presented.

Institute of
Baltic Sea Fisheries

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Cruise report
Cruise number 774 FRV „Solea"
20/02/- 06/03 – 09-16/03/2020

Baltic International Trawl Spring Survey (BITS) in the Arkona Sea, Mecklenburg- and Kiel Bay (ICES SD 24+22)

Scientists in charge**: A. Velasco and M. Bleil**

1. Summary

The 774 cruise of the FRV "Solea" is the 39th German Spring survey since 1981. It was part of the Baltic International Trawl Survey (BITS), which was coordinated by ICES (WGBIFS). The main objective of the survey was to estimate fishery independent stock indices for the two Baltic cod stocks, flounder and plaice.
In total 56 fishery hauls and 56 hydrography stations were carried out.
A preliminary analysis of the survey results suggests a better year class of cod in 2019 compared with the previous weak year class 2018 (recruits at length range 10 - 25 cm). The proportion of recruits between 10 - 25 cm was lower in all depth layers compared to the previous year. The proportion of cod between 26 - 40 cm was also lower in all depth layers compared to the previous year.
The abundance of flounder increased in all depth layers in subdivisions 22 and 24 compared to the previous year, with the exception of the depth layer of 10 - 19 meters in subdivision 24.
During the survey habitual salinity-gradients were observed. The oxygen concentration was sufficiently high down to the bottom at the stations in subdivisions 22 and 24.
In addition to the BITS program 8 fishery and 8 hydrographic stations were conducted in SD22 to investigate the reproduction of cod.

Verteiler:
BLE, Hamburg
Schiffsführung FFS „Solea"
BMELV, Ref. 614
Thünen-Institut, Präsidialbüro (M. Welling)
TI, Verwaltung Hamburg
TI, FI
TI, OF
TI, SF
Fahrtteilnehmer
TI, FIZ-Fischerei
Verantw. Seeeinsatzplanung, Herr Dr. Rohlf
BFEL Hamburg, FB Fischqualität
IFM-GEOMAR, Kiel
Institut für Fischerei der Landesforschungsanstalt
LA für Landwirtschaft, Lebensmittels. u. Fischerei
BSH, Hamburg
Deutscher Fischerei-Verband e. V., Hamburg
Leibniz-Institut für Ostseeforschung
Doggerbank GmbH
Mecklenburger Hochseefischerei Sassnitz
Kutter- und Küstenfisch Sassnitz
Landesverband der Kutter- und Küstenfischer
Sassnitzer Seefischer
Deutsche Fischfang Union Cuxhaven

2. Research program

The cruise took place from the 20th February -6st March and 9th - 16th March 2020. Corresponding to the recommendations of the WGBIFS in 2007, the survey of the FRV "Solea" covered the subdivisions 22 and 24 (Figure 1).

The following stock assessment objectives were covered during the survey:

- Collecting data for assessing stock indices, the structure and recruitment of the stocks, especially for cod and flatfish
- Monitoring the composition of fish species in the western Baltic Sea
- Collecting samples of cod and flounder for biological investigations (i.e. sex, maturity, fecundity, age)
- Monitoring the actual hydrographical situation in the survey area

3. Narrative

The internationally coordinated trawl survey is planned as a Stratified Random Survey where ICES subdivisions and depth layers are used as strata. A total of 59 stations (43 in subdivision 24 and 16 in subdivision 22) were planned for the German part of the survey, which covered the southern part of ICES subdivision 22 and subdivision 24 in total. The haul positions were selected from the TOW Database by the coordinator of the BITS surveys (ICES 2008, WGBIFS report). 48 fishing stations were covered and can be used for stock assessment. The fishing hauls were carried out between 7:00 and 15:00 UTC (8:00 and 16:00 local time).
The positions of the trawl hauls are shown in Figure 1. 17 fishing hauls and 15 hydrographic stations were done in subdivision 22, and 41 fishing hauls and 41 hydrographical stations were realized in subdivision 24.

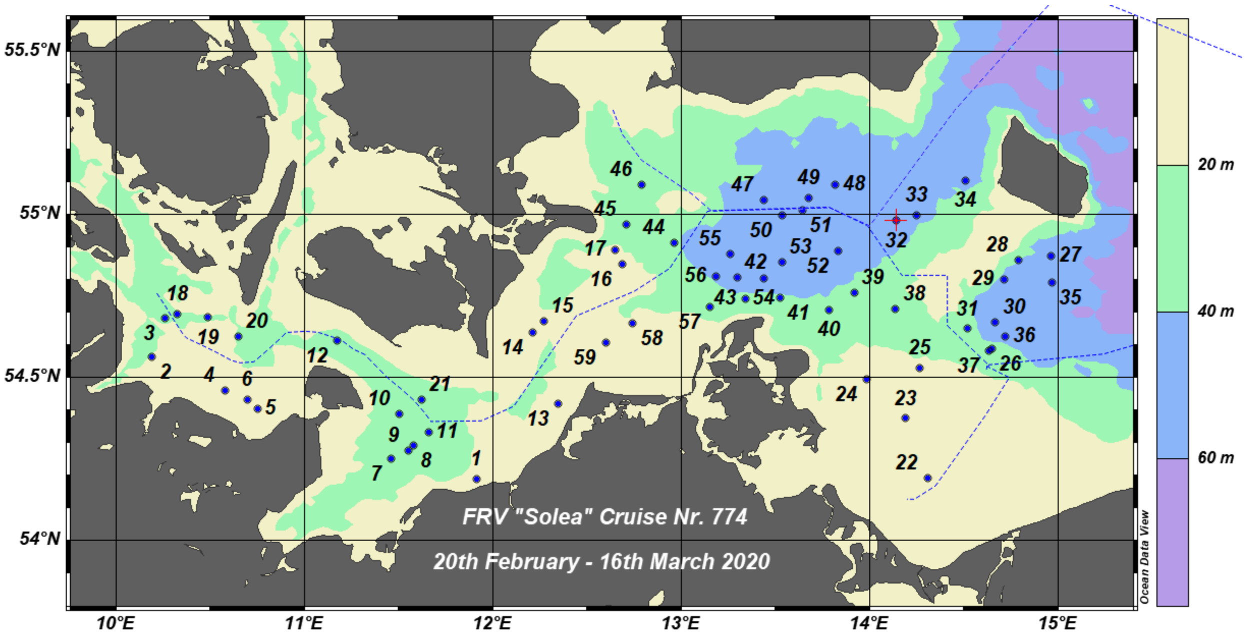

Figure 1: BITS Stations of the 774th FRV "SOLEA" cruise (Ocean Data View, R. Schlitzer, www.awi-bremerhaven.de/GEO/ODV)

The numbers of fishing hauls and hydrographic stations by subdivision and 20 m depth layers are given in Table 1. Most hauls in subdivision 22 were located at depths from 10 m to 29 m and 22 of 42 hauls in subdivision 24 between 40 and 59 m.

Table 1: Sampling intensity (evaluated fishing stations) of BITS and additional hauls

Area		Stations		
Subdivision	**Stratum Depth [m]**	**Total trawl distance [sm]**	**Fishing [n]**	**Hydrography [n]**
22	**1 [10-19]**	4,6	3	3
	2 [20-29]	18,2	12	12
24	**1 [10-19]**	9,3	6	6
	2 [20-39]	20,3	13	13
	3 [40-59]	32,5	22	22
25	**2 [15-29]**	**Additional hauls**	8	8

Trawling was done following the standard BITS trawl "TV3 520#". The stretched mesh size in the codend was 20 mm. The duration of each haul was 30 minutes at a velocity of 3 kn as required in the BITS manual. The total catch of each haul was analysed to determine species composition in weight and number as well as the length distribution of all species. Subsamples of cod, flounder, plaice, dab and turbot were investigated concerning sex, maturity and age.
Vertical profiles of the hydrographical parameters temperature, salinity and oxygen were sampled from the surface to the bottom immediately after every fishing haul with a CTDO probe (Sea Bird 19+ 6434).

In addition to the BITS standard program 8 stations in the Mecklenburg- and Kiel Bight in ICES subdivision 22 were also conducted to investigate the reproduction of cod in relation to water deep.

4. Preliminary results

4.1 Biological data

In total 1084 cod, 652 flounder, 843 plaice, 609 dab, 154 turbot and 17 brill were collected for measuring length, weight, sex, maturity and age. The total catches and numbers of length samples of cod, flounder, plaice and dab are given in Table 2 by subdivision and depth stratum.
The mean catch per hour (CPUE) was 122.2 kg of cod and 38.4 kg of flounder. In general the catch composition was dominated by cod. However, flounder, plaice and dab were also abundant in the catches. The mean fraction of cod biomass in the hauls was 44.8 % and mean fraction of flounder, plaice and dab was 14.1 %, 17.3 % and 11.4 %, respectively. Sprat and herring represented 6.1 % of the total biomass in mean.

Table 2: Numbers of length measurements of cod, flounder, plaice and dab by depth stratum and ICES subdivision

Area		Sample			
		Cod		Flounder	
Subdivision	Depth [m]	Weight [kg]	Number [n]	Weight [kg]	Number [n]
22	10-29	2744.9	2128	259.1	983
24	10-19	354.5	552	27.5	160
	20-39	535.1	2705	156.3	727
	40-59	1556.6	5129	1187.9	6463

Area		Sample			
		Plaice		Dab	
Subdivision	Depth [m]	Weight [kg]	Number [n]	Weight [kg]	Number [n]
22	10-29	1367.7	6988	1089.7	9184
24	10-19	76.4	260	17.6	99
	20-39	151.7	918	164.2	1283
	40-59	398.7	2930	50.6	343

The highest abundances in weight and number of cod and flounder were observed in subdivision 24 in depths between 40 - 59 m. The highest abundances in weight and number of plaice and dab were observed in subdivision 22 in depths between 10 - 29 m.

Mean CPUE of cod and flounder are given in Table 3 by subdivision and depth stratum.

Table 3: Mean CPUE of cod and flounder and average individual weights by subdivision and depth

Area		Catch							
		Cod				Flounder			
Subdivision	Depth [m]	Weight [kg/sm]	Number [n/sm]	Average Weight [g]	Stations [n]	Weight [kg/sm]	Number [n/sm]	Average Weight [g]	Stations [n]
22	10-29	120.4	93	1289.9	15	11.4	43	263.6	15
24	10-19	38.1	59	642.1	6	3.0	17.2	171.8	6
	20-39	26.3	133	197.8	13	7.7	36	215.5	13
	40-59	47.8	158	303.5	22	36.5	199	183.8	22

Area		Catch							
		Plaice				Dab			
Subdivision	Depth [m]	Weight [kg/sm]	Number [n/sm]	Average Weight [g]	Stations [n]	Weight [kg/sm]	Number [n/sm]	Average Weight [g]	Stations [n]
22	10-29	60.4	307	197.0	15	47.8	403	118.7	15
24	10-19	8.2	28	293.7	6	1.9	11	178.2	6
	20-39	7.5	45	165.3	13	8.1	63	128.0	13
	40-59	12.3	90	136.1	22	1.6	11	147.6	22

The frequencies of cod grouped by subdivision and depth strata are presented in figures 1 to 3. Noteworthy is the abundance of cod ranging in length from 10 to 25 cm in subdivision 24. Compared to last year, the frequency of cod in the length range 10–25 increased in all depth layers in subdivision 24 (Table 4 and Figures 2 to 4).

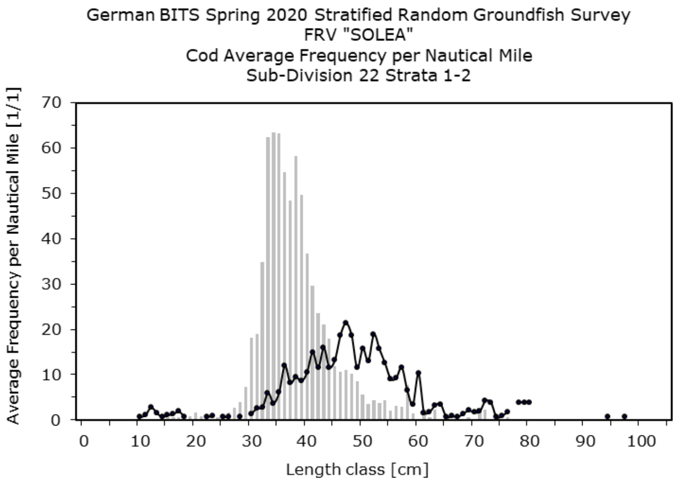

Figure 2: Length frequencies of cod in number per mile in depth strata 10 m to 29 m in SD 22 2020 (line) and 2019 (bars), (15 Hauls)

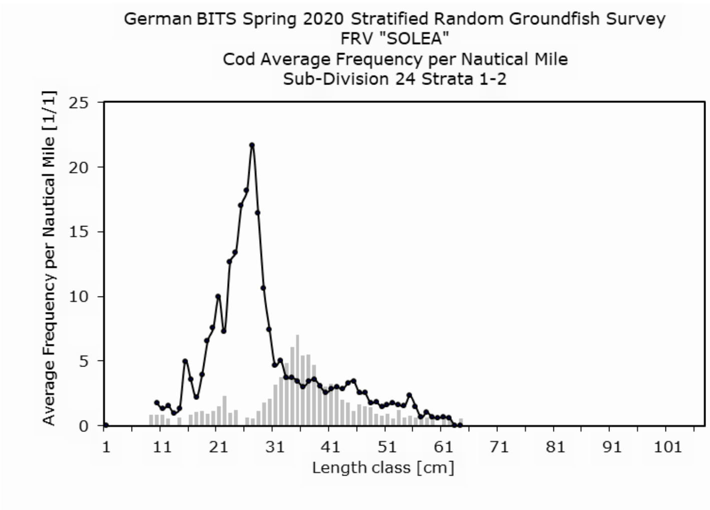

Figure 3: Length frequencies of cod in number per mile in depth strata 10 m to 39 m in SD 24 2020 (line) and 2019 (bars), (19 Hauls)

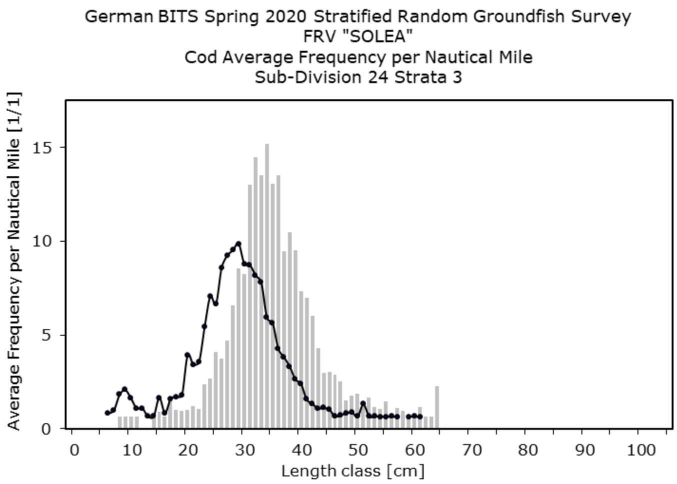

Figure 4: Length frequencies of cod in number per mile in depth strata 40 m to 59 m in SD 24 2020 (line) and 2019 (bars), (22 Hauls)

Table 4: Recruitment by length group of the year 2020 in comparison to the previous year

Area		Catch	2020		
Subdivision	**Depth [m]**	**Length range [cm]**	**Number [n]**	**Number/ Mile [n/sm]**	**Trawl distance [sm]**
22	**10-29**	**26 - 40**	252	11	22.8
24	**10-19**	**26 - 40**	213	23	9.3
	20-39	**26 - 40**	1163	57	20.3
	40-59	**26 - 40**	3501	108	32.5
22 - 24	**10-59**	**26 - 40**	5129	60	85.0
22	**10-29**	**10 - 25**	30	1	22.8
24	**10-19**	**10 - 25**	63	7	9.3
	20-39	**10 - 25**	1805	89	20.3
	40-59	**10 - 25**	897	28	32.5
22 - 24	**10-59**	**10 - 25**	2815	33	85.0

Area		Catch	2019		
Subdivision	**Depth [m]**	**Length range [cm]**	**Number [n]**	**Number/ Mile [n/sm]**	**Trawl distance [sm]**
22	**10-29**	**26 - 40**	4985	239	20.9
24	**10-19**	**26 - 40**	543	41	13.3
	20-39	**26 - 40**	538	32	16.7
	40-59	**26 - 40**	3598	147	24.4
22 - 24	**10-59**	**26 - 40**	9664	128	75.3
22	**10-29**	**10 - 25**	32	2	20.9
24	**10-19**	**10 - 25**	4	0.3	13.3
	20-39	**10 - 25**	57	3	16.7
	40-59	**10 - 25**	272	11	24.4
22 - 24	**10-59**	**10 - 25**	365	5	75.3

Under the assumption that the survey covered the entire nursery ground of one-year old cod, a better year class of cod in 2019 compared with the previous weak year class 2018 can be assumed.

Moreover at the additional 8 hauls to the BITS standard program cod were sampled in the ICES SD 22 to estimate the current spawning activities and the distribution of maturity in relation to the condition in the main spawning area of the western cod stock.

4.2 Hydrographical data

Figure 5 shows the distribution of temperature, salinity and oxygen near the bottom and at the surface in the covered area.
The hydrography was characterised by atypical winter conditions with surface temperatures between 4.6 °C and 5.7 °C. The salinity of the surface water decreased from 21.7 to 8.0 from west to east. The lowest temperature value was found in the area of Adler Ground with 3.0 °C (at 11.4 m water depth).

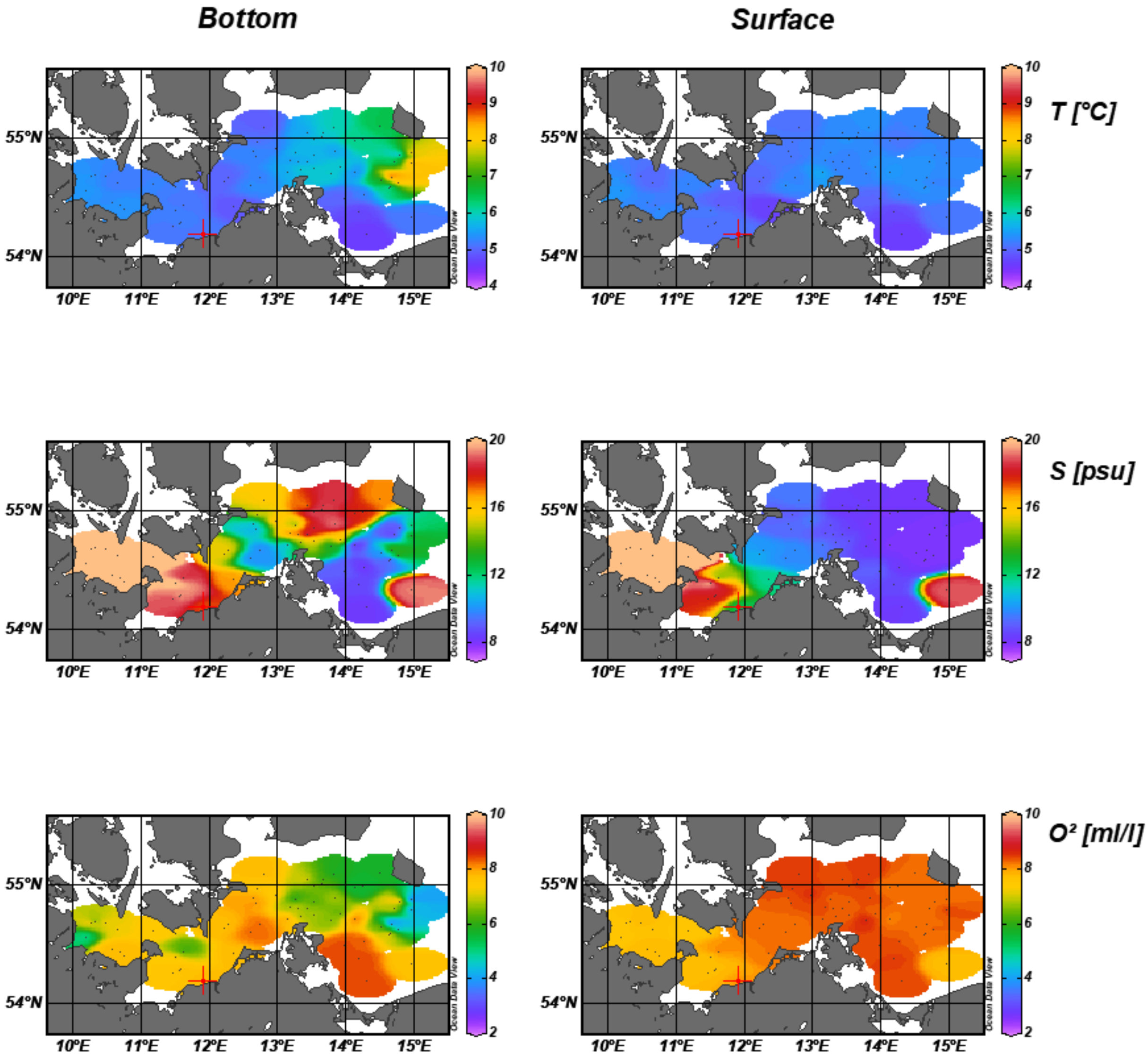

Figure 5: Hydrography of the survey near the bottom (left) and at the surface (right)

The salinity above the permanent halocline at a depth of 30 m in the Arkona Basin was approximately 10. The salinity increased below the halocline up to 19.2 at a depth of 43 m (Figure 5). The oxygen concentration close to the bottom was sufficiently high (33 – 8.5 ml*L-1) at all stations in the Belt Sea and Arkona Sea.

5. Participants

Part I (20/02/-06/03/20) Part II (09-16/03/20)

M. Bleil Cruise leader
A. Velasco Cruise leader
T. Rohde Technician Thünen-OF
S. Dressler Technician Thünen-OF
N. Gerull Student helper University of Hamburg
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T. Hogh Technician Thünen-OF
M. Bächtiger Student helper University of Hamburg
C. Albrecht Technician Thünen-OF
S. Winning Student helper University of Rostock
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N. K. Pedersen Technician DTU-Aqua, DK

6. Acknowdgelements

We would like to express our gratitude to Capts. Koops his crews on the FRV "Solea" for their good cooperation. Many thanks to the scientific team for their processing of catches and entering of data on board.

sgd. scientists in charge

Institute of Food Safety, Animal Health and Environment (BIOR), Riga (Latvia)
National Marine Fisheries Research Institute (NMFRI), Gdynia (Poland)

THE CRUISE REPORT

FROM THE JOINT LATVIAN-POLISH BITS 1Q SURVEY ON THE POLISH R.V. "BALTICA"
IN THE CENTRAL-EASTERN BALTIC (07-15 March 2020)

by
Ivo Sics*, Radosław Zaporowski** and Tycjan Wodzinowski **

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Gdynia - Riga, April 2020

Introduction

The joint Latvian-Polish BITS survey, conducted in the period of 07-15.03.2020 on the r.v. "Baltica", was based on the agreement between the Institute of Food Safety, Animal Health and Environment (BIOR) in Riga and the National Marine Fisheries Research Institute (NMFRI) in Gdynia. The joint Latvian-Polish BITS 1Q survey was conducted in the Latvian EEZ (the ICES Sub-divisions 26 and 28). It was part of the Baltic International Trawl Survey (BITS), which was co-ordinated by the ICES Baltic International Fish Survey Working Group [WGBIFS] (Anon. 2019).

The main aims of reported cruise were:

1. Collecting materials to investigate the distribution, abundance and biological structure of cod stock.
2. Determine distribution and abundance of cod recruits. Estimates of year – class strength of cod.
3. Collecting materials to investigate the distribution abundance and biological structure of flounder stock.
4. Collect data on cod feeding.
5. Analysis of the hydro-meteorological conditions (seawater temperature, salinity, oxygen content, air temperature, atmospheric pressure, wind velocity and directions) in the ICES Sub-divisions 26N and 28.
6. Acoustical data recording during trawling and on the distance between consecutive catch-stations.
7. A collection of information about marine litter.
8. Collection of ichthyoplankton samples.

MATERIALS AND METHODS

Personnel

The BITS 1Q - 2020 survey scientific staff was composed of nine persons, i.e.:
Radosław Zaporowski, NMFRI, Poland - cruise leader,
Maciej Bielak, NMFRI, Poland - acoustician,
Bartosz Witalis, NMFRI, Poland - hydrologist,
Wojciech Deluga, NMFRI, Poland - ichthyologist,
Ivo Sics, BIOR, Latvia – scientific leader,
Janis Aizups, BIOR, Latvia - ichthyologist,
Vadims Červoncevs, BIOR, Latvia - ichthyologist,
Laura Briekmane, BIOR, Latvia – ichthyologist,
Janis Gruduls, BIOR, Latvia – ichthyologist.

Narrative

The reported survey research tasks realisation took place during the period of 07-15 March 2020 and overall, nine full days was devoted to survey plan accomplishment. The at sea researches were conducted within the Latvian EEZ (the ICES Sub-divisions 26 and 28) moreover, inside the Latvian territorial waters not shallower than 20 m (the ICES Sub-division 28).

The vessel left the Gdynia port (Poland) on 07.03.2020 at 00.05 o'clock and was navigated towards the south-western corner of the Latvian EEZ (Fig. 1). The direct at sea researches began on 07.03.2020 at 15:00 and was ended on 14.03.2020. On 15.03.2020 r.v. "Baltica" returned to the homeport.

Survey design and realization

The original surveys plan provided that 25 control-hauls will be realized in the Latvian EEZ (24 trawls in SD 28 and one trawl in SD 26). Five additional trawls were planned in the SD 26, in the Latvian EEZ.

The r.v. "Baltica" realized 17 bottom control-hauls including the Latvian territorial waters (Fig. 1). Trawls with track numbers 28194, 28033, 28167 and 28017 were not in the correct depth zone as it was indicated in track database. These tracks were realized. Information about correct depths for these trawls will be sent to track database administrator. **Investigations were not realized during three days of the survey due to very bad weather conditions,**

All trawl catches were performed in the daylight. The hard bottom ground-rope (rockhopper) trawl, type TV-3#930 (with 10-mm mesh bar length in the codend) was applied for fish catches. The standard trawling duration was 30 minutes. The mean speed of vessel while trawling was 3.0 knots. However, in the case of 4 hauls, their duration was shortened to 20 minutes, due to dense clupeids concentrations observed on the echosounder or poor ground for trawling.

The length measurements in the 1.0-cm classes were realised for all 124 cod and 2068 flounder. Length measurements in the 0.5-cm classes were realized for 1236 herring and 1830 sprat. In total, 124 cod and 344 flounder individuals were taken for biological analysis. Stomachs from the 101 cod were taken for investigation of cod feeding.

Acoustic data, i.e. the echo-integration records (SA = NASCs; Nautical Area Scattering (Strength) Coefficient) were collected with the EK-60 scientific echosounder during fishing operations and on the distances between consecutive hauls. Echo-sounding data collected during the BITS survey were delivered to the Latvian researchers for further analysis.

Directly before every haul, the seawater temperature, salinity and oxygen content were measured continuously from the sea surface to the bottom. The seawater samples were taken also at the standard HELCOM stations. Totally, 22 hydrological stations were inspected with the Neil-Brown CTD-probe combined with the rosette sampler (the bathometer rosette). Oxygen content was determined by the standard Winkler's method.

Meteorological observations of wind velocity and directions and the sea state were realized at the actual geographic position of each control-haul.

Ichthyoplankton samples were collected in 10 stations.

Results

Fish catches and biological data

The control-catches basic results collected in March 2020 during the Latvian-Polish BITS-1Q survey are presented in Table 1. Overall, 12 fish species were recognised in hauls performed in the central-eastern Baltic. Only one haul was performed in SD 26.

Herring dominated by mass in the ICES Sub-division 28 with the average share of 49.5% respectively. Sprat was the next species most frequently represented in terms of mass, i.e. 27.6%. Flounder was the third species most frequently represented in terms of mass in the ICES SD 28 (19.9%). The share of cod in control-catches made out in the ICES SD 28 was 2.3 %. By-catch of other fishes was insignificant.

The mean CPUE for all species in SD 28 amounted 234.5 kg/h, and in this 119.2, 65.3, 43.1

and 9.8 kg/h were for herring, sprat, flounder and cod, respectively.

Total catch of fishes and the number of realized hauls in the Latvian EEZ, during reported BITS survey is presented in the text-table below:

EEZ	Number of hauls	Total catch [kg]				
		Cod	Herring	Sprat	Flounder	Others
Latvian	17	38.9	848.0	529.5	403.8	11.1

The length distribution of cod, flounder, herring and sprat, according to the ICES Sub-divisions 26 and 28 are illustrated in Figures 2-5 and in Tables 3-6.

Cod

Only one haul was performed in SD 26.

The total length of cod in scrutinized samples ranged from 12 to 48 cm and specimens from the length classes of 26 - 34 cm dominated in samples from the ICES Sub-division 28 (Fig. 2, Table 3). Totally 123 cod was sampled from hauls in Sub-division 28.

Flounder

The total length of flounder in samples ranged from 16 to 29 cm in sample from the ICES Sub-division 26. Totally 205 flounder was sampled from haul in Sub-division 26.

The total length of flounder in scrutinized samples ranged from 13 to 39 cm and specimens from the length classes of 18 - 25 cm dominated in samples from the ICES Sub-division 28 (Fig. 3, Table 4).

Herring

The length range of collected herring was 15-21 cm, and specimens from the length classes of 16-19.5 cm were most frequently represented in sample from the ICES Sub-division 26 (Fig. 4, Table 5). Totally 101 herring was sampled from haul in Sub-division 26.

The length range of collected herring was 9.5-23.5 cm, and specimens from the length classes of 15.5-18.5 cm were most frequently represented in samples from the ICES Sub-divisions 28 (Fig. 4, Table 5).

Sprat

The length range of collected sprat was 7.5-14 cm in ICES Sub-divisions 26 and 6.5-14.5 in ICES Sub-divisions 28. The length frequency apex of 11-11 cm was characteristically for sprat samples from the ICES Sub-division 26 and the length frequency apexes of 7.0-9.0 cm and 10.5-13 cm were characteristically for sprat samples from the ICES Sub-division 28 (Fig. 5, Table 6). Totally 107 sprat was sampled from haul in Sub-division 26.

Hydrological Situation in March 2020

Graphic illustration of the main hydrological parameters are shown in the figures 7, 8, 9 and 10. Hydrological parameters were measured at each trawling (17) and hydrological stations (6) (Fig. 1). Measurements were conducted with the CTD SeaBird 911-probe combined with the rosette sampler. Oxygen content was determined by the standard Winkler's method. The STD data were aggregated to the 1-m depth strata. The salinity parameter was presented in Practical Salinity

Unit (PSU). Meteorological parameters were measured by MicroStep-MIS AMS 111 automatic weather station.

The most frequent winds (Fig. 6) were from SSW direction. The average (for 10 min measurement) wind speed varied from 0.3 m/s to 19.1 m/s (up to 35.8 m/s). The air temperature ranged from -2.1 °C to 9.1 °C, and average temperature was 4.3°C.

The seawater temperature in the surface layer (Fig. 7) varied from 4.69 to 5.20 °C. The lowest values were observed at the station 37, while the warmest surface water was at the station 40A. The average value equaled 4.89 °C. The average surface salinity was 7.43 PSU. The minimum value was 7.38 PSU at the trawls 14, 15 and 16. The maximum 7.52 PSU was at the station 46. The highest oxygen content in surface water layer was 8.71 ml/l (trawl 11) while the lowest one 7.26 ml/l (trawl 10). Mean value of dissolved oxygen equaled 8.06 ml/l.

Near-bottom layer conditions are presented in the (Fig. 8). Water temperature varied from 4.77 °C (trawl 13) to 7.30 °C (station 46). The mean value calculated for the whole area covered during the cruise was 5.93 °C. The average salinity in the close-to-the-bottom water layers was 9.48 PSU. The highest value was measured at the hydrological station 37 (13.18 PSU). The lowest one was 7.38 PSU at the trawls 15 and 16. The dissolved oxygen varied from 0.00 ml/l (hydrological stations 43 and 37) to 8.49 ml/l (trawl 14).The mean value was 4.60 ml/l.

The vertical distribution of the seawater temperature, salinity and oxygen content along the hydrological transect is presented on the figure 9. The 11 PSU halocline was on the depth about 70 m. The no oxygen zone started even at the depth 100 m. The comparison of the vertical distribution of the seawater temperature, salinity and oxygen content at the hydrological station 37 with the years 2010 – 2019 is presented on figure 10. The water in the column at the station 37 was much warmer, more saline and the dissolved oxygen content value was lower than last 10 years mean.

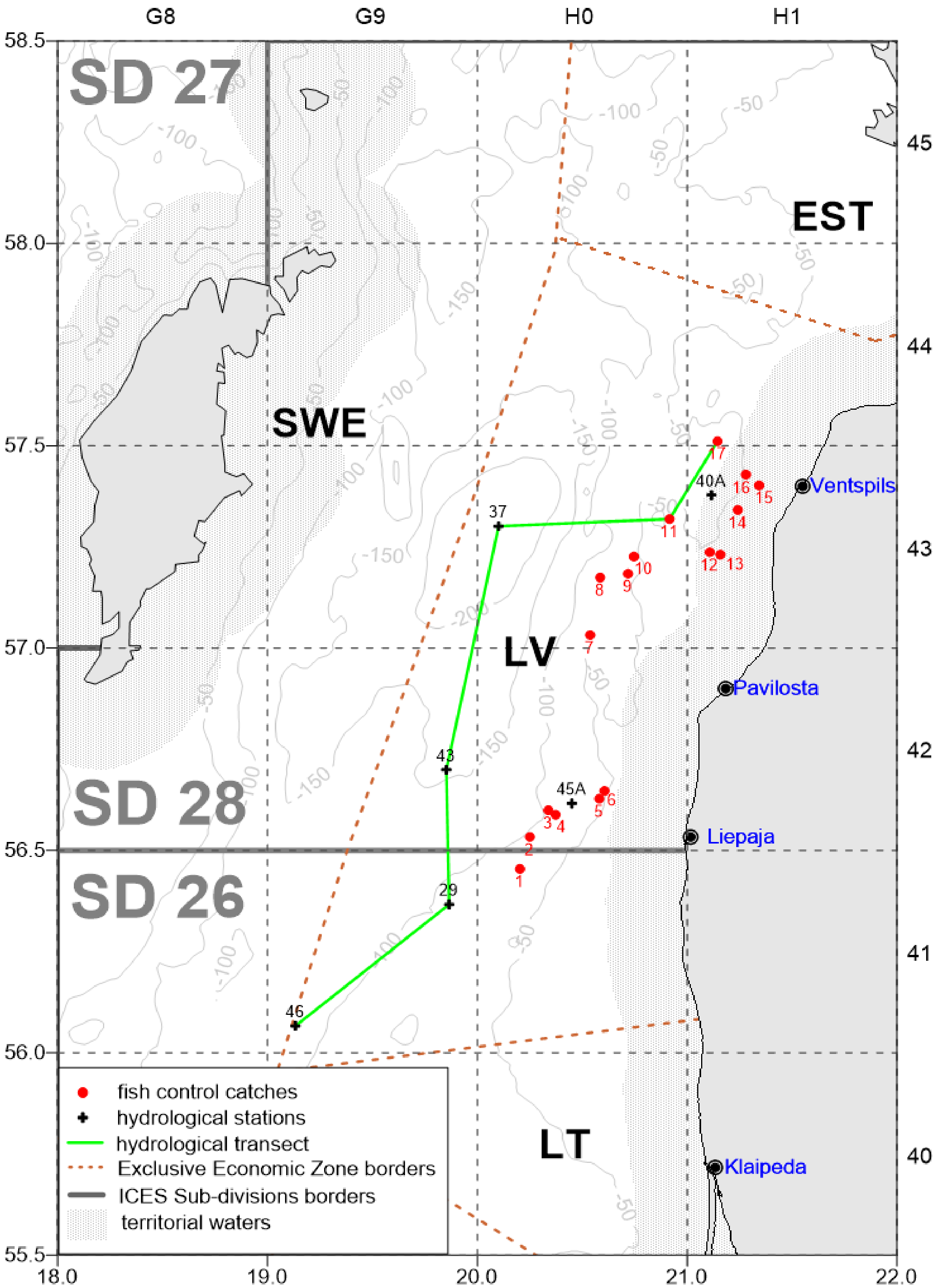

Figure 1. Locations of the fish bottom control catches and hydrological stations during the survey (March 2020)

Table 1. Catch results from the Latvian-Polish BITS 1Q survey; r.v. "Baltica", 07-15 March 2020

Haul number	Date of catch	EEZ	ICES rectangle	ICES SD	Depth to the bottom [m]	The ship's course during fishing [°]	Geographical position of the catch station				Time of		Haul duration [min.]	Total catch	all species CPUE [kg/0.5h]	CATCH of particular fish species [kg]				
							start		end											
							latitude 00°00' N	longitude 00°00' E	latitude 00°00' N	longitude 00°00'E	shutting net	pulling up net				Sprat	Herring	Cod	Flounder	Others
1	08.03.2020	0	41H0	26	82	010	56°28.1	20°12.5	56°29.2	20°12.9	07:05	07:25	20	140.535	210.8025	62.583	9.567	0.372	67.94	0.073
2	08.03.2020	0	42H0	28	93	210	56°32.3	20°15.0	56°31.5	20°14.1	08:40	09:00	20	7.955	11.9325	4.63	0.029	0	3.29	0.006
3	08.03.2020	0	42H0	28	92	215	56°35.4	20°19.8	56°34.2	20°18.3	10:35	11:05	30	8.808	8.808	6.24	0.022	0.204	2.342	0
4	08.03.2020	0	42H0	28	88	235	56°35.0	20°21.2	56°34.3	20°19.3	12:15	12:45	30	15.778	15.778	7.97	0.318	0	7.49	0
5	08.03.2020	0	42H0	28	60	010	56°38.5	20°35.4	56°39.7	20°35.8	14:50	15:20	30	111.532	111.532	11.464	71.166	2.32	23.8	2.782
6	08.03.2020	0	42H0	28	59	020	56°38.4	20°36.0	56°39.6	20°36.8	16:20	16:50	30	166.524	166.524	41.815	85.475	1.409	32.64	5.185
7	09.03.2020	0	43H0	28	90	015	57°02.9	20°33.1	57°04.2	20°33.8	07:20	07:50	30	17.308	17.308	10.02	0.165	0	7.12	0.003
8	09.03.2020	0	43H0	28	95	005	57°10.1	20°35.5	57°11.5	20°35.8	09:35	10:05	30	19.035	19.035	17.26	0.079	0	1.691	0.005
9	09.03.2020	0	43H0	28	78	340	57°11.9	20°43.0	57°13.1	20°42.6	11:20	11:50	30	174.647	174.647	71.656	98.234	0.494	4.263	0
10	09.03.2020	0	43H0	28	65	350	57°12.1	20°44.4	57°13.5	20°44.0	13:00	13:30	30	138.614	138.614	17.927	27.643	0.846	92.06	0.138
11	09.03.2020	0	43H0	28	62	305	57°19.5	20°56.4	57°20.3	20°54.5	15:20	15:50	30	197.275	197.275	65.139	123.941	5.18	3.015	0
12	10.03.2020	0	43H1	28	57	030	57°14.8	21°07.3	57°15.9	21°08.6	06:50	07:20	30	119.292	119.292	29.417	36.063	7.04	45.57	1.202
13	10.03.2020	0	43H1	28	45	015	57°13.1	21°07.4	57°14.4	21°08.4	08:30	09:00	30	87.373	87.373	17.486	50.614	0	18.69	0.583
14	10.03.2020	0	43H1	28	54	005	57°21.2	21°15.1	57°22.6	21°15.5	10:25	10:55	30	142.22	142.22	38.128	39.372	0	64.11	0.61
15	10.03.2020	0	43H1	28	33	340	57°24.3	21°20.7	57°26.0	21°20.4	11:50	12:10	20	94.042	141.063	4.093	80.747	0	9.06	0.142
16	10.03.2020	0	43H1	28	63	010	57°24.6	21°16.1	57°26.0	21°16.7	13:25	13:55	30	121.58	121.58	20.966	74.524	10.03	15.71	0.35
17	10.03.2020	0	43H1	28	69	350	57°29.1	21°08.4	57°30.1	21°08.2	15:15	15:35	20	268.667	403.0005	102.662	150.018	11	4.987	0

Table 2. Number of fish biologically analysed during the BITS 1Q (07-15 March 2020).

Species	Number of samples			Number of fish								
				measured			analyzed			stomach samples		
	SD 26	SD 28	Total	SD 26	SD 28	Total	SD 26	SD 28	Total	SD 26	SD 28	Total
Cod	1	9	10	0	0	0	1	123	124	1	100	101
Flounder	1	16	17	161	1563	1724	44	300	344			
Herring	1	15	16	101	1135	1236						
Sprat	1	16	17	107	1723	1830						
Four Bearded Rockling	1	1	2	1	1	2						
Eelpout	0	4	4	0	17	17						
Greater Sandeel	0	2	2	0	4	4						
Smelt	0	4	4	0	6	6						
Three-spined Stickleback	0	3	3	0	8	8						
Sea Scorpion	0	6	6	0	68	68						
Plaice	0	1	1	0	1	1						
Four-horned Sculpin	0	1	1	0	1	1						
Total	5	78	83	370	4527	4897	45	423	468	1	100	101

Fig. 2. Length frequency of cod from Sub-Division 28 in the control catches during the r/v "Baltica" BITS survey, 07-15 March 2020

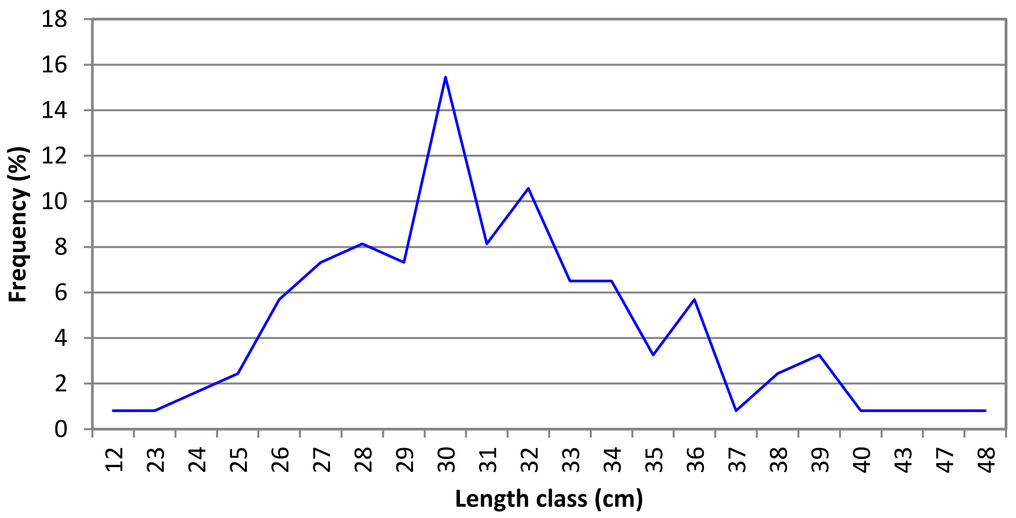

Fig. 3. Length frequency of flounder from Sub-Divisions 26 and 28 in the control catches during the r/v "Baltica" BITS survey, 07-15 March 2020

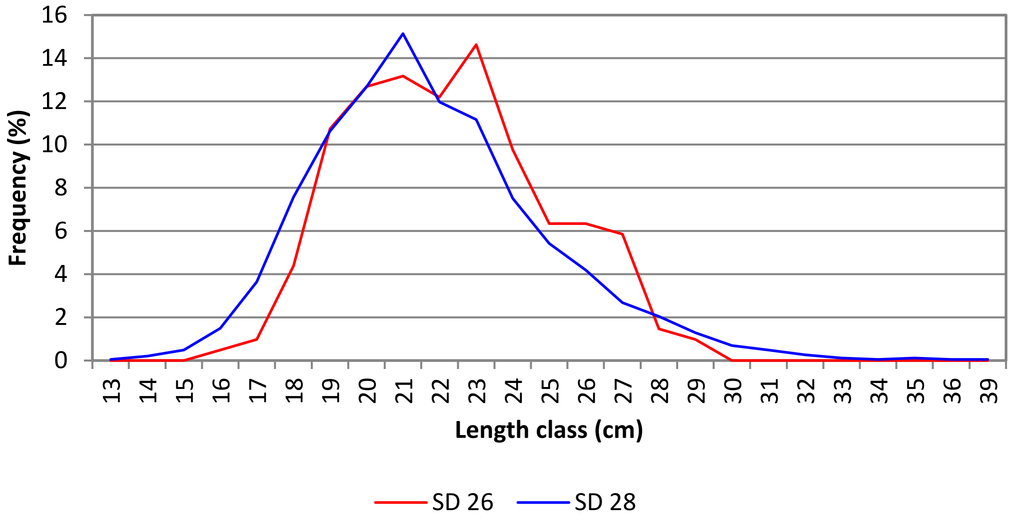

Fig. 4. Length frequency of herring from Sub-Divisions 26 and 28 in the control catches during the r/v "Baltica" BITS survey, 07-15 March 2020

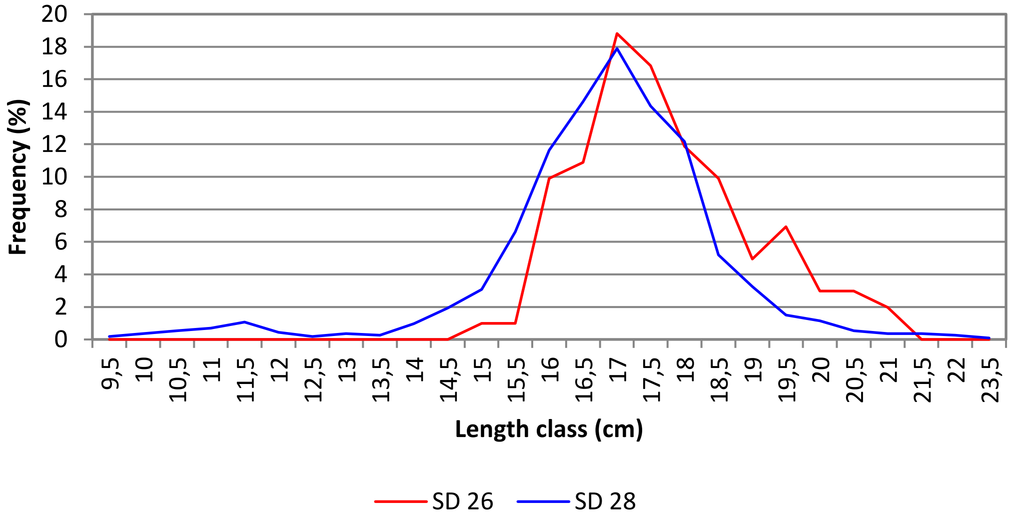

Fig. 5. Length frequency of sprat from Sub-Divisions 26 and 28 in the control catches during the r/v "Baltica" BITS survey, 07-15 March 2020

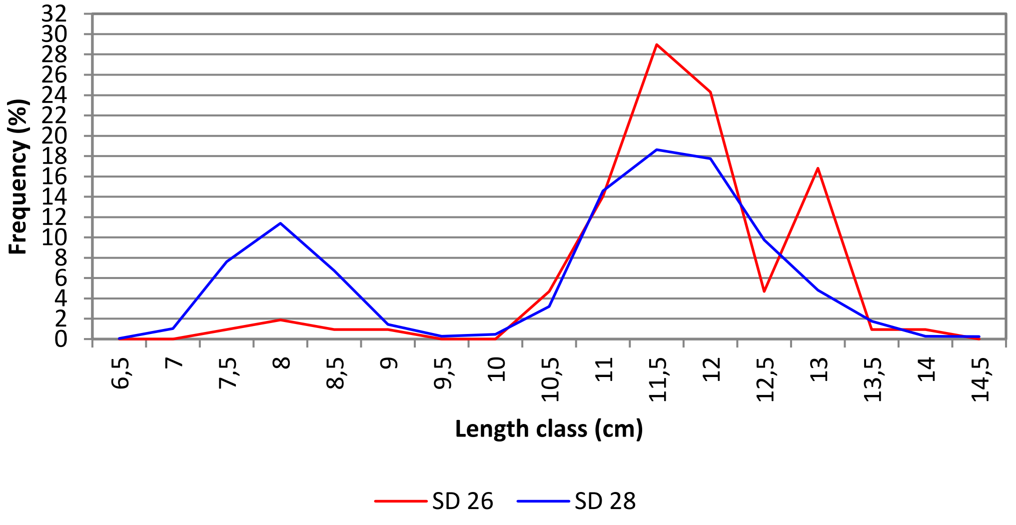

Table 5. Herring length measurements by consecutive hauls in the r.v. “Baltica” Latvian-Polish BITS 1Q survey (07 - 15 March 2020); specimens grouped by 0.5 cm length classes.

		cm_group																											
Haul no	SD	9.5	10	10.5	11	11.5	12	12.5	13	13.5	14	14.5	15	15.5	16	16.5	17	17.5	18	18.5	19	19.5	20	20.5	21	21.5	22	23.5	Sum
1	26												1	1	10	11	19	17	12	10	5	7	3	3	2				101
2	28																1												1
3	28													1															1
4	28															1	1	1	2	2	2								9
5	28													6	9	7	25	24	16	10		3							100
6	28											2	2	4	8	15	24	18	10	9	2	2	1	1	1	1			100
7	28	2															2	2	1										7
8	28												1			1	1												3
9	28			1		3	2				1	1	1	5	16	20	16	15	12	6	1	2				2			104
10	28					1					1	2	2	6	5	13	14	20	19	6	6		2			1	2		100
11	28			1	4	2		1		2	1	1	5	7	12	8	25	15	8	5	5		1	2	1		1		107
12	28								1		2	4	6	7	21	18	10	12	9	2	3	4	1						100
13	28							1			3	3	4	10	13	22	15	10	9	4	2		2	1				1	100
14	28										2	2	6	10	25	14	14	10	8	2	4	1	1		1				100
15	28											2	2	6	9	11	21	13	19	6	7		2	2					100
16	28		1	3	3	5	3		1	1		4	5	8	5	18	10	10	8	4	4	3	1						97
17	28		3	1	1	1			2		1	1	1	5	9	18	24	13	17	3	1	2	2		1				106
SD 26													1	1	10	11	19	17	12	10	5	7	3	3	2				101
SD 28		2	4	6	8	12	5	2	4	3	11	22	35	75	132	166	203	163	138	59	37	17	13	6	4	4	3	1	1135
Total		2	4	6	8	12	5	2	4	3	11	22	36	76	142	177	222	180	150	69	42	24	16	9	6	4	3	1	1236

Table 6. Sprat length measurements by consecutive hauls in the r.v. “Baltica” Latvian-Polish BITS 1Q survey (07 - 15 March 2020); specimens grouped by 0.5 cm length classes.

		cm_group																	
Haul no	SD	6.5	7	7.5	8	8.5	9	9.5	10	10.5	11	11.5	12	12.5	13	13.5	14	14.5	Sum
1	26			1	2	1	1			5	15	31	26	5	18	1	1		107
2	28		1	1	5	4	3			3	25	27	23	9	6				107
3	28		1	2	5	1				1	19	32	26	14	7	2			110
4	28		1	4	2					3	11	33	33	16	6	1			110
5	28		1	11	12	10	5	1	1	6	15	18	14	7	1	1	1		104
6	28			18	20	14	2			4	13	15	9	9		2			106
7	28			5	9	14	3	1	2	3	15	21	21	8	3				105
8	28				3	3	2			3	30	34	23	4	2	2			106
9	28		1	10	11	5			1	1	14	20	21	17	6				107
10	28		4	27	36	14	1		1	2	5	8	17	4	5				124
11	28		6	17	17	14	2			4	18	16	10	4	2				110
12	28			6	22	13	3	2	1	5	9	12	24	8	3				108
13	28			4	8	8	2			7	12	20	18	6	12	5		1	103
14	28			1	5	1			1	3	17	20	20	26	6	3			103
15	28			1	3	1				1	7	10	19	25	17	13	4	3	104
16	28	1	3	12	27	3		1		4	18	12	12	7	6	1			107
17	28			12	11	11	2		1	5	23	23	16	4	1				109
SD 26				1	2	1	1			5	15	31	26	5	18	1	1		107
SD 28		1	18	131	196	116	25	5	8	55	251	321	306	168	83	30	5	4	1723
Total		1	18	132	198	117	26	5	8	60	266	352	332	173	101	31	6	4	1830

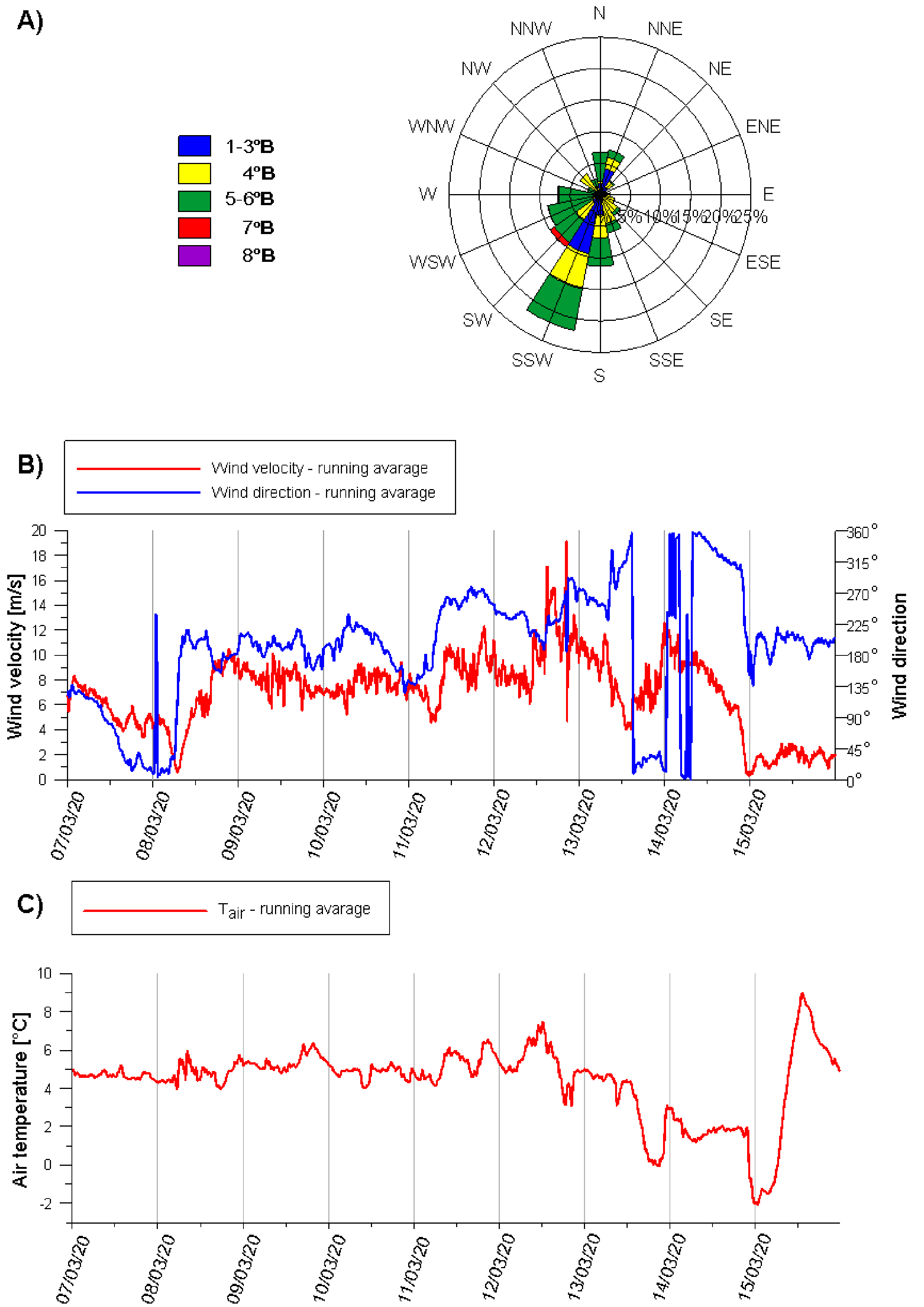

Figure 6. Changes of the main meteorological parameters (March 2020).

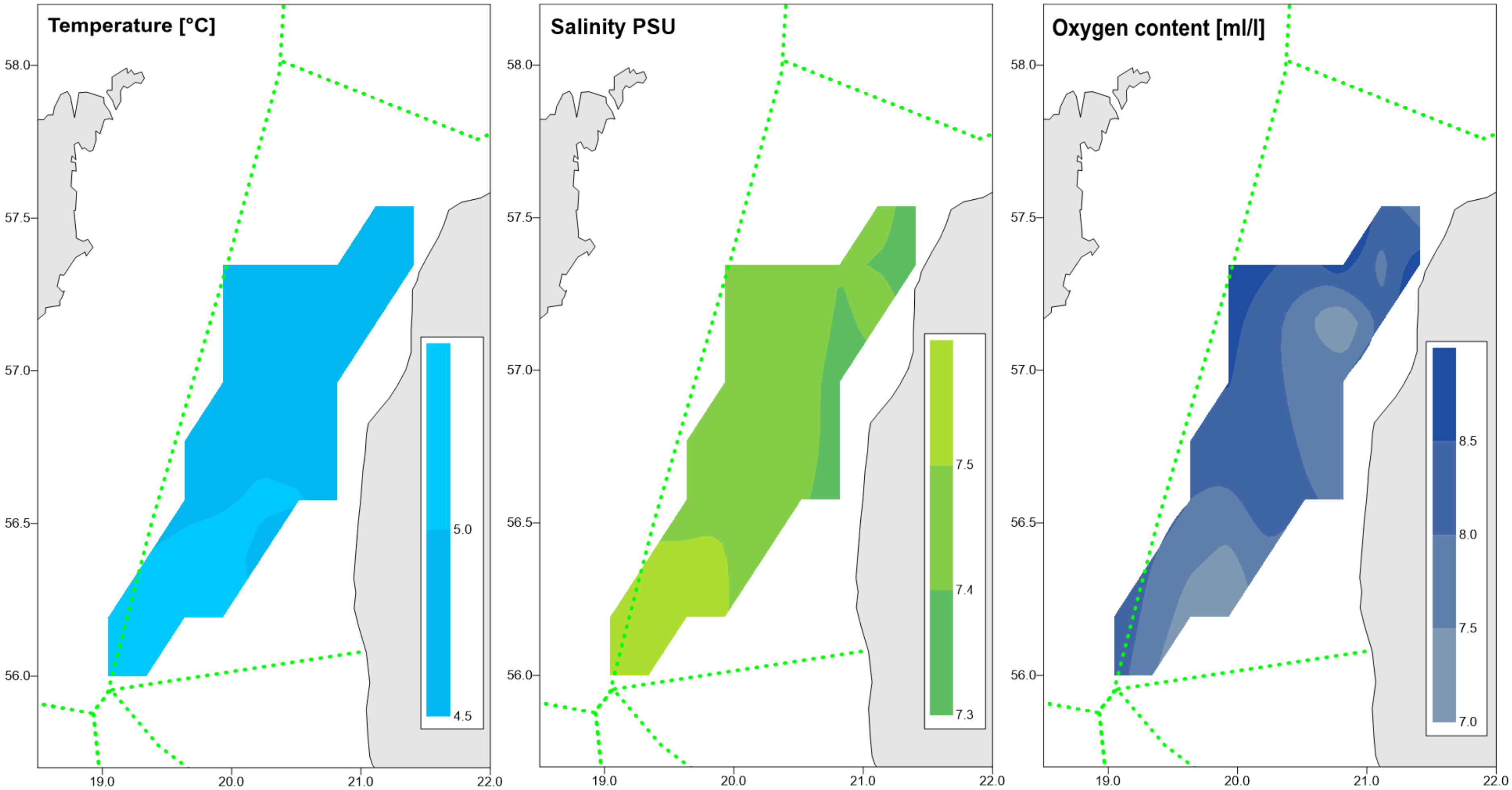

Figure 7. Distribution of the seawater temperature, salinity and oxygen content in the surface waters (March 2020).

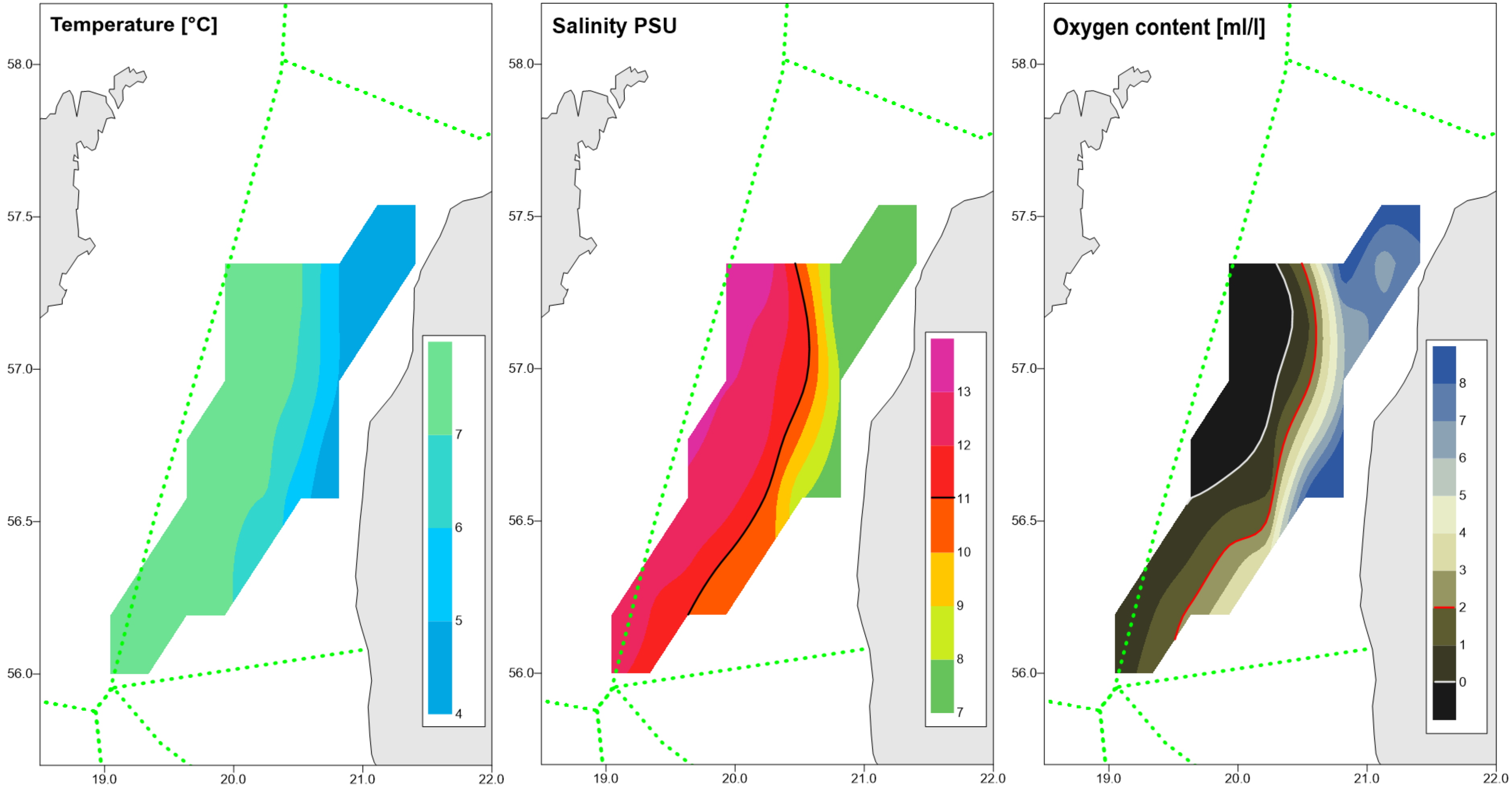

Figure 8. Distribution of the seawater temperature, salinity and oxygen content in the near bottom waters (March 2020).

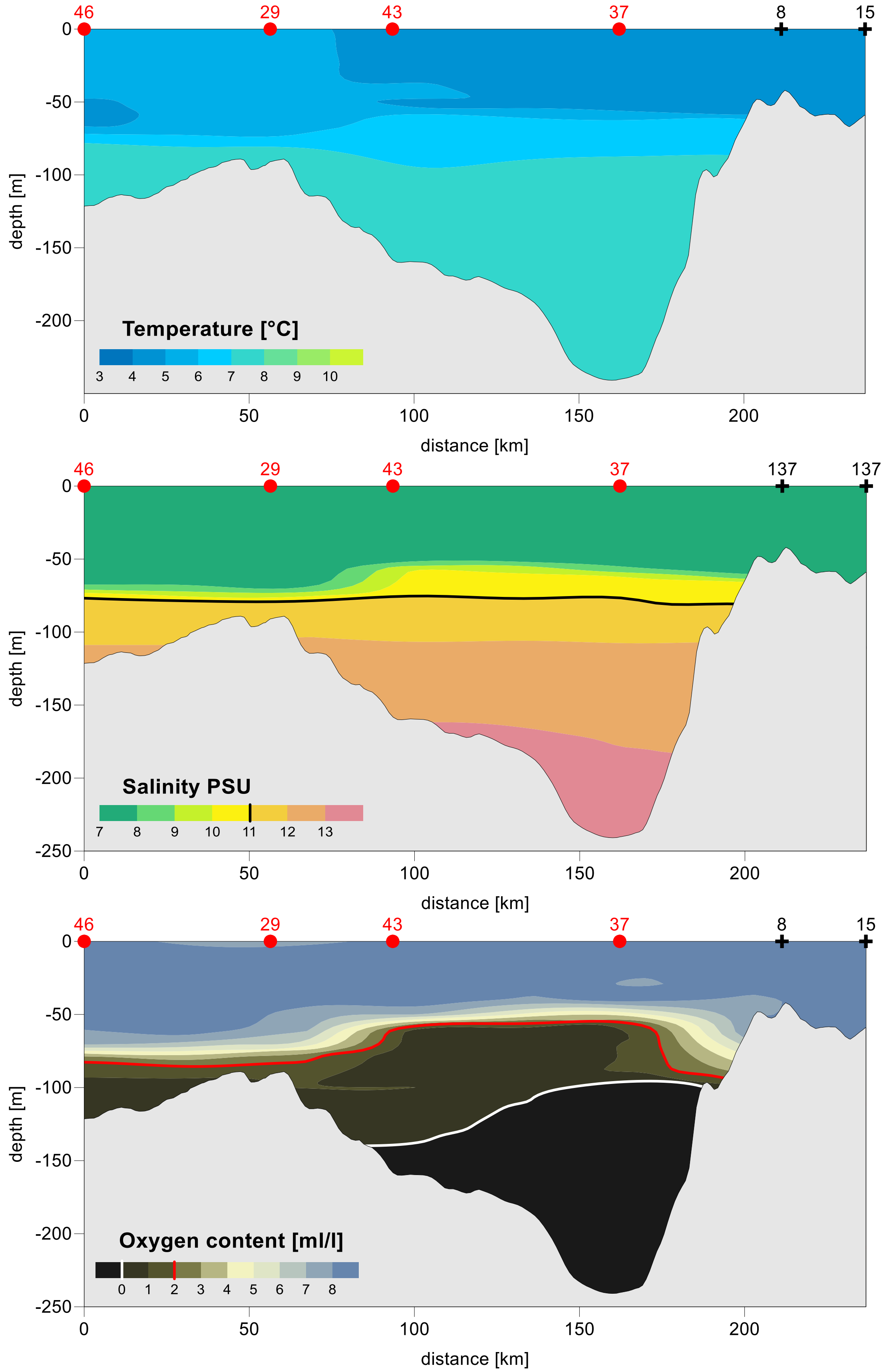

Figure 9. Vertical distribution of the seawater temperature, salinity and oxygen content along the hydrological transect of the Gotland Deep (March 2020)

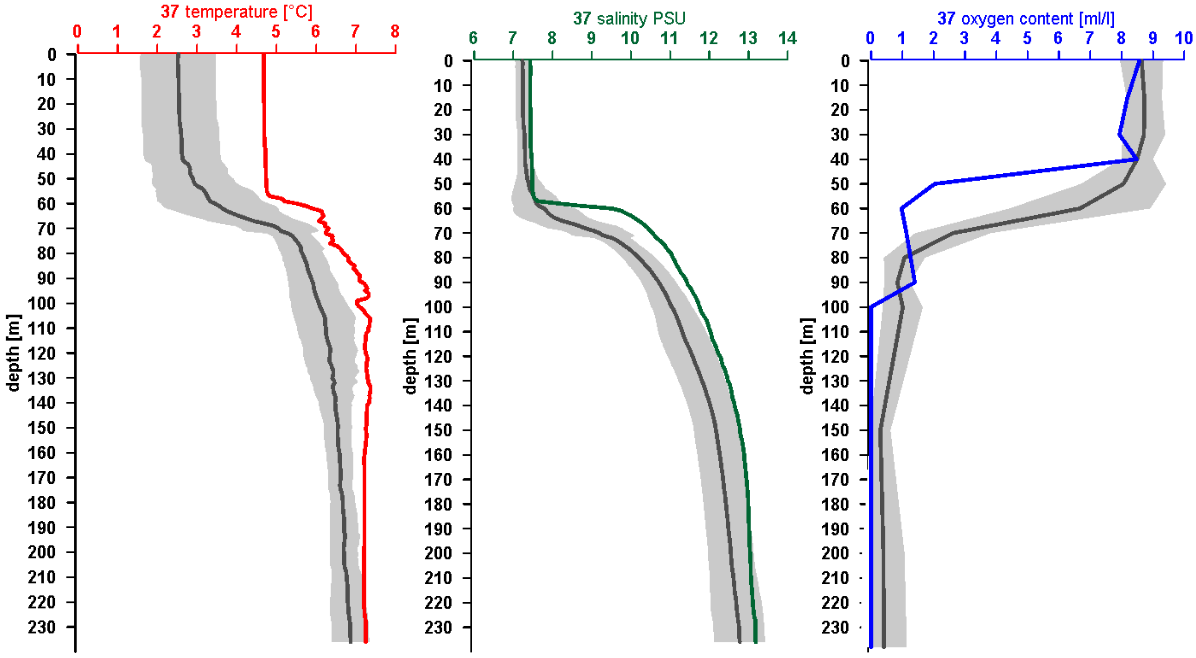

Figure 10. Vertical distribution of the seawater temperature, salinity and oxygen content at the hydrological profile 37. The mean 03.2010/2019 of the parameter – gray line, the gray shade – standard deviation 03.2010/2019 (Match 2020).

Klaipeda University
Marine Research Institute

Lithuania BITS Q1 2020 report

Marijus Špėgys

1. INTRODUCTION

The cruise with the FV "659" was part of the Baltic International Trawl Survey (BITS) which is coordinated by ICES WGBIFS. The main objective of the survey is the estimation of fishery independent stock indices of both Baltic cod stocks, of flounder and other flat fish.

The following further objectives were covered during the survey:

Collecting data for assessing stock indices, the structure and recruitment of the stocks especially for cod and flatfish.

Monitoring the composition of fish species in the South-Eastern Baltic Sea

Collecting length samples for all species.

Collecting samples of cod and flounder for biological investigations (i.e., sex, maturity, age).

Collecting litters from trawl.

2 METHODS

2.1 Personnel

Žilvinas Kregždys, Marine research institute, Klaipeda University - cruise leader;
Deividas Norkus, Marine research institute, Klaipeda University –fish sampling.

2.2 Description

The cruise took place two days (5-6 March 2020). FV "659" has covered the Sub-division 26 in Lithuanian EEZ.

2.3 Survey design and realization

The international coordinate trawl survey is planned as Stratified Random Survey where ICES subdivisions and depth layers are used as strata. A total of 6 stations were planned for the Lithuania part of the survey, which realize complete accordance with the agreements of WGBIFS during the meeting in 2019. The hauls' positions were selected from the TOW Database by the coordinator of the BITS surveys (ICES 2019, WGBIFS report as reference). All 6 fishing stations were successfully realized. The fishing hauls were realized in the daylight, between 08:30 and 16:00 local time.

Trawling was done with the standard trawl "TV3/520#". The stretched mesh size in the codend was 20 mm. The duration of the hauls was 30 minutes and the velocity was 3 knots. The total catch of each haul was analysed to determine the species' composition in weight and number as well as the distribution of length among all species. Sub-samples of cod, flounder were investigated concerning sex, maturity and age. Surface temperature and salinity were immediately sampled after every fishing hauls.

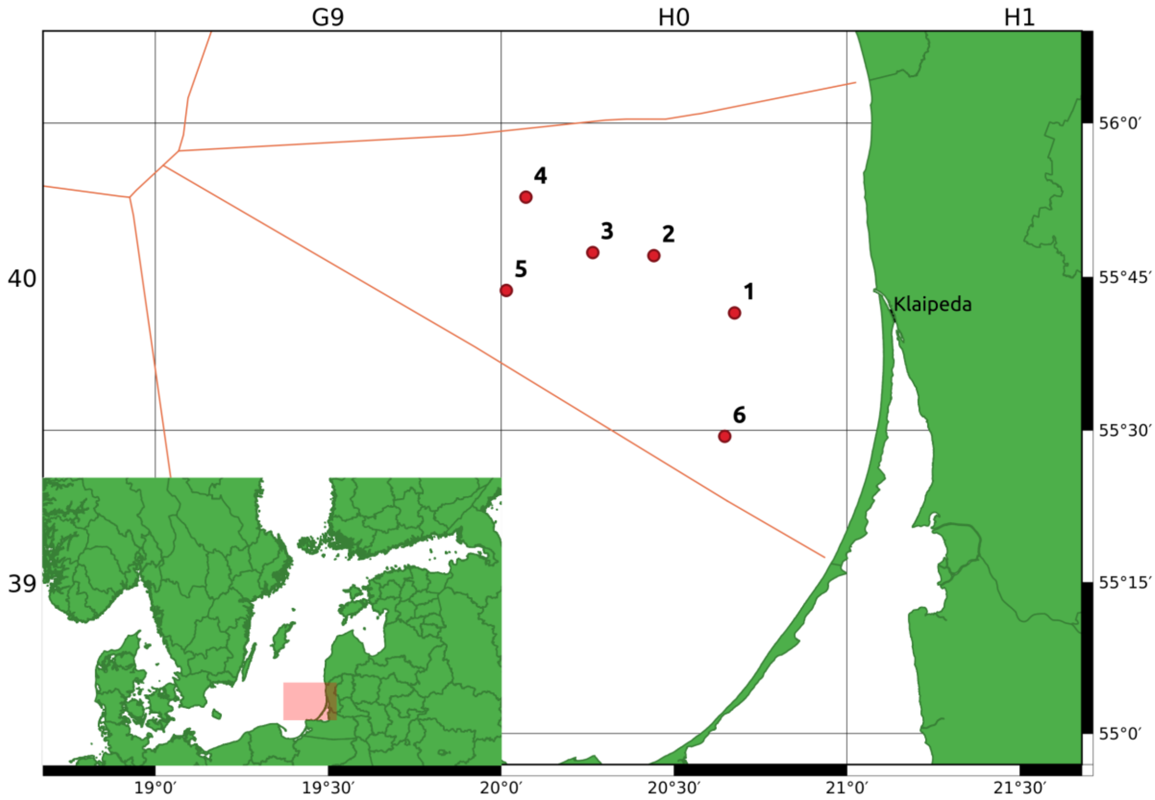

Figure 1. Trawl hauls position of C/V "LBB -1010" in BITS 2020 m. Q1 survey

The length measurements in the 1.0 cm classes was realised for cod, flounder and turbot, subsample were taken for biological analysis to laboratory. The length measurements in the 0.5 cm classes was realised of herring and sprat.

All information about haul and catches are shown in table 1 and table 2.

Table 1. Haul information from the Lithuania BITS Q1 survey with the TV3/520# bottom trawl

Haul number according to TD data	The ICES rectangle (subdivision)	Trawling depth (m)	Geographical position of catch station			
			00.00 N	00.00 E	00.00 E	00.00 N
26028	40H0 (26)	49	55.69	20.68	55.70	20.61
26027	40H0 (26)	51	55.79	20.44	55.79	20.28
26026	40H0 (26)	62	55.79	20.27	55.78	20.33
26158	40H0 (26)	60	55.88	20.07	55.86	20.07
26057	40H0 (26)	75	55.73	20.02	55.72	20.13
26153	39H0 (26)	64	55.49	20.65	55.50	20.48

Table 2 Fish catches results from the Lithuania BITS 2020 1Q survey with the TV3/520# bottom trawl

Haul number according to TD data	Catch date	The ICES rectangle (subdivision)	Trawling depth (m)	Total CPUE (kg/h)	CPUE per species (kg/h)				
					Cod	Flounder	Place	Turbot	Others
26028	2020-03-05	40H0 (26)	49	192.0	139.7	45			7.4
26027	2020-03-05	40H0 (26)	51	98.9	33.6	50.1			15.2
26026	2020-03-05	40H0 (26)	62	157.7	84.5	46.3			26.9
26158	2020-03-05	40H0 (26)	60	149.0	69.0	61.2			18.9
26057	2020-03-05	40H0 (26)	75	100.3	16.0	72.8		1.0	10.6
26153	2020-03-06	39H0 (26)	64	122.0	39.5	52.5	0.4		29.6
Mean					63.7	54.6	0.1	0.2	18.1

3. RESULTS

In total 726 cods, 1138 flounders, 2 places, 1 turbots 1316 herrings and 232 other species were collected for measuring and from that measurement sample 299 cods and 288 flounders and 2 place and 1 turbot were collected for weight, sex, maturity and age. Numbers of biological samples by haul given in Table 3.

Cod from the length classes range of 24-38 dominated in samples, it is slightly better situation than 2019 Q1 Baltic international bottom trawl survey. The fish with this length range constituted about 84.6% of all measured cod. (Fig. 1).

The total length of flounder ranged from 14 to 37 cm, with dominating length classes of 18-29 cm. The fish with this length range constituted about 90 % of all measured flounder.

The total length of herring ranged from 8 to 26 cm. Herring from the length classes has two peaks one 10-11 cm length and the second 16-20 cm- (Fig. 3).

The length distributions of cod, flounder, herring and sprat, according to the ICES Sub-divisions 26 are shown in Figures 1-3.

Table 3. Biological samples of all hauls from the Lithuania BITS 2020 Q1 survey

Haul number	Catch date	The ICES rectangle and subdivision	Trawling depth (m)	Numbers of biological samples					
				Length				Age, sex, maturity	
				Cod	Flounder	Place	Turbot	Cod	Flounder
1	2020-03-05	40H0 (26)	49	162	311	1	1	299	288
2	2020-03-05	40H0 (26)	51	4	34				
3	2020-03-05	40H0 (26)	62	271	263	1	1		
4	2020-03-05	40H0 (26)	60	32	46				
5	2020-03-05	40H0 (26)	75	43	143				
6	2020-03-06	39H0 (26)	64	242	279		4		
Sum				**754**	**1076**	**2**	**6**		

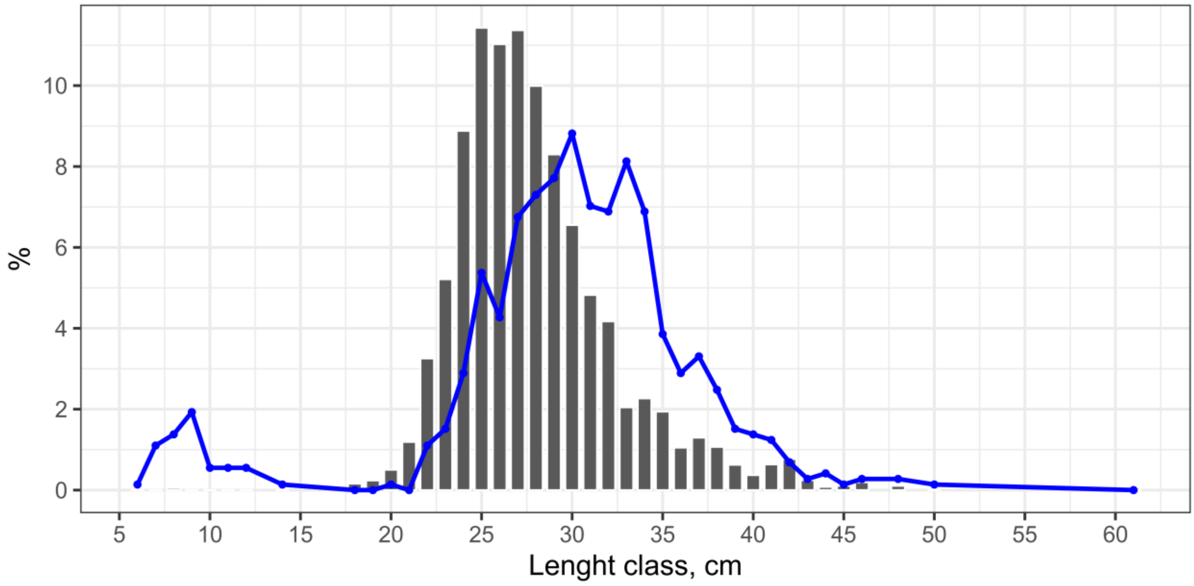

Figure 2. Cod length distribution from Lithuania BITS 2019 and 2020 Q1 surveys. Line – 2020 Q1 survey; bars – 2019 Q1 survey.

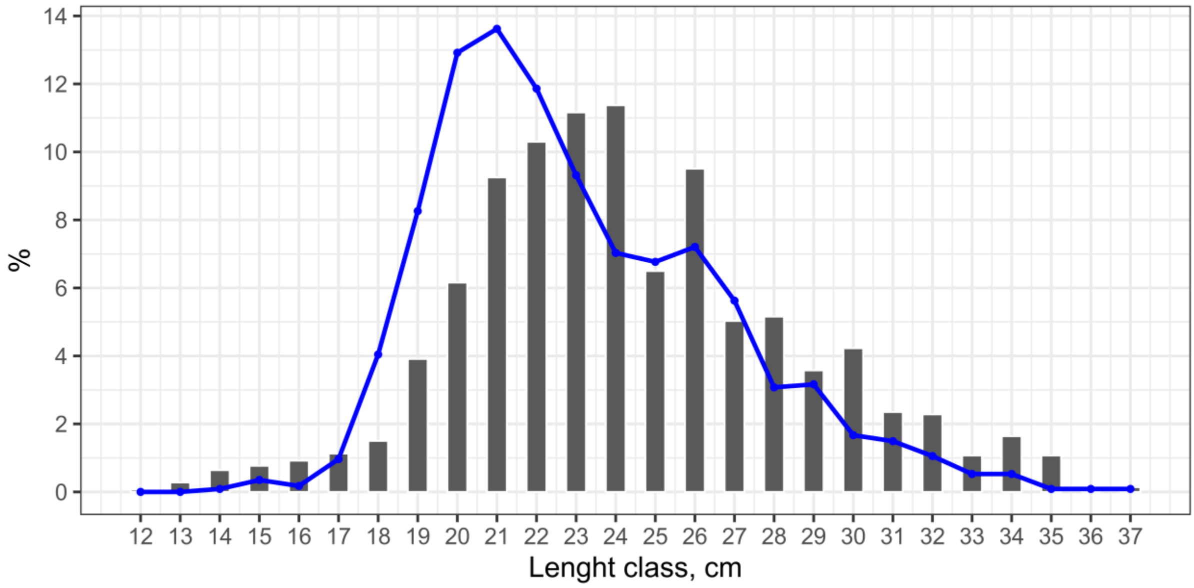

Figure 3. Flounder length distribution from Lithuania BITS 2019 and 2020 Q1 surveys. Line – 2020 Q1 survey; bars – 2019 Q1 survey.

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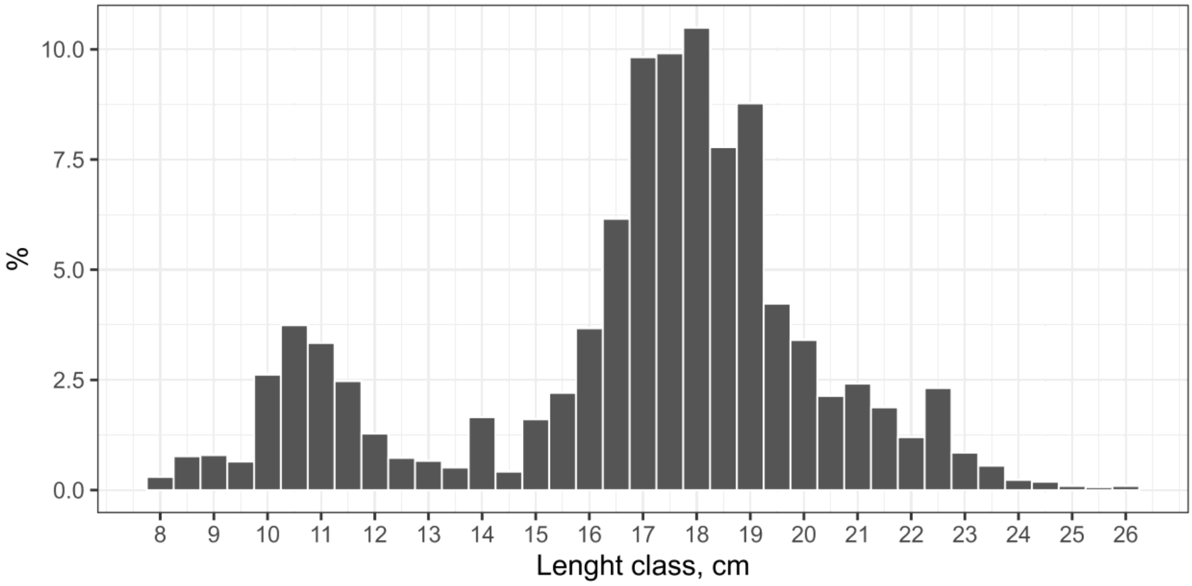

Figure 4. Herring length distribution from Lithuania BITS 2019 m. Q4 survey

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Working paper on the WGBIFS meeting, 30.03-03.04.2020

CRUISE REPORT

FROM THE POLISH R/V BALTICA BITS 1Q 2020 SURVEY
IN THE SOUTHERN BALTIC
(04 February - 03 March 2020)

by

Krzysztof Radtke and Tycjan Wodzinowski

Gdynia, 02 April 2020

INTRODUCTION

Since 1995, the permanent participation of Polish R/V Baltica operated by the National Marine Fisheries Research Institute (NMFRI) in Gdynia, has taken place in autumn and winter Baltic International Trawl Surveys (BITS-4Q and BITS-1Q) realised in the southern Baltic. In March 2000 when the research standard fishing gear in the Baltic Sea - the cod bottom trawl type TV-3, has been applied by the vessels assigned to the BITS surveys realization, the principal methods of investigations within BITS-1Q ground-trawl surveys designated to particular national laboratories, including the NMFRI were designed and co-ordinated by the Baltic International Fish Survey Working Group (WGBIFS; Anon. 2019). The main aim of the BITS-1Q survey planned in winter 2020 was to monitor abundance and spatial distribution of the main demersal fish species and to some extent also clupeids in the bottom zone of the Baltic, taking into account hydrological parameters. The R/V Baltica BITS-1Q 2020 survey, which was realized in the Polish part of the ICES Sub-divisions 25 and 26 and Swedish part of the ICES Sub-divisions 25 and 26, was aimed at:

- determination of the spatial distribution of cod, flounder, herring and sprat in the near bottom zone of the southern and central Baltic during winter 2020 applying method of random selection of control-hauls,
- estimation of the fishing efficiency, i.e. catch per unit effort (CPUE), the share of particular species in total mass of bottom control-catches,
- collecting biological samples of dominated fish for the determination of the age-length-mass relationship, sex, sexual maturation, feeding conditions and externally visible diseases,
- analysis of the vertical and horizontal changes of the basic hydrological parameters (temperature, salinity, oxygen content) in the areas of fish catches and in neighbouring standard hydrological stations.
- collect and identify the abundance of marine litter present in the fishing hauls.

MATERIAL AND METHODS

The above purposes of the February/March 2020 BITS 1Q survey aboard of R/V Baltica were realized by the NMFRI nine members of scientific team, with Krzysztof Radtke as a cruise leader. The scientific team was also composed of seven ichthyologists including technicians, responsible for determination of fish species composition of catches, fish biological analyses and data processing and one hydrologist, responsible for seawater sampling and analysing as well as for meteorological monitoring.

Narrative

The reported Polish ground-trawl survey on board of R/V Baltica, marked with the number 3/2020/MIR took place during the period of 04.02-03.03. 2020 within the framework of the ICES Baltic International Trawl Surveys (BITS) long-term programme (Anon. 2019) and the Polish Fisheries Data Collection Programme for 2020. The vessel left the port of Gdynia on 04.02.2020 in the morning and at sea investigations began in the southern part of the Gulf of Gdańsk (Fig. 1, Tab. 1). During the period of 29.02-01.03. 2020, the investigations were conducted in Swedish waters. The survey ended on 03.03.2020 (morning) in Gdynia harbour. The R/V Baltica operated mostly in the Polish EEZ. Overall, 29 days were utilized for fulfilling the BITS 1Q survey, including three days spent in Gdynia harbour due to heavy weather conditions and including time spent for the vessel translocation from the Gdynia port to research area and in the final phase of the survey, a return way to the vessel home-port.

Survey design and realization – sampling description

According to the WGBIFS plan, the Polish vessel was recommended to cover in February/March 2020 survey, the Polish part of ICES Sub-divisions 25 and 26 with 29 and 32, respectively randomly selected bottom control-hauls, and also in Swedish EEZ to cover Swedish part of ICES Sub-division 25 and 26 with 6 and 2 control-hauls, respectively. The R/V Baltica realized 70 of the 69 planned hauls for this survey. One haul (no 7 - ICES no 26270, see Table 3) was considered as „Invalid" due to technical problems associated with gear performance observed during trawling. The haul was repeated successfully in the place as assigned in the survey plan. In total 12 hauls (ICES no 26165, 26172, 26236, 26284, 25162, 25311, 25512, 25038, 26221, 26140, 26138 and 26257) were not realized due to oxygen level on the bottom below 0.5 ml/l. The hauls were classified as „No oxygen" and the catch result was considered as „zero catch haul". Finally, it can be concluded that the hauls realized during the survey corresponded to the plan and could be therefore accepted as fully representative from the technical point of view (Fig. 1, Table 1) taking into account gear performance during hauls.

Trawling was done with the standard rigging ground trawl type TV-3#930 (without bobbins and additional chains connected to the footrope), with 10-mm mesh bar length in the codend. A standard vertical fish-sounder was used to monitor the trawling depth. Usually a 6-7 m vertical net opening was achieved, which was monitored by the net echosounder. The catch stations were located on the depth range from 20 to 120 m. Fish control-hauls were conducted at the daylight only, lasting maximum 30 minutes, at 3.0 knots vessel speed.

Each control-catch was sorted out for the determination of the species composition. Mean CPUE of each fish species and their average share in mass of catches was calculated. From each catch station, representative samples of dominated fishes were collected to determine age-length-mass relationships, sex, sexual maturation, feeding conditions, externally visible diseases and additionally stomach samples for food composition estimation of cod were collected for further examinations in the Institute.

In the case of cod, turbot and plaice all the caught specimens were taken for total length and mass measurements. In the case of clupeids and flounder, the representative sub-samples of these fish species were investigated. Overall, 12212 cod, 6241 flounder, 1109 plaice, 52 turbot, 7499 sprat and 8920 herring were taken for the length and mass determination. In total, 539, 756, 433, 52, 522 and 904 individuals of the above-mentioned species were aged. Biological analyses of fishes were performed directly on board of surveying vessel, according to standard methodological procedures. The length of 35 cm, 23 cm (ICES SD 25) and 21 cm (ICES SD 26), 16 cm and 10 cm was taken into account as a separation (protective) length between juvenile and commercial size of cod, flounder (differed by the ICES Sub-divisions), herring and sprat, respectively.

Externally visible diseases of fish's skin and their vertebral column anomalies were monitored for 12212 cod, 6241 flounder, 1109 plaice, 7499 sprat and 8920 herring. Data on pathological symptoms were registered based on the visual inspection of fish taken for length measurements.

Every control-haul was preceded by the measurements of basic hydrological parameters continuously from the sea surface to the bottom. Overall, 98 hydrological stations (including hydrographic standard stations) were inspected with the automatic CTD probe SeaBird 911 combined with the rosette sampler (the bathometer rosette). Oxygen content was determined using the standard Winkler's method. The seawater temperature and salinity row data was aggregated to the 1-m depth stratum while oxygen content was aggregated to the 10-m intervals. Temperature, salinity and oxygen content was the source of information on abiotic factors potentially influencing fish spatial distribution. Distribution of all hydrological stations inspected by the R/V Baltica in February/March 2020 is presented in Figure 1.

RESULTS

Fish catches and biological data

In total, twenty two different fish species were recognized in 69 scrutinized valid bottom catches (Table 1). Only one fish species – European anchovy represented fish species permanently inhabiting Atlantic Ocean.

The frequency of the most important commercial species occurrence in the hauls - flounder, cod, herring and sprat was - 83%, 81%, 73% and 59% of the hauls, respectively (Table 1). Cod, flounder, herring, and sprat dominated also with respect to mass of catch (kg) and efficiency (CPUE). By-catch of other fish species was insignificant.

The average CPUE of cod in ICES SD 25 (202,8 kg/1h) was the highest out of all the species in the SD 25, exceeding markedly sprat CPUE (124,0 kg/1h), herring (114,8 kg/1h) and flounder (79,8 kg/1h) (Fig. 2). However, cod CPUE (89,0 kg/1h) in ICES SD 26 was the lowest in comparison of CPUEs of herring (276,3 kg/1h), flounder (130,5 kg/1h) and sprat (118,8 kg/1h). Much lower CPUE of cod obtained in ICES SD 26 than in ICES SD 25 is explained by very low oxygen content in the near bottom zone observed in a large part of the ICES SD 26 (Fig. 7). The area of low oxygen content (below 2 ml/l and also below 0.5 ml/l) was extremely extended during the described survey. The average CPUE of cod, in analogous survey in February/March 2019 r., was lower (134.6 kg/1h) in ICES SD 25, while in ICES SD 26 in February/March 2019 it was higher (93.3 kg/1h) than in February/March 2020 r.

Herring definitely dominated among all the fish species in respect of CPUE (276,3 kg/1h) in ICES SD 26. The average CPUE of herring in ICES SD 25 was much lower - 114,8 kg/1h. During the last year’s survey the CPUEs of herring were higher in ICES SDs 25 and 26 and amounted to 347.6 and 344.0 kg/1h, respectively.

The average CPUEs of sprat in ICES SDs 25 and 26 were very similar and amounted to 124.0 and 118.8 kg/1h, respectively. In the same type of survey from February/March 2019 the CPUEs of sprat in ICES SD 25 was 142.7 kg/1h, and in ICES SD 26 the average CPUE of sprat was more than twice as much higher than in February/March 2020 and amounted to 252.7 kg/1h.

The average CPUE of flounder in ICES SD 25 was the lowest as compared to the other three species CPUEs described in the report. The flounder CPUEs in ICES SD 25 and in SD 26 was 79.8 kg/1h and 130.5 kg/1h, respectively. The average CPUEs of flounder in February/March 2019 in ICES SDs 25 and 26 were also low and amounted to 80.3 and 89.1 kg/1h, respectively.

Length distributions of the main fish species according to the ICES Sub-divisions are illustrated in Figure 3. The curves of cod length distributions for both of the ICES SDs were almost identical, what indicates for a very low cod length variety observed in the two ICES SDs in the area of investigation. The length distributions clearly demonstrate a definite prevalence of cod from length classes 20-46 cm. The numerical share of the cod 20-46 cm in ICES SDs 25 and 26 was 98.3% and 96.6%, respectively. Cod smaller than 20 cm was very seldom represented in the hauls and the abundance was very low. In the length distribution curve of cod in ICES SD 25 there was clearly distinguished single peak corresponding to length class 32 cm (8.9%). Two peaks of frequency in the length distribution of cod from ICES SD 26 were noted, corresponding to length classes 30 and 32 cm (frequency of 8.9% for both peaks).

Two herring length fractions in the length distribution curves from ICES SD 25 and 26 were clearly distinguished. In the ICES SD 25, the first fraction of small size herring (12.0-15.5 cm) and second fraction of larger ones (16.0-25.5 cm). In the ICES SD 26 the first fraction of small size herring (9.5-15.0 cm) and second fraction of larger ones (15.5-24.5 cm). The first fraction of smaller size herring in ICES SD 26 was much bigger than in ICES SD 25, indicating higher abundance of young herring in ICES SD 26.

Sprat length distribution curves in both ICES SD 25 and SD 26 indicated that two sprat length fractions inhabited the ICES SDs. In ICES SD 25 and in SD 26, the first length fraction of the smaller size sprat was the same – 7.0-9.5 cm. The second length fraction of larger sprat in

ICES SD 25 and in SD 26 was 10.0-15.5 cm and 10.0-14.5 cm, respectively. Larger sprat fraction of sprat in both ICES SDs was much bigger than the smaller size sprat fraction. Sprat of more favourable length size for commercial fishery was observed in ICES SD 25, similarly like in the former BITS surveys.

Flounder length distributions indicated large differences of flounder size depending on the ICES SD they occupied. In respect of flounder length distribution in ICES SD 26, a marked shift of the length distribution curve to the left along the horizontal axis was noted as compared to length distribution curve from ICES SD 25, what indicated that much higher share of smaller flounder inhabited ICES SD 26. Flounder length distribution in ICES SD 26 covered length range 10-34 cm, and in ICES SD 25 the length range was 15-38 cm. In addition, a clearly distinguished single peaks of frequency were visible in both the ICES SDs. The most represented frequency (10%) of the numerical share was observed in both ICES SDs and it corresponded to length class 20 cm in ICES SD 26, and to 25 cm in ICES SD 25.

Figure 4 shows the numerical shares of the undersized fish fractions of cod, herring, sprat and flounder. In cod catches from ICES SDs 25 and 26 the undersized fraction of cod prevailed markedly. Their numerical share in the above-mentioned ICES SDs was 71.9% and 73.7%, respectively. In the same cruise from February/March 2019, the share of undersized cod was higher and amounted to 84.3% and 87.4%, respectively. The total share of undersized cod from the February/March 2019 survey was high and amounted to 72.4%. The share of the undersized fraction of herring in ICES SD 25 and 26 amounted to 17.2% and 50.2%, respectively. The largest share of undersized sprat was observed in samples from ICES SD 26 (17.3%). The share in ICES SD 25 was only 6.1%. Flounder undersized share was the highest in the ICES SD 26 (46.8%). The share of undersized flounder in the ICES SD 25 was 13.5%.

Mean length (l.t.) and mean mass of sprat, herring, cod and flounder calculated for the whole cruise and separately for ICES SDs 25 and 26 are presented in the text table below (in parenthesis are shown parameters from February/March 2019 cruise):

ICES Subdivision	parameter	sprat	herring	cod	flounder
24	mean length [cm]	(13.7)	(20.9)	(29.8)	(26.1)
25		12.4 (12.3)	18.7 (19.6)	32.2 (29.8)	27.2 (27.4)
26		11.4 (10.9)	16.1 (18.8)	32.0 (28.3)	21.5 (20.6)
whole cruise		11.8 (11.5)	17.4 (19.3)	32.2 (29.2)	23.1 (22.7)
24	mean mass [g]	(15.4)	(59.9)	(272.5)	(188.1)
25		12.1 (12.9)	40.6 (63.4)	310.0 (267.3)	215.9 (230.8)
26		8.7 (7.8)	26.7 (40.3)	322.7 (236.1)	113.9 (105.8)
whole cruise		10.0 (9.7)	33.4 (52.9)	313.8 (255.4)	142.1 (180.4)

The measurement of the length of the main fish species was accompanied by a macroscopic analysis of the presence of symptoms of visible diseases of fish's skin. i.e. anatomopathological changes (Fig. 5). The highest prevalence of fish with externally visible pathological changes was recorded for flounder (6.4%) and for cod (2.2%). The share of herring and sprat with observed pathological symptoms was very low and amounted to 0.64% and 0.03% in the whole area investigated.

Hydrological situation in the southern Baltic

In the near-bottom water layer (Fig. 6) temperatures in the range from 10.45°C to 4.72°C were noted. The lowest temperature was noted in the control haul no 23, while the highest in haul station no 36. The highest salinity was recorded in hydrological station no IBY5 (Bornholm

Deep) (16.92 on the PSU scale). The station IBY5 is monitored permanently during BITS surveys in Bornholm Basin. Salinity measured in Gdańsk Deep amounted to 12.58 in hydrological station (G2). The lowest oxygen content in the water was noted on the fishing catch no 66 (0.12 ml/l). In the Gdańsk Deep (G2) the oxygen content noted in hydrological station G2 was 0.31 ml/l and in the hydrological station IBY5 the content amounted to 2.92 ml/l. The hydrological situation with regard to oxygen content has markedly worsened since the last autumn BITS 4Q 2019 survey. The range of hypoxic waters increased considerably (Fig 7).

CONCLUSIONS

The data collected during Polish BITS-1Q 2020 cruise is considered as representative. taking into account the degree of the survey plan realization. and therefore can be used by the ICES Baltic International Fish Survey Working Group (WGBIFS) and the Baltic Fisheries Assessment Working Group (WGBFAS) for evaluation of fish species abundance and their distribution. The survey data collected during the survey is stored in the international DATRAS database publicly available and managed by the ICES Secretariat.

References:

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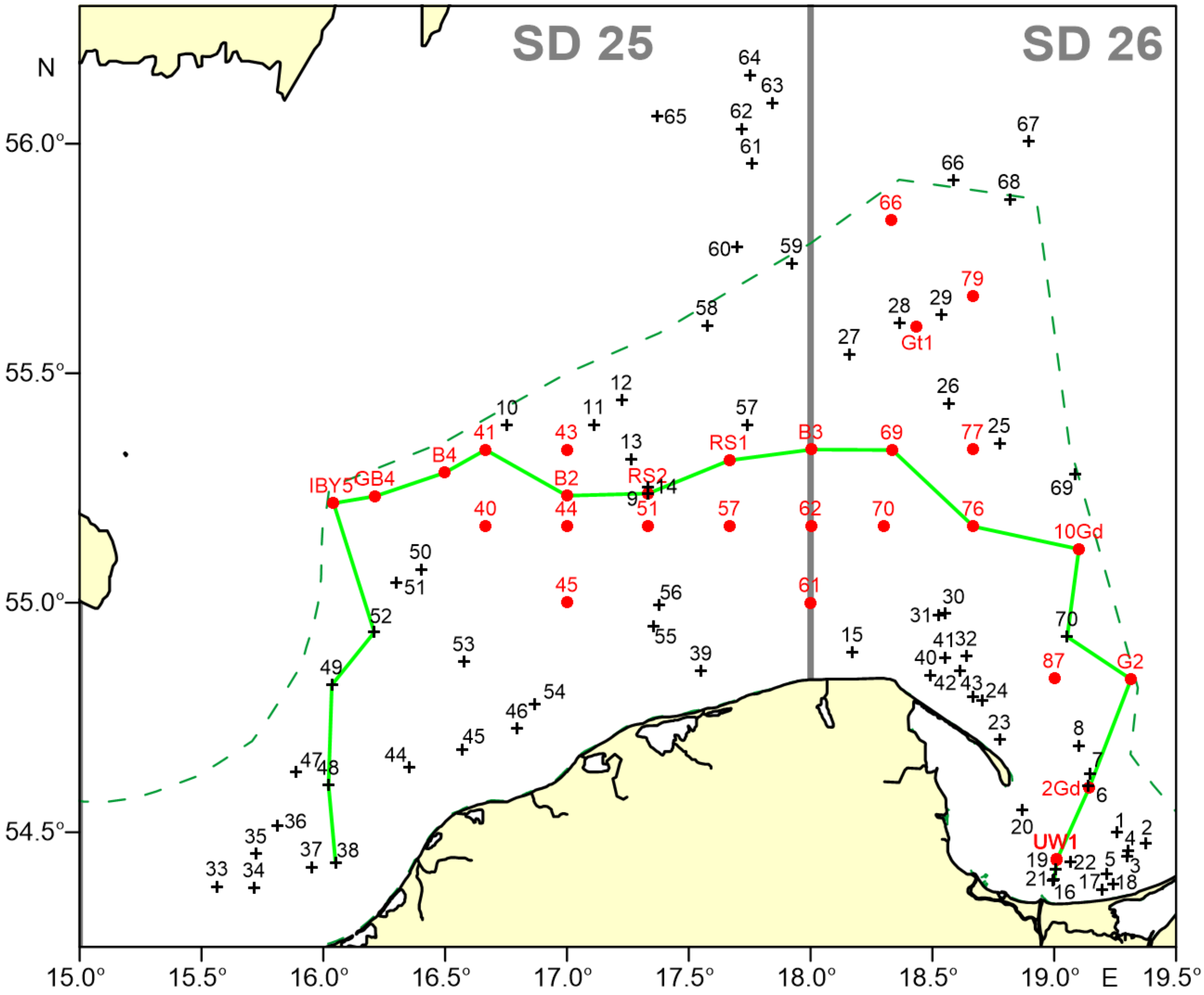

Fig. 1. Location of fish control-hauls (black crosses) and hydrological standard stations (red dots) realised during the r/v Baltica BITS-1Q cruise (04.02-03.03. 2020). (green solid line indicates hydrological research profile).

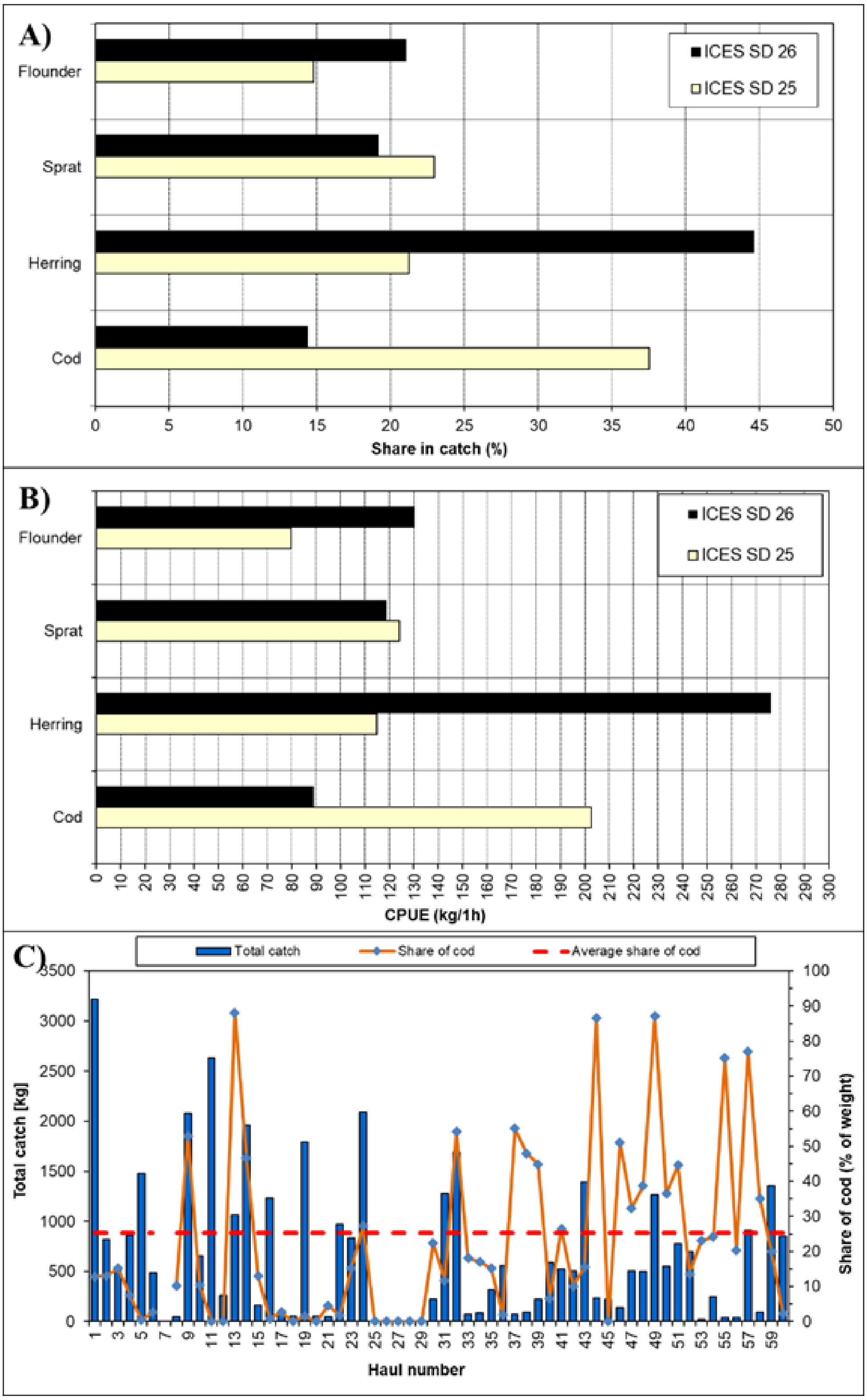

Fig. 2. Mean share in mass of control hauls (A). and mean CPUE (B) of dominant fish species. and share of cod (C) in particular catches conducted during r/v Baltica BITS-1Q cruise (04.02-03.03. 2020).

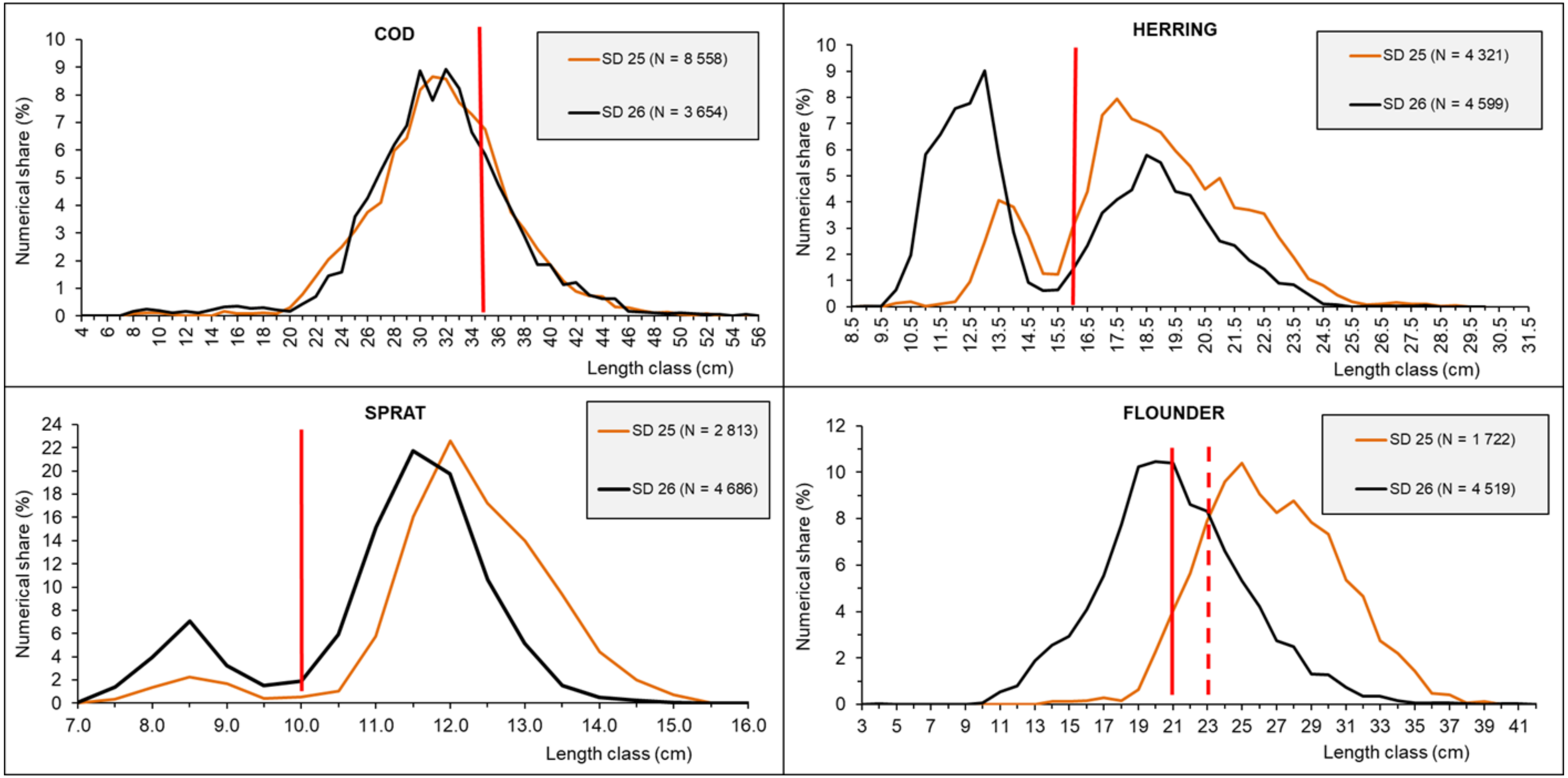

Fig. 3. Length distributions of cod. herring. sprat and flounder in samples from fish control hauls conducted during r/v Baltica BITS-1Q cruise (04.02-03.03. 2020). (red horizontal lines indicate minimum landing size).

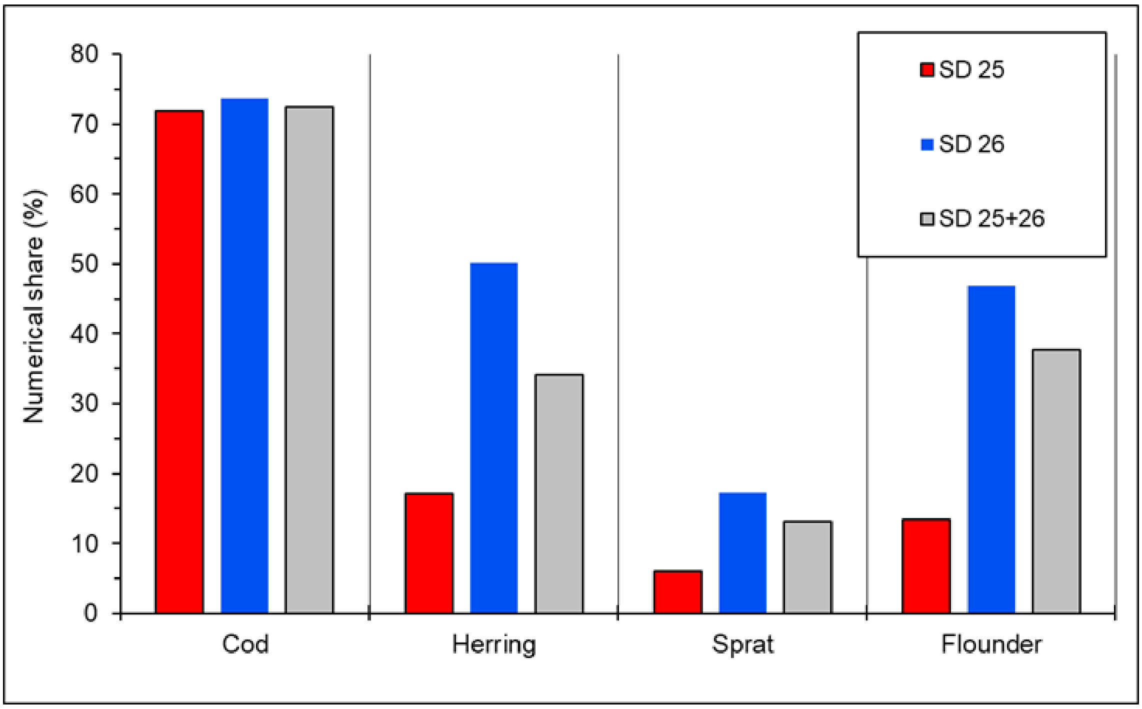

Fig. 4. Mean numerical share (in %) of undersized fish species in samples from fish control hauls conducted during r/v Baltica BITS-1Q cruise (04.02-03.03. 2020).

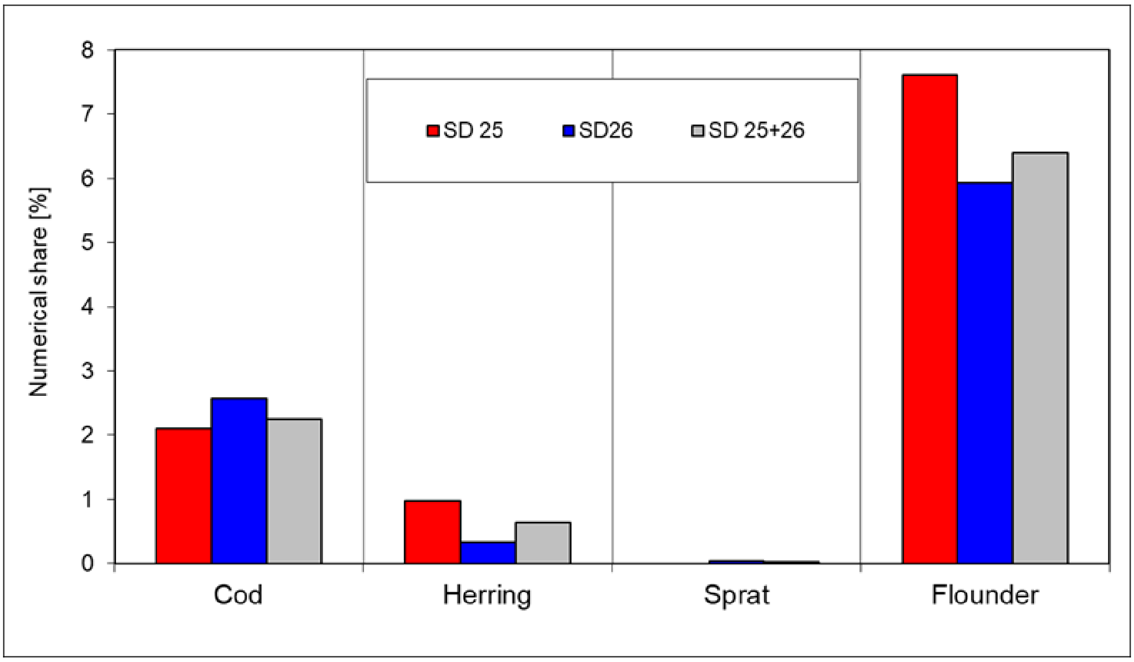

Fig. 5. Mean prevalence (in %-indiv.) of fish with externally visible diseases in samples from fish control hauls conducted during r/v Baltica BITS-1Q cruise (04.02-03.03. 2020).

Tab. 1. Number of fish species individuals measured and aged during r/v Baltica BITS-1Q cruise (04.02-03.03. 2020).

Species name	Number of fish mesured (l.t)			Numer of fish aged and weighed (g)		
	26 ICES Sub-division	25 ICES Sub-division	total	26 ICES Sub-division	25 ICES Sub-division	total
Cod	3654	8558	12212	218	321	539
Baltic herring	4599	4321	8920	304	600	904
Sprat	4686	2813	7499	264	258	522
Flounder	4519	1722	6241	441	315	756
Plaice	144	965	1109	142	291	433
Hooknose	0	2	2	0	0	0
Eelpout	31	7	38	7	0	7
Fourbeard rockling	9	278	287	4	22	26
European perch	74	1	75	4	1	5
Three-spined stickle	0	150	150	0	0	0
Lumpfish	3	2	5	0	1	1
Short-horn scorpion	45	244	289	6	17	23
Round goby	13	0	13	2	0	2
Sand goby	5	0	5	0	0	0
Smelt	40	0	40	5	0	5
Twaite shad	115	0	115	9	0	9
Turbot	37	15	52	37	15	52
Whiting	1	97	98	1	24	25
European anchovy	5	0	5	2	0	2
Ruffe	2	0	2	2	0	2
Greater sandeel	73	217	290	0	0	0
Small sandeel	1	0	1	0	0	0
TOTAL	18056	19392	37448	1448	1865	3313

Tab. 2. Fish control-hauls data obtained during r/v Baltica BITS-1Q cruise (04.02-03.03. 2020) (**Hauls no. 1-35**)

invalid haul -> haul repeated

Haul number according to survey order	Haul number according to ICES database	Catch date	ICES rectangle	ICES Sub-division	Trawling depth [m]	Geographical position of the catch-station: start/shoot szerokość (N)	start/shoot długość (E)	end szerokość (N)	end długość (E)	Time of shooting net	Time of hauling up net	Trawling duration [min]	Total catch [kg]
1	26211	2020-2-4	38G9	26	72	54°30.3'	19°17.1'	54°30.5'	19°18.4'	11:46	12:01	15	803.752
2	26256	2020-2-5	37G9	26	63	54°28'	19°21.9'	54°27.2'	19°20'	07:53	08:23	30	411.850
3	26258	2020-2-5	37G9	26	64	54°27'	19°18.5'	54°27.8'	19°20.5'	11:36	12:06	30	269.519
4	26015	2020-2-5	37G9	26	68	54°29'	19°20.1'	54°28.2'	19°18.4'	14:20	14:50	30	428.521
5	26217	2020-2-6	37G9	26	42	54°24.6'	19°14.6'	54°24.7'	19°17.2'	07:50	08:20	30	737.822
6	26269	2020-2-6	38G9	26	82	54°35.5'	19°10.4'	54°35.1'	19°12.8'	11:26	11:56	30	243.361
7	**26270**	**2020-2-6**	**38G9**	**26**	**84**	**54°37.1'**	**19°10.7'**	**54°36.6'**	**19°13.1'**	**13:39**	**14:09**	**30**	**208.160**
8	26090	2020-2-6	38G9	26	92	54°41.8'	19°4.4'	54°41.6'	19°5.5'	15:54	16:09	15	11.378
9	25463	2020-2-7	39G7	25	91	55°14.2'	17°18'	55°14.2'	17°15.7'	07:59	08:29	30	1036.920
10	25081	2020-2-8	39G6	25	59	55°23.4'	16°47.1'	55°23.9'	16°49.5'	08:00	08:30	30	328.268
11	25456	2020-2-8	39G7	25	61	55°23'	17°2.6'	55°23.3'	17°5'	10:47	11:17	30	1315.269
12	25455	2020-2-8	39G7	25	44	55°26.8'	17°15'	55°27.3'	17°17.4'	13:00	13:30	30	131.272
13	25232	2020-2-8	39G7	25	75	55°19.1'	17°17.7'	55°19.3'	17°20.2'	15:29	15:59	30	533.912
14	25339	2020-2-9	39G7	25	88	55°15.4'	17°22.2'	55°15.5'	17°23.5'	07:59	08:14	15	490.307
15	26274	2020-2-9	38G8	26	22	54°53.7'	18°11.4'	54°53.9'	18°13.8'	13:22	13:52	30	80.702
16	26131	2020-2-10	37G9	26	31	54°23.9'	19°1.2'	54°24'	19°2.4'	08:49	09:04	15	309.061
17	26001	2020-2-10	37G9	26	22	54°22.7'	19°12.4'	54°22.8'	19°14.8'	11:14	11:44	30	29.095
18	26216	2020-2-10	37G9	26	25	54°23.3'	19°15.4'	54°23.4'	19°17.7'	12:57	13:27	30	26.243
19	26264	2020-2-11	37G9	26	42	54°25.3'	19°1.6'	54°25.3'	19°2.9'	07:35	07:50	15	448.284
20	26270	2020-2-11	38G8	26	67	54°33'	18°53.8'	54°33.2'	18°56.6'	10:04	10:34	30	27.403
21	26263	2020-2-12	37G8	26	28	54°24'	18°59.2'	54°24.4'	18°57.7'	09:52	10:12	20	16.482
22	26014	2020-2-13	37G9	26	50	54°26.1'	19°5.2'	54°26.2'	19°6.6'	07:52	08:07	15	243.037
23	26133	2020-2-13	38G8	26	51	54°42.4'	18°46.4'	54°43.1'	18°45.7'	12:16	12:36	20	278.427
24	26020	2020-2-13	38G8	26	45	54°46.4'	18°42.8'	54°45.6'	18°43.3'	14:12	14:27	15	521.789
25	26105	2020-2-14	39G8	26	89	55°21.5'	18°47.9'	55°22.4'	18°49.9'	07:41	08:11	30	6.188
26	**26165**	**2020-2-14**	**39G8**	**26**	**87**	**55°26'**	**18°34'**			**10:30**			
27	**26172**	**2020-2-14**	**40G8**	**26**	**77**	**55°32.4'**	**18°9.6'**			**12:10**			
28	**26136**	**2020-2-14**	**40G8**	**26**	**94**	**55°36.5'**	**18°22'**			**13:26**			
29	**26286**	**2020-2-14**	**40G8**	**26**	**98**	**55°37.6'**	**18°32.3'**			**14:55**			
30	26271	2020-2-15	38G8	26	70	54°58.9'	18°32.2'	54°59.8'	18°30.4'	07:43	08:13	30	111.401
31	26167	2020-2-15	38G8	26	63	54°59'	18°30.5'	54°59.4'	18°29.4'	09:39	09:54	15	320.275
32	26019	2020-2-19	38G8	26	48	54°53.5'	18°37.9'	54°54.6'	18°36.6'	14:17	14:47	30	844.476
33	25008	2020-2-20	37G5	25	30	54°22.9'	15°35'	54°22.9'	15°37.6'	07:32	08:02	30	36.867
34	25009	2020-2-20	37G5	25	30	54°22.8'	15°44.1'	54°23'	15°46.7'	09:00	09:30	30	43.766
35	25040	2020-2-20	37G5	25	49	54°27.2'	15°44.7'	54°27.7'	15°47.1'	10:47	11:17	30	159.460

Haul number according to survey order	Weight of the catch by fish species [kg]: Cod	Herring	Sprat	Flounder	Plaice	Hooknose	Eelpout	Fourbeard rockling	European perch	Three-spined stickleback	Lumpfish	Short-horn scorpion	Round goby	Sand goby	Smelt	Twaite shad	Turbot	Whiting	European anchovy	Ruffe	Greater sandeel	Small sandeel
1	103.160	176.726	437.694	81.720	2.600				0.066							1.786						
2	53.700	99.823	66.412	189.140	0.696				0.202				0.069		0.116	1.662		0.030				
3	40.820	50.297	25.403	151.100	0.735							0.138			0.460	0.566						
4	31.960	196.400	53.506	143.750	0.641				0.202						0.425	1.637						
5	2.824	593.264	34.457	104.460	0.272			0.384	0.143			1.057	0.018					0.836	0.034	0.073		
6	6.558	38.972	147.007	50.400	0.140									0.001		0.283						
7	**3.595**	**21.444**	**144.715**	**38.160**	**0.117**				**0.049**										**0.080**			
8	1.152	0.269	5.650	4.261															0.046			
9	548.600			422.860	45.360				19.250								0.850					
10	34.200	129.819	145.661	17.350	1.238																	
11		313.809	997.071	4.337	0.052																	
12	13.000	66.288	1.208	36.830	2.081	0.710					0.305	10.850										
13	470.610			58.780	3.672				0.850													
14	229.020			235.250	15.440				10.380								0.217					
15	10.397	48.760	1.210	9.246	1.737	0.351						0.760		0.001							8.240	
16	2.596	288.670	2.566	13.546	0.012			0.025				0.510			0.859			0.223			0.054	
17	0.773	0.465		25.990	0.375							1.427			0.050						0.015	
18				25.301	0.280	0.253						0.370			0.039							
19	6.878	271.234		160.600	0.624	0.259		0.368	0.093			0.391	0.178		6.811	0.060	0.432	0.356				
20		12.703	11.387	3.177				0.012	0.028				0.024	0.002				0.057	0.013			
21	0.750	14.840		0.866																	0.026	
22	4.065	150.056	22.532	63.990	0.133			0.403				0.095			1.687			0.023			0.053	
23	42.490	133.744	31.266	69.040	0.875	0.434		0.017				0.495	0.066									
24	142.500	237.144	19.786	119.605	1.859			0.171			0.562	0.162										
25			4.039	2.149																		
26	**no oxygen -> haul not conducted**																					
27	**no oxygen -> haul not conducted**																					
28	**no oxygen -> haul not conducted**																					
29	**no oxygen -> haul not conducted**																					
30	24.880	10.384	10.800	65.060	0.277																	
31	37.620	127.171	82.889	72.270	0.214				0.111													
32	457.260	165.108	52.662	167.160	1.202	0.838						0.246										
33	6.677	4.833		8.370	12.461							4.466									0.060	
34	7.482	2.208		8.199	18.316	0.164	0.083					7.314										
35	24.155	84.165	42.945	6.880	0.165												1.150					

Tab. 2. Fish control-hauls data obtained during r/v Baltica BITS-1Q cruise (04.02-03.03. 2020) (**Hauls no. 36-70**)

Haul number according to survey order	Haul number according to ICES database	Catch date	ICES rectangle	ICES Sub-division	Trawling depth [m]	Geographical position of the catch-station: start/shoot szerokość (N)	start/shoot długość (E)	end szerokość (N)	end długość (E)	Time of shooting net	Time of hauling up net	Trawling duration [min]	Total catch [kg]	Weight of the catch by fish species [kg]: Cod	Herring	Sprat	Flounder	Plaice	Hooknose	Eelpout	Fourbeard rockling	European perch	Three-spined stickleback	Lumpfish	Short-horn scorpion	Round goby	Sand goby	Smelt	Twaite shad	Turbot	Whiting	European anchovy	Ruffe	Greater sandeel	Small sandeel
36	25042	2020-2-20	38G5	25	53	54°30.7'	15°49.5'	54°31'	15°51.9'	13:00	13:30	30	277.450	5.229	23.484	244.576	3.869													0.292					
37	25011	2020-2-20	37G5	25	27	54°23.9'	15°59'	54°24.4'	16°1.4'	15:11	15:41	30	37.182	20.460			2.106	6.840	0.147		0.134				1.095									6.400	
38	25010	2020-2-20	37G6	25	28	54°25.4'	16°0.1'	54°26'	16°2.2'	16:19	16:49	30	47.283	22.699	16.018		3.104	3.417	1.213						0.590									0.242	
39	25024	2020-2-21	38G7	25	25	54°51'	17°31'	54°51.1'	17°32.3'	16:36	16:51	15	54.700	24.520	24.100		4.810	0.090	0.209						0.951									0.020	
40	26266	2020-2-22	38G8	26	20	54°50.1'	18°30.2'	54°48.9'	18°31.7'	07:52	08:22	30	295.011	19.430	212.889	34.751	25.720	0.426	1.490						0.293										0.012
41	26007	2020-2-22	38G8	26	30	54°52.2'	18°33.9'	54°51'	18°35.2'	09:47	10:17	30	262.582	69.24	145.909	25.662	18.920	1.266	0.545						0.921									0.119	
42	26183	2020-2-22	38G8	26	30	54°51.7'	18°35.5'	54°50.6'	18°37.1'	11:46	12:16	30	251.905	25.450	158.793	42.457	22.975	1.212	0.584						0.434										
43	26169	2020-2-22	38G8	26	33	54°47.2'	18°40.6'	54°46.2'	18°41.8'	13:28	14:53	25	581.747	90.360	197.541	232.809	56.360	1.030	2.373		0.097			0.308	0.869										
44	25013	2020-2-24	38G6	25	33	54°38.5'	16°22.4'	54°39.2'	16°24.8'	12:03	12:33	30	117.146	101.440	11.296		0.181	3.234							0.127									0.868	
45	25014	2020-2-24	38G6	25	30	54°41.1'	16°35.9'	54°41.6'	16°38.3'	14:05	14:35	30	111.905	33.930	64.060	0.093	4.635	7.507	0.160						0.807									0.713	
46	25017	2020-2-24	38G6	25	29	54°43.7'	16°49'	54°44.2'	16°51.4'	15:49	16:19	30	70.141	35.880	30.820		1.157	1.399	0.647		0.238														
47	25051	2020-2-25	38G5	25	55	54°38.3'	15°54.2'	54°39.2'	15°54.7'	07:23	07:43	20	169.465	54.760	11.151	85.642	16.450	0.479							0.258					0.725					
48	25052	2020-2-25	38G6	25	50	54°36.7'	16°2.1'	54°37.5'	16°3.2'	09:15	09:35	20	165.417	63.960	70.185	12.175	12.255	2.442												4.400					
49	25060	2020-2-25	38G6	25	52	54°49.7'	16°2.5'	54°50.5'	16°3.3'	12:30	12:50	20	422.623	368.275	16.780	1.872	19.724	5.027												10.945					
50	25067	2020-2-27	39G6	25	59	55°3.9'	16°23.1'	55°3.2'	16°22.5'	07:27	07:42	15	138.300	50.390	13.196	37.024	33.240	3.905				0.089								0.456					
51	25066	2020-2-27	39G6	25	66	55°1.9'	16°17'	55°1.3'	16°16.5'	09:18	09:33	15	194.399	86.630	12.940	69.590	21.420	3.819																	
52	25062	2020-2-27	38G6	25	51	54°55.6'	16°11.6'	54°55'	16°10.9'	11:14	11:29	15	175.319	23.720	101.483	15.048	26.361	8.300												0.407					
53	25004	2020-2-27	38G6	25	20	54°52.1'	16°35.6'	54°52.1'	16°36.9'	13:51	14:06	15	6.036	1.391		0.363	3.086	1.099							0.097										
54	25016	2020-2-27	38G6	25	31	54°46.1'	16°51.5'	54°45.4'	16°50.5'	15:58	16:18	20	81.791	19.770	60.144	1.146	0.048	0.305							0.221						0.122			0.035	
55	25022	2020-2-28	38G7	25	27	54°57.1'	17°22.4'	54°57.2'	17°24.2'	07:09	07:29	20	12.938	9.715	0.343		1.717	0.965							0.159									0.039	
56	25364	2020-2-28	38G7	25	32	54°59.7'	17°23.7'	54°59.8'	17°26.3'	08:30	09:00	30	19.658	4.008	1.626		4.466	5.080	0.461						4.000									0.017	
57	25089	2020-2-28	39G7	25	74	55°23.7'	17°45.8'	55°24.4'	17°47.2'	12:51	13:11	20	304.699	234.93	18.76	3.3	45.96	0.703				0.090	0.249							0.707					
58	25380	2020-2-28	40G7	25	39	55°36.7'	17°35.3'	55°37.8'	17°36.9'	15:48	16:18	30	47.537	16.671	18.13	1.212	6.591		1.339				0.531	0.245	2.803									0.015	
59	25308	2020-2-29	40G7	25	63	55°44.2'	17°56.4'	55°44'	17°57.7'	07:23	07:38	15	339.014	67.82	187.771	76.909	6.261	0.112			0.030				0.111										
60	25136	2020-2-29	40G7	25	58	55°46.6'	17°42'	55°47.5'	17°41.3'	09:51	10:11	20	284.694	6.631	154.313	121.127	1.113					0.097			1.413										
61	**25162**	**2020-2-29**	**40G7**	**25**	**62**	**55°57.4'**	**17°45.6'**			**11:54**				**no oxygen -> haul not conducted**																					
62	**25311**	**2020-2-29**	**41G7**	**25**	**63**	**56°2.1'**	**17°43.2'**			**12:44**				**no oxygen -> haul not conducted**																					
63	**25512**	**2020-2-29**	**41G7**	**25**	**65**	**56°5.5'**	**17°50.8'**			**13:34**				**no oxygen -> haul not conducted**																					
64	**25038**	**2020-2-29**	**41G7**	**25**	**50**	**56°9'**	**17°45.3'**			**14:24**				**no oxygen -> haul not conducted**																					
65	25461	2020-3-1	41G7	25	40	56°4'	17°24'	56°4.5'	17°25.4'	08:00	08:20	20	118.902	66.12	43.524	0.996	0.337	0.227			0.280		0.763		6.590									0.065	
66	**26221**	**2020-3-1**	**40G8**	**26**	**112**	**55°55.2'**	**18°35.6'**			**13:56**				**no oxygen -> haul not conducted**																					
67	**26140**	**2020-3-1**	**41G8**	**26**	**120**	**56°0.3'**	**18°54.1'**			**15:39**				**no oxygen -> haul not conducted**																					
68	**26138**	**2020-3-2**	**40G8**	**26**	**117**	**55°52.7'**	**18°49.1'**			**07:03**				**no oxygen -> haul not conducted**																					
69	26045	2020-3-2	39G9	26	82	55°16.3'	19°5.2'	55°15.6'	19°5.5'	12:20	12:35	15	25.925	0.612	0.033	20.75	4.53																		
70	**26257**	**2020-3-2**	**38G9**	**26**	**103**	**54°55.7'**	**19°3.2'**			**15:48**				**no oxygen -> haul not conducted**																					

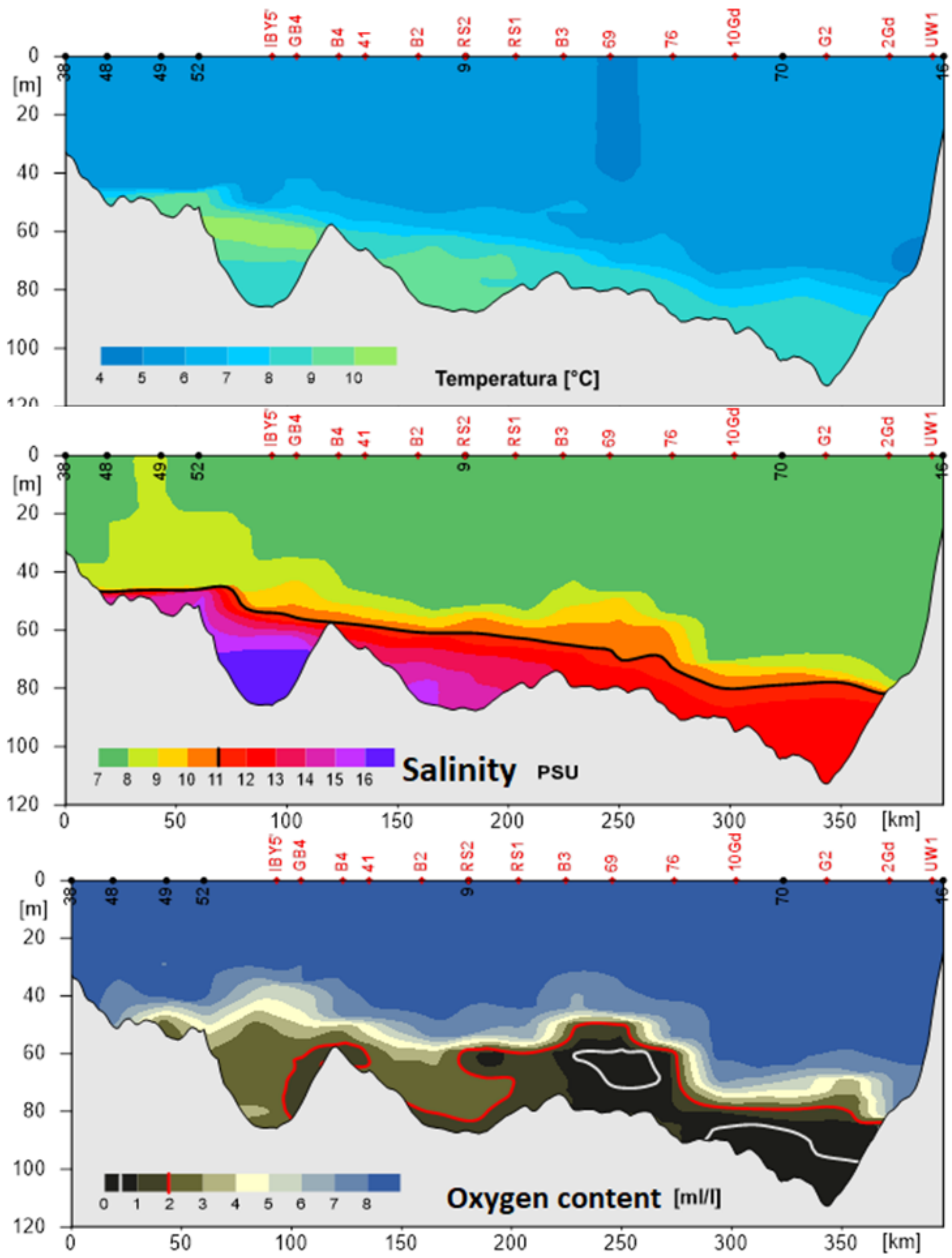

Fig. 6. Vertical distribution of the seawater temperature. salinity and oxygen content along the hydrological research profile during r/v Baltica BITS-1Q cruise (04.02-03.03. 2020).

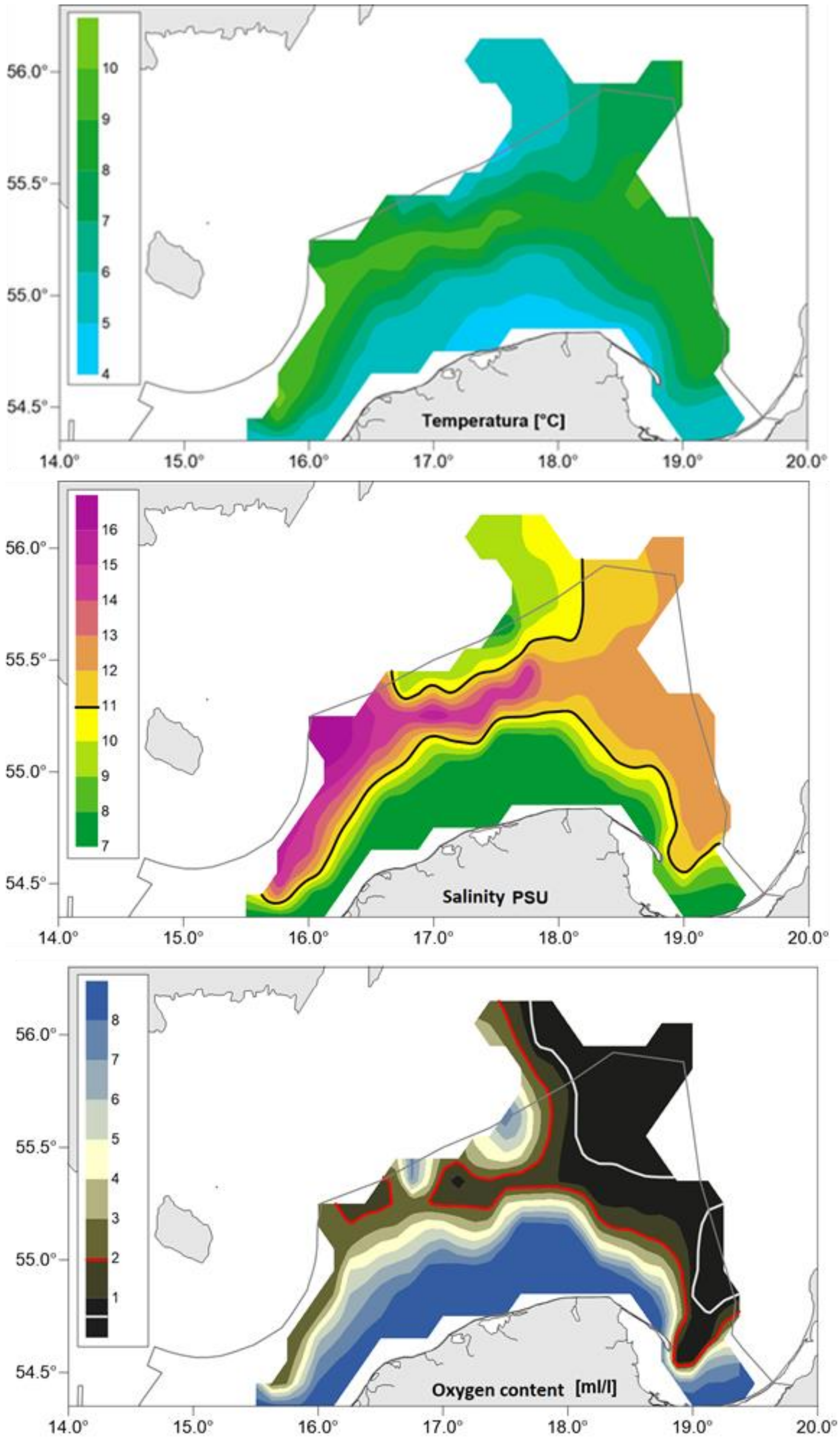

Fig. 7. Horizontal distribution of the seawater temperature. salinity and oxygen content in the near bottom layer during r/v Baltica BITS-1Q cruise (04.02-03.03. 2020).

Baltic International Trawl Survey (BITS)
R/V Svea, 24 February – 9 March 2020

Cruise leader : Olof Lövgren
Scientific leader : Michele Casini

Summary

The survey was conducted using the TV3L demersal trawl according to the Baltic International Trawl Survey (BITS) manual (ICES, 2017). Sweden was assigned 50 randomly selected hauls. In total 50 hauls were performed with TV3L demersal trawl including six hauls which were not trawled because the oxygen concentration close to the bottom was <0,5 ml/l. It is included in stock assessment as zero catch.

SVEA covered parts of SD 24, 25, 27 and 28 this year. During the whole survey, acoustic data were continuously recorded.

During this survey 28 fish species were caught. Herring, sprat, cod, and flounder dominated the total catch, in terms of weight.

The hydrographical conditions were observed and measured at most of the stations. Only the oxygen concentration at the bottom is presented here.

Background
The expedition was performed according to the BITS manual (ICES, 2017) and the recommendations from ICES Working Group on Baltic International Fish Surveys (WGBIFS) latest report (ICES 2016). Sweden is one of several countries performing the BITS survey during this period of the year.

The expedition started in Lysekil on Monday evening February 24 and ended up in Karlskrona monday 9 of March. The weather was hard in the beginning of the survey with winds up to 20 m/s and temperature around 5 degrees. After a couple of days, the winds decreased and we had winds in between 7 – 12 m/s. The winds declined even more towards the end of the survey.

Sweden was allocated 50 random stations: six in SD 24, 24 in SD 25, 10 in SD 27 and 10 in SD 28 (Fig. 1, Table 1). Of these 50 allocated hauls, 41 were realised including six hauls with oxygen deficiency. The main reason for nine replacement station are that three station was doublets and the rest was really bad bottom conditions all of these stations could be replaced with a station in the same depth interval and SD. Overall, Svea performed 50 valid trawl hauls (including six stations with low oxygen content) that can be used in stock assessment. The oxygen depleted stations are used in stock assessment as 0-catch stations. We also made two complementary hauls In SD 28 due to low cod catches.

Hydrography
Hydrographical measurements with CTD and oxygen probe were taken at all of the trawl stations (Fig. 2). Oxygen concentrations at 1 m from the bottom are presented in Fig. 2.

Fish catches
Overall, 28 fish species were caught (Table 2). A total of 42,2 tons of fish were caught, of which 2,2 tons of cod (11 066 individuals), 22.7 tonnes of herring and 14,4 tonnes of sprat.

Sampling
Almost all cod were measured. At stations with high cod catches, a subsample was analysed. Otoliths were collected for age determination with the aim to sample 1 individuals per 1 cm-class and haul in SD 25. In SD 26, 27 and 28 we tried to spread out the sampling throughout the area. In SD 25 individuals were sampled in each of the areas 25W, 25C and 25E. Overall, 939 cods were age-estimated.

For flounder, otoliths were collected with the aim to sample three individuals per 1 cm-class and haul. Totally, 2 141 flounder otoliths were sampled.

The other fish species were measured, weighed and total catch recorded.

Ad-hoc studies and sampling were performed:

- Stomach sampling of cod and flounder for Michele Casini. Institute of marine research
- Length distributions and individual collection of *Saduria entomon*
- Liver, spleen, blood analysis were made with personnel from National Veterinary Institute (SVA)

Other

The results of The Swedish BITS expeditions are presented yearly in a report by SLU-Department of Aquatic Resources (SLU Aqua).

All Swedish BITS data are uploaded into FISKDATA 2 database at SLU Aqua and are delivered to ICES database DATRAS for international compilation. The data from this survey are used within the Baltic International Fish Survey Working Group (WGBIFS) and Baltic Fisheries Assessment Working Group (WGBFAS) in ICES.

We thank all the participants, scientists, technicians and crew, which contributed to the accomplishment of the expedition.

Participants

Johnnie Bengtsson	SLU, Havsfiskelaboratoriet
Maranne Johansson	SLU, Havsfiskelaboratoriet
Per Andersson	SLU, Kustlaboratoriet
Federico Maioli	SLU, Havsfiskelaboratoriet
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Mattias Sköld	SLU, Havsfiskelaboratoriet
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Sara Johansson	SVA
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Olof Lövgren, exp.leader	SLU, Havsfiskelaboratoriet
Peter Wickström	SLU, Havsfiskelaboratoriet
Peter Jakobsson	SLU, Havsfiskelaboratoriet
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References

ICES. 2017. Manual for the Baltic International Trawl Surveys (BITS). Series of ICES Survey Protocols SISP 7 - BITS. 95 pp. http://doi.org/10.17895/ices.pub.2883

ICES. 2017. Final Report of the Baltic International Fish Survey Working Group. WGBIFS Report 2017 27-31 March 2017. Riga, Latvia. ICES CM 2017/SSGIEOM:07. 684 pp.

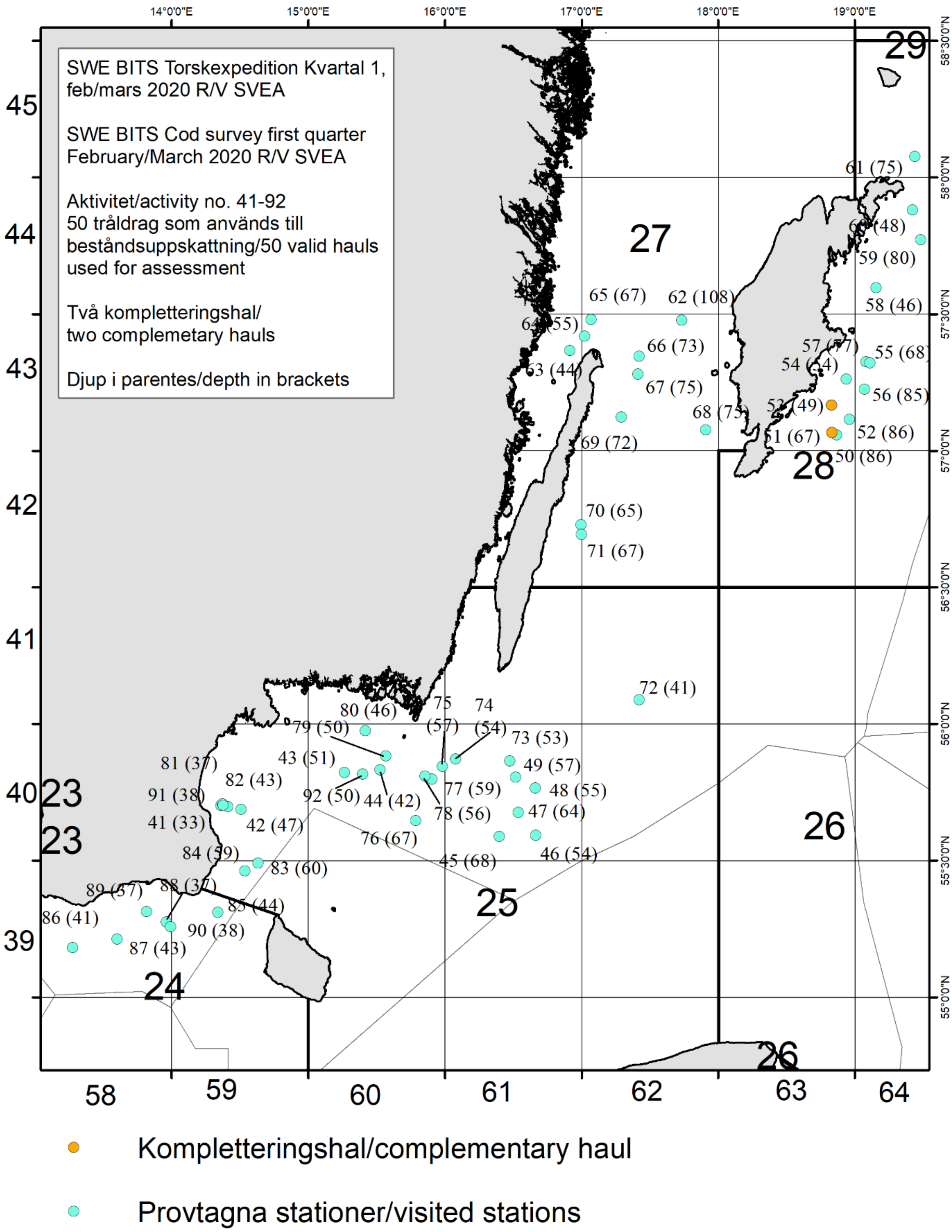

Figure 1. Map of the trawl hauls performed during the Swedish BITS, Quarter 1 2020.

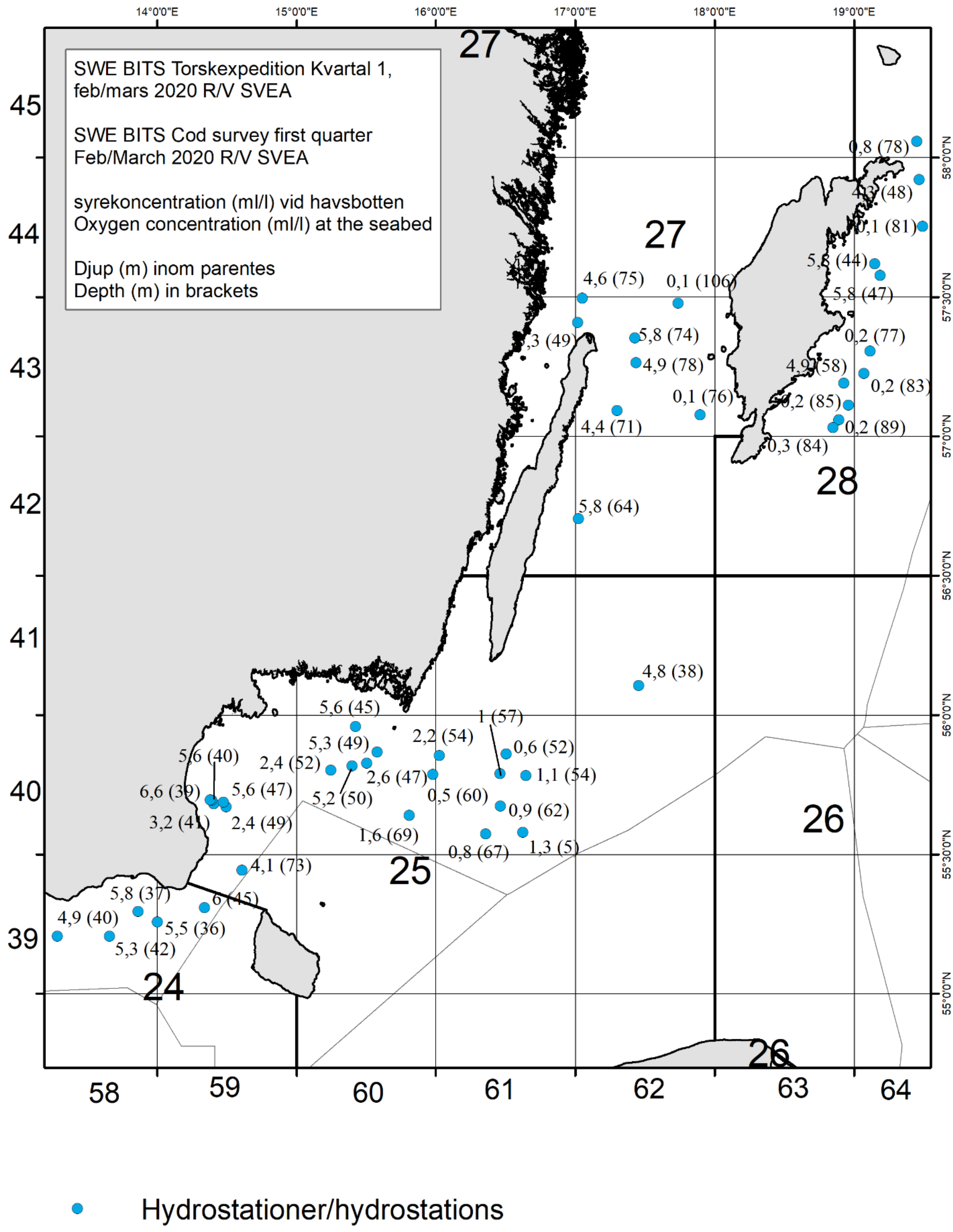

Figure 2. Oxygen concentration 1 m from the bottom at the trawl stations. Numbers in brackets indicate bottom depth. Swedish BITS, Quarter 1 2020.

Table 1. Summary of all stations. Swedish BITS, quarter 1 2020

Tråldrag som används för beståndsuppskattning/Valid hauls used for assessment	50	Tråldrag som används för beståndsuppskattning/ Valid hauls used for assessment			
Slumpade trålade stationer/Randomized trawled hauls	41	Slumpade tilldelade drag/	SD28	10	
Ersättningsdrag/Replacement hauls	9	Randomized allocated	SD27	10	
			SD25	24	
Slumpade syrefria drag/Random anoxic hauls	6		SD24	6	
		Tråldrag som används för			
Kompletteringsdrag/additional hauls	2	beståndsuppskattning/	SD28	10	Kompletteringshal
Ogiltiga drag/invalid hauls	0	Valid hauls used for	SD27	10	TV3 Trål station
Slumpade stationer, ej trålade/random stations, not trawled	9		SD25	24	Syrefritt tråldrag
			SD24	6	Hydrografisk station (CTD)

Datum Date	Akt. nr Act. no	Om-råde Area SD	Ruta Rect.	Position N Latitude	Position E Longitude	Stat. nr Haul No	Stationsnamn Station name	Trålning Gear	Tråltid Duration min	Tråldjup Trawl depth	Hydro Djup Depth m	Hydro O2 Oxygen ml/l	Kommentar	Remarks
2020-02-26	99	25	4059	55 40,886	14 24,381	25419	3,5 NE Stens Huvud	CTD			41	3,2		
2020-02-26	41	25	4059	55 42,076	14 21,595	25419	3,5 NE Stens Huvud	TV3L	30	33		5,8		
2020-02-26	100	25	4059	55 40,212	14 29,687	25353	Rackaput Nord	CTD			49	2,4		
2020-02-26	42	25	4059	55 41,192	14 30,430	25353	Rackaput Nord	TV3L	30	47		2,5		
2020-02-26	101	25	4060	55 48,112	15 14,630	25426	3 NW Västra Nabben	CTD			52	2,4		
2020-02-26	43	25	4060	55 49,283	15 15,837	25426	3 NW Västra Nabben	TV3L	30	51		2,4		
2020-02-26	102	25	4060	55 49,568	15 30,125	25140	Klippebank	CTD			47	2,6		
2020-02-26	44	25	4060	55 49,860	15 31,517	25140	Klippebank	TV3L	30	42		4,8		
2020-02-27	103	25	4061	55 34,352	16 21,466	25286	4 SW Holgers Sten	CTD			67	0,8		
2020-02-27	45	25	4061	55 35,252	16 23,914	25286	4 SW Holgers Sten	TV3L	25	68		0,8		
2020-02-27	104	25	4061	55 34,706	16 37,348	25389	4 SE Holgers Sten	CTD			5	1,3		
2020-02-27	46	25	4061	55 35,529	16 39,863	25389	4 SE Holgers Sten	TV3L	30	54		1,3		
2020-02-27	47	25	4061	55 40,564	16 32,238	25450	2 N Holgers Sten	TV3L	25	64		0,9		
2020-02-27	105	25	4061	55 40,338	16 27,698	25450	2 N Holgers Sten	CTD			62	0,9		
2020-02-27	48	25	4061	55 45,897	16 39,729	25428	1 Syd Teneriffa	TV3L	30	55		1,1		
2020-02-27	106	25	4061	55 46,937	16 38,616	25428	1 Syd Teneriffa	CTD			54	1,1		
2020-02-27	49	25	4061	55 48,247	16 30,900	25359	3 W Teneriffa	TV3L	30	57		1		
2020-02-27	107	25	4061	55 47,342	16 27,479	25359	3 W Teneriffa	CTD			57	1		
2020-02-28	108	28	4363	57 03,485	18 53,424	28107	12 SE När	CTD			89	0,2		
2020-02-28	50	28	4363	57 03,394	18 51,978	28107	12 SE När	TV3L	30	86		0,3	Syrefritt	Oxygen free
2020-02-28	51	28	4363	57 03,934	18 49,879	28101	10 SE När	TV3L	30	67		4,2	Kompletteringshal	complementary haul
2020-02-28	109	28	4363	57 01,810	18 50,942	28101	10 SE När	CTD			84	0,3		
2020-02-28	110	28	4363	57 06,644	18 57,597	28067	11 ESE När	CTD			85	0,2		
2020-02-28	52	28	4363	57 06,790	18 57,488	28067	11 ESE När	TV3L	30	86		0,2	Syrefritt	Oxygen free
2020-02-28	53	28	4363	57 09,972	18 49,647	28016	5 SE När	TV3L	30	49		5,4	Kompletteringshal	complementary haul
2020-02-28	111	28	4363	57 11,433	18 55,579	28016	5 SE När	CTD			58	4,9		
2020-02-28	54	28	4363	57 15,631	18 56,109	28180	8 ESE Ljugarn	TV3L	30	54		5,4		
2020-02-28	112	28	4363	57 18,267	19 06,777	28103	12 E Ljugarn	CTD			77	0,2		
2020-02-28	55	28	4364	57 19,495	19 04,821	28103	12 E Ljugarn	TV3L	30	68		1,6		
2020-02-28	113	28	4364	57 13,514	19 04,181	28071	12 E När	CTD			83	0,2		
2020-02-28	56	28	4364	57 13,454	19 04,130	28071	12 E När	TV3L	30	85		0,2	Syrefritt	Oxygen free
2020-02-29	57	28	4364	57 19,251	19 06,588	28051	8 SE Östergarn Syd	TV3L	30	77		0,3		
2020-02-29	114	28	4364	57 34,634	19 11,133	28188	9 SSE Grauten	CTD			47	5,8		
2020-02-29	58	28	4464	57 35,690	19 09,245	28188	9 SSE Grauten	TV3L	30	46		5,9		
2020-02-29	115	28	4364	57 37,082	19 08,882	28187	6 SSE Grauten	CTD			44	5,8		
2020-02-29	116	28	4464	57 45,134	19 29,435	28182	13 SSE Fårö	CTD			81	0,1		
2020-02-29	59	28	4464	57 46,234	19 28,854	28182	13 SSE Fårö	TV3L	30	80		0,2	Syrefritt	Oxygen free
2020-02-29	60	28	4464	57 52,846	19 25,291	28027	5 SSE Fårö	TV3L	30	48		4,3		
2020-02-29	117	28	4464	57 55,253	19 27,919	28027	5 SSE Fårö	CTD			48	4,3		
2020-02-29	118	28	4564	58 03,417	19 26,907	28106	2 E Salvorev	CTD			78	0,8		
2020-03-01	61	28	4564	58 04,511	19 26,341	28106	2 E Salvorev	TV3L	30	75		1		
2020-03-01	119	27	4362	57 28,619	17 44,156	27017	10 SE Knolls Grund	CTD			106	0,1		
2020-03-01	62	27	4362	57 28,550	17 43,891	27017	10 SE Knolls Grund	TV3L	30	108		0,1	Syrefritt	Oxygen free
2020-03-02	63	27	4361	57 21,936	16 54,858	27020	4 NW Byxelkrok	TV3L	20	44		5,9		
2020-03-02	120	27	4361	57 24,423	17 00,965	27003	5 N Byxelkrok	CTD			49	5,3		
2020-03-02	64	27	4362	57 25,113	17 01,270	27003	5 N Byxelkrok	TV3L	20	55		5,3		
2020-03-02	121	27	4362	57 29,665	17 03,000	27012	3 SW Ölands Norra Grund	CTD			75	4,6		
2020-03-02	65	27	4362	57 28,727	17 04,060	27012	3 SW Ölands Norra Grund	TV3L	17	67		5,4		
2020-03-02	122	27	4362	57 21,119	17 25,557	27029	11 ESE Ölands Norra Udde	CTD			74	5,8		
2020-03-02	66	27	4362	57 20,684	17 25,217	27029	11 ESE Ölands Norra Udde	TV3L	24	73		5,8		
2020-03-02	123	27	4362	57 15,803	17 26,030	27030	11 E Böda	CTD			78	4,9		
2020-03-02	67	27	4362	57 16,762	17 24,782	27030	11 E Böda	TV3L	20	75		5,3		
2020-03-02	124	27	4362	57 04,583	17 53,611	27009	9 NW Hoburg	CTD			76	0,1		
2020-03-02	68	27	4362	57 04,532	17 54,478	27009	9 NW Hoburg	TV3L	30	75		0,1	Syrefritt	Oxygen free
2020-03-03	69	27	4362	57 07,310	17 17,340	27010	7 ESE Högby Fyr	TV3L	30	72		4,4		
2020-03-03	125	27	4362	57 05,487	17 17,981	27010	7 ESE Högby Fyr	CTD			71	4,4		
2020-03-03	70	27	4261	56 43,692	16 59,711	27022	9 SE Kapelludden	TV3L	30	65		5,8		
2020-03-03	126	27	4261	56 42,206	17 01,311	27022	9 SE Kapelludden	CTD			64	5,8		

Datum Date	Akt. nr Act. no	Om-råde Area SD	Ruta Rect.	Position N Latitude	Position E Longitude	Stat. nr Haul No	Stationsnan Station name	Trål-ning Gear	Trål-tid Duration min	Trål-djup Trawl depth	Hydro Djup Depth m	Hydro O2 Oxygen ml/l	Komm entar	Remarks
2020-03-03	71	27	4261	56 41,542	16 59,876	27028	10 SSE Kapelludden	TV3L	30	67		5,8		
2020-03-04	127	25	4162	56 06,304	17 27,290	25462	4 SE Norra Midsjöbanken	CTD			38	4,8		
2020-03-04	72	25	4162	56 05,259	17 25,225	25462	4 SE Norra Midsjöbanken	TV3L	30	41		4,7		
2020-03-04	128	25	4061	55 51,596	16 30,188	25403	7 NW Teneriffa	CTD			52	0,6		
2020-03-04	73	25	4061	55 51,847	16 28,509	25403	7 NW Teneriffa	TV3L	16	53		0,6		
2020-03-04	74	25	4061	55 52,265	16 04,691	25431	Argos Track	TV3L	20	54		2,2		
2020-03-04	129	25	4061	55 51,272	16 01,368	25431	Argos Track	CTD			54	2,2		
2020-03-04	75	25	4060	55 50,688	15 58,879	25413	11 SE Utklippan	TV3L	20	57		2,2		
2020-03-05	130	25	4060	55 38,371	15 48,448	25279	Tången	CTD			69	1,6		
2020-03-05	76	25	4060	55 38,795	15 47,167	25279	Tången	TV3L	30	67		1,7		
2020-03-05	77	25	4060	55 47,834	15 54,304	25409	Inre U10	TV3L	21	59		0,6		
2020-03-05	131	25	4060	55 47,216	15 58,621	25409	Inre U10	CTD			60	0,5		
2020-03-05	78	25	4060	55 48,531	15 51,190	25427	5 N Tången	TV3L	30	56		0,8		
2020-03-05	132	25	4060	55 52,013	15 34,620	25142	5 SSW Utklippan	CTD			49	5,3		
2020-03-05	79	25	4060	55 52,963	15 34,030	25142	5 SSW Utklippan	TV3L	30	50		5,3		
2020-03-05	133	25	4060	55 57,513	15 25,411	25429	Innertorpet	CTD			45	5,6		
2020-03-05	80	25	4060	55 58,491	15 24,965	25429	Innertorpet	TV3L	30	46		5,6		
2020-03-06	134	25	4059	55 41,594	14 23,502	25418	Rackaputt 38M	CTD			40	5,6		
2020-03-06	81	25	4059	55 42,389	14 22,311	25418	Rackaputt 38M	TV3L	30	37		2,9		
2020-03-06	135	25	4059	55 41,232	14 28,478	25422	Rackaputt Väst	CTD			47	5,6		
2020-03-06	82	25	4059	55 41,821	14 24,654	25422	Rackaputt Väst	TV3L	30	43		5,7		
2020-03-06	83	25	3959	55 29,436	14 37,949	25435	Slaggenabben	TV3L	26	60		4,4		
2020-03-06	136	25	3959	55 26,535	14 36,378	25435	Slaggenabben	CTD			73	4,1		
2020-03-06	84	25	3959	55 27,732	14 32,197	25502	8 E Skillinge	TV3L	30	59		4,5		
2020-03-06	85	24	3959	55 18,592	14 20,310	24142	NE Svartegrund	TV3L	30	44		6,1		
2020-03-06	137	24	3959	55 18,463	14 20,363	24142	NE Svartegrund	CTD			45	6		
2020-03-07	138	24	3958	55 12,369	13 17,015	24252	S Trelleborg	CTD			40	4,9		
2020-03-07	86	24	3958	55 10,886	13 16,451	24252	S Trelleborg	TV3L	20	41		4,9		
2020-03-07	87	24	3958	55 12,743	13 36,102	24321	Y 17	TV3L	30	43		5,3		
2020-03-07	139	24	3958	55 12,312	13 39,451	24321	Y 17	CTD			42	5,3		
2020-03-07	88	24	3958	55 16,492	13 57,689	24288	E Ystadkroken	TV3L	30	37		5,9		
2020-03-07	140	24	3958	55 17,619	13 51,795	24303	5 SE Klostergrundet	CTD			37	5,8		
2020-03-07	89	24	3958	55 18,736	13 48,902	24303	5 SE Klostergrundet	TV3L	26	37		5,9		
2020-03-07	90	24	3958	55 15,442	13 59,431	24267	8,9 SE Klostergrundet	TV3L	30	38		5,5		
2020-03-07	141	24	3958	55 15,413	14 00,003	24267	8,9 SE Klostergrundet	CTD			36	5,5		
2020-03-08	142	25	4059	55 41,660	14 22,898	25401	5 NE Stens	CTD			39	6,6		
2020-03-08	91	25	4059	55 42,179	14 22,550	25401	5 NE Stens	TV3L	30	38		6,6		
2020-03-08	92	25	4060	55 48,943	15 23,823	25125	Yttertorpet	TV3L	30	50		5,2		
2020-03-08	143	25	4060	55 48,971	15 23,840	25125	Yttertorpet	CTD			50	5,2		

Table 2. Summary of the species in the catches. Swedish BITS, Q1 2020

Name	24		25W		25C		25E		27		28		Total	
	Antal	Vikt	Antal	Vikt	Antal	Vikt	Antal	Vikt	Antal	Vikt	Antal	Vikt	Antal	Vikt
Species	No.	Weight	No.	Weight	No.	Weight	No.	Weight	No.	Weight	No.	Weight	No.	Weight
Gadus morhua	4 110	862	4 617	825	725	82	1 359	334	50	15	205	49	11 066	2 166
Clupea harengus	28 247	1 044	81 683	2 590	113 529	2 916	98 888	2 949	522 666	9 866	163 879	3 486	1 008 891	22 850
Sprattus sprattus	33 619	457	284 157	3 238	999 863	6 521	312 100	2 873	65 544	652	106 340	711	1 801 624	14 453
Engraulis encrasicolus	36	0,2	22	0,3			2	0,02					60	1
Enchelyopus cimbrius	1	0,002	3	0,3	2	0,2	4	0,4			4	0,3	14	1
Trisopterus minutus			1	0,01									1	0,01
Myoxocephalus quadricornis									20	3	1 486	235	1 506	239
Aphia minuta	14	0,01	213	0,1			2	0,002					229	0,2
Eutrigla gurnardus			6	0,5									6	0,5
Melanogrammus aeglefinus	1	0,2											1	0,2
Scomber scombrus							1	0,3					1	0,3
Osmerus eperlanus									1	0,03			1	0,03
Scophthalmus maximus	14	7	69	38	5	1	4	1			2	1	94	49
Pomatoschistus	10	0,01	6	0,004	1	0,001	1	0,001			4	0,004	22	0,02
Pleuronectes platessa	1 943	275	2 185	305	77	12	65	8	2	0,2	5	0,4	4 277	600
Myoxocephalus scorpius	6	1	39	5	185	33	135	18	370	49	365	53	1 100	158
Limanda limanda	123	18	140	21	13	2							276	41
Cyclopterus lumpus	1	0,4			3	1	2	1			1	0,3	7	2
Platichthys flesus	891	204	2 763	589	984	181	646	110	375	54	1 619	244	7 277	1 382
Agonus cataphractus							1	0,02					1	0,02
Scophthalmus rhombus	1	0,4											1	0,4
Pungitius pungitius							2	0,002	4	0,004			6	0,01
Lumpenus lampretaeformis					1	0,02			1	0,01	6	0,2	8	0,2
Gasterosteus aculeatus					31	0,04	623	1	1 268	2	20	0,04	1 942	3
Trachurus trachurus			66	1	1	0,02							67	1
Hyperoplus lanceolatus	8	0,1	14	0,2	1	0,02	2	0,02					25	0,4
Merlangius merlangus	672	71	219	18	5	1			1	0,2			897	90
Zoarces viviparus					4	0,1	14	1	83	2	33	2	134	5
Total	69 962	3 018	376 646	7 666	1 115 732	9 756	414 062	6 299	590 389	10 643	274 009	4 786	2 840 799	42 168

Annex 7: Cruise reports of BASS and BIAS surveys at the WGBIFS 2020 meeting

Note: Authors are fully responsible for quality of the prepared text and all kind of presented data.

List of cruise reports:

- 1. Cruise Report of Estonia-Poland joint BASS 2019;
- 2. Cruise Report of Germany BASS 2019;
- 3. Cruise Report of Latvia-Poland joint BASS 2019;
- 4. Cruise Report of Lithuania BASS 2019;
- 5. Cruise Report of Poland BASS 2019;
- 6. Cruise Report of Estonia-Poland joint BIAS 2019;
- 7. Cruise Report of Finland BIAS 2019;
- 8. Cruise Report of Germany BIAS 2019;
- 9. Cruise Report of Germany BIAS 2019 (Summary Table);
- 10. Cruise Report of Latvia BIAS 2019;
- 11. Cruise Report of Lithuania BIAS 2019;
- 12. Cruise Report of Poland joint BIAS 2019;
- 13. Cruise Report of Russian BIAS 2019;
- 14. Cruise Report of Sweden BIAS 2019.

PRELIMINARY REPORT

FROM THE JOINT ESTONIAN-POLISH BASS 2019 CONDUCTED BY THE R.V. "BALTICA" IN THE NORTH-EASTERN BALTIC SEA (26-31 May 2019)

by
Radosław Zaporowski*, Tiit Raid**, Elor Sepp** Krzysztof Koszarowski*
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Gdynia, Tallinn June 2019

Introduction

The recent joint Estonian-Polish Baltic Acoustic Spring Survey (BASS), marked with the number 10/2019/NMFRI/TUEMI was based on the procurement contract between the University of Tartu/Estonian Marine Institute in Tallinn and the National Marine Fisheries Research Institute in Gdynia. The survey was conducted in the Estonian EEZ (the ICES Sub-divisions 28.2, 29 and 32 West).

The Estonian Data Collection Program for 2019 and the European Union (the Commission regulations Nos. 2016/1251 financially supported the EST-POL BASS 2019. Timing, surveying area in the North-eastern Baltic Sea and the principal methods of investigations concerns the above mentioned survey were designed and coordinated by the ICES WGBIFS.

The main aims of the reported cruise were:

- to provide the echo-integration and to collect the acoustic data along the planned transects in the north-eastern Baltic Sea,
- to conduct the fish pelagic control-catches in the fish concentration locations,
- to collect ichthyological samples especially for herring and sprat,
- to provide hydrological monitoring (water temperature, salinity and oxygen content) at the catch locations.

Personnel

The EST-POL BASS 2019 scientific staff was composed of 9 persons:
Radosław Zaporowski (NMFRI, Gdynia – Poland) – survey leader,
Bartłomiej Nurek (NMFRI, Gdynia – Poland) – acoustician,
Krzysztof Koszarowski (NMFRI, Gdynia – Poland) – ichtiologist,
Bartosz Witalis (NMFRI, Gdynia – Poland) – hydrologist,
Tiit Raid (TUEMI, Tallinn - Estonia) – Estonian scientific staff leader,
Andrus Hallang (TUEMI, Tallinn - Estonia) – ichthyologist,
Elor Sepp (TUEMI, Tallinn - Estonia) – acoustician,
Ain Lankov (TUEMI, Tallinn - Estonia) – ichthyologist,
Viktor Kajalainen (TUEMI, Tallinn - Estonia) – ichthyologist.

Narrative

The reported survey took place during the period of 26-31 May 2019. The at sea researches (echo-integration, fish control catches, hydrological and plankton stations) were conducted aboard r.v. “Baltica” within Estonian EEZ (the ICES Sub-divisions 28.2, 29 and 32 West), moreover inside the territorial waters of this country not shallower than 20 m depth.

The survey started from the Ventspils port (Latvia) on 25.05.2019 after the midday and was navigated in the North-eastern direction to the entering point of planned acoustic transect at the geographical position 59°17’N 022°45’E on May 26 (Fig. 1). The at sea researches were ended on 30.05.2019 before the midday in the port of Ventspils (Latvia). Then the r.v. “Baltica” started its journey to the home-port in Gdynia (Poland), reaching it on 31.05.2019 afternoon.

Survey design and realization

The r.v. “Baltica” realized 380 Nm echo-integration transect and 14 fish control-catches (Fig. 1). All planned ICES rectangles were covered with acoustic transect and control catches. All control catches were performed in the daylight (between 07:25 am. and 18:40 p.m.) using the pelagic trawl type WP 53/64x4 (with 6 mm mesh bar length in the codend). The hauls trawling duration varied from 15 to 30 minutes due to different fish densities observed on the net-sounder monitor. The mean speed of vessel while providing echo-integration was 8.0 knots, but in case of trawling was 3.0 knots. Overall, 4 hauls were conducted in SD 28.2, 8 hauls in SD 29 and 2 hauls in SD 32.

The length measurements (in 0.5 cm classes) were realized for totally 2919 sprat and 3276 herring individuals. Totally, 387 sprat and 619 herring individuals were taken for biological analysis.

Acoustic data were collected using the EK-60 echo-sounder equipped with “Echo-view V4.10” software for the data analysis. The acoustic equipment was calibrated at sea in the Gulf of Gdansk before the survey, according to the methodology described in the IBAS manual (ICES, 2017). The basic acoustic and biological data collected during recently carried out BASS were delivered to the TUEMI laboratories for further elaboration. Next they will be stored in the BASS_DB.mdb and the new acoustic data base WKBIFS-ACOU in the accepted CSV or XML formats, managed by ICES.

The rosette sampler with connected CTD Seabride 911+ probe were used for hydrological sampling,

Data analysis

The MYRIAX “EchoView v.10.0” software was used for the analysis of the acoustic data.

The total number of fish in each the ICES rectangle was estimated as a product of the mean NASCs from scrutinized acoustic data and a rectangle area, divided by corresponding mean acoustic cross-section (σ) which is based on the trawl catch results. The abundance of clupeids was separated into sprat and herring according to the mean catch composition.

Mean target strength (TS) – one of the principal acoustic parameter – of clupeids was calculated according to following formula:

$TS = 20 \log L – 71.2$

Due to fortunate weather conditions, all transects and planned trawls were conducted according to the plan.

Catch results and fish measurements

Overall, 7 fish species were identified in hauls performed at the North-eastern Baltic Sea (SDs 28.2, 29 and 32 West) in May 2019. Sprat and herring dominated in the catches in Estonian EEZ. Sprat amounted for 46.1%, while herring – 52.1%. With respect to ICES Sub-divisions, sprat dominated in SD 28.2 – 61%, while herring in SDs 29 and 32, respectively 59.6% and 61.5%. The other 5 fish species recorded (cod, flounder, three-spined stickleback, smelt and lumpfish) represented only about 1.8% of the total mass on average.

The detailed catch and CPUE results are presented in the Table 1 and Fig. 2. The biological sampling is shown in Table 2.

Mean CPUE for all species in the investigated area in May 2019 amounted for 320.7 kg/h (comparing to 619.6 and 630.6 kg/h in the same period in 2018 and 2017, respectively).

The highest value of CPUE for sprat was observed in SD 28.2 (220.7 kg/h) and the lowest in SD 32 (57.1 kg/h). In SD 29 mean value of CPUE for sprat amounted for 146.7kg/h. Highest values of CPUE for herring in SD 29, 28.2 and 32 amounted for 217.7 kg/h, 137.5 kg/h, and 112 kg/h, respectively. Mean values of CPUE for cod and three-spined stickleback amounted for 3.9 kg/h and 1.5 kg/h, respectively.

The length distributions of sprat, herring and three-spine stickleback according to the ICES Sub-divisions 28.2, 29 and 32 are shown on Fig. 3-5.

The sprat length distribution curves represent similar character in three investigated SDs. First length frequency peak was observed at 9 cm length class (9%, 5%, 4% of all measured sprats in SD 28.2, 29, 32 respectively). Second length frequency peak for SD 28.2 and SD 29 was observed at 10,5 cm length class (17% and 22% of all measured sprats, respectively). Second length frequency peak for SD 32, representing adult sprat, was observed at 11 cm length class and amounted for 25% of all measured sprats.

Herring length distribution curves by Sub-divisions show generally one frequency peak at 15.5 cm length class (15,2%, 17%, 21% of all measured herring in SD 28.2, 29, 32, respectively). The length distribution of three spine stickleback was in range 2-8 cm with modal length at 6 cm length class, taking into account all investigated area. The length range of cod was between 18 and 49 cm with modal length 21 cm length class.

Acoustic results

The survey statistics concerning the survey area, the mean NASC, the mean sigma, the estimated total number of fish, the percentages of herring and sprat per ICES statistical rectangles are presented in Table 3. Overall fish abundances were similar to that in 2018 with higher values around island Hiiumaa.

Abundance and biomass estimates

The estimated abundances of herring and sprat by age group and Sub-division/ICES statistical rectangle are given in Table 4. The estimated biomass by age group and Sub-division/ICES statistical rectangle is shown in Table 5. Corresponding mean weights by age group and Sub-division/ICES statistical rectangle are summarized in Table 6.

Sprat abundance was about 27% lower compared to previous year and concentrations were evenly distributed through survey area. Average weights were higher than the 2018 results. Abundance of herring was almost twice as low as in the previous survey and average weights were slightly lower.

Meteorological and hydrological characteristics

In total 14 control catches (Fig. 1) were inspected with the CTD-probe combined with the rosette sampler. Oxygen content was determined by the standard Winkler's method. The CTD row data aggregated to the 1- m depth stratum. The oxygen probes ware taken on every 10 meter intervals, and at the depth of catch.

The wind force varied from 1.1 m/s to 12.6 m/s and the average force was 6,6 m/s. The most often wind direction was WSW. The air temperature ranged from 6,8 °C to 12,2 °C, and average temperature was 9,4 °C (Fig. 6).

The seawater temperature in the surface layers (Fig. 7) varied from 7.45 to 9.79 °C (the mean was 8.71°C). The lowest surface temperature was recorded at the haul No 3. The highest one was noticed at the haul No 9. The minimum value of salinity in Practical Salinity Unit (PSU) was 5.99 at the haul No 3. The maximum was 7.12 PSU at the haul No 14. The mean value of salinity was 6.50 PSU. The oxygen content in the surface layers of investigated area varied in the range of 7.19 ml/l (haul No 8) - 8.72 ml/l (haul No 9). The mean value of surface water oxygen content was 8.03 ml/l.

The temperature of near bottom zone (Fig. 8) was in the range from 3.64 °C (haul No 14) to 6.91 °C (haul No 13), the mean value was 5.81 °C. Salinity in the bottom waters varied from 7.55 (haul No 14) to 11.48 PSU (haul No 12), and the mean value was 10.55 PSU. Oxygen content varied from 0.00 ml/l (haul Nos. 2, 4, 5, 6 and 8) to 6.43 ml/l (haul No 11), the mean value was 1.51 ml/l.

The final report from the EST-POL BASS 2019 will be presented at the meeting of the ICES Baltic International Fish Survey Working Group (WGBIFS) at March 30 - 03 April, 2020 in Cadiz (Spain)

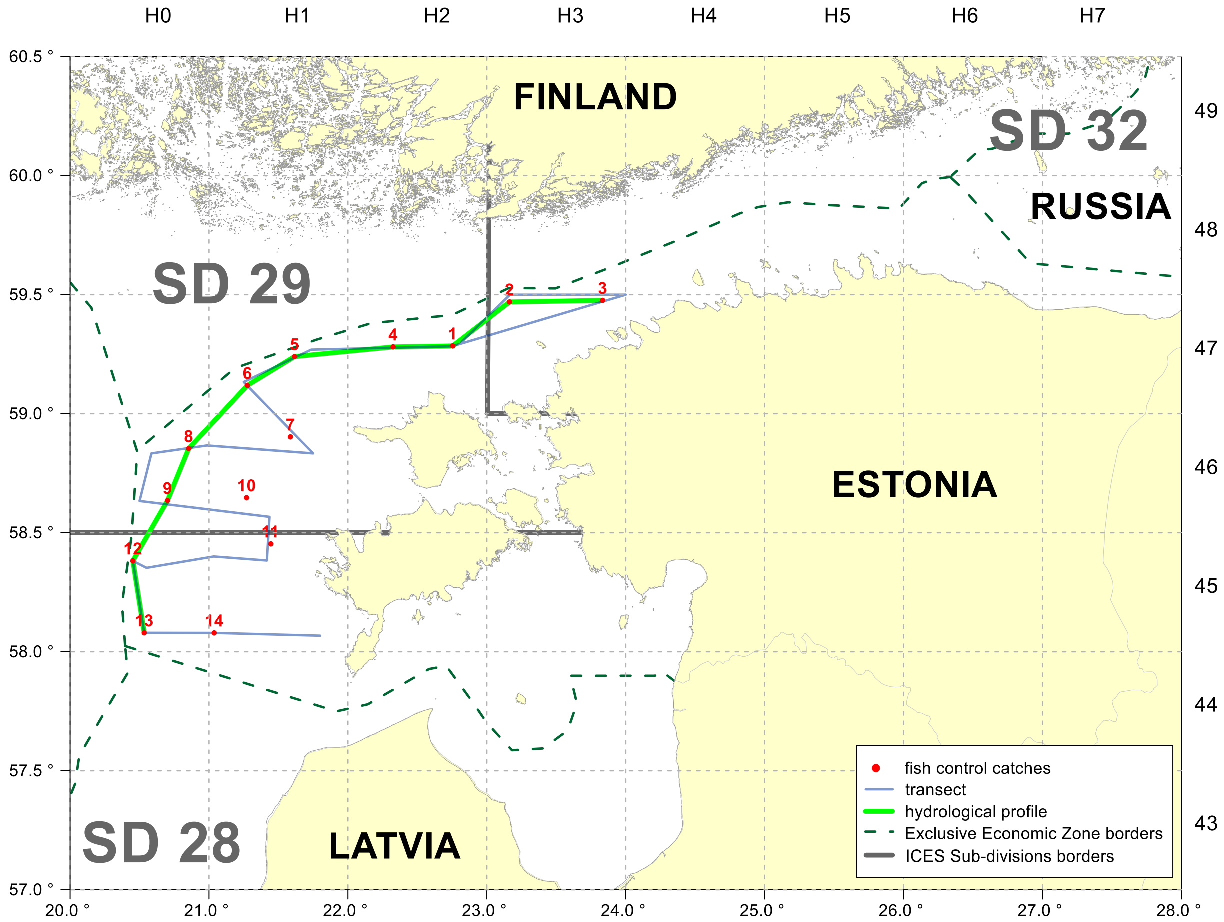

Fig. 1. Acoustic transects and pelagic fish control catches with connected hydrological stations realised during the joint EST-POL BASS (May 2019).

Table 1. Catch results during joint Estonian-Polish BASS conducted by r.v. “Baltica” in the Estonian EEZ in May 2019.

Haul No	Date of catch	ICES rectangl	ICES Sub-div.	Depth to fishing trawl [m]	Depth to the bottom [m]	The ship's course during fishing [°]	Geographical position of the catch station				Time of		Haul duration [min.]	Total catch	all species CPUE [kg/h]	CATCH of particular fish species [kg]						
							start		end													
							latitude 00°00' N	longitude 00°00'E	latitude 00°00' N	longitude 00°00'E	shutting net	pulling up net				sprat	herring	cod	flounder	three-spined stickleback	lumpfish	smelt
1	2019-05-26	47H2	29	60	132	055°	59°17' 6	022°46′ 9	59°18′ 0	022°48′ 2	07:35	07:50	15	66,045	264,180	29,272	33,407	2,011	0,115	1,187		0,053
2	2019-05-26	47H3	32	65	91	090°	59°28' 4	023°11′ 5	59°28′ 5	023°13′ 3	10:25	10:45	20	90,26	270,780	26,08	59,393	3,96		0,81		0,017
3	2019-05-26	47H3	32	60	90	040°	59°29' 1	023°51′ 5	59°29′ 7	023°52′ 8	13:55	14:15	20	31,049	93,147	12,01	15,24	3,352	0,161	0,11		0,176
4	2019-05-27	47H2	29	65	118	040°	59°16' 9	022°21′ 1	59°17′ 0	022°22′ 5	08:15	08:30	15	344,694	1378,776	164,481	177,877	2,085		0,219		0,032
5	2019-05-27	47H1	29	65	106	270°	59°14' 4	021°35′ 7	59°14′ 5	021°33′ 9	12:30	12:50	20	87,484	262,452	26,572	59,216	1,277	0,181	0,221		0,017
6	2019-05-27	47H1	29	65; 15	140	145°	59°06' 5	021°17′ 4	59°05′ 3	021°19′ 0	15:15	15:45	30	87,624	175,248	47,005	37,533	0,724		2,362		
7	2019-05-27	46H1	29	40	64	145°	58°53' 7	021°34′ 7	58°52′ 4	021°34′ 1	18:10	18:40	30	14,535	29,07	5,69	8,35			0,495		
8	2019-05-28	46H0	29	60	122	345°	58°52' 1	020°50′ 8	58°53′ 6	020°50′ 0	07:25	07:55	30	42,68	85,36	3,713	35,984	2,515	0,387	0,081		
9	2019-05-28	46H0	29	51	90	000°	58°39' 1	020°42′ 4	58°40′ 7	020°42′ 7	12:10	12:40	30	377,257	754,514	97,351	275,364	4,352		0,19		
10	2019-05-28	46H1	29	60; 15	81	035°	58°39' 5	021°17′ 3	58°40′ 8	021°19′ 2	15:35	16:05	30	67,448	134,896	46,477	20,038	0,518		0,415		
11	2019-05-28	45H1	28	45	79	035°	58°26' 6	021°26′ 5	58°25′ 6	021°25′ 8	18:40	19:00	20	199,015	597,045	26,193	171,382	0,823		0,617		
12	2019-05-29	45H0	28	59	144	100°	58°22' 6	020°29′ 3	58°22′ 3	020°32′ 1	08:50	09:20	30	5,747	11,494	0,35	4,000	0,985	0,165	0,102	0,145	
13	2019-05-29	45H0	28	40;15	71	090°	58°04' 5	020°33′ 5	58°04′ 4	020°36′ 5	12:35	13:05	30	83,076	166,152	74,758	6,915			1,403		
14	2019-05-29	45H1	28	41	64	095°	58°04' 5	021°04′ 3	58°04′ 3	021°06′ 7	15:25	15:55	30	374,147	748,294	303,269	69,859			0,822	0,197	
												Total catch [kg]	SD 28.2	661,985	361,148	404,57	252,156	1,808	0,165	2,944	0,342	0
													SD 29	1087,767	326,333	420,561	647,769	13,482	0,683	5,17	0	0,102
													SD 32	121,309	182,146	38,09	74,633	7,312	0,161	0,92	0	0,193
													Total	1871,061	320,755	863,221	974,558	22,602	1,009	9,034	0,342	0,295

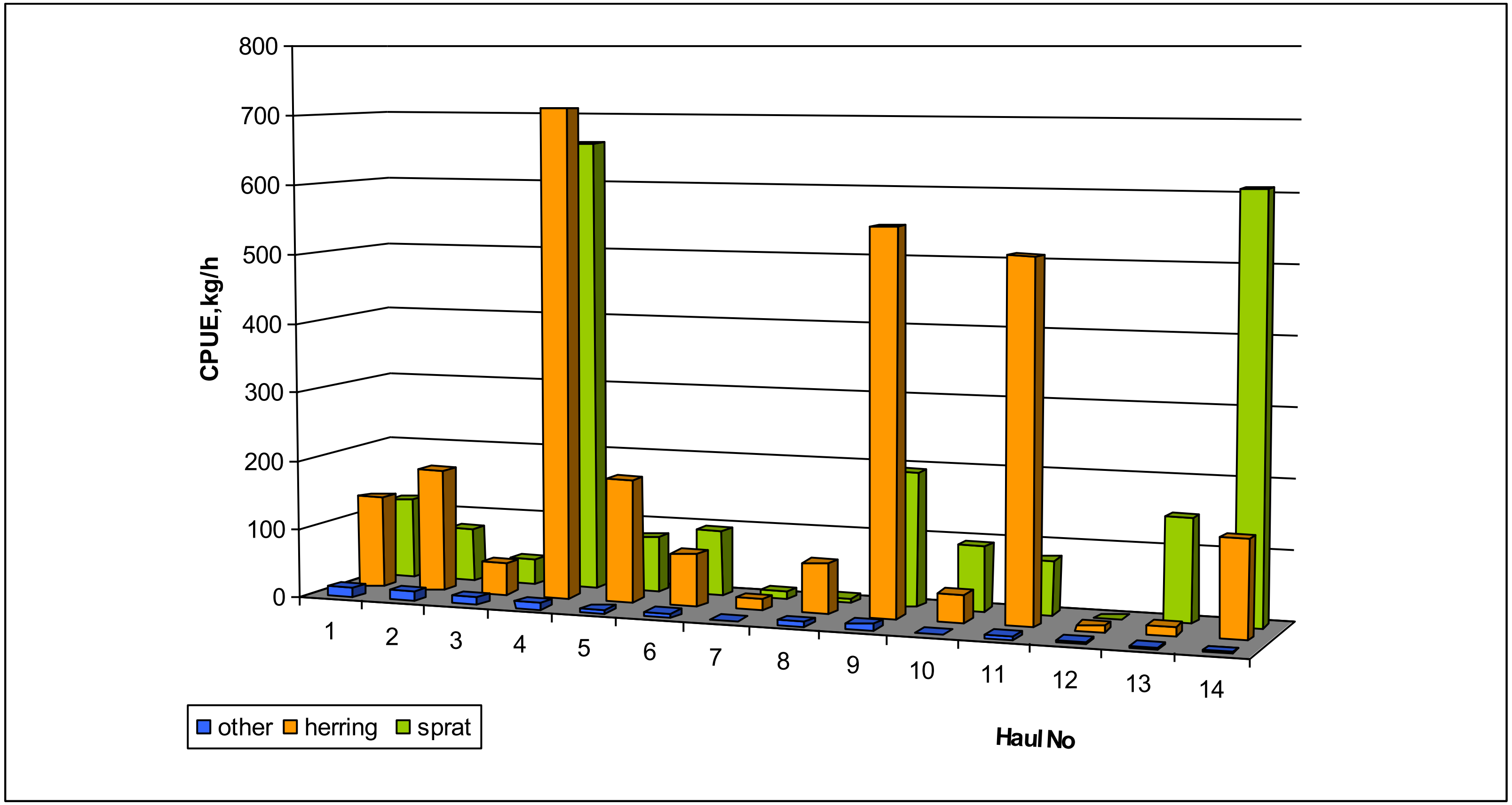

Fig. 2. CPUE values (kg/h) of sprat and herring in particular pelagic fish control catches during the joint EST-POL BASS in the North-eastern Baltic Sea (Sub-divisions 28.2, 29 and 32), May 2019.

Table. 2. Biological sampling in the r.v."Baltica" joint EST-POL BASS in May 2019.

SD 28		SPRAT	HERRING	COD	FLOUNDER	LUMPFISH	THREE- SPINED STICKLEBACK	SMELT	TOTAL
Samples taken	measurements	4	4	2	1	2	4		17
	analyses	4	4						8
Fish measured		700	755	8	2	2	179		1646
Fish analysed		122	196						318

SD 29		SPRAT	HERRING	COD	FLOUNDER	LUMPFISH	THREE- SPINED STICKLEBACK	SMELT	TOTAL
Samples taken	measurements	8	8	7	3		8	3	37
	analyses	8	8						16
Fish measured		1760	1975	47	5		262	3	4052
Fish analysed		146	250						396

SD 32		SPRAT	HERRING	COD	FLOUNDER	LUMPFISH	THREE- SPINED STICKLEBACK	SMELT	TOTAL
Samples taken	measurements	2	2	2	2		2	2	12
	analyses	2	2	0	0	0	0	0	4
Fish measured		459	546	16	1		120	12	1154
Fish analysed		119	173	0	0	0	0	0	292

SUM		SPRAT	HERRING	COD	FLOUNDER	LUMPFISH	THREE- SPINED STICKLEBACK	SMELT	TOTAL
Samples taken	measurements	14	14	11	6	2	14	5	66
	analyses	14	14	0	0	0	0	0	28
Fish measured		2919	3276	71	8	2	561	15	6852
Fish analysed		387	619	0	0	0	0	0	1006

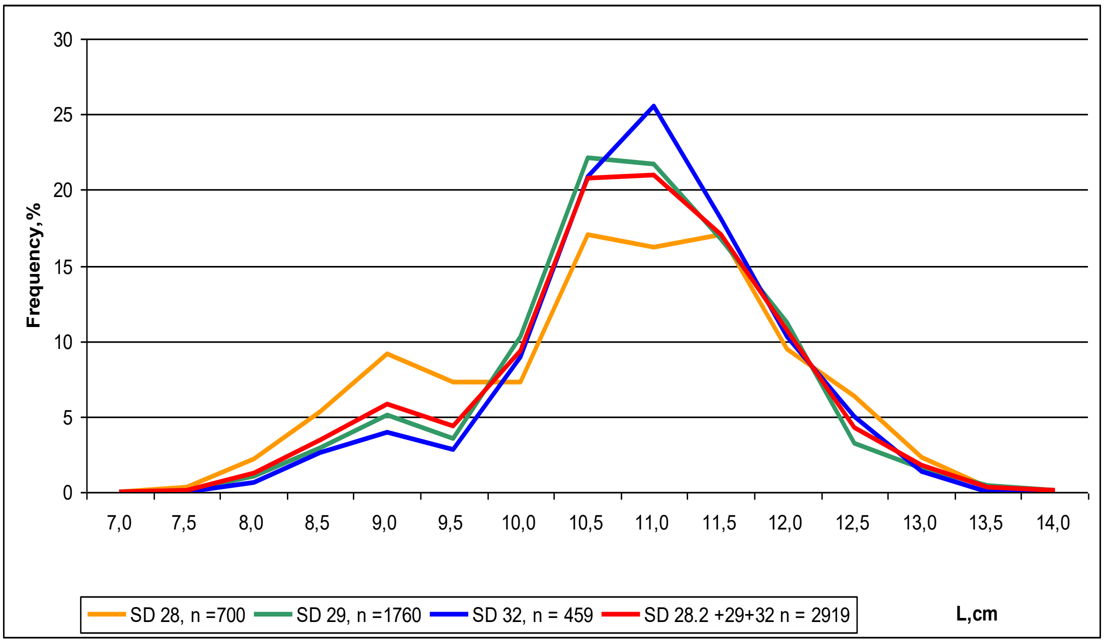

Fig. 3. Sprat length distributions from the control catches conducted by the r.v. "Baltica" during joint EST-POL BASS in the SDs 28.2, 29 and 32 (May 2019).

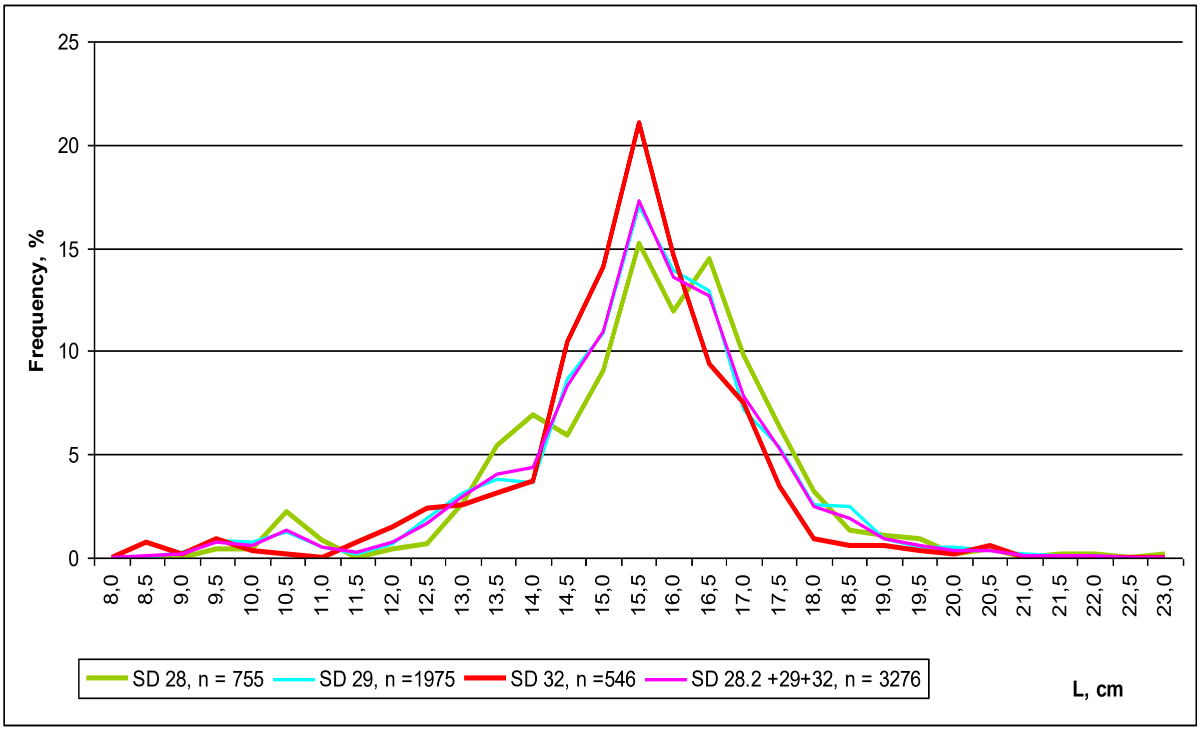

Fig. 4. Herring length distributions from the control catches conducted by the r.v. "Baltica" during joint EST-POL BASS in the SDs 28.2, 29 and 32 (May 2019).

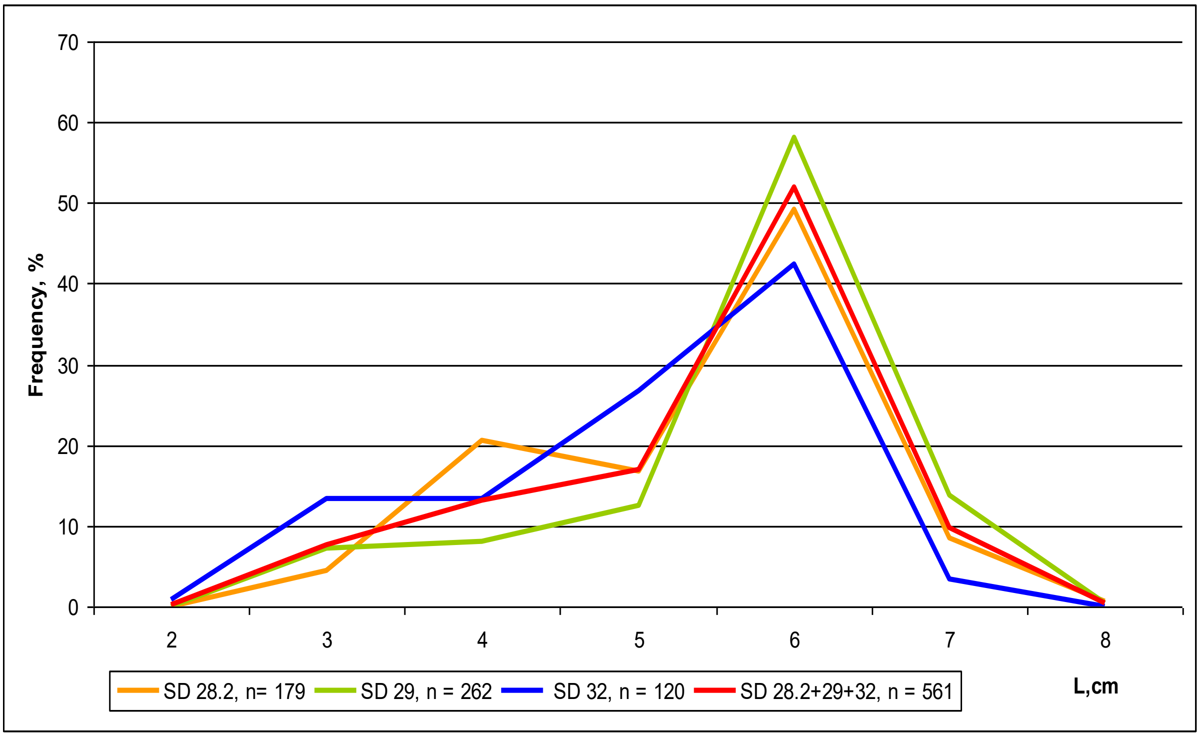

Fig. 5. Three spined stickleback length distributions from the control catches conducted by the r.v. “Baltica” during joint EST-POL BASS in the SDs 28.2, 29 and 32 (May 2019).

Table 3. The BASS survey basic biological and acoustic data concerning the clupeid stocks inhabiting the north- eastern Baltic Sea in May 2019.

ICES Sub-div.	ICES rectangle	Area [NM^2]	Share [%-indiv.]		Total abundance [x10^6]	Abundance density [10^6/NM^2]	NASC [m^2/NM^2]	σ [cm^2]
			herring	sprat				
28	45H0	947.2	31.9	54.1	1465.73	1.547	266.5	1.722
28	45H1	827.1	34.9	62.7	1158.61	1.401	218.1	1.557
29	46H0	933.8	62.4	36.4	1392.94	1.492	302.4	2.027
29	46H1	921.5	20.4	70.3	3353.93	3.640	482.3	1.325
29	47H1	920.3	32.0	61.7	2517.19	2.735	405.5	1.482
29	47H2	793.9	28.4	65.0	2655.99	3.345	493.4	1.475
32	47H3	536.2	37.6	57.3	1881.14	3.508	571.0	1.627
Average			**35.4**	**58.2**		**2.524**	**391.3**	**1.602**
Total		**5880**			**14426**			

Table 4. Abundance (in 10^6 indiv.) of herring and sprat per age groups according to the ICES rectangles and Sub-divisions of the north-eastern Baltic in May 2019.

ICES Sub-div.	ICES rectangle	HERRING – age groups								
		1	2	3	4	5	6	7	8+	total
28	45H0	10	43	52	30	194	11	72	57	468
28	45H1	8	46	57	32	177	8	41	35	405
total		18	89	109	61	371	19	113	92	872
29	46H0	42	48	71	136	279	25	158	111	869
29	46H1	29	20	65	118	239	17	115	80	683
29	47H1	25	101	91	123	253	20	115	77	805
29	47H2	11	43	108	148	271	17	101	56	754
total		105	212	335	524	1042	79	489	324	3110
32	47H3	14	54	66	99	285	106	60	23	708
total		14	54	66	99	285	106	60	23	708
Grand total		138	355	510	684	1698	204	662	440	4691

Table 4. Continued

ICES Sub-div.	ICES rectangle	SPRAT – age groups								
		1	2	3	4	5	6	7	8+	total
28	45H0	60	221	72	76	267	41	14	43	793
28	45H1	230	187	44	44	160	28	6	26	726
total		289	409	117	120	427	69	20	69	1520
29	46H0	41	160	28	39	179	36	3	21	507
29	46H1	330	934	99	135	690	112	7	52	2359
29	47H1	206	588	65	90	470	80	8	48	1553
29	47H2	77	597	101	137	617	123	6	68	1726
total		653	2279	293	401	1956	351	24	188	6145
32	47H3	77	310	55	63	472	20	35	47	1079
total		77	310	55	63	472	20	35	47	1079
Grand total		1020	2997	465	584	2855	440	79	304	8743

Table 5. Biomass (in tons) of herring and sprat per age groups according to the ICES rectangles and Sub-divisions of the north-eastern Baltic in May 2019.

ICES	ICES	HERRING – age groups								
Sub-div.	rectangle	1	2	3	4	5	6	7	8+	total
28	45H0	328	1667	625	760	2432	403	158	430	6803
28	45H1	1112	1377	398	447	1504	286	76	281	5480
total		1441	3043	1023	1207	3937	689	234	710	12283
29	46H0	180	1131	248	355	1580	343	32	224	4093
29	46H1	1428	6490	876	1239	6019	1078	85	582	17797
29	47H1	832	4083	568	811	4054	774	93	522	11738
29	47H2	322	4053	834	1161	5151	1075	66	675	13337
total		2762	15758	2525	3566	16804	3270	276	2004	46965
32	47H3	290	1991	417	500	3926	189	317	472	8102
total		290	1991	417	500	3926	189	317	472	8102
Grand total		4493	20792	3964	5272	24667	4148	826	3186	67350

Table 5. Continued

ICES	ICES	SPRAT – age groups								
Sub-div.	rectangle	1	2	3	4	5	6	7	8+	total
28	45H0	328	1667	625	760	2432	403	158	430	6803
28	45H1	1112	1377	398	447	1504	286	76	281	5480
total		1441	3043	1023	1207	3937	689	234	710	12283
29	46H0	180	1131	248	355	1580	343	32	224	4093
29	46H1	1428	6490	876	1239	6019	1078	85	582	17797
29	47H1	832	4083	568	811	4054	774	93	522	11738
29	47H2	322	4053	834	1161	5151	1075	66	675	13337
total		2762	15758	2525	3566	16804	3270	276	2004	46965
32	47H3	290	1991	417	500	3926	189	317	472	8102
total		290	1991	417	500	3926	189	317	472	8102
Grand total		4493	20792	3964	5272	24667	4148	826	3186	67350

Table 6. Mean weight (in grams) of herring and sprat per age groups, according to the ICES rectangles of the north-eastern Baltic in May 2019.

ICES Sub-div.	ICES rectangle	HERRING – age groups								
		1	2	3	4	5	6	7	8+	avg.
28	45H0	6.45	15.72	21.10	23.63	26.22	28.85	29.55	33.50	25.55
28	45H1	7.47	15.77	21.29	23.24	24.64	27.74	28.68	27.98	23.46
29	46H0	6.32	13.15	18.56	22.29	23.09	25.18	26.92	29.75	22.84
29	46H1	6.88	13.81	18.30	21.89	22.63	24.98	26.00	29.29	22.58
29	47H1	5.23	12.51	17.36	21.29	21.46	23.80	26.38	29.80	20.91
29	47H2	4.94	11.48	16.97	19.62	19.75	21.89	23.27	25.84	19.62
32	47H3	4.50	11.31	15.59	17.70	19.82	22.54	26.18	30.99	19.50

Table 6, Continue

ICES Sub-div,	ICES rectangle	SPRAT – age groups								
		1	2	3	4	5	6	7	8+	avg.
28	45H0	5.51	7.53	8.65	10.05	9.11	9.84	11.59	10.02	8.58
28	45H1	4.85	7.35	8.95	10.09	9.38	10.10	12.17	10.86	7.54
29	46H0	4.41	7.06	8.70	9.00	8.84	9.61	11.51	10.78	8.07
29	46H1	4.33	6.95	8.87	9.20	8.73	9.65	11.71	11.12	7.54
29	47H1	4.05	6.95	8.75	9.05	8.63	9.65	11.85	10.96	7.56
29	47H2	4.18	6.79	8.25	8.44	8.34	8.74	10.86	9.99	7.73
32	47H3	3.74	6.43	7.56	7.98	8.32	9.36	8.98	10.12	7.51

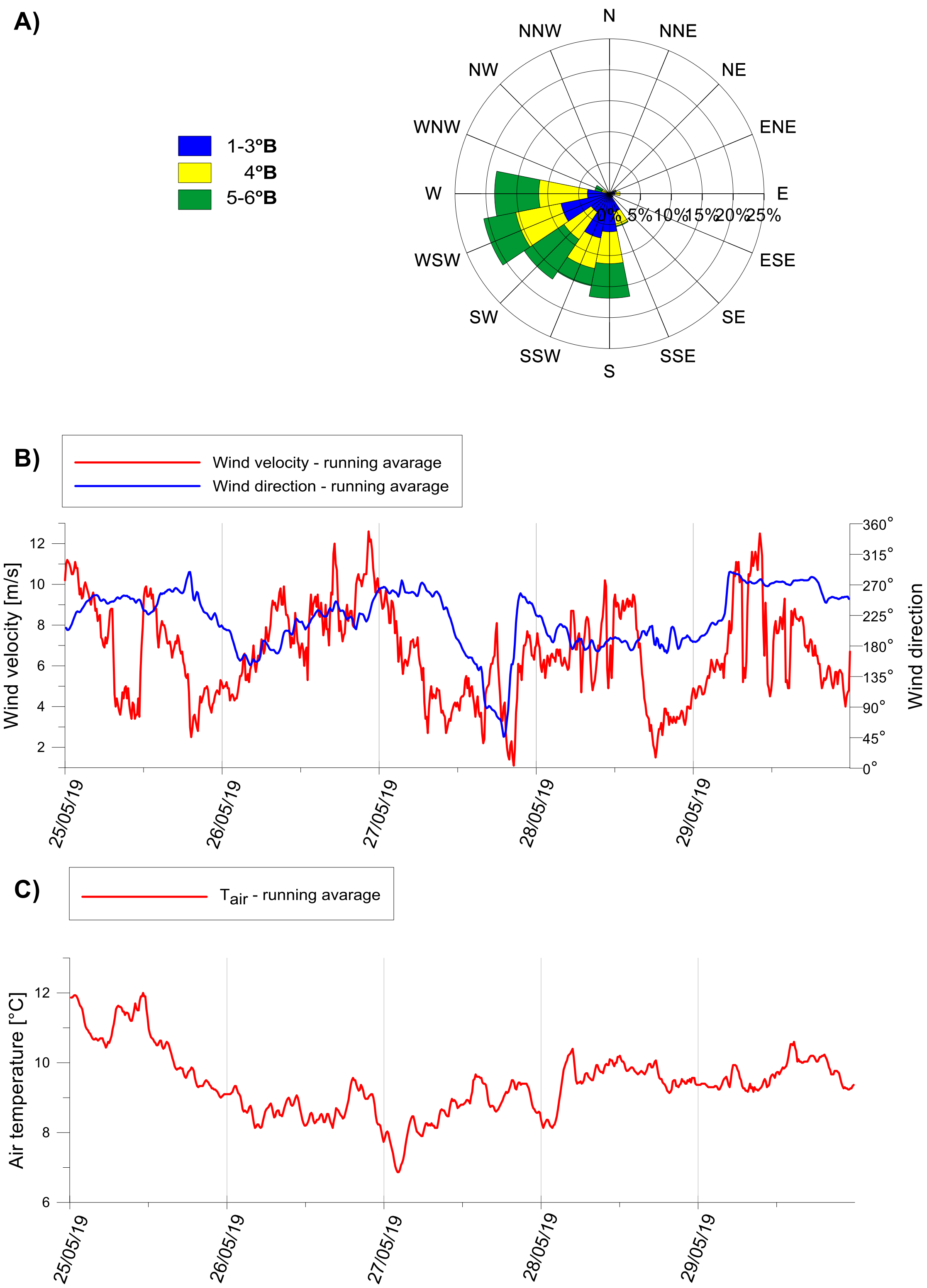

Fig. 6. Changes of the main meteorological parameters during the joint EST-POL BASS conducted in May 2019 (A and B – wind direction and velocity, C – air temperature).

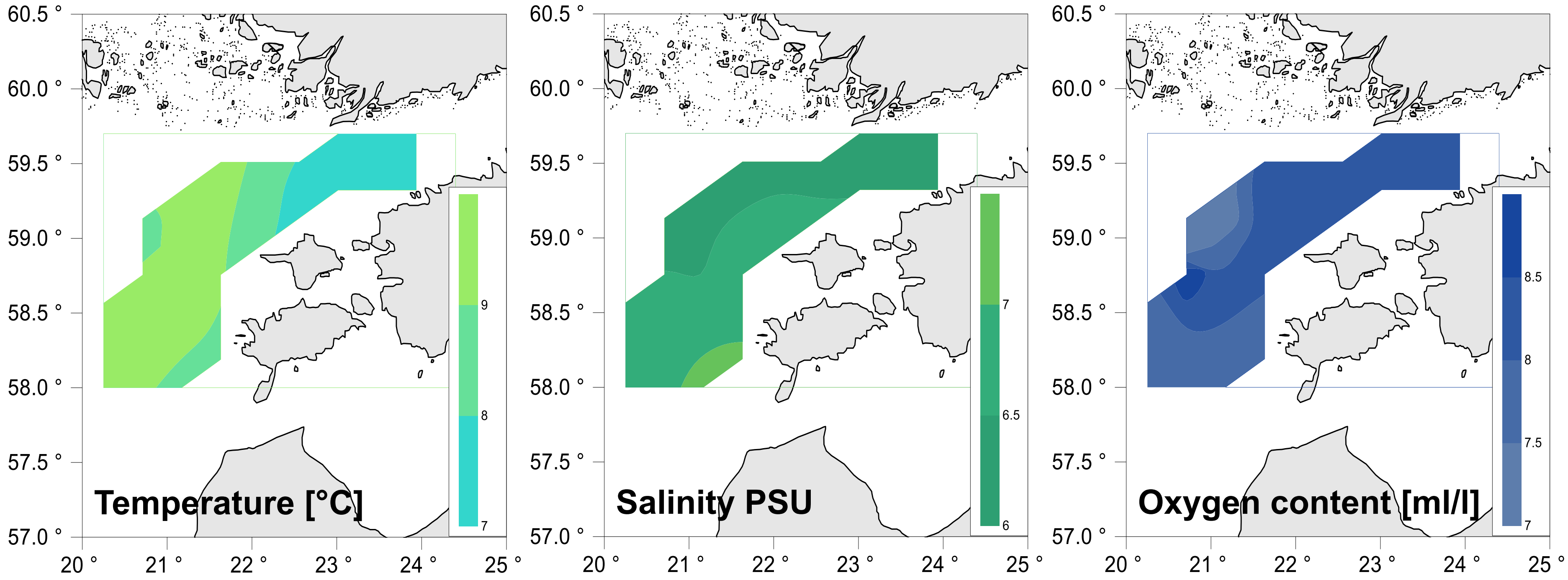

Fig. 7. Horizontal distribution of the seawater temperature, salinity and oxygen content in the surface waters during the joint EST-POL BASS (May 2019)

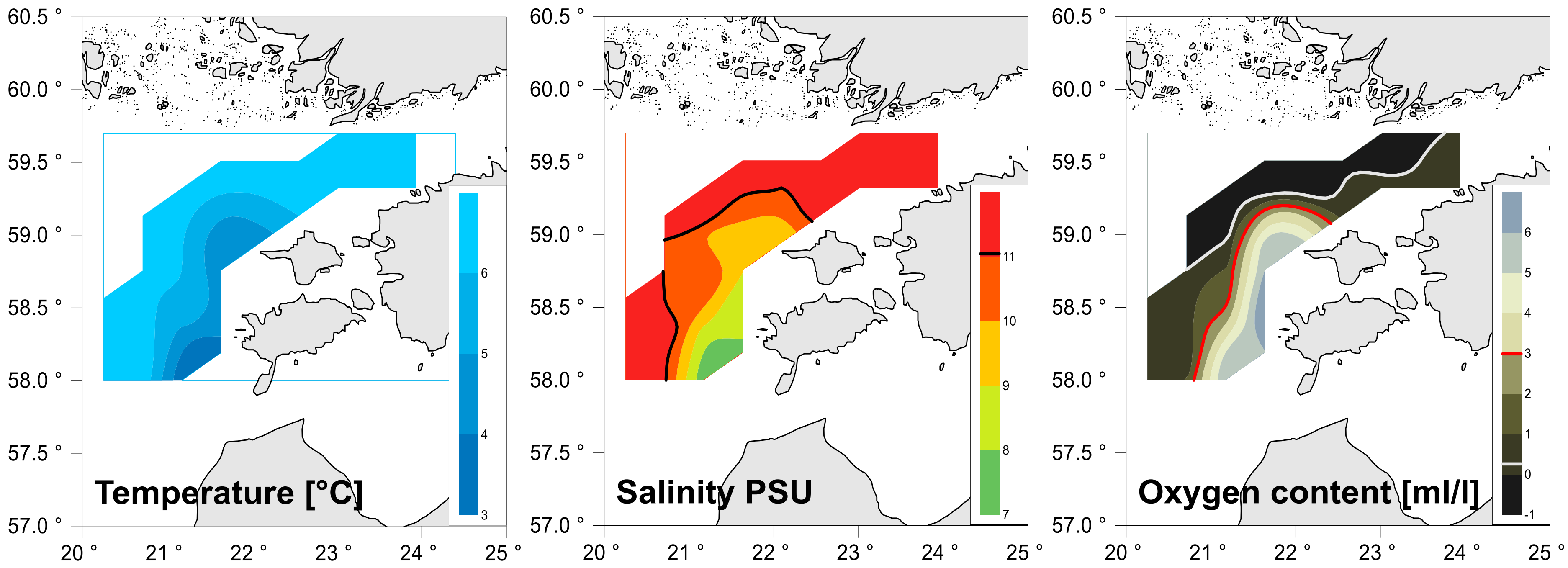

Fig. 8. Horizontal distribution of the seawater temperature, salinity and oxygen content on the control catch depth during the joint EST-POL BASS (May 2019)

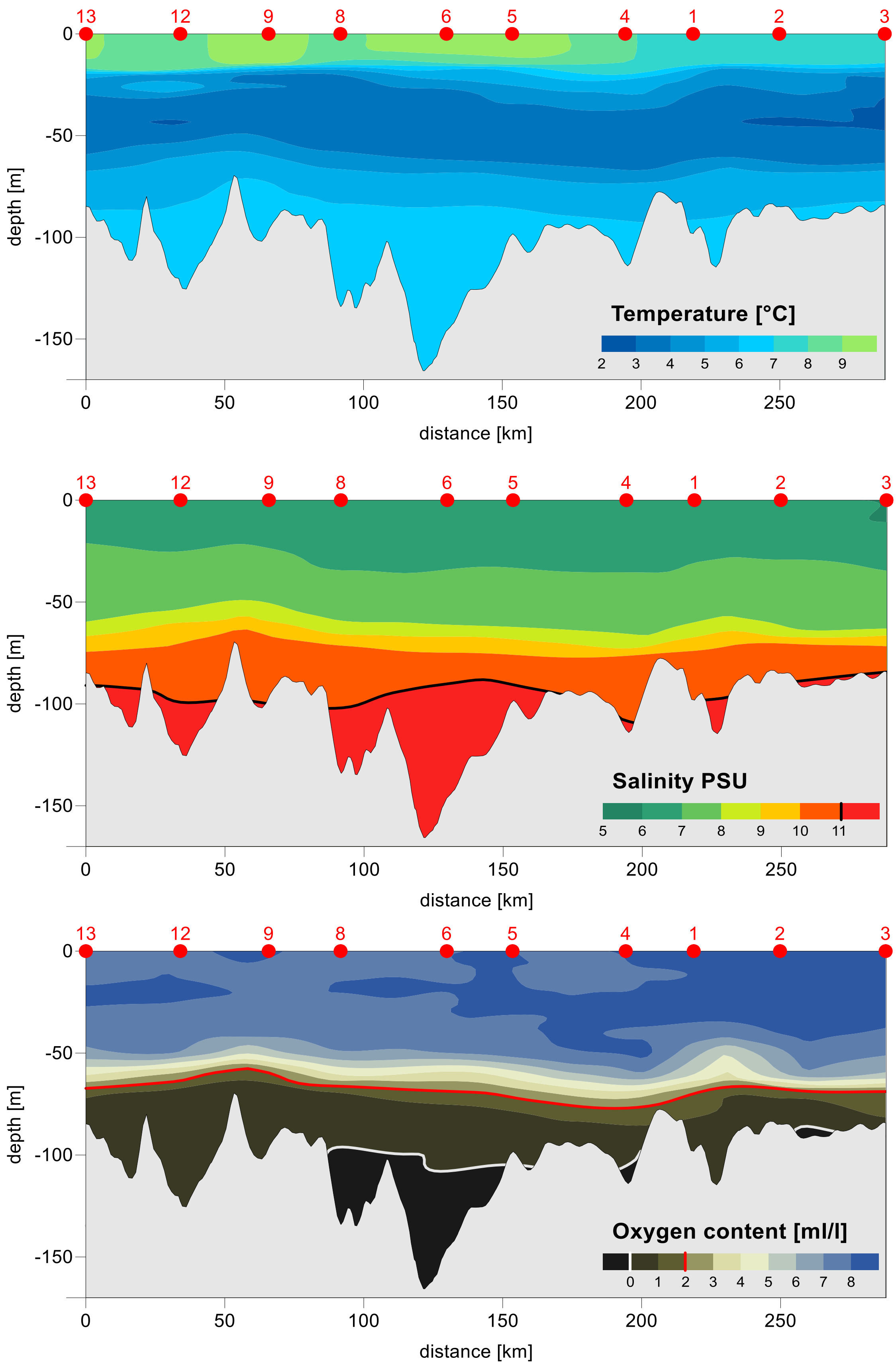

Fig. 9. Vertical distribution of the seawater temperature, salinity and oxygen content along the hydrological profile during the joint EST-POL BASS (May 2019).

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Cruise Report FRV "Solea II" Cruise 761
03.05. – 28.05.2019

Hydroacoustic survey for the assessment of small pelagics in the Baltic Sea

Scientist in charge: Paco Rodriguez-Tress (TI-OF)

Summary

1. Introduction

Cruise no. 761 of the FRV "Solea II" was conducted as part of the annual ICES Baltic International Acoustic Spring Survey (BASS). The main objective of this hydroacoustic survey is the yearly assessment of small pelagic fishes stock, especially sprat, in the Baltic proper. BASS is co-ordinated at the international level by the ICES Baltic International Fish Survey Working Group (WGBIFS) where timing, surveying area and the principal methods of investigations are discussed and decided. German investigation area in 2019 covered ICES subdivisions 24, 25, 26, 27, 28 and 29. Other areas in the Baltic Sea were covered by Lithuania, Latvia, Estonia and Poland.

2. Cruise narrative and methods

2.1. Narrative

The FRV "Solea II" departed from Cuxhaven harbour the 3rd May in the morning, subsequently crossing the Kiel Channel in direction of Kiel harbour where the scientific team boarded the ship. The ship left Kiel harbour the 4th May in the early morning. Due to good weather conditions the 4th May, the day was used to calibrate the echosounder in the Kiel bight after what the ship steamed to the survey area.

Acoustic recording for the BASS started in the morning of the 5th May after reaching the area of investigation in ICES subdivision 24. Despite minor technical problems with the Ek80 software, the first days of cruise were completed according to the objectives of the survey. The main net broke while fishing close to the ground (station 250/79) in the afternoon of the 11th and the spare net was then used as replacement until the next afternoon. Due to the long-time at sea and good progress of the survey a two days break was done the 18th and 19th May in the harbour of Visby, Gotland. The survey was then resumed the 20th in the morning and went uninterrupted until the 25th when all transects required for the BASS were covered. Due to bad weather at sea during the last days of survey the two additional transects east of Gotland were cancelled in favour of the last remaining priority transect in SD 25. The ship then took shelter from the wind close to the coast of Bornholm for the day the 26th. The day of the 27th was used to redo part of the transect conducted the 7th May , as no fish catches had been previously made in rectangle 38G4, and to extend the survey in the rectangle 37G4. This rectangle was historically avoided during this survey as the overall shallow waters limit acoustic recording and fishing operation in this area. Once more, the shallow depth didn't allow conducting fishing operation. A map summarizing the daily transects performed is presented Figure 1.

The cruise ended the 28th May after a total of 21 days of hydroacoustic monitoring when scientists disembarked in the morning in the harbour of Marienehe, Rostock.

2.2. Hydrography

A Seabird-CTD-probe equipped with a carousel water sampler and oxygen sensor was used for hydrographical measurements. Vertical profiles were taken on a fixed station grid along the track. Additional CTD casts were done after or before each trawl if distance from the planned station was high enough (ca. 5 nmi). The profiles covered the entire water column to about 2 m above the sea bottom except on the deepest station were the cable length of the ship was limited to ~320 m. Water samples were taken once per day from different depths to check the oxygen data by Winkler titration and to collect reference salinity samples. The hydrological raw data were aggregated to 1 m depth strata. Altogether 237 CTD casts were performed during the cruise.

2.3. Echosounder calibration and hydroacoustic sampling

The Solea II is equipped with four Simrad EK80 wideband echosounders (34-45, 45-90, 90-160 and 160-260 kHz). Although the BASS was done with a narrowband, 38 kHz frequency setting (pulse length = 1024 µs; pingrate = 500 ms) each transducer were calibrated at a pulse length of 1024, 512 and 256 µs in narrow and broadband mode. Calibration procedure itself was carried out as described in the "Manual for International Baltic Acoustic Surveys (IBAS)" (ICES 2017).

In addition to the standard recording at 38 kHz along the transects, the echosounder was usually set in frequency modulated (FM) mode with a frequency band ranging from 34 to 260 kHz while fishing to gather fish-frequency response data of the catches. As this setting is non-standard for this survey these wideband acoustic data were discarded from the final analysis for the BASS. To avoid having portions of the acoustic transects empty of recording because of the fishing operation, trawling was usually done by going backward on the track whenever time permitted it.

The acoustic and ichthyologic sampling stratification was based on ICES statistical rectangles (0.5 degree in latitude and 1 degree in longitude). The daily surveyed distance amounted to approximately 90-100 nautical miles with an objective of 60 nautical miles per statistical rectangle. In general each ICES-rectangle was covered with two parallel transects spaced by a maximum of 15-18 nm whenever possible. Ship's speed was 10 knots during acoustic measurements while fishing operation were conducted at 3 to 3.5 knots. The standard acoustic investigations and the fishing hauls were carried out at daylight from 4:00 - 19:00 UTC (6:00 and 21:00 local time; see Table 1).

With the exception of rectangle 43G8 (SD 28) where fishing license were not granted all rectangles assigned to German investigation in subdivisions 24 to 29 were covered by hydroacoustic transects. For some rectangles, due to time or spatial constrain the total hydroacoustic track length was however lower than the recommended 60 nautical miles (see Table 2). Absence of licence delivery for some specific planned station in the Swedish EEZ or military exercise also forced some track changes (rectangle 42G8 and 46G8 respectively, see Figure 1).

In total, out of 1845 nmi of acoustic track 1388 nmi laying in the survey area were deemed valid and used in the further biomass estimation analysis.

2.4. Biological sampling

Trawling was done with the pelagic gear "PSN388" in the midwater as well as near the bottom to identify the echo signals. The aim was to conduct at least two fishing hauls per ICES statistical rectangle. The trawling time lasted usually 30 minutes at a speed of 3 to 3.5 knots. The fishing time was however decreased in case of abundant echo observed with the Scanmar-net-probe. In accordance to the IBAS manual cod end inlets with stretched 20 mm mesh sizes in Subdivision 24 and 12 mm in Subdivision 25 to 28 were used.

The trawling depth and the net opening were controlled by a Scanmar-net-probe. Generally the net opening was of circa 8 m when deployed. The trawl depth (headrope below the surface) was chosen regarding highest density of fish on the echogram and ranged from 9 m to 81 m. The bottom depth at the trawling positions varied from 20 m to 459 m.

Samples were taken from each hauls in order to determine the length and weight distribution of fish. Sub-samples of cod, herring and sprat were done to investigate sex, maturity and age of the catches. Samples of whole fishes and parts of different organs/tissues were also taken for later investigations in the laboratory. Detailed biological analyses were made according to the standard procedure (i.e. sex, maturity, otolith dissection).

In total 68 standard hauls were (67 valid) carried out for the BASS :

Subdivision	Hauls (n)
24	11
25	24
26	4
27	6
28	14
29	9

Altogether 31,102 fish were measured and 2,197 additional fish (652 sprats, 1,352 herrings and 193 cods) were sampled for further age determination

2.5. Data analysis

The pelagic target species sprat and herring are usually distributed in mixed layers and in combination with other species so that the echo integration readings cannot be allocated directly to a single species. Therefore, the species composition used for the conversion of echo integrals into fish abundance was based on trawl catch results accordingly. For each rectangle the species composition and length distribution was determined as the unweighted mean of all trawl results in this rectangle. In case of missing hauls within an individual ICES rectangle (due to gear problems or other limitations), hauls results from neighbouring rectangles was used.

From these distributions, the mean acoustic cross section σ was calculated according to the following target strength-length (TS) relations:

- Clupeids/*Gasterosteus aculeatus*: TS = 20 log L (cm) - 71.2 (ICES 1983)
- Gadoids: TS = 20 log L (cm) - 67.5 (Foote et al. 1986)

The total number of fish (total N) in one rectangle was estimated as the product of the mean nautical area backscattering coefficient (i.e. echo integral) (Sa in $m^2/n.mi.^2$) and the rectangle area ($n.mi.^2$), divided by the corresponding mean cross section. The total number of fish was separated into herring, sprat and cod according to the mean catch composition. In accordance with the guidelines in the 'Manual for the Baltic International Acoustic Surveys (ICES 2017)', the further calculation was performed in the following way:

With the exception of cod, species with an overall mean contribution to all sampled hauls of less than one percent are excluded from further total species frequency calculation.

Fish species considered in this report are thus (see results for catch statistics):

- *Clupea harengus*
- *Gadus morhua*
- *Gasterosteus aculeatus*
- *Sprattus sprattus*

Hauls with low level of catch and/or non-representative species compositions were excluded from analysis. This includes the following hauls:

- Haul n°8; 38G4/SD24: no catches
- Haul n°23; 41G6/SD25: codend damaged while fishing
- Haul n°27; 41G7/SD25: only 1.7 kg catch

Usage of neighbouring trawl information for investigated rectangles which contain only one or no haul:

- Haul n°1: 38G2/SD24 for 39G2/SD24
- Haul n°2: 39G2/SD24 for 38G2/SD24
- Haul n°3: 38G3/SD24 for 37G4/SD24
- Haul n°7: 38G4/SD24 for 37G4/SD24
- Haul n°10: 40G4/SD25 for 39G4/SD25

Final results will be compared to those of the BASS 2019 or other previous surveys when relevant.

3. Survey results

3.1. Hydrographic data

Measurements showed a regular stratification of the water column during the survey. Temperature, salinity and oxygen profile are represented in Figure 2. Seawater temperature ranged from 13.9 °C at the surface to 2.9°C (recorded at 39.5 m depth). At the deepest CTD recording of the survey (326.5 m) temperature was measured at 6.4°C. Overall intermediate water masses (depth ranging from 17.5 to 71.5 m) presented temperature below 4°C, which is considered as a temperature threshold limit for the distribution of sprat in the water column, while higher temperature were recorded above and below this stratum. Measured salinity ranged from 5.7 psu at the surface layer up to a maximum of 17.1 psu at the bottom of the Bornholm Basin. Regarding oxygen, concentration ranged from 4.9 to 11.0 $mL.L^{-1}$ in the intermediate water mass and dropped below 1 $mL.L^{-1}$ under this layer. Overall hypoxic conditions (<1.4 $mL.L^{-1}$) were observed below circa 60 m depth all along the survey. Few fish echo was usually observed under these conditions (Figure 3).

3.2. Acoustic data

The basic hydroacoustic results are given in Table 3 (survey area, mean Sa, mean scattering cross section σ, estimated total number of fish and percentage of herring and sprat per rectangle). The valid measured cruise track reached a distance of 1388 nautical miles. Overall mean NASC recorded through the survey is mostly comparable or higher, with the exception of SD 26, to previous year with a mean NASC across the water column of 596.1 m^2/nm^2 versus 439.2 m^2/nm^2 in 2018 where a similar ICES rectangles were covered. On an ICES subdivision scale the mean NASC per subdivision were relatively comparable to those recorded in the past 10 years with the exception of SD25 were values were the highest of the decade (Figure 4). Map of the echo distributions is shown in Figure 5.

3.3. Biological data

Catch statistics per fishing hauls and species and subdivision are presented in Table 4 and Table 5 respectively. Overall 13 fish species were recorded in 68 pelagic trawl hauls. Dismissing the invalid hauls and all species included, the CPUE ranged from 5.0 to 905.3 kg/0.5h. The mean CPUE reached 208.1 kg/0.5h, notably higher than the value calculated in the 2018 survey (76.7 kg/0.5h) but. In terms of weight, catch was dominated by sprat (88.2%) followed by herring (9.6%) and stickleback (1.5%). Those three species were caught on the majority of the trawls through the survey, in respectively 62, 62 and 44 hauls. The numbers and biomass of species other than sprat, herring and stickleback was negligible.

Figure 6 show the length frequency distribution for sprat and herring per subdivision in 2018 and 2019. Overall, with the exception of herring in SD 27, length distribution of clupeids tended to be relatively similar than observed during the BASS 2018. Age distribution per length class is presented in Figure 7. Final age distribution by subdivision for 2019 (Figure 8) was calculated according to the minimum effort method by multiplying the length frequency distribution with the age distribution per length class as recommended in the IBAS Manual (2017: eq 5.3.1).

As shown in Figure 8, for herring and with the exception of SD 24 and SD 27, most of the individuals were in the 5 years age class. Incoming year class represented by 1 year old individuals was mostly present in SD 24 and SD 27. In comparison, for sprat most represented age class was globally the 4 year old individuals. As for herring though, incoming year class represented the bulk of the population in SD 27.

3.4. Abundance Estimate

The calculated abundance in number and weight of sprat and herring per rectangle and subdivision is presented in Table 6. Overall estimated abundances in all overlapping rectangle for herring and sprat are higher in 2019 compared to 2018 with respectively $6.90*10^9$ versus $3.99*10^9$ herrings (+72%) and $77.45*10^9$ versus $59.87*10^9$ sprats (+29%). Estimated biomass is also higher in 2019 for herring with $217.74*10^3$ tonnes versus $111.60*10^3$ tonnes estimated in 2018 (+95%). Estimated biomass of sprat was again higher in 2019 with $842.49*10^3$ tonnes versus $661.62*10^3$ tonnes in 2018(+27%).

Year	Species	n total (million)	total biomass (tonne)
2018	*Clupea harengus*	3990.1	111596.0
2019		6902.3	217742.1
2018	*Sprattus sprattus*	59867.5	661615.2
2019		77450.2	842492.0

4. Survey participants

Name	Function	Institution
M. Bachtiger	Fishery biology	TI-OF (student assistant)
A. Fiek	Fishery biology	TI-OF (student assistant
L. Hartkens	Acoustics	TI-SF
M. Koth	Fishery biology	TI-OF
N. Plantener	Fishery biology	TI-OF

P. Rodriguez-Tress	Cruise leader	TI-OF
S. Winning	Fishery biology	TI-OF (student assistant)

5. Acknowledgement

We hereby thank all participants, the crew of FRV "Solea" and Captain S. Meier for their outstanding cooperation and commitment.

6. Literature

ICES 1983: Report of the Planning Group on ICES co-ordinated herring and sprat acoustic surveys. ICES CM 1983/H:12.

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

Foote, K.G., Aglen, A. and Nakken, O. 1986. Measurement of fish target strength with a split-beam echosounder. Journal of the Acoustical Society of America, 80(2): 612-621.

7. Tables

Table 1: FRV "Solea" cruise 761/2019 BASS: Start and end time of hydroacoustic recording during the cruise.

Date	Recording start time (UTC)	Recording end time (UTC)	Date	Recording start time (UTC)	Recording end time (UTC)
05.05.2019	07:55	18:54	15.05.2019	04:00	17:39
06.05.2019	04:07	17:27	16.05.2019	04:11	17:29
07.05.2019	06:55	17:35	17.05.2019	03:07	15:39
08.05.2019	03:59	17:57	20.05.2019	03:59	16:34
09.05.2019	04:13	17:25	21.05.2019	04:16	17:11
10.05.2019	04:12	15:57	22.05.2019	03:57	17:17
11.05.2019	04:10	17:02	23.05.2019	04:07	16:58
12.05.2019	03:10	16:24	24.05.2019*	04:05	00:55
13.05.2019	04:15	19:11	25.05.2019	04:07	12:42
14.05.2019	04:12	18:10	27.05.2019	04:01	17:06

* additional recording on optional transect while steaming at night

Table 2: FRV "Solea" cruise 761/2019 BASS: Hydroacoustic track length per ICES rectangle.

Subdivision	ICES rectangle	Valid acoustic track length (nmi)	Subdivision	ICES rectangle	Valid acoustic track length (nmi)
24	37G3*	5	26	40G8*	20
24	37G4	20	26	41G8	64
24	38G2	19	27	42G7*	31
24	38G3	51	27	43G7*	30
24	38G4	83	27	44G7*	32
24	39G2	18	27	45G7*	22
24	39G3	61	27	45G8	50
24	39G4	60	27	46G8	57
25	38G5*	11	28	42G8	72
25	39G4	21	28	42G9	53
25	39G5	47	28	43G8	1
25	39G6*	31	28	43G9	72
25	40G4	48	28	44G9	61
25	40G5	50	28	45G9	56
25	40G6	52	29	46G9	57
25	40G7	58	29	46H0	34
25	41G6	64	29	47G9	60
25	41G7	70	29	47H0	29

*ICES rectangle not assigned to German investigation

Table 3: FRV "Solea" cruise 761/2019 BASS: Survey statistics of the cruise

Subdivision	Rectangle	area (nmi^2)	Sa (m^2/nmi^2)	sigma (m^2)(*10e-4)	n total (million)	*Clupea harengus* (%)	*Sprattus sprattus* (%)	*Gadus morhua* (%)
24	37G4	875.1	137.2	1.698	707.09	0.91	99.07	0.020
24	38G2	832.9	203.2	2.914	580.8	86.81	13.19	0.000
24	38G3	865.7	266.6	1.825	1264.63	10.89	89.11	0.000
24	38G4	1034.8	326.2	1.692	1994.99	0.85	99.13	0.020
24	39G2	406.1	76.1	2.914	106.05	86.81	13.19	0.000
24	39G3	765.0	223.9	2.991	572.67	67.53	32.45	0.020
24	39G4	524.8	591.4	1.759	1764.45	6.17	93.83	0.000
25	39G4	287.3	1681.0	1.553	3109.74	2.66	97.33	0.000
25	39G5	979.0	1087.3	1.435	7417.82	0.16	99.83	0.010
25	40G4	677.2	1496.3	0.725	4658.66	1.59	31.74	0.000
25	40G5	1012.9	927.7	1.284	7314.22	0.75	99.17	0.030
25	40G6	1013.0	1014.1	1.387	7405.42	2.51	97.43	0.040
25	40G7	1013.0	278.4	1.35	2077.55	0.47	98.98	0.000
25	41G6	764.4	664.4	1.166	3574.32	1.90	80.11	0.050
25	41G7	1000.0	419.6	1.465	2759.68	1.50	94.82	0.030
26	41G8	1000.0	611.3	1.806	3341.18	26.60	72.11	0.000
27	45G8	947.2	364.9	0.986	2909.42	7.04	75.94	0.020
27	46G8	884.8	607.7	0.894	4013.39	5.91	60.81	0.010
28	42G8	945.4	552.5	1.357	3839.43	1.79	97.94	0.010
28	42G9	986.9	683.4	1.289	5231.83	0.99	98.99	0.010
28	43G9	973.7	549.5	1.266	4171.2	2.65	96.02	0.020
28	44G9	876.6	424.7	1.282	2822.74	5.20	91.99	0.020
28	45G9	924.5	573.5	0.97	3029.33	8.48	46.94	0.000
29	46G9	933.8	409.1	1.148	2393.68	13.14	58.78	0.010
29	46H0	933.8	472.2	1.458	2833.49	21.36	72.22	0.110
29	47G9	876.2	551.1	0.747	2405.09	4.56	32.64	0.000
29	47H0	920.3	513.3	1.278	2778.09	33.36	41.78	0.010

Table 4: FRV "Solea" cruise 761/2019 BASS: Overall catch statistics per fishing haul.

Haul n°	Catch weight (kg)	Fish number (n)	CPUE (kg/0.5 hr)	Haul n°	Catch weight (kg)	Fish number (n)	CPUE (kg/0.5 hr)
1	8.63	218	17.26	37	129.7	15232	259.4
2	24.346	797	24.346	38	157.502	16317	236.253
3	87.337	6609	87.337	39	74.321	9058	63.7037143
4	126.982	4881	126.982	40	63.962	7363	63.962
5	24.653	499	24.653	41	86.99	10374	86.99
6	51.2	2198	76.8	42	39.237	4716	39.237
7	352.593	19946	705.186	43	43.868	4683	43.868
9	301.629	26704	904.887	44	78.058	7285	78.058
10	366.427	29345	732.854	45	14.928	6139	13.5709091
11	5.484	2861	5.484	46	86.996	20795	86.996
12	8.079	4569	16.158	47	126.271	13873	252.542
13	183.403	17593	366.806	48	93.669	9447	187.338
14	303.692	29164	303.692	49	81.313	8855	162.626
15	206.984	22745	413.968	50	148.244	16858	177.8928
16	299.409	30330	359.2908	51	144.557	15625	216.8355
17	308.046	38119	308.046	52	128.984	13473	193.476
18	407.606	45555	611.409	53	83.688	7574	125.532
19	333.283	32620	666.566	54	27.705	2479	27.705
20	263.172	25895	526.344	55	45.91	5098	68.865
21	394.992	50047	789.984	56	83.572	10889	125.358
22	211.252	22215	316.878	57	36.33	7017	43.596
24	227.648	32183	195.12686	58	28.518	4536	28.518
25	101.025	8968	94.710938	59	17.943	2744	21.5316
26	23.46	1981	23.46	60	57.828	9946	69.3936
28	43.569	3905	40.845938	61	40.296	6099	48.3552
29	24.225	2683	19.125	62	64.443	11520	77.3316
30	59.222	5214	50.761714	63	50.403	4699	50.403
31	2.512	73	5.024	64	58.738	4017	58.738
32	179.682	20046	359.364	65	156.603	14468	156.603
33	200.918	20835	401.836	66	121.86	6666	121.86
34	316.325	32494	632.65	67	154.483	11036	185.3796
35	210.78	20576	421.56	68	70.428	5591	60.3668571
36	223.427	24918	446.854				

Table 5: FRV "Solea" cruise 761/2019 BASS: Catch statistics per species. Values < 0.01 are indicated by a "-".

Species	No. of hauls with the species	No. Of length measurements	No. Of individaul measurements	Total catch (kg)	Percent of total catch weight	Overall mean contribution to all sampled hauls (%)
Ammodytes tobianus	1	1	0	-	-	-
Clupea harengus	62	12320	21593	813.28	9.58	18.96
Cyclopterus lumpus	3	3	0	0.68	0.01	0.01
Gadus morhua	30	193	8234	45.95	0.54	0.45
Gasterosteidae	1	1	0	-	-	-
Gasterosteus aculeatus	45	2340	0	132.39	1.56	7.95
Hyperoplus lanceolatus	4	79	0	1.23	0.01	0.15
Merlangius merlangus	9	45	0	4.50	0.05	0.05
Platichthys flesus	19	31	0	4.49	0.05	0.06
Scomber scombrus	1	1	0	0.28	-	-
Sprattus sprattus	62	16082	11988	7489.42	88.19	72.36
Trachurus trachurus	4	4	0	0.08	-	-
Zoarces viviparus	1	1	0	0.04	-	-

Table 6: FRV "Solea" cruise 761/2019 BASS: Total number and biomass of sprat and herring per rectangle.

Subdivision	ICES rectangle	n herring (million)	Herring biomass (tonne)	n sprat (million)	Sprat biomass (tonne)
24	37G4	6.44	413.48	700.51	11335.2525
24	38G2	504.16	27167.92	76.63	1345.18491
24	38G3	137.69	9056.39	1126.94	18180.762
24	38G4	16.99	1044.48	1977.63	31772.0385
24	39G2	92.07	4961.42	14.00	245.76
24	39G3	386.73	22165.91	185.82	3261.141
24	39G4	108.81	6465.90	1655.66	25814.1046
25	39G4	82.86	3167.63	3026.90	37395.1874
25	39G5	12.09	439.50	7405.30	88673.178
25	40G4	222.43	6764.37	4436.23	54983.9021
25	40G5	55.12	1884.97	7257.18	73805.5206
25	40G6	185.95	6210.27	7216.25	76768.8729
25	40G7	9.91	351.88	2067.64	21500.0099
25	41G6	82.57	2619.84	3489.46	36185.7002
25	41G7	43.03	1360.55	2715.92	33122.5843
26	41G8	900.35	28932.75	2440.69	25694.364
27	45G8	246.75	5713.80	2661.86	24390.2429
27	46G8	355.74	8355.00	3657.25	34184.8382
28	42G8	69.06	1863.93	3769.94	38221.806
28	42G9	52.03	1365.66	5179.30	50061.634
28	43G9	112.04	2917.10	4058.19	38518.0205

28	44G9	150.95	3722.24	2671.27	25399.9616
28	45G9	463.55	11330.90	2565.57	24827.3874
29	46G9	437.31	10204.08	1955.90	19654.3501
29	46H0	646.02	15399.50	2184.05	21532.0029
29	47G9	294.90	6579.59	2110.20	21281.367
29	47H0	1233.15	27696.55	1544.43	15672.1034

8. Figures

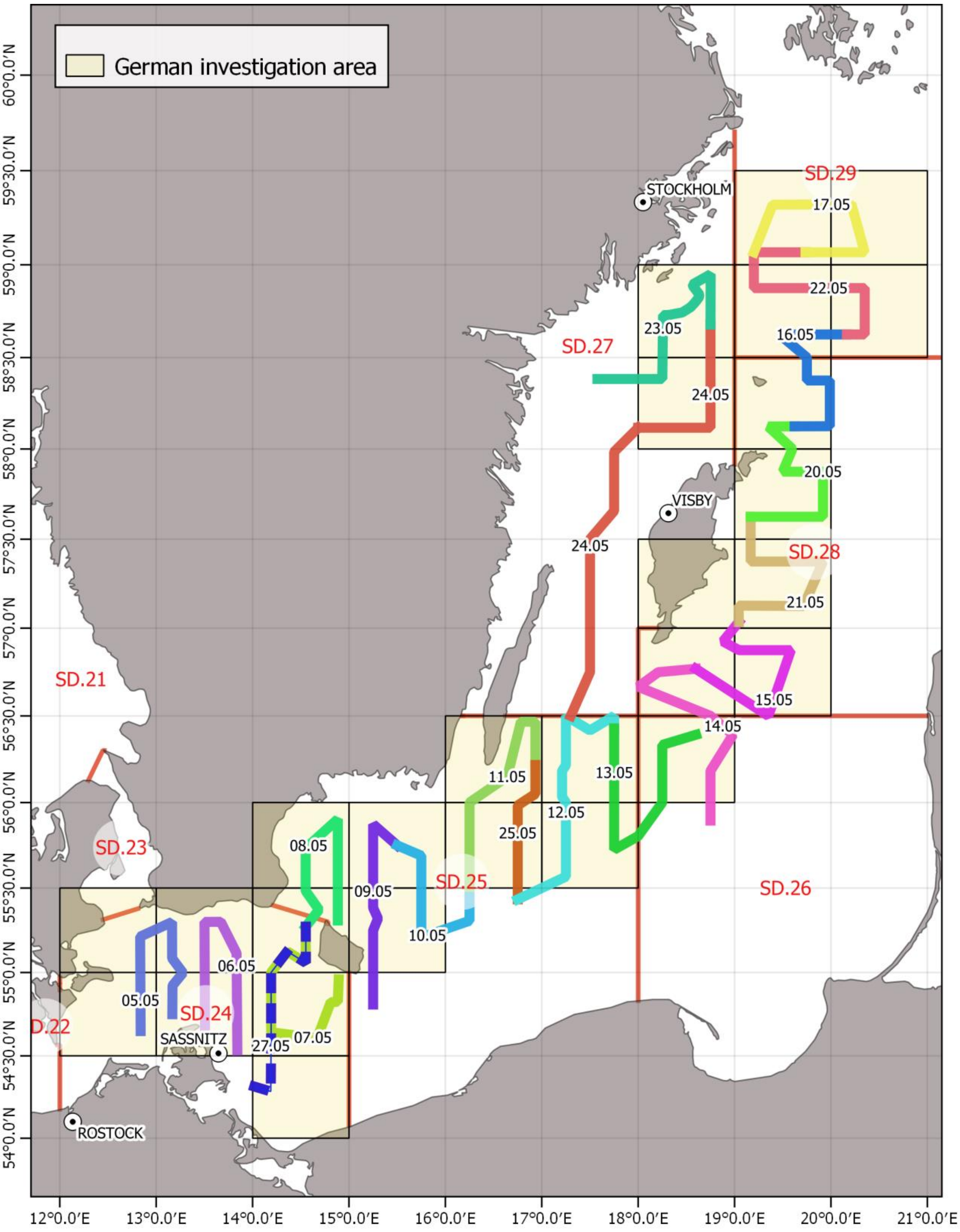

Figure 1: FRV "Solea" cruise 761/2019 BASS: Daily hydroacoustic track done during the BASS survey 2019.

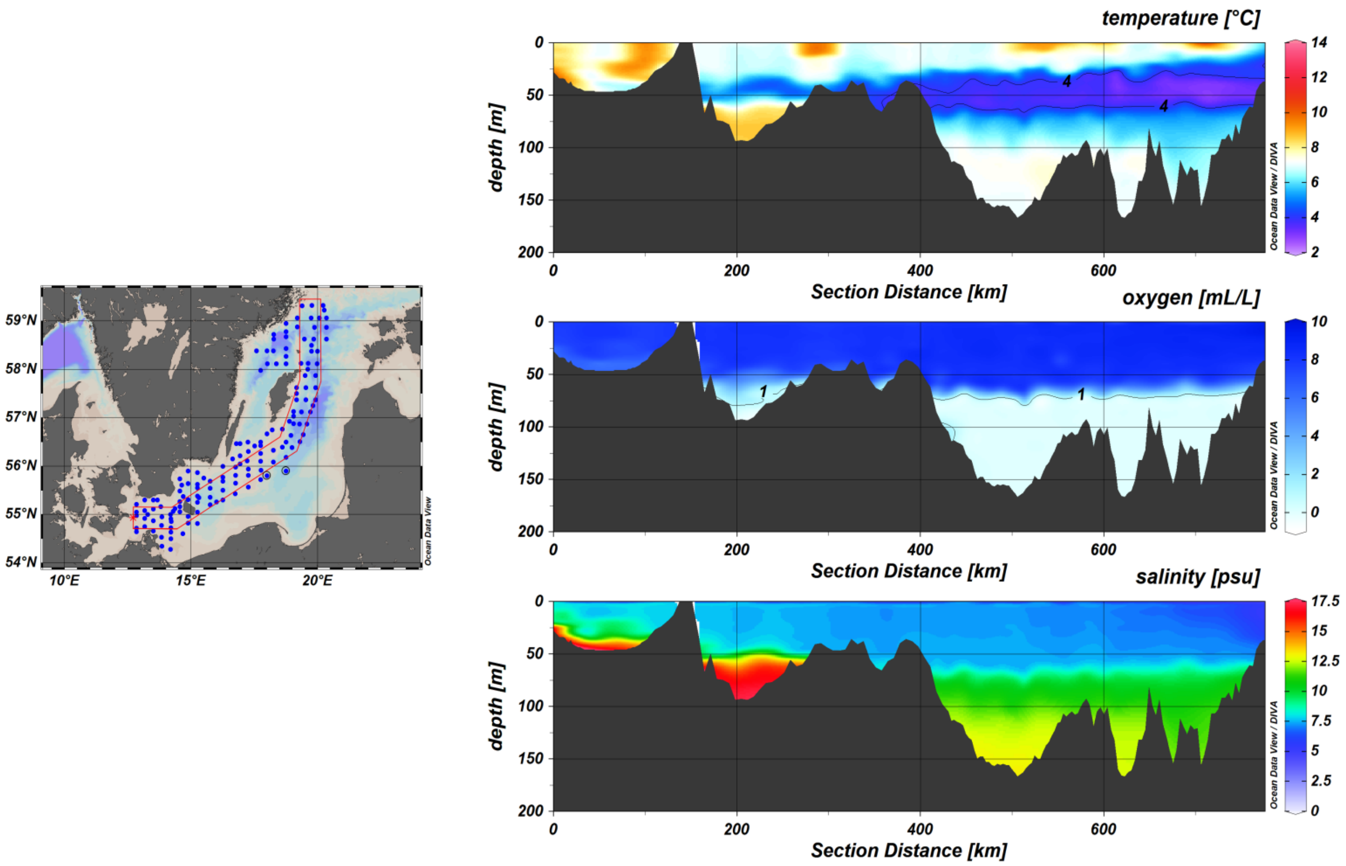

Figure 2: FRV "Solea" cruise 761/2019: Temperature (upper right panel), oxgen (middle right panel) and salinity (lower right panel) interpolated from CTD casts along a south/west - north/east transect as shown in the left panel (red line). CTD casts coordinates are display as blue dots on the map in the left panel.

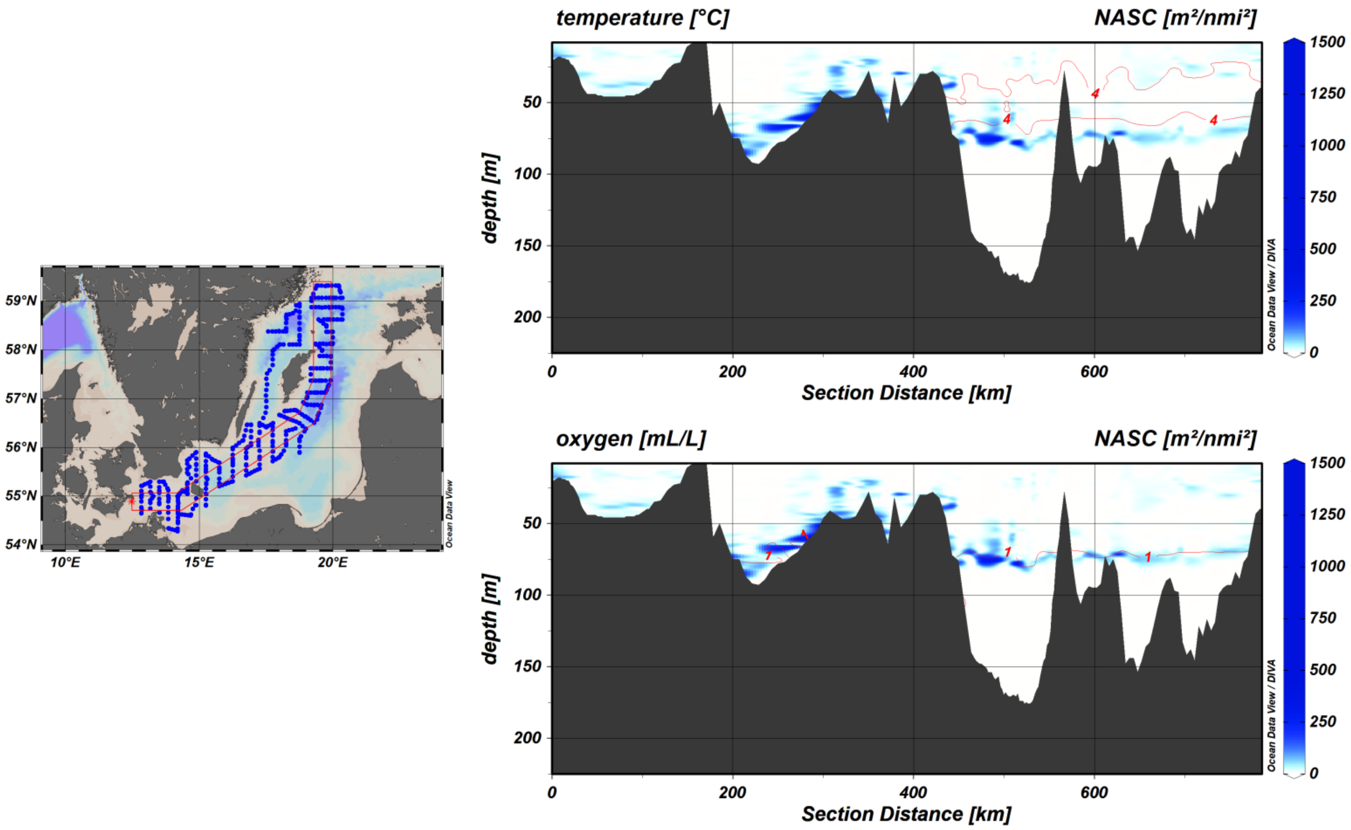

Figure 3: FRV "Solea" cruise 761/2019: Vertical distribution of temperature and oxygen related to the echogram of fish (blue clouds).

Figure 4: FRV "Solea" cruise 761/2019 BASS: Mean NASC calculated per year and per subdivision (red bar correspond to 2019).

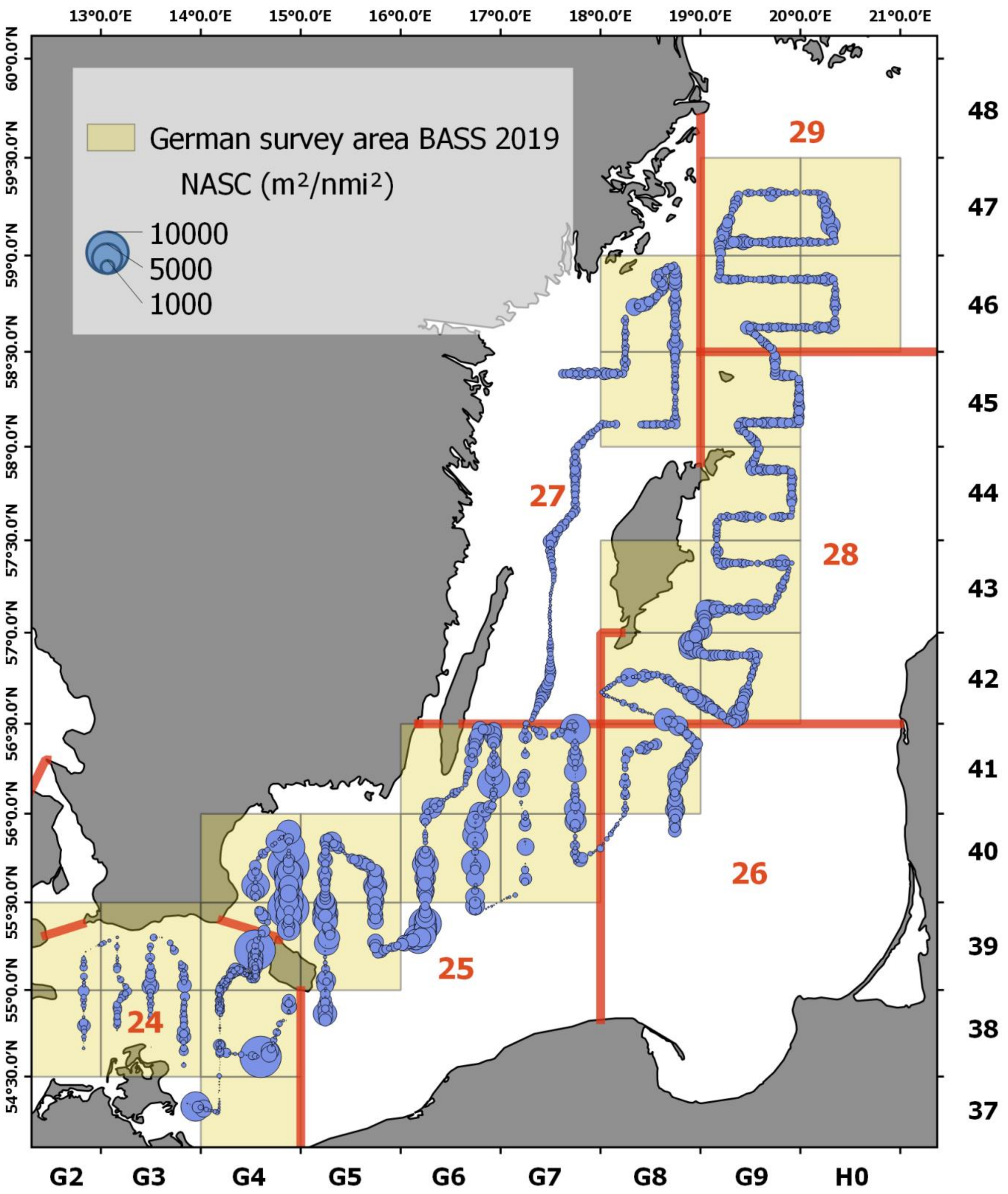

Figure 5: FRV "Solea" cruise 761/2019 BASS: hydroacoustic results: NASC (m^2/nm^2) per 1 nmi recorded during the survey.

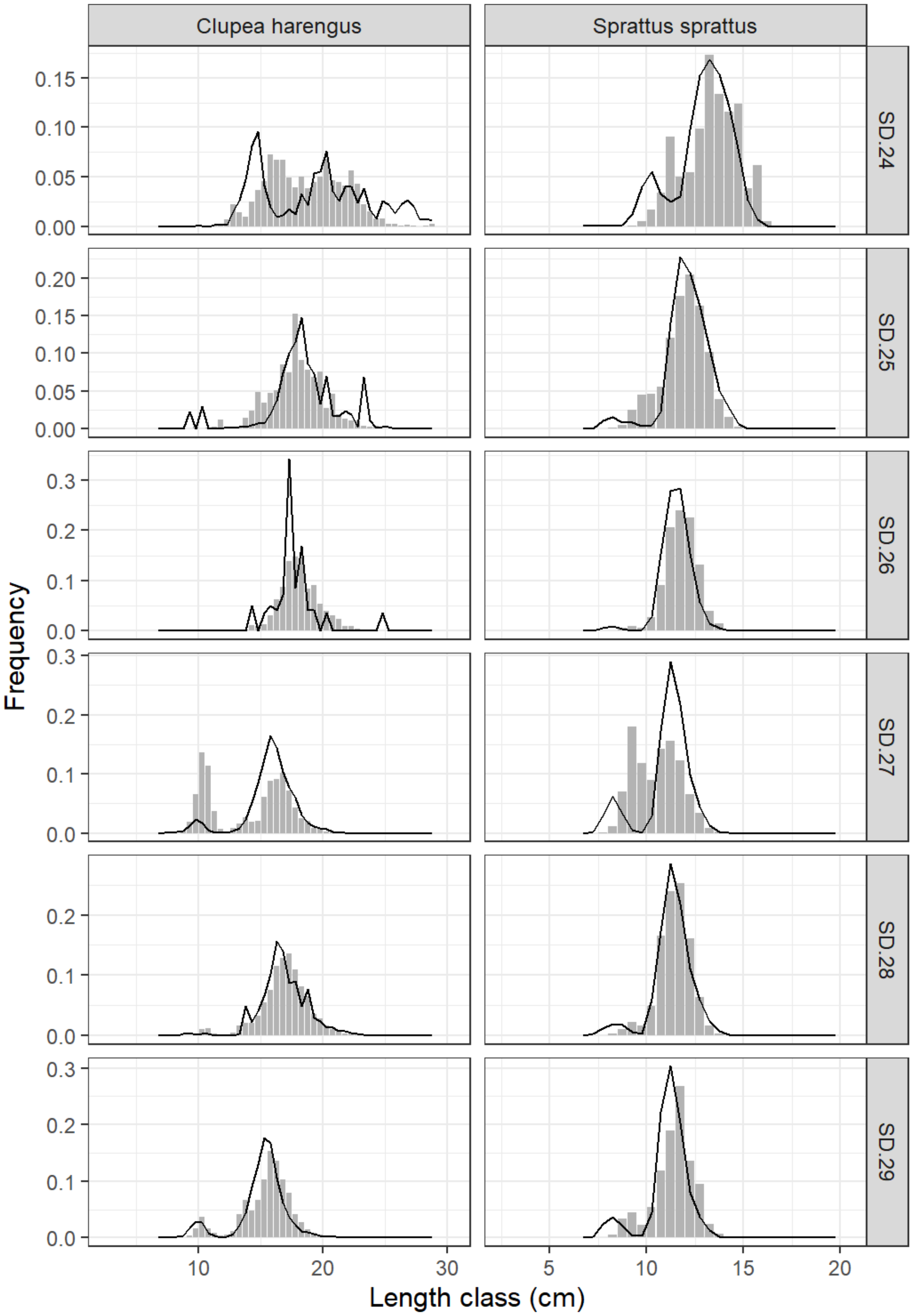

Figure 6: FRV "Solea" cruise 761/2019 BASS: Herring and sprat length distribution measured per ICES subdivision during BASS 2018 (black line) and BASS 2019 (bars).

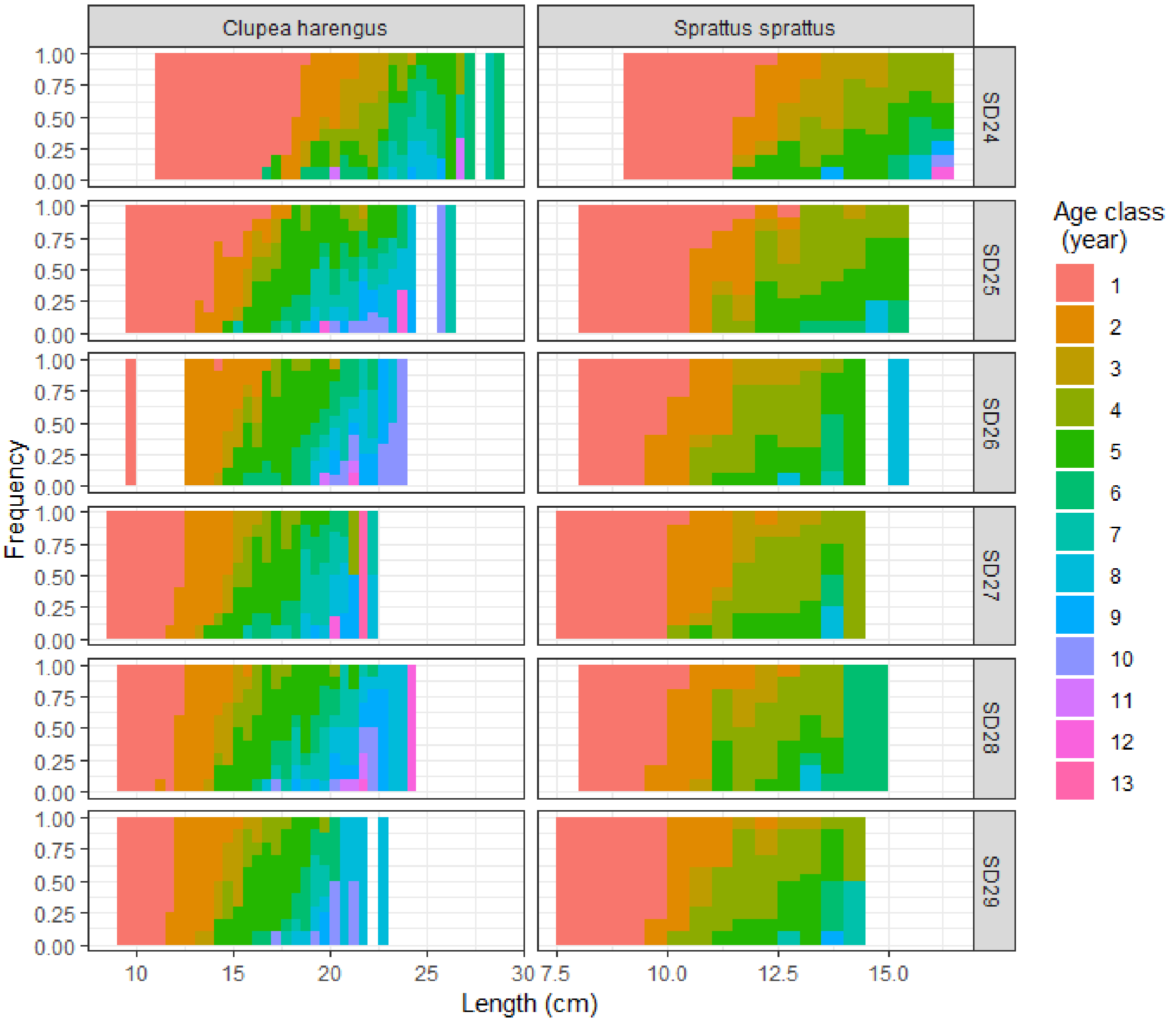

Figure 7: FRV "Solea" cruise 761/2019 BASS: Age distribution per length class, species and subdivision for 2019.

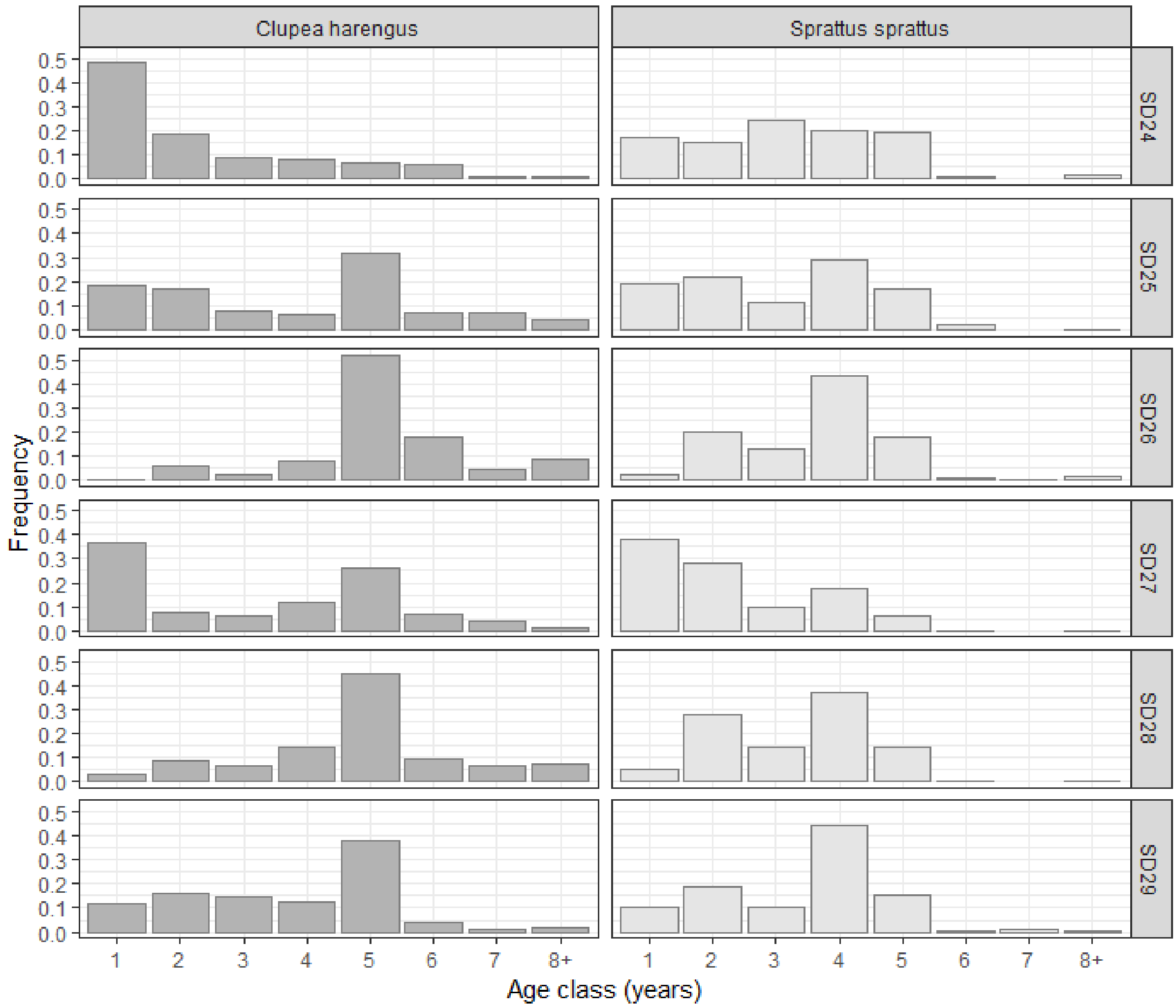

Figure 8: FRV "Solea" cruise 761/2019 BASS: Calculated age class distribution per species and subdivision in 2019.

Institute of Food Safety, Animal Health and Environment – BIOR, Riga (Latvia)

National Marine Fisheries Research Institute – NMFRI, Gdynia (Poland)

THE CRUISE REPORT

FROM THE JOINT LATVIAN-POLISH BALTIC ACOUSTIC SPRING SURVEY – BASS 2019 ON THE R/V "BALTICA" IN THE ICES SUBDIVISIONS 26N AND 28.2 OF THE BALTIC SEA (18-25 MAY 2019)

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Riga – Gdynia, March 2020

CONTENTS

INTRODUCTION

More less regular acoustic estimations of pelagic fish stocks in the Baltic Sea initiated by BaltNIIRH (now BIOR) and Institute für Hochseefischerei in Rostock (GDR) was performed since 1983, but the first scattered surveys was made since 1977 [Shvetsov 1983, Hoziosky et al. 1987, Shvetsov et al. 1988]. Several years in May (2005-2008) BIOR as assignee of BaltNIIRH, LatFRI and LatFRA cooperated with Polish NMFRI (former SFI) in Gdynia, but before – in 2003-2004 with AtlantNIRO in Kaliningrad, Russia. In 2009 due to collapse of Latvian economy the survey was not performed. In 2010 we resumed our international cooperation in the fisheries research, but this time on the Lithuanian r/v “Darius” board. The collaboration lasted for three years till the 2012. In May 2013 The Latvian Baltic Acoustic Spring Survey (BASS) in the ICES Sub-divisions 26N and 28 was conducted on Latvian commercial fishing vessel “Ulrika” with which crew and the owners cooperation in research for pelagic fish distribution and feeding conditions in the recent decade has developed a very close and productive. Due to BONUS EEIG project INSPIRE (INSPIRE) funding historically the first Latvian-Estonian joint BASS in the ICES Sub-divisions 26N, 28 29 and 32W in May 2014 was conducted on the Latvian commercial fishing vessel “Ulrika” and in May 2015 the same survey was performed, too [Svecovs et al., 2015, 2016]. In May 2016 we renew cooperation with Polish NMFRI.

This was the 8th joint Latvian-Polish Baltic Acoustic Spring Survey (BASS) in the ICES Sub-divisions 26N and 28.2 conducted by the r/v “Baltica” in May 2019. The reported survey was organized on the basis of the public procurement contract No. BIOR 2019/2/AK/EJZF from 6th March 2019 between the Institute of Food Safety, Animal Health and Environment (BIOR) from Riga and the National Marine Fisheries Research Institute (NMFRI) from Gdynia. The vessel was operated within the Latvian and Swedish EEZs (ICES Sub-divisions 26N and 28.2). The “Latvian National Fisheries Data Collection Program, 2019” in accordance with the EU Commission Regulations No. 1639/2001, 1581/2004, 665/2008, 1078/2008 and 199/2008 was partly subsidized this survey. These investigations were coordinated by the ICES Baltic International Fish Survey Working Group (WGBIFS) [ICES 2019].

Pelagic research catches carried out during the acoustic survey are the information source, independent from topical preferences in fishery, about quantitative changes in a process of clupeids geographical and bathymetrical distribution in the Baltic Sea. The data from hydrological measurements are the information source about abiotic environmental factors (seawater temperature, salinity, oxygen content) influencing sprat and herring spatial distribution. Echo-integration results along the pre-selected tracks are the basic materials for fish stock biomass calculations.

The ICES Baltic Fisheries Assessment Working Group (WGBFAS) applies the BASS data for clupeids (specially sprat and herring) stock biomass assessment and spatial distribution updating. The basic acoustic and biological data collected during recently carried out survey will be stored in the BASS_DB.mdb and the new acoustic data base WKBIFS-ACOU in the accepted CSV or XML formats, managed by ICES.

The main aims of cruise were:

- to collect the echo-integration data for the estimation of the clupeids stocks biomass and abundance in the central-eastern Baltic;
- to collect materials from the fish control catches for investigations of the Baltic sprat, and in lesser degree herring, spawning stocks spatial distribution in the offshore waters of Latvia, Estonia and Sweden, moreover for analyses of the age-length structure and recruiting year-class strength of these fishes populations;
- to collect sprat and herring stomachs samples for feeding condition and food components analyses;
- to analyze the vertical and horizontal changes of the basic hydrological parameters (temperature, salinity and oxygen content) at the trawling positions and at the standard HELCOM hydrological stations;
- to collect the zooplankton and ichthyoplankton samples at the referring area.

1. MATERIALS AND METHODS

1.1. PERSONNEL ASSIGNMENT

The scientific staff – nine persons:

R. Zaporowski (NMFRI, Gdynia – Poland) – survey leader, ichthyologist
B. Nurek (NMFRI, Gdynia – Poland) – acoustician
B. Witalis (NMFRI, Gdynia – Poland) – hydrologist
K. Koszarowski ((NMFRI, Gdynia – Poland) - ichthyologist
G. Strods (BIOR, Riga - Latvia) – Latvian scientific staff leader, acoustician
I. Briekmane (BIOR, Riga - Latvia) – ichthyologist
I. Ozolina (BIOR, Riga - Latvia) - ichthyologist
V. Cervoncevs (BIOR, Riga - Latvia) – ichthyologist
A. Makarcuks (BIOR, Riga - Latvia) – hydrobiologist.

1.2. SURVEY DESCRIPTION

The reported survey took place during the period of 18-25 May 2019 (8 working days at sea in accordance with Latvian-Polish survey plan). The at sea researches were conducted within Latvian and Swedish EEZs (the ICES Sub-divisions 26 and 28.2), moreover inside the Latvian territorial waters not shallower than 20 m.

The vessel left the Gdynia port (Poland) on 18.05.2019 at 00:05 o'clock a.m. and was navigated in the north direction to the echo-integration start point at the geographical position 56°07'N 019°00'E. The direct at sea researches began on 18.05.2019 after the midday. The survey ended on 25.05.2019 before midday in the port Ventspils (Latvia).

1.3. SURVEY METHODS AND PERFORMANCE

1.3.1. ACOUSTICAL AND TRAWLING METHODS

Acoustic data were collected with the SIMRAD EK-60 38 kHz and 120 kHz two frequency split beam scientific echo-sounder equipped with "EchoView Version 7.10" software for the data analysis. These data collected during the described here BASS were delivered to the Latvian researchers for further elaboration. The survey echo-integration tracks were planned in the similar pattern as in the previous years, due to historical comparability of the data. Overall 611 nautical miles long survey tracks was observed and recorded with hydroacoustic equipment. The final pattern of transects was covered with a relatively good density. The area covered in May 2019 was 1953.3 nm^2 in the northern part of the ICES Sub-division 26 and 6977.2 nm^2 in Sub-division 28.2, totally 8930.5 nm^2 (Fig. 1).

The pre-selection of the pelagic fish catches based on the ICES statistical rectangle area (with range of 0.5 degree in latitude and 1 degree in longitude) and the present density pattern of vertical distribution of clupeids along a transect. The intention was to carry out at least two control hauls per the ICES statistical rectangle [ICES 2003]. The water depth range-layer with sufficient for fish oxygen content (minimum 1.0÷2.0 ml/l) were taken into account in the process of the hauls distribution.

Survey was performed in accordance to "SISP Manual of International Baltic Acoustic Surveys (IBAS)" [ICES 2017]. The r/v "Baltica" realized 19 fish control-catches (Tab. 1). All catches were performed in the daylight between 07:45 and 17:50 (GMT+01:00; UTC+02:00) using the pelagic trawl type WP 53/64x4 (with 6 mm mesh bar length in the codend). The standard trawling duration was 30 minutes, but 8 hauls was shortened to 20 minutes and 2 hauls to 15 minutes, according to higher power of the echo-integration. The mean speed of vessel while trawling was 3.0 knots. Overall, 4 hauls were conducted in SD 26N and 15 hauls in SD 28.2. Totally 15 hauls were performed in the Latvian EEZ and 4 hauls in Swedish EEZ

1.3.2. BIOLOGICAL SAMPLING

All biological material of fish collected in the survey is presented in Table 2.

The length measurements in 0.5 cm length classes were realized for 4113 sprat, 2185 herring and 41 three-spine sticklebacks, the length measurements in 1.0 cm length classes were realized for 404 cod, 116 flounder and 1 lumpfish individuals. In total, 2018 sprat and 1276 herring individuals were taken for biological analysis.

Due to herring and sprat normally cannot be distinguished from other species by visual inspection of the echogram species composition and fish length distributions were based on trawl catch results. Mean target strength of fish was calculated according to the following formulas [Foote et al. 1986, ICES 1983, 2017]:

for clupeids: TS = 20logL-71.2;
for gadoids: TS = 20logL-67.5;
cross-section $\sigma = 4\pi 10^{a/10} \times L^{b/10}$.

The total number of fish in each ICES rectangle was estimated as a product of the mean area scattering cross-section – NASC (S_A) and the rectangle area, divided by corresponding mean acoustic cross-section. Fish abundance was separated into different species according to the mean catch composition in the given rectangle.

Ichthyoplankton and zooplankton samples were collected at the positions of the hydrological stations or after trawling. Totally 22 ichthyoplankton and zooplankton stations were realized (Fig. 2) and 44 and 37 samples were taken accordingly. Ichthyoplankton was collected with IKS-80 net (mouth opening 0.5 m^2, mesh size 500 µm). This net was towed vertically from the depths 150 or from the bottom in case of lesser depth, to the water surface with speed of 0.4 m/s. Zooplankton was collected with Judday net (mouth opening 0.1 m^2, mesh size 160 µm). This net was towed vertically from the depths 50 and 100, or from the bottom in case of lesser depth, to the water surface with speed of 0.4 m/s. Low speed of lifting allowed preventing all plankton objects from destroying by mechanic forces. All samples were conserved in 2.5% unbuffered formaldehyde solution with sea water and processed during the year.

1.3.2. HYDROLOGICAL AND METEOROLOGICAL OBSERVATIONS

The measurements of the basic hydrological parameters were realized in the period of 18-25 May 2019, totally at 22 stations, int. al. at 19 fish catch-station (Fig. 2). Hydrological stations were inspected with the IDRONAUT CTD-probe combined with the rosette sampler (the bathometer rosette). Oxygen content was determined by the standard Winkler's method. The hydrological row data, originated from measuring realized from the sea surface layer up to the bottom, were aggregated to the 1-m depth stratums, were information source about the abiotic factors potentially influencing fishes spatial distribution. The oxygen probes ware taken on every 10 meters. The salinity parameter was presented in Practical Salinity Unit (PSU).

Meteorological observations of air temperature, wind velocity and directions and atmospheric pressure were realized at the actual geographic position of each control-haul and in every 10 minutes interval over the whole survey. The automatic meteorological station type "Milosz" was applied for measurements of the above-mentioned parameters. The values of meteorological and hydrological parameters registered at trawling stations are aggregated in Table 3.

2. RESULTS

2.1. BIOLOGICAL DATA

2.1.1. CATCH STATISTICS

Overall, 6 fish species were identified in hauls performed in the Central-eastern Baltic Sea in May 2019. Sprat was the dominating species by mass in the both ICES Sub-divisions 26 and 28.2 (97.6% and 78.4% respectively). The share of the herring was 1.5% and 20.0% respectively. The other 4 fish species represented 1.4% (in which 1.2% belonging to cod) of the average total mass in all investigated areas.

Mean CPUE in BASS 2019 for all species in the investigated area amounted for 974.1 kg/h (comparing to 1253.7 and 1436.4 kg/h in 2018 and 2017 respectively). The mean CPUEs for sprat was: 1436.3 kg/h in ICES SD 26, and 721,3 kg/h in SD 28.2. The mean CPUEs for herring was as follows: in SD 26 – 28.0 kg/h and 170.6 kg/h in SD 28.2. The particular values of CPUE for each haul for herring and sprat are presented at the Fig. 2. The highest CPUE values for sprat were observed from the Central-western part of SD 28.2 to the Northern part of SD 26. The highest CPUEs values for herring were distributed in Central part of SD 28.2 and partly in Northern SD 26.

2.1.2. ACOUSTICAL AND BIOLOGICAL ESTIMATES

The basic acoustic and biological data (surveyed area statistics, mean NASC, the mean scattering cross-section, the total number of fish, percentages of herring and sprat) per ICES rectangles and the estimated abundance and biomass of sprat and herring per above mentioned rectangles, collected in May 2019, are given in Table 5. The characteristics of the pelagic fish stock are aggregated in Table 6 for sprat and Table 7 for herring. The geographical distributions of NASC, sprat and herring stock densities in the central-eastern Baltic Sea in May 2019 are shown in Figures 5, 6 and 7 respectively.

The pelagic fish stock was represented mostly by sprat – 94.0 %, in comparison – 71.5% in 2013, 86.8 % in 2014, 88.2 % in 2015 and 92.9 % in 2016, 94.1 % in 2017, and 93.8 % in 2018. Herring was represented as 5.9 %, 28.5 % in 2013, 13.2 % in 2014, 11.8 % in 2015, 7.1 % in 2016 and 5.9 % in 2017, 6.2 % in 2018. The highest sprat stock density 77.7 n×10^6/nm^2 according to acoustic estimates were recorded in ICES rectangle 41G9 of the ICES Sub-division 26. The highest average abundance 4.3 n×10^6/nm^2 and biomass of the sprat stock were recorded in the southern part of investigated area in ICES rectangle 41G9. The distribution of the high density sprat concentrations in May 2019 were significantly smaller compared to recent years and had different pattern as in May 2017 and more-less copy distribution in previous year [Hoziosky et al. 1988, Shvetsov et al. 1988, 1989, 1992, 2002, Svecovs 2016].

The herring stock density was significantly lower in comparison to sprat stock density. The highest density value was 1.3 n×10^6/nm^2 and noted in ICES rectangle 43H0 in central part of the investigated area in Sub-division 28.2 and was the lowest recorded since 2005. in 2013 it was 8.8 n×10^6/nm^2 in rectangle 44H0, in 2014 values over 10.0 n×10^6/nm^2 were recorded in two rectangles 43H0 and 45H0, in 2015 highest density values were not over 10.2 n×10^6/nm^2 and noted in rectangle 44H0, in 2016 the highest density 18.1 n×10^6/nm^2 was recorded in rectangle 42G9 in central part of estimated aquatory and in May 2017 the highest density 26.1 n×10^6/nm^2 was recorded in rectangle 44H0 in northern part of estimated aquatory.

Comparison of the acoustic results from May of 2005-2014 indicated that investigated sprat stock abundance and biomass had decreasing tendency, but herring stock had a slight increase. In 2015-2016 sprat stock abundance increased due to highly abundant generation of sprat in 2014. In 2017 both of sprat and herring stocks had decreased in numbers, but in biomass herring stock had significantly increased. In 2018-2019 sprat stock had significant decrease, but herring stock significant increase in abundance. The geographical distribution of main sprat stock shows different pattern as in years 2005-2016 and 2018 and 2017 when stock was less scattered with two large and dense concentrations of high abundance [Svecovs et al. 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018]. In 2019 sprat made weak aggregations.

The mean length and mean weight distributions of dominant fish species (sprat and herring) by hauls and rectangles in the ICES Sub-divisions 26 and 28 are shown in Figures 8 and 9 respectively. The total length and mean weight in control hauls of sprat, herring and cod ranged as follows:

- sprat – 7.0÷14.0 cm (average TL = 11.3 cm), 2.6÷17.0 g (average W = 8.5 g);
- herring – 10.5÷23.0 cm (average TL = 16.9 cm), 9.0÷68.0 g (average W = 28.5 g);

The sprat length distribution curves have a bimodal character for both Sub-divisions mentioned above. First length frequency peak takes place at 9 cm length class in SDs 26 and 28.2 respectively, with considerably low frequency values in SD 28.2 comparing to data from 2018. The second peak can be observed at 11 cm length class (SD 26) and 11,5 cm length class (SD 28.2), which represents adult sprat.

The herring length distribution curves have a similar multimodal character in both Sub-divisions 26 and 28.2. In subdivision 26 the highest peaks were observed for 18,5 cm, 17 cm and 16 cm length classes, respectively. In subdivision 28.2 the highest peak was observed for 16 cm length class.

The cod and flounder abundance in the pelagic control catches was on similar level, comparing to the data from the last few years. Cod from SD 26 characterized by fish length range 21-39 cm, with modal length frequency value at 28 cm length class. But in SD 28.2 its length range was 17-51 cm, and modal length frequency values at 26 cm length classes. Flounder occurrence was more abundant in the catches in SD 28.2. Its length ranged from 16 to 33 cm, with modal length frequency values at 22-25 cm length classes.

2.1.3. ICHTHYOPLANKTON ESTIMATES

Totally 44 ichthyoplankton samples collected at 22 station positions during BASS on RV "Baltica", including 22 samples collected in vertical hauls with IKS-80 net and 22 samples from horizontal hauls on water surface during 10 minutes. The number of sprat eggs and larvae in ICES SD 26 and 28 are aggregated in Table 9.

Sprat eggs and larvae prevailed in the ichthyoplankton in May 2019. The average numbers of sprat eggs in the investigated region were above the corresponding average values for the previous years. Sprat eggs were more abundant in the southern and central parts of the Gotland Basin. Amount of eggs of sprat as usual increased towards the greater depths near the center of the basin. Amount of sprat larvae was approximately at the average level for the previous years. Most of the larvae were sampled in the vertical hauls. They were distributed very unevenly: lot of them in the southern part of the Gotland Basin, less in the central part, and almost no larvae in the northern part of it (actually only in the hauls at the water surface). They also were more numerous over the bigger depths.

Sprat larvae in the water surface layer were not numerous in all the parts of the Gotland Basin with maximal abundance in the southern and central parts of the Gotland Basin. This must be the evidence that the spawning of sprat this year has started moderately early.

This year there were fewer larvae of flounder compared with the years 2015 – 2018. More larvae were collected on the water surface than during vertical hauls. They were more abundant in the southern part of the Gotland Basin (Last year there were more larvae in the central part).

The hydrological conditions in the Gotland Basin in 2019 improved compared with 2018, which was beneficial for the survival of pelagic fish eggs, and especially for those of cod and four-bearded rockling. As a result average amount of the cod eggs amounted to 7.14 eggs *m-2 in the southern part of the Gotland Basin (depth>70 m). As usual in the last years, number of cod eggs rapidly decreased in the northern direction, dropping to 0.8 eggs *m-2 in the central part of the basin, and to 0 in the northern part of it. No larvae of cod were found. Number of rockling eggs was rather low, but they are usually more abundant later in the year.

Biodiversity in the ichthyoplankton was below the medium level – several eggs of cod, flounder, and four-bearded rockling, and also some larvae of flounder and sand-eel were found in May, apart from those of sprat.

2.1.4. ZOOPLANKTON ESTIMATES

The calculated average number and average biomass of zooplankton organisms in 0-100 m water column per volume unit from 37 samples taken in 22 stations are aggregated in Table 10.

In May 2019 in the Baltic Sea the estimated zooplankton biomass was significantly higher in comparison to 2018. Total zooplankton biomass in 2018 was 194.20 mg/m^3, but in May 2019 306.48 mg/m3. The most part of the biomass (44.79 %) was made from small rotatories and copepods (41.43 %), the residual part was made from cladocers (7.33 %) and other planktonic organisms (6.44 %). The dominance of rotatorians in the spring season in the Baltic Sea creates favorable feeding conditions for larvae and smaller groups of pelagic fish species. Amount of them in 2019 on average was significantly higher than in 2018 and the long-term average, too. Overall, the biomass of *Temora longicornis*, taking the top rank among copepods, has the highest biomass recorded since May 1960. *Acartia* spp. biomass had increased and reach level of 2007-2009. *Pseudocalanus* sp. had decreased in comparison to 2018 and is on the lovest level since 2000. In 2019 increased average biomass of rotatorians *Synchaeta* spp. and *Polychaeta* worms enhancing the role of above mentioned copepods in all aquatory. In deep stations has remarkably increased estimated quantity and biomass of *Centropages hamatus* reaching the highest level since 1960. In the upper layer (0-50 m) of water column the dominant object of zooplankton was rotatorians *Synchaeta* spp. and cladocerans *Evadne* spp. Biomass of *Evadne* spp. was highest since 2013 and two times higher than the level of long-term average. Overall, the favorable feeding conditions in May 2019 as in 2018 formed in the upper water column of the investigated area.

2.2. METEOROLOGICAL AND HYDROLOGICAL DATA

2.2.1. WEATHER CONDITIONS

Changes of the main meteorological parameters during joint LAT-POL BASS in May 2019 are shown at the Figure 12. The wind force varied from 0,4 m/s to 12,8 m/s and average was 5,7 m/s. The most often wind direction was NE and ESE. The air temperature ranged from 8,1°C to 20,9 °C, and average temperature was 12,2 °C

2.2.2. HYDROLOGY OF THE GOTLAND DEEP

Changes of the main hydrological parameters of seawater during joint LAT-POL BASS in May 2019 are shown at the Figures 13-15.

The seawater temperature in the surface layers varied from 7.19 to 10.96 °C (the mean was 9.40 °C). The lowest surface temperature was recorded at the haul station No 1. The highest one was noticed at the haul 18. The minimum value of salinity in Practical Salinity Unit (PSU) was 7.01 at the hydrological station 15 in the surface layer. The maximum was 7.39 PSU at the haul station No 1. The mean value of salinity was 7.24 PSU. The oxygen content in the surface layers of the investigated area varied in the range of 7.29 ml/l (haul No 10) - 9.50 ml/l (haul No 16). The mean value of surface water oxygen content was 8.50 ml/l.

The temperature of near bottom zone was in the range from 4.51 (haul No 2) to 7.42 °C (haul No 17), the mean was 6.62 °C. Salinity in the bottom waters varied from 7.47 (haul No 2) to 13.28 PSU (haul No 14), and the mean was 11.65 PSU. Oxygen content varied from 0.00 ml/l (haul Nos. 5, 9, 10, 11, 15 and hydrological station No 37) to 6.13 ml/l (haul No 2), the mean was 1.60 ml/l.

3. DISCUSSION

The data of the Latvian-Polish BASS in the 2nd quarter of 2019 were considered by the ICES BIFS Working Group as representative for the central-eastern Baltic for the estimation of abundance and spatial distribution of pelagic fishes (herring and sprat) recruiting year classes and were provided to the Baltic Fisheries Assessment Working Group (WGBFAS) as the input data for fish stocks resources calculation. The acoustic, catch, biological and hydrological data, collected during reported survey were uploaded to the BAD1 and to the emerging international databases managed by the ICES Secretariat.

The collected data shows that sprat population in ICES SD 26N and 28.2 till the 2014 had overall decreasing tendency of abundance, but in 2015 had increased due to very abundant sprat generation of 2014. The next recent generations of sprat was on low abundance level and stock abundance in both SDs had decreased evidently. The mean length and weight of adult sprat had minor increasing tendency in 2019 compared to previous years. The geographical distribution of sprat densities in the May 2019 had different pattern as in recent years before and shows weak aggregations with densities on low level. The overall estimated good feeding conditions should ensure increasing of individual fish body condition and young fish surviving of pelagic fish species in future.

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ANNEX. TABLES AND FIGURES

Table 1. Fish control-catch statistics in the Baltic Sea ICES SD 26N and 28.2 from the Latvian-Polish BASS conducted by r/v "Baltica" in the period of 18-25.05.2019

Haul number	Date	ICES rectangle	ICES SD	Mean bottom depth [m]	Headrope depth [m]	Vertical opening [m]	Trawling speed [knt]	Trawling direction [°]	Geographical position				Time Start	Haul duration [min]	Total catch [kg]
									Start		End				
									Latitude 00°00.0'N	Longitude 00°00.0'E	Latitude 00°00.0'N	Longitude 00°00.0'E			
1	2019-05-18	41G9	26	124	60	19	3	80	56°05.0'	19°10.2'	56°05.3'	19°11.3'	15:45	15	233.415
2	2019-05-19	41H0	26	41	22	16	3.2	180	56°09.9'	20°38.1'	56°08.4'	20°38.0'	07:45	30	656.630
3	2019-05-19	41H0	26	75	50	20	3	275	56°22.4'	20°03.4'	56°22.5'	20°01.6'	13:00	20	715.270
4	2019-05-19	41G9	26	107	60	20	3	90	56°22.9'	19°42.7'	56°22.9'	19°44.1'	15:45	15	383.349
5	2019-05-20	42G9	28.2	145	60	20	3	95	56°37.2'	19°08.1'	56°37.1'	19°09.7'	07:50	20	239.483
6	2019-05-20	42G9	28.2	156	60	20	3	105	56°42.0'	19°52.1'	56°41.8'	19°53.7'	12:10	20	267.741
7	2019-05-20	42H0	28.2	75	50	20	3	285	56°37.3'	20°25.9'	56°37.8'	20°23.3'	15:50	30	356.056
8	2019-05-21	42H0	28.2	117	60	20	3	270	56°52.9'	20°16.5'	56°52.9'	20°14.7'	09:30	20	536.130
9	2019-05-21	42G9	28.2	135	65	19	3	270	56°52.9'	19°42.3'	56°52.9'	19°40.5'	13:00	20	545.133
10	2019-05-21	43G9	28.2	173	70	20	3	30	57°02.6'	19°19.8'	57°03.8'	19°21.2'	17:50	30	220.682
11	2019-05-22	43H0	28.2	202	55	19	3	90	57°06.9'	20°03.9'	57°06.9'	20°05.6'	08:00	20	92.556
12	2019-05-22	43H0	28.2	89	60	19	3	130	57°07.2'	20°36.3'	57°06.3'	20°38.3'	11:25	30	735.173
13	2019-05-22	43H1	28.2	69	44	19	3	30	57°23.1'	21°07.6'	57°24.3'	21°08.9'	17:15	30	132.880
14	2019-05-23	43H0	28.2	127	58	19	3	270	57°22.2'	20°33.2'	57°22.2'	20°30.4'	07:40	30	569.790
15	2019-05-23	43G9	28.2	101	63	16	3	265	57°19.5'	19°41.9'	57°19.1'	19°40.4'	13:05	20	370.583
16	2019-05-23	44G9	28.2	107	55	20	3	355	57°32.4'	19°32.5'	57°33.9'	19°32.4'	16:40	30	279.611
17	2019-05-24	44H0	28.2	129	60	19	3	80	57°36.7'	20°28.7'	57°36.9'	20°31.3'	07:45	30	178.579
18	2019-05-24	44H1	28.2	78	57	19	3	280	57°51.5'	21°13.1'	57°51.7'	21°11.3'	14:20	20	573.701
19	2019-05-24	44H0	28.2	100	62	19	3	340	57°53.1'	20°47.1'	57°54.6'	20°47.7'	17:15	30	380.928
												SD26			1988.664
												SD28.2			5479.026
												SD26+28.2			7467.690

Table 2. Number of measured and aged fish individuals in the Baltic Sea ICES SD 26N and 28.2 from the Latvian-Polish BASS conducted by r/v "Baltica" in the period of 18-25.05.2019

SD 26		Sprat	Herring	Cod	Flounder	Three spined stickleback	Lumpfish	Total
Samples taken	Measurements	4	4	3	2			13
	analyses	4						4
Fish measured		878	103	66	19			1066
Fish analysed		413						413
SD 28.2		Sprat	Herring	Cod	Flounder	Three spined stickleback	Lumpfish	Total
Samples taken	Measurements	15	15	14	13	6	1	64
	analyses	15	14					29
Fish measured		3235	2082	338	97	41	1	5794
Fish analysed		1605	1276					2881
SUM		Sprat	Herring	Cod	Flounder	Three spined stickleback	Lumpfish	Total
Samples taken	Measurements	19	19	17	15	6	1	77
	analyses	19	14					33
Fish measured		4113	2185	404	116	41	1	6860
Fish analysed		2018	1276					3294

Table 3. The values of meteorological and hydrological parameters registered at the trawling position and depth in the Baltic Sea ICES SD 26N and 28.2 from the Latvian-Polish BASS conducted by r/v "Baltica" in the period of 18-25.05.2019

Haul number	Date of catch	Meteorological parameters			Trawling depth		Hydrological parameters		
		wind direction	wind force [°B]	sea state [Degrees]	Headrope [m]	Footrope [m]	temperature [°C]	salinity [PSU]	oxygen [ml/l]
1	2019-05-18	E	3	1	60	79	5.39	9.36	1.49
2	2019-05-19	Changeable	2	1	22	38	4.51	7.47	6.13
3	2019-05-19	Changeable	2	1	50	70	4.26	7.61	7.25
4	2019-05-19	Changeable	2	1	60	80	3.70	7.59	6.49
5	2019-05-20	SE	4	2	60	80	4.11	7.87	3.37
6	2019-05-20	SE	3	2	60	80	4.20	7.92	5.08
7	2019-05-20	E	4	2	50	70	4.24	7.60	5.78
8	2019-05-21	E	4	2	60	80	4.67	8.52	2.28
9	2019-05-21	E	4	2	65	84	4.89	8.79	1.34
10	2019-05-21	Changeable	2	1	70	90	3.63	7.55	6.05
11	2019-05-22	NE	4	2	55	74	4.55	8.39	4.40
12	2019-05-22	Changeable	1	1	60	79	4.00	7.80	3.62
13	2019-05-22	Changeable	1	1	44	63	3.64	7.50	7.56
14	2019-05-23	N	3	1	58	77	4.57	8.49	4.30
15	2019-05-23	N	4	2	63	79	3.79	7.58	2.00
16	2019-05-23	N	4	2	55	75	3.60	7.43	8.54
17	2019-05-24	W	4	2	60	79	3.97	7.83	4.94
18	2019-05-24	Changeable	2	1	57	76	3.61	7.47	7.71
19	2019-05-24	Changeable	2	1	62	81	3.62	7.59	6.60

Table 4. Fish control-catch results by species in the Baltic Sea ICES SD 26N and 28.2 from the Latvian-Polish BASS conducted by r/v "Baltica" in the period of 18-25.05.2019

Haul number	Date	ICES rectangle	ICES SD	Total Catch [kg]	Catch per species [kg]					
					sprat	herring	cod	flounder	threespine stickleback	Lumpfish
					161789	161722	164712	172894	166365	127214
1	2019-05-18	41G9	26	233.415	213.130	15.340	3.185	1.760		
2	2019-05-19	41H0	26	656.630	653.540	2.770	0.320			
3	2019-05-19	41H0	26	715.270	711.840	3.430				
4	2019-05-19	41G9	26	383.349	362.530	8.730	11.340	0.749		
5	2019-05-20	42G9	28.2	239.483	217.890	17.680	3.535	0.378		
6	2019-05-20	42G9	28.2	267.741	252.720	11.710	1.798	1.513		
7	2019-05-20	42H0	28.2	356.056	325.670	29.720	0.236	0.428	0.002	
8	2019-05-21	42H0	28.2	536.130	487.290	34.670	10.710	3.460		
9	2019-05-21	42G9	28.2	545.133	522.380	17.458	4.460	0.784	0.051	
10	2019-05-21	43G9	28.2	220.682	182.845	24.295	12.850	0.692		
11	2019-05-22	43H0	28.2	92.556	53.652	36.094	1.944	0.861	0.005	
12	2019-05-22	43H0	28.2	735.173	493.400	230.780	9.729	1.109		0.155
13	2019-05-22	43H1	28.2	132.880	64.030	68.850				
14	2019-05-23	43H0	28.2	569.790	418.780	146.930	3.526	0.554		
15	2019-05-23	43G9	28.2	370.583	325.640	40.740	4.203			
16	2019-05-23	44G9	28.2	279.611	226.330	48.877	4.090	0.288	0.026	
17	2019-05-24	44H0	28.2	178.579	112.480	60.990	3.623	0.868	0.618	
18	2019-05-24	44H1	28.2	573.701	369.430	202.360	1.808	0.103		
19	2019-05-24	44H0	28.2	380.928	243.191	128.089	9.080	0.538	0.030	
SD26				1988.664	1941.040	30.270	14.845	2.509		
SD28.2				5479.026	4295.728	1099.243	71.592	11.576	0.732	0.155
SD26+28.2				7467.690	6236.768	1129.513	86.437	14.085	0.732	0.155

Table 5. BASS statistics of pelagic fish species from the Latvian-Polish BASS in the Baltic Sea ICES SD 26N and 28.2 conducted by r/v "Baltica" in the period of 18-25.05.2019

Table 5A

ICES SD	ICES Rect.	Hauls No	NASC Pel m^2nm^{-2}	σ $m^2 10^4$	ρ $n10^6nm^{-2}$	TS db	Sprat n, %	Herring n, %	Stickleback n, %
26	41G9	1,3,4,5	547.19	1.30	4.22	0.08	99.23	0.77	
	41H0	2,3,7	113.73	1.17	0.97	-0.38	99.59	0.41	0.0004
28	42G9	5,6,9,10	394.23	1.27	3.10	-0.01	98.51	1.48	0.0128
	42H0	6,7,8	294.59	1.27	2.32	-0.02	98.27	1.73	0.0006
	43G9	10,11,15,16	260.83	1.34	1.95	0.21	94.45	5.53	0.0138
	43H0	11,12,13,14	271.19	1.41	1.92	0.45	87.55	12.44	0.0052
	43H1	12,13	100.77	1.43	0.71	0.49	86.09	13.91	
	44G9	15,16,17	213.02	1.36	1.57	0.28	93.12	6.60	0.2817
	44H0	13,17,19	334.80	1.53	2.19	0.79	81.74	17.75	0.5077
	44H1	13,18	164.99	1.33	1.24	0.19	84.25	15.75	

Table 5B

ICES	ICES	Abundance, $n10^6$				Biomass, $kg10^3$			
SD	Rect.	∑	Sprat	Herring	Stickleback	∑	Sprat	Herring	Stickleback
26	41G9	4222.015	4189.650	32.365		37205.194	36074.395	1130.799	
	41H0	928.691	924.863	3.825	0.004	7310.156	7178.174	131.976	0.007
28	42G9	3061.947	3016.299	45.257	0.392	27140.351	25686.646	1452.530	1.175
	42H0	2248.914	2210.051	38.850	0.013	19840.489	18557.081	1283.382	0.026
	43G9	1899.312	1793.945	105.105	0.262	18892.403	15840.381	3051.480	0.543
	43H0	1868.789	1636.207	232.484	0.098	20305.792	13777.408	6528.286	0.098
	43H1	291.568	251.009	40.559		3205.841	2085.072	1120.769	
	44G9	1375.051	1280.422	90.755	3.874	13983.702	11581.141	2393.546	9.016
	44H0	2107.358	1722.520	374.140	10.698	25637.061	15863.555	9749.014	24.493
	44H1	1023.596	862.363	161.233		10260.742	6403.350	3857.392	

Table 5C

ICES	ICES	Sprat		Herring		Stickleback	
SD	Rect.	L, cm	w, g	L, cm	w, g	L, cm	w, g
26	41G9	11.56	8.61	17.98	34.94		
	41H0	10.95	7.76	18.22	34.51	6.25	2.00
28	42G9	11.40	8.52	17.41	32.10	6.25	3.00
	42H0	11.36	8.40	17.79	33.03	6.25	2.00
	43G9	11.44	8.83	16.90	29.03	5.79	2.07
	43H0	11.27	8.42	16.89	28.08	5.25	1.00
	43H1	11.22	8.31	16.84	27.63		
	44G9	11.53	9.04	16.45	26.37	6.12	2.33
	44H0	11.65	9.21	16.45	26.06	6.07	2.29
	44H1	10.73	7.43	16.00	23.92		

Table 6. Sprat stock characteristics in the Baltic Sea ICES SD 26N and 28.2
from the Latvian-Polish BASS conducted by r/v "Baltica" in the period of 18-25.05.2019

Table 6A CANUM		Age group								∑
ICES SD	ICES Rect.	1	2	3	4	5	6	7	8+	
26	41G9	43169.59	159473.89	54797.90	78302.18	227364.20	9200.51	13930.91	5121.69	591360.88
	41H0	180116.56	117801.59	27418.23	55199.31	132138.20	3274.90	10571.21	958.80	527478.78
28	42G9	29884.21	132837.35	47432.34	36767.91	125372.43	11404.86	4669.49	4383.85	392752.45
	42H0	28141.97	127534.29	32177.11	29819.94	108444.44	7871.78	1531.17	6444.40	341965.10
	43G9	15205.69	69306.60	26731.23	19846.83	81811.27	2810.02	3371.79	2461.83	221545.26
	43H0	49041.14	62526.55	15840.31	28876.80	79932.51	4191.70	6771.36	3804.41	250984.80
	43H1	32722.46	30963.76	7336.93	13248.71	40148.41	3450.36	3250.20	3090.11	134210.94
	44G9	8253.31	58320.42	21788.00	19708.80	66783.42	2863.83	2548.63	2661.05	182927.47
	44H0	5030.08	21174.89	10180.04	15383.38	33766.51	1993.59	1730.41	1886.28	91145.19
	44H1	72383.17	27901.01	13269.25	11756.63	36931.53	3726.08	348.18	188.10	166503.95

Table 6B $n10^6$		Age group								∑
ICES SD	ICES Rect.	1	2	3	4	5	6	7	8+	
26	41G9	305.85	1129.83	388.23	554.75	1610.82	65.18	98.70	36.29	4189.65
	41H0	315.81	206.55	48.07	96.78	231.69	5.74	18.54	1.68	924.86
28	42G9	229.51	1020.18	364.28	282.37	962.85	87.59	35.86	33.67	3016.30
	42H0	181.88	824.23	207.95	192.72	700.85	50.87	9.90	41.65	2210.05
	43G9	123.13	561.20	216.45	160.71	662.46	22.75	27.30	19.93	1793.94
	43H0	319.71	407.62	103.27	188.25	521.09	27.33	44.14	24.80	1636.21
	43H1	61.20	57.91	13.72	24.78	75.09	6.45	6.08	5.78	251.01
	44G9	57.77	408.22	152.51	137.95	467.46	20.05	17.84	18.63	1280.42
	44H0	95.06	400.18	192.39	290.72	638.14	37.68	32.70	35.65	1722.52
	44H1	374.89	144.51	68.72	60.89	191.28	19.30	1.80	0.97	862.36

Table 6C n, %		Age group								∑
ICES SD	ICES Rect.	1	2	3	4	5	6	7	8+	
26	41G9	7.30	26.97	9.27	13.24	38.45	1.56	2.36	0.87	100.00
	41H0	34.15	22.33	5.20	10.46	25.05	0.62	2.00	0.18	100.00
28	42G9	7.61	33.82	12.08	9.36	31.92	2.90	1.19	1.12	100.00
	42H0	8.23	37.29	9.41	8.72	31.71	2.30	0.45	1.88	100.00
	43G9	6.86	31.28	12.07	8.96	36.93	1.27	1.52	1.11	100.00
	43H0	19.54	24.91	6.31	11.51	31.85	1.67	2.70	1.52	100.00
	43H1	24.38	23.07	5.47	9.87	29.91	2.57	2.42	2.30	100.00
	44G9	4.51	31.88	11.91	10.77	36.51	1.57	1.39	1.45	100.00
	44H0	5.52	23.23	11.17	16.88	37.05	2.19	1.90	2.07	100.00
	44H1	43.47	16.76	7.97	7.06	22.18	2.24	0.21	0.11	100.00

Table 6D W, $kg10^3$		Age group								∑
ICES SD	ICES Rect.	1	2	3	4	5	6	7	8+	
26	41G9	1608.98	8334.81	3380.15	5362.73	15051.26	705.42	1190.97	440.07	36074.40
	41H0	1525.72	1559.84	438.59	988.39	2337.76	75.17	232.12	20.58	7178.17
28	42G9	1102.28	7637.09	3239.24	2727.58	9211.87	893.74	433.93	440.91	25686.65
	42H0	883.78	6112.33	1917.37	1858.50	6651.19	525.33	105.39	503.20	18557.08
	43G9	593.15	4318.96	2101.68	1544.69	6482.02	259.84	309.58	230.47	15840.38
	43H0	1490.90	3237.00	974.64	1818.77	5103.45	305.89	536.33	310.44	13777.41
	43H1	277.40	465.14	124.56	251.18	745.44	71.48	77.79	72.08	2085.07
	44G9	281.47	3186.87	1502.89	1340.99	4633.76	232.84	199.54	202.78	11581.14
	44H0	464.96	3161.55	1736.54	2864.32	6383.16	443.24	396.12	413.66	15863.55
	44H1	1665.32	1122.62	663.34	673.37	1992.73	248.46	25.41	12.10	6403.35

Table 6E W, %		Age group								∑
ICES SD	ICES Rect.	1	2	3	4	5	6	7	8+	
26	41G9	4.46	23.10	9.37	14.87	41.72	1.96	3.30	1.22	100.00
	41H0	21.26	21.73	6.11	13.77	32.57	1.05	3.23	0.29	100.00
28	42G9	4.29	29.73	12.61	10.62	35.86	3.48	1.69	1.72	100.00
	42H0	4.76	32.94	10.33	10.02	35.84	2.83	0.57	2.71	100.00
	43G9	3.74	27.27	13.27	9.75	40.92	1.64	1.95	1.45	100.00
	43H0	10.82	23.49	7.07	13.20	37.04	2.22	3.89	2.25	100.00
	43H1	13.30	22.31	5.97	12.05	35.75	3.43	3.73	3.46	100.00
	44G9	2.43	27.52	12.98	11.58	40.01	2.01	1.72	1.75	100.00
	44H0	2.93	19.93	10.95	18.06	40.24	2.79	2.50	2.61	100.00
	44H1	26.01	17.53	10.36	10.52	31.12	3.88	0.40	0.19	100.00

Table 6F w, g		Age group								∑
ICES SD	ICES Rect.	1	2	3	4	5	6	7	8+	
26	41G9	5.26	7.38	8.71	9.67	9.34	10.82	12.07	12.13	8.61
	41H0	4.83	7.55	9.12	10.21	10.09	13.09	12.52	12.24	7.76
28	42G9	4.80	7.49	8.89	9.66	9.57	10.20	12.10	13.10	8.52
	42H0	4.86	7.42	9.22	9.64	9.49	10.33	10.65	12.08	8.40
	43G9	4.82	7.70	9.71	9.61	9.78	11.42	11.34	11.56	8.83
	43H0	4.66	7.94	9.44	9.66	9.79	11.19	12.15	12.52	8.42
	43H1	4.53	8.03	9.08	10.14	9.93	11.08	12.80	12.47	8.31
	44G9	4.87	7.81	9.85	9.72	9.91	11.62	11.19	10.89	9.04
	44H0	4.89	7.90	9.03	9.85	10.00	11.76	12.11	11.60	9.21
	44H1	4.44	7.77	9.65	11.06	10.42	12.87	14.09	12.42	7.43

Table 6G L, g		Age group								∑
ICES SD	ICES Rect.	1	2	3	4	5	6	7	8+	
26	41G9	9.72	11.02	11.67	12.06	11.94	12.60	12.89	13.14	11.56
	41H0	9.41	10.97	11.70	12.20	12.11	13.16	12.91	12.75	10.95
28	42G9	9.50	10.89	11.63	11.95	11.94	12.18	13.06	13.43	11.40
	42H0	9.50	10.86	11.84	12.02	11.92	12.30	12.43	12.99	11.36
	43G9	9.40	10.95	11.86	11.80	11.88	12.56	12.63	12.79	11.44
	43H0	9.33	11.10	11.82	11.90	11.95	12.55	12.97	13.22	11.27
	43H1	9.25	11.17	11.68	12.13	12.04	12.54	13.28	13.23	11.22
	44G9	9.39	10.99	11.90	11.85	11.91	12.63	12.65	12.52	11.53
	44H0	9.38	11.06	11.66	11.96	12.02	12.70	12.81	12.81	11.65
	44H1	9.25	11.00	11.85	12.47	12.19	13.01	13.53	12.96	10.73

Table 7. Herring stock characteristics in the Baltic Sea ICES SD 26N and 28.2
from the Latvian-Polish BASS conducted by r/v "Baltica" in the period of 18-25.05.2019

Table 7A CANUM		Age group								
ICES SD	ICES Rect.	1	2	3	4	5	6	7	8+	∑
26	41G9		282.90	279.44	322.01	1676.16	346.63	806.58	854.58	4568.29
	41H0			26.40	305.22	855.79	359.62	287.50	346.81	2181.34
28	42G9		528.95	394.76	502.23	2575.77	319.50	854.31	717.35	5892.86
	42H0		169.80	153.48	1080.75	2034.68	686.92	1189.84	695.91	6011.38
	43G9		870.83	1148.43	2050.76	5578.19	1095.13	1381.62	855.12	12980.09
	43H0		2086.35	3983.03	8984.56	9977.41	3323.48	5159.23	2147.67	35661.74
	43H1		1130.78	2717.37	6018.50	5771.19	1873.34	3091.02	1084.39	21686.59
	44G9		1067.31	1455.13	2359.89	5363.81	919.46	1125.46	674.68	12965.74
	44H0		1081.47	1465.48	5239.91	6790.05	1254.01	2372.03	1594.23	19797.18
	44H1	129.72	2639.58	2159.87	10393.71	9709.05	2360.08	2654.93	1083.64	31130.57

Table 7B n10^6		Age group								
ICES SD	ICES Rect.	1	2	3	4	5	6	7	8+	∑
26	41G9		2.00	1.98	2.28	11.88	2.46	5.71	6.05	32.37
	41H0			0.05	0.54	1.50	0.63	0.50	0.61	3.82
28	42G9		4.06	3.03	3.86	19.78	2.45	6.56	5.51	45.26
	42H0		1.10	0.99	6.98	13.15	4.44	7.69	4.50	38.85
	43G9		7.05	9.30	16.61	45.17	8.87	11.19	6.92	105.11
	43H0		13.60	25.97	58.57	65.04	21.67	33.63	14.00	232.48
	43H1		2.11	5.08	11.26	10.79	3.50	5.78	2.03	40.56
	44G9		7.47	10.19	16.52	37.54	6.44	7.88	4.72	90.76
	44H0		20.44	27.70	99.03	128.32	23.70	44.83	30.13	374.14
	44H1	0.67	13.67	11.19	53.83	50.29	12.22	13.75	5.61	161.23

Table 7C n, %		Age group								
ICES SD	ICES Rect.	1	2	3	4	5	6	7	8+	∑
26	41G9		6.19	6.12	7.05	36.69	7.59	17.66	18.71	100.00
	41H0			1.21	13.99	39.23	16.49	13.18	15.90	100.00
28	42G9		8.98	6.70	8.52	43.71	5.42	14.50	12.17	100.00
	42H0		2.82	2.55	17.98	33.85	11.43	19.79	11.58	100.00
	43G9		6.71	8.85	15.80	42.97	8.44	10.64	6.59	100.00
	43H0		5.85	11.17	25.19	27.98	9.32	14.47	6.02	100.00
	43H1		5.21	12.53	27.75	26.61	8.64	14.25	5.00	100.00
	44G9		8.23	11.22	18.20	41.37	7.09	8.68	5.20	100.00
	44H0		5.46	7.40	26.47	34.30	6.33	11.98	8.05	100.00
	44H1	0.42	8.48	6.94	33.39	31.19	7.58	8.53	3.48	100.00

Table 7D W, kg10^3		Age group								
ICES SD	ICES Rect.	1	2	3	4	5	6	7	8+	∑
26	41G9		41.99	55.25	69.81	365.04	93.34	222.72	282.65	1130.80
	41H0			0.90	15.70	46.86	23.17	18.76	26.58	131.98
28	42G9		87.13	78.34	106.31	603.20	88.38	248.09	241.08	1452.53
	42H0		25.97	25.27	195.85	404.72	162.89	279.84	188.85	1283.38
	43G9		119.89	217.89	443.05	1310.88	290.77	382.12	286.89	3051.48
	43H0		244.61	601.82	1470.95	1828.34	700.26	1143.92	538.38	6528.29
	43H1		39.51	116.97	279.11	300.99	112.82	195.48	75.88	1120.77
	44G9		127.01	231.26	410.96	1024.98	191.12	247.42	160.79	2393.55
	44H0		352.19	579.38	2325.28	3307.80	762.31	1425.47	996.59	9749.01
	44H1	6.05	220.87	224.43	1277.62	1241.46	340.92	377.91	168.14	3857.39

Table 7E W, %					Age group				
ICES SD	ICES Rect.	1	2	3	4	5	6	7	8+	∑
26	41G9		3.71	4.89	6.17	32.28	8.25	19.70	25.00	100.00
	41H0			0.68	11.90	35.50	17.55	14.22	20.14	100.00
28	42G9		6.00	5.39	7.32	41.53	6.08	17.08	16.60	100.00
	42H0		2.02	1.97	15.26	31.54	12.69	21.80	14.71	100.00
	43G9		3.93	7.14	14.52	42.96	9.53	12.52	9.40	100.00
	43H0		3.75	9.22	22.53	28.01	10.73	17.52	8.25	100.00
	43H1		3.53	10.44	24.90	26.86	10.07	17.44	6.77	100.00
	44G9		5.31	9.66	17.17	42.82	7.98	10.34	6.72	100.00
	44H0		3.61	5.94	23.85	33.93	7.82	14.62	10.22	100.00
	44H1	0.16	5.73	5.82	33.12	32.18	8.84	9.80	4.36	100.00

Table 7F w, g					Age group					
ICES SD	ICES Rect.	1	2	3	4	5	6	7	8+	∑
26	41G9		20.95	27.91	30.60	30.74	38.01	38.97	46.68	34.94
	41H0			19.50	29.34	31.23	36.74	37.22	43.71	34.51
28	42G9		21.45	25.84	27.56	30.49	36.02	37.81	43.76	32.10
	42H0		23.67	25.48	28.04	30.78	36.69	36.39	41.99	33.03
	43G9		17.00	23.43	26.68	29.02	32.79	34.16	41.43	29.03
	43H0		17.98	23.18	25.11	28.11	32.32	34.01	38.45	28.08
	43H1		18.68	23.02	24.80	27.89	32.20	33.81	37.42	27.63
	44G9		17.00	22.71	24.88	27.30	29.70	31.41	34.05	26.37
	44H0		17.23	20.92	23.48	25.78	32.17	31.80	33.08	26.06
	44H1	9.00	16.16	20.06	23.73	24.69	27.89	27.48	29.96	23.92

Table 7G L, g					Age group					
ICES SD	ICES Rect.	1	2	3	4	5	6	7	8+	∑
26	41G9		15.02	16.60	17.29	17.19	18.62	18.87	20.13	17.98
	41H0			15.25	17.22	17.56	18.58	18.56	20.28	18.22
28	42G9		14.90	16.19	16.70	17.17	18.33	18.61	19.45	17.41
	42H0		15.57	16.26	16.84	17.36	18.54	18.38	19.63	17.79
	43G9		13.97	15.71	16.41	16.93	17.77	18.08	19.34	16.90
	43H0		14.25	15.78	16.29	16.95	17.89	18.19	19.04	16.89
	43H1		14.46	15.74	16.24	16.96	17.89	18.19	19.04	16.84
	44G9		13.98	15.53	16.11	16.69	17.32	17.76	18.27	16.45
	44H0		14.07	15.16	15.92	16.43	17.81	17.79	17.99	16.45
	44H1	10.75	13.80	15.06	16.01	16.22	16.99	16.84	17.59	16.00

Table 8. BASS statistics related to cod from the Latvian-Polish BASS in the Baltic Sea ICES SD 26N and 28.2 conducted by r/v "Baltica" in the period of 18-25.05.2019

Table 5A									
ICES SD	ICES Rect.	L, cm	w, g	$NASC_{PEL}$ m^2nm^{-2}	σ 10^4 m^2	TS calc. dB	ρ $n10^6nm^{-2}$	Abundance $n10^6$	Biomass $kg10^3$
26	41G9	28.19	225.15	0.283	18.20	-28.45	155.36	155364.74	34.98
	41H0	27.17	185.33	0.001	16.87	-28.78	0.76	728.04	0.13
28	42G9	27.47	208.63	0.261	17.42	-28.64	149.82	147856.70	30.85
	42H0	27.72	217.12	0.148	17.88	-28.53	82.85	80242.07	17.42
	43G9	27.64	211.83	0.275	17.67	-28.58	155.46	151368.83	32.06
	43H0	27.43	197.21	0.155	17.31	-28.67	89.64	87283.33	17.21
	43H1	27.42	190.76	0.066	17.23	-28.69	38.26	15791.94	3.01
	44G9	27.18	198.83	0.065	17.14	-28.71	37.97	33283.52	6.62
	44H0	28.96	244.29	0.255	19.45	-28.16	131.24	126056.68	30.79
	44H1	27.00	180.80	0.025	16.51	-28.87	15.17	12511.91	2.26

Table 9. Number of sprat eggs and larvae per 1 m^2 or per 10 minutes of sampling on water surface in the Baltic Sea ICES SD 26N and 28.2 from the Latvian-Polish BASS conducted by r/v "Baltica" in the period of 18-25.05.2019

Aquatory	Northern part		Central part		Southern part	
Depth strata	>70m	<70m	>70m	<70m	>70m	<70m
Eggs (per 1m^2)	74	–	158	0	246	11.4
Larvae (per 1m^2)	0	–	6	0	23.6	0
Eggs (per 10 min. of haul on the water surface)	0	–	2.7	7	8.5	8
Larvae (per 10 min. of haul on the water surface)	0.3	–	0.7	2.25	2.3	1

Northern part of the Gotland Basin – to the north from 57°30’N
Central part of the Gotland Basin – between 56°30’N and 57°30’N
Southern part of the Gotland Basin – to the south from 56°30’N.

Table 10. The average number and average biomass of zooplankton organisms in 0-100m water column per volume unit in the Baltic Sea ICES SD 26N and 28.2 from the Latvian-Polish BASS conducted by r/v "Baltica" in the period of 18-25.05.2019

Species	2019		Long term average (1960-2018)	
	Biomass (mg/m^3)	Biomass (%)	Biomass (mg/m^3)	Biomass (%)
Acartia spp.	43.6200	14.2324	18.1156	11.5366
Centropages hamatus	16.3000	5.3184	2.6632	1.6960
Cyclops spp.			0.0519	0.0331
Eurytemora affinis	0.8400	0.2741	0.2936	0.1870
Limnocalanus macrurus			0.3199	0.2037
Mesochra rapiens			0.0005	0.0003
Oithona sp.	0.0100	0.0033	0.1181	0.0752
Pseudocalanus sp.	10.7200	3.4977	31.4565	20.0325
Temora longicornis	55.5000	18.1087	11.5951	7.3842
Bosmina spp.	0.0800	0.0261	0.0912	0.0581
Evadne spp.	22.1100	7.2141	11.7479	7.4814
Podon spp.	0.2900	0.0946	1.5285	0.9734
Keratella spp.	0.0030	0.0010	0.0004	0.0002
Synchaeta spp.	137.2700	44.7888	58.6496	37.3500
Amphibalanus improvisus larvae			0.0012	0.0007
Bivalvia larvae	0.3100	0.1011	0.0959	0.0611
Fritillaria borealis	13.0700	4.2645	14.3987	9.1696
Pleurobrachia pileus			0.1276	0.0812
Polychaeta larvae	6.3600	2.0752	5.7692	3.6740
Copepoda	126.9900	41.4346	64.6144	41.1486
Cladocera	22.4800	7.3348	13.3675	8.5129
Eurotatoria	137.2730	44.7898	58.6500	37.3502
Varia	19.7400	6.4408	20.3953	12.9884
Total	306.4830	100.0000	157.0273	100.0000

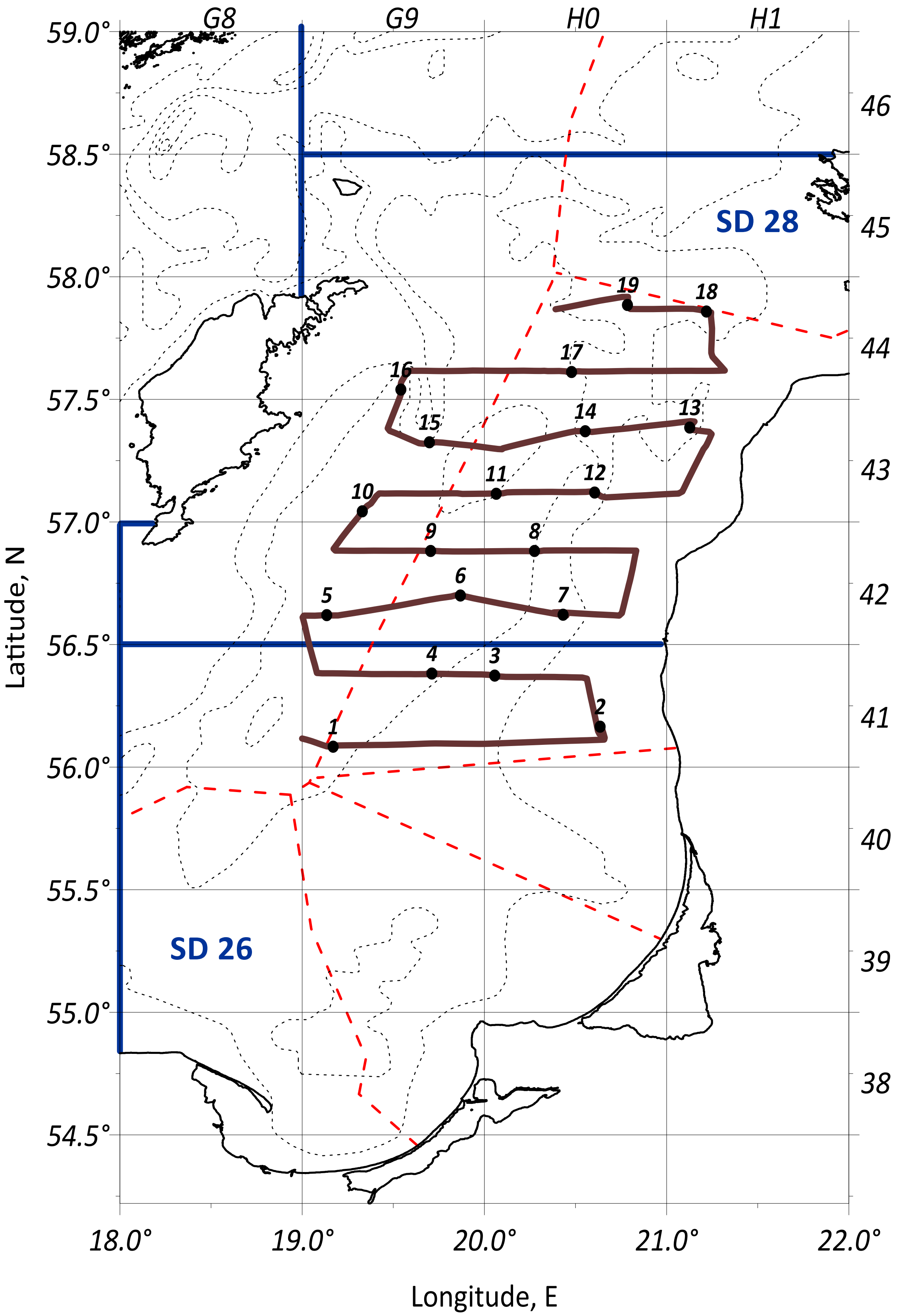

Figure 1: Cruise track design and trawling positions of the Latvian-Polish BASS on the r/v "Baltica" in the period of 18-25.05.2019.

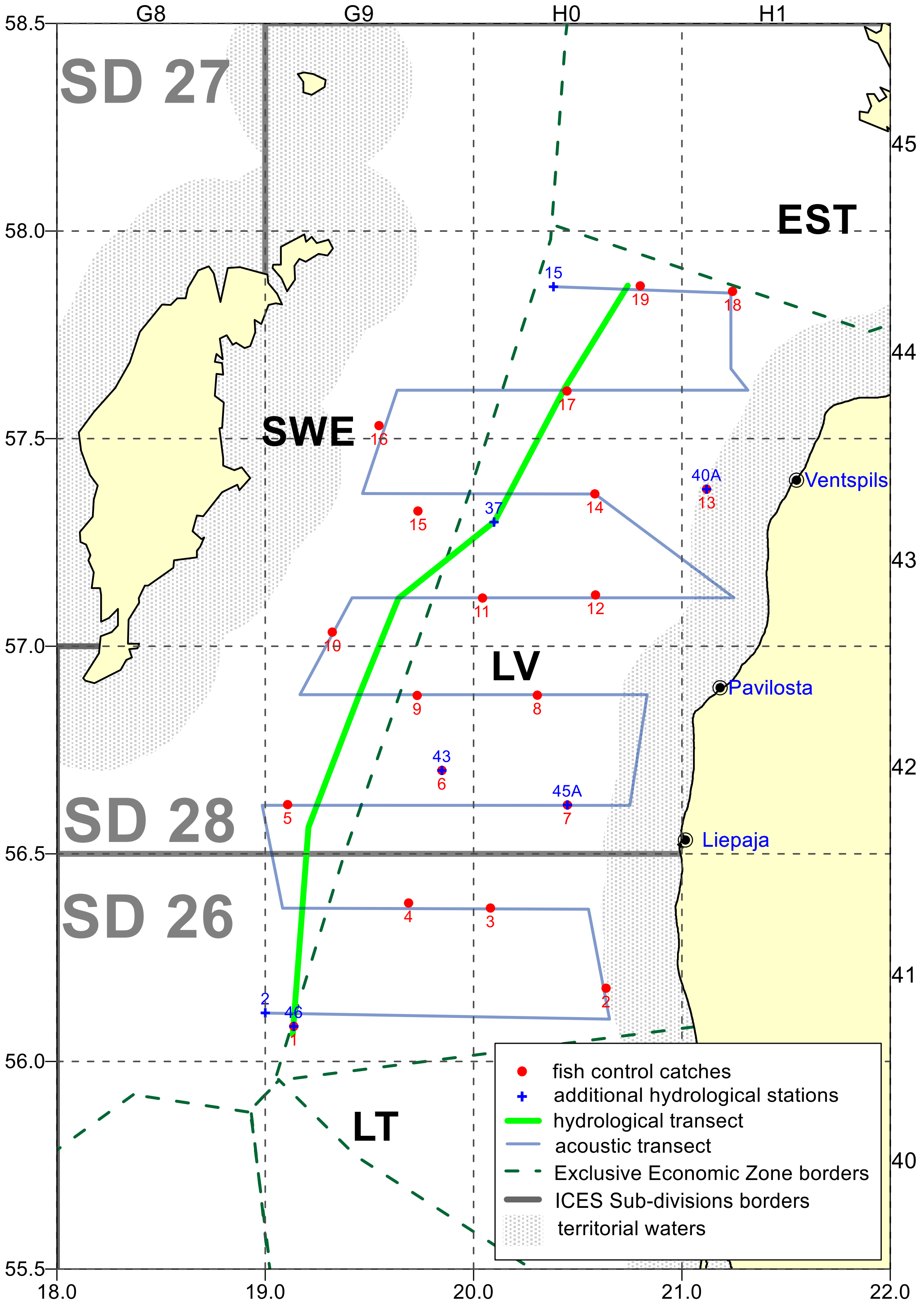

Figure 2: Locations of the hydrological, ichthyoplankton and zooplankton stations performed during the Latvian-Polish BASS on the r/v "Baltica" in the period of 18-25.05.2019.

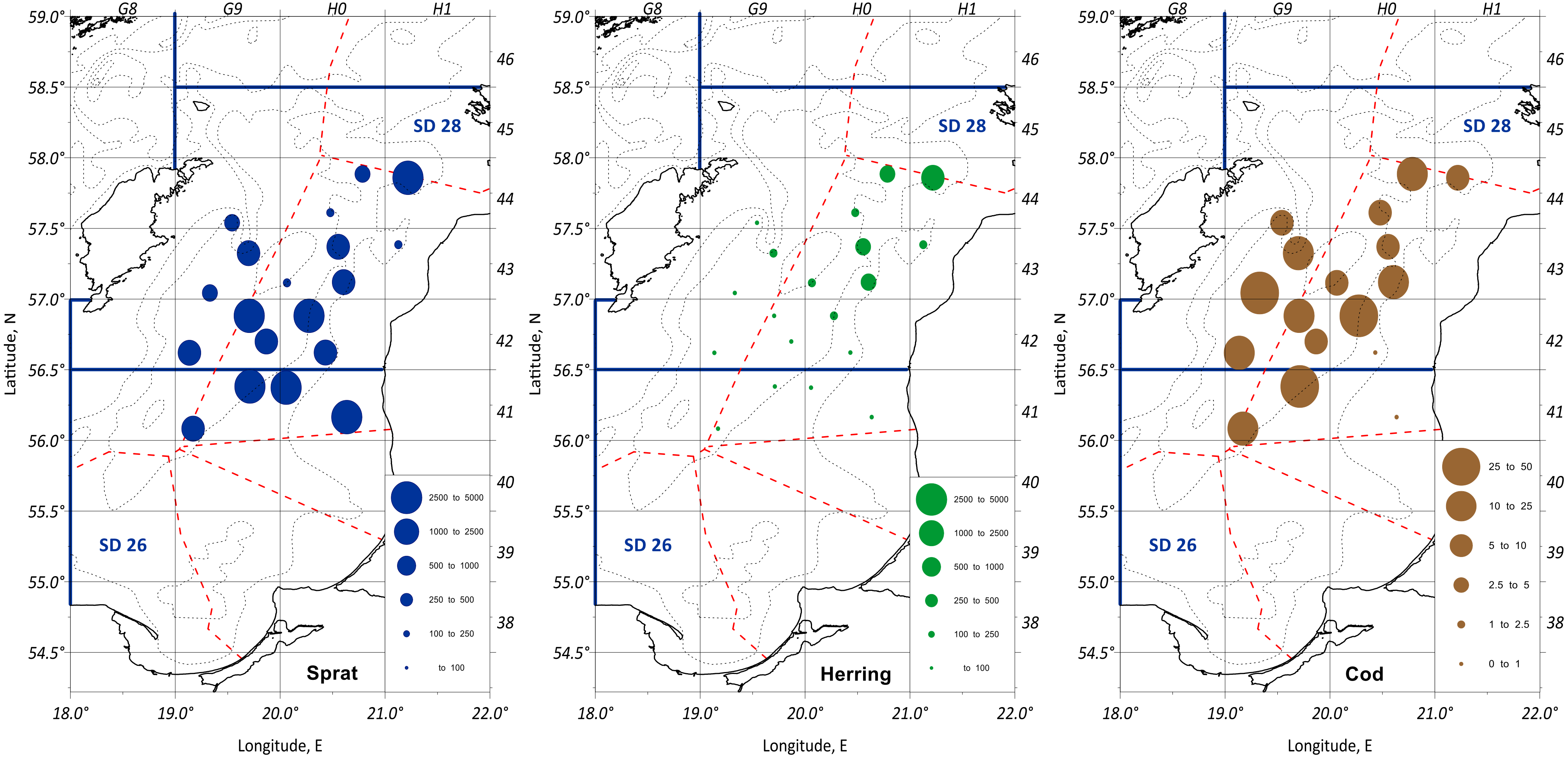

Figure 3: CPUE [kg/h] ranges distribution of dominant fish in the catch hauls in the Baltic Sea ICES SD 26N and 28.2 from the Latvian-Polish BASS conducted by r/v "Baltica" in the period of 18-25.05.2019.

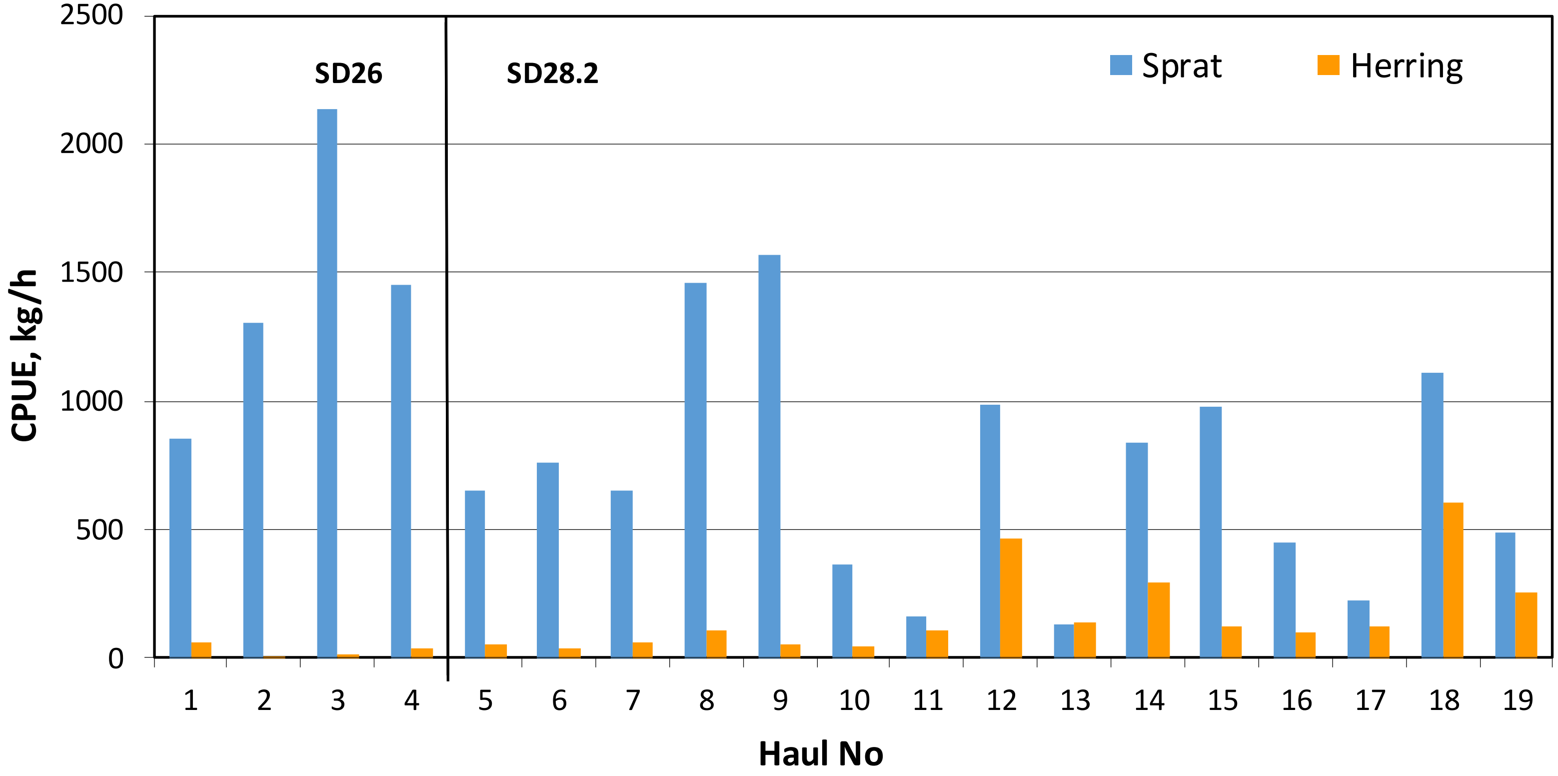

Figure 4: CPUE [kg/h] of dominant pelagic fish in the catch hauls in the Baltic Sea ICES SD 26N and 28.2 from the Latvian-Polish BASS conducted by r/v "Baltica" in the period of 18-25.05.2019.

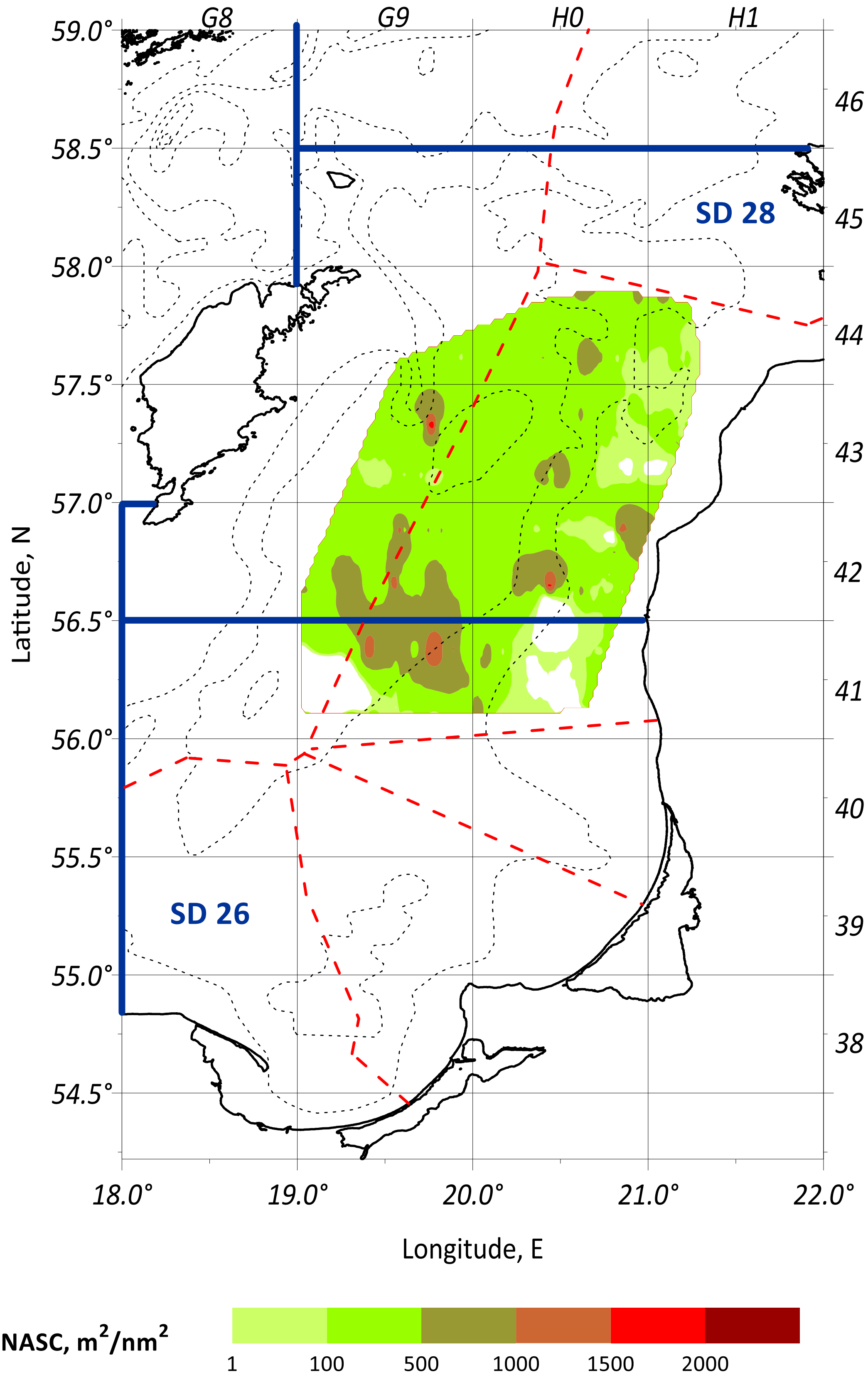

Figure 5: Acoustic parameter NASC distribution in the Baltic Sea ICES SD 26N and 28.2 from the Latvian-Polish BASS conducted by r/v "Baltica" in the period of 18-25.05.2019.

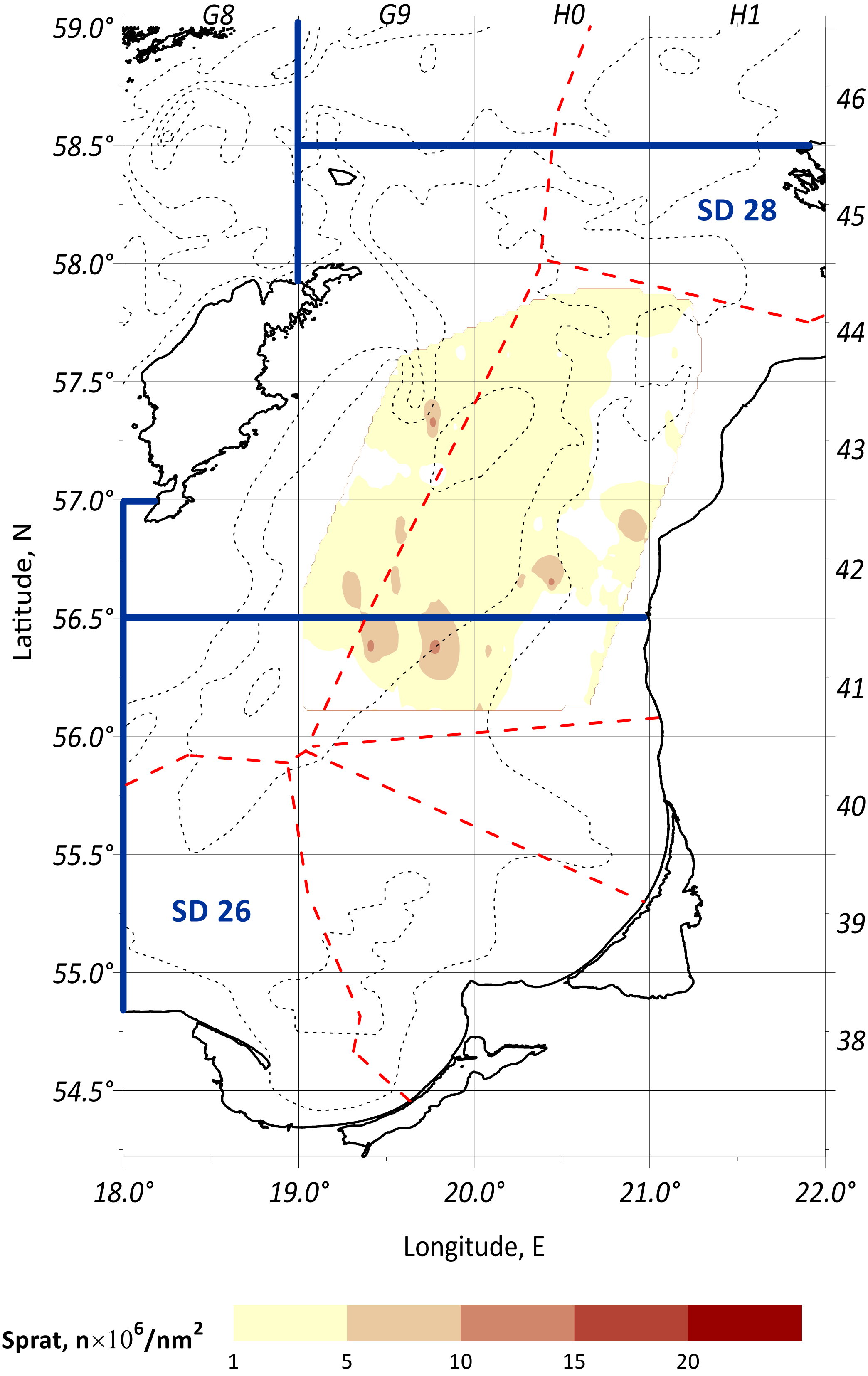

Figure 6: Sprat distribution in the Baltic Sea ICES SD 26N and 28.2 from the Latvian-Polish BASS conducted by r/v "Baltica" in the period of 18-25.05.2019.

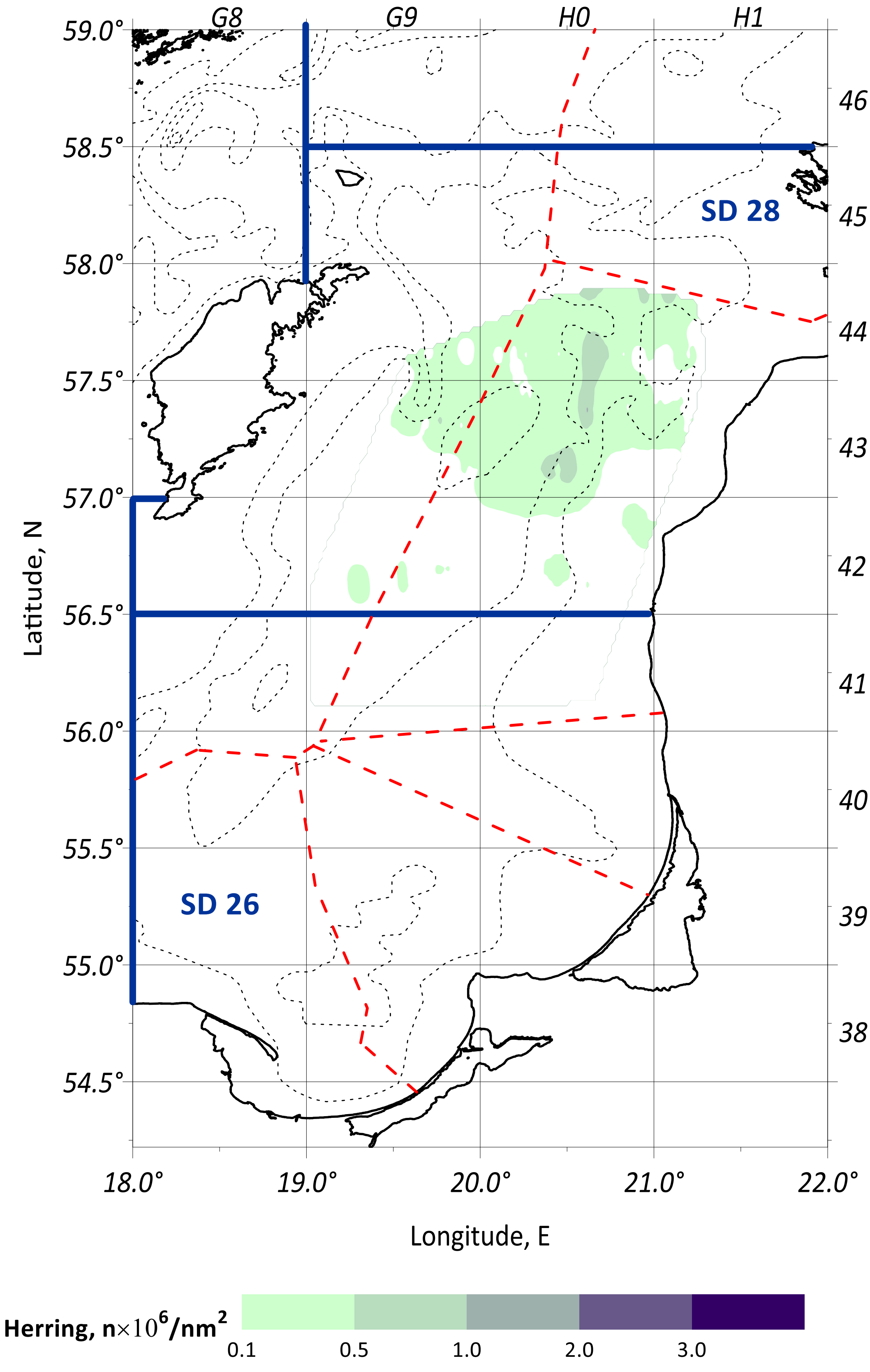

Figure 7: Herring distribution in the Baltic Sea ICES SD 26N and 28.2 from the Latvian-Polish BASS conducted by r/v "Baltica" in the period of 18-25.05.2019.

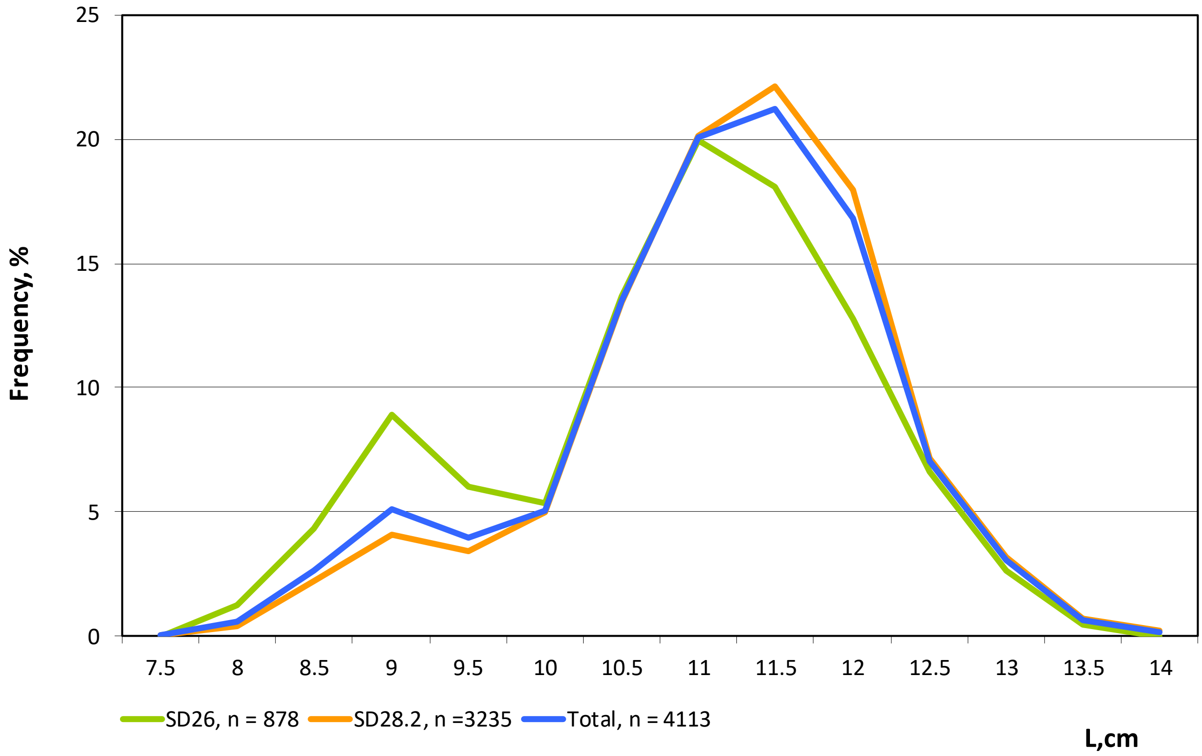

Figure 8: Sprat length distributions in control catches in the Baltic Sea ICES SD 26N and 28.2 from the Latvian-Polish BASS conducted by r/v "Baltica" in the period of 18-25.05.2019.

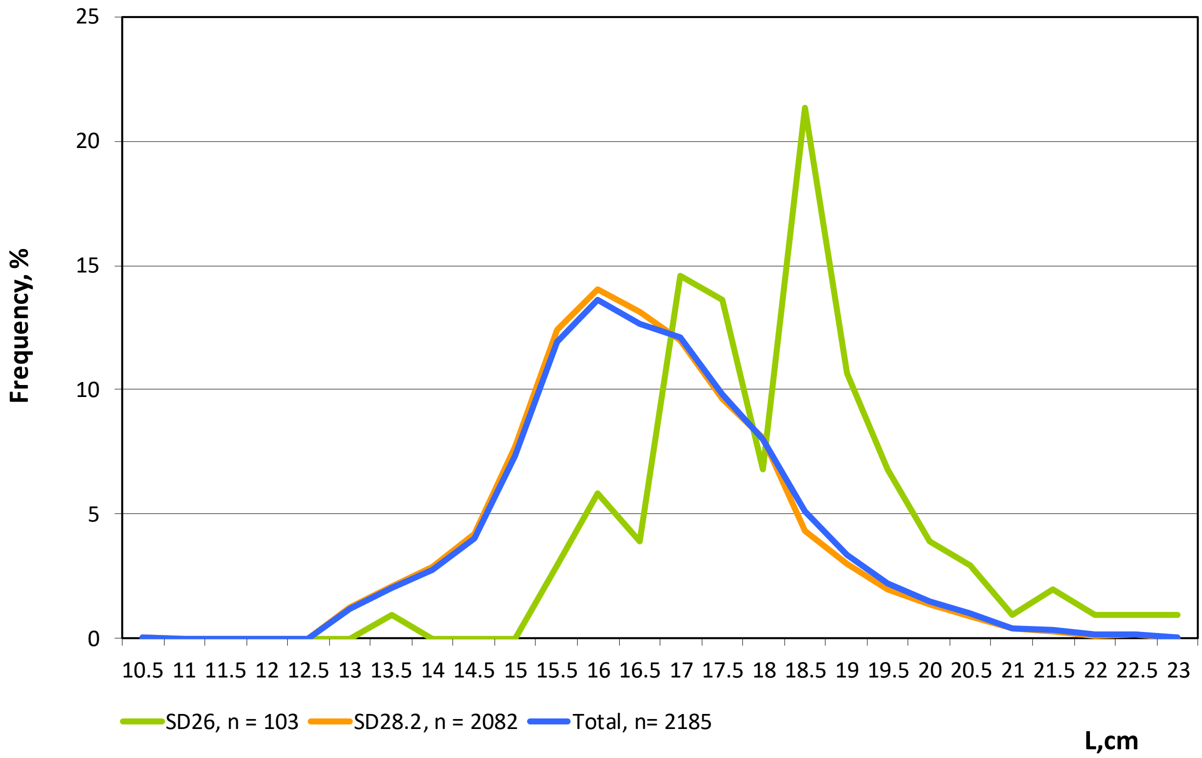

Figure 9: Herring length distributions in control catches in the Baltic Sea ICES SD 26N and 28.2 from the Latvian-Polish BASS conducted by r/v "Baltica" in the period of 18-25.05.2019.

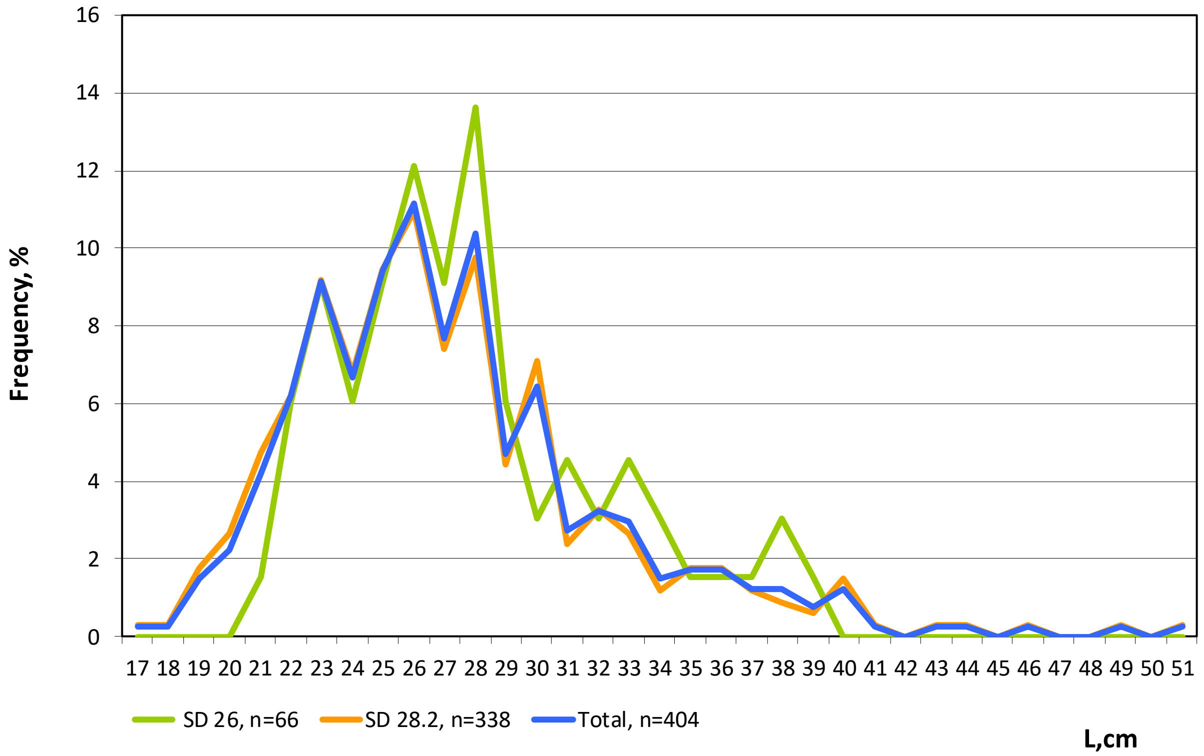

Figure 10: Cod length distributions in control catches in the Baltic Sea ICES SD 26N and 28.2 from the Latvian-Polish BASS conducted by r/v "Baltica" in the period of 18-25.05.2019.

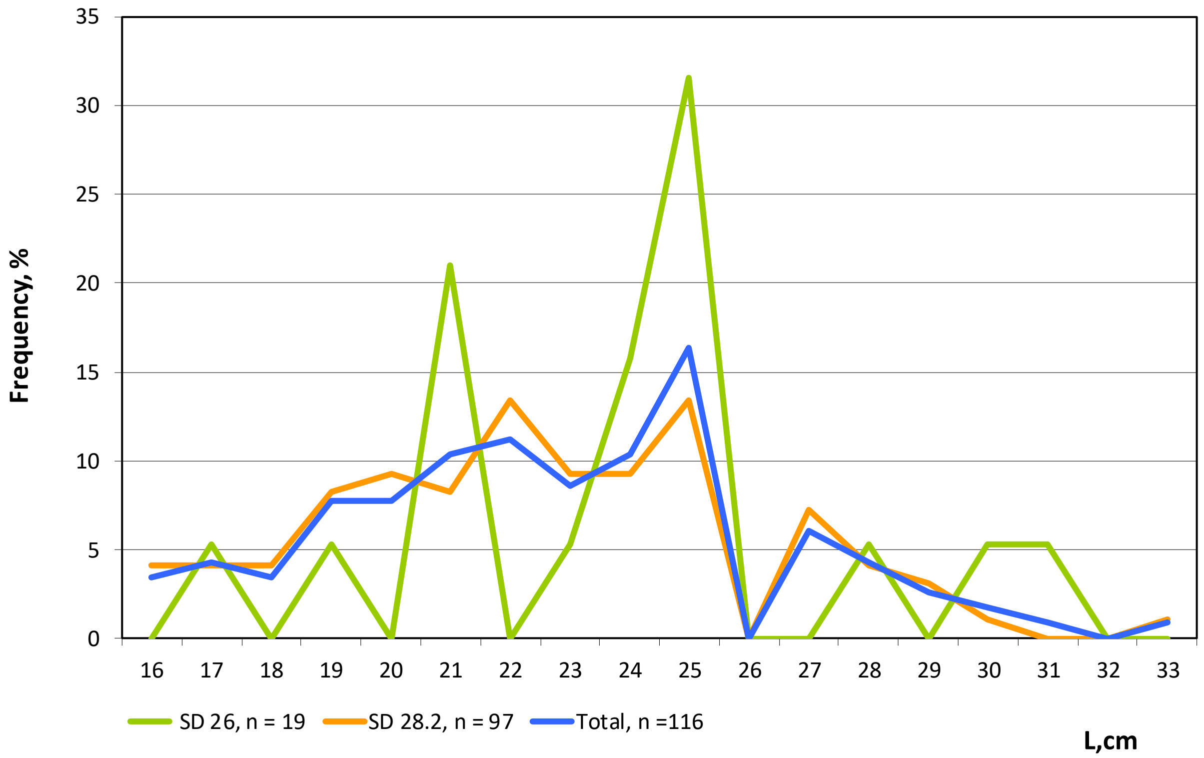

Figure 11: Flounder length distributions in control catches in the Baltic Sea ICES SD 26N and 28.2 from the Latvian-Polish BASS conducted by r/v "Baltica" in the period of 18-25.05.2019.

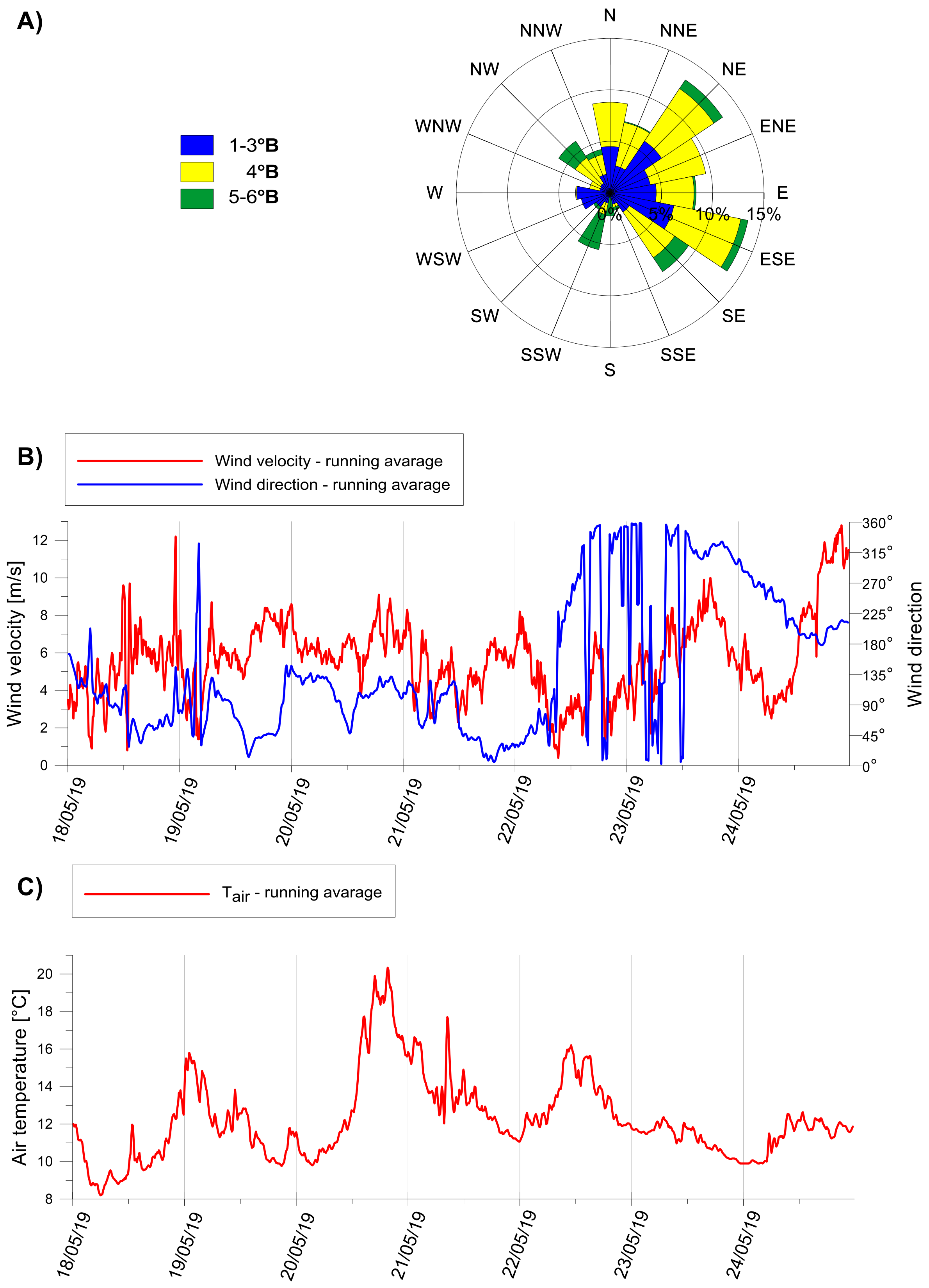

Figure 12: Changes of the main meteorological parameters (wind force, direction and the daily air temperature) during the Latvian-Polish BASS in the Baltic Sea ICES SD 26N and 28.2 conducted by r/v "Baltica" in the period of 18-25.05.2019.

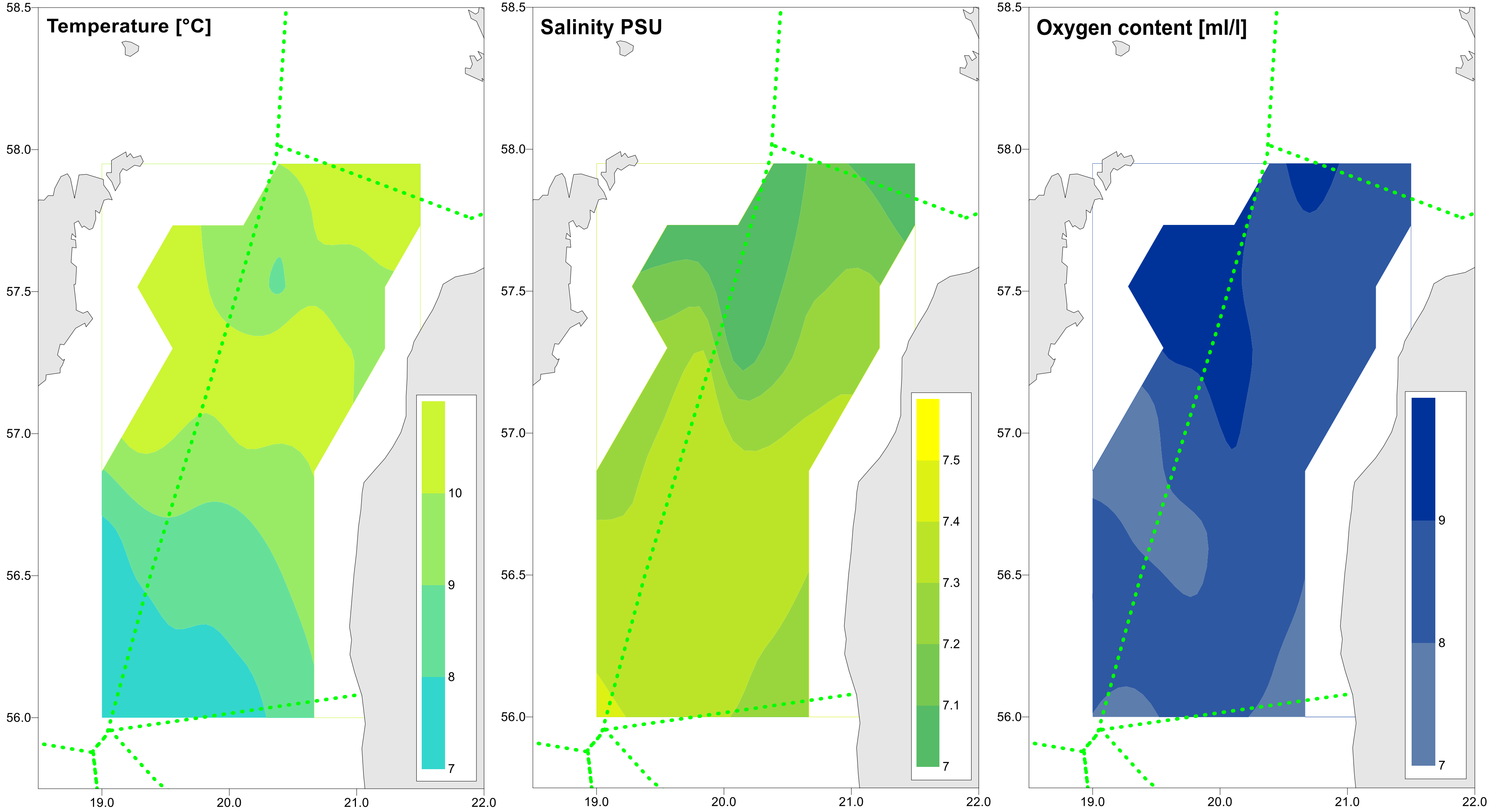

Figure 13: Horizontal distribution of the main hydrological parameters (temperature, salinity, oxygen content) measured in the surface water layer of the Gotland Deep in the Baltic Sea ICES SD 26N and 28.2 from the Latvian-Polish BASS conducted by r/v "Baltica" in the period of 18-25.05.2019.

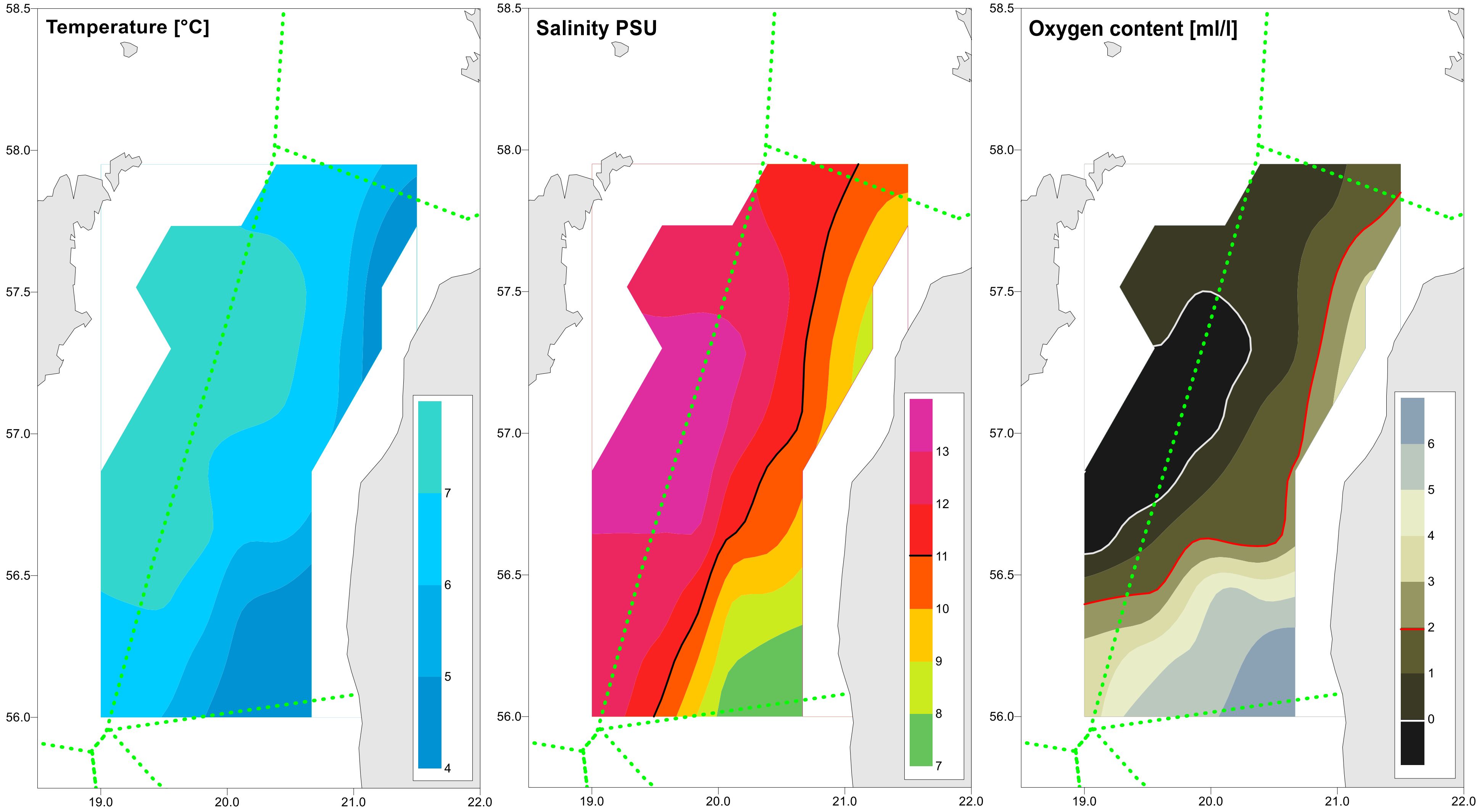

Figure 14: Horizontal distribution of the main hydrological parameters (temperature, salinity, oxygen content) measured in the bottom water layer of the Gotland Deep in the Baltic Sea ICES SD 26N and 28.2 from the Latvian-Polish BASS conducted by r/v "Baltica" in the period of 18-25.05.2019.

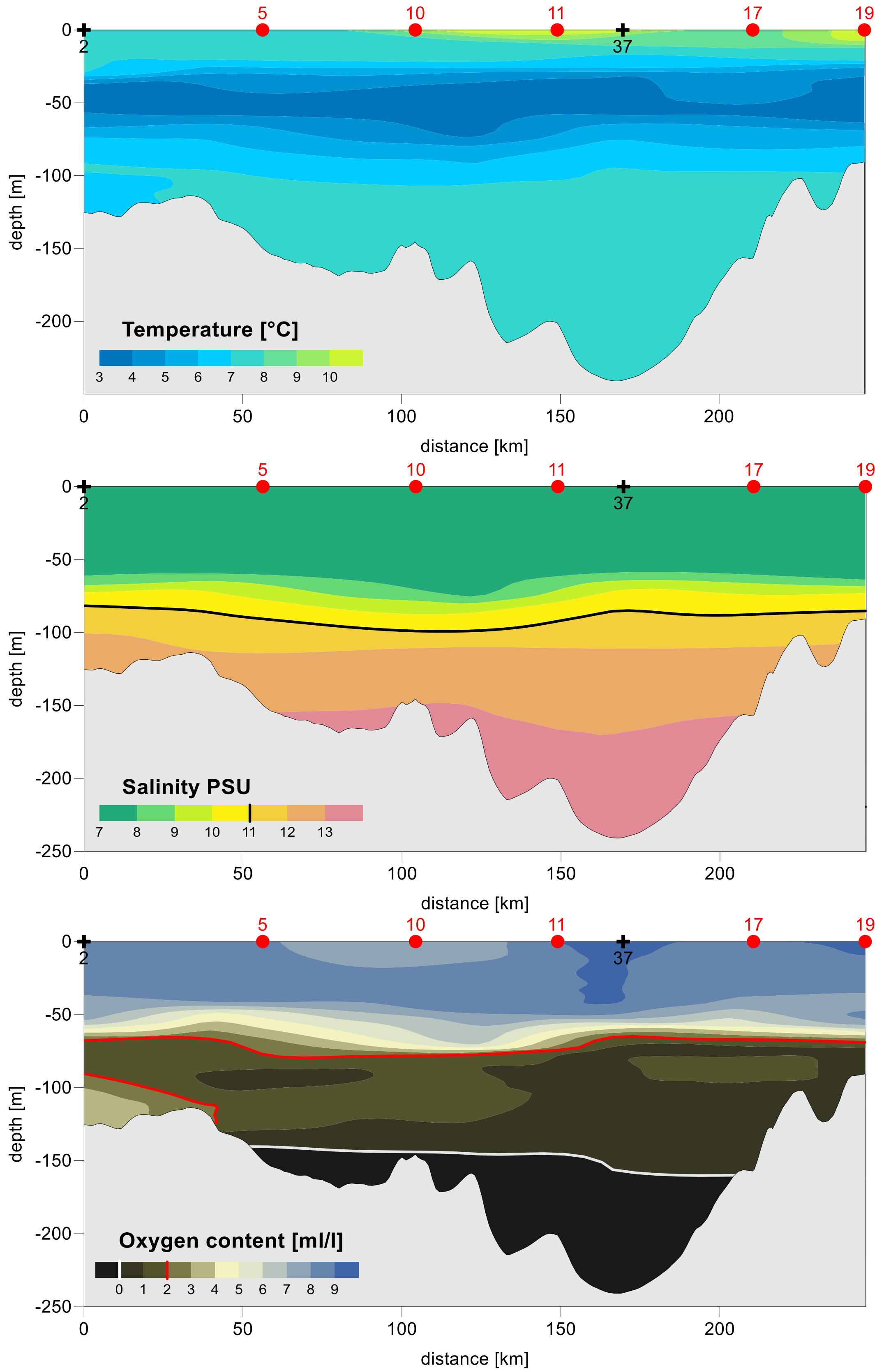

Figure 19: Vertical distribution of the seawater temperature, salinity and oxygen content along the hydrological profile in the Baltic Sea ICES SD 26N and 28.2 from the Latvian-Polish BASS survey conducted by r/v "Baltica" in the period of 18-25.05.2018.

Table 3. Cod length measurements by consecutive hauls in the r.v. "Baltica" Latvian - Polish BITS 1Q survey (07-15 March 2020); specimens grouped by 1 cm length classes.

		cm_group																						
Haul no	SD	12	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	43	47	48	Sum
1	26															1								1
3	28								1															1
5	28	1		1			1	1	1	2		1								1				9
6	28		1						1	1		1							1					5
9	28									1		1												2
10	28				1							1				1								3
11	28				1	2		1		5		1		2	1				1				1	15
12	28				1	1	5	2	1	2	4	2	2	2		3								25
16	28					3	3	5	3	1	2	5	4	2	1	1		2	1					33
17	28			1		1		1	2	7	4	1	2	2	2	2	1	1	1		1	1		30
SD 26																1								1
SD 28		1	1	2	3	7	9	10	9	19	10	13	8	8	4	7	1	3	4	1	1	1	1	123
Total		1	1	2	3	7	9	10	9	19	10	13	8	8	4	8	1	3	4	1	1	1	1	124

Table 4. Flounder length measurements by consecutive hauls in the r/v "Baltica" Latvian - Polish BITS 1Q survey (07 - 15 March 2020); specimens grouped by 1 cm length classes.

		cm_group																								
Haul no	SD	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	39	Sum
1	26				1	2	9	22	26	27	25	30	20	13	13	12	3	2									205
2	28							5	2		4	4	1	2	1	1	2	1		1							24
3	28						1	1	3	7	4	2		1	1							1					21
4	28			1		3	3	3	6	9	7	4	10	5	3	2	2	2		1							61
5	28				1	3	6	15	18	20	19	26	18	15	8	11	7	2	2	2	1			1			175
6	28				3	5	22	28	31	43	30	26	22	14	14	6	9	5	2	1	2			1			264
7	28						4	10	8	9	4	8	3	1	1	1	2			1	1				1	1	55
8	28		1				1	2	1	4	3	1	1	1	2												17
9	28			1		2	4	2	4	2	5	6	3	4	1	1		2									37
10	28			1	2	4	8	13	19	22	19	24	17	16	20	10	5	9	6	3	1	1					200
11	28				2	3	3	2	2	1	1	3	1	3	2	1	1										25
12	28			2	7	18	27	33	36	44	38	29	15	8	8	6		1									272
13	28		1		4	9	20	30	29	33	11	10	20	8	5	1	1										182
14	28	1		2	7	12	19	27	33	34	44	39	14	12	7	3	6	1	2								263
15	28			1		3	10	11	15	24	6	6	4	1	2	2			1								86
16	28					2	9	9	22	22	22	15	9	8	3	5	3						1				130
17	28		2	1	2	4	4	7	7	8	6	5	2	2				1									51
SD 26					1	2	9	22	26	27	25	30	20	13	13	12	3	2									205
SD 28		1	4	9	28	68	141	198	236	282	223	208	140	101	78	50	38	24	13	9	5	2	1	2	1	1	1863
Total		1	4	9	29	70	150	220	262	309	248	238	160	114	91	62	41	26	13	9	5	2	1	2	1	1	2068

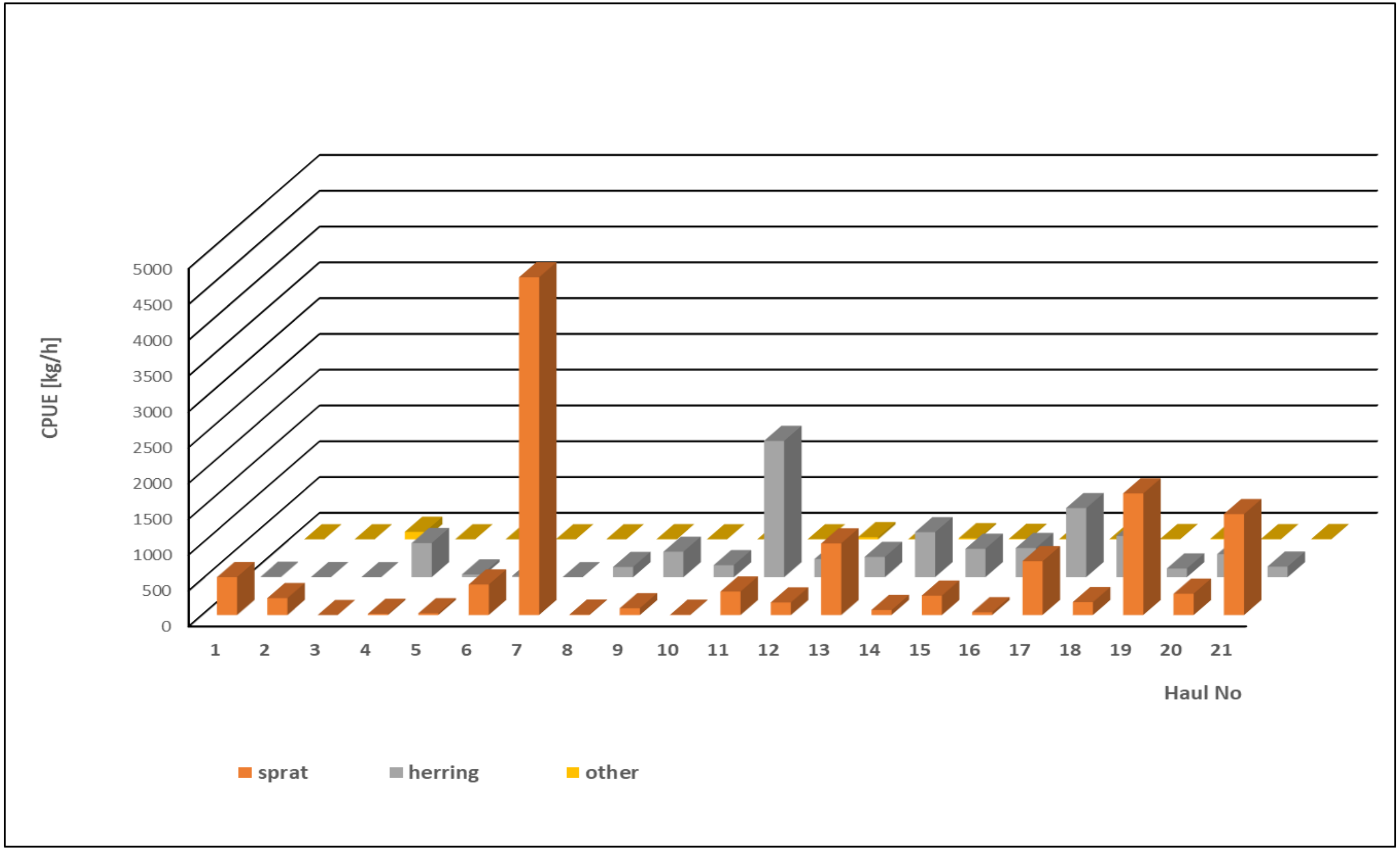

Fig. 2. CPUE values (kg/h) of sprat and herring in particular pelagic fish control catches during the joint EST-POL BIAS in the North-eastern Baltic Sea (Sub-divisions 28.2, 29 and 32), October 2019.

MARINE RESEARCH INSTITUTE, KLAIPEDA UNIVERSITY

RESEARCH REPORT FROM THE BALTIC ACOUSTIC SPRING SURVEY (BASS) IN THE ICES SUBDIVISION 26 (LITHUANIAN EXCLUSIVE ECONOMIC ZONE) OF THE BALTIC SEA

(Vessel “169”; 02.06 - 03.06.2019)

Klaipeda, June, 2019
Lithuania

1 INTRODUCTION

The main objective is to assess clupeids resources in the Baltic Sea. The Lithuanian survey is coordinated within the frame of the **Baltic International Spring Survey (BASS).** The reported acoustic survey is conducted to supply the ICES Baltic Fisheries Assessment Working Group (WGBFAS) and the Marine Research Institute, (Klaipeda University, Lithuania) with an index value for the stock size of herring and sprat in parts of the ICES subdivision (SD) 26 (Lithuanian Exclusive Economic Zone).

2 METHODS

2.1 Participants

The main research tasks of the BASS survey on board of the vessel "169" were realized by the Marine Research Institute two members of the scientific team. The group of researchers was composed of:

M. Špėgys, MRI KU, Klaipeda - cruise leader and acoustics;
J.Fedotova MRI KU, Klaipeda – scientific staff and fish sampling.

2.2 Narrative

The cruise of BASS survey took place from 02-th to 03-th of May 2019. The cruise was intended to cover parts of ICES subdivisions (SD) 26, constituting the Lithuanian Exclusive Economic zone in 40H0 and 40G9 rectangles.

2.3 Survey design

The statistical rectangles were used as strata (ICES 2016). The area is limited by the 20 m depth line. The scheme of transects is defined as the regular. The average speed of a vessel for the period of acoustic survey was 8 knots. The average speed of the vessel with a trawl was 2.8 knots. Duration of trawling was 30 minutes. The survey was conducted in the daytime from 08.00 up to 20.00. The survey area was 1520 nm^2 and the distance used for acoustic estimates was 125 nm. The entire cruise track with positions of the trawling is shown in Fig. 1.

2.4 Calibration

The SIMRAD EK60 echo sounder with split beam transducer ES38 - 12 was calibrated (17 of October 2018) at the site of 30 m depth, located 3.5 nm northwest of Klaipeda harbour according to the BIAS manual (ICES 2016). S_v correction after calibration was set to 21.94 dB.

THE RESULTS OF CALIBRATION PROCEDURE FOR EK60 SCIENTIFIC ECHOSOUNDER	
Date: 17.10.2018	Place : near Klaipeda port
Type of transducer	Split – beam for 38 kHz
Gain (38 kHz)	21.94 dB
Athw. Angle Sens	12.5
Along. Angle Sens	12.5
Athw. Beam Angle	12.06
Along. Beam Angle	11.96
Athw. Offset Angle	-0.15
Along. Offset Angle	-0.15
SA Correction (38 kHz)	0.0 dB

2.5 Acoustic data collection

The acoustic sampling was performed around the clock. The main pelagic species of interest were herring and sprat. The SIMRAD EK60 echo sounder with hull mounted 38 kHz transducer ES38-12 was used during the cruise. The specific settings of the hydro acoustic equipment were used as described in the BIAS manual (ICES 2016). The post-processing of the stored echo signals was made using the Sonar4 (Balk & Lindem, 2005). The mean volume back scattering values S_v, were integrated over 1 nm intervals, from 10 m below the surface 1 m to the bottom. Contributions from air bubbles, bottom structures and noise scattering layers were removed from the echogram using Sonar4.

2.6 Biological data – fishing stations

All trawling was done with the pelagic gear in the midwater as well as near the bottom. The mesh size in the codend was 10 mm. The intention was to carry out at least two hauls per ICES statistical rectangle. The trawling depth was chosen by the echogram, in accordance to the characteristic of echo records from the fish. Normally, the trawl had vertical opening of about 12 m. The trawling time lasted 30 minutes. From each haul sub-samples were taken to determine length and weight composition of fish. Samples of herring and sprat were analyzed for further investigations on the board of vessel (i.e. sex, maturity, age).

2.7 Data analysis

The pelagic target species sprat and herring are usually distributed in mixed layers in combination with other species, so that it is impossible to allocate the integrator readings to a single species. Therefore, the species composition was based on the trawl catch results. For each rectangle the species composition and length distribution were determined as the mean - weighted of all trawl results in this rectangle. From these distributions the mean acoustic cross section σ was calculated according to the following target strength-length (TS) relationships:

Clupeoids	TS = 20 log L (cm) - 71.2	(ICES 1983/H:12)
Gadoids	TS = 20 log L (cm) - 67.5	(Foote et al. 1986)

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

3 RESULTS

3.1 Biological data

726 herrings and 1919 sprats were measured and 469 herrings and 510 sprats were aged in 7 trawl hauls (Fig. 1)

The results of the catch composition are presented in Table 1. In all catch compositions sprat was dominated (from 61.68% to 100%).

The length distributions of herring and sprat of the June 2019 were presented in Fig.2 and Fig.3. In the both ICES rectangles in herring catches were dominated by 16-17.5 cm length classes and more of them were 2014 herring generation in the 40Ho rectangle (29.5%). (Table 10, 12).

Sprat dominated by 9.5 – 11.5 cm length class in 40H0 ICES rectangle (79.0%). And 74% of sprats dominated by 10.5 – 12.0 cm length classes in 40G 9 rectangle witch age were 4-5 years old fishes.

3.2 Acoustic data

The survey statistics concerning the survey area, the mean S_a, the mean scattering cross section **σ**, the estimated total number of fish, the percentages of herring, sprat per rectangle are shown in Table 2-14.

3.3 Abundance estimates

Vessel "Darius" survey statistics (aggregated data for herring and sprat), included the total abundance of herrings and sprats are presented in Tables 2-4. The estimated age composition of sprat and herring are given in Tables 5, 10. The estimated number sprat and herring by age group and rectangle are given in Table 6, 11. The estimates of sprat and herring biomass by age group and rectangle are summarised in Table 7, 12. The corresponding mean weights and mean length by age group and rectangle for each species are shown in Table 8-9 and 13-14.

The herring stock was estimated to be $104.01 \cdot 10^6$ fishes or about 3648 tonnes.

The estimated sprat stock was $2298.3 \cdot 10^6$ fish or 19550 tonnes.

3.4 The hydrologic data

The basic hydrological parameters (seawater temperature, salinity and oxygen contents) were measured from the surface to the bottom after every haul if weather conditions were favorable. Totally, 7 hydrological stations were making. The hydrological and hydro biological research profiles location is presented in Table.15.

Water temperature in hauls was from 6.85.4 to 10,32 ºC. Differences between the first haul and others caused by wind direction. Wind direction was west in the first half day of cruise. Later wind direction changed to east, north-east and south-east at the last haul. There was no thermocline in 2019 of May. Salinity was about 7.2 ‰ in all hauls and depts. The oxygen-condition was excellent in all hauls and depts.

4. REFERENCES

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

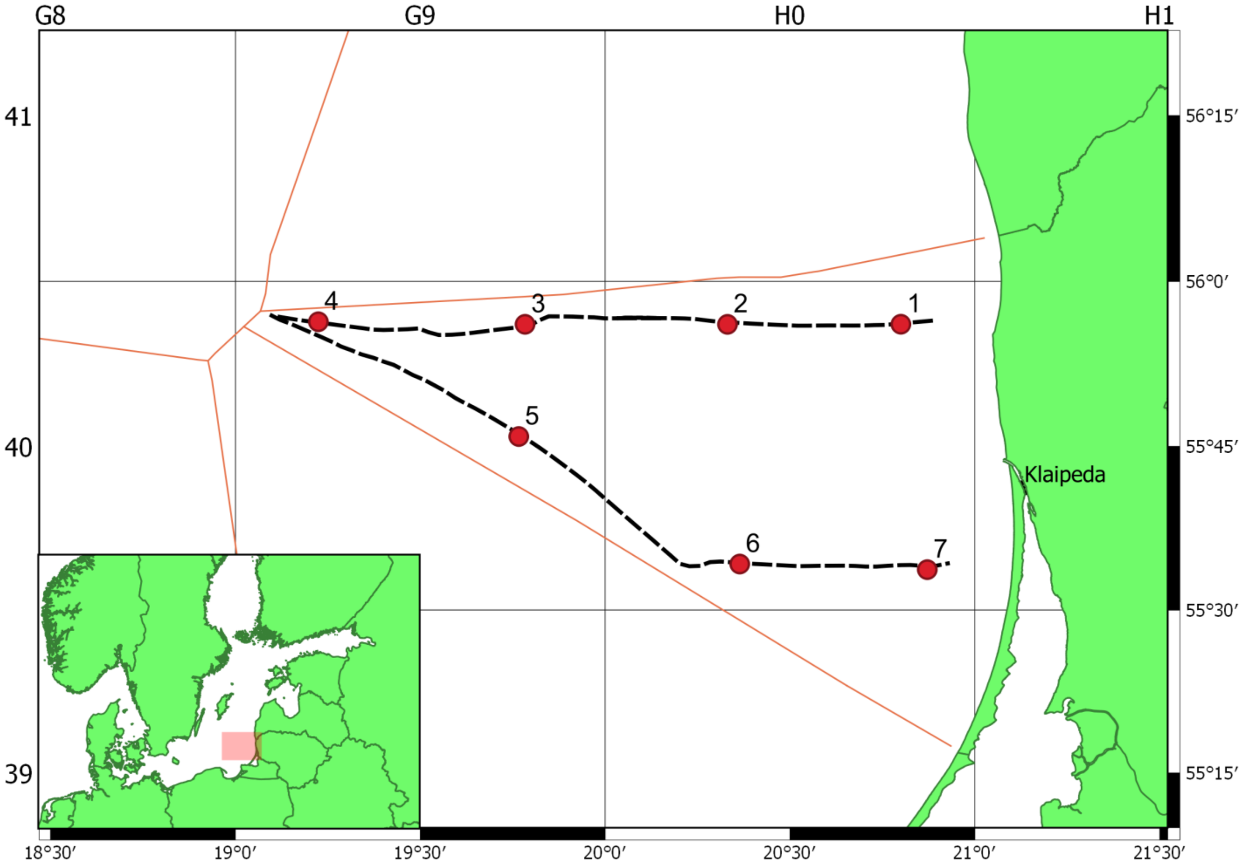

Figure1 The survey grid ant trawl hauls position of F/V "169", 02-03.06.2019

Table 1 Catch composition (kg/1hour) per haul (F/V "169", 02-03.06.2019)

ICES subdivision 26							
Haul No	1	2	3	4	5	6	7
Date	2019.06.02	2019.06.02	2019.06.02	2019.06.02	2019.06.03	2019.06.03	2019.06.03
Validity	Valid	Valid	Valid	Valid	Valid	Valid	Valid
Species/ICES rectangle	40H0	40H0	40G9	40G9	40G9		
Clupea hrengus	926.08	48.83	14.74	17.98	30.342		99.65
Sprattus spratus	2073.92	1951.17	45.26	102.020	49.658	600.0	2900.35
Gasterosteus aculeatus		0.024					
Platichthys flesus		0.644		0.32			
Gadus morhua					0.514		3.03
Hyperoplius lanceolatus		0.84					
Total	3000.00	2000.75	60.00	120.32	80.514	600.0	3003.03

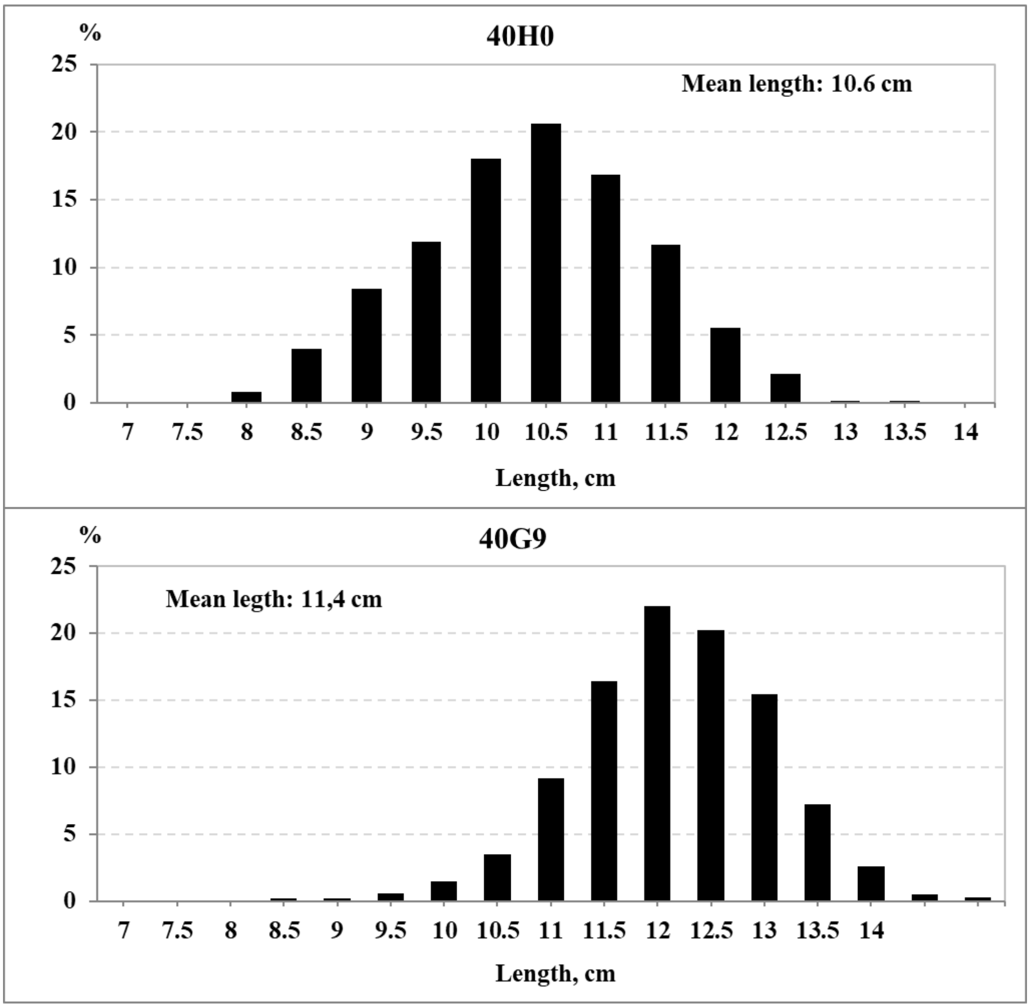

Figure 3 Length distribution of sprat (%) (F/V "169", 02-03.06.2019)

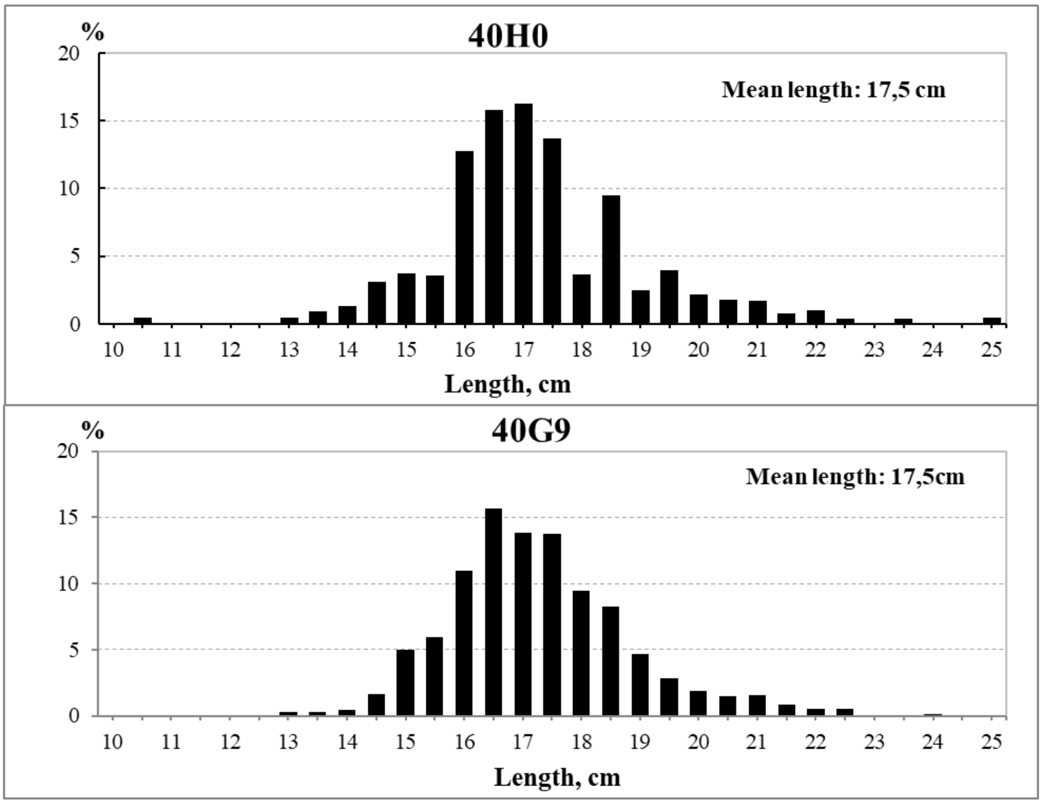

Figure 2. Length composition of herring (%) (F/V "169", 02-03.06.2019)

Table 2 F/V "169" survey statistics (abundance of herring and sprat), 02-03.06.2019

ICES SD	ICES Rect.	Area nm^2	ρ mln/nm^2	Abundance, mln			Biomass, tonn		
				N sum	N her	N spr	W sum	W her	W spr
26	40H0	1012.1	1.84	1862.9	57.1	1805.7	16822	2102	14720
	40G9	1013.0	0.53	539.4	46.9	492.5	6376	1546	4829

Table 3 F/V "169" survey statistics (aggregated data of herring and sprat), 02-03.06.2019

ICES SD	ICES Rect.	No trawl	Herring			Sprat			SA m^2/nm^2	TS calc. dB
			L, cm	w, g	Numb.,%	L, cm	w, g	Numb.,%		
26	40H0	1,2,6,7	17.47	36.79	3.07	10.65	8.15	96.93	211.0	-50.4
	40G9	3,4,5	17.53	32.98	8.69	11.40	9.81	91.31	74.3	-49.5

Table 4 F/V "169" survey statistics (herring and sprat), 02-03.06.2019

ICES SD	ICES Rect.	Area nm^2	SA m^2/nm^2	σ *10^4 nm^2	Abundance, mln	Species composition (%)	
						herring	sprat
26	40H0	1012	211.0	1.14648	1862.9	3.07	96.93
	40G9	1013	74.3	1.39585	539.4	8.69	91.31

Table 5 F/V "169" estimated age composition (%) of sprat, 02-03.06.2019

SD	Rect.	Age									
		Total	0	1	2	3	4	5	6	7	8
26	40H0	100.0	0.0	26.7	16.0	15.7	23.6	15.4	2.6	0.0	0.0
	40G9	100.0	0.0	2.6	8.9	9.8	49.2	26.8	2.5	0.1	0.0

Table 6 F/V "169" estimated number (millions) of sprat, 02-03.06.2019

SD	Rect.	Age									
		Total	0	1	2	3	4	5	6	7	8
26	40H0	1805.7	0.0	481.8	288.4	283.5	425.7	278.8	47.5	0.0	0.0
	40G9	492.5	0.0	12.9	44.0	48.3	242.3	132.1	12.2	0.7	0.0

Table 7 F/V "169" estimated biomass (in tons) of sprat, 02-03.06.2019

SD	Rect.	Age									
		Total	0	1	2	3	4	5	6	7	8
26	40H0	14720	0	2498	2138	2405	4098	2991	589	0	0
	40G9	4829	0	55	286	361	2335	1599	179	13	0

Table 8 F/V "169" estimated mean weights (g) of sprat 02-03.06.2019

SD	Rect.	Age									
		Mean	0	1	2	3	4	5	6	7	8
26	40H0	8.15		5.2	7.4	8.5	9.6	10.7	12.4		
	40G9	9.81		4.3	6.5	7.5	9.6	12.1	14.7	17.5	

Table 9 F/V "169" estimated mean length (cm) of sprat, 02-03.06.2019

SD	Rect.	Age									
		Mean	0	1	2	3	4	5	6	7	8
26	40H0	10.6		9.5	10.3	10.8	11.5	12.0	12.7		
	40G9	11.4		9.0	10.1	10.6	11.5	12.3	13.1	14.3	

Table 10 F/V "169" estimated age composition (%) of herring, 02-03.06.2019

SD	Rect.	Age									
		Total	0	1	2	3	4	5	6	7	8
SD 26	40H0	100.0	0.0	1.3	7.3	9.9	28.2	29.5	7.6	10.4	5.9
	40G9	100.0	0.0	0.2	15.0	12.1	27.6	23.8	13.2	4.5	3.5

Table 11 F/V "169" estimated number (millions) of herring, 02-03.06.2019

SD	Rect.	Age									
		Total	0	1	2	3	4	5	6	7	8
SD 26	40H0	57.1	0.0	0.8	4.1	5.6	16.1	16.9	4.4	5.9	3.3
	40G9	46.9	0.0	0.1	7.1	5.7	12.9	11.2	6.2	2.1	1.7

Table 12 F/V "169" estimated biomass (in tons) of herring, 02-03.06.20198

SD	Rect.	Age									
		Total	0	1	2	3	4	5	6	7	8
26	40H0	2102	0.0	12.9	103.4	167.8	556.8	687.1	188.4	222.4	163.1
	40G9	1546	0.0	1.9	195.0	166.0	404.7	388.2	235.2	82.4	73.1

Table 13 F/V "169" estimated mean weights (g) of herring, 02-03.06.2019

SD	Rect.	Age									
		Total	0	1	2	3	4	5	6	7	8
26	40H0	36.8		17.1	25.0	29.8	34.6	40.7	43.1	37.5	48.8
	40G9	33.0		19.3	27.7	29.3	31.3	34.7	38.1	38.6	44.0

Table 14 F/V "169" estimated mean length (cm) of herring, 02-03.06.2019

SD	Rect.	Age									
		Total	0	1	2	3	4	5	6	7	8
26	40H0	17.5		13.1	15.2	16.3	17.1	18.2	18.1	18.0	20.2
	40G9	17.5		14.3	16.1	16.6	17.2	18.0	18.7	18.9	19.9

Table 15. The values of hydrological parameters registered at the catching depth in the Baltic Sea ICES SD from the Lithuanian BIASS survey conducted by f/v "169" in the period of 02.06-03.06.2019.

Haul number	**Date of catch**	**Trawling depth, m**	**Hydrological parameters**		
			Temperature, °C	**Salinity, ‰**	**Oxygen, ml/l**
1	**2019.06.02**	28-29	9.41	7.52	7.63
2	**2019.06.02**	39-40	8.11	7.81	7.85
3	**2019.06.02**	62-63	7.72	7.64	7.93
4	**2019.06.02**	77-78	6.85	7.60	8.11
5	**2019.06.03**	73-74	6.91	7.58	8.10
6	**2019.06.03**	65-66	8.94	7.55	7.71
7	**2019.06.03**	40-41	10.32	7.47	7.38
Average			8.32	7.60	7.61

Working paper on the WGBIFS meeting in Cadiz (Spain), 30.03-03.04.2020

Research report from the Polish part of the SPRat Acoustic Survey (SPRAS) on board of the r.v. "Baltica" (03-15.05.2019)

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INTRODUCTION

The Polish SPRAS/2019 survey was conducted in the framework of the ICES International Baltic Acoustic Surveys (IBAS) long-term programme including spring (Sprat Acoustic Survey SPRAS, previously named Baltic Acoustic Spring Survey BASS) and autumn (Baltic International Acoustic Survey BIAS) acoustic surveys. The ICES Baltic International Fish Survey Working Group (WGBIFS) coordinates methods of investigations, the timing of surveys, spatial allocation of vessels and the general pattern of pelagic control-hauls distribution in the Baltic, regarding both types of acoustic surveys, i.e. SPRAS and BIAS. The above-mentioned working group is also responsible for the compilation of international results required for assessment of clupeids stocks size in the Baltic. The set of input data and recommendations are next transferred to the ICES Baltic Fisheries Assessment Working Group (WGBFAS) for the final evaluation of fish stocks size.

In the period of 03-15 May 2019, the SPRAS survey was conducted on board of the r.v. "Baltica" inside the Polish EEZ. The Polish Fisheries Data Collection Programme for 2019 and the European Union (the Regulation (EU) 2017/1004 of the European Parliament and of the Council of 17 May 2017) financially supported the Polish SPARS survey marked with internal No. 7/2019/MIR-PIB.

The survey was focused on monitoring of clupeids and cod spatial-seasonal distribution in the pelagic zone of the southern Baltic (parts of the ICES Sub-divisions 25 and 26), giving high priority to the assessment of sprat spawning stock size and distribution. The SPRAS survey was carried out in the season of herring initial phase of intensive feeding and sprat and cod spawning time in the southern Baltic. The acoustic system EK60 SIMRAD with the newly determined calibration parameters were applied to completing the SPRAS survey tasks.

The main goal of the current paper is a brief description of the results of analysis focused on sprat, herring and cod stocks size changes and their spatial distribution as well as the CPUE variation within the Polish part of the southern Baltic in the spring 2019. Moreover, the paper contains a description of sprat, herring and cod biological parameters variation. The principal hydrological parameters fluctuation in the water column of the southern Baltic are also described.

MATERIAL AND METHODS

Research team personnel

The main research tasks of the Polish SPRAS/2019 survey on board of the r.v. "Baltica" were realized by the NMFRI (Gdynia) nine members of the scientific team, with Beata Schmidt as a cruise leader. The group of researchers was composed of:
Beata Schmidt – hydroacoustician,
Zuzanna Celmer - hydroacoustician,
Julia Gutkowska – ichthyologist, sprat analyses,
Grzegorz Modrzejewski – technician, sprat analyses,
Wojciech Deluga – technician, herring analyses,
Stanisław Trella - technician, herring analyses,
Krzysztof Radtke - ichthyologist, cod and other fish species analyses,
Ireneusz Wybierała – technician, cod and other fish species analyses,
Anetta Ameryk – hydrologist.

The course of the cruise

The r.v. "Baltica" left Gdynia port on the 3rd of May 2019 at 05:00 a.m. and was navigated in the south-east direction. At the mouth of the Vistula River a successful calibration of the acoustic system SIMRAD EK60, installed on the vessel, was carried out. On the same day, acoustic integration and control pelagic hauls were started on transects located in the southern part of the Gulf of Gdansk. In the following days, work was continued on transects in the Gulf of Gdansk and the eastern part of the Polish EEZ. Due to the forecasted deterioration of weather conditions in the Eastern Baltic, on the 8th of May at 16:54 measurements were completed at the B3 hydrological station (λ = 018°00.0'E, ϕ = 55°20.0'N). During the night r.v. "Baltica" was moved west where on the 9th of May at the most west position (λ = 015°00.0'E, ϕ = 54°30.0'N) the acoustic integration and control hauls were resumed in the east direction. The survey was completed on the 14th of May 2019 at the position of hydrological station B3. The r.v. "Baltica" returned to the Gdynia port on the 15th of May 2019 at 07:00 a.m.

Survey design and realization – sampling description

The ICES statistical rectangles, designated by the ICES-WGBIFS as mandatory to Poland, were fully covered with the standard acoustic-biotic researches (Fig. 2). However, because of very limited survey time, the echosounding could not be performed in the 38G4 ICES rectangles (ICES SD 24), which as optional was allocated to Poland (ICES, 2019).

The SIMRAD EK-60 version 2.2.0, a split-beam scientific echosounder, as in the previous years, was used in the recent Polish SPRAS 2019 survey. The echosounder was linked with the GPT transceivers, operating at 38 and 120 kHz frequencies. Calibration of the vessel's acoustic system was performed on the 3rd of May 2019 at the following location: λ = 019°12.6'E and φ = 54°26.4'N over seabed depth of 60 m (Fig. 2). The echosounder calibration was performed as described in Simrad (2012) using copper spheres of diameters 60 mm and 23 mm for 38 kHz and 120 kHz frequency respectively as reference targets. Calibration results obtained in May 2019 were considered good based on calculated RMS values which were 0.12 dB and 0.16 dB for 38 kHz and 120 kHz respectively. Resulting transducer parameters were applied for consecutive data-collection and post-processing of hydroacoustic survey data. Calibration results for the 38 kHz transducer are given in Fig. 1.

The acoustic sampling was performed along the pre-selected acoustic transects on the distance of 774 NM. The echo-integration data were collected in a daytime regime at the shipping speed of 7 kn. Because of the historical comparability of data, pre-selected echo-integration transects were planned in a similar pattern as in recent years. The survey effort was comparable to previous years.

The settings of the hydroacoustic equipment were as described in the IBAS Manual (ICES, 2017). The post-processing of the stored raw data was done using the Echoview software (www.echoview.com). Only 38 kHz transmitter's data were taken into further processing because that frequency is recommended for fish trace recording. In the first step of acoustic data checking, all visible interferences from the sea surface turbulences and bottom structures visible on echogram were excluded from further analysis. The minimum threshold on mean volume backscattering strength S_v was set at -60 dB. Calculation of parameter S_A [m^2NM^{-2}] (hereinafter called NASC) for 1 nautical mile elementary standard distance units (ESDUs) was carried out by integrating S_v values (in a linear domain) from 10 m below the surface to about 0.5 m over the seafloor and then averaged within 1 NM interval. Then the mean NASC (Nautical Area Scattering Coefficient) per ICES rectangles were calculated.

Overall 31 catch-stations (18 in the ICES SD 25 and 13 in the ICES SD 26) were conducted by the r.v. "Baltica" in spring 2019 (Fig. 2, Table 3), using the herring small-meshed pelagic trawl type WP53/64x4, with 6 mm mesh bar length in the codend (Table 3). All control-catches were accepted as representative from a technical point of view. The trawling depth was chosen in accordance with echo distribution on the echogram. Because of a relatively high vertical opening (up to 20 m) of applied pelagic trawl and the technical-acoustics disturbances from a set vessel-trawl, the areas shallower than 25-m were not examined with the catch-stations. The trawling time for most hauls was 30 minutes, however, it was shortened when echogram and net-sounder indicated a large concentration of fishes in the area of operating a fishing gear. In one case the trawling time was extended to 45 minutes. The mean speed of the surveying vessel during trawling was ranged from 3.1 to 3.5 knots. Fish catches were localized at the depth ranged from 10 to 75 m from the sea surface (position of the headrope). Depth to the bottom at trawling positions varied from 29 to 116 m.

Fish caught in each haul were separated by species and weighted. The results of catch per unit effort of dominated fish species and their average share in the r.v. "Baltica" pelagic catches are presented in Table 3 and in Figures 5-7. The samples for sprat, herring, and cod were taken for length and mass measurements and ageing. Fish total length distribution (Fig. 8) and the mean mass were determined at the 0.5-cm classes - in the case of clupeids and 1-cm classes in the case of cod. The numerical share of juvenile, undersized (below minimum landing/protective size) sprat, herring and cod in samples was determined (Table 4) based on fish length distribution results. For sprat, the minimum commercial size (the separate length) is equal to 10.0 cm, for herring is equal to 16.0 cm and for cod is 35.0 cm.

Detailed ichthyological analyses were made according to standard procedures (Anon., 2012), directly on board of surveying vessel. Overall, 29, 29 and 11 samples were taken for the length and mass determination of sprat, herring and cod, respectively. Altogether, the length and mass were measured for 6074 sprat, 1184 herring, and 501 cod individuals. Respectively, 499, 443 and 438 individuals of the above-mentioned species were biologically analysed (sex, maturity, stomach fullness and age).

Before each haul and at the standard hydrological stations located within the Polish EEZ, the seawater temperature, salinity, and oxygen content were measured continuously from the sea surface to the seabed. Totally, 39 hydrological stations were inspected using the CTD SeaBird 911+ probe combined with the rosette sampler. Oxygen content was determined by the standard Winkler's method. The hydrological row data, aggregated to the 1-m depth stratum, were information source about the abiotic factors potentially influencing fish's spatial distribution. The basic meteorological parameters i.e. air temperature, air pressure, wind direction, and force, and sea state were registered at each catch-station location with the automatic station MILOS 500.

Data analysis

Distinguishing herring and sprat from other species is impossible by visual inspection of the echogram, therefore species composition and fish length distributions from trawl catch results are used to aid acoustic species identification. Such data analysis is sectioned according to the ICES statistical rectangles. Based on trawl results, for each rectangle, the share of number and length distribution of all species was calculated as the unweighted mean. We intended to carry out at least two control-hauls per ICES rectangle, according to the guidelines in the "SISP Manual of International Baltic Acoustic Surveys (IBAS)" (ICES, 2017). Hauls with low level of catch and/or non-representative species composition were excluded from the analysis. This included hauls no.15, 24 and 28 (see Table 3). In the case of missing hauls within individual ICES rectangle, hauls results from neighbouring rectangles were used. The assignment of hauls carried out during SPRAS 2019 cruise to ICES Sub-divisions and rectangles are presented below:

Sub-division (SD)	ICES rectangle	Haul no.
25	37G5	19
25	38G5	16,17,18,20
25	38G6	20,21,25
25	38G7	31
25	39G6	22,23,26
25	39G7	27,28,30,31
26	37G8	3
26	37G9	1,2
26	38G8	4,11
26	38G9	6,7
26	39G8	5,10,12,31
26	39G9	5,7
26	40G8	8,9,13,14

Based on species distributions the mean acoustic cross section σ was calculated according to the following target strength-length (TS) relation:

	TS	References
Clupeids	= 20 log L (cm) - 71.2	ICES 1983
Gadoids	= 20 log L (cm) - 67.5	Foote et al. 1986
Scomber scombrus	= 20 log L (cm) - 84.9	ICES 2017

The total number of fish in each of the ICES rectangle was estimated as a product of the mean NASCs from scrutinised acoustic data and a rectangle area, divided by the corresponding mean acoustic cross-section σ. Clupeids abundance was separated as sprat or herring according to their mean share in catches of given ICES rectangle. In case when the mean numerical share of sprat, herring and cod in ICES rectangle exceeded 99%, then other species were excluded from further calculations. Thus, fish species considered in this report are as follows: *Clupea harengus*, *Sprattus sprattus* and *Gadus morhua*.

RESULTS

Acoustic results

The spatial distribution of mean NASC values (5 NM intervals), predominantly derived from clupeids, measured on hydroacoustic transects during SPRAS 2019 survey is presented in Fig. 3. The highest NASC values were recorded in the eastern part of Polish EEZ in SD26 and in the area of the Słupsk Furrow and Bornholm Basin in SD25. The mean NASC values per ICES Sub-divisions presented in Table 1 were calculated with the use of areas of ICES rectangles as weight. Overall NASC values recorded in the Polish EEZ during SPRAS 2019 survey remain at a similar level as recorded during SPRAS 2018 cruise (Table 2, Trella et al., 2018, Schmidt and Grygiel, 2019). In ICES Sub-division 25, the NASC value decreased by about 5% compared to the previous year, while in ICES Sub-division 26 it increased by about 2%. Similarly to 2018, the highest NASC values were recorded in Sub-division 26, where the average NASC values exceeded 1000 m^2/ Nm^2 in almost all rectangles (in rectangle 39G9 mean NASC value per rectangle reached the value 2084.7 m^2/Nm^2). The highest NASC value per 1 mile equal to 15044 m^2/Nm^2 was recorded in rectangle 37G9 (Fig. 4). The highest average NASC values in ICES Sub-division 25 were recorded in the Bornholm Basin (ICES rectangles 38G5 and 39G6) and in the Słupsk Furrow (ICES rectangle 39G7).

Fish catches, biological parameters and stocks size

In May 2019, overall, fourteen fish species were recorded in 31 scrutinized pelagic control-hauls taking place in the Polish parts of the ICES Sub-divisions 25 and 26 (Table 3, Fig. 2). 16229 kg of fish were caught, and the mean share of sprat, herring, cod and all other fish species was 97.0, 2.1, 0.8 and 0.1%, respectively. Sprat distinctly dominated by mass in hauls, and herring, as well as cod, can be considered as a significant bycatch in accomplished hauls (Table 3, Figs. 5-7). From the remaining fish species, only flounder with a total catch of 7.5 kg in the entire study area was remarkable as a component of bycatch. Sprat and herring occurred in each pelagic haul and cod in 35% of realized hauls. Neither sea-mammals nor sea-birds were detected in the catches.

In the ICES Sub-division 26, sprat dominated by the total mass (9033.6 kg), the mean CPUE (2682.2 kg h^{-1}) and the mean share (99%) in 13 hauls realised inside the Polish part of the mentioned Sub-division. The above-mentioned exploitation parameters were somewhat lower for sprat caught in the ICES Sub-division 25, where amounted 7356.1 kg, 1074.6 kg·h^{-1} and 95%, respectively in 18 hauls. Sprat highest CPUE was obtained in a few single research catches conducted, e.g.: in the area close to the border between the ICES rectangle 38G9 and 38G8 (4181.8-6520.8 kg h^{-1}) and also in the Słupsk Furrow (4006.5 kg h^{-1}).

The total weight of catches, mean CPUE and a mean share of herring in hauls from the Polish part of the ICES Sub-division 25 was higher than in the ICES Sub-division 26. In the ICES SD25 values of above parameters were as follow: 272.0 kg, 41.1 kg h^{-1} and 3.5%, whereas in the ICES SD26 was: 82.26 kg; 23.0 kg·h^{-1} and 0.9%. The CPUE of herring was relatively high in the limited number of hauls, i.e. in the east and south part of the Bornholm Deep (170.0 and 94.0 kg h^{-1}) and in the rectangle 38G9 (70 and 26 kg h^{-1}).

The mean share of cod in the mass of the pelagic trawl catches conducted in the ICES SD25 was a bit higher than in the ICES SD26, where amounted 1.6 and 0.2%, respectively.

The results of sprat, herring and cod some biological features investigations in May 2019 are presented in Figure 8 and in Tables 4, 8, 11, 14. The total length of species dominated in hauls conducted in the all investigated areas ranged as follows:

- sprat – 8.0 ÷ 15.5 cm (avg. l.t. = 11.9 cm, avg. W = 10.1 g),
- herring – 11.5 ÷ 26.0 cm (avg. l.t. = 18.6 cm, avg. W = 40.4 g),
- cod – 20.0 ÷ 50.0 cm (avg. l.t. = 31.6 cm, avg. W = 285.0 g).

The bimodal shape of length distribution curve for sprat in May 2018 was very different from the one originated from May 2019. In 2019 the length distribution curve had a unimodal shape. The difference between the ICES Sub-divisions 25 and 26 is well visible (Fig. 8). The frequency apex is distinguished for adults, commercially sized fish collected in the ICES SD26, i.e. from the length classes of 11.5 cm (May 2018) and 11.0 cm (May 2019). In the length distribution of sprat originated from catches in the ICES SD25, in both SPRAS surveys prevailed specimens from the same 12.0 cm class. In the case of May 2018 and samples from both the ICES SDs, the second, minor frequency apex representing young, undersized specimens is visible for fish from the length class of 8.0 cm. In the recent SPRAS survey, the mean numerical share of undersized sprat (<10.0 cm length) was somewhat similar in the ICES Sub-divisions 25 and 26 and amounted 1.66 and 6.25% (Table 4). In the previous SPRAS (2018) survey bycatch of undersized sprat was 10.7 and 14.5%, in the ICES SDs 25 and 26, respectively. The mean share of undersized sprat in the entire study area in May 2019 and 2018 was 3.8 and 12.6%, respectively.

For herring the polymodal shape of length distribution curve was characteristic for both the ICES SDs in May 2018 but not in May 2019 (Fig. 8). In May 2018 herring from the length classes of 22.0 and 16.0-16.5 cm dominated. In herring samples from that cruise, young undersized specimens, from the length classes of 15.0 and 16.0 cm prevailed by numbers in the ICES SDs 26 and 25, respectively. Moreover, the second, smaller pick of the curve was noticeable for herring from the length classes 20.0 – 26.0 cm. In May 2019 the frequency apex was different for ICES Sub-divisions 25 and 26. In ICES SD 25 it was visible for the length classes 16.0 – 18.0 cm. The mean numerical share of undersized herring (<16.0 cm length) in samples collected in May 2019 was different between the ICES SDs 25 and 26, i.e. amounted of 9.91 and 27.91% (Table 4). In May 2018, values of the mentioned parameter were much higher and amounted 42.5 and 42.3% on average, respectively in the ICES SDs 25 and 26.

The length distribution curve for cod sampled in the ICES SD25 differed between May 2018 and May 2019 (Fig. 8). For the previous survey in ICES Sub-division 25, two maxima of numerical share were visible, i.e. in 23 and 34 cm length classes, in ICES Sub-division 26 the maxima are not clearly noticeable. In May 2019 in ICES SD 25 to picks are visible for the cod of the length classes 29.0 and 33.0 cm. In ICES SD 26 several apexes were recorded because of a little number of caught cod in that area. The mean bycatch of undersized cod (<35 cm length) in samples collected in May 2019 was 76.2 and 75.0% in the ICES SDs 25 and 26, respectively (Table 4). For comparison, in May 2018 in the ICES SD 26 was similar and slightly higher in ICES SD 26: 76.8 and 84.9%, respectively.

Data reflects changes of the mean weight of sprat, herring, and cod per age groups according to inspected ICES rectangles are presented in Tables 8, 11 and 14.

The basic data evaluated in May 2019, including data on Baltic sprat, herring and cod stocks total abundance and biomass per age groups and the ICES rectangles, adequately to echosounding under the frequency of 38 kHz are given in Tables 6, 7, 9, 10, 12 and 13. The above-mentioned materials are strongly linked with data on SPRAS/2019 cruise statistics and average NASC values for acoustically covered ICES rectangles, within the Polish EEZ (Table 5). The mean surface biomass density of sprat, herring, and cod, per the ICES rectangles, inspected during the Polish SPRAS cruise is shown in Figures 11 and 12. The abundance of the above-mentioned species per age groups, according to inspected in May 2018 and 2019 the Polish parts of the ICES Sub-divisions 25 and 26 is demonstrated in Figure 10.

In May 2019, the highest mean surface biomass density of sprat stock was estimated for the ICES rectangles: 39G9, 39G8, and 37G9, where amounted: 142.3; 103.1 and 92.6 t NM^{-2}, respectively (Fig. 11). The maximum of sprat surface biomass density was obtained in the Gdansk Deep and south-eastern part of the Gulf of Gdansk. In contrast, the minimum values of this parameter were noticed in the south-middle parts of the Polish marine waters. The recent pattern of sprat surface biomass density distribution per ICES rectangles can be considered as almost a mirror picture from May 2018 (Fig. 11). In May 2018 and May 2019 the mean biomass density of sprat in the ICES SD25 was 35.8 and 38.2 t NM^{-2}, respectively and in the ICES SD26 was 92.6 and 98.0 t NM^{-2} (Fig. 9).

In May 2019, the highest mean surface biomass density of herring stock was estimated for the ICES rectangles: 37G9 (2.6 t NM^{-2}), 38G5 (2.4 t NM^{-2}), 37G8 (2.1 t NM^{-2}) and 38G6 (2.0 t NM^{-2}) – located adequately, in the Gulf of Gdansk and the west-middle part of the Polish marine waters, except for the Słupsk Furrow (Fig. 11). The recent pattern of herring surface biomass density distribution per ICES rectangles can be considered only little different from May 2018 (Schmidt and Grygiel, 2018), when the maximum of herring stock biomass density was obtained in the ICES rectangles 39G9 (3.0 t NM^{-2}) and 38G6 (3.0 t NM^{-2} (Fig. 11). In May 2018 and May 2019 the mean biomass density of herring in the ICES SD25 was 1.6 and 1.3 t NM^{-2}, respectively and in the ICES SD 26 was 1.7 and 0.5 t NM^{-2} (Fig. 9).

Results of the acoustic-biotic monitoring in the Polish marine waters indicate much lower cod biomass in May 2019 comparing to May 2018 (Schmidt and Grygiel, 2018). In May 2019, the mean biomass surface density per rectangle did not exceed 1.0 t NM^{-2}, whereas in the previous year reached 12.7 t NM^{-2} (Fig. 12). Cod resources were patchily distributed inside the Polish marine waters, however in seven ICES rectangles located in the southern part of the Polish EEZ (in the vicinity of seacoast) and in the middle part of the surveyed area, cod was not detected (Tables 3, 13, Fig. 12). The biomass density of Baltic cod in scrutinized a part of the ICES Sub-division 26 was on a similar level to this in the ICES Sub-division 25, and amounted 0.4 and 0.3 t NM^{-2}, on average (Fig. 9).

Meteorological and hydrological characteristics of the southern Baltic

Changes of the main meteorological parameters – wind velocity and direction, and air temperature in consecutive days of the Polish SPRAS survey carried out in 2019 are illustrated in Figure 13. The air temperature during the reported survey varied from 4.6 to 11.1°C (avg. was 7.5°C). The wind force changed from 2 to 6°B, and winds from the west direction prevailed.

The main hydrological parameters at the depths of fish pelagic catches (Table 15), i.e. in the range of 17-84 m (with 18 m vertical net opening on average) changed in the relatively broad ranges. The seawater temperature fluctuated from 4.1 to 8.5°C (the mean was 6.3°C), salinity from 7.5 to 16.4 PSU (the mean was 10.1 PSU) and oxygen content from 0.5 to 8.8 ml/l (the mean was 5.4 ml/l).

The surface water hydrological parameters changed in relatively narrow ranges: 6.1-8.6°C, 7.3-7.9 PSU and 7.99-9.08 ml/l for temperature, salinity and oxygen content respectively. Horizontal distribution of these parameters in the near bottom zone of the southern Baltic (within the Polish waters) is illustrated in Fig. 14. The temperature in near bottom layer was changing horizontally within the range of 4.2-9.1°C. The lowest seawater temperature was recorded at the station no. 14 (southward of the Gotland Basin) and the highest at the hydrographical station no. G2 (the Gdansk Deep) (Fig. 1). Salinity in the bottom waters varied from 7.5 PSU – noticed at the catch-stations no. 2 (south part of the Gdansk Gulf), to the maximum of 17.1 PSU - appeared at the hydrographical station no. IBY5 (the Bornholm Basin). Oxygen content near bottom of deep waters varied from 0.00 ml l^{-1} – measured at the hydrographical station no. G2 (the Gdansk Deep) to the maximum of 8.77 ml l^{-1} – calculated at the catch-stations no. 2.

The vertical distribution of the seawater temperature, salinity and oxygen content, along the hydrological research profile determined in the southern Baltic in May 2019 is presented in Fig. 15. During the survey period, the waters with oxygen content below 2 ml l^{-1} occurred at depth just below 60 m at the Gdansk Deep (with anoxic bottom condition) and below 70 m at the Bornholm Basin. The Słupsk Furrow was well-oxygenated – the mean oxygen content in near-bottom waters was 2.31 ml l^{-1}.

DISCUSSION

Compared to May 2018, the present estimates show slight decrease in sprat abundance (- 2.3%) and increase in sprat biomass (+6%). However these changes differ between ICES Sub-divisions. In May 2019, the total biomass (B1), the mean surface biomass density (B2) and abundance (A) significantly differed between fish species and the ICES Sub-divisions:

	parameter	sprat	herring	cod
ICES SD25	B1 (tons)	196380.2	6898.6	1560.1
	B2 (t NM^{-2})	38.19	1.34	0.30
	A (10^6 indiv.)	17450.6	160.1	4.7
ICES SD26	B1 (tons)	474750.6	2424.3	1896.4
	B2 (t NM^{-2})	97.98	0.50	0.39
	A (10^6 indiv.)	54482.2	70.9	6.0

The above-listed data indicate that the centre of temporal fish resources distribution in the Polish EEZ, during reported the SPRAS/2019 survey, in the case of sprat and cod, was located adequately, in the northern and southern parts of Gdansk Basin, but in the case of herring - in the middle of the southern Baltic (Figs. 11, 12). Abundance and biomass of sprat during May 2019 markedly prevailed in Polish marine waters.

Compared to May 2018, the abundance of sprat did not change considerably in ICES Sub-division 26. Nevertheless, the number of individuals of sprat from the age group 5 (year-class 2014, which was very abundant in the previous years) dropped significantly from $21600*10^6$ individuals to $8000*10^6$ individuals. However, the abundance of the sprat from the younger age groups increased, in some cases even twice. Also in ICES SD 26, the biomass of the sprat slightly increased. Similarly to the results from the SPRAS survey from 2018, the sprat abundance, total biomass and mean surface biomass density were higher in the ICES Sub-division 26 than in ICES Sub-division 25. Moreover, in May 2019, in the catches, almost 87% of males and 89% of females were spawning which indicates that the spawning took place in the ICES SD 26.

During the SPRAS in 2018, the abundance and biomass of herring were larger than during the latest SPRAS/2019. For both ICES Sub-divisions, 25 and 26, those two parameters decreased. Except for age group 5 (year-class 2014, which was very abundant in the previous years) in ICES Sub-division 25, the abundance and biomass increased compared to May 2018. Nevertheless, in ICES Sub-division 26 there was the opposite situation, those two parameters decreased significantly for age group 5. During the SPRAS/2019, we noticed a slight increase of the abundance and biomass of the herring from age groups 2-4 (year-classes 2017-2015) in the Polish coastal areas in the ICES rectangle 38G8 and 38G9. Moreover, most of those fish were spawning. It shows that in the region occurred spawning of herring.

Compared to May 2018, the abundance and biomass of cod dropped over 80%. More than half of the fish had gonads at maturity stage VI. It indicates that cod spawning took place also in May 2019.

CONCLUSION

The ICES Baltic International Fish Survey Working Group and the Baltic Fisheries Assessment Working Group for the Baltic clupeids and cod stocks size analysis and their spatial distribution characteristics can apply the Polish SPRAS-2019 survey data obtained by the r.v. “Baltica” scientific team. Results presented in this paper can be considered as representative for the Polish part of the southern Baltic, namely for the ICES Sub-divisions 25 and 26. The basic acoustic, fisheries, biological and hydrological data collected during reported survey will be stored in the ICES Data-Centre international databases, managed by the ICES Secretariat and designated experts from WGBIFS.

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Table 1. Weighted mean NASC values ($m^2 \cdot NM^{-2}$) for the Polish parts of the ICES SDs 25 and 26, calculated with use of areas of ICES rectangles as weight, for SPRAS 2018 and 2019 cruises.

ICES SDs	< NASC > SPRAS 2018	< NASC > SPRAS 2019
25	520.6	496.8
26	1404.1	1431.4

Table 2. Average NASC values ($m^2 \cdot NM^{-2}$) for the acoustically covered ICES rectangles, during Polish 2018 and 2019 SPRAS cruises (the NASC values from 2018 from Schmidt and Grygiel, 2019).

ICES SDs	ICES rectangles	Area [NM^2]	< NASC > SPRAS 2018	< NASC > SPRAS 2019
25	37G5	642.2	162.0	242.9
25	38G5	1035.7	292.7	761.1
25	38G6	940.2	339.3	316.5
25	38G7	471.7	305.9	49.1
25	39G6	1026.0	751.7	588.1
25	39G7	1026.0	1009.0	668.7
26	37G8	86.0	904.4	536.4
26	37G9	151.6	750.6	1360.3
26	38G8	624.6	907.3	1126.5
26	38G9	918.2	580.2	1260.3
26	39G8	1026.0	1477.1	1486.7
26	39G9	1026.0	2408.6	2084.7
26	40G8	1013.0	1506.2	1143.4

Table 3. Fish control-catches data from the Polish SPRAS survey conducted on board of the r.v. “Baltica” in May 2019.

Haul number	Date of catch	ICES rectangles	ICES SDs	Geographical position of the catch- start latitude N	start longitude E	end latitude N	end longitude E	Mean depth to the bottom [m]	Headrope depth from the sea surface [m]	Vertical net opening [m]	Trawling speed [w]	The ship's course during fishing [°]	Local time of shutting net	Trawling duration [min]	Total catch [kg]	CPUE of all species [kg·h^{-1}]	Catch per species [kg] sprat	herring	cod	flounder	salmon	lumpfish	Atlantic mackerel	garfish	greater sand eel	three spined stickleb	lesser sand eel	anchovy	whiting	plaice
1	2019-05-03	37G9	26	54°29.5'	19°11.5'	54°29.1'	19°14.3'	70	51	18	3.5	104	12:35	30	1073.8	2147.5	1064.4	9.4												
2	2019-05-03	37G9	26	54°25.4'	19°22.5'	54°26.3'	19°20.7'	48	25	18	3.0	300	17:00	30	87.7	175.5	79.9	3.5			4.370				0.017					
3	2019-05-04	37G8	26	54°27.3'	18°55.4'	54°28.0'	18°55.8'	47	28	18	3.2	15	08:35	15	585.8	2343.4	553.8	32.0									0.080			
4	2019-05-04	38G8	26	54°41.2'	18°59.5'	54°41.9'	18°58.9'	87	65	19	3.2	330	12:20	15	1383.4	5533.6	1376.1	6.0	0.282	1.049										
5	2019-05-04	39G8	26	55°14.3'	18°55.9'	55°13.5'	18°58.4'	80	56	18	3.1	120	18:40	30	442.6	885.2	441.9	0.7												
6	2019-05-05	38G9	26	54°35.2'	19°09.5'	54°34.8'	19°10.6'	80	56	18	3.1	120	08:30	15	1631.8	6527.2	1630.2	1.0						0.608						
7	2019-05-05	38G9	26	54°49.3'	19°16.6'	54°49.4'	19°13.4'	105	75	18	3.0	70	11:50	10	823.4	4940.3	808.2	3.2	11.659	0.274										
8	2019-05-06	40G8	26	55°51.9'	18°47.0'	55°51.9'	18°48.3'	116	63	18	3.3	90	10:40	15	523.1	2092.4	515.5	3.6	1.809	2.229										
9	2019-05-06	40G8	26	55°40.6'	18°40.9'	55°41.2'	18°41.7'	92	67	18	3.1	35	13:55	15	194.3	777.3	191.9	2.1		0.401										
10	2019-05-07	39G8	26	55°10.6'	18°37.1'	55°10.7'	18°37.7'	86	62	18	3.1	70	07:25	10	570.1	3420.5	569.0	1.0	0.165											
11	2019-05-07	38G8	26	54°52.7'	18°43.3'	54°52.7'	18°44.4'	88	64	19	3.0	80	11:00	15	1064.3	4257.1	1045.4	10.7	6.456					1.717						
12	2019-05-07	39G8	26	55°20.2'	18°21.5'	55°20.5'	18°23.6'	81	41	18	3.2	70	18:45	30	462.5	925.1	456.5	6.0												
13	2019-05-08	40G8	26	55°36.3'	18°25.4'	55°36.7'	18°24.1'	93	62	19	3.0	295	09:50	15	307.5	1230.1	300.9	3.1	2.237	1.249										
14	2019-05-08	40G7	25	55°44.0'	17°59.0'	55°43.7'	17°56.5'	61	30	19	3.1	255	14:40	30	47.4	94.9	47.2	0.0		0.228						0.003				
15	2019-05-09	37G5	25	54°28.8'	15°23.0'	54°29.5'	15°20.8'	46	24	17	3.1	290	13:25	30	0.0	0.0														
16	2019-05-09	38G5	25	54°43.5'	15°19.3'	54°44.4'	15°17.3'	67	40	18	3.1	305	16:10	30	44.3	88.6	44.2	0.1												
17	2019-05-10	38G5	25	54°56.9'	15°40.6'	54°57.9'	15°40.9'	80	59	18	3.1	5	07:30	20	701.2	2103.5	647.0	22.0	31.341	0.762										
18	2019-05-10	38G5	25	54°45.5'	15°38.6'	54°45.7'	15°36.1'	72	53	17	3.1	280	10:15	30	226.4	452.8	215.5	9.1	1.344	0.404								0.028	0.023	
19	2019-05-10	37G5	25	54°23.8'	15°44.9'	54°24.6'	15°47.2'	38	18	17	3.0	60	15:40	30	607.2	1214.4	601.2	6.0												
20	2019-05-10	38G6	25	54°31.0'	16°00.9'	54°31.5'	15°58.3'	43	23	17	3.3	290	18:20	30	452.3	904.6	415.7	36.6												
21	2019-05-11	38G6	25	54°54.5'	16°01.0'	54°55.7'	16°02.9'	68	48	18	3.2	40	09:50	20	632.7	1898.1	526.2	104.4	1.701				0.101						0.298	
22	2019-05-11	39G6	25	55°13.2'	16°00.7'	55°12.5'	16°02.8'	87	67	18	3.1	120	14:30	30	2014.6	4029.1	1877.6	51.0	85.020	0.897										0.052
23	2019-05-11	39G6	25	55°09.6'	16°20.1'	55°08.6'	16°20.1'	67	46	18	3.0	81	18:30	20	166.4	499.3	161.2	5.0				0.295								
24	2019-05-12	38G6	25	54°42.9'	16°19.0'	54°43.1'	16°16.3'	35	15	17	3.2	280	07:40	30	7.9	15.8	0.9	6.2	0.769											
25	2019-05-12	38G6	25	54°44.5'	16°29.5'	54°43.5'	16°25.5'	39	19	17	3.2	260	09:45	45	1076.8	1435.7	1067.6	9.1												
26	2019-05-12	39G6	25	55°14.7'	16°41.3'	55°14.6'	16°43.0'	73	46	18	3.2	90	16:50	30	170.7	341.4	166.7	3.9								0.007				
27	2019-05-13	39G7	25	55°13.4'	17°02.4'	55°13.0'	17°02.3'	91	68	18	3.1	125	07:40	10	673.7	4041.9	667.7	5.9												
28	2019-05-13	38G7	25	54°58.6'	17°20.5'	54°59.0'	17°23.2'	29	10	14	3.2	70	13:10	30	0.9	1.9						0.587		0.356		0.0055				
29	2019-05-13	39G7	25	55°14.2'	17°18.8'	55°14.3'	17°17.7'	91	68	20	3.0	280	16:40	10	124.2	745.1	112.9	11.3												
30	2019-05-14	39G7	25	55°17.7'	17°39.6'	55°16.9'	17°39.5'	83	58	19	3	185	08:15	15	456.3	1825.0	455.5	0.8												
31	2019-05-14	39G7	25	55°07.3'	17°59.9'	55°05.8'	18°00.2'	48	26	17	3.2	165	14:40	30	349.5	699.0	349.0	0.5												

Table 4. The mean numerical share of young, undersized fishes per ICES SDs (the Polish SPRAS/2019 and SPRAS/2018).

Species	Fish length	SPRAS 2018 Mean share in % numbers SD25	SD26	Mean	SPRAS 2019 Mean share in % numbers SD25	SD26	Mean
sprat	< 10 cm	10.7	14.5	12.8	1.7	6.3	3.8
herring	< 16 cm	42.5	42.3	42.4	9.9	27.9	14.9
cod	< 35 cm	84.9	76.8	81.5	76.2	75.0	76.1

Table 5. Cruise statistics of the Polish SPRAS survey on board of the r.v. "Baltica", 03-15.05.2019.

ICES SDs	ICES rectangles	EDSU [NM]	<σ> $[m^2 \cdot 10^{-4}]$	$< S_A >$ $[m^2 \cdot NM^{-2}]$	Area $[NM^2]$	species composition [%]			Abundance $\cdot 10^6$			
						sprat	herring	cod	total	sprat	herring	cod
25	37G5	44	1.60	242.9	642.2	99.48	0.52	0.00	973.5	968.5	5.0	0.0
25	38G5	70	1.52	761.1	1035.7	99.02	0.94	0.04	5183.5	5132.6	48.8	2.0
25	38G6	73	1.61	316.5	940.2	97.30	2.70	0.00	1842.8	1793.1	49.7	0.0
25	38G7	26	1.48	49.1	471.7	99.89	0.11	0.00	157.0	156.8	0.2	0.0
25	39G6	79	1.42	588.1	1026	99.28	0.66	0.06	4246.0	4215.5	27.8	2.6
25	39G7	102	1.32	668.7	1026	99.45	0.55	0.00	5212.6	5184.0	28.6	0.0
Sum SD25		**394**							**17615.4**	**17450.6**	**160.1**	**4.7**
26	37G8	8	1.33	536.4	86	97.79	2.21	0.00	347.3	339.7	7.7	0.0
26	37G9	26	1.31	1360.3	151.6	99.15	0.85	0.00	1580.1	1566.7	13.4	0.0
26	38G8	51	1.26	1126.5	624.6	99.86	0.13	0.01	5563.5	5555.8	7.2	0.5
26	38G9	54	1.25	1260.3	918.2	99.93	0.05	0.02	9252.7	9246.0	5.1	1.7
26	39G8	83	1.29	1486.7	1026	99.90	0.10	0.00	11821.7	11810.2	11.5	0.0
26	39G9	32	1.26	2084.7	1026	99.91	0.07	0.02	16913.1	16898.5	11.6	3.1
26	40G8	89	1.28	1143.4	1013	99.83	0.16	0.01	9080.6	9065.4	14.6	0.7
Sum SD26		**343**							**54559.1**	**54482.2**	**70.9**	**6.0**

Table 6. Abundance of sprat (in millions of individuals) per age groups, ICES rectangles and ICES SDs, estimated using acoustic method, based on data collected during the Polish SPRAS survey on board of the r.v. “Baltica”, 03-15.05.2019.

ICES SDs	ICES rectangles	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8+	Total sprat abundance [mln indiv.]
25	37G5	3.4	34.4	176.0	296.4	348.1	63.1	32.1	15.0	968.5
25	38G5	52.0	242.3	1304.8	1547.0	1663.9	194.1	78.9	49.7	5132.6
25	38G6	12.8	68.9	336.0	560.6	640.5	101.8	46.5	26.0	1793.1
25	38G7	0.3	6.6	38.6	51.9	53.1	4.5	0.7	1.2	156.8
25	39G6	73.2	224.6	1420.3	1209.3	1154.9	83.7	29.7	19.8	4215.5
25	39G7	332.2	407.6	2107.0	1181.8	1075.2	57.2	7.5	15.5	5184.0
Sum SD25		**474.0**	**984.4**	**5382.6**	**4847.1**	**4935.6**	**504.4**	**195.2**	**127.2**	**17450.6**
26	37G8	22.8	42.4	80.1	124.9	55.5	12.4	0.6	0.9	339.7
26	37G9	55.9	202.6	443.1	570.6	242.9	50.6	0.9	0.0	1566.7
26	38G8	159.4	875.8	1621.7	1989.9	761.9	140.2	1.0	5.9	5555.8
26	38G9	275.4	1508.8	2960.4	3034.4	1230.5	234.7	1.9	0.0	9246.0
26	39G8	837.2	1466.7	2919.8	4350.0	1857.7	355.2	7.8	15.8	11810.2
26	39G9	1047.4	2304.9	4488.1	6168.6	2450.4	432.1	7.0	0.0	16898.5
26	40G8	751.2	1211.8	2370.7	3075.5	1393.4	247.8	9.3	5.7	9065.4
Sum SD26		**3149.2**	**7612.9**	**14883.9**	**19313.9**	**7992.4**	**1473.0**	**28.5**	**28.3**	**54482.2**

Table 7. Biomass of sprat (in tons) per age groups, ICES rectangles and ICES SDs, estimated using acoustic method, based on data collected during the Polish SPRAS survey on board of the r.v. “Baltica”, 03-15.05.2019.

ICES SDs	ICES rectangles	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8+	Total sprat biomass [t]
25	37G5	23.5	378.9	1878.6	4048.4	4880.4	1082.7	551.5	225.1	13069.0
25	38G5	310.2	2490.6	13171.7	19302.5	21598.6	2997.6	1296.4	743.8	61911.4
25	38G6	80.9	748.2	3582.8	7458.5	8848.4	1651.9	777.3	389.0	23536.9
25	38G7	2.4	73.1	409.1	624.8	651.4	63.0	11.0	17.3	1852.2
25	39G6	411.7	2153.4	13628.9	13899.8	13736.8	1218.8	502.4	295.2	45846.9
25	39G7	1768.1	3351.7	18852.8	12912.5	12131.0	800.3	121.0	226.2	50163.7
Sum SD25		**2596.7**	**9195.9**	**51523.9**	**58246.5**	**61846.7**	**7814.4**	**3259.6**	**1896.6**	**196380.2**
26	37G8	114.4	311.4	664.1	1251.7	583.2	140.9	8.5	15.4	3089.6
26	37G9	256.0	1540.2	3643.6	5619.2	2446.5	516.7	12.8	0.0	14035.0
26	38G8	806.4	6619.8	13011.2	18765.4	7191.6	1356.9	13.9	100.9	47866.0
26	38G9	1398.1	11385.4	23609.6	28416.9	11458.7	2108.5	27.0	0.0	78404.2
26	39G8	3884.6	10859.2	24308.4	43371.1	19115.3	3822.1	109.8	268.4	105738.9
26	39G9	4822.6	17505.0	36967.6	58990.1	23564.1	4063.1	98.4	0.0	146010.8
26	40G8	3427.1	8936.8	19390.2	30595.9	14429.0	2600.1	130.6	96.3	79606.0
Sum SD26		**14709.2**	**57157.8**	**121594.7**	**187010.2**	**78788.4**	**14608.2**	**401.0**	**481.1**	**474750.6**

Table 8. Mean weight of sprat (in grams) per age groups, ICES rectangles and ICES SDs, based on data collected during the Polish SPRAS survey on board of the r.v. “Baltica”, 03-15.05.2019.

ICES SDs	ICES rectangles	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8+	Mean W sprat [g]
25	37G5	6.97	11.02	10.67	13.66	14.02	17.15	17.21	15.00	13.49
25	38G5	5.96	10.28	10.10	12.48	12.98	15.44	16.44	14.97	12.06
25	38G6	6.3	10.85	10.66	13.30	13.81	16.23	16.73	14.99	13.13
25	38G7	7.23	11.05	10.61	12.04	12.28	14.06	16.22	14.64	11.81
25	39G6	5.62	9.59	9.60	11.49	11.89	14.56	16.90	14.87	10.88
25	39G7	5.32	8.22	8.95	10.93	11.28	14.00	16.22	14.61	9.68
MW SD25		**5.48**	**9.34**	**9.57**	**12.02**	**12.53**	**15.49**	**16.70**	**14.91**	**11.25**
26	37G8	5.01	7.35	8.29	10.02	10.50	11.36	14.08	17.0	9.10
26	37G9	4.58	7.60	8.22	9.85	10.07	10.20	14.08	-	8.96
26	38G8	5.06	7.56	8.02	9.43	9.44	9.68	14.08	17.0	8.62
26	38G9	5.08	7.55	7.98	9.36	9.31	8.98	14.08	-	8.48
26	39G8	4.64	7.40	8.33	9.97	10.29	10.76	14.08	17.0	8.95
26	39G9	4.60	7.59	8.24	9.56	9.62	9.40	14.08	-	8.64
26	40G8	4.56	7.37	8.18	9.95	10.36	10.49	14.08	17.0	8.78
MW SD26		**4.67**	**7.51**	**8.17**	**9.68**	**9.86**	**9.92**	**14.08**	**17.00**	**8.71**

Table 9. Abundance of herring (in millions of individuals) per age groups, ICES rectangles and ICES SDs, estimated using acoustic method, based on data collected during the Polish SPRAS survey on board of the r.v. “Baltica”, 03-15.05.2019.

ICES SDs	ICES rectangles	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8+	Total herring abundance [mln indiv.]
25	37G5	2.4	1.4	0.7	0.1	0.3	0.0	0.0	0.0	5.0
25	38G5	2.4	7.8	2.0	5.5	12.7	4.0	3.9	10.5	48.8
25	38G6	10.6	11.6	5.0	3.9	9.2	2.2	2.5	4.7	49.7
25	38G7	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
25	39G6	1.7	5.4	2.0	2.8	7.7	1.6	2.6	4.0	27.8
25	39G7	4.9	6.7	2.5	2.8	5.4	1.6	1.2	3.5	28.6
Sum SD25		**22.1**	**33.0**	**12.3**	**15.0**	**35.3**	**9.5**	**10.2**	**22.7**	**160.1**
26	37G8	1.3	4.5	0.5	0.8	0.5	0.0	0.1	0.0	7.7
26	37G9	1.8	6.2	0.9	1.3	1.4	0.8	0.6	0.4	13.4
26	38G8	0.0	1.5	0.4	0.7	1.3	0.9	1.9	0.5	7.2
26	38G9	0.2	1.1	0.8	0.7	1.1	0.4	0.5	0.2	5.1
26	39G8	1.6	3.6	0.5	0.5	1.8	1.1	1.5	0.8	11.5
26	39G9	0.4	5.1	0.6	0.9	2.4	0.7	1.1	0.4	11.6
26	40G8	0.3	5.7	1.1	1.7	2.7	1.1	1.5	0.4	14.6
Sum SD26		**5.5**	**27.7**	**4.8**	**6.6**	**11.2**	**5.0**	**7.3**	**2.8**	**70.9**

Table 10. Biomass of herring (in tons) per age groups, ICES rectangles and ICES SDs, estimated using acoustic method, based on data collected during the Polish SPRAS survey on board of the r.v. "Baltica", 03-15.05.2019.

ICES SDs	ICES rectangles	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8+	Total herring biomass [t]
25	37G5	61.5	34.7	20.0	3.8	10.8	0.6	0.0	0.0	131.5
25	38G5	62.4	291.4	83.2	277.4	633.4	239.1	229.3	666.9	2483.0
25	38G6	253.2	347.1	152.2	177.6	415.1	119.0	138.8	293.2	1896.1
25	38G7	1.4	0.9	0.6	0.0	0.0	0.0	0.0	0.0	2.9
25	39G6	43.8	198.8	79.1	139.1	354.4	83.0	138.7	239.1	1276.1
25	39G7	89.2	208.5	68.5	123.7	253.7	83.9	63.8	217.8	1109.1
Sum SD25		**511.5**	**1081.3**	**403.5**	**721.6**	**1667.4**	**525.6**	**570.6**	**1417.1**	**6898.6**
26	37G8	16.5	107.5	13.8	23.0	15.5	0.9	3.1	0.0	180.4
26	37G9	24.7	153.3	30.3	41.9	48.0	41.9	30.0	25.0	395.1
26	38G8	0.0	48.7	15.0	26.5	57.7	47.1	113.3	33.2	341.4
26	38G9	2.6	35.0	30.5	27.1	41.3	15.3	23.8	10.6	186.2
26	39G8	21.0	92.6	19.1	19.6	73.3	54.8	80.8	47.7	408.9
26	39G9	6.0	143.3	20.0	31.1	80.8	27.5	52.0	24.2	384.8
26	40G8	6.5	162.7	36.8	61.9	107.5	55.0	73.4	23.6	527.5
Sum SD26		**77.2**	**743.1**	**165.5**	**231.2**	**424.3**	**242.5**	**376.4**	**164.2**	**2424.3**

Table 11. Mean weight of herring (in grams) per age groups, ICES rectangles and ICES SDs, based on data collected during the Polish SPRAS survey on board of the r.v. "Baltica", 03-15.05.2019.

ICES SDs	ICES rectangles	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8+	Mean W herring [g]
25	37G5	25.37	25.11	26.87	28.40	33.93	40.37	-	-	26.19
25	38G5	26.12	37.24	41.02	50.80	49.72	59.39	58.95	63.69	50.85
25	38G6	23.82	29.97	30.67	46.04	45.18	53.57	54.59	62.56	38.18
25	38G7	15.74	18.98	18.13	-	-	-	-	-	17.06
25	39G6	25.92	36.67	38.99	49.52	46.31	50.90	53.76	59.75	45.88
25	39G7	18.12	30.96	27.73	44.96	46.62	53.56	54.79	61.44	38.78
MW SD25		**23.10**	**32.78**	**32.90**	**48.07**	**47.18**	**55.56**	**56.07**	**62.41**	**43.09**
26	37G8	13.02	24.12	27.83	27.78	29.91	36.43	36.88	-	23.50
26	37G9	13.90	24.69	32.71	33.17	34.06	53.44	48.64	57.39	29.44
26	38G8	-	33.22	34.82	40.28	44.36	50.33	61.16	60.44	47.48
26	38G9	14.50	30.52	37.75	37.40	37.52	39.88	45.38	58.50	36.87
26	39G8	13.32	25.53	37.18	37.83	40.11	51.23	52.65	60.75	35.71
26	39G9	14.50	28.17	34.44	34.28	34.30	40.83	45.25	58.50	33.24
26	40G8	19.31	28.47	34.64	36.06	39.97	49.12	47.83	60.68	36.22
MW SD26		**13.93**	**26.82**	**34.35**	**34.93**	**37.86**	**48.59**	**51.59**	**59.66**	**34.18**

Table 12. Abundance of cod (in millions of individuals) per age groups, ICES rectangles and ICES SDs, estimated using acoustic method, based on data collected during the Polish SPRAS survey on board of the r.v. "Baltica", 03-15.05.2019.

ICES SDs	ICES rectangles	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8+	Total cod abundance [mln indiv.]
25	37G5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
25	38G5	0.00	0.41	0.90	0.61	0.11	0.00	0.01	0.00	2.04
25	38G6	0.00	0.00	0.02	0.02	0.00	0.00	0.00	0.00	0.04
25	38G7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
25	39G6	0.02	1.48	0.96	0.16	0.02	0.00	0.00	0.00	2.63
25	39G7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sum SD25		**0.02**	**1.90**	**1.88**	**0.79**	**0.12**	**0.00**	**0.01**	**0.00**	**4.71**
26	37G8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
26	37G9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
26	38G8	0.00	0.26	0.18	0.03	0.00	0.01	0.00	0.00	0.49
26	38G9	0.00	0.45	0.85	0.22	0.14	0.00	0.00	0.00	1.67
26	39G8	0.00	0.04	0.01	0.00	0.00	0.00	0.00	0.00	0.04
26	39G9	0.00	0.83	1.56	0.41	0.26	0.00	0.00	0.00	3.06
26	40G8	0.00	0.37	0.20	0.04	0.08	0.00	0.00	0.00	0.69
Sum SD26		**0.00**	**1.96**	**2.79**	**0.71**	**0.49**	**0.01**	**0.00**	**0.00**	**5.96**

Table 13. Biomass of cod (in tons) per age groups, ICES rectangles and ICES SDs, estimated using acoustic method, based on data collected during the Polish SPRAS survey on board of the r.v. "Baltica", 03-15.05.2019.

ICES SDs	ICES rectangles	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8+	Total cod biomass [t]
25	37G5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
25	38G5	0.00	95.22	313.55	368.41	69.36	0.00	12.41	0.00	858.94
25	38G6	0.00	0.40	9.04	11.50	0.00	0.00	0.00	0.00	20.94
25	38G7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
25	39G6	1.00	279.24	306.85	81.69	11.43	0.00	0.00	0.00	680.20
25	39G7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sum SD25		**1.00**	**374.86**	**629.43**	**461.60**	**80.79**	**0.00**	**12.41**	**0.00**	**1560.09**
26	37G8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
26	37G9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
26	38G8	0.00	39.83	46.59	14.61	2.58	7.99	0.00	0.00	111.59
26	38G9	0.00	75.41	275.33	116.13	90.61	0.00	0.00	0.00	557.47
26	39G8	0.00	5.50	1.10	0.00	0.00	0.00	0.00	0.00	6.60
26	39G9	0.00	137.84	503.27	212.27	165.64	0.00	0.00	0.00	1019.02
26	40G8	0.00	60.20	64.00	20.93	56.59	0.00	0.00	0.00	201.72
Sum SD26		**0.00**	**318.77**	**890.28**	**363.94**	**315.43**	**7.99**	**0.00**	**0.00**	**1896.41**

Table 14. Mean weight of cod (in grams) per age groups, ICES rectangles and ICES SDs, based on data collected during the Polish SPRAS survey on board of the r.v. “Baltica”, 03-15.05.2019.

ICES SDs	ICES rectangles	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8+	Mean W cod [g]
25	37G5	-	-	-	-	-	-	-	-	-
25	38G5	-	230.5	348.0	608.7	655.4	-	1085.0	-	421.75
25	38G6	-	419.9	461.2	512.8	-	-	-	-	-
25	38G7	-	-	-	-	-	-	-	-	-
25	39G6	63.5	188.4	321.0	501.3	725.0	-	-	-	258.41
25	39G7	-	-	-	-	-	-	-	-	-
MW SD25		-	**197.7**	**335.4**	**583.8**	**664.4**	-	-	-	**328.3**
26	37G8	-	-	-	-	-	-	-	-	-
26	37G9	-	-	-	-	-	-	-	-	-
26	38G8	-	152.5	260.2	479.3	529.8	655.0	-	-	228.82
26	38G9	-	165.9	323.2	516.3	631.2	-	-	-	332.85
26	39G8	-	147.7	147.7	-	-	-	-	-	147.71
26	39G9	-	165.9	323.2	516.3	631.2	-	-	-	332.85
26	40G8	-	160.7	322.6	529.8	716.2	-	-	-	291.76
MW SD26		-	**354.2**	**544.0**	**1169.3**	**808.8**	**655.0**	-	-	**577.7**

Table 15. Values of the basic meteorological and hydrological parameters recorded in May 2019 at the positions of the r.v. "Baltica" fish control catches.

Haul number	Date of catch	Haul start time	Meteorological parameters					Hydrological parameters			Depth of meauserment [m]
			Air preasure [hPa]	Air temperature [°C]	Wind direction	Wind force [B]	Sea state	Temperature [°C]	Salinity [PSU]	Oxygen [ml/l]	
1	2019-05-03		1004.2	6.6	N	3	1	4.82	7.73	6.34	57
2	2019-05-03		1005.1	7.8	ZM	2	2	7.13	7.49	8.79	33
3	2019-05-04		1003.3	5.9	SW	4	2	6.69	7.58	8.40	41
4	2019-05-04		1003.9	7.3	SW	4	2	5.52	9.87	3.53	74
5	2019-05-04		1005.8	6.2	W	4	3	4.82	8.85	6.59	65
6	2019-05-05		1012.2	5.6	NNW	4	2	4.08	7.64	7.62	66
7	2019-05-05		1014.1	6.2	NW	3	1	7.94	12.40	1.48	84
8	2019-05-06		1013.2	6.3	SW	4	2	5.70	9.75	1.38	72
9	2019-05-06		1013.8	7.1	SW	4	2	5.70	10.47	3.65	77
10	2019-05-07		1012.8	6.9	W	4	3	6.08	11.39	3.72	71
11	2019-05-07		1013.8	7.3	W	5/6	3/4	4.81	8.33	7.79	73
12	2019-05-07		1014.7	7.4	W	5	3	5.75/6.35	10.07/7.48	3.68/8.70	68/31
13	2019-05-08		1015.6	7.1	S	3/4	2	5.54	9.55	0.54	71
14	2019-05-08		1013.9	7.4	SSE	5	3	4.61	7.58	8.42	40
15	2019-05-09		1001.2	9.2	SSE	4	2	5.20	7.82	8.07	34
16	2019-05-09		1001.8	8.4	SE	4	2	4.68	8.54	5.65	51
17	2019-05-10		1004.1	7.9	ZM	2	1	8.51	15.88	2.24	68
18	2019-05-10		1004.7	8.3	SW	2/3	1	7.64	15.25	2.93	65
19	2019-05-10		1006.5	7.7	ZM	2	1	7.46	7.95	7.92	27
20	2019-05-10		1008.1	7.4	ZM	2	1	7.47	7.98	7.78	32
21	2019-05-11		1012.4	7.8	NW	4	2	6.66	13.21	3.61	57
22	2019-05-11		1013.6	9.2	WNW	3	2	8.46	16.41	1.23	76
23	2019-05-11		1014.4	8.6	W	4	2	6.17	12.63	4.93	55
24	2019-05-12		1021.9	8	NW	4	3	8.28	7.91	7.72	24
25	2019-05-12		1023.5	7.9	NW	4	2/3	7.65	7.90	7.63	27
26	2019-05-12		1026.8	8.3	W	4	2	4.80	8.70	6.69	55
27	2019-05-13		1031.2	8.1	NW	5	3	7.35	14.14	2.91	77
28	2019-05-13		1032.5	7.6	NW	5	3	7.40	7.72	8.30	17
29	2019-05-13		1032.6	7.8	NW	4	2	7.06	13.57	3.21	78
30	2019-05-14		1034.7	7.2	N	5	3	6.30	12.25	4.19	67
31	2019-05-14		1032.8	7.7	N	5	3	5.99	7.69	7.97	35

* data of the mean depth of the fish control-catches (in the middle of trawl vertical opening)

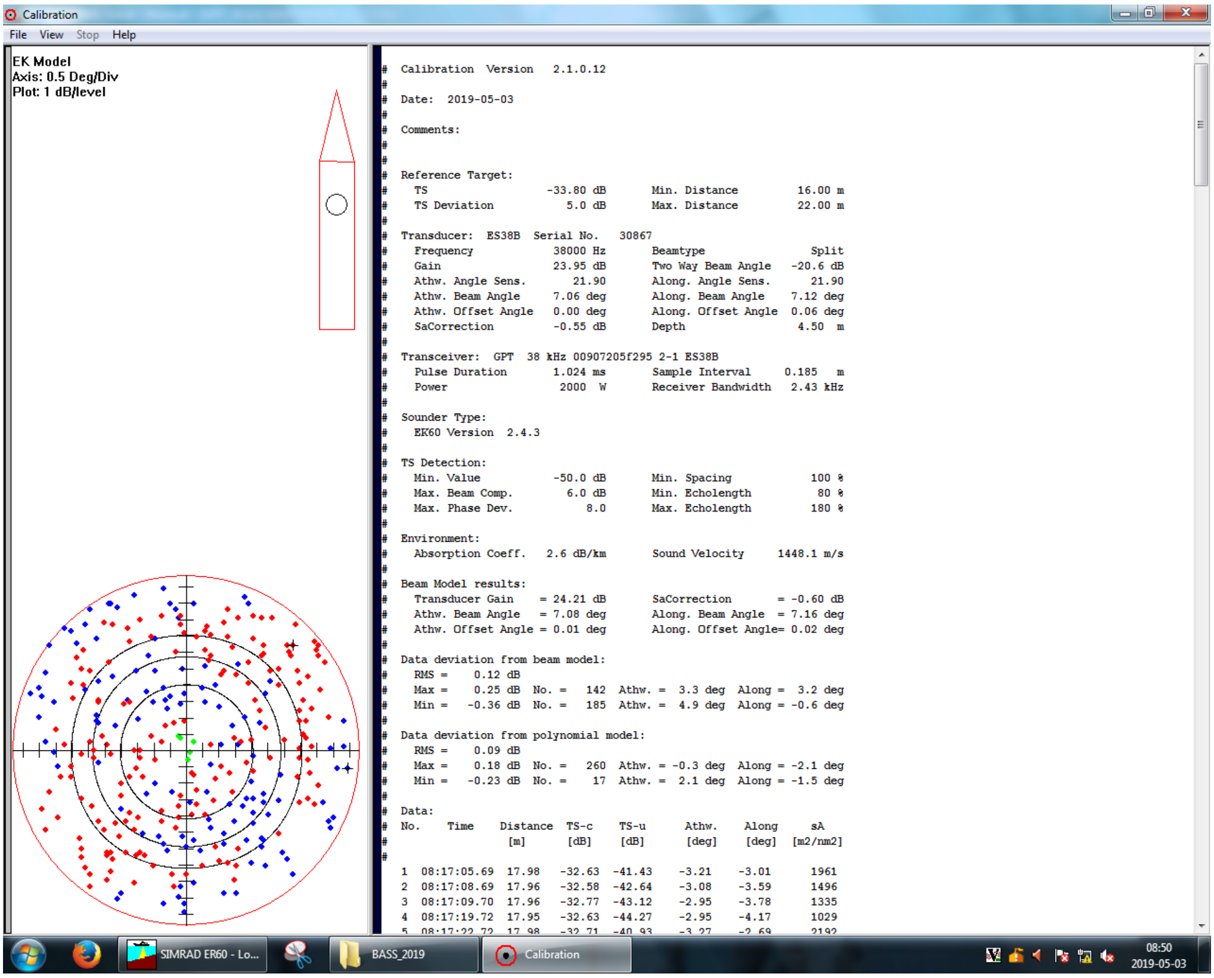


Fig. 1. R.v. “Baltica” cruise SPRAS 2019: Simrad EK60 calibration report (38 kHz transducer).

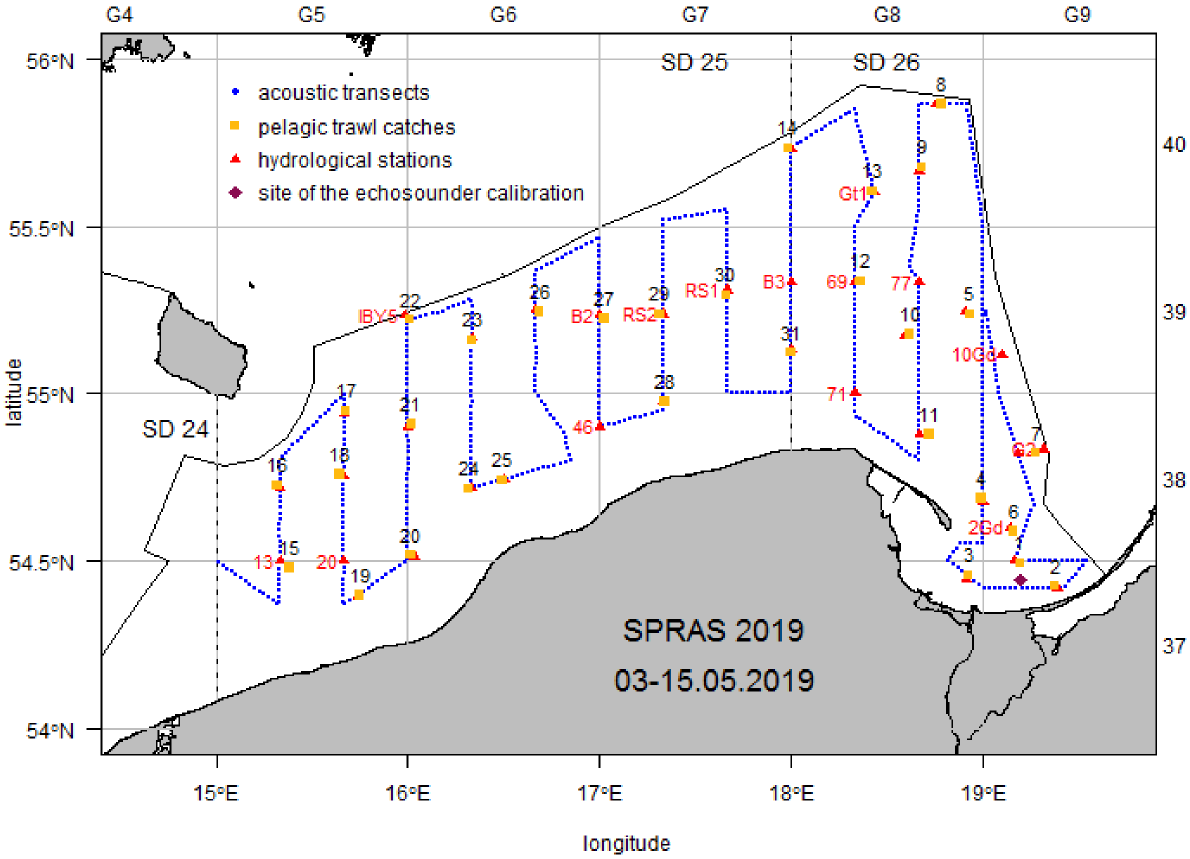


Fig. 2. Location of realized investigations during the Polish SPRAS survey on board of the r.v. "Baltica", 03–15.05.2019.

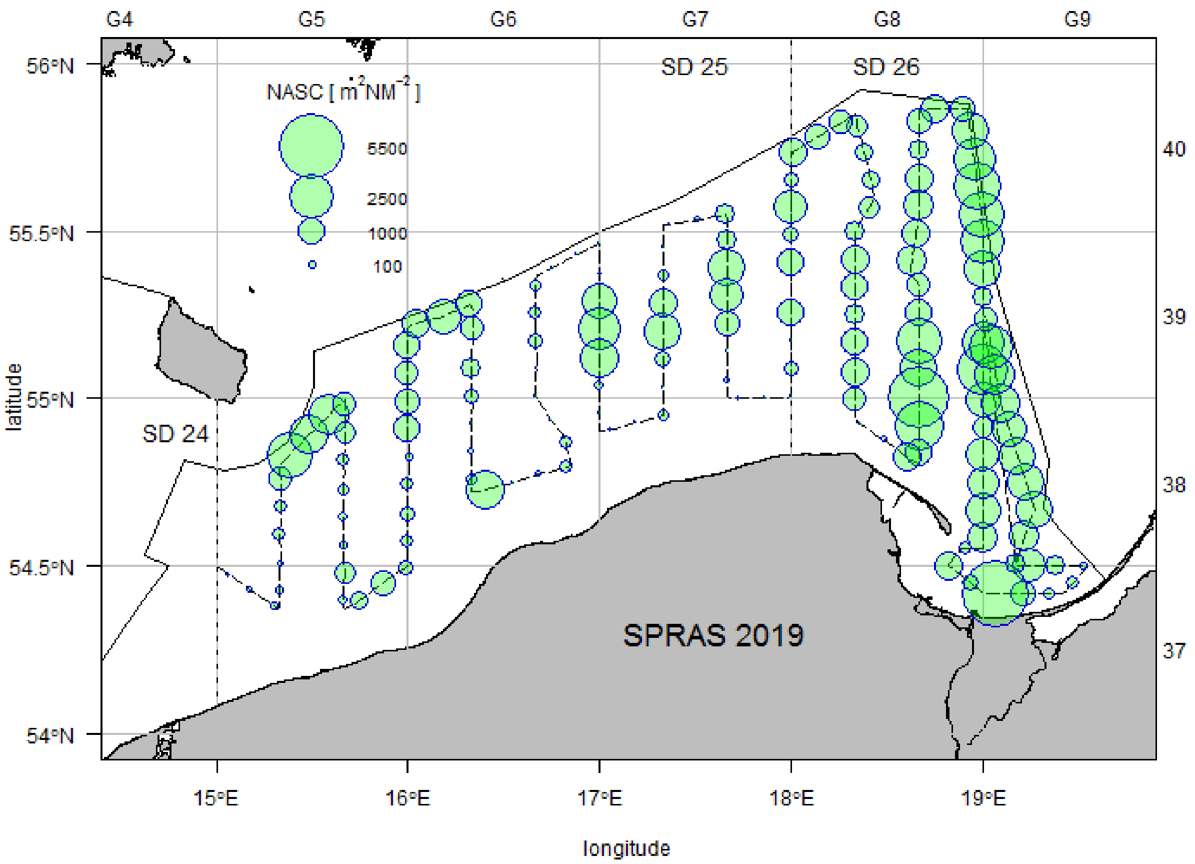


Fig. 3. Cruise track (thin dashed line) and the mean NASC (5 NM intervals, bubbles) recorded during SPRAS 2019 cruise.

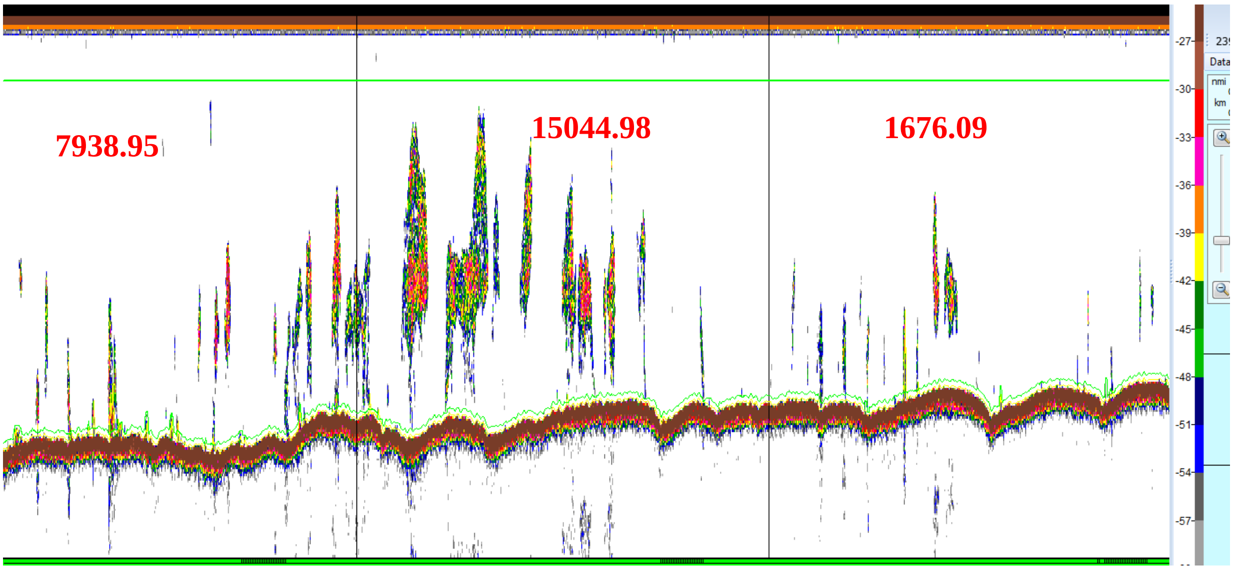


Fig. 4. An example of an echogram analysis for 33th mile of the integration, NASC = 15044.98 m^2/NM^2 (ICES rectangle 37G9, bottom depth 37 m; 04.05.2019).

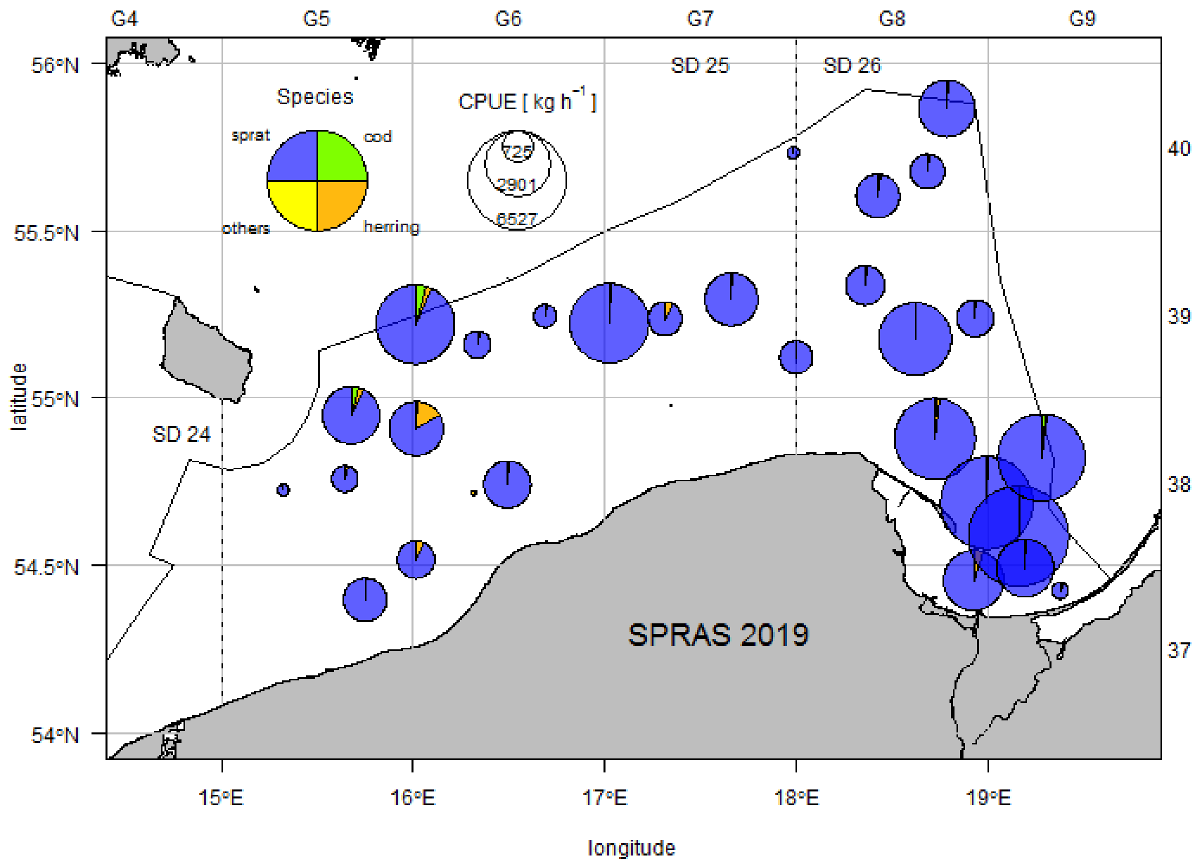


Fig. 5. CPUE [kg h^{-1}] of fish species per single pelagic hauls conducted in the Polish EEZ (SPRAS/2019 survey).

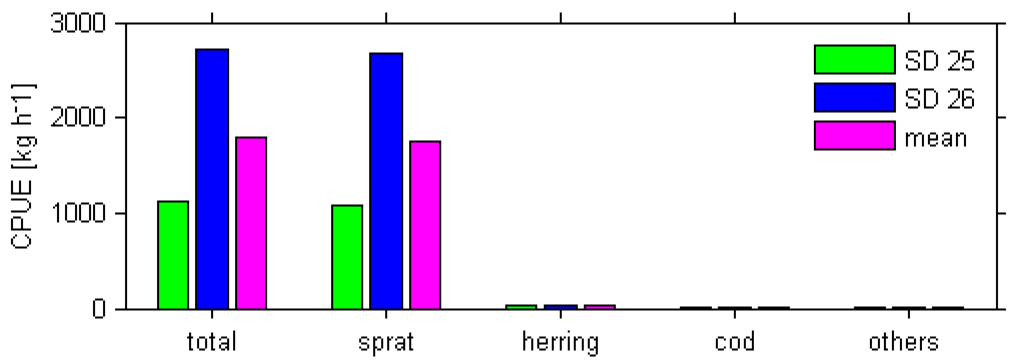
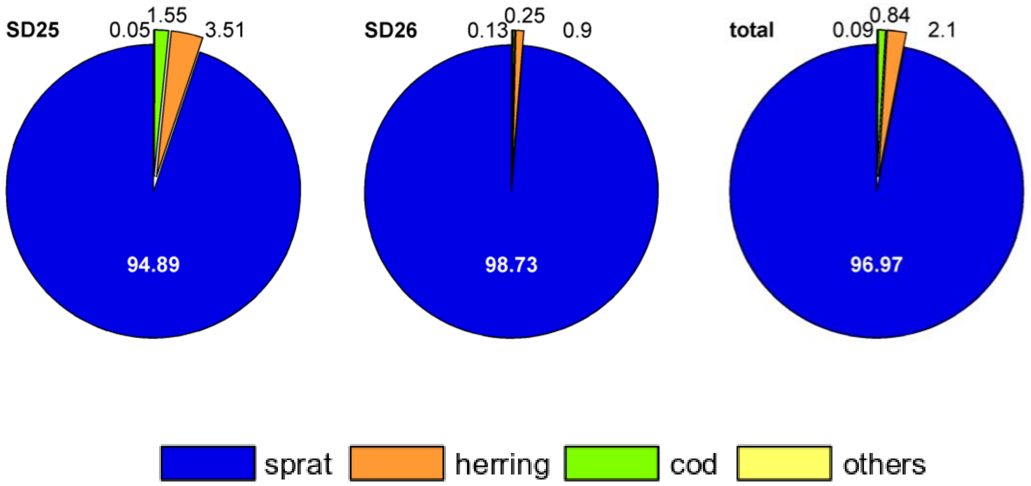


Fig. 6. Mean CPUE [kg h^{-1}] per fish species and the ICES SDs (the Polish SPRAS/2019 survey).

Fig. 7. Share (%) of sprat, herring, cod and other fishes in the mass of total catches per the ICES SDs (the Polish SPRAS/2019).



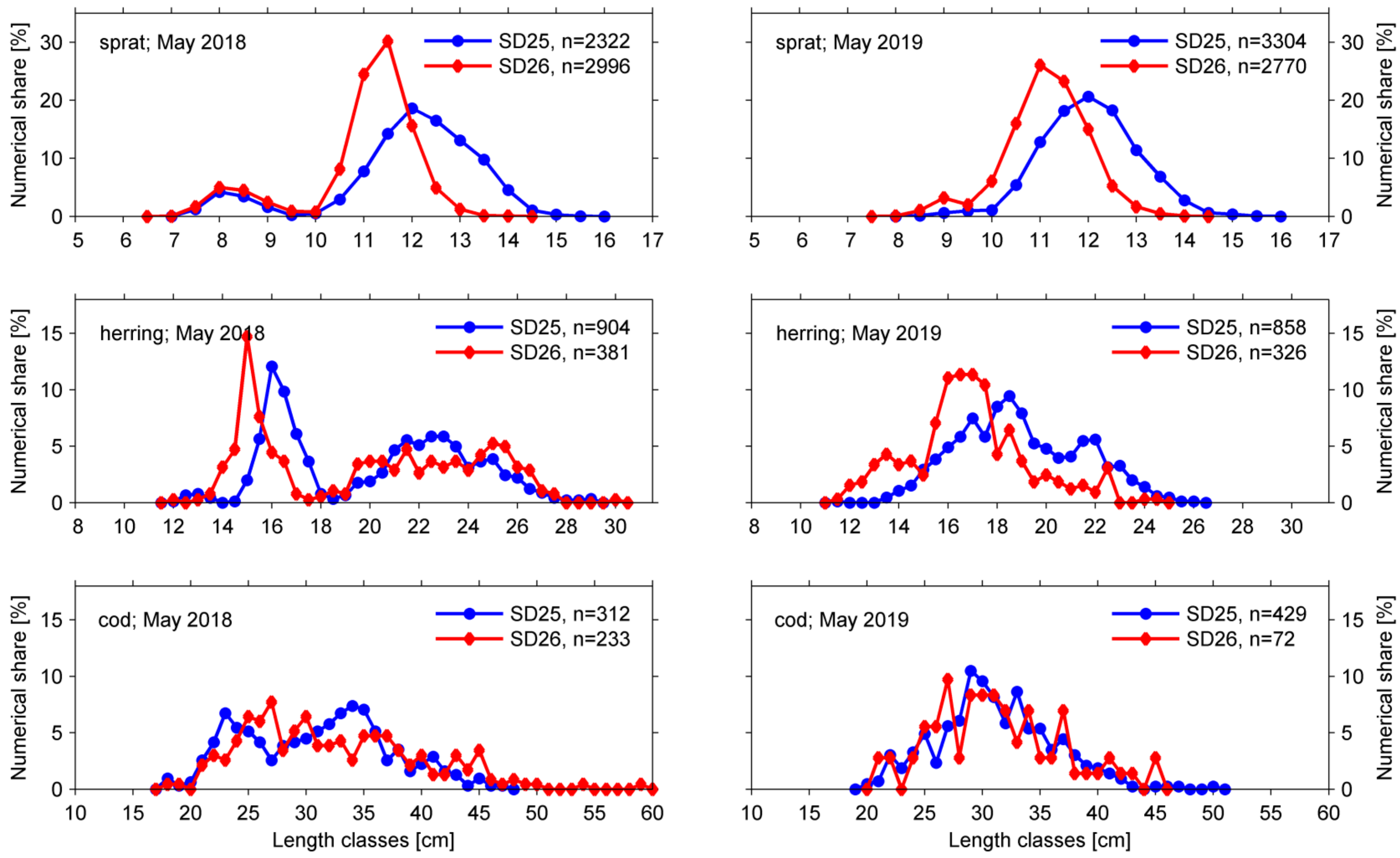


Fig. 8. Length distribution of sprat, herring and cod in samples taken from the control-catches conducted during the Polish SPRAS/2018 and SPRAS/2019 surveys (length distribution of sprat, herring and cod from 2018 from Schmidt and Grygiel, 2019).

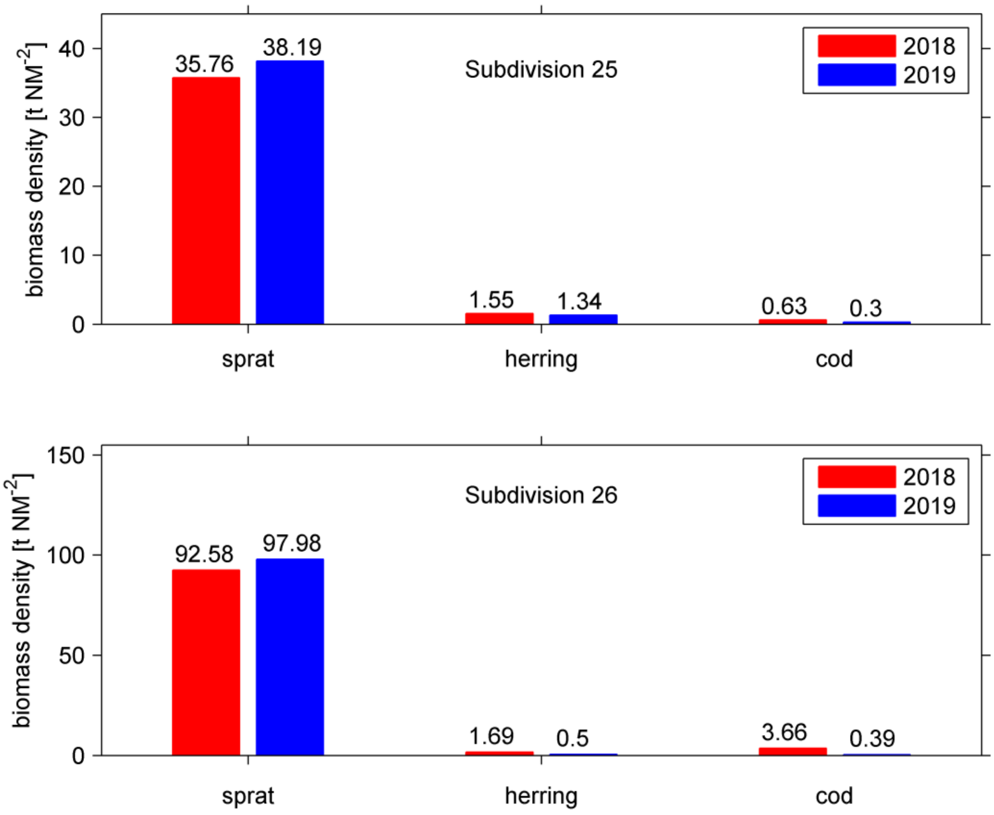


Fig. 9. Mean biomass density in the ICES Sub-divisions 25 and 26 in the Polish SPRAS 2018 and 2019 for the three major fish species (mean biomass density values from 2018 from Schmidt and Grygiel, 2019).

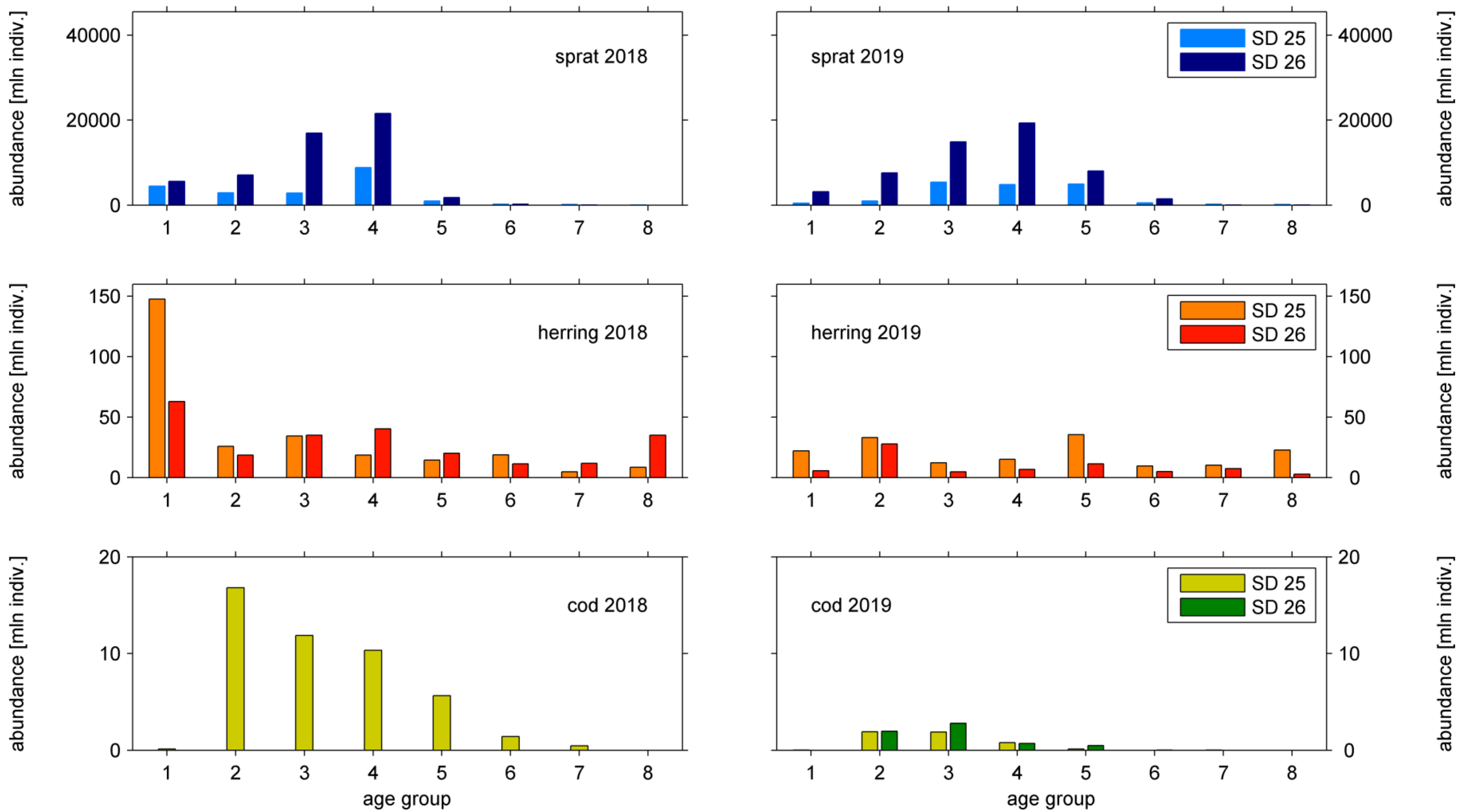


Fig. 10. Abundance of sprat, herring and cod stocks per age groups, according to the ICES Sub-divisions 25 and 26, based on data from the Polish SPRAS surveys in 2018 and 2019 (abundance values from 2018 from Schmidt and Grygiel, 2019).

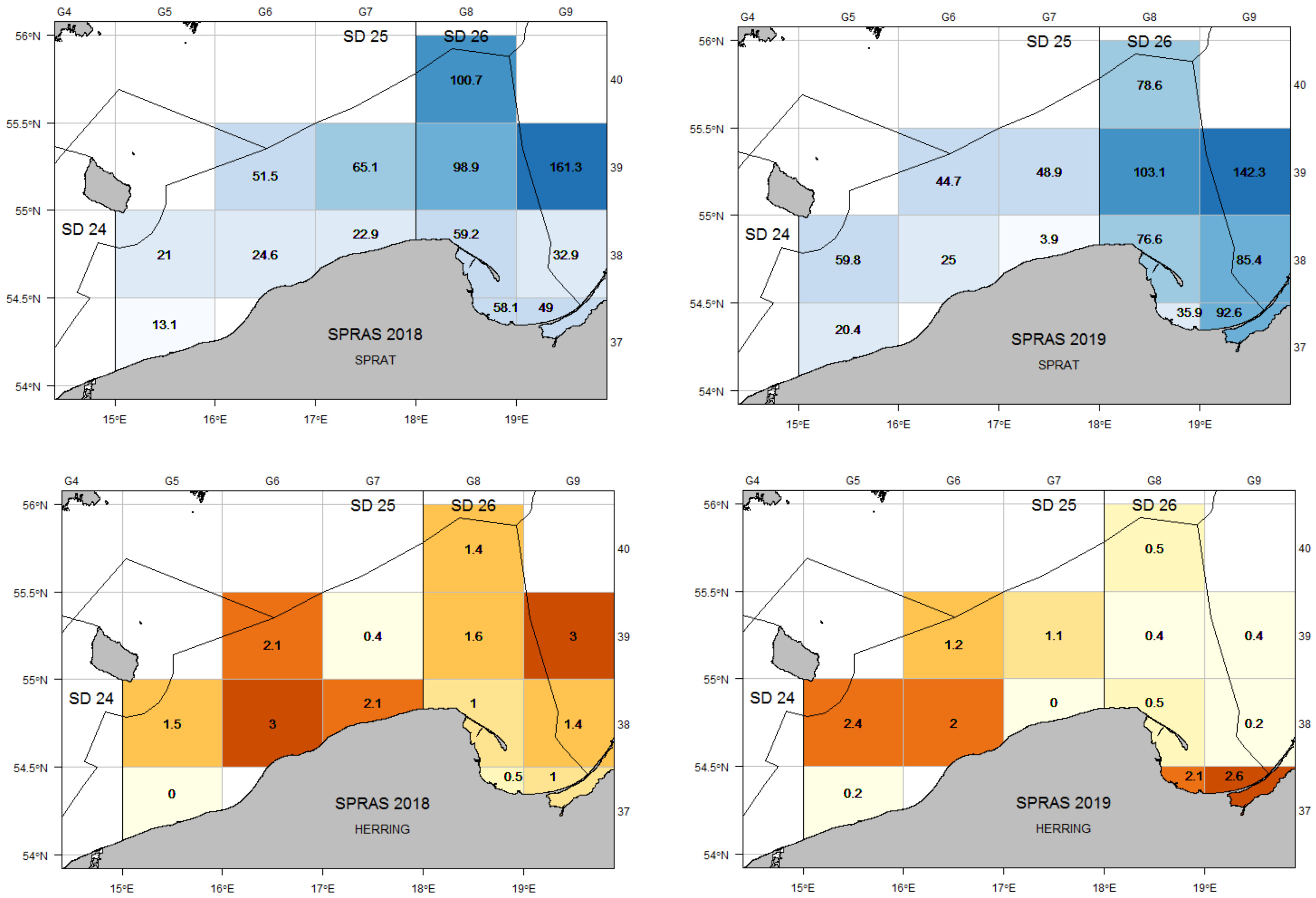
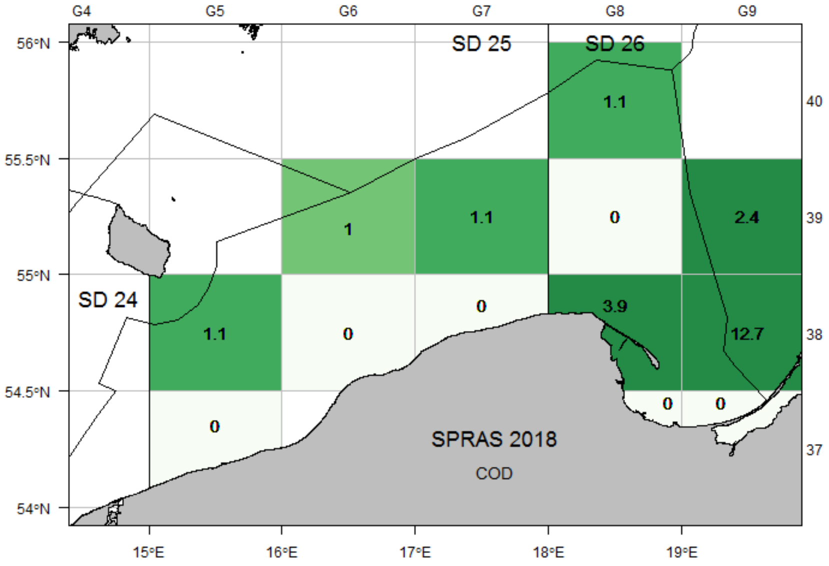


Fig. 11. Biomass surface density of sprat and herring [t·NM^{-2}] in ICES rectangles, estimated using acoustic method, and based on data collected during the Polish SPRAS 2018 and 2019 surveys (biomass surface density of sprat and herring from 2018 from Schmidt and Grygiel, 2019).



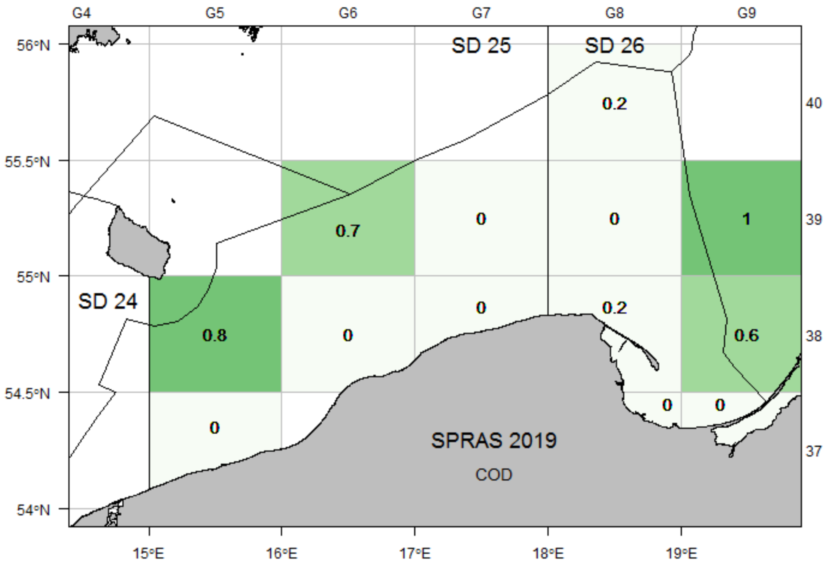


Fig. 12. Biomass surface density of cod [t·NM^{-2}] in ICES rectangles, estimated using acoustic method, and based on data collected during the Polish SPRAS 2018 and 2019 surveys (biomass surface density of cod from 2018 from Schmidt and Grygiel, 2019).

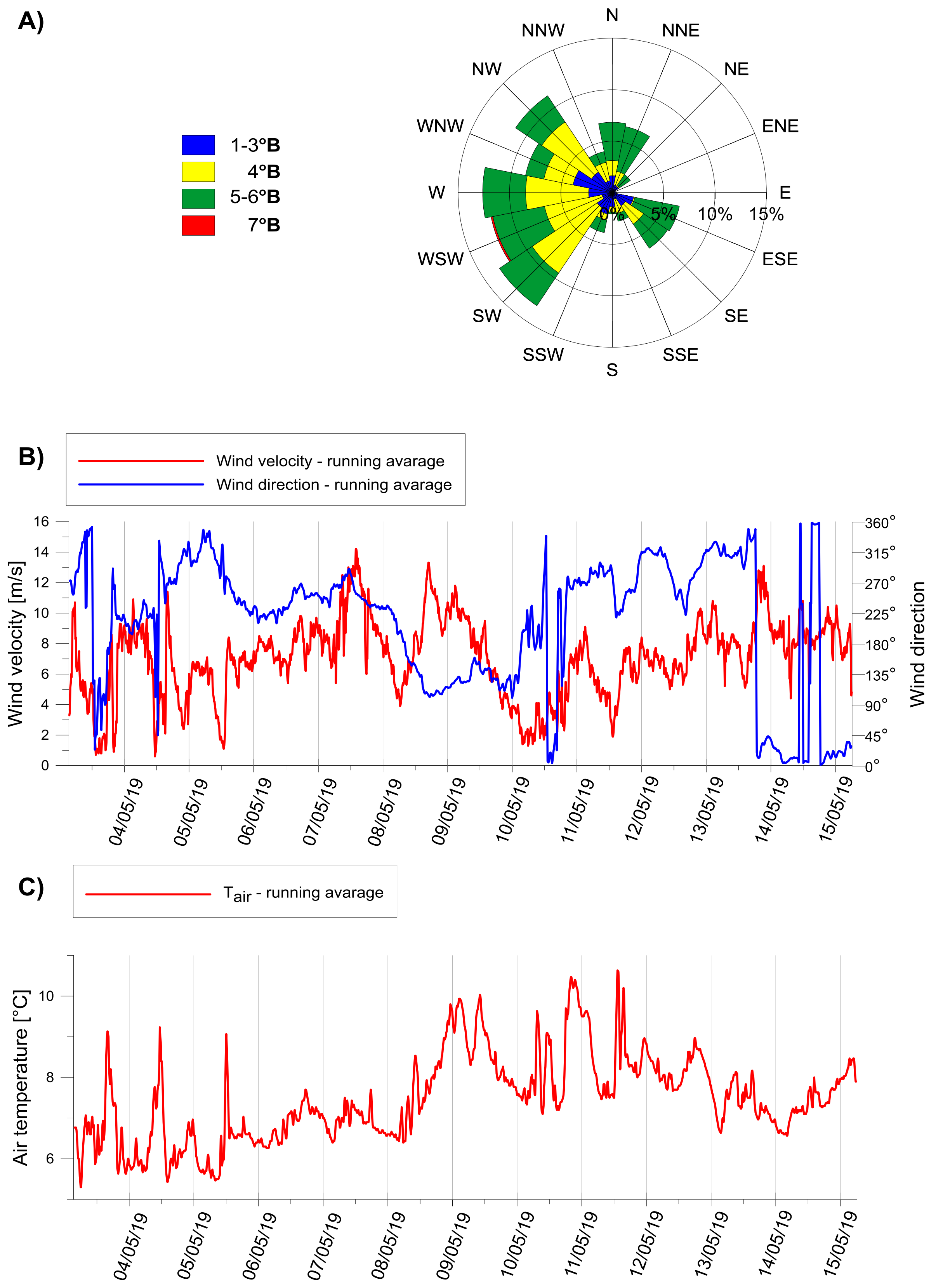


Fig. 13. Changes of meteorological parameters during consecutive days of the Polish SPRAS survey in May 2019 (fig. Wodzinowski cit. in Schmidt et al., 2019).

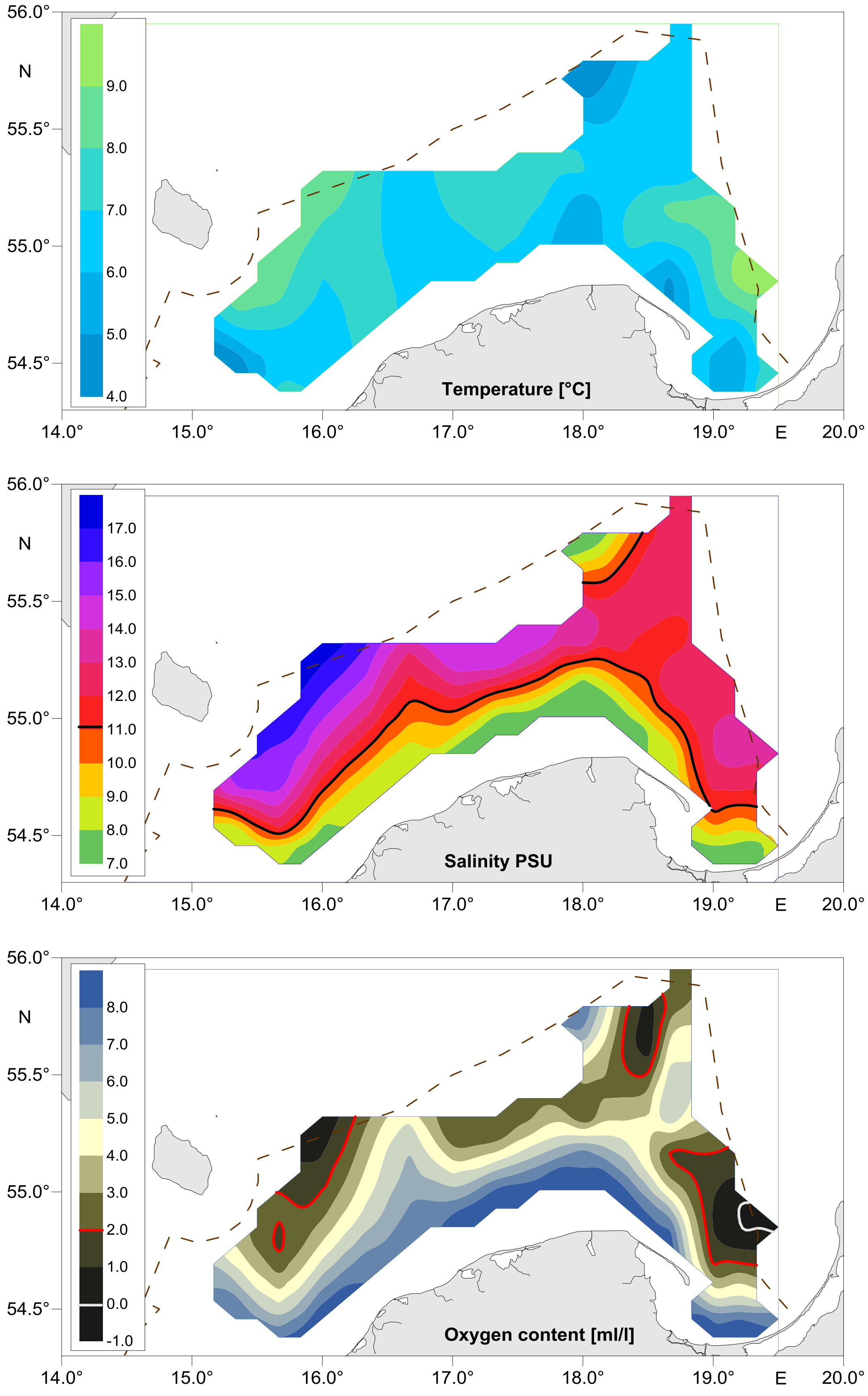


Fig. 14. Horizontal distribution of the seawater temperature, salinity and oxygen content in the near seabed layer of the southern Baltic in May 2019 (fig. Wodzinowski cit. in Schmidt et al., 2019).

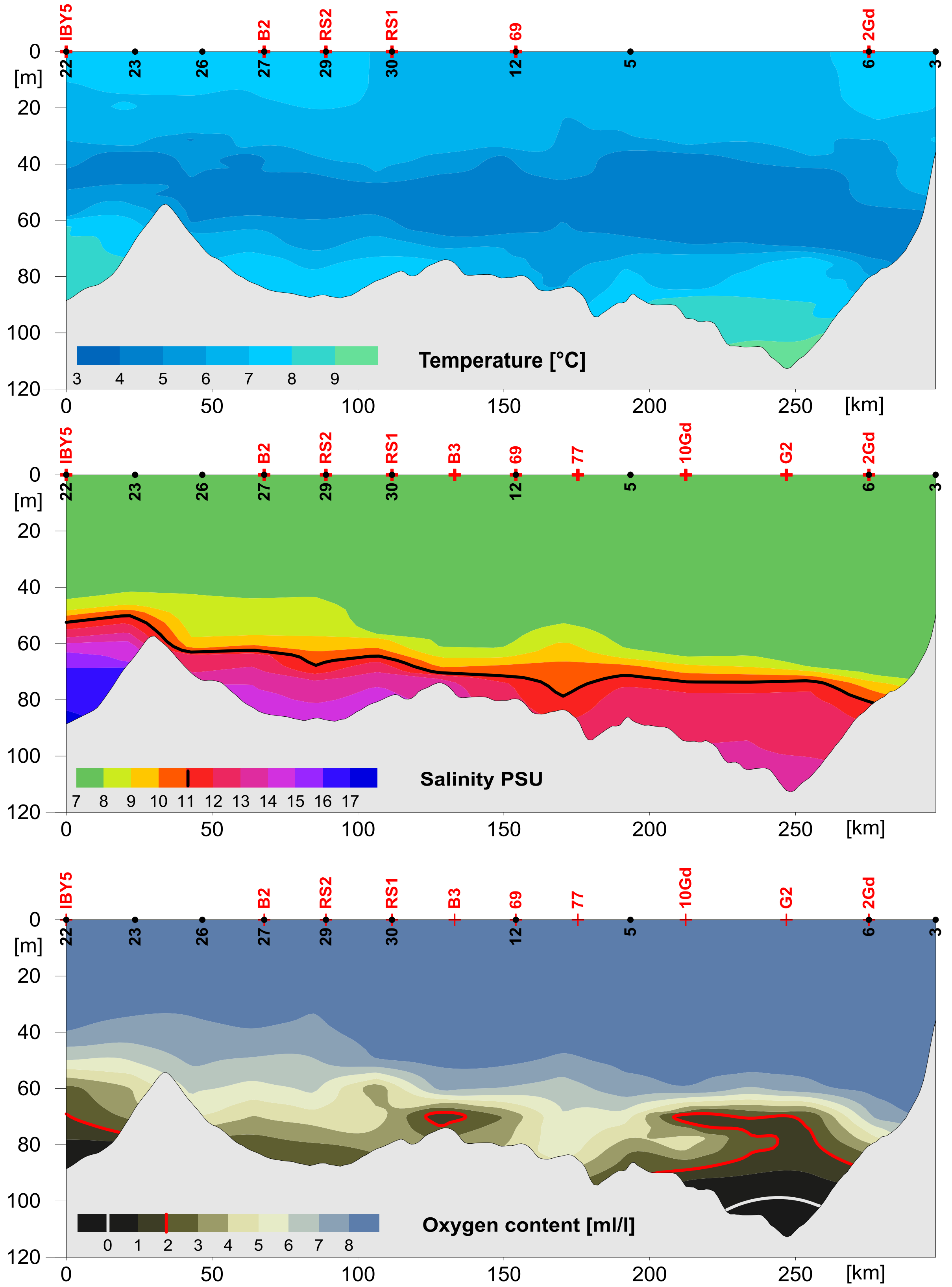


Fig. 15. Vertical distribution of the seawater temperature, salinity and oxygen content, along the hydrological research profile determined in the southern Baltic (May 2019); X- and Y-axes reflects distance (in kilometres) and depth (in meters) from the sea surface to the seabed, respectively (fig. Wodzinowski cit. in Schmidt et al., 2019).

PRELIMINARY REPORT

FROM THE JOINT ESTONIAN-POLISH BIAS 2019 CONDUCTED BY THE R.V. "BALTICA" IN THE NORTH-EASTERN BALTIC SEA (21-31 October 2019)

by
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Introduction

The recent joint Estonian-Polish Baltic International Acoustic Survey (BIAS), marked with the number 21/2019/NMFRI/TUEMI was based on the procurement contract between the University of Tartu/Estonian Marine Institute in Tallinn and the National Marine Fisheries Research Institute in Gdynia. The survey was conducted in the Estonian EEZ (the ICES Sub-divisions 28.2, 29 and 32 West).

The Estonian Data Collection Program for 2019 and the European Union (the Commission regulations Nos. 2016/1251 financially supported the EST-POL BIAS 2019. Timing, surveying area in the North-eastern Baltic Sea and the principal methods of investigations during the above mentioned survey were designed and coordinated by the ICES WGBIFS.

The main aims of the reported cruise were:

- to provide the echo-integration and to collect the acoustic data along the planned transects in the north-eastern Baltic Sea,
- to conduct the fish pelagic control-catches in the fish concentration locations,
- to collect ichthyological samples especially for herring and sprat,
- to provide hydrological monitoring (water temperature, salinity and oxygen content) at the catch locations.

Personnel

The EST-POL BIAS 2019 scientific staff was composed of 9 persons:
Radoslaw Zaporowski (NMFRI, Gdynia – Poland) – survey leader
Krzysztof Koszarowski (NMFRI, Gdynia – Poland) – acoustician
Wojciech Deluga (NMFRI, Gdynia – Poland) - ichtyologist
Lena Szymanek (NMFRI, Gdynia – Poland) – hydrologist
Tiit Raid (TUEMI, Tallinn - Estonia) – Estonian scientific staff leader
Andrus Hallang (TUEMI, Tallinn - Estonia) – ichthyologist
Elor Sepp (TEMI, Tallinn - Estonia) – acoustician
Ain Lankov (TUEMI, Tallinn - Estonia) – ichthyologist
Timo Arula (TUEMI, Tallinn - Estonia) – biologist

Narrative

The reported survey took place during the period of 21-31 October 2019. The at sea investigations (echo-integration, fish control catches, hydrological and plankton stations) were conducted aboard r.v. "Baltica" within Estonian EEZ (the ICES Sub-divisions 28.2, 29 and 32 West), moreover inside the territorial waters of this country not shallower than 20 m depth.

The survey started from the Ventspils port (Latvia) on 20.10.2019 after midday and was navigated in the North-eastern direction to the entering point of planned acoustic transect at the geographical position 58°05'N 021°48'E on October 21 (Fig. 1). The at sea research ended on 29.10.2019 before the midday in the port of Ventspils (Latvia). Then the r.v. “Baltica” started her journey to the home-port in Gdynia (Poland), reaching it on 31.10.2019 in the morning.

Survey design and realization

The r.v. “Baltica” realized 468 NM echo-integration transect and 19 fish control-catches (Fig. 1). All planned ICES rectangles were covered with acoustic transect and control catches. All control catches were performed in the daylight (between 07:30 am. and 3:35 p.m.) using the pelagic trawl type WP 53/64x4 (with 6 mm mesh bar length in the codend). The hauls trawling duration varied from 5 to 30 minutes due to different fish densities observed on the net-sounder monitor. The mean speed of vessel while providing echo-integration was 8.0 knots, but in case of trawling the speed was 3.0 knots. Overall, 4 hauls were conducted in SD 28.2, 7 hauls in SD 29 and 10 hauls in SD 32.

The length measurements (in 0.5 cm classes) were realized for totally 3967 sprat and 3486 herring individuals. Totally, 323 sprat and 558 herring individuals were taken for biological analysis.

Acoustic data were collected using the EK-60 echo-sounder equipped with “Echo-view V4.10” software for the data analysis. The acoustic equipment was calibrated at sea in the Gulf of Gdansk before the survey, according to the methodology described in the IBAS manual (ICES, 2017). The basic acoustic and biological data collected during recently carried out BIAS were delivered to the TUEMI laboratories for further elaboration. Next they will be stored in the BIAS_DB.mdb and the new acoustic data base WKBIFS-ACOU in the accepted CSV or XML formats, managed by ICES.

The rosette sampler with connected CTD Seabird 911+ probe were used for hydrological sampling,

Data analysis

The MYRIAX “EchoView v.10.0” software was used for the analysis of the acoustic data.

The total number of fish in each the ICES rectangle was estimated as a product of the mean NASCs from scrutinized acoustic data and a rectangle area, divided by corresponding mean acoustic cross-section (σ) which is based on the trawl catch results. The abundance of clupeids was separated into sprat and herring according to the mean catch composition.

Mean target strength (TS) – one of the principal acoustic parameter – of clupeids was calculated according to following formula:

$$TS = 20 \log L - 71.2$$

Despite the bad weather conditions, all transects and planned trawls were conducted according to the plan.

Catch results and fish measurements

Overall, 11 fish species were identified in hauls performed at the North-eastern Baltic Sea (SDs 28.2, 29 and 32 West) in October 2019. Sprat and herring were dominating species in EEZ of Estonia. Sprats accounted for 52.6% and herring for 45.5%. Sprat dominated in all SD: 28.2 - 46.9% 29-55.5% and 32-51.3%. Herring accounted for 43.5% in SD 28.2, and 44.4% and 47.7% in SD 29 and 32 respectively. In SD 28.2, the three-spined stickleback accounted for 9.3% of the total biomass. The other 9 fish species (cod, flounder, three-spined stickleback, nine-spined stickleback, smelt, lumpfish, salmon, straightnose pipefish) represented only 1.8% of the total biomass in average.

The detailed catch and CPUE results are presented in the Table 1 and Fig. 2. The biological sampling is shown in Table 2.

Mean CPUE for all species in the investigated area in October 2019 amounted for 647,8 kg/h (comparing to 630,6 kg/h in the same period of 2017 respectively).

The highest values of CPUEs for sprat and herring was noted in SD 32 - 895 kg/h. The mean value of CPUEs for sprat were as follow: 458,9kg/h in ICES SD 32; 359,4 kg/h in SD 29 and 148.0 kg/h in SD 28.2. The mean CPUEs value for herring were: 427,0; 312,3 and 137 kg/h in SDs 32, 29 and 28.2 respectively. Mean CPUE for other species amounted for 11,3 kg/h (of which 9,6 kg/h for three-spined stickleback and 0,8 kg/h for smelt).

The length distributions of sprat, herring and three-spine stickleback according to the ICES Sub-divisions 28.2, 29 and 32 are shown on Fig. 3-5.

Length distribution of sprat in all surveyed subdivisions was bimodal. The first frequency peak occurred at a length of 7.5 cm and was most frequently represented in SD 28.2 - 37.7%, and in SD 29-29.1% of all measured sprat. In SD 32 the first peak occurred at a length of 8 cm and amounted for 11.4% of all measured sprat. The second peak in SD 28.2 and 32 occurred at the 11 cm class and accounted for 6% in SD 28.2 and 26.1% in SD 32. In SD 29 the second peak occurred at the class 11.5 cm and accounted for 11.9% of all measured sprat in this subdivision.

Length distribution of herring in all surveyed subdivisions was bimodal. The first frequency peak in SD 28.2 occurred at a length of 10,5 cm and amounted for 4% of all measured fish. In SD 32 first frequency peak was observed at 9,5 cm length class and amounted for 10,1% of all measured fish. SD 29 first frequency peak was observed at 9,0 cm length class and amounted for 6,1% of all measured fish. Second frequency peak in all investigated subdivisions was as follow: SD 28.2 -16 cm length class – 18,8% of measured fish; SD 29 – 15,5 cm length class – 15,7% of measured fish; SD 32 – 15,0 cm length class – 14,4% of measured fish.

The length distribution of three-spined stickleback was in range 3-8 cm with modal frequency at 6 cm length class, taking into advice all investigated area.

Acoustic results

The survey statistics concerning the survey area, the mean NASC, the mean sigma, the estimated total number of fish, the percentages of herring and sprat per ICES statistical rectangles are presented in Table 3. Fish concentrations were found generally lower than in previous years.

Abundance and biomass estimates

The estimated abundances of herring and sprat by age group and Sub-division/ICES statistical rectangle are given in Table 4. The estimated biomass by age group and Sub-division/ICES statistical rectangle is shown in Table 5. Corresponding mean weights by age group and Sub-division/ICES statistical rectangle are summarized in Table 6.

The abundance of sprat was about 30% lower than in previous year, abundance being highest in mouth of Gulf of Finland and west of island Hiiumaa. The abundance and biomass of herring was highest in the eastern part of Gulf of Finland and lowest in the Baltic Proper. The average weight of herring was slightly lower than in the previous survey. Abundance of herring was slightly higher compared to the previous survey.

Meteorological and hydrological characteristics

Hydrological parameters were measured at each trawling station (21) (Fig. 1). Measurements were conducted with the CTD SeaBird 911-probe combined with the rosette sampler. Oxygen content was determined by the standard Winkler's method. The STD data were aggregated to the 1-m depth strata. The oxygen samples were taken every 10 meters. The salinity parameter was presented in Practical Salinity Unit (PSU). Meteorological parameters were measured by MicroStep-MIS AMS 111 automatic weather station.

The most frequent winds (Fig. 6~~2~~) were from directions: WSW and NNW (the second half of the cruise). The average (10 min) wind speed varied from 0.6 m/s to 16.3 m/s (wind gusts up to 26.5 m/s). The air temperature ranged from 2.5 °C to 13.9 °C with the average value 9.4°C. Significant air temperature drop and change of the wind direction occurred in the second half of the cruise and was connected to the weather front passage.

The seawater temperature in the surface layer varied from 10.55 to 12.88 °C (Fig.7~~3~~). The lowest values were observed at the trawl station no. 16 while the highest - trawl no. 2, and this spatial distribution resulted from a decrease of the air temperature in the second half of the research period. The average value equaled 11.67°C. The average surface salinity was 6.29 PSU. The minimum value was 5.01 PSU (trawl no. 13, easternmost station) and maximum 7.08 PSU (trawl no. 2). The highest oxygen content in surface layer was 7.36 ml/l (trawl no. 12 and 13) while the lowest one 6.74 ml/l (trawl no. 21). Mean value of dissolved oxygen equaled 7.05 ml/l.

The variability range of all surface water parameters was low, but it could be noticed that the salinity of surface water decreased towards the east, into the Gulf of Finland, which is due to the greater impact of the riverine inflow on the hydrological regime. In addition, water oxygenation increased, which in turn was probably caused by a decrease of the air temperature, and thus water temperature, in the second half of the cruise (the lower the temperature, the higher the solubility of oxygen in water).

Near-bottom layer conditions are presented in the Fig. 8~~4~~ and Fig 9~~5~~. Water temperature varied from 4.58 °C (trawl no. 7) to 13.00 °C (trawl no. 1). The mean value was 6.51 °C. The highest salinity was found at the deepest station – trawl no. 3 (11.77 PSU); the lowest salinity – 6.52 PSU – trawl no. 19. The average salinity in the close-to-the-bottom water layer was 8.88 PSU. The dissolved oxygen content varied from 0.00 ml/l to 6.68 ml/l (maximum at the trawl station no. 1 - a shallow station, 39m with strong mixing to the bottom). The lack of oxygen was observed at six stations in the deepest areas (over 87m deep) but on another five stations, just a little bit shallower, situation was also bad – oxygen content less than 1 ml/l. The mean value of the oxygen content was 2.05 ml/l.

To sum up, the highest temperature and oxygen content as well as the lowest salinity in the near-bottom waters were observed in the shallower part of the research area. With the depth, the salinity increased and the oxygen content decreased. The temperature reached a minimum in the area of contact of the winter water layer with the bottom (about 50-70m).

In comparison to October 2019, the situation at the bottom has deteriorated: the anoxic zone is larger and reaches further east into the Gulf of Finland and at the same time salinity of near bottom layer has decreased. However, the vertical anoxic layer is less thick and the hypoxia zone is wider, possibly due to storm mixing.

The final report from the EST-POL BASS 2019 will be presented at the meeting of the ICES Baltic International Fish Survey Working Group (WGBIFS) in the period of 30 March – 3 April 2020 in Cadiz (Spain).

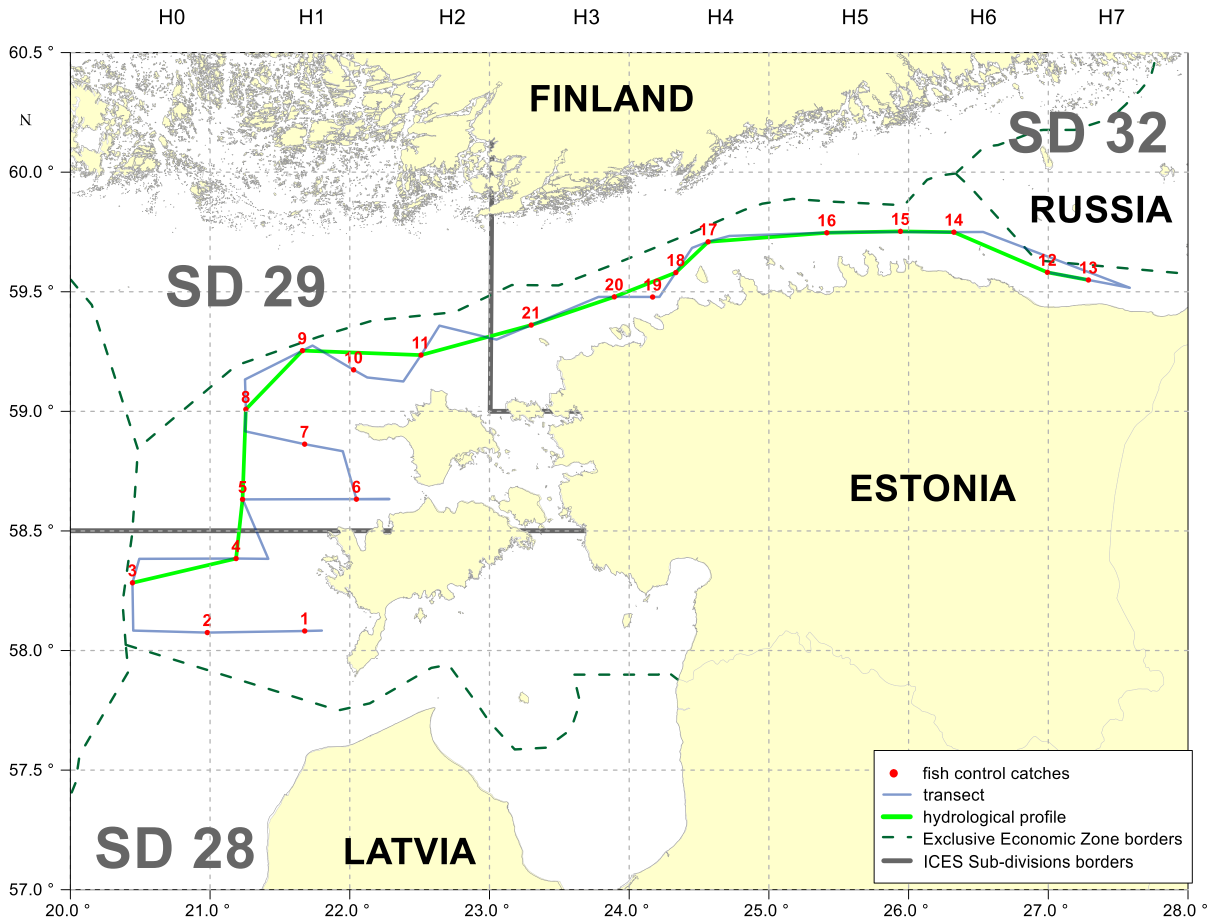


Fig. 1. Acoustic transects and pelagic fish control catches with connected hydrological stations realised during the joint EST-POL BIAS (October 2019).

Table 1. Catch results during joint Estonian-Polish BIAS conducted by r.v. “Baltica” in the Estonian EEZ in October 2019.

Haul number	Date of catch	ICES rectangl	ICES Sub-div.	Depth to fishing trawl [m]	Depth to the bottom [m]	The ship's course during fishing [°]	Geographical position of the catch station: start latitude 00°00' N	start longitude 00°00'E	end latitude 00°00' N	end longitude 00°00'E	Time of shutting net	Time of pulling up net	Haul duration [min.]	Total catch	all species CPUE [kg/h]	CATCH of particular fish species [kg]: sprat	herring	cod	flounder	salmon	threespined stickleback	niniespined stickleback	anchovy	straightnose pipefish	lumpfish	smelt
1	21.10.2019	45H1	28.2	20	41	240°	58°04' 5	021°39′ 7	58°04′ 1	021°38′ 7	07:50	08:05	15	133,95	535,800	132,479	1,432				0,039					
2	21.10.2019	45H0	28.2	40-45	66	285°	58°04' 7	020°27′ 3	58°05' 0	020°54′ 4	11:25	11:55	30	118,822	237,644	118,29	0,187				0,064				0,281	
3	21.10.2019	45H0	28.2	35	144	030°	58°17' 4	020°27′ 1	58°18' 9	020°28′ 1	16:00	16:30	30	52,272	104,544						51,75				0,522	
4	22.10.2019	45H1	28.2	65	91	030°	58°23' 7	021°12′ 8	58°24' 7	021°14′ 7	08:10	08:40	30	246,764	493,528	8,238	238,172								0,354	
5	22.10.2019	46H1	29	60	85	080°	58°38' 1	021°15′ 8	58°38' 3	021°18′ 2	12:05	12:35	30	31,788	63,576	12,08	19,353				0,044	0,002	0,031		0,278	
6	23.10.2019	46H2	29	15-20	40	080°	58°38' 0	022°04′ 3	58°38' 1	022°05′ 7	07:30	07:45	15	111,288	445,152	106,661	4,476		0,138		0,013					
7	23.10.2019	46H1	29	35	59	100°	58°51' 6	021°42' 0	58°51' 6	021°43′ 0	11:45	11:55	10	786,56	4719,36	786,56										
8	23.10.2019	47H1	29	65	120-168	050°	59°01' 2	021°17′ 1	59°02' 1	021°19′ 3	15:40	16:10	30	76,427	152,854	3,227	71,548	1,237			0,415					
9	24.10.2019	47H1	29	60-65	108	060°	59°16' 0	021°41′ 8	59°16' 8	021°41′ 9	07:35	08:05	30	225,648	451,296	47,642	177,634				0,074				0,298	
10	24.10.2019	47H2	29	65	108	050°	59°10' 8	022°03′ 4	59°11' 6	022°05′ 3	10:25	10:55	30	86,411	172,822	2,3	83,975				0,132	0,004				
11	24.10.2019	47H2	29	60-65	102	020°	59°14' 9	022°31′ 7	59°15' 6	022°32′ 3	14:10	14:25	15	558,283	2233,132	82,088	475,908				0,263					0,024
12	25.10.2019	47H6	32	25	50	290°	59°34' 7	026°59′ 1	59°35' 0	026°57′ 9	09:30	09:45	15	114,68	458,720	43,842	63,332			3,82	3,616	0,07				
13	25.10.2019	47H7	32	22	45	290°	59°33' 3	027°16′ 6	59°33' 7	027°15′ 5	11:45	12:00	15	321,69	1286,760	250,114	70,859				0,633	0,063		0,021		
14	27.10.2019	48H6	32	45	83	275°	59°45' 0	026°18′ 0	59°45' 0	026°17′ 3	07:15	07:25	10	118,879	713,274	11,561	104,709				0,289	0,028				2,292
15	27.10.2019	48H5	32	40-42	83	275°	59°45' 2	025°55′ 2	59°45' 3	025°54′ 4	09:25	09:35	10	112,642	675,852	45,243	66,18				0,31	0,021				0,888
16	27.10.2019	48H5	32	44-45	87	270°	59°44' 8	025°23′ 4	59°44' 7	025°21′ 6	12:05	15:25	20	150,54	451,620	13,089	136,017				0,756	0,033		0,007		0,638
17	28.10.2019	48H4	32	40	87	250°	59°42' 8	024°32′ 4	59°42' 2	024°31′ 4	06:50	07:00	10	286,909	1721,454	125,342	160,788				0,292					0,487
18	28.10.2019	48H4	32	50-52	79	215°	59°34' 3	024°19′ 4	59°33' 8	024°18′ 8	08:55	09:05	10	126,661	759,966	30,035	96,078				0,209	0,008				0,331
19	28.10.2019	47H4	32	40	68	265°	59°28' 8	024°09′ 0	59°28' 7	024°08′ 4	10:35	10:40	5	152,430	1829,16	141,578	10,075				0,588	0,021				0,168
20	28.10.2019	47H3	32	60	90	270°	59°28' 9	023°52′ 2	59°28' 8	023°51′ 8	12:15	12:20	5	51,791	621,492	24,804	26,846				0,08	0,004				0,057
21	28.10.2019	47H3	32	47-50	106	245°	59°21' 3	023°16′ 7	59°21' 1	023°16′ 2	15:30	15:35	5	130,100	1561,2	117,503	12,314				0,04	0,01				0,233
												Total catch [kg]	SD 28.2	551,808	315,31886	259,007	239,791	0	0	0	51,853	0	0	0	1,157	0
													SD 29	1876,405	703,56393	1040,558	832,894	1,237	0,138	0	0,941	0,006	0,031	0	0,576	0,024
													SD 32	1566,322	895,04114	803,111	747,198	0	0	3,82	6,813	0,258	0	0,028	0	5,094
													Sum	3994,535	647,75893	2102,676	1819,883	1,237	0,138	3,82	59,607	0,264	0,031	0,028	1,733	5,118

Table. 2. Biological sampling in the r.v.”Baltica” joint EST-POL BIAS in October 2019.

Biological materials collected during EST-POL BIAS;
r.v. "Baltica", 21.-31.10.2019.

SD 28		SPRAT	HERRING	COD	FLOUNDER	LUMPFISH	THREE SPINED STICKLEBACK	NINE SPINED STICKLEBACK	SALMON	SMELT	ANCHOVY	STRAGHTNOSE PIPEFISH	TOTAL
Samples	measurements	3	3			3	3						12
taken	analyses	3	3										6
Fish measured		620	223			4	61						908
Fish analysed		77	130										207

SD 29		SPRAT	HERRING	COD	FLOUNDER	LUMPFISH	THREE SPINED STICKLEBACK	NINE SPINED STICKLEBACK	SALMON	SMELT	ANCHOVY	STRAGHTNOSE PIPEFISH	TOTAL
Samples	measurements	7	6	1	1	2	6	2		1	1		27
taken	analyses	7	6										13
Fish measured		1308	1181	3	1	4	111	2		1	1		2612
Fish analysed		114	229										343

SD 32		SPRAT	HERRING	COD	FLOUNDER	LUMPFISH	THREE SPINED STICKLEBACK	NINE SPINED STICKLEBACK	SALMON	SMELT	ANCHOVY	STRAGHTNOSE PIPEFISH	TOTAL
Samples	measurements	10	10	1	1	5	10	9	1	8	1	2	58
taken	analyses	10	10	0	0	0	0				0	0	20
Fish measured		2039	2082	3	1	8	297	42	1	89	1	2	4565
Fish analysed		132	199	0	0	0	0				0	0	331

SUM		SPRAT	HERRING	COD	FLOUNDER	LUMPFISH	THREE SPINED STICKLEBACK	NINE SPINED STICKLEBACK	SALMON	SMELT	ANCHOVY	STRAGHTNOSE PIPEFISH	TOTAL
Samples	measurements	20	19	2	2	7	19	11	1	9	2	2	94
taken	analyses	20	19	0	0	0					0	0	39
Fish measured		3967	3486	6	2	12	469	44	1	90	2	2	8081
Fish analysed		323	558	0	0	0	0				0	0	881

Table 3. The BIAS survey basic biological and acoustic data concerning the clupeid stocks inhabiting the north- eastern Baltic Sea in October 2019.

ICES Sub-div.	ICES rectangle	Area [NM^2]	Share [%-indiv.]		Total abundance [$x10^6$]	Abundance density [$10^6/NM^2$]	NASC [m^2/NM^2]	σ [cm^2]
			herring	sprat				
28	45H0	947.2	0.0	49.9	3940.56	4.16	202.3	0.486
28	45H1	827.1	41.1	58.8	8144.85	9.847	1434.6	1.457
29	46H1	921.5	16.8	83.0	11917.18	12.93	1160.4	0.897
29	46H2	258.0	2.8	97.2	3062.62	11.87	1195.8	1.007
29	47H1	920.3	58.3	38.9	2116.22	2.299	389.7	1.695
29	47H2	793.9	79.1	19.9	4312.55	5.432	1022.6	1.883
32	47H3	536.2	32.0	66.6	8562.93	15.97	2099.9	1.315
32	48H4	835.1	39.7	59.0	6853.71	8.207	1136.7	1.385
32	48H5	767.2	57.1	36.6	5819.76	7.586	1280.0	1.687
32	48H6	776.1	57.3	29.7	9781.93	12.6	1626.0	1.290
32	48H7	851.4	22.8	75.1	8399.03	9.865	1185.6	1.202
Average			**37.0**	**55.9**		**6.946**	**1157.6**	**1.30**
Total		**8434**			**72911**			

Table 4. Abundance (in 10^6 indiv.) of herring and sprat per age groups according to the ICES rectangles and Sub-divisions of the north-eastern Baltic in October 2019.

ICES Sub-div.	ICES rectangle	HERRING – age groups									
		0	1	2	3	4	5	6	7	8+	total
28	45H0	1.51	0.22								1.73
28	45H1	106.31	122.60	381.29	668.73	435.59	1149.04	79.88	209.33	182.71	3335.48
total		107.82	122.82	381.29	668.73	435.59	1149.04	79.88	209.33	182.71	33370.20
29	46H1	1218.61	183.16	76.49	104.50	74.57	242.15	13.83	54.04	23.46	1990.81
29	46H2	52.91	14.29	6.42	4.65	0.81	4.10	0.37	0.59	0.29	84.43
29	47H1	128.95	76.59	129.67	163.84	124.91	392.07	50.55	106.50	59.88	1232.97
29	47H2	500.29	442.03	687.38	576.72	194.89	835.51	33.36	99.13	42.44	3411.76
total		1900.77	716.07	899.95	849.71	395.17	1473.84	98.11	260.27	126.07	6719.96
32	47H3	905.21	14.55	178.51	831.08	412.78	253.35	104.60	35.92	5.98	2741.98
32	48H4	419.42	74.29	395.28	1128.92	415.16	210.21	68.76	7.98	1.30	2721.32
32	48H5	184.43	64.12	598.13	1369.40	635.96	343.18	110.82	14.57	0.59	3321.20
32	48H6	2450.32	117.41	546.32	1085.78	761.78	438.03	161.59	26.42	19.37	5607.00
32	48H7	1351.95	66.78	248.34	223.76	14.31	6.54	2.22			1913.90
total		5311.33	337.15	1966.58	4638.94	2239.99	1251.30	447.99	84.89	27.25	16305.41
Grand total		7319.91	1176.04	3247.83	6157.38	3070.75	3874.18	625.98	554.49	336.03	26362.58

Table 4. Continued

ICES	ICES rectangle	SPRAT – age groups									
Sub-div.		0	1	2	3	4	5	6	7	8+	Total
28	45H0	1949.11	3.58	7.64	2.60	0.81	3.25	0.00	0.00	0.00	1967.00
28	45H1	3242.77	640.04	586.74	160.78	27.88	96.06	11.69	3.90	0.00	4769.86
total		5191.89	643.61	594.38	163.38	28.70	99.31	11.69	3.90	0.00	6736.85
29	46H1	6928.91	327.24	1045.36	170.15	223.91	998.03	92.14	18.43	55.34	9859.50
29	46H2	1078.24	326.70	840.61	87.71	117.01	500.57	14.02	0.00	11.68	2976.55
29	47H1	668.57	17.09	49.00	6.49	15.39	58.72	2.96	0.00	4.49	822.71
29	47H2	334.30	37.89	159.89	26.76	49.49	208.12	16.55	4.93	20.81	858.73
total		9010.02	708.93	2094.85	291.11	405.80	1765.43	125.67	23.36	92.32	14517.49
32	47H3	899.53	577.09	1585.80	385.94	191.22	1327.56	411.90	74.95	250.74	5704.74
32	48H4	1632.92	265.18	833.99	196.63	82.99	680.62	204.94	21.98	124.76	4044.01
32	48H5	205.81	207.32	649.50	156.00	79.19	542.17	158.53	25.97	102.77	2127.26
32	48H6	1578.68	148.61	446.84	107.90	51.24	373.80	112.84	15.32	68.03	2903.26
32	48H7	843.07	413.73	1714.76	442.35	268.01	1598.71	575.58	95.76	355.44	6307.41
total		5160.01	1611.93	5230.90	1288.82	672.66	4522.86	1463.78	233.97	901.74	21086.68
Grand total		19361.92	2964.47	7920.13	1743.30	1107.16	6387.61	1601.14	261.24	994.07	42341.02

Table 5. Biomass (in tons) of herring and sprat per age groups according to the ICES rectangles and Sub-divisions of the north-eastern Baltic in October 2019.

ICES	ICES	HERRING – age groups									
Sub-div.	rectangle	0	1	2	3	4	5	6	7	8+	total
28	45H0	6.71	2.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	8.82
28	45H1	461.18	1891.89	8476.98	16791.02	11724.16	33565.16	2107.24	6802.88	6352.02	88172.53
total		468	1894	8477	16791	11724	33565	2107	6803	6352	88181
29	46H1	6199.12	1559.16	1792.23	2628.18	2031.11	6537.65	443.16	1594.66	713.29	23498.55
29	46H2	276.65	149.99	144.11	111.04	22.94	109.15	10.92	16.64	8.47	849.90
29	47H1	672.65	1004.50	2925.91	4092.53	3556.37	10895.40	1580.42	3209.29	1902.64	29839.71
29	47H2	2348.84	6844.62	14924.47	13637.50	5387.99	21669.68	1047.58	2851.09	1250.00	69961.76
total		9497	9558	19787	20469	10998	39212	3082	7672	3874	124150
32	47H3	4251.64	218.84	3207.31	17731.67	10187.25	6801.25	2927.23	1250.53	221.34	46797.05
32	48H4	2075.04	1151.76	7188.42	24299.11	10212.84	5555.62	1862.35	224.60	40.68	52610.42
32	48H5	841.75	1077.22	11071.31	29165.54	15368.24	8924.60	2915.41	480.31	17.73	69862.10
32	48H6	13475.84	2000.29	10004.38	24246.80	18142.41	11395.17	4335.34	761.99	725.90	85088.12
32	48H7	6440.49	1123.91	4627.14	4788.05	345.24	196.98	70.63	0.00	0.00	17592.45
total		27085	5572	36099	100231	54256	32874	12111	2717	1006	271950
Grand total		37050	17024	64362	137491	76979	105651	17300	17192	11232	484281

Table 5. Continued

ICES Sub-div.	ICES rectangle	SPRAT – age groups									
		0	1	2	3	4	5	6	7	8+	total
28	45H0	5425.33	30.04	66.62	22.34	7.32	29.26	0.00	0.00	0.00	5580.90
28	45H1	8013.39	4952.52	4989.26	1433.65	275.40	938.63	138.99	48.58	0.00	20790.41
total		13439	4983	5056	1456	283	968	139	49	0	26371
29	46H1	19236.81	2623.75	9436.32	1698.56	2205.01	9923.71	1086.47	276.46	643.31	47130.39
29	46H2	3119.30	2615.81	7495.58	828.25	1150.43	4761.78	161.91	0.00	119.62	20252.69
29	47H1	1972.77	166.11	554.64	82.27	159.62	640.63	35.96	0.00	49.85	3661.84
29	47H2	1050.82	321.05	1512.60	265.57	500.29	2123.82	195.91	69.88	235.08	6275.02
total		25380	5727	18999	2875	4015	17450	1480	346	1048	77320
32	47H3	2557.60	4924.59	14987.03	3754.36	2033.40	13131.65	4462.50	871.44	2708.85	49431.42
32	48H4	4414.16	2315.27	7852.00	1894.99	856.05	6695.66	2186.53	252.98	1328.88	27796.51
32	48H5	701.41	1865.19	6251.91	1542.81	855.70	5439.75	1754.43	324.28	1129.21	19864.70
32	48H6	5488.30	1330.33	4351.18	1082.51	571.21	3797.94	1256.82	193.20	750.24	18821.72
32	48H7	2922.64	3889.05	17889.48	4764.65	3109.99	17378.48	6774.90	1246.49	4121.10	62096.80
total		16084	14324	51332	13039	7426	46443	16435	2888	10038	178011
Grand total		54903	25034	75387	17370	11724	64861	18054	3283	11086	281702

Table 6. Mean weight (in grams) of herring and sprat per age groups, according to the ICES rectangles of the north-eastern Baltic in October 2019.

ICES Sub-div.	ICES rectangle	HERRING – age groups									
		0	1	2	3	4	5	6	7	8+	avg.
28	45H0	4.44	9.80								5.11
28	45H1	4.34	15.43	22.23	25.11	26.92	29.21	26.38	32.50	34.77	26.43
29	46H1	5.09	8.51	23.43	25.15	27.24	27.00	32.05	29.51	30.40	11.80
29	46H2	5.23	10.50	22.45	23.89	28.45	26.60	29.80	28.38	28.90	10.07
29	47H1	5.22	13.11	22.56	24.98	28.47	27.79	31.26	30.13	31.77	24.20
29	47H2	4.69	15.48	21.71	23.65	27.65	25.94	31.40	28.76	29.45	20.51
32	47H3	4.70	15.04	17.97	21.34	24.68	26.85	27.99	34.81	37.02	17.07
32	48H4	4.95	15.50	18.19	21.52	24.60	26.43	27.08	28.14	31.20	19.33
32	48H5	4.56	16.80	18.51	21.30	24.17	26.01	26.31	32.97	30.00	21.04
32	48H6	5.50	17.04	18.31	22.33	23.82	26.01	26.83	28.85	37.47	15.18
32	48H7	4.76	16.83	18.63	21.40	24.12	30.12	31.80			9.19

Table 6. Continue

ICES Sub-div.	ICES rectangle	SPRAT – age groups									
		0	1	2	3	4	5	6	7	8+	avg.
28	45H0	2.78	8.40	8.72	8.59	9.00	9.00				2.84
28	45H1	2.47	7.74	8.50	8.92	9.88	9.77	11.89	12.47		4.36
29	46H1	2.78	8.02	9.03	9.98	9.85	9.94	11.79	15.00	11.63	4.78
29	46H2	2.89	8.01	8.92	9.44	9.83	9.51	11.55		10.24	6.80
29	47H1	2.95	9.72	11.32	12.68	10.37	10.91	12.14		11.09	4.45
29	47H2	3.14	8.47	9.46	9.92	10.11	10.21	11.84	14.16	11.30	7.31
32	47H3	2.84	8.53	9.45	9.73	10.63	9.89	10.83	11.63	10.80	8.66
32	48H4	2.70	8.73	9.42	9.64	10.31	9.84	10.67	11.51	10.65	6.87
32	48H5	3.41	9.00	9.63	9.89	10.81	10.03	11.07	12.49	10.99	9.34
32	48H6	3.48	8.95	9.74	10.03	11.15	10.16	11.14	12.61	11.03	6.48

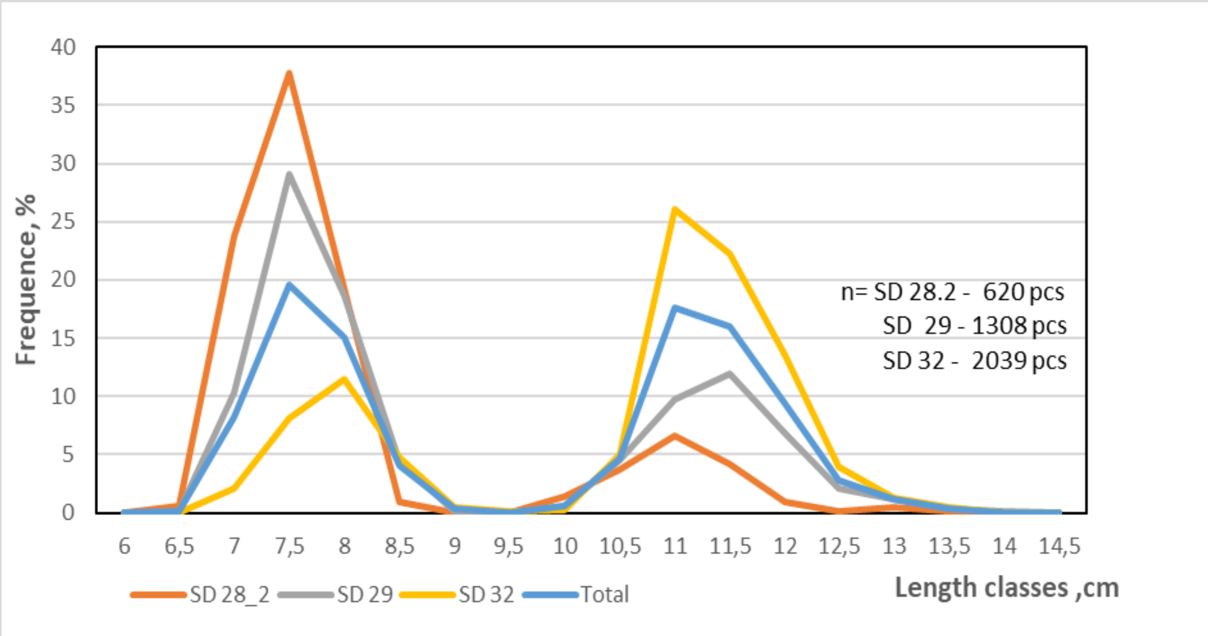


Fig. 3. Sprat length distributions from the control catches conducted by the r.v. "Baltica" during joint EST-POL BIAS in the SDs 28.2, 29 and 32 (October 2019).

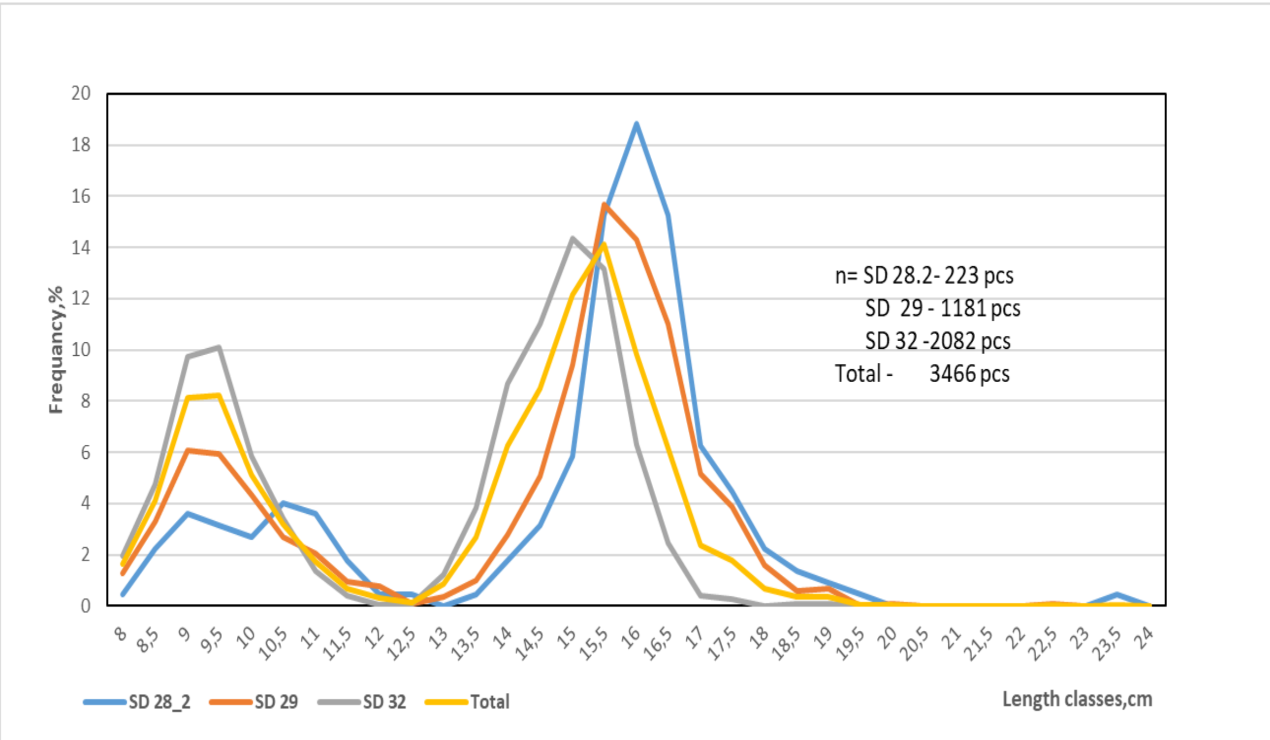


Fig. 4. Herring length distributions from the control catches conducted by the r.v. "Baltica"

during joint EST-POL BIAS in the SDs 28.2, 29 and 32 (October 2019).

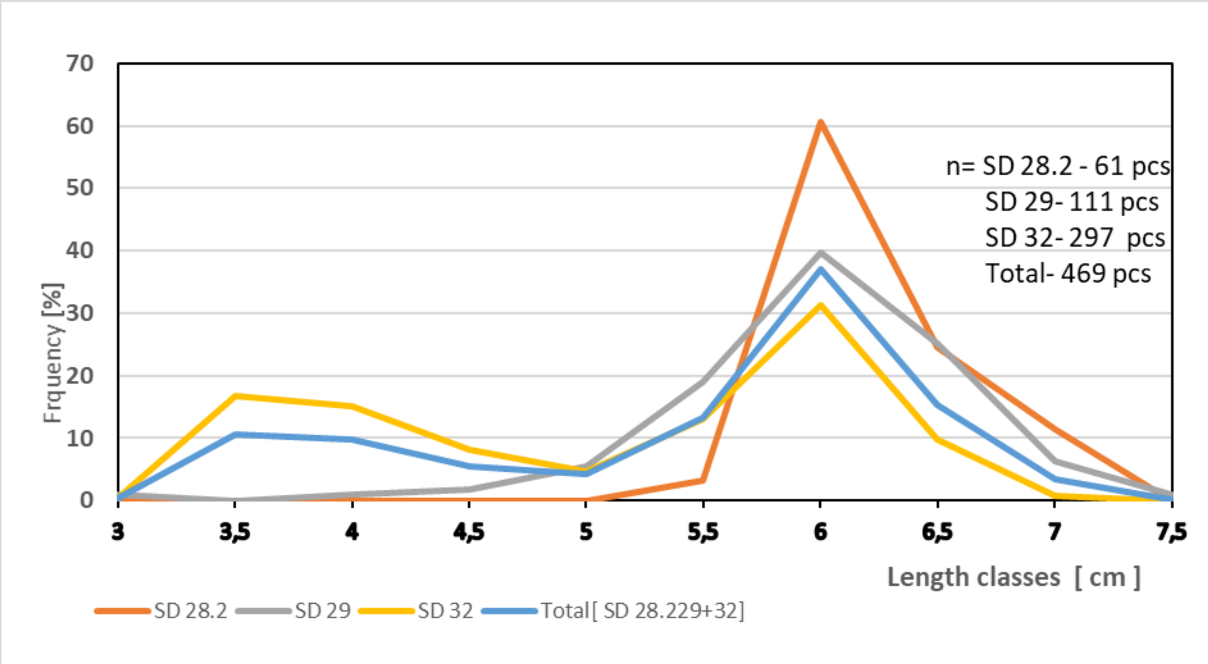


Fig. 5. Three spined stickleback length distributions from the control catches conducted by the r.v. “Baltica” during joint EST-POL BIAS in the SDs 28.2, 29 and 32 (October 2019).

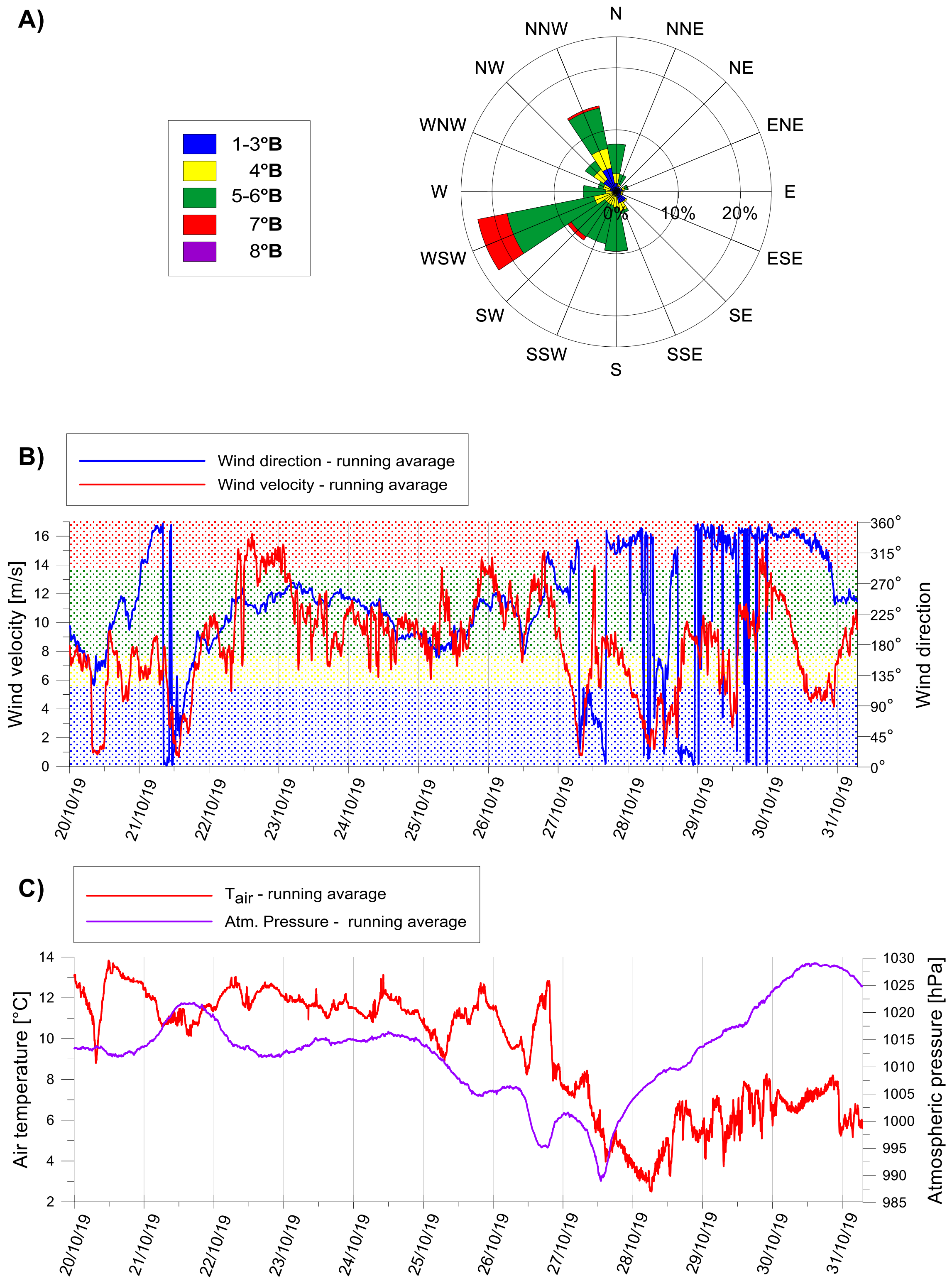
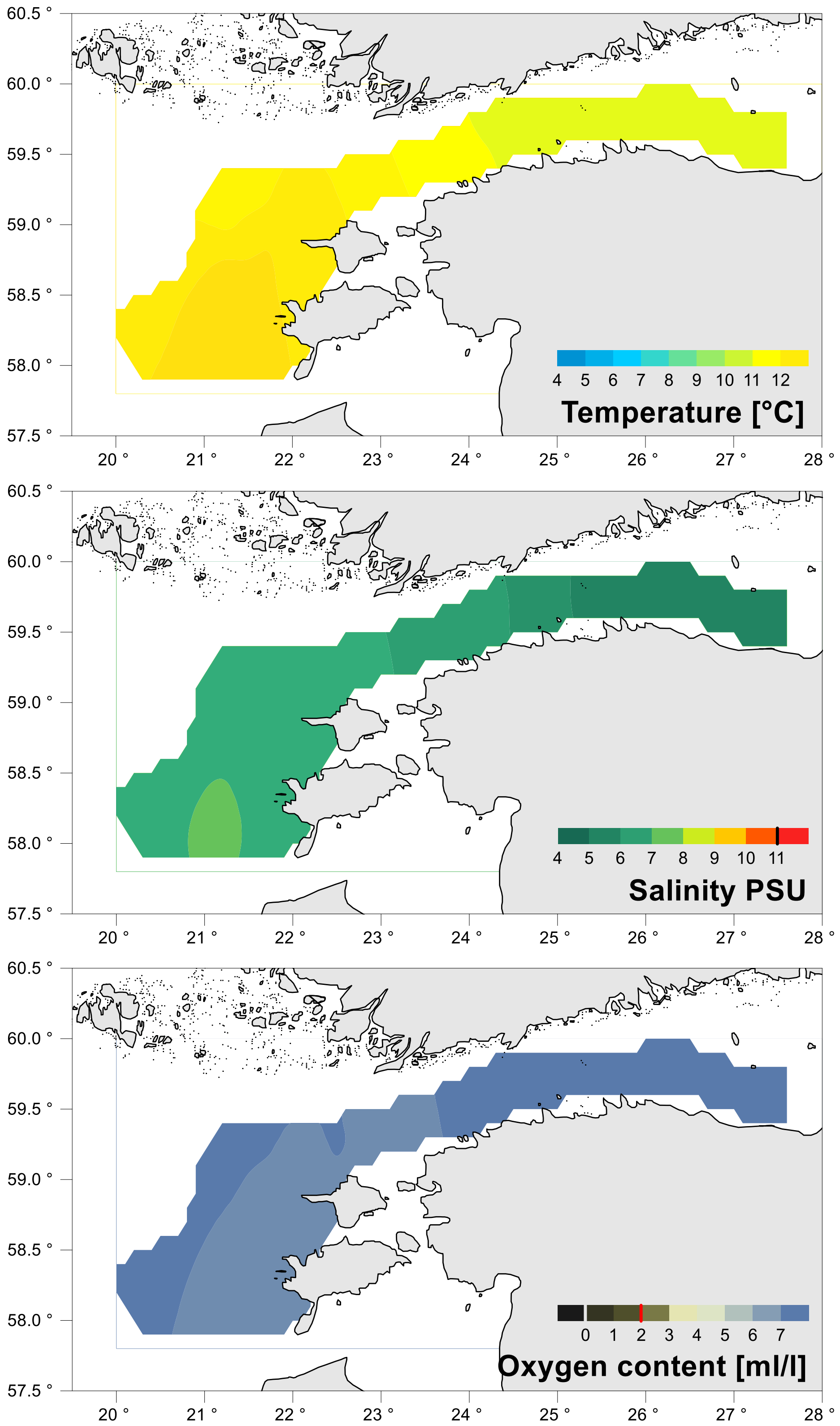


Figure 6. Changes of the main meteorological parameters (October 2019)

~~Fig. 6. Changes of the main meteorological parameters during the joint EST-POL BIAS conducted in October 2019 (A and B – wind direction and velocity, C).~~


Temperature [°C]
4 5 6 7 8 9 10 11 12
Salinity PSU
4 5 6 7 8 9 10 11
Oxygen content [ml/l]
0 1 2 3 4 5 6 7
60.5 ° 60.0 ° 59.5 ° 59.0 ° 58.5 ° 58.0 ° 57.5 °
20 ° 21 ° 22 ° 23 ° 24 ° 25 ° 26 ° 27 ° 28 °

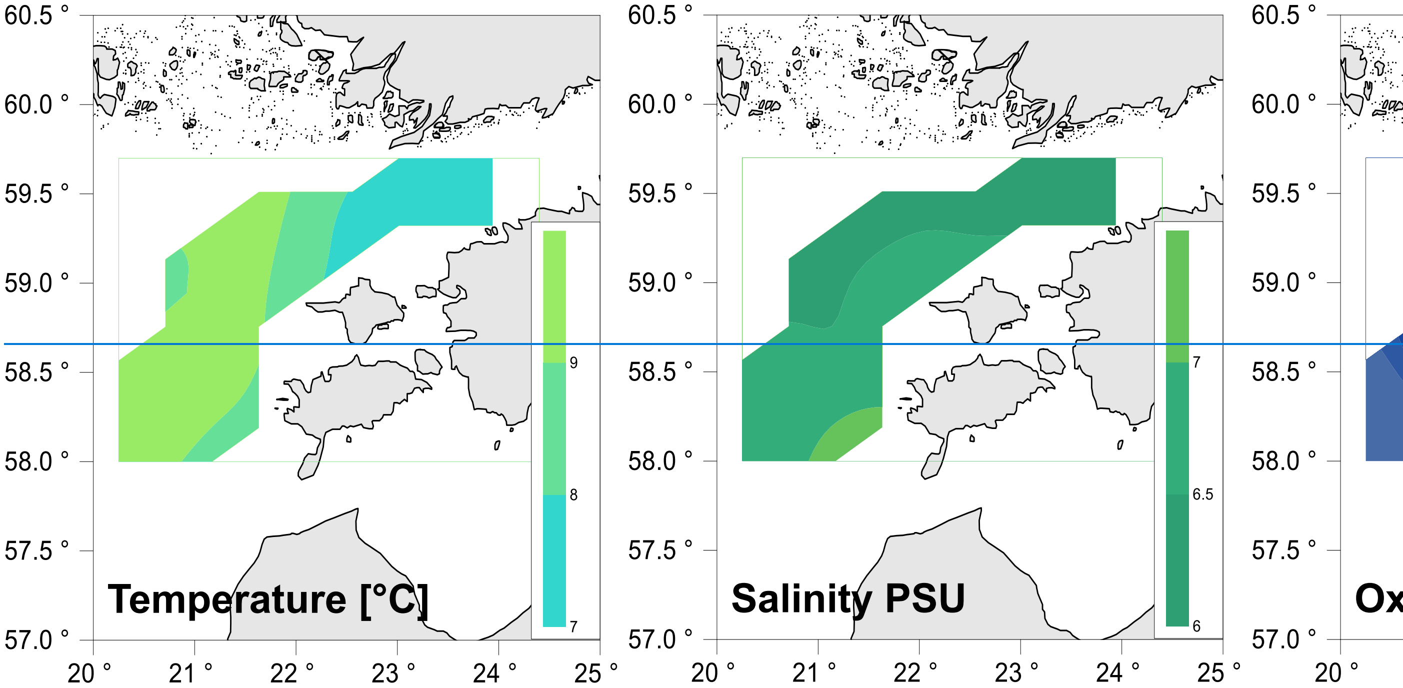
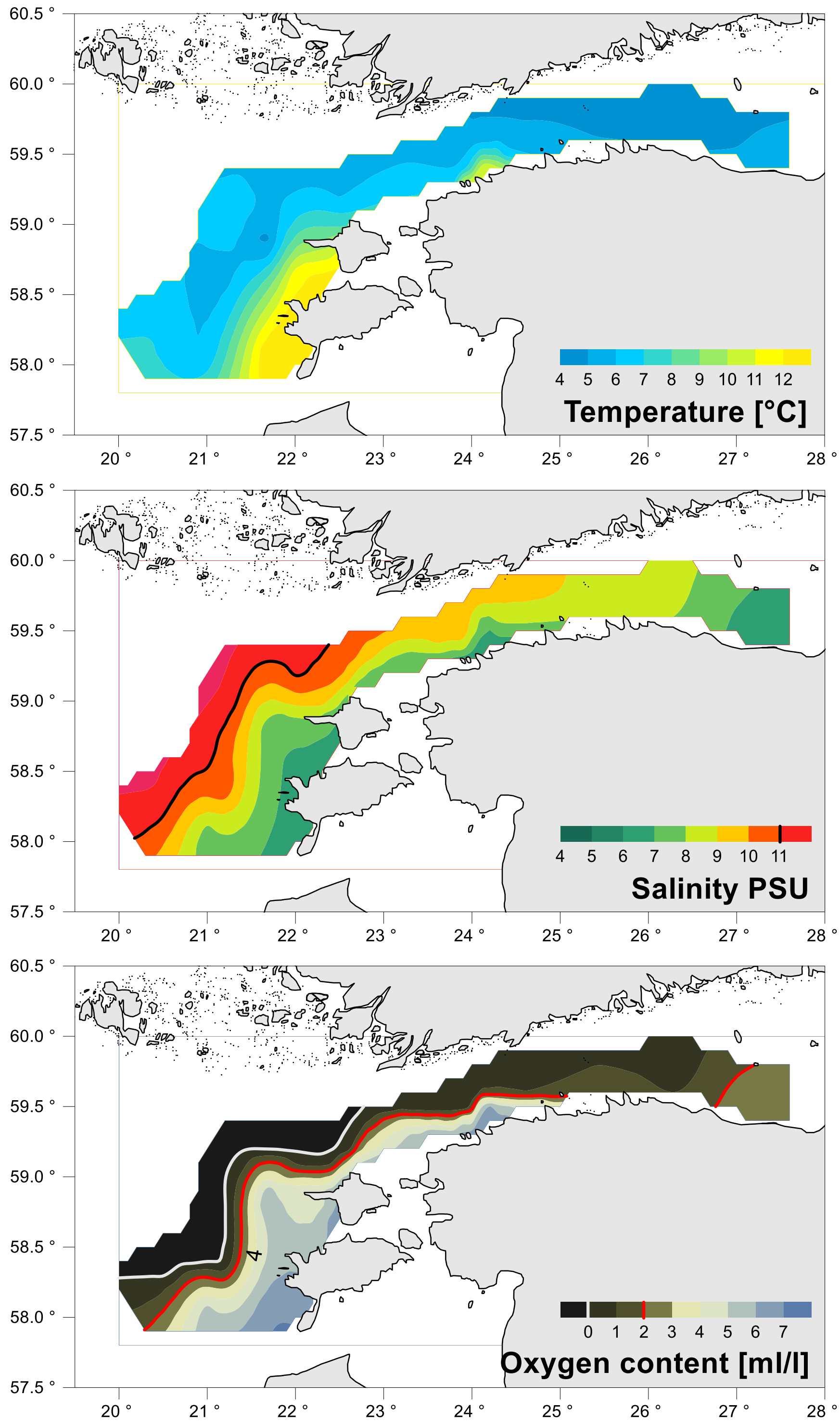


Fig. 7. Horizontal distribution of the seawater temperature, salinity and oxygen content in the surface waters during the joint EST-POL BIAS
(October 2019)


60.5 °
60.0 °
59.5 °
59.0 °
58.5 °
58.0 °
57.5 °
20 ° 21 ° 22 ° 23 ° 24 ° 25 ° 26 ° 27 ° 28 °
4 5 6 7 8 9 10 11 12
Temperature [°C]
4 5 6 7 8 9 10 11
Salinity PSU
0 1 2 3 4 5 6 7
Oxygen content [ml/l]

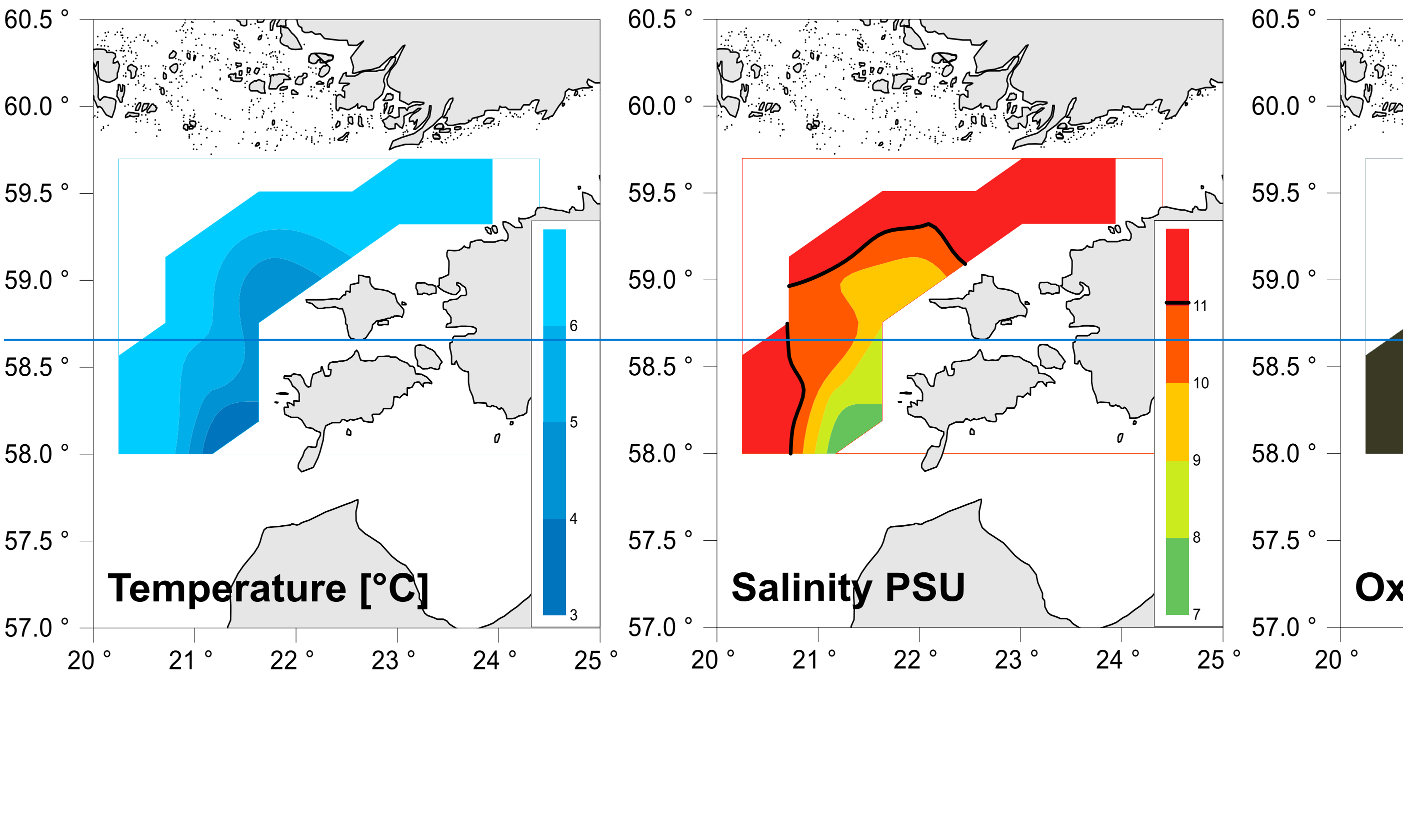


Fig. 8. Horizontal distribution of the seawater temperature, salinity and oxygen content on the control catch depth during the joint EST-POL BIAS (October 2019)

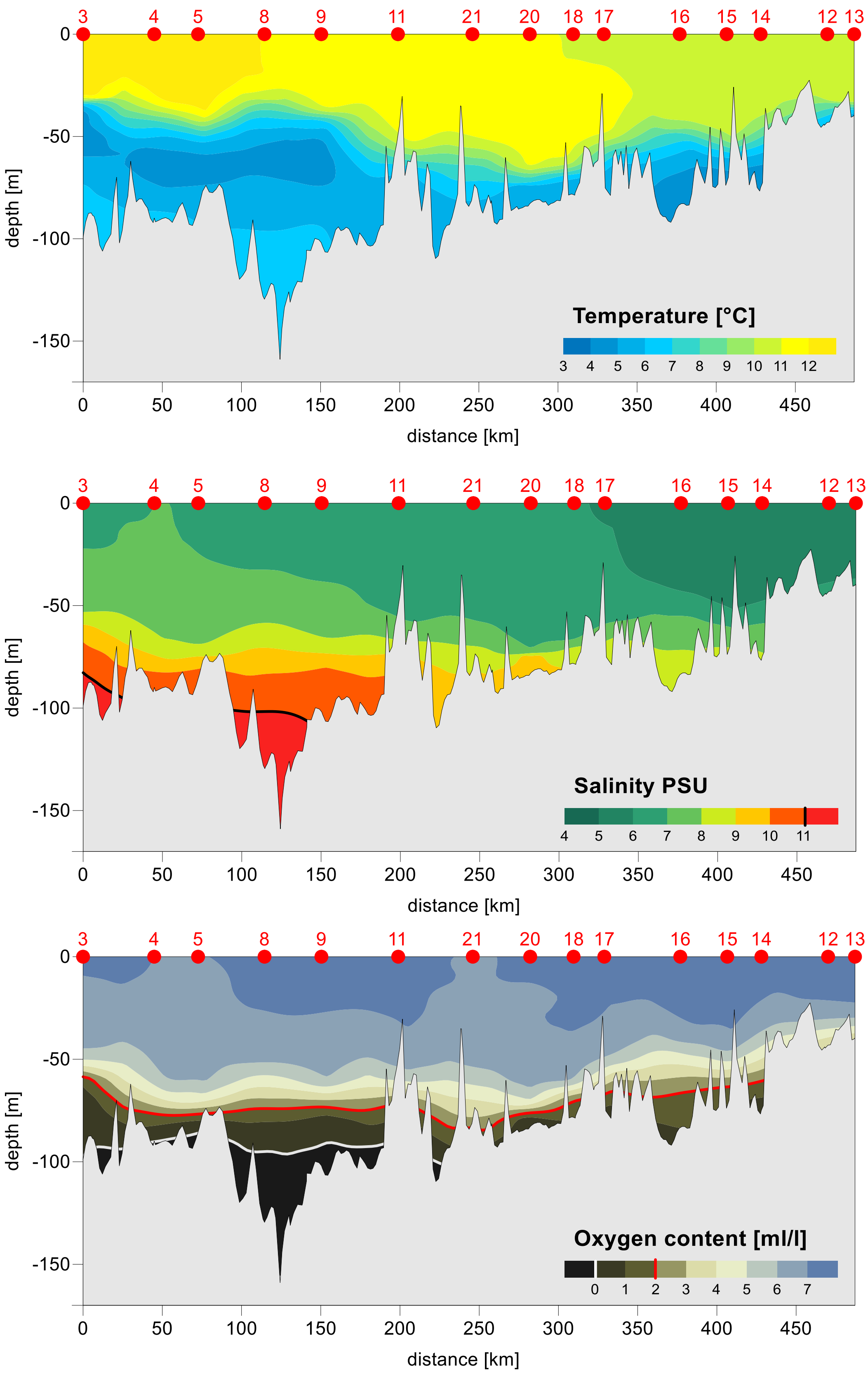


Fig. 9. Vertical distribution of the seawater temperature, salinity and oxygen content along the hydrological profile during the joint EST-POL BIAS (October 2019).

Baltic International Acoustic Survey

Report for R/V Aranda

Cruise 18/2019

ICES_BIAS2019

25th September – 8th October 2019

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INTRODUCTION

International hydroacoustic surveys have been conducted in the Baltic Sea since 1978 (Håkansson et al. 1979). The initial Finnish-Estonian (FIN-EST) research survey on the R/V Baltica was realised in October 2006 (Grygiel et al. 2007), in the framework of the long-term ICES Baltic International Acoustic Surveys (BIAS) programme. The FIN-EST BIAS surveys on the R/V Baltica were continued until 2012. Since 2007, Finland and Sweden joined together to additionally cover Bothnian Sea (ICES Subdivision 30). In 2012 Sweden could not support the funding of the survey in the Bothnian Sea due to economic difficulties within the DCF program and therefore the coverage of the SD30 had to be based on Finnish funding which resulted in half the normal effort (ICES 2013). In 2013, Finland installed fishing equipment and a Simrad EK60 echo sounder into the R/V Aranda and used the vessel in order to cover ICES SDs 29N, 30, and 32N. In 2017, the R/V Aranda was in dry dock for major renovation and therefore Danish R/V Dana was hired for Finnish BIAS2017 survey.

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. The BIAS survey in September/October are co-ordinated and managed by the ICES working group WGBIFS. The main objective of BIAS is to assess clupeoid resources in the Baltic Sea. The survey will provide data to the ICES Baltic Fisheries Assessment Working Group (WGBFAS). The aim of the cruise was to carry out Baltic International Acoustic Survey on herring and sprat covering SDs 29N, 30, and 32N during the autumn 2019, within the remit of the Natural Resources Institute Finland (Luke).

MATERIALS AND METHODS

NARRATIVE

The cruise was completed in two legs covering most of the Bothnian Sea (BS), the Northern Baltic Sea and the Gulf of Finland (GoF). Altogether 43 stations of 49 planned were completed during the survey. The research area, cruise track and trawl stations are shown in Figure 1. At every station also a CTD (Conductivity Temperature Depth) cast was made.

The R/V Aranda departed from the harbour of Helsinki (Finland) on Sat 25.09.2018 at 18:35 (UTC 15:35) and the direct at sea researches begun. Investigations were continued in the northern direction to SD 30. All at sea researches were finalised in the morning 08.10.2018 and the vessel was navigated back to the port of Helsinki.

The Finnish BIAS 2019 survey had only a few interruptions when the fishing could not be performed due to stormy weather or fishing was skipped due to low fish abundance.

SURVEY DESIGN AND HYDROGRAPHICAL DATA

During the cruise, echo-integration was performed along the survey track from ICES Sub-Divisions 29N, 30, and 32N. A SeaBird CTD instrument (SBS 19 plus) was used with state-of-the-art sensors for salinity, temperature, oxygen, connectivity and depth.

CALIBRATION

The SIMRAD EK60 echo sounder with 38 kHz transducer was calibrated on 25.9.2019, according to manuals (ICES 2017; Demer *et al.* 2015). The reference target strength of the 60 mm diameter copper sphere under the prevailing conditions was calculated using a web page application (https://swfscdata.nmfs.noaa.gov/AST/SphereTS/). Values from the calibration were within required accuracy.

Acoustic data collection

The acoustic sampling was performed around the clock. SIMRAD EK60 echo sounder with the 38 kHz hull mounted transducer (ES38B) was used for the acoustic data collection. The settings of the hydroacoustic equipment were as described in the IBAS manual (ICES 2017). The post processing of the stored raw data was done using the Echoview software (www.echoview.com). The mean volume back scattering values (Sv) were integrated over 1 nautical mile elementary distance sampling units (ESDUs) from 10 m below the surface to the bottom at 10 m intervals.

Data analysis

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

Clupeoids:	TS = 20 log L (cm) - 71.2	(ICES 1983/H:12)
Gadoids:	TS = 20 log L (cm) - 67.5	(Foote et al. 1986)

Salmonids and 3-spined stickleback were assumed to have the same acoustic properties as herring.

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

PERSONNEL

Cruise leader during the survey was Juha Lilja from Natural Resources Institute Finland (Luke). The acoustic measurements were performed by Natural Resources Institute Finland (Luke) and fish sampling together by Luke and Swedish University of Agricultural Sciences (SLU). The participating scientific crew can be seen in the list below.

Juha Lilja	Luke	Cruise Leader, Acoustics
Jukka Pönni	Luke	Fish sampling
Arto Koskinen	Luke	Fish sampling
Hannu Harjunpää	Luke	Fish sampling
Meri Helisevä	Luke	Fish sampling
Velimatti Leinonen	Luke	Fish sampling
Mikko Leminen	Luke	Fish sampling
Timo Myllylä	Luke	Fish sampling
Mikko Olin	Luke	Fish sampling
Jari Raitaniemi	Luke	Fish sampling
Per Andersson	SLU	Fish sampling
Rickard Yngwe	SLU	Fish sampling
Sami Vesala	Luke	Trawling
Pasi Ala-opas	Luke	Trawling
Markku Gavrilov	Luke	Trawling
Otto Kiukkonen	Private specialist	Trawling, equipment maintenance
Kimmo Kirstua	Private specialist	Trawling, equipment maintenance
Tommi Lindroth	Private specialist	Trawling, equipment maintenance
Konsta Isometsä	Luke	Acoustics
Erkki Jaala	Luke	Acoustics
Perttu Rantanen	Luke	Database maintenance
Petri Sarvamaa	Luke	Database maintenance
Joni Tiainen	Luke	Fish sampling
Anna Lingman	SLU	Fish sampling
Anu Lastumäki	SYKE	Special sampling
Tanja Kinnunen	SYKE	Special sampling
Hanna Niemikoski	HY/SYKE	Special sampling

Luke: Luonnonvarakeskus / Natural Resources Institute Finland
SLU: Sveriges lantbruksuniversitet / Swedish University of Agricultural Sciences
SYKE: Suomen ympäristökeskus / Finnish Environment Institute
HY: Helsingin yliopisto / University of Helsinki

RESULTS

FISH CATCHES, BIOLOGICAL AND HYDRO-METEOROLOGICAL DATA

The number of planned trawling stations was 49. From these, 43 trawling stations were accomplished, and from those 42 were counted as “valid” (technically sound hauls and sufficient catch for a sample) (Table 1). The total number of trawling stations in Bothnian Sea (ICES SD 30) was 29 and 8 in northern Baltic proper (SD 29) . 6 trawl hauls were done in the northern Gulf of Finland (SD 32).

The 8730 kg combined catches (Table 1) consisted of 20 fish species (7773 kg) and mostly unidentified organic matter categorized as “waste” (415 kg), but also large amounts of common jellyfish *Aurelia aurita* (540 kg) and small amounts of the isopod *Saduria entomon*. The most common and abundant species were herring (*Clupea harengus*) (5061 kg), sprat (*Sprattus sprattus*) (1605 kg) and three-spined stickleback (*Gasterosteus aculeatus*) (1048 kg). All observed species are presented in Table 2. From the sub-samples of the 42 fish catches a total of 20892 measurements for species-specific length distributions (0,5 cm interval for herring and sprat, and 1 cm interval for other species) were performed according to Table 3.

Ten individual samples per statistical rectangle for age determination and maturity definitions by length-class were collected from herring and sprat, 3611 and 972 samples respectively (Table 4). The mean weights for each length-class were also derived from these individual fish samples.
In addition from BIAS survey on R/V Aranda 100 specimens of herring were collected from the Sea of Bothnia for contaminant analysis of Swedish Museum of Natural History (NRM).

Hydrographical data: temperature (°C), oxygen concentration (ml/l), salinity (psu), sound speed (m/s), oxygen concentration (% saturation), conductivity (mS/cm) and sound speed (m/s) were measured. Total of 44 CTD casts were done during the entire cruise.

ABUNDANCE ESTIMATES

The total area covered by the Finnish BIAS survey was 16519 square nautical miles (nmi^2), 22 rectangles, and after the scrutinizing, the distance used for acoustic estimates was 1623 nautical miles (nmi). The cruise track and positions of trawl hauls are shown in Figure 1. In Figure 2, the abundance of herring and sprat per age groups are shown according to the ICES Sub-divisions during Finnish BIAS survey in 2019. Length distributions for herring and sprat by ICES subdivision in 2018 are shown in Figure 3. The total abundance of herring and sprat is presented in Table 6. Estimated numbers of herring and sprat by age group and Subdivision/rectangle are given in Table 7 and Table 10, respectively. Corresponding mean weights by age group and Subdivision/rectangle are shown in Table 8 and Table 11, respectively. Estimates of herring and sprat biomass by age group and Subdivision/rectangle are summarized in Table 9 and Table 12, respectively.

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TABLES, MAP, AND FIGURES

Table 1.Trawl catches (kg) by species/category during the Finnish BIAS-survey in 2019.

Haul num.	ICES SD	Rectangle	*Ammodytes tobianus*	*Aurelia aurita*	*Clupea harengus*	*Cyclopterus lumpus*	*Gasterosteus aculeatus*	*Hyperoplus lanceolatus*	*Lampetra fluviatilis*	*Liparis liparis*	*Lumpenus lampretaeformis*	*Myoxocephalus scorpius*	*Neogobius melanostomus*	*Nerophis ophidion*	*Osmerus eperlanus*	*Pholis gunnellus*	*Pomatoschistus minutus*	*Pungitius pungitius*	*Saduria entomon*	*Salmo salar*	*Scophthalmus maximus*	*Sprattus sprattus*	*Triglopsis quadricornis*	*Zoarces viviparus*	"Waste"	Fish Catch (kg)	Total Catch (kg)
1	32	48H3		224.5	1.3		2.4						0.003	0.001	0.030			0.078				34.0			104.7	37.8	367.00
2	29	48H2		1.2	13.3	0.230	32.5							0.010				0.244				76.9			5.6	123.2	130.00
3	30	50G8			23.4		8.5	0.045	0.112					0.001					0.004	2.026		9.5			29.4	43.6	73.00
4	30	50G8			643.5		34.9	0.031						0.001								194.5		0.001	12.2	872.8	885.00
5	30	51G8			115.6		2.2					0.037		0.001				0.009				0.8			34.4	118.6	153.00
6	30	51G8	0.027		131.3		162.5												0.005			0.1			2.1	293.9	296.00
7	30	51G9			262.9		54.6												0.019						0.6	317.4	318.00
9	30	52G9			130.8		43.3								0.048				0.010			1.1			0.8	175.2	176.00
10	30	52G8			177.5		39.6								0.002							0.4			0.4	217.6	218.00
11	30	52G8			213.2		26.4												0.010	0.295					0.1	239.9	240.00
12	30	53G9			149.1		8.6			0.021								0.027	0.036						5.3	157.7	163.00
13	30	53G8	0.009		141.1		65.9			0.367				0.009					0.009			0.0			2.6	207.4	210.00
14	30	54G8	0.036		81.0		71.9								0.404				0.022			0.1			2.6	153.4	156.00
15	30	54G9			261.3		40.0	0.003												0.315					8.4	301.6	310.00
16	30	55G9			120.8		18.9	0.003						0.010	0.014				0.001			3.7			6.6	143.4	150.00
17	30	55H0	0.009		215.7		1.5			0.090	0.014			0.001	0.124			0.002	0.038			1.4	0.016	0.042	18.2	218.8	237.00
18	30	54G9	0.017		77.2		13.7			0.009								0.009				0.4			3.7	91.3	95.00
19	30	54H0	0.024		84.2		5.1								2.355				0.028			20.3			3.0	112.0	115.00
20	30	54H0			215.3		3.4		0.097						35.363				0.020			10.7		0.001	2.2	264.8	267.00
21	30	53H0			98.5		1.3			0.037					0.124				0.023			3.5			8.6	103.4	112.00
22	30	53G9			147.5		10.2												0.010			0.8			1.6	158.4	160.00
23	30	53H0			47.0		6.6			0.062									0.607			0.3			0.4	54.0	55.00
24	30	52H0			111.4		16.6	0.021		0.065				0.001				0.003	0.150			0.2			3.6	128.2	132.00
25	30	52G9			61.7		20.2											0.004	0.055			0.3			2.7	82.2	85.00
26	30	52H0			146.1		53.9			0.008					0.037							1.2			0.6	201.4	202.00
27	30	51H0	0.010		65.3		30.4			0.030				0.001			0.001			0.312		0.4			10.5	96.5	107.00
28	30	51G9			85.8		19.3			0.011								0.003	0.052			0.6			4.2	105.8	110.00
29	30	51H0			75.8		13.3								0.050			0.002	0.003			0.4			2.4	89.6	92.00
30	30	50H0			104.4		4.0	0.042			0.003				6.340	0.006	0.001	0.001	0.001			0.6		0.024	0.5	115.5	116.00
31	30	50G9	0.027		57.5		80.1								1.465		0.001		0.038			0.2		0.047	3.6	139.4	143.00
32	29	49G9			238.9		16.3								0.190							1.2			3.4	256.6	260.00
33	29	48G9		1.7	193.3		18.2	0.029							0.176		0.007	0.111				12.9			1.6	224.7	228.00
34	29	47H0		3.5	101.5	0.068	53.9							0.002	0.114				0.001			98.0			4.9	253.6	262.00
35	29	47H0		8.3	39.7		13.5							0.001								120.5			4.1	173.6	186.00
36	29	48H1	0.003		145.4	0.190	6.2							0.002	0.223			0.012				62.1			4.9	214.1	219.00
37	29	48H1		1.3	50.0	0.115	32.7							0.001				0.467				129.6			12.8	212.8	227.00
38	29	48H2		20.9	11.5		2.3	0.017						0.002	0.459			0.050				81.8			29.0	96.0	146.00
39	32	48H3	0.015	6.4	41.2	0.056	4.8	0.029						0.001	0.887			0.011				160.5			12.1	207.5	226.00
40	32	48H4		271.9	8.8		2.8							0.001	0.707			0.163			0.491	91.3			18.9	104.2	395.00
41	32	48H5		0.6	118.1		4.1	0.016						0.003	0.261			0.010				347.5			18.5	469.9	489.00
42	32	49H6			26.1		0.8							0.001	1.813			0.009				75.8			10.4	104.6	115.00
43	32	49H5			27.3		0.8							0.005	1.050			0.065				61.6			13.2	90.8	104.00
Total (kg)			**0.177**	**540.4**	**5061.0**	**0.66**	**1047.7**	**0.236**	**0.209**	**0.700**	**0.017**	**0.037**	**0.003**	**0.055**	**52.2**	**0.006**	**0.010**	**1.280**	**1.142**	**2.948**	**0.491**	**1605.3**	**0.016**	**0.115**	**415.2**	**7773.2**	**8730.0**

Table 2.English, scientific, and Finnish names of observed species in Finnish 2018 BIAS-survey.

Fishnames		
English	**Scientific**	**Finnish**
Striped Seasnail	Liparis liparis	Imukala
Greater Sandeel	Hyperoplus lanceolatus	Isotuulenkala
Saduria entomon	Saduria entomon	Kilkki
Sprat	Sprattus sprattus	Kilohaili
Three-spined Stickleback	Gasterosteus aculeatus	Kolmipiikki
Smelt	Osmerus eperlanus	Kuore
Nine-spined Stickleback	Pungitius pungitius	Kymmenpiikki
Common Goby	Pomatoschistus microps	Liejutokko
Atlantic Salmon	Salmo salar	Lohi
Lamprey	Lampetra fluviatilis	Nahkiainen
Longspined Bullhead	Taurulus bubalis	Piikkisimppu
Small Sandeel	Ammodytes tobianus	Pikkutuulenkala
Lumpsucker	Cyclopterus lumpus	Rasvakala
Whitefish	Coregonus lavaretus	Siika
Baltic Herring	Clupea harengus membras	Silakka
Straightnose Pipefish	Nerophis ophidion	Siloneula

Table 3. Number of length measurements /species and Sub-Division in Finnish 2019 BIAS-survey.

Species	ICES SD			Total
	29	30	32	
Ammodytes tobianus	1	20	7	28
Clupea harengus	2317	9263	1439	13019
Cyclopterus lumpus	4		1	5
Gasterosteus aculeatus	630	1795	587	3012
Hyperoplus lanceolatus	5	16	15	36
Lampetra fluviatilis		2		2
Liparis liparis		43		43
Lumpenus lampretaeformis		2		2
Myoxocephalus scorpius		1		1
Neogobius melanostomus			1	1
Nerophis ophidion	36	13	32	81
Osmerus eperlanus	58	227	411	696
Pholis gunnellus		1		1
Pomatoschistus minutus	1	3		4
Pungitius pungitius	47	84	46	177
Salmo salar		7		7
Scophthalmus maximus			1	1
Sprattus sprattus	1462	928	1377	3767
Triglopsis quadricornis		1		1
Zoarces viviparus		8		8
Total	4561	12414	3917	**20892**

Table 4.Individual samples of herring and sprat (for age determination) per SD in 2019.

	Sprat			Sprat tot	Herring			Herring tot	
L-class	29	30	32		29	30	32		
40						1		1	
45						2		2	
50					1	11	1	13	
55	2		3	5		22		22	
60	7		7	14	3	19	1	23	
65	14	1	12	27	8	28	4	40	
70	18		15	33	15	30	8	53	
75	18	2	16	36	16	33	16	65	
80	16		16	32	15	41	16	72	
85	14	2	12	28	16	37	15	68	
90	6	1	1	8	16	32	15	63	
95	3		2	5	16	30	15	61	
100	2	3	8	13	15	26	15	56	
105	22	10	29	61	41	40	32	113	
110	34	20	51	105	32	27	15	74	
115	37	41	51	129	12	20	2	34	
120	25	50	40	115	1	27	3	31	
125	23	65	32	120	3	62	2	67	
130	10	73	9	92	10	90	3	103	
135	5	80	1	86	27	132	12	171	
140	1	50		51	35	151	23	209	
145		11		11	43	166	21	230	
150		1		1	41	173	10	224	
155					47	181	9	237	
160					38	180	10	228	
165					32	175	6	213	
170					24	182		206	
175					18	182	1	201	
180					11	163		174	
185					6	154	1	161	
190						134		134	
195						108		108	
200						61		61	
205						31		31	
210						25		25	
215						12		12	
220						11		11	
225						8		8	
230						2		2	
235						4		4	
Total	257	410	305	972	542	2813	256	3611	**4583**

Table 5.Numbers and locations of fishing stations (WGS-84) during Finnish BIAS-survey in 2019.

Haul num.	Haul name	Date	ICES SD	Start latitude	Start longitude	End latitude	End longitude	Haul duaration (min)	Haul speed (knot)	Haul distance (nmi)	Catch (kg)	Sample weight (kg)	Headrope depth (m)	Bottom depth (m)	Doors spread (m)	Trawl height (m)
1	48H3-1	26.09.2019	32	59.6082	23.2487	59.5892	23.2587	25	2.7	1.13	367	28.2	21	66	78	18
2	48H2-1	27.09.2019	29	59.5025	22.2067	59.5124	22.1171	60	2.9	2.9	130	14.11	20	66	78	18
3	50G8-1	28.09.2019	30	60.6314	18.9394	60.6703	18.9447	53	2.5	2.21	73	32.18	60	105	102	18
4	50G8-2	28.09.2019	30	60.7662	18.0330	60.7513	18.1033	45	3	2.25	885	32.24	10	56	70	20
5	51G8-1	28.09.2019	30	61.0999	18.0482	61.1229	17.9706	53	3	2.65	153	16.21	8	71	68	18
6	51G8-2	29.09.2019	30	61.0783	18.7638	61.0682	18.7790	17	2.8	0.79	296	46.02	21	60	77	20
7	51G9-1	29.09.2019	30	61.1163	19.1390	61.1410	19.1393	30	3	1.5	318	52.52	19	63	81	18
8	52G8-1(INV)	29.09.2019	30	61.6365	18.0847	61.6368	17.9810	60	3	3	7		22	70	83	19
9	52G9-1	29.09.2019	30	61.6588	19.0953	61.6332	19.0888	30	3	1.5	176	19.01	8	50	68	18
10	52G8-2	30.09.2019	30	61.8623	18.5577	61.8438	18.5263	30	3	1.5	218	51.92	8	78	68	20
11	52G8-3	30.09.2019	30	61.8892	18.0803	61.9152	18.0157	48	2.9	2.32	240	45.27	10	70	70	21
12	53G9-1	30.09.2019	30	62.3467	19.2175	62.3750	19.2255	40	2.5	1.67	163	18.62	80	110	102	18
13	53G8-1	30.09.2019	30	62.4022	18.8705	62.4485	18.8260	60	2.5	2.5	210	23.17	82	110	100	19
14	54G8-1	30.09.2019	30	62.5993	18.7581	62.6230	18.7646	30	3	1.5	156	26.74	10	130	67	21
15	54G9-1	01.10.2019	30	62.6230	19.3287	62.6533	19.3275	39	2.8	1.82	310	32.58	10	130	66	22
16	55G9-1	01.10.2019	30	63.0332	19.0540	63.0598	19.0265	38	2.8	1.77	150	44.81	11	170	66	18
17	55H0-1	01.10.2019	30	63.2962	20.2638	63.3365	20.3260	60	2.8	2.8	237	40.25	75	110	106	20
18	54G9-2	01.10.2019	30	62.6054	19.6288	62.6197	19.7556	75	3	3.75	95	22.55	8	115	69	20
19	54H0-1	02.10.2019	30	62.6094	20.0475	62.5962	20.1228	45	3	2.25	115	24.41	11	95	72	20
20	54H0-2	02.10.2019	30	62.5510	20.4307	62.5610	20.3675	40	3	2	267	50.53	10	65	70	19
21	53H0-1	02.10.2019	30	62.3048	20.4375	62.3307	20.4862	45	2.9	2.18	112	35.3	12	95	67	23
22	53G9-2	03.10.2019	30	62.1296	19.6044	62.1641	19.6920	68	3	3.4	160	44.9	13	100	71	21
23	53H0-2	03.10.2019	30	62.1327	20.1428	62.1725	20.2378	75	2.8	3.5	55	35.4	80	144	104	18
24	52H0-1	03.10.2019	30	61.8583	20.1723	61.8938	20.2406	60	2.6	2.6	132	33.48	82	130	110	20
25	52G9-2	03.10.2019	30	61.6255	19.6300	61.6402	19.6685	32	3	1.6	85	23.52	14	80	72	21
26	52H0-2	04.10.2019	30	61.6341	20.0387	61.6720	20.1048	60	2.8	2.8	202	40.89	12	122	68	21
27	51H0-1	04.10.2019	30	61.3608	20.1058	61.4080	20.1868	75	2.5	3.13	107	49.88	79	125	109	17
28	51G9-2	04.10.2019	30	61.1349	19.7212	61.1915	19.7795	75	2.8	3.5	110	27.71	80	120	118	17
29	51H0-2	05.10.2019	30	61.1268	20.5685	61.1589	20.6081	45	3	2.25	92	25.24	26	85	77	20
30	50H0-1	05.10.2019	30	60.8648	20.5838	60.8846	20.6227	46	2.9	2.22	116	50.86	19	61	71	22
31	50G9-1	05.10.2019	30	60.9175	19.3530	60.9837	19.3645	62	3	3.1	143	52.78	75	115	75	17
32	49G9-1	05.10.2019	29	60.1287	19.2342	60.1143	19.3468	78	2.7	3.51	260	32.46	63	235	110	15
33	48G9-1	05.10.2019	29	59.8562	19.7922	59.8772	19.8078	30	2.7	1.35	228	34.16	15	100	67	20
34	47H0-1	05.10.2019	29	59.4263	20.1382	59.4117	20.1332	20	2.7	0.9	262	24.49	8	58	65	21
35	47H0-2	05.10.2019	29	59.2208	20.2735	59.2104	20.2657	15	2.8	0.7	186	20.03	13	81	73	20
36	48H1-1	06.10.2019	29	59.5382	21.0260	59.5643	21.0687	40	2.5	1.67	219	18.92	55	100	100	20
37	48H1-2	06.10.2019	29	59.5146	21.4978	59.5338	21.5199	30	2.8	1.4	227	10.16	17	80	67	20
38	48H2-2	06.10.2019	29	59.5743	22.7485	59.5742	22.7778	20	2.9	0.97	146	13.29	17	72	74	20
39	48H3-2	06.10.2019	32	59.5768	23.5504	59.5848	23.5787	20	2.8	0.93	226	21.11	19	82	78	19
40	48H4-1	07.10.2019	32	59.8177	24.2180	59.8233	24.2473	21	2.8	0.98	395	34.46	10	62	67	20
41	48H5-1	07.10.2019	32	59.9302	25.2922	59.9602	25.3092	45	2.7	2.03	489	17.97	4	65	67	20
42	49H6-1	07.10.2019	32	60.0957	26.3872	60.0913	26.3663	15	2.8	0.7	115	13.33	17	66	80	19
43	49H5-1	08.10.2019	32	60.0207	25.8728	60.0141	25.8309	29	3	1.45	104	19.34	11	60	70	20

Table 6. Survey statistics by area r/v Aranda in 2019.

ICES SD	ICES Rect.	NM	N (million/nm²)	Area (nm²)	Sa (m²/nm²)	σ (cm²)	N total (million)	Herring (%)	Sprat (%)	Cod (%)	3-spinn. (%)
29	47H0	61	23.50	920.30	1434.17	0.610249	21628.36	7.01	60.37	0.00	32.60
29	48G9	57	8.47	772.80	877.77	1.036841	6542.412	60.37	7.09	0.00	32.24
29	48H0	39	12.23	730.30	1076.83	0.880209	8934.376	52.54	32.09	0.00	15.22
29	48H1	63	39.88	544.00	2597.56	0.651398	21692.93	28.63	54.49	0.00	16.59
29	48H2	53	30.86	597.00	2086.06	0.676023	18422.12	7.90	59.31	0.00	32.14
32	48H3	75	16.64	615.70	1159.31	0.696863	10242.83	13.09	75.89	0.00	10.67
32	48H4	61	20.59	835.10	1760.72	0.855338	17190.58	6.74	80.21	0.00	11.93
32	48H5	42	8.62	767.20	611.98	0.710007	6612.755	19.88	76.74	0.00	3.35
29	49G9	64	2.23	564.20	337.32	1.512846	1258.001	57.00	0.90	0.00	42.05
32	49H5	23	9.58	306.90	954.42	0.996138	2940.462	30.74	63.17	0.00	4.64
32	49H6	35	8.72	586.50	639.15	0.732747	5115.831	24.46	71.66	0.00	3.01
30	50G7	18	2.20	403.10	297.19	1.348099	888.6387	65.49	18.00	0.00	16.50
30	50G8	59	5.22	833.40	582.43	1.115421	4351.692	62.70	17.57	0.00	19.71
30	50G9	50	5.36	879.50	375.11	0.699612	4715.593	10.87	1.55	0.00	87.44
30	50H0	35	1.66	795.10	297.22	1.790222	1320.04	72.73	0.54	0.00	23.29
30	51G7	23	1.89	614.50	429.89	2.271528	1162.938	82.26	1.20	0.00	16.33
30	51G8	63	4.18	863.70	579.34	1.387	3607.62	10.94	0.08	0.00	88.97
30	51G9	67	4.82	865.80	441.16	0.91555	4171.916	9.27	0.11	0.00	79.59
30	51H0	73	1.88	865.70	172.44	0.917647	1626.746	24.28	0.21	0.00	75.48
30	52G7	30	2.47	482.60	345.20	1.396001	1193.354	38.94	0.00	0.00	61.06
30	52G8	64	3.09	852.00	379.22	1.225336	2636.77	31.78	0.08	0.00	68.14
30	52G9	66	7.75	852.00	642.05	0.828469	6602.813	19.34	0.38	0.00	80.24
30	52H0	74	2.59	852.00	257.24	0.992863	2207.411	22.80	0.23	0.00	76.94
30	53G8	51	6.46	838.10	440.14	0.680937	5417.253	18.92	0.03	0.00	80.98
30	53G9	64	2.62	838.10	468.97	1.791819	2193.567	56.91	0.32	0.00	42.66
30	53H0	85	2.23	838.10	373.08	1.675178	1866.559	63.01	3.17	0.00	33.65
30	54G8	21	12.06	642.20	651.42	0.540066	7746.161	8.41	0.02	0.00	91.50
30	54G9	69	3.44	824.20	346.42	1.005622	2839.222	28.97	0.07	0.00	70.91
30	54H0	50	2.01	727.90	363.99	1.808359	1465.118	58.73	11.24	0.00	19.92
30	55G9	34	4.51	625.60	508.75	1.127128	2823.785	38.30	2.04	0.00	59.62
30	55H0	31	1.53	688.60	346.28	2.266538	1052.032	91.84	1.07	0.00	6.93

Table 7.Numbers (millions) of herring by age and area (r/v Aranda 2019).

SD	Rect	0	1	2	3	4	5	6	7	8+	Total
29	47H0	438.22	109.97	343.12	262.27	100.69	197.77	23.70	17.74	21.75	1515.24
29	48G9	2246.96	801.89	385.14	233.95	86.12	154.44	14.23	11.76	15.25	3949.73
29	48H0	3720.30	403.89	239.58	148.05	56.26	98.97	9.69	7.55	10.21	4694.50
29	48H1	5964.12	31.73	85.31	55.69	23.21	38.66	4.44	2.96	4.50	6210.62
29	48H2	1329.21	28.02	49.67	24.40	8.93	13.50	1.54	0.23	0.23	1455.73
32	48H3	1237.71	14.33	28.97	17.60	4.73	26.77	5.26	4.60	1.31	1341.28
32	48H4	1114.27	16.13	25.61	2.12	0.00	0.71	0.00	0.00	0.00	1158.84
32	48H5	1260.37	21.52	28.92	2.98	0.00	0.72	0.00	0.00	0.00	1314.51
29	49G9	10.97	139.29	176.99	148.11	63.00	126.28	17.95	15.17	19.33	717.10
32	49H5	781.51	27.85	46.93	15.27	3.37	20.28	3.28	2.05	3.28	903.82
32	49H6	1213.97	8.34	17.02	3.78	1.81	3.81	1.39	0.00	1.39	1251.51
30	50G7	253.19	274.48	38.32	11.71	2.31	1.28	0.50	0.07	0.12	581.98
30	50G8	1160.06	1301.77	186.12	58.17	11.77	6.83	2.64	0.45	0.82	2728.62
30	50G9	127.10	172.23	95.82	60.12	22.92	20.12	6.94	2.62	4.61	512.48
30	50H0	12.23	449.51	232.81	132.79	44.51	43.88	14.34	6.23	23.73	960.03
30	51G7	7.57	153.73	218.26	202.60	99.53	132.09	44.34	27.00	71.50	956.63
30	51G8	1.40	87.55	96.42	82.17	37.89	46.11	15.06	7.92	20.14	394.68
30	51G9	11.34	23.69	95.88	104.10	50.89	56.78	18.15	8.15	17.68	386.66
30	51H0	42.64	86.20	100.06	75.81	30.86	32.11	10.45	5.09	11.67	394.90
30	52G7	0.00	15.54	70.44	112.47	64.24	106.07	33.05	19.49	43.36	464.66
30	52G8	0.00	40.04	125.49	198.94	117.30	186.61	58.68	33.21	77.57	837.84
30	52G9	85.18	82.63	197.70	288.37	163.40	244.50	77.96	43.71	93.54	1277.00
30	52H0	24.41	58.29	111.83	116.59	56.34	69.75	22.37	12.19	31.56	503.33
30	53G8	400.24	20.80	90.96	153.55	92.74	132.88	43.82	24.55	65.44	1024.98
30	53G9	12.45	110.33	195.82	287.37	161.76	246.92	78.42	45.61	109.75	1248.44
30	53H0	184.90	141.31	228.42	226.18	107.78	134.69	42.91	27.09	82.91	1176.21
30	54G8	116.47	19.62	66.94	121.61	73.47	125.81	40.22	26.41	61.20	651.74
30	54G9	35.55	37.98	111.88	181.46	107.98	175.78	56.90	34.84	80.12	822.50
30	54H0	112.42	145.37	182.84	162.50	72.42	91.87	29.48	18.52	45.01	860.44
30	55G9	222.37	153.98	149.38	183.31	95.78	145.31	44.71	26.55	60.13	1081.51
30	55H0	110.74	118.86	192.59	206.52	106.65	127.14	42.68	19.56	41.43	966.16

Table 8.Mean weight (g) of herring by age and area (r/v Aranda 2019).

SD	Rect.	0	1	2	3	4	5	6	7	8+
29	47H0	4.80	18.53	23.99	25.66	26.17	26.67	26.52	29.03	29.37
29	48G9	5.14	17.49	21.89	24.19	24.77	25.82	25.74	28.68	29.32
29	48H0	4.96	17.45	22.36	24.42	25.08	25.80	25.50	28.68	29.27
29	48H1	4.88	16.84	23.95	25.13	25.93	25.75	24.92	28.67	29.17
29	48H2	4.37	18.55	22.41	23.06	23.07	23.57	24.22	26.87	26.87
32	48H3	4.61	17.95	18.73	22.96	24.39	24.53	25.56	24.32	27.10
32	48H4	4.13	17.48	17.61	19.93		19.93			
32	48H5	4.42	16.85	17.99	19.49		19.93			
29	49G9	5.45	17.38	23.80	26.12	27.23	27.87	29.65	29.84	30.02
32	49H5	4.59	17.70	19.26	21.72	23.66	24.73	25.56	24.54	37.15
32	49H6	3.98	17.86	18.38	23.01	25.92	25.61	27.10		27.10
30	50G7	8.28	13.86	17.77	20.22	21.96	22.46	22.88	22.90	22.34
30	50G8	8.28	13.94	17.88	20.38	22.33	23.24	23.52	25.64	26.60
30	50G9	3.49	16.72	22.47	25.34	27.80	29.64	29.51	32.46	36.45
30	50H0	9.70	16.69	21.79	24.64	27.59	30.50	30.68	34.74	51.60
30	51G7	6.33	17.75	24.17	28.09	30.25	34.07	34.04	38.19	46.23
30	51G8	6.55	18.00	23.66	27.39	29.73	33.05	33.00	36.70	44.97
30	51G9	4.59	20.35	25.17	28.22	29.76	32.23	32.09	34.50	39.95
30	51H0	4.34	17.93	23.52	26.45	28.55	31.52	31.52	34.86	41.61
30	52G7		20.66	25.59	30.37	31.81	34.96	35.05	38.04	41.83
30	52G8		19.89	25.32	30.32	31.85	34.76	34.79	38.06	42.63
30	52G9	2.95	18.29	25.30	29.90	31.44	34.47	34.36	37.30	41.71
30	52H0	6.32	18.46	24.51	28.13	30.00	33.19	33.11	36.73	44.57
30	53G8	2.33	20.22	25.84	30.20	31.62	34.43	34.47	38.33	44.30
30	53G9	4.08	17.87	25.29	29.85	31.40	34.59	34.77	38.31	43.35
30	53H0	5.37	17.85	24.35	27.95	29.94	33.45	33.48	38.23	47.28
30	54G8	2.40	19.74	25.65	30.77	32.18	35.43	35.48	38.97	42.35
30	54G9	2.24	18.70	25.42	30.48	31.89	35.10	35.11	38.84	41.98
30	54H0	4.67	17.60	23.86	27.54	29.67	33.42	33.50	37.39	44.08
30	55G9	4.24	17.62	24.06	29.12	31.09	34.44	34.54	37.95	41.56
30	55H0	3.59	18.59	24.16	28.38	30.38	32.87	32.48	35.43	40.04

Table 9.Total biomass (ton) of herring by age and area (r/v Aranda 2019).

SD	Rect.	0	1	2	3	4	5	6	7	8+	Total
29	47H0	2105.0	2038.0	8231.0	6728.8	2635.3	5274.0	628.7	515.1	638.8	28794.5
29	48G9	11557.8	14021.1	8429.9	5658.7	2132.8	3987.0	366.2	337.2	446.9	46937.7
29	48H0	18444.6	7048.8	5358.2	3615.3	1410.9	2553.5	246.9	216.5	298.9	39193.6
29	48H1	29094.3	534.3	2042.9	1399.8	601.7	995.8	110.5	85.0	131.1	34995.5
29	48H2	5802.7	519.8	1113.4	562.7	205.9	318.1	37.3	6.2	6.2	8572.4
32	48H3	5702.0	257.2	542.7	404.1	115.5	656.5	134.4	111.9	35.6	7959.9
32	48H4	4601.2	281.9	451.1	42.3	0.0	14.1	0.0	0.0	0.0	5390.6
32	48H5	5576.7	362.6	520.4	58.1	0.0	14.3	0.0	0.0	0.0	6532.1
29	49G9	59.8	2420.6	4212.4	3868.6	1715.3	3520.0	532.2	452.8	580.3	17362.0
32	49H5	3588.6	492.9	904.0	331.8	79.6	501.3	83.9	50.4	122.0	6154.5
32	49H6	4834.1	148.9	312.9	87.0	46.9	97.7	37.7	0.0	37.7	5602.8
30	50G7	2097.2	3804.3	680.7	236.7	50.8	28.7	11.5	1.7	2.8	6914.3
30	50G8	9606.0	18140.6	3327.7	1185.7	262.8	158.7	62.1	11.6	21.8	32776.9
30	50G9	444.0	2879.8	2153.4	1523.5	637.1	596.3	204.9	85.2	168.1	8692.4
30	50H0	118.7	7500.8	5073.2	3271.4	1228.2	1338.4	439.8	216.5	1224.8	20411.7
30	51G7	47.9	2729.3	5275.4	5690.4	3010.4	4500.7	1509.3	1031.2	3305.5	27100.1
30	51G8	9.2	1575.8	2280.9	2251.0	1126.5	1524.1	497.1	290.9	905.8	10461.3
30	51G9	52.1	482.1	2413.4	2937.4	1514.3	1830.0	582.3	281.2	706.5	10799.2
30	51H0	184.9	1545.9	2354.0	2005.2	881.2	1011.8	329.5	177.5	485.7	8975.7
30	52G7	0.0	321.0	1802.2	3415.5	2043.2	3707.9	1158.5	741.4	1813.6	15003.3
30	52G8	0.0	796.5	3177.4	6032.2	3736.1	6487.2	2041.1	1264.0	3307.2	26841.5
30	52G9	251.5	1511.2	5001.5	8623.4	5137.2	8427.3	2678.4	1630.6	3901.9	37163.1
30	52H0	154.4	1076.0	2740.6	3280.2	1690.2	2315.5	740.9	447.9	1406.5	13852.1
30	53G8	934.0	420.6	2350.5	4637.1	2931.8	4575.0	1510.6	941.1	2898.7	21199.4
30	53G9	50.8	1971.7	4951.5	8577.6	5080.0	8541.8	2726.6	1747.2	4757.9	38405.1
30	53H0	993.6	2521.8	5562.1	6321.4	3227.3	4504.8	1436.5	1035.9	3919.4	29522.8
30	54G8	279.1	387.2	1716.8	3742.0	2364.5	4457.4	1427.1	1029.2	2591.5	17994.7
30	54G9	79.7	710.2	2843.9	5531.6	3443.8	6169.3	1997.7	1353.2	3363.7	25493.1
30	54H0	525.1	2557.8	4362.9	4476.1	2148.4	3070.4	987.7	692.3	1984.1	20804.7
30	55G9	942.8	2713.0	3593.5	5337.5	2977.5	5004.4	1544.1	1007.5	2499.1	25619.3
30	55H0	397.7	2209.2	4653.4	5860.7	3240.2	4178.5	1386.3	693.1	1659.1	24278.2

Table 10.Numbers (millions) of sprat by age and area (r/v Aranda 2019).

SD	Rect.	0	1	2	3	4	5	6	7	8+	Total
29	47H0	11960.06	170.57	380.53	95.28	116.38	270.21	28.91	0.00	35.47	13057.41
29	48G9	253.42	26.90	59.75	18.47	23.92	61.83	9.96	0.00	9.64	463.89
29	48H0	2707.59	22.63	47.39	13.45	16.97	45.08	6.58	0.00	6.96	2866.64
29	48H1	11234.51	146.67	243.61	33.45	29.00	111.33	9.22	0.00	13.36	11821.15
29	48H2	7926.50	651.64	1227.92	191.44	217.16	583.62	66.45	0.00	60.76	10925.49
32	48H3	6012.16	398.80	672.02	135.27	63.06	431.31	17.96	16.84	25.49	7772.91
32	48H4	7066.58	782.38	1974.63	674.52	380.24	2289.57	188.80	178.03	253.71	13788.45
32	48H5	4485.12	98.17	212.52	54.40	21.90	176.92	6.15	7.94	11.40	5074.51
29	49G9	5.99	0.19	1.03	0.50	0.73	2.14	0.43	0.00	0.36	11.37
32	49H5	737.62	132.37	318.71	116.38	67.72	373.13	37.10	29.88	44.48	1857.38
32	49H6	2980.39	100.97	229.82	75.42	32.18	212.91	12.32	9.02	13.10	3666.14
30	50G7	0.00	7.79	30.32	12.29	14.08	76.39	8.37	2.90	7.82	159.96
30	50G8	0.00	36.68	141.58	58.28	67.73	367.63	40.33	14.37	37.91	764.52
30	50G9	0.28	2.24	6.38	4.57	7.33	40.33	4.51	2.49	4.80	72.93
30	50H0	0.00	0.07	0.42	0.41	0.72	4.07	0.45	0.34	0.71	7.18
30	51G7	0.00	0.00	1.66	0.92	1.39	7.86	0.87	0.48	0.76	13.95
30	51G8	0.00	0.00	0.30	0.18	0.26	1.57	0.18	0.11	0.20	2.80
30	51G9	0.00	0.00	0.16	0.25	0.41	2.66	0.32	0.25	0.50	4.55
30	51H0	0.00	0.00	0.13	0.16	0.30	1.87	0.20	0.23	0.55	3.45
30	52G7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30	52G8	0.00	0.23	0.30	0.30	0.00	0.64	0.30	0.04	0.30	2.12
30	52G9	0.00	0.12	0.52	1.08	2.16	15.03	1.59	1.71	2.85	25.05
30	52H0	0.00	0.05	0.61	0.31	0.46	2.86	0.30	0.23	0.35	5.16
30	53G8	1.37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.37
30	53G9	0.00	0.40	0.69	0.35	0.60	3.80	0.39	0.33	0.42	6.99
30	53H0	0.00	1.80	7.30	4.00	5.60	31.67	3.53	1.76	3.47	59.13
30	54G8	0.00	0.00	0.00	0.07	0.07	0.85	0.10	0.14	0.34	1.56
30	54G9	0.00	0.06	0.16	0.08	0.13	0.94	0.09	0.16	0.38	2.00
30	54H0	0.00	5.86	21.01	10.63	15.10	87.47	9.31	5.42	9.92	164.73
30	55G9	0.74	1.28	8.60	4.17	5.48	29.69	3.25	1.23	3.06	57.49
30	55H0	0.00	0.12	1.77	0.72	0.95	6.05	0.60	0.43	0.61	11.24

Table 11.Mean weight (g) of sprat by age and area (r/v Aranda 2019).

SD	Rect.	0	1	2	3	4	5	6	7	8+
29	47H0	2.52	9.51	10.05	11.16	11.38	11.17	11.51		12.10
29	48G9	2.77	9.11	10.28	11.32	11.43	11.61	12.08		12.72
29	48H0	2.55	9.36	10.21	11.29	11.45	11.53	12.01		12.51
29	48H1	2.62	8.91	9.19	10.01	11.16	10.22	11.59		11.86
29	48H2	2.70	9.19	9.71	10.43	10.96	10.57	11.55		11.53
32	48H3	2.75	8.88	9.33	10.33	10.84	10.37	12.11	12.09	11.99
32	48H4	3.14	9.97	10.11	10.69	11.06	10.71	12.24	12.23	12.16
32	48H5	3.37	9.58	9.82	10.40	10.50	10.27	12.26	12.29	12.25
29	49G9	2.70	10.59	10.84	11.53	11.50	12.01	12.29		12.09
32	49H5	3.29	9.70	10.05	10.76	11.17	10.85	12.47	12.16	12.08
32	49H6	3.15	9.84	10.06	10.57	11.02	10.63	12.18	12.11	12.00
30	50G7		10.53	12.14	12.97	13.68	13.69	13.82	14.72	14.34
30	50G8		10.53	12.15	12.99	13.71	13.72	13.85	14.77	14.41
30	50G9	3.50	10.45	12.33	13.70	14.22	14.38	14.35	15.46	15.49
30	50H0		11.16	12.33	13.89	14.40	14.64	14.56	16.13	16.41
30	51G7		0.00	12.61	13.48	14.18	14.34	14.26	15.55	14.43
30	51G8		0.00	12.61	13.69	14.28	14.55	14.49	15.77	15.08
30	51G9		0.00	13.23	14.50	14.62	15.14	14.99	16.07	15.78
30	51H0		0.00	12.89	14.37	14.69	15.00	14.87	16.59	17.14
30	52G7									
30	52G8		9.64	14.00	11.80	0.00	13.79	16.30	9.64	16.30
30	52G9		11.16	12.17	15.03	15.17	15.43	15.47	16.04	16.47
30	52H0		11.16	12.27	13.60	14.46	14.67	14.71	15.75	15.26
30	53G8	3.50								
30	53G9		10.68	11.81	13.82	14.71	14.86	14.93	15.68	15.39
30	53H0		10.86	12.13	13.45	14.12	14.31	14.35	15.65	14.93
30	54G8				16.61	16.61	16.61	16.61	16.61	16.61
30	54G9		11.16	11.26	13.80	15.12	15.33	15.62	16.75	17.45
30	54H0		10.56	12.16	13.50	14.23	14.35	14.43	15.49	15.41
30	55G9	2.00	10.92	12.23	13.29	13.95	14.00	14.08	15.60	15.04
30	55H0		11.16	12.21	13.39	14.43	14.51	14.68	15.63	15.14

Table 12.Total biomass (ton) of sprat by age and area (r/v Aranda 2019).

SD	Rect.	0	1	2	3	4	5	6	7	8+	Total
29	47H0	30136.9	1622.5	3825.1	1063.7	1325.0	3019.5	332.7	0.0	429.4	41754.7
29	48G9	701.6	245.1	614.3	209.2	273.3	717.8	120.3	0.0	122.6	3004.3
29	48H0	6902.2	211.7	483.6	151.9	194.4	519.6	79.0	0.0	87.0	8629.5
29	48H1	29437.1	1307.3	2239.2	335.0	323.6	1138.2	106.9	0.0	158.4	35045.7
29	48H2	21408.1	5986.2	11919.7	1995.8	2379.8	6167.8	767.7	0.0	700.5	51325.6
32	48H3	16542.5	3541.0	6273.1	1396.8	683.3	4470.6	217.4	203.5	305.6	33634.0
32	48H4	22185.5	7800.8	19954.3	7209.5	4207.3	24525.0	2311.0	2177.3	3086.4	93457.2
32	48H5	15117.6	940.9	2087.4	565.8	230.0	1817.6	75.4	97.6	139.6	21071.9
29	49G9	16.2	2.1	11.1	5.8	8.3	25.8	5.3	0.0	4.4	78.9
32	49H5	2426.9	1283.5	3203.9	1252.4	756.5	4047.4	462.7	363.3	537.3	14333.8
32	49H6	9401.6	993.4	2311.5	797.0	354.6	2263.5	150.1	109.3	157.2	16538.1
30	50G7	0.0	82.1	368.1	159.3	192.7	1045.8	115.7	42.6	112.1	2118.6
30	50G8	0.0	386.3	1719.7	757.1	928.5	5045.6	558.6	212.3	546.3	10154.6
30	50G9	1.0	23.4	78.7	62.6	104.2	579.8	64.8	38.5	74.4	1027.3
30	50H0	0.0	0.8	5.2	5.7	10.3	59.6	6.5	5.4	11.6	105.2
30	51G7	0.0	0.0	20.9	12.4	19.7	112.8	12.5	7.5	11.0	196.7
30	51G8	0.0	0.0	3.8	2.4	3.8	22.9	2.6	1.8	3.0	40.2
30	51G9	0.0	0.0	2.1	3.6	6.0	40.3	4.7	4.1	7.9	68.7
30	51H0	0.0	0.0	1.7	2.3	4.4	28.1	3.0	3.8	9.5	52.8
30	52G7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
30	52G8	0.0	2.2	4.2	3.6	0.0	8.9	4.9	0.4	4.9	29.1
30	52G9	0.0	1.4	6.3	16.2	32.8	231.9	24.6	27.4	46.9	387.5
30	52H0	0.0	0.5	7.5	4.3	6.6	41.9	4.4	3.6	5.3	74.0
30	53G8	4.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.8
30	53G9	0.0	4.3	8.1	4.9	8.8	56.5	5.8	5.2	6.5	100.1
30	53H0	0.0	19.6	88.5	53.8	79.1	453.1	50.6	27.5	51.8	824.0
30	54G8	0.0	0.0	0.0	1.1	1.1	14.1	1.7	2.3	5.6	25.9
30	54G9	0.0	0.6	1.8	1.2	1.9	14.5	1.4	2.7	6.5	30.6
30	54H0	0.0	61.9	255.5	143.6	214.8	1255.1	134.4	83.9	152.9	2302.0
30	55G9	1.5	14.0	105.2	55.5	76.4	415.7	45.7	19.1	46.0	779.0
30	55H0	0.0	1.3	21.6	9.6	13.8	87.8	8.8	6.7	9.2	158.7

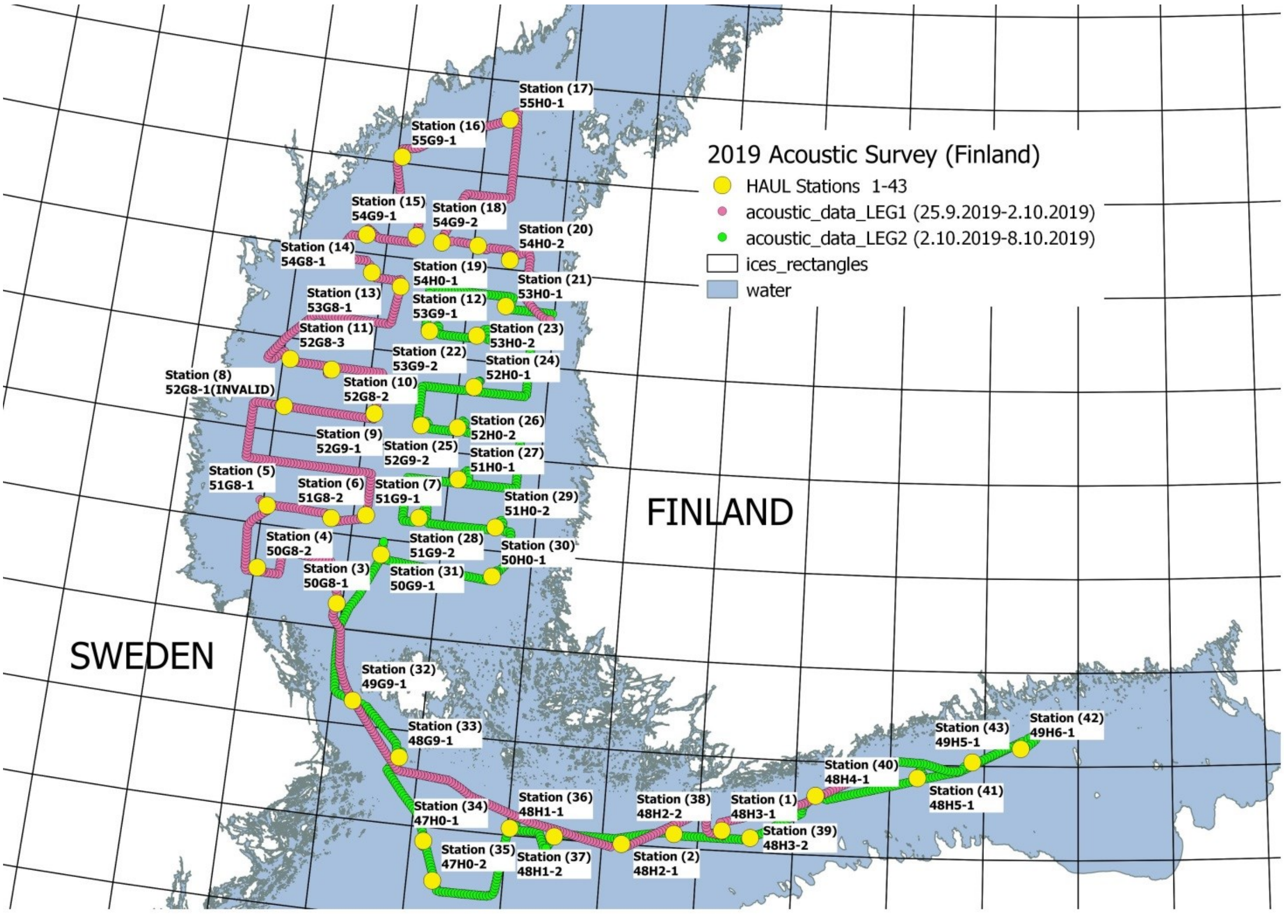

Figure 1. Cruise track and trawl stations of r/v Aranda during the Finnish BIAS-survey in 2019.

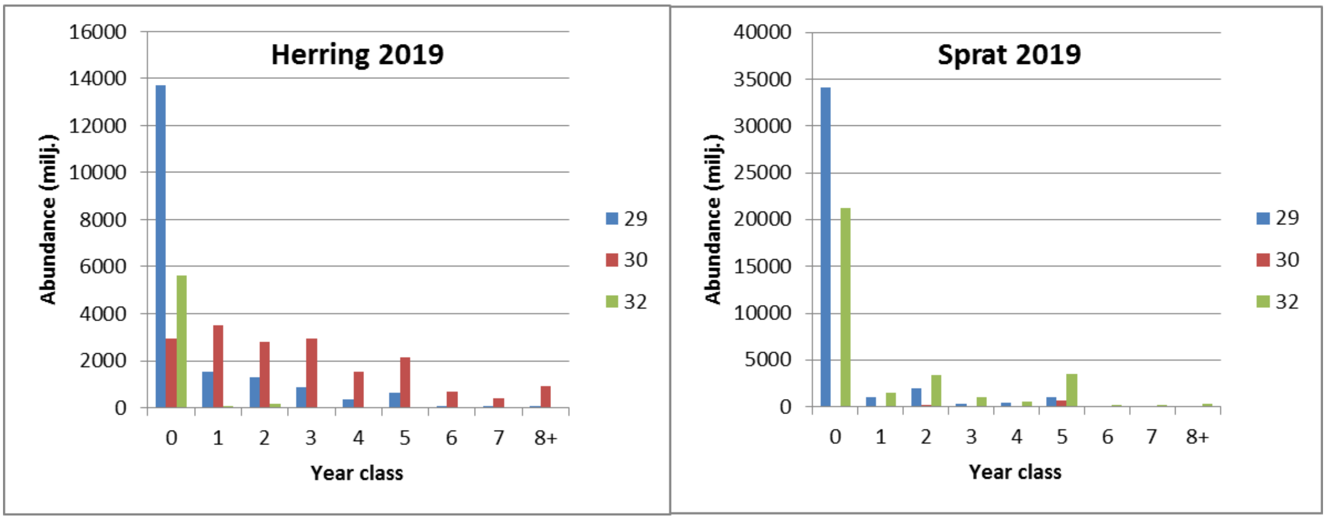

Figure 2. Abundance of herring and sprat per age groups according to the ICES Sub-divisions in Finnish BIAS survey 2019.

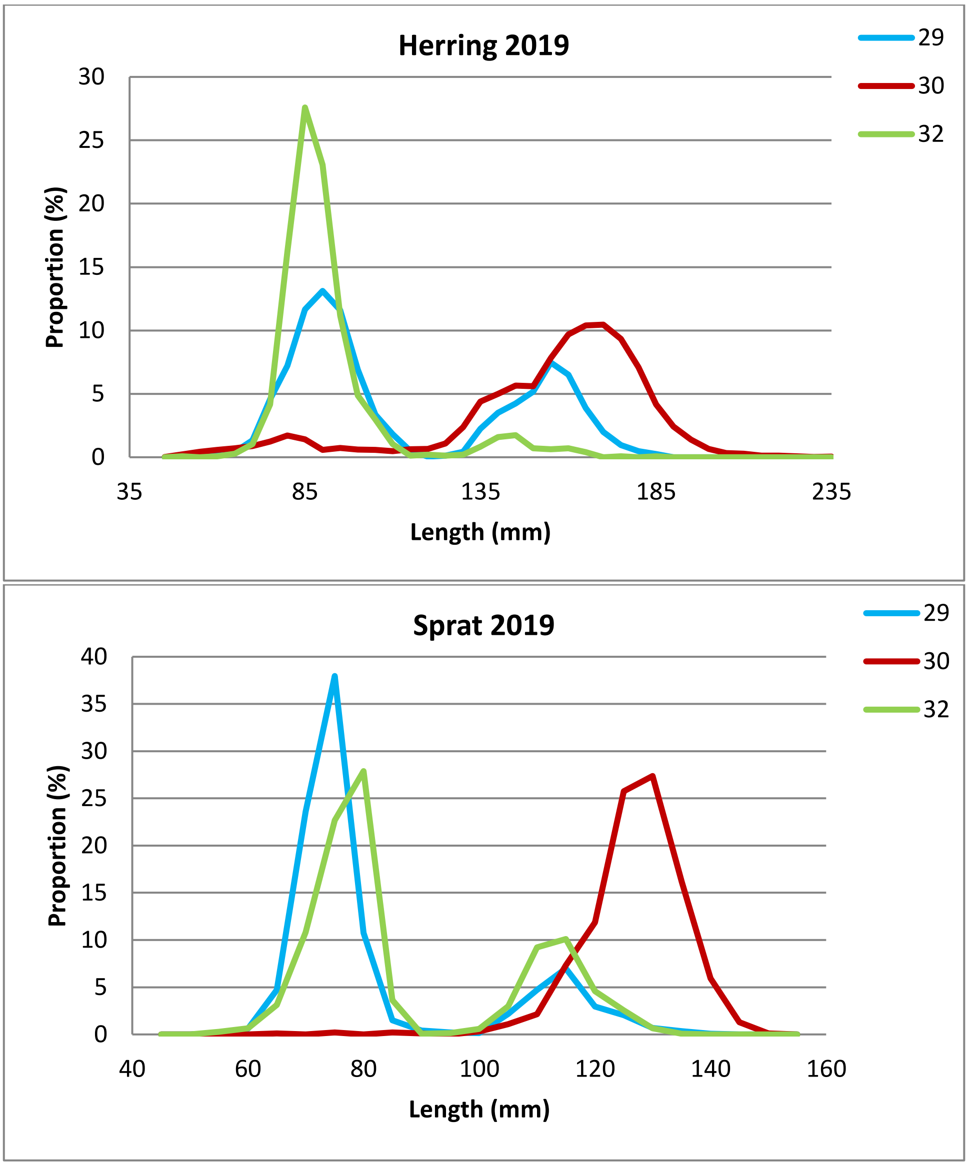

Figure 3. Proportional length distributions of measured herring and sprat in Sub-Divisions 29, 30, and 32.

Working document

Baltic International Fish Survey Working Group (WGBIFS)
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Federal Research Institute for Rural Areas, Forestry and Fisheries

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THÜNEN

Survey Report FRV "Solea" SB768

German Acoustic Autumn Survey (GERAS)

01 – 21 October 2019

Matthias Schaber[1] & Tomas Gröhsler[2]

1 INTRODUCTION

1.1 Background

The cruise was part of an international hydroacoustic survey providing information on stock parameters of small pelagics in the Baltic Sea, coordinated by the ICES Working Group of International Pelagic Surveys (WGIPS) and the ICES Baltic International Fish Survey Working Group (WGBIFS). Further WGBIFS contributors to the Baltic survey are national fisheries research institutes of Sweden, Poland, Finland, Latvia, Estonia and Lithuania. FRV "Solea" participated for the 32nd time. The survey area covered the western Baltic Sea including Kattegat, Belt Sea, Sound and Arkona Sea (ICES Subdivisions (SD) 21, 22, 23 and 24).

1.2 Objectives

The survey has the main objective to annually assess the clupeid resources of herring and sprat in the Baltic Sea in autumn. The reported acoustic survey is conducted every year to supply the ICES Herring Assessment Working Group for the Area South of 62°N (HAWG) and Baltic Fisheries Assessment Working Group (WGBFAS) with an index value for the stock size of herring and sprat in the Western Baltic area (Kattegat/Subdivisions 21 and Subdivisions 22, 23 and 24).

The following objectives were planned for SB768:

- Hydroacoustic measurements for the assessment of small pelagics in the Kattegat and western Baltic Sea including Belt Sea, Sound and Arkona Sea (ICES Subdivisions 21, 22, 23 and 24)
- (Pelagic) trawling according to hydroacoustic registrations
- Hydrographic measurements on hydroacoustic transects and after each fishery haul
- Identification and recording of species- and length-composition of trawl catches
- Collection of biological samples of herring, sprat and additionally European anchovy and cod for further analyses
- Parallel survey with RV "Clupea" (CLU338) on the regular transect in Subdivision 23 to compare day- and nighttime clupeid distribution and catchability.

1.3 Survey summary

The objectives of the survey were carried out successfully and largely as planned in all of the covered ICES Subdivisions. Only in SD 21 (Kattegat), the two northernmost statistical rectangles had to be omitted due to a loss of survey time from adverse weather conditions requiring a temporal interruption of survey operations earlier. Neither the interruption nor the reduction of the surveyed area are considered to affect quality or quantity of acoustic estimates.

Altogether, 1124 nautical miles of hydroacoustic transects (plus 103 nmi night and daytime transects for comparison) were covered. For species allocation and identification as well as to collect biological data for an age stratified abundance estimation of the target species herring and sprat, altogether 45 fishery hauls were conducted. Vertical hydrography profiles were measured on 76 stations.

In roughly half of all sampled rectangles, mean NASC values per nautical mile were either comparable with or higher than the values measured in 2018, and lower in the remaining rectangles. Compared to the long-time survey mean however, mean NASC values in the large majority of rectangles covered were distinctly lower. On ICES subdivision scale, mean NASC values were overall lower than in the previous year in subdivision 21, slightly higher in SD 22, distinctly lower in SD 23 and almost identical to 2018 in SD 24.

2 SURVEY DESCRIPTION & METHODS APPLIED

2.1 Cruise narrative

The 768th cruise of FRV "Solea" represents the 32nd subsequent GERAS survey. Equipment of the vessel as well as calibration of echosounders took place on October 1st, embarkation of scientific crew and beginning of survey was scheduled for the following day, when FRV "Solea" left Kiel harbor in the afternoon. The hydroacoustic survey operations commenced October 2nd in SD 22 (Kiel Bight).

Generally, survey operations were conducted during nighttime to account for the more pelagic distribution of clupeids during that time. Weather conditions at the beginning of the survey required to start survey operations in the westerly survey area of the comparatively sheltered western Baltic SD 22. Several scheduled changes of scientific crew during SB768 (exceptional case in 2019) required interruption of survey operations in SD 22 to enter Rostock-Warnemünde port for the first exchange of the chief scientist on October 7th. Afterwards, survey operations commenced in SD 22 (finished on October 8th) and continued in SD 24. There, adverse weather conditions required a one day interruption of survey work on October 11th. After conditions improved, the survey commenced in SD 24, where 2 out of 3 transect sections (SD 24 south, SD north) were finished before FRV "Solea" entered Copenhagen port for another exchange of the chief scientist on October 14th. In late afternoon of October 15th, FRV "Solea" left Copenhagen port to commence survey operations in SD 23, where after accomplishing the regular night time transect another parallel run of that transect was accomplished the following day together with FRV "Clupea" to collect hydroacoustic data (both vessels) and biological samples (FRV "Clupea") for a comparison of day-night distributions and catchability of herring in the Sound. Afterwards, SD 21 was covered with a reduced sampling effort (the two northernmost rectangles had to be omitted) due to the previous loss of survey time (crew change, weather conditions). After accomplishing SD 21 on October 18th, the remaining transect in SD 24 (SD24 middle) was covered on October 19th accomplishing survey operations in all ICES Subdivisions. The scientific survey program was finished on October 20th, 05:40 AM. Afterwards, FRV "Solea" steamed to Marienehe port, where the survey ended on October 21st.

Altogether, the following survey schedule was accomplished:

Belt Sea	(SD 22)	02. - 07.10.
Arkona Sea	(SD 24)	08. - 13.10. & 19.10.
Sound	(SD 23)	15.10. & 18.10. (Additional fishery haul)
Kattegat	(SD 21)	16. - 18.10.
Sound	(SD 23) (day)	16.10. (Parallel survey with FRV "Clupea")

Total survey time	16 nights (+ 1 day comparison in SD 23), excl. 1 day loss (bad weather)
Fishery hauls	45
CTD-casts	76
Hydroacoustic transects	1124 nmi (+ 103 nmi transects for comparison)

2.2 Survey design

ICES statistical rectangles were used as strata for all Subdivisions (ICES, 2017). The area was limited by the 10 m depth line. The survey area in the Western Baltic Sea is characterized by a number of islands and sounds. Consequently, parallel transects would lead to an unsuitable coverage of the survey area. Therefore a zig-zag track was adopted to cover all depth strata regularly and sufficiently. Overall, the covered regular cruise track length was 1124 nautical miles (2018: 1211 nmi) (Figure 1).

2.3 Acoustic data collection

All acoustic investigations were performed during night time to account for the more pelagic distribution of clupeids during that time. Hydroacoustic data were recorded with a Simrad EK80 scientific echosounder with hull-mounted 38, 70, 120 and 200 kHz transducers at a standard ship speed of 10 kn. Post-processing and analysis of hydroacoustic data were conducted with Echoview 10 software (Echoview Software Pty Ltd, 2019). Mean volume back scattering values (S_v) were integrated over 1 nmi intervals from 10 m below the surface to ca. 0.5 m over the seafloor. Interferences from surface turbulence, bottom structures and scattering layers were removed from the echogram. The transducer settings applied were in accordance with the specifications provided in ICES (2015, 2017).

2.4 Calibration

All transducers (38, 70, 120 and 200 kHz) were calibrated prior to the beginning of the survey in acceptable weather conditions from an anchored vessel in Strande Bay/Kiel Bight (54°25.35 N, 10°12.29 E). Overall calibration results were considered good based on calculated RMS values. Resulting transducer parameters were applied for consecutive data-collection and post-processing of hydroacoustic survey data. Calibration results for the 38 kHz transducer are given in Table 1.

2.5 Biological data – trawl hauls

Trawl hauls were conducted with a pelagic gear "PSN388" in midwater layers as well as near the seafloor. Mesh size in the codend was 10 mm. It was planned to carry out at least two hauls per ICES statistical rectangle. Both trawling depth and net opening were continuously controlled by a netsonde during fishing operations. Trawl depth was chosen in accordance with echo distributions on the echogram. Normally, a vertical net opening of about 7-9 m was achieved. The trawling time usually lasted 30 minutes but was shortened when echograms and netsonde indicated large catches. To validate and allocate echorecordings, altogether 45 fishery hauls were conducted (Figure 1). From each haul sub-samples were taken to determine length and weight of fish. Samples of herring and sprat were frozen for additional investigations (e.g. determining sex, maturity, age).

2.6 Hydrographic data

Hydrographic conditions were measured after each trawl haul and in regular distances on the survey transect. On each corresponding station, vertical profiles of temperature, salinity and oxygen concentration were measured using a "Seabird SBE 19 plus" CTD. Water samples for calibration purposes (salinity) were taken on every station. Altogether, 76 CTD-profiles were measured (Figure 8).

2.7 Data analysis

All data analyses were conducted using GERIBAS II software (Arivis, 2014) and Microsoft Office.

The pelagic target species sprat and herring are often distributed in mixed layers together with other species. Thus, echorecordings cannot be allocated to a single species. Therefore the species composition allocated to echorecordings was based on corresponding trawl catch results. For each rectangle, species composition and length distributions were determined as the unweighted mean of all trawl results in this rectangle. From these distributions the mean acoustic cross section σ was calculated according to the following target strength-length (TS) relation:

	TS	References
Clupeids	= 20 log L (cm) - 71.2	ICES (1983)
Gadids	= 20 log L (cm) - 67.5	Foote et al. (1986)
Scomber scombrus	= 20 log L (cm) - 84.9	ICES (2017)

All other species that were included in the analysis based on their contribution to the catches per rectangle were allocated the clupeid TS (see table above).

The total number of fish (total N) in one rectangle was estimated as the product of the mean Nautical Area Scattering Coefficient (NASC; S_A) and the rectangle area, divided by the corresponding mean cross section σ. The total number was separated into the categories mentioned above and further into herring and sprat according to the mean catch composition.

All calculations performed were in accordance with the guidelines in the "SISP Manual of International Baltic Acoustic Surveys (IBAS)" (ICES, 2017).

Some hauls with very low catches in terms of numbers and biomass as well as hauls conducted with unclear fishing gear were rendered invalid for further analyses. Based on survey design restrictions, comprehensive sampling is not feasible in all statistical rectangles surveyed. Biological information from neighboring rectangles is used for generating estimates in these cases. This mostly applies to rectangles with low abundance as well as to rectangles where low catch hauls and invalid hauls need to be omitted.

Stock splitting / Application of the separation function (SF):

In the western Baltic, the distribution areas of two stocks, the Western Baltic Spring Spawning herring (WBSSH) and the Central Baltic herring (CBH) overlap. Survey results from recent years indicated that in SD 24, which is part of the WBSSH management area, a considerable fraction of CBH is present and correspondingly erroneously allocated to WBSSH stock indices (ICES, 2013). Accordingly, a stock separation function (SF) based on growth parameters derived from 2005 to 2010 has been developed to quantify the proportion of CBH and WBSSH in the area (Gröhsler et al., 2013; Gröhsler et al., 2016). The estimates of the growth parameters from baseline samples of WBSSH and CBH in 2011-2018 support the applicability of the SF (Oeberst et al., 2013; WD Oeberst et al., 2014, 2015, 2016, 2017; WD Gröhsler and Schaber, 2018, 2019).

The ICES Herring Assessment Working Group for the area south of 62° N (HAWG)) is yearly supplied with an index for this survey (GERAS), which since 2005 excludes CBH and in general covers the total standard survey area, excluding ICES rectangles 43G1 and 43G2 in SD 21 and 37G3 and 37G4 in SD 24, which were not covered in 1994-2004.

3 RESULTS

3.1 Hydroacoustic data (M. Schaber)

Figure 2 depicts the spatial distribution of mean NASC values (5 nmi intervals) measured on the hydroacoustic transects covered in 2019. In general, the majority of these NASC measurements can be allocated to clupeids. In 13 out of 25 rectangles surveyed, mean NASC values were comparable (7) or (partly significantly) higher (6) than those recorded in 2018. However, in 20 out of 25 rectangles, mean NASC levels recorded were well below the long-term survey average. On ICES subdivision scale, mean NASC values were slightly lower than in the previous year in subdivision 21, slightly higher in SD 22, distinctly lower in SD 23 and almost identical to 2018 in SD 24.

In SD 21, overall NASC values measured were lower than those measured in the previous year. Only in one rectangle (41G0), mean NASC per 1 nmi EDSU was almost tenfold higher than the one measured in 2018, driving the overall only slightly lower mean NASC in this subdivision as compared to 2018. This rectangle however only contained a short section of transect. Aggregations were mostly patchy along the cruisetrack, with highest NASC levels measured in the southern parts of the Kattegat.

In SD 22, mean overall NASC values recorded were comparable or higher than in 2018 in 8 out of 11 rectangles surveyed. Lower values were measured in 3 rectangles. In some rectangles, the increase in NASC measured was significant, but often originated from rather unusual aggregations of fishes in rectangles containing only short transect sections or in an area that usually is characterized by very low NASC levels. In comparison to the long-term survey mean, all but 2 rectangles in SD 22 again showed decreased NASC values. No clear aggregation or area of increased NASC measurements was evident, but highest measurements origin from distinct aggregations of (most likely) anchovies in the area north of the Little Belt.

As in the previous years, the large aggregations of big herring that usually could be observed in SD 23 in the Sound were not present in autumn 2019. Mean NASC values were again distinctly lower than the levels measured in 2018 in the relevant rectangles. They also were well below the long-term survey mean. Only in the southern part of the Sound, NASC levels were above the 2018 measurements (rectangle 39G2). A daytime replicate hydroacoustic measurement of the inner Sound parallel with FRV “Clupea” (hydroacoustics and fishing operations) showed differing but consistent distribution patterns with somewhat increased NASC values as compared to the regular nighttime transect coverage (Figure 3). This comparison will be fully evaluated in later steps.

In SD 24, mean NASC values were comparable to or higher than the levels measured in 2018 in 7 out of 9 rectangles. While an eightfold increase was measured in the southernmost transect parts of 37G4, NASC levels measured in the Kadetrinne area west of Fischland-Darß-Zingst (37G2) and northern Arkona Basin along the Swedish coast (39G3) were distinctly lower than in 2018. The former however had shown a fourfold increase in 2018 and is characterized as an area with usually rather low NASC measurements. As in the years before, somewhat notable aggregations were detected around Rügen Island.

3.2 Biological data (T. Gröhsler)

Fishery hauls according to ICES Subdivision (Figures 1 & 4):

SD	Hauls (n)
21	8 (incl. 1 invalid haul)
22	16
23	4
24	17

Altogether, 1 165 individual herring, 792 sprat, 318 European anchovies and 5 sardines were frozen for further investigations (e.g. determining sex, maturity, age). Results of catch compositions by Subdivision are presented in Tables 2-5. Altogether, 34 different species were recorded. Herring were caught in 42, sprat in 38 hauls. SD 23, which is typically characterized by the highest mean herring catch rates per station (kg 0.5 h^{-1}), showed the lowest values ever recorded (during nighttime hauls). In contrast to 2018, when sardines (*Sardina pilchardus*) only appeared in catches from SD 22 and SD 23, this species was caught in SD 21 and SD 23 in 2019. As in previous years, anchovy (*Engraulis encrasicolus*) were present in the whole survey area, albeit in a higher frequency of occurrence compared to 2018 (26 of 58 day- and nighttime hauls in 2018, 36 of 45 nighttime hauls in 2019). A map depicting clupeid catches per haul is shown in Figure 4.

Altogether, the following fish species were sampled and processed:

Species	Length measurements (n)	Prevalence (n of hauls)
Aphia minuta	307	21
Clupea harengus	5737	42
Ctenolabrus rupestris	3	3
Engraulis encrasicolus	1181	36
Eutrigla gurnardus	6	4
Gadus morhua	60	14
Gasterosteus aculeatus	452	23
Limanda limanda	72	14
Merlangius merlangus	274	30
Mullus surmuletus	3	3
Platichthys flesus	22	12
Pomatoschistus minutus	138	12
Sardina pilchardus	5	3
Scomber scombrus	125	11
Sprattus sprattus	4266	38
Syngnathus typhle	301	3
Trachinus draco	703	18
Trachurus trachurus	1	37
Others	42	-

Figures 5 and 6 show relative length-frequency distributions of herring and sprat in ICES subdivisions 21, 22, 23 and 24 for the years 2018 and 2019. Compared to results from the previous survey in 2018, the following conclusions for **herring** can be drawn (Figure 5):

- Catches in SD 21 showed a bimodal distribution with modes at 15.25-15.75 cm and 18.75 cm. This is in contrast to 2018, when a multimodal distribution showed modes at 11.75 cm, 15.25-15.75 cm and 21.2.5-21.75 cm.
- Catches in SD 22 were dominated in the last two years by the incoming year class (ca. ≤15 cm) with a mode at 12.75-13.25 cm.
- As in the years 2016-2018, larger herring (>20 cm) were almost absent from night time catches conducted in SD 23 in 2019. Catches in 2019 showed – quite similar to the results in SD 21 - a bimodal distribution with modes at 14.25 cm and 18.75 cm. This is in contrast to 2018, when the catches were only dominated by the contribution of the incoming year class (ca. ≤15 cm), showing a mode at 13.25 cm.
- Catches in SD 24 showed in both years a similar bimodal distribution with modes at 13.25-13.75 cm and 17.75-18.25 cm accompanied by the almost absence of herring larger than ca. 23 cm.

Relative length-frequency distributions of **sprat** in the years 2018 and 2019 (Figure 6) can be characterized as follows:

- In SD 21 catches of the incoming year class (ca. ≤10 cm) were virtually absent in both years. In The catches were dominated by the contribution of larger sprat in both years.
- Catches in SD 22 were dominated in 2019 by the contribution of the incoming year class (ca. ≤10 cm). This is contrast to the results in 2018, where the contribution of larger sprat (>10 cm) was highest.
- In SD 23, the catches showed a bimodal distribution with a higher contribution of the incoming year class (ca. ≤10 cm, mode at 8.75 cm) compared to amount of older sprat (mode at 12.15 cm). This is in contrast to the results in 2018 where almost exclusively the incoming year class (ca. ≤10 cm) contributed to the catches.
- In SD 24, the bimodal sprat length-frequency distribution was characterized by a similar contribution of the incoming year class (ca. ≤10 cm) and older sprat in both years. The catches were dominated by the contribution of larger sprat (>10 cm) in 2018 and in 2019.
- Altogether, the present contribution of the incoming year class (ca. ≤10 cm) seemed to be higher than the lower one in 2018.

For abundance and biomass estimates, the following considerations and calculation steps were included in the analysis:

<u>Fish species considered:</u>

Transparent goby	(*Aphia minuta*)
Herring	(*Clupea harengus*)
European anchovy	(*Engraulis encrasicolus*)
Cod	(*Gadus morhua*)
Three-spined stickleback	(*Gasterosteus aculeatus*)
Haddock	(*Melanogrammus aeglefinus*)
Whiting	(*Merlangius merlangus*)
Mackerel	(*Scomber scombrus*)
Sprat	(*Sprattus sprattus*)
Greater weever	(*Trachinus draco*)
Horse mackerel	(*Trachurus trachurus*)

<u>Exclusion of trawl hauls with very low catches:</u>

Haul No.	Rectangle	Subdivision (SD)
2, 11	38G0	22

4, 7	40G0	22
14, 15	37G1	22
18	38G2	24
32	41G2	23
37	42G1	21
45	39G2	24

Exclusion of trawl hauls due to net damage:

Haul No.	Rectangle	Subdivision (SD)
39	42G2	21

Inclusion of hauls with low catches:

Despite low catches of both herring and sprat, the following hauls were not excluded from the analysis as they were the only trawl hauls conducted in the corresponding rectangles and thus provided the only available information on species composition in the following rectangles:

Haul No.	Rectangle	Subdivision (SD)
5	41G0	22
6	40G1	22
8, 9	39G0	22
10	39G1	22
12	37G0	22
17	37G2	24
27	39G4	24
40	42G2	21

Usage of neighboring trawl information for rectangles which contain only acoustic investigations:

Rectangle/SD to be filled	with Haul No.	of Rectangle/SD
39F9/22	8 and 9	39G0/22
40F9/22	3	40G0/22
39G2/23	29	39G2/24
37G4/24	20 and 23	38G4/24

3.3 Stock Splitting / Application of the Separation Function

The age-length distribution of herring in SDs 21, 22 and SD 23 in 2019 indicated some contribution of fish of CBH origin. This also included the SD 23 area of ICES rectangle 39G2, since biological samples of that rectangle were also used to raise the corresponding mean NASC values in the SD 24 area of the rectangle. Accordingly, the SF was applied all areas (SDs 21-24) in 2019.

The applicability of the SF, which is normally checked by analyzing the growth parameters based on baseline samples of WBSSH in SDs 21 and 23, could not be tested in 2019 due some degree of mixing of CBH/WBSSH in SDs 21 and 23.

3.4 Biomass and abundance estimates

The total abundance of herring and sprat is presented in Table 6. Estimated numbers of herring and sprat by age group and SD/rectangle are given in Table 7 and Table 10. Corresponding mean weights by age group and SD/rectangle are shown in Table 8 and Table 11. Estimates of herring and sprat biomass by age group and SD/rectangle are summarised in Table 9 and Table 12.

3.4.1 Herring incl. Central Baltic Herring (CBH)

The herring stock in Subdivisions 21-24 was estimated to be 3.3 x 10^9 fish (Table 7) or 89.6 x 10^3 tonnes (Table 9). For the included area of Subdivisions 22-24 the number of herring was calculated to be 3.1 x 10^9 fish or 81.7 x 10^3 tonnes.

3.4.2 Herring excl. Central Baltic Herring (CBH)

Estimated numbers of herring excluding CBH in SDs 21-24 by age group and SD/rectangle for 2019 are given in Table 13. Corresponding herring mean weights by age group and SD/rectangle are shown in Table 14. Estimates of herring biomass excluding CBH by age group and SD/rectangle are summarized in Table 15.

Gradual removal of the CBH fraction by SD (total survey area) yielded the following results:

Numbers (millions)	Total	excluding CBH in SD:			
	incl. CBH	24 & 39G2/23	24 & 22	24 & 22 & 23	21-24
SDs 21-24	3264.7	2448.3	2436.8	2434.2	2419.2
Percent of Total	100.0%	75.0%	74.6%	74.6%	74.1%
Difference		-25.0%	-0.5%	-0.1%	-0.6%
Biomass (t)	Total	excluding CBH in SD:			
	incl. CBH	24 & 39G2/23	24 & 22	24 & 22 & 23	21-24
SDs 21-24	89624.0	56993	55992	55886	55093
Percent of Total	100.0%	63.6%	62.5%	62.4%	61.5%
Difference		-36.4%	-1.8%	-0.2%	-1.4%

A removal of the CBH fraction in SDs 21-24 from the herring HAWG-GERAS index of the standard area (excluding 43G1/43G2 in SD 21 and 37G3/37G4 in SD 24) in 2019 also resulted in biomass reductions of 36 % with corresponding reductions in numbers of 24 % (2018: -20 % and -11 %, respectively; Figure 7; survey indices time series depicted in Figure 8).

3.4.3 Sprat

The estimated sprat stock in Subdivisions 21-24 was 4.5x 10^9 fish (Table 10) or 51.0 x 10^3 tonnes (Table 12). For the included area of Subdivisions 22-24 the number of sprat was calculated to be 4.2 x 10^9 fish or 45.6 x 10^3 tonnes. The overall abundance estimate in 2019 was dominated by the new incoming year class (Figure 6 and Table 10).

3.5 Hydrography

Vertical profiles of temperature, salinity and oxygen concentration were measured with a SeaBird SBE CTD-probe on a station grid covering the whole survey area. Hydrography measurements were either conducted directly after a trawl haul or, in case of no fishing activity, in regular intervals along the cruise track. Altogether, 76 CTD casts were conducted during this survey (Figure 9).

Surface temperatures ranged from ca. 11°C in the northeastern Arkona Basin (SD 24) and ca. 13 °C in the Kattegat area (SD 21) to > 14°C in the southwestern coastal areas of SD 22. Bottom temperatures were similar in most parts of Subdivisions 21, 22 and 23, but more variable due to strong thermohaline layering in some parts of SD 24 (eastern central Arkona) and SD 22 (inner Mecklenburg Bight). While bottom temperatures in the central and eastern Arkona Sea exceeded surface temperatures (maximum temperatures > 15 °C), lowest bottom temperatures were recorded in the inner Mecklenburg Bight at around 11-12 °C. Overall lowest temperatures of ca. 8 °C were recorded in the northeastern Arkona Sea in intermediate layers.

As usual due to the hydrographic nature of the western Baltic Sea, surface salinities showed a large gradient (from ca. 7.5 PSU in the eastern Arkona Sea to > 25 PSU in the Kattegat). As in the previous year, surface salinity in the western parts of the survey area (SD 22) was comparatively high at levels of ca. 20 PSU. Salinity near the seafloor ranged from 8 PSU in the Arkona Sea to ca. 34 PSU in the Kattegat. Especially in the Sound (SD 23), a very strong stratification with steep salinity gradients was observed.

Surface waters were well oxygenated throughout the survey area. Near the seafloor, local oxygen depletion was measured in the southwestern coastal area of SD 22 between the Little Belt and Kiel Bight.

4 DISCUSSION

Compared to 2018, the present estimates of herring **incl. CBH** show an increase in stock biomass, whereas abundance values decreased (ICES rectangles 43G1 and 43G2 in SD21 removed from 2018 results for comparison):

Herring (incl. CBH)	Difference compared to 2018	
Area	Numbers (%)	Biomass (%)
Subdivisions 21-24	-11	+8

This present decrease of 11 % in numbers was mainly driven by distinctly lower numbers in SD 21 (-74 %) and SD 23 (-82 %) as compared to 2018, together with higher numbers in SD 24 (+48 %). The increase in total biomass of 8 % was mainly driven by a presently very high contribution of age group 5 (+179 %).

Compared to 2018, the present estimates of herring **excl. CBH** now show a significant decrease in stock biomass and abundance values (ICES rectangles 43G1 and 43G2 in SD21 removed from 2018 results for comparison):

Herring (excl. CBH)	Difference compared to 2018	
Area	Numbers (%)	Biomass (%)
Subdivisions 21-24	-26	-16

The application of the Separation Function to remove CBH from the index calculation yields robust results, even though the actual applicability of the SF could not be tested in 2019 due to a lack of "clean" baseline samples from SDs 21 and 23. However, several issues were resolved and results corroborated after applying the SF and removing CBH from the samples from all areas (SD 21-24) in 2019: Mean weights of different age groups that prior to removal showed somewhat untypical growth pattern for WBSSH became distinctly more realistic for older age groups after removing the CBH fraction. Additionally, a conspicuous peak of abundance of 5 year old herring that otherwise could not be explained vanished after removing the CBH fraction. The 2014 year class represents only a weak year class in the WBSSH assessment (ICES, 2019a). The assumption of this peak originating from CBH is realistic, since latest assessment results for CBH show a very strong (strongest in the time series) 2014 year class (ICES, 2019b).

The present Western Spring Spawning Herring biomass estimate represents the lowest recorded value in the whole time series since 1993 (Figure 8).

Prior to 2016, high numbers of large herring were usually and regularly recorded in SD 23 (the Sound), which is considered an important transition and aggregation area for the WBSSH stock during its spawning migration (Nielsen, 1996). In 2019, for the fourth consecutive year, those fishes were absent. This virtual complete absence could, as in the previous years, be explained by a possibly delayed immigration of WBSSH from the feeding areas in the Skagerrak. The exceptionally low numbers of large and older herring 2016-2019 could also be explained by the very low recruitment, which was recorded through the N20 larval survey index during the last years. The sustained downward trend in recruitment could explain the further disappearance of older herring in time. The strong correlation of the N20 index with the 1-age group of the GERAS index (Polte et al., 2019) supports this assumption. Methodological biases leading to the low numbers observed can again not be ruled out, but at least in terms of overall acoustic detections of clupeids seem unlikely. Possible shifts in distribution of herring aggregations towards shallower areas would be undetected by the current survey and cannot be disregarded. During the 2019 initial parallel survey of the inner Sound transect with FRV "Solea" and FRV "Clupea" (day and night comparison based on registrations and catches from the regular sampling the night before), different (compared to the night) but consistent (amongst vessels) NASC measurements were made. The difference was observed spatially as well as in terms of somewhat higher NASC levels recorded, albeit the latter does not seem significant based on a preliminary scrutinisation of data. Length-Frequency-Distributions from herring catches made in two daytime hauls from FRV "Clupea" in the Sound (not included in the 2019 analysis, not shown here) show modes at ca. 14, 18 and 24 cm, as opposed to only two modes at 14 and 18 cm in the regular nighttime hauls conducted with FRV "Solea". Accordingly, the fraction of larger herring present in the daytime hauls was not recorded during the regular survey the night before. FRV "Clupea" also conducted a trial hydroacoustic trawl survey in the Sound covering also shallow water areas on east-west transects. Final analysis of both parallel and trial surveys is pending.

Migrations of herring out of the sound can be triggered by hydrographic conditions in a way that barotropic inflow events in late summer and early autumn prevent deoxygenation in the Sound. This leads to prolonged aggregations of herring in the Sound (Miethe et al., 2014). In 2019, no such migration could be assumed since no older and bigger herring were detected in corresponding areas of the adjacent SD 24, nor was there an indication of according hydrographic conditions driving herring out of the Sound.

5 SURVEY PARTICIPANTS

Name	Function	Institute
Dr. M. Schaber (15.-21.10.)	Cruise Leader (Hydroacoustics, Hydrography)	TI-SF
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Dr. A. Velasco (07.-14.10.)	Cruise Leader (Hydrography)	TI-OF
D. Andersen (15.-21.10.)	Fishery biology	DTU Aqua (DK)
M. Koth	Fishery biology	TI-OF
L. S. Lundgaard (02.-14.10.)	Fishery biology	DTU Aqua (DK)
S. Niemann	Fishery biology	TI-OF
S. Winning	Fishery biology, Hydroacoustics	TI-SF

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7 FIGURES

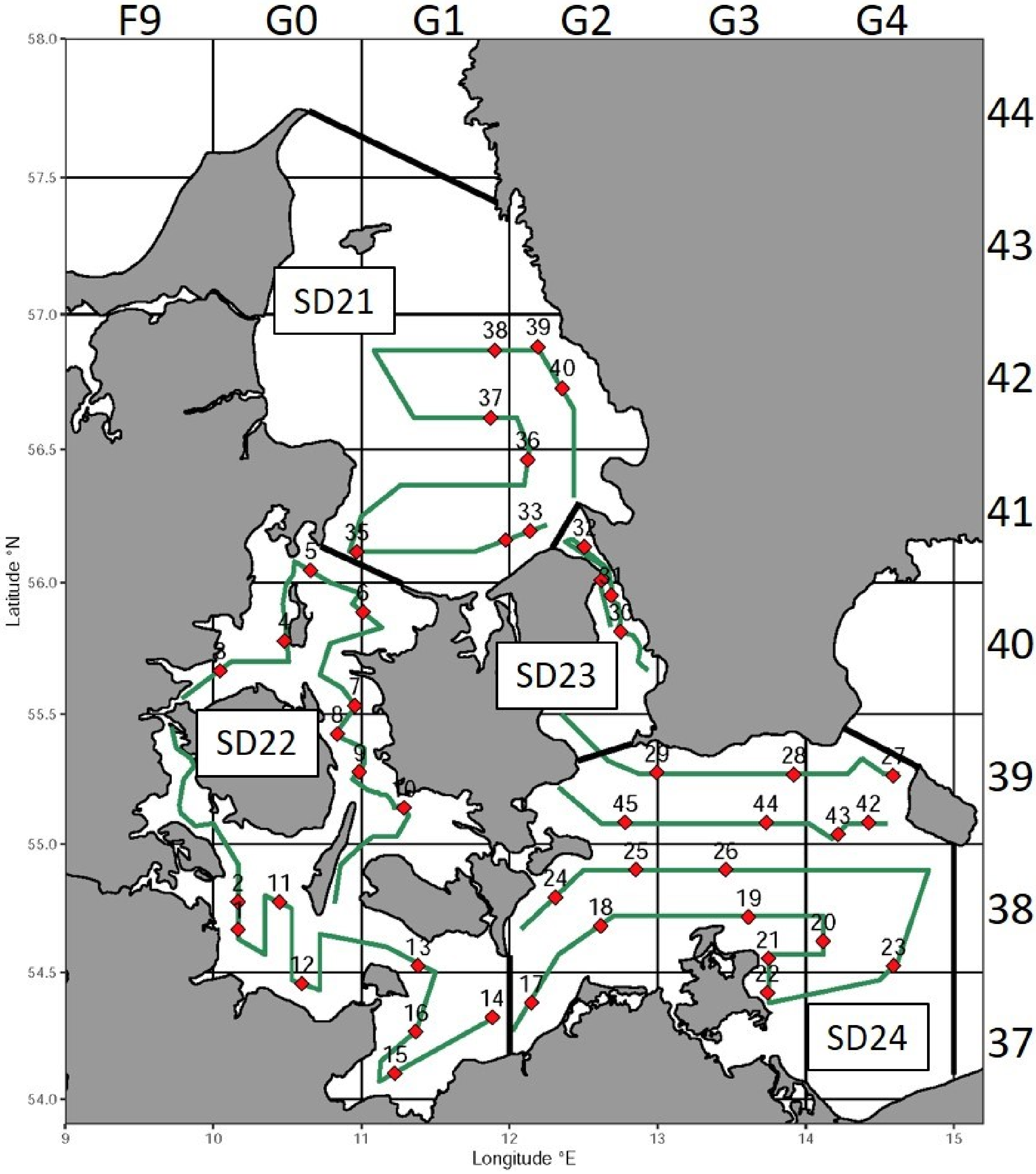

Figure 1: FRV "Solea" cruise 768/2019. Cruise track (dark green lines) and fishery hauls (red diamonds). ICES statistical rectangles are indicated in the top and right axis. Thick black lines separate ICES subdivisions (SD).

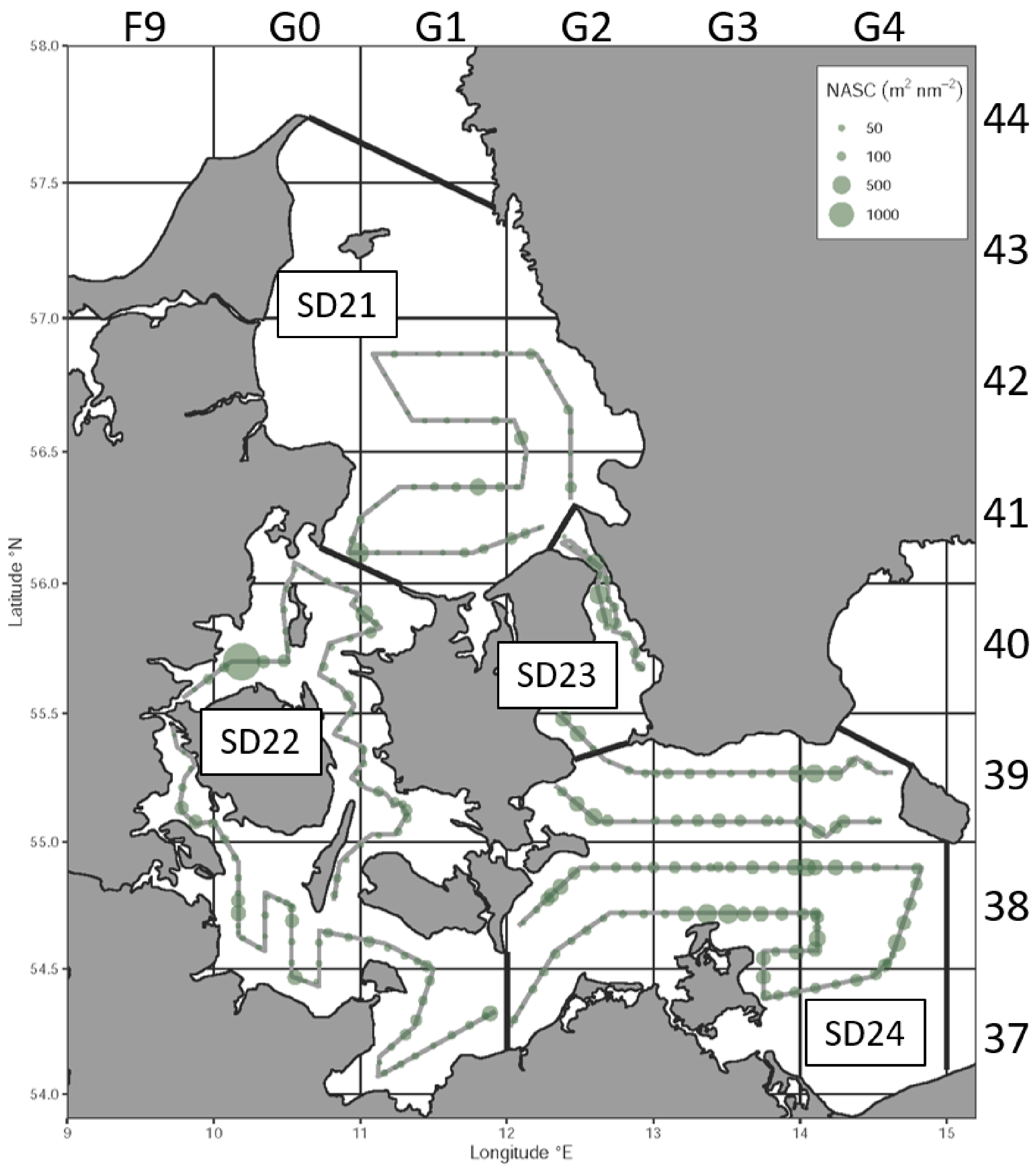

Figure 2: FRV "Solea" cruise 768/2019. Cruise track (thin grey lines) and mean NASC (5 nmi intervals, dots). ICES statistical rectangles are indicated in the top and right axis. Thick black lines separate ICES subdivisions (SD).

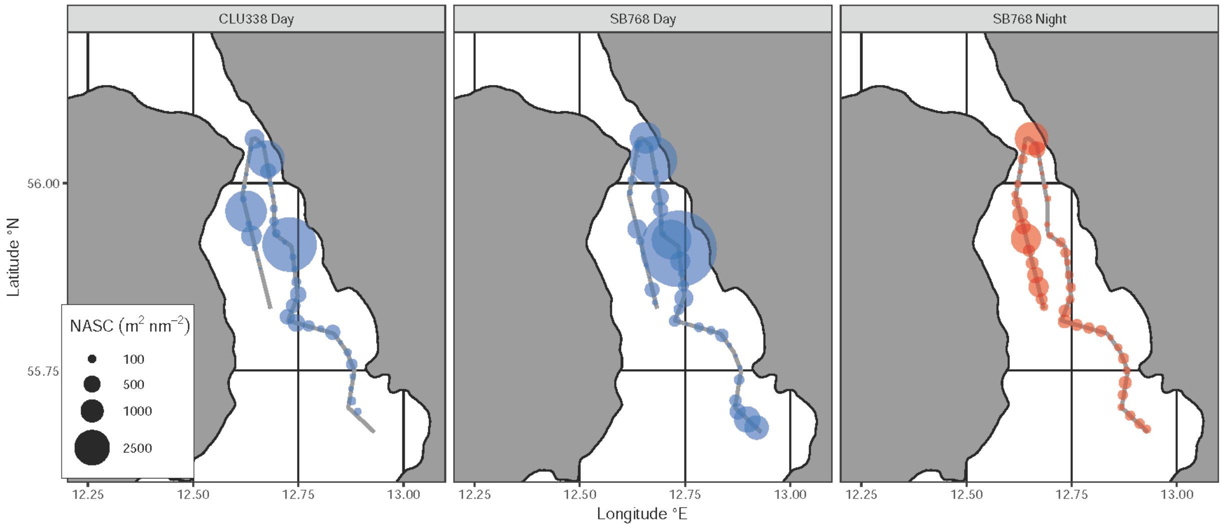

Figure 3: FRV "Solea" cruise 768/2019 and FRV "Clupea" cruise 338/2019: Comparison of clupeid distribution and abundance in the inner Sound (SD 23) 15.-16.10.2019. Cruise tracks (thin grey lines) and mean NASC (1 nmi intervals, dots) measured during daytime (blue dots, left and middle panel) and nighttime (red dots, right panel).

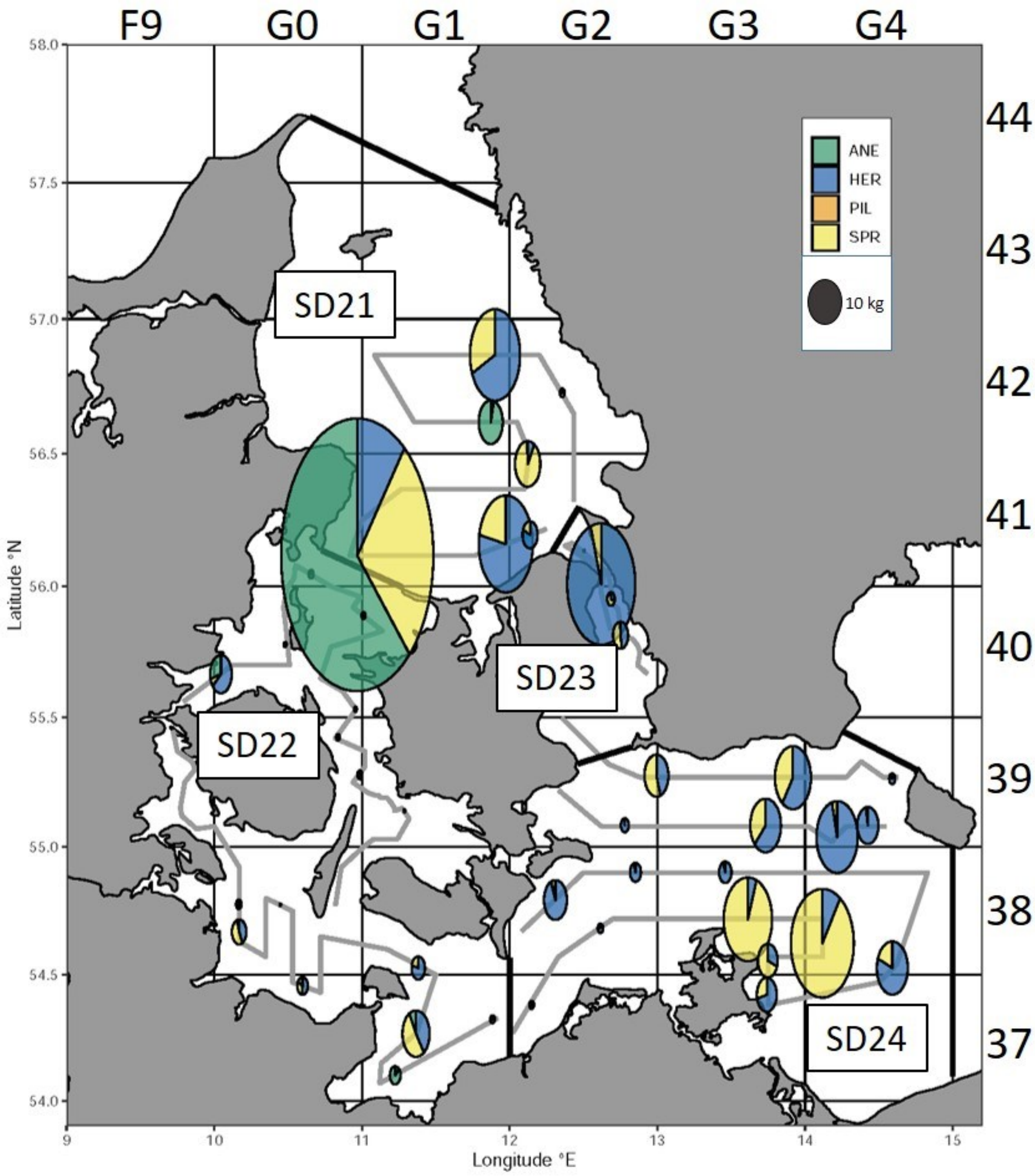

Figure 4: FRV "Solea" cruise 768/2019. Clupeid catch per haul (kg $30min^{-1}$). ANE = European anchovy (*Engraulis encrasicolus*), HER = Herring (*Clupea harengus*), PIL = Sardine (*Sardina pilchardus*), SPR = Sprat (*Sprattus sprattus*). ICES statistical rectangles are indicated in the top and right axis. Thick black lines separate ICES subdivisions (SD). Thin grey lines indicate cruise track.

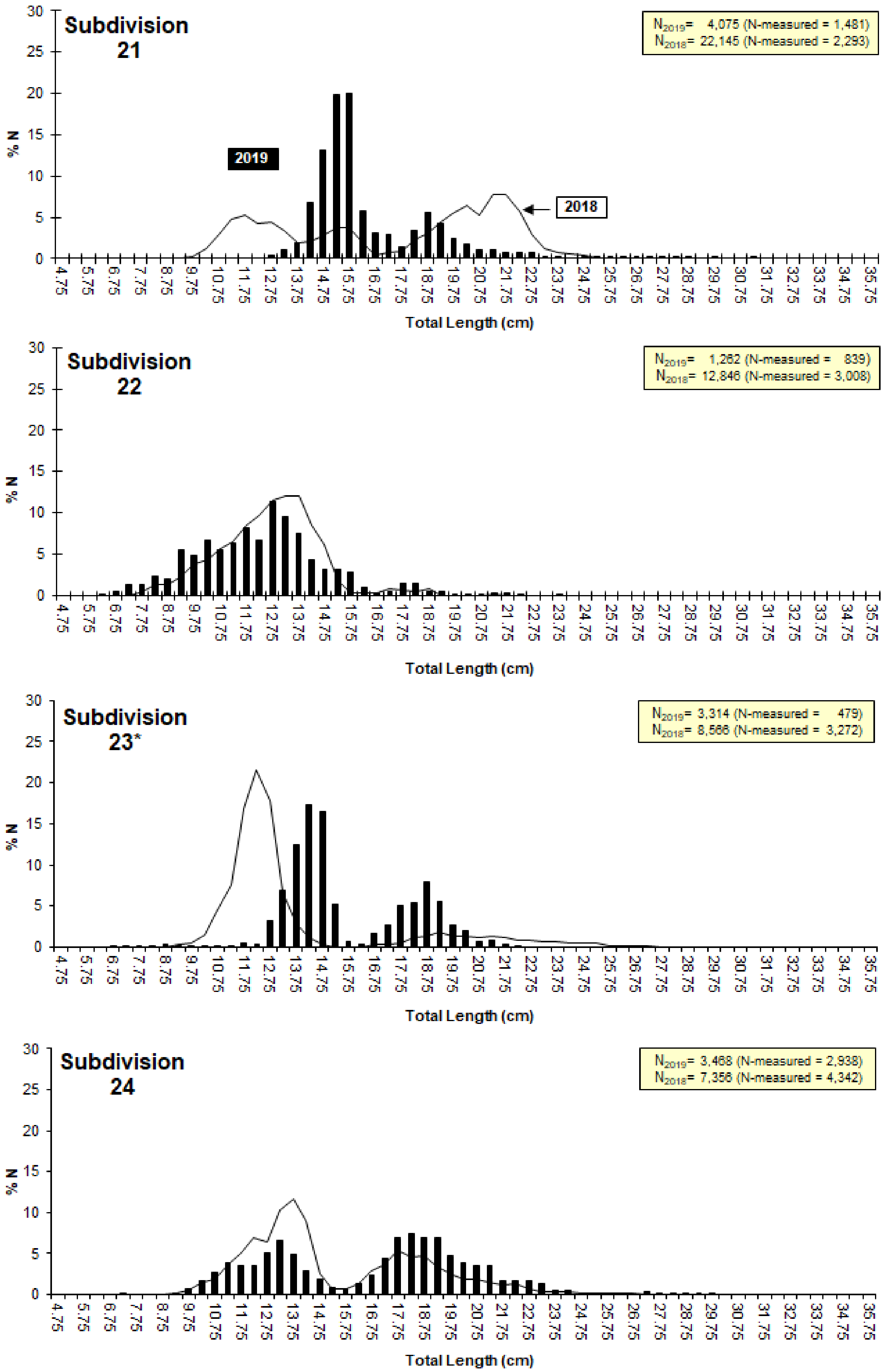

Figure 5: FRV "Solea" cruise 768/2019. Herring (Clupea harengus) length-frequency distribution (bars) compared to the previous year (cruise 754/2018, lines). In 2018, daytime comparison hauls conducted in SD 23 were included.

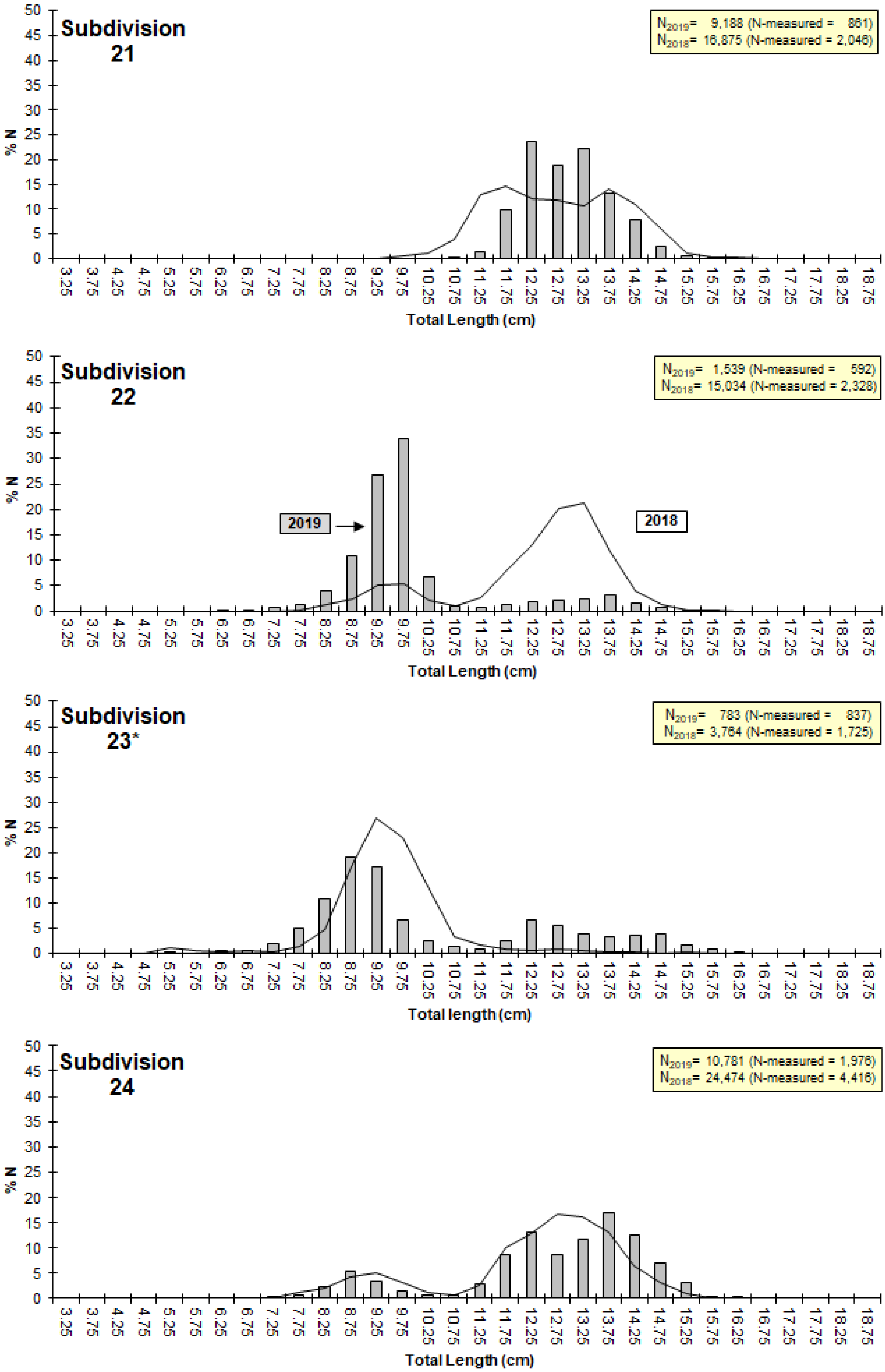

Figure 6: FRV "Solea" cruise 768/2019. Sprat (*Sprattus sprattus*) length-frequency distribution (bars) compared to the previous year (cruise 754/2018, lines). In 2018, daytime comparison hauls conducted in SD 23 were included.

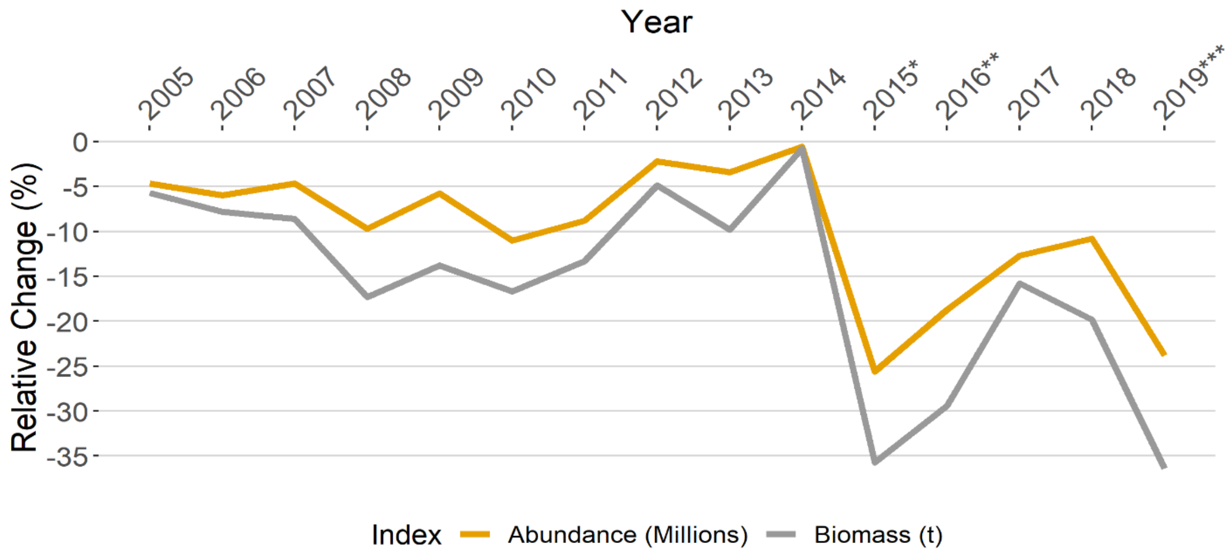

Figure 7: Relative changes in abundance and biomass of Western Baltic Spring Spawning herring in ICES Subdivisions 21-24 (2005-2019) after application of the stock Separation Function (SF, Gröhsler et al., 2013) to the abundance and biomass index generated from German acoustic survey data (GERAS). **2015 excl. of CBH in SD 22 and SD 24 and mature herring (stages ≥6) in SD 23;**2016 excl. of CBH in SD 22 and SD 24; ***2019 excl. of CBH in SDs 21-24.*

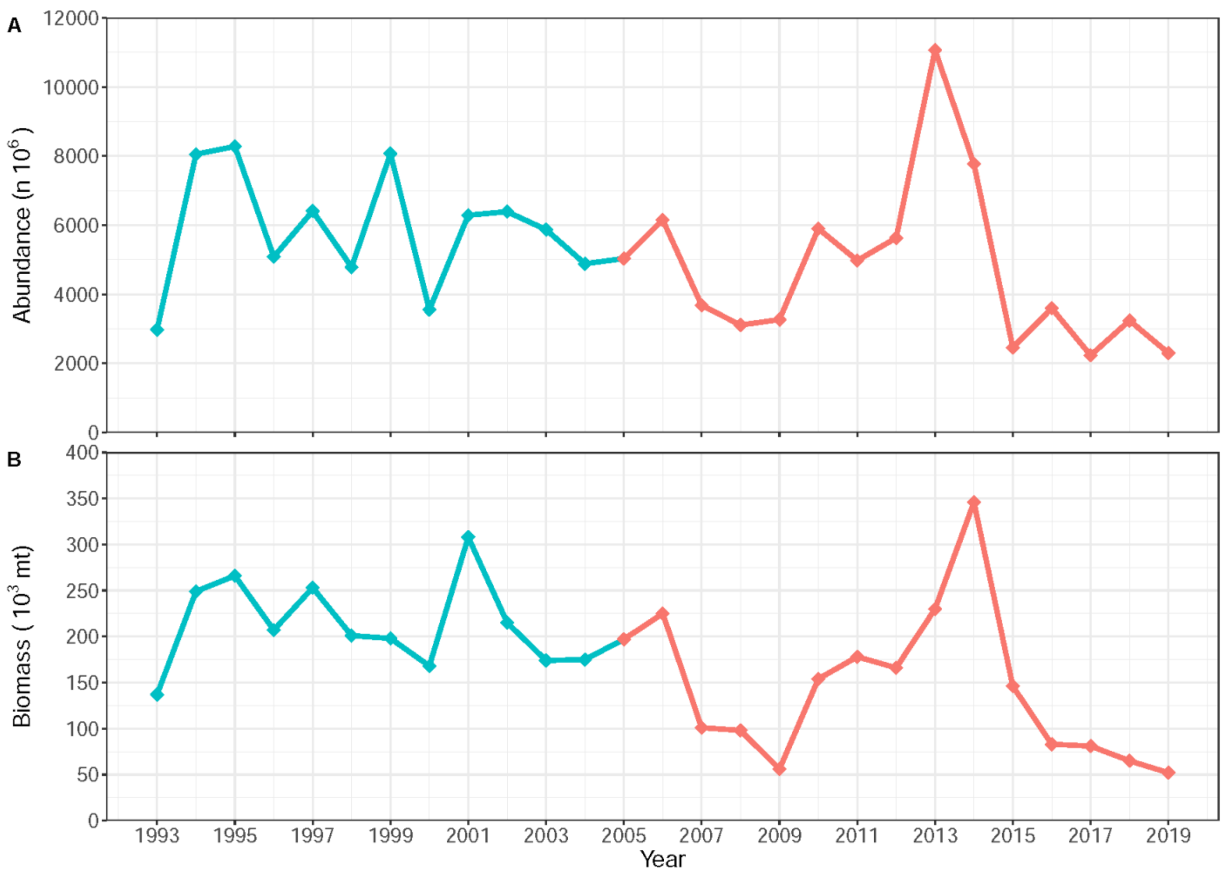

Figure 8: Time series of GERAS survey indices for Western Baltic Spring Spawning Herring (WBSSH) age groups 0-8^+. A) Abundance and B) Biomass of herring in ICES Subdivisions 21 (Southern Kattegat, ICES statistical rectangles 41G0 - 42G2) – 24 (excl. ICES statistical rectangles 37G3 & 37G4). Blue line (until 2005): WBSSH including Central Baltic Herring fraction; Red line (from 2005): WBSSH after application of Separation Function (SF).

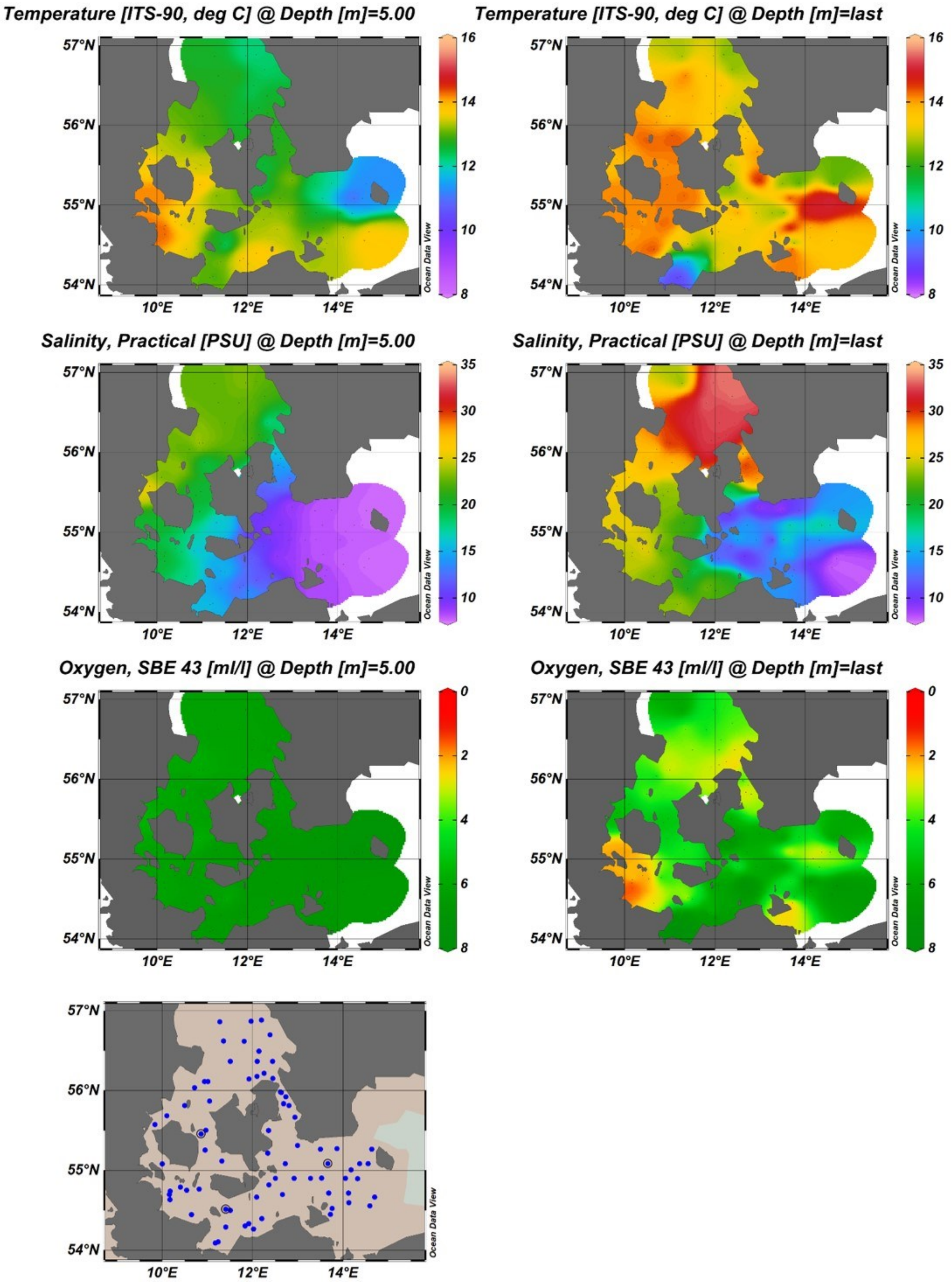

Figure 9: FRV "Solea" cruise 768/2019: Hydrography. CTD stations are depicted as blue dots in the area map (lower panel). Temperature (°C, top panels), salinity (PSU, middle panels and oxygen concentration (ml/l, lower panels) near the surface (left) and near the seafloor (right).

8 TABLES

Table 1: FRV "Solea" cruise 768/2019: Simrad EK80 calibration report (38 kHz Transducer).

Date:	01.10.2019		
Calibration Site:	Strande Bay/Kiel Bight (54°25.35 N, 10°12.29 E)		
Transceiver Type:	WBT		
Software Version:	EK80 1.12.2.0		
Reference Target:	Tungsten (WC-Co) 38.1 mm		
Transducer:	ES38-7 Serial No. 147		
Frequency:	38000 Hz	Beamtype:	Split/Narrow
Gain:	26.66 dB	Equivalent Beam Angle:	-20.7 dB
Beamwidth Athw.:	6.35 deg	Beamwidth Along.:	6.27 deg
Offset Athw.:	0.33 deg	Offset Along.:	-0.26 deg
Depth:	4.20 m		
Pulse Duration:	1.024 ms		
Power:	2000 W		
TS Detection:			
Min. Value:	-50.0 dB	Min. Spacing:	0.0
Max. Gain Comp.:	3.0 dB	Min. Echolength:	0.8
Max. Echolength:	1.8		
Environment:			
Absorption Coeff.:	0.005349	Sound Velocity:	1487.1 m/s
Temperature:	14.4 °C	Salinity:	19.7 PSU
Calibration results:			
Transducer Gain:	26.76 dB	SaCorrection:	-0.14 dB
Beamwidth Athw.:	6.35 deg	Beamwidth Along.:	6.27 deg
Offset Athw.:	0.33 deg	Offset Along.:	-0.26 deg
RMS-Error:	0.13		

Table 2: FRV "Solea" cruise 768/2019: Catch composition (kg 0.5 h^{-1}) by haul in SD 21.

Haul No.	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**	**Total**
Species/ICES Rectangle	**41G2**	**41G1**	**41G0**	**41G2**	**42G1**	**42G1**	**42G2**	**42G2**	
APHIA MINUTA					+		0.22	0.05	**0.27**
CARCINUS							0.01		**0.01**
CLUPEA HARENGUS	3.37	41.85	45.23	0.95	0.17	31.50		0.11	**123.18**
ENGRAULIS ENCRASICOLUS		0.03	263.68	0.05	10.14	0.07			**273.97**
EUTRIGLA GURNARDUS	0.07			0.04					**0.11**
GASTEROSTEUS ACULEATUS								+	**+**
LIMANDA LIMANDA	0.09	0.15							**0.24**
LOLIGO	0.08	0.03	0.03	0.03	0.22	0.01	0.15	0.02	**0.57**
MERLANGIUS MERLANGUS	0.03	0.09		+	0.08	0.05		0.10	**0.35**
MULLUS SURMULETUS	+	0.01							**0.01**
POMATOSCHISTUS MINUTUS	+								**+**
SARDINA PILCHARDUS			0.12						**0.12**
SCOMBER SCOMBRUS		2.95	0.90	0.08	3.26	0.89			**8.08**
SEPIOLA		+							**+**
SPRATTUS SPRATTUS	0.79	11.74	115.88	9.64	0.25	14.48		0.28	**153.06**
TRACHINUS DRACO	2.87	10.62	0.15	0.17	0.55	22.10	0.04	0.11	**36.61**
TRACHURUS TRACHURUS	1.47	0.23	0.21	0.04	0.07	0.06		+	**2.08**
Total	**8.77**	**67.70**	**426.20**	**11.00**	**14.74**	**69.16**	**0.42**	**0.67**	**598.66**
Medusae	1.58	3.02	1.60	1.65	1.71	0.86	4.85	9.90	25.16

+ = < 0.01 kg   Haul 39 not valid

Table 3: FRV "Solea" cruise 768/2019: Catch composition (kg 0.5 h^{-1}) by haul in SD 22.

Haul No.	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
Species/ICES Rectangle	**38G0**	**38G0**	**40G0**	**40G0**	**41G0**	**40G1**	**40G0**	**39G0**	**39G0**	**39G1**	**38G0**	**37G0**	**38G1**
ALLOTEUTHIS					+								
APHIA MINUTA	+	+	0.01	+	+		0.01	+	+	+		+	
BELONE BELONE										0.05			
CLUPEA HARENGUS	1.60	0.23	5.46		0.04	0.02	0.11	0.14	0.10		0.02	1.06	2.61
CRANGON CRANGON							+					+	
CTENOLABRUS RUPESTRIS					+		+						
ENGRAULIS ENCRASICOLUS	0.17	0.01	2.46	0.15	0.38	0.05	0.01	0.07	0.28	0.04	0.02	0.35	0.01
GADUS MORHUA	0.01												
GASTEROSTEUS ACULEATUS	0.71	0.38		+				+		1.70	0.01		+
GOBIUS NIGER	0.02												
LIMANDA LIMANDA	2.29	0.29		0.13	0.08		0.01	0.05	0.03			1.53	1.07
LOLIGO				+		+	0.01	+					
LUMPENUS LAMPRETAEFORMIS	0.02												
MERLANGIUS MERLANGUS	0.04	0.05	0.06		0.01		0.01	0.02			0.04	0.35	0.12
MULLUS SURMULETUS					0.01								
PLATICHTHYS FLESUS	0.12												
PLEURONECTES PLATESSA	0.52												
POMATOSCHISTUS MINUTUS	0.01												
SCOMBER SCOMBRUS					0.13	0.01			0.99		0.18		
SEPIOLA					+								
SPRATTUS SPRATTUS	2.02	0.28	0.60			0.21	0.02	0.02	0.08	0.01		0.59	0.69
SYNGNATHUS				+									
SYNGNATHUS TYPHLE				+	+					+			
TRACHINUS DRACO			0.06	0.02	0.38	0.09	0.25	0.01					
TRACHURUS TRACHURUS			0.08	0.01	0.02	0.05	0.13	0.12	0.09	0.09	+	0.24	0.17
TRISOPTERUS MINUTUS				+									
Total	**7.53**	**1.24**	**8.73**	**0.31**	**1.05**	**0.43**	**0.56**	**0.43**	**1.57**	**1.89**	**0.27**	**4.12**	**4.67**
Medusae	33.53	64.40	17.76	41.95	21.78	14.98	15.93	26.10	12.98	4.81	34.56	34.72	15.30

Haul No.	**14**	**15**	**16**	**Total**
Species/ICES Rectangle	**37G1**	**37G1**	**37G1**	
ALLOTEUTHIS				**+**
APHIA MINUTA				**0.02**
BELONE BELONE				**0.05**
CLUPEA HARENGUS	0.29	0.24	5.42	**17.34**
CRANGON CRANGON				**+**
CTENOLABRUS RUPESTRIS			0.01	**0.01**
ENGRAULIS ENCRASICOLUS	0.04	1.83	1.12	**6.99**
GADUS MORHUA				**0.01**
GASTEROSTEUS ACULEATUS		0.01	0.04	**2.85**
GOBIUS NIGER				**0.02**
LIMANDA LIMANDA			0.11	**5.59**
LOLIGO				**0.01**
LUMPENUS LAMPRETAEFORMIS				**0.02**
MERLANGIUS MERLANGUS		0.01	0.01	**0.72**
MULLUS SURMULETUS				**0.01**
PLATICHTHYS FLESUS			0.37	**0.49**
PLEURONECTES PLATESSA				**0.52**
POMATOSCHISTUS MINUTUS		+		**0.01**
SCOMBER SCOMBRUS				**1.31**
SEPIOLA				**+**
SPRATTUS SPRATTUS	0.03	0.03	6.94	**11.52**
SYNGNATHUS				**+**
SYNGNATHUS TYPHLE				**+**
TRACHINUS DRACO				**0.81**
TRACHURUS TRACHURUS	0.06	0.10	0.36	**1.52**
TRISOPTERUS MINUTUS				**0.00**
Total	**0.42**	**2.22**	**14.38**	**49.82**
Medusae	12.46	17.71	12.79	381.77

+ = < 0.01 kg

Table 4: FRV "Solea" cruise 768/2019: Catch composition (kg 0.5 h^{-1}) by haul in SD 23.

Haul No.	30	31	32	41	Total
Species/ICES Rectangle	40G2	40G2	41G2	41G2	
APHIA MINUTA	0.02	0.00	0.00		**0.02**
CLUPEA HARENGUS	2.00	0.31	0.03	80.66	**83.00**
CRANGON CRANGON		+			**+**
ENGRAULIS ENCRASICOLUS	0.04	0.03		0.02	**0.09**
EUTRIGLA GURNARDUS		0.07		0.42	**0.49**
GADUS MORHUA	15.53	11.24	2.08	7.35	**36.20**
GASTEROSTEUS ACULEATUS	+		+		**+**
LIMANDA LIMANDA			0.03	0.40	**0.43**
LOLIGO	0.03	0.15	0.07	0.03	**0.28**
MELANOGRAMMUS AEGLEFINUS		8.09			**8.09**
MERLANGIUS MERLANGUS	0.11	0.01		1.96	**2.08**
MYSIDACEA		+			**+**
POMATOSCHISTUS MINUTUS	+				**+**
SARDINA PILCHARDUS	0.01			0.01	**0.02**
SCOPHTHALMUS RHOMBUS	0.39			0.21	**0.60**
SEPIOLA		0.02	0.01	0.01	**0.04**
SPRATTUS SPRATTUS	2.16	0.71		4.26	**7.13**
SYMPHODUS MELOPS				0.05	**0.05**
TRACHINUS DRACO	0.02	0.03	0.06	0.01	**0.12**
TRACHURUS TRACHURUS	0.09	0.08	0.02	0.28	**0.47**
Total	**20.40**	**20.74**	**2.30**	**95.67**	**139.11**
Medusae	2.04	1.99	3.45	0.38	**7.86**

+ = < 0.01 kg

Table 5: FRV "Solea" cruise 768/2019: Catch composition (kg 0.5 h^{-1}) by haul in SD 24.

Haul No.	17	18	19	20	21	22	23	24	25	26	27	28	29
Species/ICES Rectangle	37G2	38G2	38G3	38G4	38G3	37G3	38G4	38G2	38G2	38G3	39G4	39G3	39G2
APHIA MINUTA			+					+	+				
CLUPEA HARENGUS	0.13	0.52	2.49	6.95	2.14	5.11	14.13	8.99	2.07	2.63	0.68	14.26	4.69
CRANGON CRANGON			+		+								
CYCLOPTERUS LUMPUS	0.24												
ENGRAULIS ENCRASICOLUS	0.25	0.02	0.07		0.02	+	0.03	0.10	0.04	0.01			
GADUS MORHUA		0.02			3.75	9.27	0.47					7.23	
GASTEROSTEUS ACULEATUS	0.01	+	+					0.18	0.06	0.17	0.01		+
MERLANGIUS MERLANGUS	0.01		10.04		1.61	5.44		0.08	+	0.19		1.55	0.38
PLATICHTHYS FLESUS		0.58	0.83		0.10		0.27		0.35	0.17	0.51		
PLEURONECTES PLATESSA													
POMATOSCHISTUS MINUTUS			0.02		+					+			+
SCOMBER SCOMBRUS			1.05										
SPRATTUS SPRATTUS	0.02		40.36	65.76	4.84	2.06	3.33	0.52	0.07	0.17		9.48	5.83
TRACHURUS TRACHURUS	0.06	0.02	0.01		0.01	0.01	+	0.02	0.02	0.01	0.01		
Total	**0.72**	**1.16**	**54.87**	**72.71**	**12.47**	**21.89**	**18.23**	**9.89**	**2.61**	**3.35**	**1.21**	**32.52**	**10.90**
Medusae	12.22	17.35	12.32	27.58	11.21	3.84	18.03	19.17	4.15	10.77	6.97	3.16	7.36

Haul No.	42	43	44	45	Total
Species/ICES Rectangle	39G4	39G4	39G3	39G2	
APHIA MINUTA			0.01	0.01	**0.02**
CLUPEA HARENGUS	7.96	29.86	10.86	1.15	**114.62**
CRANGON CRANGON		+	+		**+**
CYCLOPTERUS LUMPUS					**0.24**
ENGRAULIS ENCRASICOLUS	0.09		0.02	0.02	**0.67**
GADUS MORHUA	0.30	+	0.42	0.04	**21.50**
GASTEROSTEUS ACULEATUS		+	+	0.09	**0.52**
MERLANGIUS MERLANGUS			1.85		**21.15**
PLATICHTHYS FLESUS		0.17	0.57	0.87	**4.42**
PLEURONECTES PLATESSA			0.30		**0.30**
POMATOSCHISTUS MINUTUS	+	0.03	0.02	+	**0.07**
SCOMBER SCOMBRUS	0.30				**1.35**
SPRATTUS SPRATTUS	0.16	1.26	6.45	0.02	**140.33**
TRACHURUS TRACHURUS	0.01			0.01	**0.19**
Total	**8.82**	**31.32**	**20.50**	**2.21**	**305.38**
Medusae	6.80	0.83	5.15	9.47	**176.37**

+ = < 0.01 kg

Table 6: FRV "Solea", cruise 768/2019. Survey statistics by area.

Sub-division	ICES Rectangle	Area (nm²)	Sa (m²/NM²)	Sigma (cm²)	N total (million)	Herring (%)	Sprat (%)	NHerring (million)	NSprat (million)
21	41G0	108.1	339.8	1.703	215.69	6.28	26.40	13.55	56.94
21	41G1	946.8	84.8	3.339	240.46	45.44	35.14	109.26	84.50
21	41G2	432.3	56.2	1.834	132.47	11.85	50.15	15.69	66.44
21	42G1	884.2	26.5	3.233	72.48	56.18	30.37	40.72	22.01
21	42G2	606.8	93.1	0.526	1074.01	1.50	8.00	16.11	85.92
21	**Total**	**2,978.2**			**1735.11**			**195.33**	**315.81**
22	37G0	209.9	107.6	1.518	148.78	20.27	14.86	30.16	22.12
22	37G1	723.3	90.9	0.976	673.65	28.34	58.98	190.90	397.30
22	38G0	735.3	87.8	0.833	775.02	20.03	26.26	155.23	203.53
22	38G1	173.2	93.1	1.472	109.54	60.81	20.95	66.61	22.94
22	39F9	159.3	121.2	0.934	206.71	7.61	6.72	15.74	13.90
22	39G0	201.7	58.5	0.934	126.33	7.61	6.72	9.62	8.49
22	39G1	250.0	96.3	0.288	835.94	0.00	0.22	0.00	1.85
22	40F9	51.3	97.0	1.590	31.30	49.48	10.24	15.49	3.21
22	40G0	538.1	245.0	1.590	829.15	49.48	10.24	410.26	84.93
22	40G1	174.5	185.1	1.230	262.60	2.44	34.15	6.40	89.67
22	41G0	173.1	28.3	2.207	22.20	1.59	0.00	0.35	0.00
22	**Total**	**3,389.7**			**4021.22**			**900.76**	**847.94**
23	39G2	130.9	278.5	1.016	358.82	13.72	86.00	49.22	308.58
23	40G2	164.0	230.2	3.417	110.49	13.12	63.32	14.49	69.96
23	41G2	72.3	112.0	2.499	32.40	90.68	7.29	29.38	2.36
23	**Total**	**367.2**			**501.71**			**93.09**	**380.90**
24	37G2	192.4	80.4	0.955	161.98	8.96	1.49	14.51	2.42
24	37G3	167.7	199.6	4.300	77.84	34.56	56.09	26.90	43.66
24	37G4	875.1	162.2	2.181	650.81	34.41	65.28	223.91	424.86
24	38G2	832.9	126.8	1.375	768.09	67.57	9.61	519.02	73.83
24	38G3	865.7	274.8	1.771	1343.28	24.00	59.05	322.34	793.27
24	38G4	1034.8	250.0	2.181	1186.15	34.41	65.28	408.10	774.33
24	39G2	406.1	166.7	1.016	666.31	13.72	86.00	91.40	573.02
24	39G3	765.0	152.1	2.581	450.82	42.98	54.79	193.76	247.00
24	39G4	524.8	251.6	3.448	382.95	71.96	6.68	275.58	25.57
24	**Total**	**5,664.5**			**5,688.23**			**2075.52**	**2957.96**
22-24	**Total**	**9,421.4**			**10,211.16**			**3069.37**	**4186.80**
21-24	**Total**	**12,399.6**			**11,946.27**			**3264.70**	**4502.61**

Table 7: FRV "Solea", cruise 768/2019. Numbers (millions) of herring incl. CBH by age/W-rings and area.

Sub-division	Rectangle/ W-rings	0	1	2	3	4	5	6	7	8+	Total
21	41G0	11.16	1.71	0.23	0.21	0.12	0.11	0.01			13.55
21	41G1	21.38	56.89	14.73	6.94	2.47	5.24	1.60			109.25
21	41G2	8.31	5.34	0.89	0.51	0.13	0.40	0.12			15.70
21	42G1	38.05	2.11	0.08	0.30	0.11	0.06				40.71
21	42G2	2.35	10.64	0.65	0.92	0.34	0.90	0.32			16.12
21	Total	81.25	76.69	16.58	8.88	3.17	6.71	2.05	0.00	0.00	195.33
22	37G0	21.77	7.22		0.37	0.24	0.56				30.16
22	37G1	190.90									190.90
22	38G0	137.41	10.67	1.72	1.24	2.85	0.77	0.57			155.23
22	38G1	62.17	2.64	0.37	0.65	0.41		0.37			66.61
22	39F9	8.66	3.33	0.98	2.14	0.52	0.10				15.73
22	39G0	5.29	2.04	0.60	1.31	0.32	0.06				9.62
22	39G1										0.00
22	40F9	14.41	0.95		0.03	0.01	0.08				15.48
22	40G0	381.77	25.15		0.79	0.31	2.25				410.27
22	40G1	6.40									6.40
22	41G0		0.30		0.02		0.02				0.34
22	Total	828.78	52.30	3.67	6.55	4.66	3.84	0.94	0.00	0.00	900.74
23	39G2	30.69	2.37	3.53	2.51	2.67	5.85	0.90	0.60	0.09	49.21
23	40G2	11.19	2.44	0.41	0.13	0.16	0.09			0.06	14.48
23	41G2	19.06	7.39	1.44	0.47	0.56	0.46				29.38
23	Total	60.94	12.20	5.38	3.11	3.39	6.40	0.90	0.60	0.15	93.07
24	37G2	9.67	0.81	0.48	0.97	0.48	1.61	0.48			14.50
24	37G3	5.73	1.29	4.44	3.56	3.09	5.71	1.80	0.82	0.45	26.89
24	37G4	69.58	20.20	28.74	25.15	24.37	42.64	7.19	4.82	1.24	223.93
24	38G2	376.21	26.93	22.87	21.00	23.24	41.23	3.12	4.40	0.04	519.04
24	38G3	190.53	13.85	25.57	17.61	21.70	41.12	5.56	5.06	1.34	322.34
24	38G4	126.81	36.82	52.39	45.83	44.42	77.71	13.10	8.78	2.25	408.11
24	39G2	57.00	4.41	6.56	4.66	4.96	10.86	1.68	1.11	0.16	91.40
24	39G3	70.08	11.52	25.70	17.91	19.06	39.06	5.59	4.01	0.83	193.76
24	39G4	15.31	12.40	46.16	41.49	46.19	70.53	27.01	10.94	5.54	275.57
24	Total	920.92	128.23	212.91	178.18	187.51	330.47	65.53	39.94	11.85	2 075.54
22-24	Total	1 810.64	192.73	221.96	187.84	195.56	340.71	67.37	40.54	12.00	3 069.35
21-24	Total	1 891.89	269.42	238.54	196.72	198.73	347.42	69.42	40.54	12.00	3 264.68

Table 8: FRV "Solea", cruise 768/2019. Mean weight (g) of herring incl. CBH by age/W-rings and area.

Sub-division	Rectangle/ W-rings	0	1	2	3	4	5	6	7	8+	Total
21	41G0	23.60	40.19	56.50	41.37	36.85	46.03	45.79			26.84
21	41G1	22.78	47.55	67.23	68.49	85.25	69.22	88.90			49.18
21	41G2	21.69	44.95	58.01	49.15	37.05	46.35	45.79			33.49
21	42G1	21.93	35.06	33.80	30.38	34.74	40.22				22.76
21	42G2	32.80	42.11	39.10	40.27	32.80	44.99	45.79			40.56
21	Total	22.67	46.11	65.32	62.53	74.06	63.97	79.44			40.15
22	37G0	19.09	35.26		36.07	34.47	36.46				23.61
22	37G1	10.20									10.20
22	38G0	7.69	39.61	55.50	54.90	50.61	40.61	53.50			11.91
22	38G1	13.07	39.10	53.50	58.08	53.46	0.00	53.50			15.24
22	39F9	9.31	43.23	71.00	66.81	65.67	38.94				30.21
22	39G0	9.31	43.23	71.00	66.81	65.67	38.94				30.24
22	39G1										0.00
22	40F9	17.10	36.98		37.19	34.47	38.69				18.48
22	40G0	17.10	36.98		37.19	34.47	38.69				18.49
22	40G1	18.42									18.42
22	41G0		38.94		38.94	0.00	38.94				38.94
22	Total	13.58	38.04	61.97	58.16	51.64	38.76	53.50			15.87
23	39G2	14.48	33.34	41.48	39.20	39.35	40.55	49.87	45.42	59.30	24.14
23	40G2	10.69	40.10	41.78	43.82	41.22	36.89			61.00	17.53
23	41G2	17.49	39.43	42.92	43.00	41.16	37.89				25.43
23	Total	14.73	38.38	41.89	39.97	39.74	40.31	49.87	45.42	59.98	23.52
24	37G2	11.79	32.89	37.88	42.87	42.87	41.87	42.87			21.31
24	37G3	9.07	34.37	52.95	54.79	52.99	46.22	62.20	57.02	70.50	42.56
24	37G4	13.77	33.37	42.11	41.37	40.84	40.55	66.41	45.88	63.18	32.98
24	38G2	9.42	33.59	34.90	33.42	35.19	36.32	36.58	37.55	64.05	16.46
24	38G3	11.04	33.63	43.37	41.62	42.69	40.97	55.21	46.96	70.94	23.77
24	38G4	13.77	33.37	42.11	41.37	40.84	40.55	66.41	45.88	63.18	32.97
24	39G2	14.48	33.34	41.48	39.20	39.35	40.55	49.87	45.42	59.30	24.14
24	39G3	15.96	33.35	44.11	41.84	42.24	42.23	57.01	48.27	61.01	33.05
24	39G4	16.64	34.57	52.86	64.14	73.48	68.36	110.97	70.81	75.03	66.00
24	Total	11.64	33.56	44.26	46.03	48.70	46.31	80.89	52.38	69.67	31.46
22-24	Total	12.63	35.08	44.49	46.35	48.62	46.11	80.10	52.28	69.55	26.64
21-24	Total	13.06	38.22	45.94	47.08	49.02	46.46	80.08	52.28	69.55	27.45

Table 9: FRV “Solea”, cruise 768/2019. Total biomass (t) of herring incl. CBH by age/W-rings and area.

Sub-division	Rectangle/ W-rings	0	1	2	3	4	5	6	7	8+	Total
21	41G0	263.4	68.7	13.0	8.7	4.4	5.1	0.5			363.7
21	41G1	487.0	2 705.1	990.3	475.3	210.6	362.7	142.2			5 373.3
21	41G2	180.2	240.0	51.6	25.1	4.8	18.5	5.5			525.8
21	42G1	834.4	74.0	2.7	9.1	3.8	2.4				926.5
21	42G2	77.1	448.1	25.4	37.1	11.2	40.5	14.7			653.9
21	Total	1 842.2	3 535.9	1 083.1	555.2	234.8	429.2	162.8	0.0	0.0	7 843.2
22	37G0	415.6	254.6		13.4	8.3	20.4				712.2
22	37G1	1 947.2									1 947.2
22	38G0	1 056.7	422.6	95.5	68.1	144.2	31.3	30.5			1 848.9
22	38G1	812.6	103.2	19.8	37.8	21.9		19.8			1 015.0
22	39F9	80.6	144.0	69.6	143.0	34.2	3.9				475.2
22	39G0	49.3	88.2	42.6	87.5	21.0	2.3				290.9
22	39G1										0.0
22	40F9	246.4	35.1		1.1	0.3	3.1				286.1
22	40G0	6 528.3	930.1		29.4	10.7	87.1				7 585.4
22	40G1	117.9									117.9
22	41G0		11.7		0.8		0.8				13.2
22	Total	11 254.5	1 989.5	227.4	381.0	240.6	148.9	50.28	0.00	0.0	14 292.0
23	39G2	444.4	79.0	146.4	98.4	105.1	237.2	44.9	27.25	5.3	1 188.0
23	40G2	119.6	97.8	17.1	5.7	6.6	3.3			3.7	253.9
23	41G2	333.4	291.4	61.8	20.2	23.1	17.4				747.2
23	Total	897.4	468.3	225.4	124.3	134.7	258.0	44.9	27.3	9.0	2 189.1
24	37G2	114.0	26.6	18.2	41.6	20.6	67.4	20.6			309.0
24	37G3	52.0	44.3	235.1	195.1	163.7	263.9	112.0	46.8	31.7	1 144.6
24	37G4	958.1	674.1	1 210.2	1 040.5	995.3	1 729.1	477.5	221.1	78.3	7 384.2
24	38G2	3 543.9	904.6	798.2	701.8	817.8	1 497.5	114.1	165.2	2.6	8 545.7
24	38G3	2 103.5	465.8	1 109.0	732.9	926.4	1 684.7	307.0	237.6	95.1	7 661.8
24	38G4	1 746.2	1 228.7	2 206.1	1 896.0	1 814.1	3 151.1	870.0	402.8	142.2	13 457.2
24	39G2	825.4	147.0	272.1	182.7	195.2	440.4	83.8	50.4	9.5	2 206.4
24	39G3	1 118.5	384.2	1 133.6	749.4	805.1	1 649.5	318.7	193.6	50.6	6 403.1
24	39G4	254.8	428.7	2 440.0	2 661.2	3 394.0	4 821.4	2 997.3	774.7	415.7	18 187.7
24	Total	10 716.2	4 304.0	9 422.6	8 201.0	9 132.2	15 305.0	5 300.9	2 092.2	825.7	65 299.7
22-24	Total	22 868.0	6 761.7	9 875.3	8 706.3	9 507.5	15 711.8	5 396.0	2 119.5	834.7	81 780.8
21-24	Total	24 710.2	10 297.6	10 958.4	9 261.5	9 742.3	16 141.0	5 558.9	2 119.5	834.7	89 624.0

Table 10: FRV “Solea”, cruise 768/2019. Numbers (millions) of sprat by age and area.

Sub-division	Rectangle/ W-rings	0	1	2	3	4	5	6	7	8+	Total
21	41G0		25.17	24.71	5.10	1.92		0.03			56.93
21	41G1		27.33	41.41	8.52	7.00		0.23			84.49
21	41G2		28.27	29.20	5.75	3.10		0.12			66.44
21	42G1		3.76	11.45	3.46	3.18		0.17			22.02
21	42G2		37.58	39.23	7.85	1.26					85.92
21	Total	0.00	122.11	146.00	30.68	16.46	0.00	0.55	0.00	0.00	315.80
22	37G0	0.67	4.81	9.39	3.36	3.29	0.60				22.12
22	37G1	395.81	1.49								397.30
22	38G0	84.79	53.66	38.99	12.28	10.94	2.87				203.53
22	38G1	12.58	2.24	5.02	1.37	1.51	0.22				22.94
22	39F9	5.79	1.07	4.19	1.24	1.26	0.35				13.90
22	39G0	3.54	0.65	2.56	0.76	0.77	0.21				8.49
22	39G1	1.85									1.85
22	40F9	1.95	0.92	0.21	0.07	0.05	0.01				3.21
22	40G0	51.70	24.42	5.44	1.94	1.22	0.22				84.94
22	40G1	8.72	44.17	21.92	7.23	6.66	0.96				89.66
22	41G0										0.00
22	Total	567.40	133.43	87.72	28.25	25.70	5.44	0.00	0.00	0.00	847.94
23	39G2	289.70	8.78	3.02	3.21	2.88	0.90	0.10			308.59
23	40G2	68.20	0.82	0.53	0.19	0.13	0.06	0.02	0.01		69.96
23	41G2	0.10	0.59	0.77	0.44	0.25	0.10	0.07	0.04	0.01	2.37
23	Total	358.00	10.19	4.32	3.84	3.26	1.06	0.19	0.05	0.01	380.92
24	37G2			0.36	0.85	1.21					2.42
24	37G3	13.73	15.71	4.41	4.41	4.33	1.02	0.05			43.66
24	37G4	13.28	50.48	68.27	115.61	132.47	32.35	9.57	2.84		424.87
24	38G2	72.11	0.63	0.33	0.39	0.22	0.14	0.02			73.84
24	38G3	92.53	362.59	97.43	109.05	101.10	26.62	3.80	0.14		793.26
24	38G4	24.21	92.00	124.42	210.70	241.43	58.96	17.44	5.18		774.34
24	39G2	537.95	16.30	5.60	5.96	5.35	1.66	0.19			573.01
24	39G3		24.18	40.43	72.69	82.24	19.99	6.41	1.06		247.00
24	39G4	0.30	3.84	3.99	6.63	7.48	2.36	0.80	0.17		25.57
24	Total	754.11	565.73	345.24	526.29	575.83	143.10	38.28	9.39	0.00	2,957.97
22-24	Total	1,679.51	709.35	437.28	558.38	604.79	149.60	38.47	9.44	0.01	4,186.83
21-24	Total	1,679.51	831.46	583.28	589.06	621.25	149.60	39.02	9.44	0.01	4,502.63

Table 11: FRV "Solea", cruise 768/2019. Mean weight (g) of sprat by age and area.

Sub-division	Rectangle/ Age group	0	1	2	3	4	5	6	7	8+	Total
21	41G0		14.89	17.50	18.20	20.25		22.73			16.51
21	41G1		15.28	18.42	19.30	20.85		22.73			17.71
21	41G2		14.86	17.80	19.06	21.07		22.73			16.82
21	42G1		15.28	19.69	20.68	22.02		22.73			19.45
21	42G2		15.76	16.95	17.47	19.81					16.52
21	Total		15.25	17.84	18.76	20.97		22.73			17.10
22	37G0	4.96	15.66	18.30	18.44	18.78	18.43				17.42
22	37G1	6.09	9.11								6.10
22	38G0	5.25	14.05	17.08	17.36	17.88	18.96				11.44
22	38G1	5.99	15.83	17.63	18.09	18.11	18.43				11.14
22	39F9	3.07	17.61	17.87	18.17	18.00	18.15				11.73
22	39G0	3.07	17.61	17.87	18.17	18.00	18.15				11.73
22	39G1	3.98									3.98
22	40F9	6.69	13.47	16.19	17.17	17.94	18.99				9.68
22	40G0	6.69	13.47	16.19	17.17	17.94	18.99				9.68
22	40G1	9.37	12.39	17.28	18.56	19.07	18.99				14.35
22	41G0										
22	Total	6.01	13.47	17.30	17.87	18.33	18.80				9.20
23	39G2	4.44	10.4	13.93	14.69	14.68	14.65	16.91			4.94
23	40G2	5.03	12.59	15.73	18.03	20.71	23.00	21.15	18.89		5.28
23	41G2	5.28	14.17	16.36	18.69	19.88	22.93	22.29	21.60	24.71	16.74
23	Total	4.55	10.79	14.58	15.31	15.32	15.90	19.34	21.06	24.71	5.08
24	37G2			15.74	15.74	15.74					15.74
24	37G3	5.06	11.59	13.37	13.99	13.98	14.30	17.45			10.27
24	37G4	6.67	12.15	15.18	15.94	16.38	16.60	17.80	20.78		15.34
24	38G2	5.34	7.34	15.10	15.20	15.77	15.06	16.91			5.50
24	38G3	5.66	11.17	13.62	14.47	14.75	15.01	17.43	19.70		11.90
24	38G4	6.67	12.15	15.18	15.94	16.38	16.60	17.80	20.78		15.34
24	39G2	4.44	10.40	13.93	14.69	14.68	14.65	16.91			4.94
24	39G3		12.16	15.26	16.06	16.41	16.74	17.85	19.70		15.78
24	39G4	5.11	11.48	15.12	16.29	16.78	16.92	17.83	19.70		15.53
24	Total	4.80	11.45	14.71	15.63	16.07	16.29	17.77	20.62		12.12
22-24	Total	5.15	11.82	15.23	15.74	16.16	16.38	17.77	20.66	24.71	10.89
21-24	Total	5.15	12.32	15.88	15.90	16.29	16.38	17.84	20.66	24.71	11.32

Table 12: FRV "Solea", cruise 768/2019. Total biomass (t) of sprat by age and area.

Sub-division	Rectangle/ Age group	0	1	2	3	4	5	6	7	8+	Total
21	41G0		374.9	432.5	92.8	38.9		0.7			939.9
21	41G1		417.6	762.9	164.3	146.1		5.3			1,496.2
21	41G2		420.1	519.6	109.7	65.4		2.7			1,117.5
21	42G1		57.4	225.4	71.5	70.1		3.8			428.1
21	42G2		592.3	665.0	137.2	25.0					1,419.5
21	Total	0.0	1,862.2	2,605.4	575.5	345.5	0.0	12.6	0.0	0.0	5,401.1
22	37G0	3.3	75.3	171.9	61.9	61.8	11.1				385.3
22	37G1	2,410.0	13.6								2,423.6
22	38G0	445.3	753.7	666.1	213.1	195.6	54.5				2,328.3
22	38G1	75.3	35.4	88.4	24.8	27.4	4.1				255.4
22	39F9	17.8	18.8	74.9	22.5	22.7	6.3				163.0
22	39G0	10.9	11.5	45.8	13.7	13.9	3.9				99.6
22	39G1	7.4									7.4
22	40F9	13.1	12.4	3.3	1.3	0.8	0.2				31.1
22	40G0	346.0	329.0	88.0	33.4	21.8	4.1				822.3
22	40G1	81.7	547.1	378.8	134.3	127.1	18.2				1,287.1
22	41G0										0.0
22	Total	3,410.6	1,796.8	1,517.2	505.0	471.1	102.4	0.0	0.0	0.0	7,803.0
23	39G2	1,285.4	91.3	42.0	47.1	42.3	13.1	1.7			1,523.0
23	40G2	342.9	10.4	8.3	3.4	2.6	1.3	0.5	0.3		369.6
23	41G2	0.5	8.3	12.6	8.1	5.0	2.3	1.5	0.9	0.2	39.5
23	Total	1,628.7	110.0	63.0	58.7	50.0	16.7	3.7	1.2	0.2	1,932.2
24	37G2			5.7	13.3	19.0					38.1
24	37G3	69.5	182.1	58.9	61.7	60.6	14.6	0.9	0.0		448.3
24	37G4	88.6	613.4	1,036.6	1,843.3	2,169.4	537.1	170.2	59.1		6,517.6
24	38G2	384.9	4.6	4.9	6.0	3.5	2.1	0.3			406.3
24	38G3	524.0	4,049.3	1,327.3	1,577.7	1,491.5	399.5	66.3	2.8		9,438.4
24	38G4	161.5	1,117.9	1,889.2	3,359.6	3,953.8	978.8	310.3	107.7		11,878.6
24	39G2	2,386.9	169.6	78.1	87.5	78.6	24.4	3.2			2,828.2
24	39G3		294.1	617.2	1,167.1	1,349.5	334.5	114.3	21.0		3,897.7
24	39G4	1.5	44.2	60.3	108.0	125.5	39.9	14.3	3.4		397.0
24	Total	3,616.9	6,475.1	5,078.1	8,224.2	9,251.4	2,330.8	679.9	193.9	0.0	35,850.1
22-24	Total	8,656.3	8,381.9	6,658.3	8,787.9	9,772.4	2,449.9	683.5	195.1	0.2	45,585.3
21-24	Total	8,656.3	10,244.1	9,263.7	9,363.4	10,117.9	2,449.9	696.1	195.1	0.2	50,986.5

Table 13: FRV "Solea", cruise 768/2019. Numbers (m) of herring excl. CBH in SDs 21-24 by age/W-rings & area.

Sub-division	Rectangle/ W-rings	0	1	2	3	4	5	6	7	8+	Total	
21	41G0	11.16	1.71	0.17	0.05						13.09	
21	41G1	21.38	56.89	14.23	4.14	1.33	0.78	0.52			99.27	
21	41G2	8.31	5.34	0.82	0.14						14.61	excl. CBH
21	42G1	38.05	2.11								40.16	
21	42G2	2.35	10.64	0.32							13.30	
21	Total	81.25	76.68	15.53	4.33	1.33	0.78	0.52	0.00	0.00	180.42	
22	37G0	21.77	7.22								28.99	
22	37G1	190.90									190.90	
22	38G0	137.42	10.67	1.72	0.77						150.57	
22	38G1	62.17	2.64	0.37	0.49						65.68	
22	39F9	8.66	3.33	0.98	2.03						15.01	
22	39G0	5.29	2.04	0.60	1.24						9.17	excl. CBH
22	39G1										0.00	
22	40F9	14.42	0.95								15.36	
22	40G0	381.82	25.10								406.92	
22	40G1	6.40									6.40	
22	41G0		0.30								0.30	
22	Total	828.85	52.25	3.68	4.53	0.00	0.00	0.00	0.00	0.00	889.31	
23	39G2	30.69	2.37	1.80	0.27	0.09					35.22	
23	40G2	11.19	2.44	0.16	0.04						13.83	excl. CBH
23	41G2	19.06	7.39	0.78	0.11						27.34	
23	Total	60.94	12.21	2.73	0.42	0.09	0.00	0.00	0.00	0.00	76.39	
24	37G2	9.67	0.81	0.16							10.64	
24	37G3	5.73	1.29	3.66	1.64	0.61	0.12	0.20			13.25	
24	37G4	69.58	20.20	13.21	4.42	1.31	0.50	0.91			110.13	
24	38G2	376.21	26.93	4.10	0.34						407.58	
24	38G3	190.53	13.85	15.14	2.12	1.85	0.31	0.34		0.16	224.30	excl. CBH
24	38G4	126.81	36.82	24.08	8.05	2.40	0.90	1.66			200.72	
24	39G2	57.00	4.41	3.35	0.51	0.16					65.43	
24	39G3	70.08	11.52	16.80	3.57	0.64	0.31	0.33	0.10	0.03	103.38	
24	39G4	15.31	12.40	37.38	23.85	17.77	15.19	13.95	1.44	0.41	137.70	
24	Total	920.92	128.23	117.88	44.50	24.74	17.33	17.39	1.54	0.60	1,273.13	
22-24	Total	1,810.70	192.68	124.29	49.46	24.83	17.33	17.39	1.54	0.60	2,238.83	
21-24	Total	1,891.96	269.36	139.82	53.79	26.16	18.11	17.91	1.54	0.60	2,419.25	

Table 14: FRV "Solea", cruise 768/2019. Mean weight (g) of herring excl. CBH in SDs 21-24 by age/W-rings & area.

Sub-division	Rectangle/ W-rings	0	1	2	3	4	5	6	7	8+	Total	
21	41G0	22.98	39.51	63.28	67.12						25.82	
21	41G1	22.30	46.64	66.64	83.24	124.92	180.70	179.85			48.59	
21	41G2	21.20	44.11	58.40	62.67						32.06	excl. CBH
21	42G1	21.37	34.66								22.07	
21	42G2	32.77	41.64	44.77							40.15	
21	Total	22.15	45.28	65.73	82.37	124.92	180.70	179.85			39.08	
22	37G0	18.28	35.66								22.61	
22	37G1	9.86									9.86	
22	38G0	7.40	39.36	61.33	69.50						10.60	
22	38G1	12.69	39.92	54.00	69.50						14.44	
22	39F9	8.90	42.17	69.50	69.50						28.47	
22	39G0	8.90	42.17	69.50	69.50						28.47	excl. CBH
22	39G1											
22	40F9	16.26	36.73								17.52	
22	40G0	16.26	36.73								17.52	
22	40G1	17.40									17.40	
22	41G0		38.38								38.38	
22	Total	12.98	37.85	64.12	69.50						14.94	
23	39G2	14.54	35.63	50.08	68.48	74.13					18.34	
23	40G2	10.42	40.46	50.55	56.89						16.32	excl. CBH
23	41G2	17.33	39.83	49.34	56.80						24.48	
23	Total	14.66	39.14	49.90	64.25	74.13					20.17	
24	37G2	11.57	35.80	48.00							13.96	
24	37G3	8.89	37.00	56.78	68.64	83.60	90.83	96.20			37.75	
24	37G4	13.79	35.72	53.14	69.98	89.45	137.08	172.95			27.56	
24	38G2	9.26	36.04	43.73	60.89						11.42	
24	38G3	10.92	36.01	50.41	76.44	86.26	89.66	92.33		100.33	16.67	excl. CBH
24	38G4	13.79	35.72	53.14	69.98	89.45	137.08	172.95			27.56	
24	39G2	14.54	35.63	50.08	68.48	74.13					18.35	
24	39G3	15.96	35.62	50.02	64.56	85.35	117.30	147.76	175.75	100.33	26.70	
24	39G4	16.58	36.99	56.99	80.48	117.41	151.20	158.55	168.18	100.33	84.53	
24	Total	11.55	35.94	53.26	75.34	108.94	147.93	158.46	168.67	100.33	26.09	
22-24	Total	12.31	36.66	53.50	74.71	108.82	147.93	158.46	168.67	100.33	21.46	
21-24	Total	12.73	39.12	54.86	75.33	109.64	149.34	159.08	168.67	100.33	22.77	

Table 15: FRV "Solea", cruise 768/2018. Total biomass (t) of herring excl. CBH in SDs 21-24 by age/W-rings & area.

Sub-division	Rectangle/ W-rings	0	1	2	3	4	5	6	7	8+	Total	
21	41G0	256.6	67.5	10.5	3.4						338.0	
21	41G1	476.7	2,653.3	948.4	344.3	166.7	140.7	93.8			4,823.7	
21	41G2	176.1	235.5	47.6	9.0						468.2	excl. CBH
21	42G1	813.1	73.0								886.1	
21	42G2	77.0	443.0	14.1							534.1	
21	Total	1,799.5	3,472.3	1,020.6	356.6	166.7	140.7	93.8	0.0	0.0	7,050.1	
22	37G0	397.9	257.5								655.5	
22	37G1	1,881.5									1,881.5	
22	38G0	1,016.8	419.8	105.7	53.2						1,595.5	
22	38G1	788.9	105.4	20.0	34.3						948.5	
22	39F9	77.1	140.5	68.4	141.3						427.3	
22	39G0	47.1	85.9	41.8	86.4						261.1	excl. CBH
22	39G1										0.0	
22	40F9	234.4	34.8								269.2	
22	40G0	6,207.1	921.9								7,129.0	
22	40G1	111.4									111.4	
22	41G0		11.6								11.6	
22	Total	10,762.1	1,977.5	235.8	315.16	0.0	0.0	0.00	0.00	0.0	13,290.6	
23	39G2	446.2	84.4	90.1	18.5	6.7					646.0	
23	40G2	116.6	98.9	7.8	2.5						225.8	excl. CBH
23	41G2	330.3	294.4	38.3	6.3						669.2	
23	Total	893.1	477.7	136.3	27.2	6.7	0.0	0.0	0.0	0.0	1,541.0	
24	37G2	111.9	29.0	7.7							148.6	
24	37G3	50.9	47.7	207.8	112.6	51.0	10.9	19.2			500.2	
24	37G4	959.5	721.5	702.0	309.3	117.2	68.5	157.4			3,035.4	
24	38G2	3,483.7	970.6	179.3	20.7						4,654.3	
24	38G3	2,080.6	498.7	763.2	162.1	159.6	27.8	31.4		16.1	3,739.4	excl. CBH
24	38G4	1,748.7	1,315.2	1,279.6	563.3	214.7	123.4	287.1			5,532.0	
24	39G2	828.8	157.1	167.8	34.9	11.9					1,200.5	
24	39G3	1,118.5	410.3	840.3	230.5	54.6	36.4	48.8	17.6	3.0	2,760.0	
24	39G4	253.8	458.7	2,130.3	1,919.5	2,086.4	2,296.7	2,211.8	242.2	41.1	11,640.5	
24	Total	10,636.4	4,608.9	6,278.0	3,352.8	2,695.3	2,563.7	2,755.6	259.8	60.2	33,210.8	
22-24	Total	22,291.6	7,064.2	6,650.1	3,695.2	2,702.0	2,563.7	2,755.6	259.8	60.2	48,042.4	
21-24	Total	24,091.1	10,536.5	7,670.7	4,051.8	2,868.7	2,704.3	2,849.5	259.8	60.2	55,092.5	

Survey Summary Table WGBIFS 2020	
Name of the survey (abbreviation):	GERAS / BIAS (GER) (FRV "Solea" SB768)
Target Species:	Herring (*Clupea harengus,* Western Baltic Spring Spawning Herring WBSSH; Central Baltic Herring CBH), Sprat (*Sprattus sprattus*) Anchovy (*Engraulis encrasicolus*), Sardine (*Sardina pilchardus*)
Survey dates:	01-21 Oct 2019

Summary:

The objectives of the survey were carried out successfully and largely as planned in all of the covered ICES Subdivisions. Only in SD 21 (Kattegat), the two northernmost statistical rectangles had to be omitted due to a loss of survey time from adverse weather conditions requiring a temporal interruption of survey operations earlier. Neither the interruption nor the reduction of the surveyed area are considered to affect quality or quantity of acoustic estimates.
Altogether, 1124 nautical miles of hydroacoustic transects (plus 103 nmi night and daytime transects for comparison) were covered. For species allocation and identification as well as to collect biological data for an age stratified abundance estimation of the target species herring and sprat, altogether 45 fishery hauls were conducted. Vertical hydrography profiles were measured on 76 stations.

In roughly half of all sampled rectangles, mean NASC values per nautical mile were either comparable with or higher than the values measured in 2018, and lower in the remaining rectangles. Compared to the long-time survey mean however, mean NASC values in the large majority of rectangles covered were distinctly lower. On ICES subdivision scale, mean NASC values were overall lower than in the previous year in subdivision 21, slightly higher in SD 22, distinctly lower in SD 23 and almost identical to 2018 in SD 24.

After excluding the Central Baltic Herring fraction from the estimates via the Separation Function, the present Western Spring Spawning Herring biomass estimate represents the lowest recorded value in the whole time series since 1993.

	Description
Survey design	Stratified systematic (parallel where applicable) design. Start point not randomized. ICES statistical rectangles used as strata for all ICES subdivisions
Index Calculation method	GERIBAS II Software. Index based on mean NASC per ICES statistical rectangle.
Random/systematic error issues	Survey design and transects restricted by area topography. No fully systematic coverage of survey area possible. Indications of large herring aggregations outside the surveyed transects/time period were registered.
Specific survey error issues (acoustic)	*There are some bias considerations that apply to acoustic-trawl surveys only, and the respective SISP should outline how these are evaluated:*
Bubble sweep down	Bubble sweep down due to adverse weather conditions occurred and required interruption of survey operations (SD 24). Due to the continuation of the survey in improved conditions, this is not considered to affect integration results.
Extinction (shadowing)	No particular issues as targets are scattered in loose aggregations in most of the surveyed areas during the survey operations.
Blind zone	Due to the night-time distribution of clupeids also in surface layers, registrations of clupeids occur in the blind zone but are not quantified (integration start depth 10 m). In some parts of the survey area, the blind zone exclusion exceeds more than half of the total water column.

Dead zone	No particular issue as clupeids are mostly distributed pelagically and away from seafloor during night-time survey operations.
Allocation of backscatter to species	Directed trawling. Mixed species category applied throughout survey. Species allocations and splitting of NASC values based on combined trawl haul composition per ICES statistical rectangle.
Target strength	Clupeids: TS = 20 log10 (L) - 71.2 Gadids: TS = 20 log10 (L) - 67.5 Mackerel: TS = 20 log10 (L) – 84.9 see SISP Survey manual (ICES, 2017). Clupeid TS allocated to other species included in analysis (see above).
Calibration	All survey frequencies calibrated and results within recommended tolerances (Demer et al., 2015).
Specific survey error issues (biological)	*There are some bias considerations that apply to acoustic-trawl surveys only, and the respective SISP should outline how these are evaluated:*
Stock containment	Time series: It is assumed that WBSSH (primary target species) is contained within the survey area. An unquantified but assumedly low degree of mixing of WBSSH and CBH (Central Baltic Herring) can occur outside of the survey area (east of SD 24). Due to transects often determined by topography/bathymetry, aggregations of WBSSH in shallower areas not sampled by the survey may have been missed. 2019 survey: Survey area not fully covered as planned resulting from a loss of survey time due to bad weather. Two rectangles in the nortern survey area of the Kattegat (SD 21) were omitted, that are not part of the standard area of the GERAS-Index for HAWG. Accordingly, this is not considered to have reduced stock containment and was also addressed in the analysis.
Stock ID and mixing issues	Time series: WBSSH and CBH mix at varying degrees in different parts of the survey area (especially in SD 24). Separation of stocks is achieved through application of an age-growth based stock separation function (SF) (Gröhsler et al. 2013). 2019 survey: The present results support the continued applicability of the SF despite occurrence of some CBH in the GERAS baseline samples of WBSSH in SDs 21 and 23. CBH were identified in herring samples from throughout the survey area, but only in SD 24 contributed significantly to the overall herring abundance (ca. 25%). Mean weights became distinctly more typical for the growth pattern of WBSSH after removal of CBH, and a conspicuous peak in abundance of year class 5 (very weak year class for WBSSH) also vanished through removal of CBH by the SF (strong 2014 year class of CBH).
Measures of uncertainty (CV)	none
Biological sampling	Time series: Based on survey design restrictions, comprehensive sampling is not feasible in all statistical rectangles surveyed. Biological information from neighboring rectangles is used for generating estimates in these cases. This mostly applies to rectangles with low abundance. 2019 survey: Biological information for ICES statistical rectangles 37G4 (SD 24), 39G2 (SD 23), 39F9, 40F9 (SD 22) used/amended from neighbouring rectangles.
Were any concerns raised during the meeting regarding the fitness of the survey for use in the assessment either for the whole times series or for individual years? (please specify)	*To be answered by Assessment Working Group*

Did the Survey Summary Table contain adequate information to allow for evaluation of the quality of the survey for use in assessment? Please identify shortfalls	*To be answered by Assessment Working Group*

Institute of Food Safety, Animal Health and Environment – BIOR, Riga (Latvia)

National Marine Fisheries Research Institute – NMFRI, Gdynia (Poland)

THE CRUISE REPORT

FROM THE JOINT LATVIAN-POLISH BALTIC INTERNATIONAL ACOUSTIC SURVEY – BIAS 2017 ON THE R/V "BALTICA" IN THE ICES SUBDIVISIONS 26N AND 28.2 OF THE BALTIC SEA (11-20 OCTOBER 2019)

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CONTENTS

INTRODUCTION

More less regular acoustic estimations of pelagic fish stocks in the Baltic Sea initiated by BaltNIIRH (now BIOR) and Institute für Hochseefischerei in Rostock (GDR) was performed since 1983, but the first scattered surveys was made since 1977 [Hoziosky et al. 1987, Shvetsov 1983, Shvetsov et al. 1988]. The first joint Latvian-Polish acoustic survey on the research vessel "Issledovatel Baltiki" (renamed on the r/v "Baltijas Petnieks") of former BaltNIRH was realised in October 1991 and was performed for the estimations of the biomas of Baltic clupeid stocks in the pelagic offshore zone of the ICES Sub-divisions 25-29 [Shvetsov et al. 1992]. The next joint acoustic survey in cooperation of scientists from Poland, Latvia and Estonia were performed on the Polish r/v "Baltica" in October 1996 [Grygiel 2006, Orłowski et al. 1997]. The permanent participation of the Polish r/v "Baltica" in the autumn Baltic International Acoustic Surveys (BIAS) within the Polish EEZ has taken place since 1994 in the framework of long-term ICES Baltic International Acoustic Surveys program, coordinated by the ICES Baltic International Fish Survey Working Group (WGBIFS). Several years in October (1994-2004) and May (2003-2004) BIOR as assignee of BaltNIIRH, LatFRI (in noted period) and LatFRA cooperated with Russian AtlantNIRO in Kaliningrad, but since 2005 the superb regular collaboration has been formed with Polish SFI (since June 2011 named as National Marine Fisheries Research Institute – NMFRI) in Gdynia and as a result we have made 8 BASS and 14 BIAS on pelagic fish stocks and 26 BITS on demersal fish stocks, 46 fish surveys totally.

This was the 14th joint Latvian-Polish Baltic International Acoustic Survey (BIAS) in the ICES Sub-divisions 26N and 28.2 signed as No. 20/2019/NMFRI/BIOR conducted by the r/v "Baltica" in October 2019. The reported cruise was organized on the basis of the agreement No. BIOR 2019/31/AK/EJZF between the Institute of Food Safety, Animal Health and Environment (BIOR) from Riga and the National Marine Fisheries Research Institute (NMFRI) from Gdynia. The vessel was operated within the Latvian, Estonian and Swedish EEZs (ICES Sub-divisions 26N and 28.2). The "Latvian National Program for Collection of Fisheries Data 2019" in accordance with the EU Council Regulation No. 2016/1251 was partly subsidized this cruise. It was coordinated by the ICES Baltic International Fish Survey Working Group (WGBIFS) [ICES 2019].

Pelagic research catches carried out during an acoustic survey are the information source, independent from topical preferences in fishery, about quantitative changes in a process of clupeids geographical and bathymetrical distribution in the Baltic Sea. The data from hydrological measurements are the information source about abiotic environmental factors (seawater temperature, salinity, oxygen content) influencing sprat and herring spatial distribution. Echo-integration results along the pre-selected tracks are the basic materials for fish stock biomass calculations.

The ICES Baltic Fisheries Assessment Working Group (WGBFAS) applies the BIAS data for clupeids (sprat and herring) stock biomass assessment and spatial distribution updating. The basic acoustic and biological data collected during recently carried out survey will be stored in the BIAS_DB.mdb and the new acoustic database WKBIFS-ACOU in the accepted CSV or XML formats, managed by ICES.

The main aims of cruise were:

- to collect the echo-integration data for the estimation of the clupeids stocks biomass and abundance in the central-eastern Baltic;
- to collect materials from the fish control catches for investigations of the Baltic sprat, and in lesser degree herring, spawning stocks spatial distribution in the offshore waters of Latvia, Estonia and Sweden, moreover for analyses of the age-length structure and recruiting year-class strength of these fishes populations;
- to collect sprat and herring stomachs samples for feeding condition and food components analyses;
- to analyze the vertical and horizontal changes of the basic hydrological parameters (temperature, salinity and oxygen content) at the trawling positions and at the standard HELCOM hydrological stations;
- to collect the zooplankton and ichthyoplankton samples at the referring area.

1. MATERIALS AND METHODS

1.1. PERSONNEL ASSIGNMENT

The BIAS 4Q 2018 survey scientific staff was composed of 8 persons:

R. Zaporowski (NMFRI, Gdynia – Poland) – survey leader,
K. Koszarowski (NMFRI, Gdynia – Poland) – acoustician,
L. Szymanek (NMFRI, Gdynia – Poland) – hydrologist,
W. Deluga (NMFRI, Gdynia – Poland)) – ichthyologist,
G. Strods (BIOR, Riga – Latvia) – Latvian scientific staff leader, acoustician
I. Sics (BIOR, Riga – Latvia) – ichthyologist,
J.Gruduls (BIOR, Riga – Latvia) – ichthyologist,
J. Aizups (BIOR, Riga – Latvia) – ichthyologist.

1.2. SURVEY DESCRIPTION

The reported survey took place during the period of 11-20 October 2019 (10 working days at sea). The at sea investigations were conducted within Latvian and Swedish EEZs (the ICES Sub-divisions 26N and 28.2), moreover inside the Latvian territorial waters not shallower than 20 m.

The vessel left the Gdynia port (Poland) on 11.10.2019 at 00:05 a.m. o'clock and was navigated in the north direction to the echo-integration start point at the geographical position 56°07N 019°00'E. The direct at sea research began on 12.10.2019 at 5:15 p.m. The survey ended on 20.10.2017 at 10:00 a.m. o'clock in the Ventspils harbor (Latvia).

1.3. SURVEY METHODS AND PERFORMANCE

1.3.1. ACOUSTICAL AND TRAWLING METHODS

Acoustic data were collected with the SIMRAD EK-60 38 kHz and 120 kHz two frequency split beam scientific echo-sounder equipped with "EchoView Version 7.10" software for the data analysis. These data collected during the described here BIAS were delivered to the Latvian researchers for further elaboration. The survey echo-integration tracks were planned in the similar pattern as in the previous years, due to historical comparability of the data. Overall 572 nautical miles long survey tracks was observed and recorded with hydroacoustic equipment. The final pattern of transects was covered with a relatively good density. The area covered in October 2019 was 1953.3 nm^2 in the northern part of the ICES Sub-division 26 and 6100.6 nm^2 in Sub-division 28.2, totally 8053.9 nm^2 (Fig. 1).

The pre-selection of the pelagic fish catches based on the ICES statistical rectangle area (with range of 0.5 degree in latitude and 1 degree in longitude) and the present density pattern of vertical distribution of clupeids along a transect. The intention was to carry out at least two control hauls per the ICES statistical rectangle [ICES 2003]. The water depth range-layer with sufficient for fish oxygen content (minimum 1.0÷2.0 ml/l) were taken into account in the process of the hauls distribution.

The r/v "Baltica" realized 19 fish control-catches (Tab. 1). All catches were performed in the daylight (between 07:10 am and 05:10 pm) using the pelagic trawl type WP 53/64x4 (with 6 mm mesh bar length in the codend). The standard trawling duration was 30 minutes, however 1 haul duration were shortened to 15 minutes (due to very dense fish concentrations observed) and 2 hauls to 20 minutes. The mean speed of vessel while trawling was 3.2 knots. Overall, 4 hauls were conducted in SD 26N and 15 hauls in SD 28.2. Totally 15 hauls were performed in the Latvian and 4 hauls in Swedish EEZs.

1.3.2. BIOLOGICAL SAMPLING

The length measurements (in 0.5 cm length classes) were realized for 3281 sprat and 2261 herring individuals. In total, 1436 sprat, 1101 herring and 18 cod individuals were taken for biological analysis. Moreover, all 521 individuals of other species (485 three-spine sticklebacks, 8 nine-spine sticklebacks, 18 cods, 4 flounders, 3 lumpfishes, 2 anchovy and 1 shorthorn sculpin) were measured (Tab. 2). Detailed ichthyologic analyses were made according to standard procedures, directly on board of surveying vessel.

Due to herring and sprat normally cannot be distinguished from other species by visual inspection of the echogram species composition and fish length distributions were based on trawl catch results. Mean target strength of fish was calculated according to the following formulas [Foote et al. 1986, ICES 1983, 2014]:

for clupeids: TS = 20logL-71.2;
for gadoids: TS = 20logL-67.5;
cross section $\sigma = 4\pi 10^{a/10} \times L^{b/10}$.

The total number of fish in each ICES rectangle was estimated as a product of the mean area scattering cross-section – NASC (S_A) and the rectangle area, divided by corresponding mean acoustic cross-section. Fish abundance was separated into different species according to the mean catch composition in the given rectangle.

Zooplankton samples were collected at the positions of the hydrological stations or after trawling. Totally 13 zooplankton stations were realized (Fig. 2) and 23 samples were taken. Zooplankton was collected with Judday net (mouth opening 0.1 m^2, mesh size 160 µm). This net was towed vertically from the depths 50 and 100, or from the bottom in case of lesser depth, to the water surface with speed of 0.4 m/s. Low speed of lifting allowed preventing all plankton objects from destroying by mechanic forces. All samples were conserved in 70% spirit solution with sea water and processed during the year.

1.3.2. HYDROLOGICAL AND METEOROLOGICAL OBSERVATIONS

The measurements of the basic hydrological parameters were realized in the period of 11-20 October 2019, totally at 24 stations, int. al. at 19 fish catch-station and 5 HELCOM stations (Fig. 2). Results presented in this paper are linked with sites of the standard HELCOM stations and locations of the catch-stations during pelagic trawl hauling up. Hydrological stations were inspected with the CTD SeaBird 911-probe combined with the rosette sampler (the bathometer rosette). Oxygen content was determined by the standard Winkler's method. The hydrological row data, originated from measuring realized from the sea surface layer up to the bottom, were aggregated to the 1-m depth stratums, were information source about the abiotic factors potentially influencing fishes spatial distribution. The oxygen probes ware taken on every 10 meters. The salinity parameter was presented in Practical Salinity Unit (PSU).

Meteorological parameters were measured by MicroStep-MIS AMS 111 automatic weather station. Meteorological observations of air temperature, wind velocity and directions and atmospheric pressure were realized at the actual geographic position of each control-haul and in every 10 minutes interval over the whole survey. The values of meteorological and hydrological parameters registered at trawling stations are aggregated in Table 3.

2. RESULTS

2.1. BIOLOGICAL DATA

2.1.1. CATCH STATISTICS

Total number of realized hauls and total catches in kg of fish in Latvian and Swedish EEZs during reported BIAS 4Q 2019 are presented in the Table 4. Overall, 9 fish species were recognized in hauls performed in the Central-eastern Baltic Sea. Sprat was dominating by mass in both ICES Sub-divisions 26N and 28.2 (94,7 and 76% respectively). Herring accounted for accordingly 5,1% and 17,4% in SD 26 and SD28.2. The other 7 species represented 1,3% (in this 1,2% was three-spine stickleback) of the total mass in average for all investigated area.

Mean CPUE for all species in the investigated area in 2019 amounted for 677 kg/h and it was a lower value comparing to the previous year (1276 kg/h in 2017). The mean CPUEs of sprat were: 878 kg/h in ICES SD 26N, and 465 kg/h in SD 28.2. The mean CPUEs of herring were as follows: 47 kg/h in SD 26N and 136 kg/h in SD 28.2. The CPUE values by particular haul and distributions for herring, sprat and for other fish species are presented at the Fig. 2. The highest CPUE values for sprat were observed in the northern part of SD 28.2., while CPUE values for herring were evenly distributed throughout the entire study area. The CPUE values by particular haul and distributions for herring, sprat and others are presented at the Fig. 2 and 3.

2.1.2. ACOUSTICAL AND BIOLOGICAL ESTIMATES

The basic acoustic and biological data (surveyed area statistics, mean NASC, the mean scattering cross-section, the total number of fish, percentages of herring and sprat) per ICES rectangles and the estimated abundance and biomass of sprat and herring per above mentioned rectangles, collected in October 2019, are given in Table. 5, for third dominant species – threespine stickleback in Table 6. The characteristics of the pelagic fish stock are aggregated in Table 6 for sprat and Table 7 for herring. The geographical distributions of NASC and pelagic fish stock densities in the central-eastern Baltic Sea in October 2019 are shown in Fig. 5, 6 and 7.

The pelagic fish stock was represented mostly by sprat – 87.2 %, in comparison – 71.5% in 2013 86.8 %, in 2014, 88.2 % in 2015, 94.4 % in 2016, 89.7 % in 2017 and 65.3 % in 2018. Herring was represented as 6.0 %, 28.5 % in 2013, 13.2 % in 2014, 11.8 % in 2015, 5.6 % in 2016, 10.3 % in 2017 and 34.7 % in 2018. The highest sprat stock density 144.4 $n\times10^6/nm^2$ (121.5 $n\times10^6/nm^2$ in 2018, 55.5 $n\times10^6/nm^2$ in 2017, 126.4 $n\times10^6/nm^2$ in 2016 and 72.6 $n\times10^6/nm^2$ in 2015) were recorded in ICES rectangle 42H0 of the ICES Sub-division 28.2. The highest average abundance per nm^2 and biomass of the sprat stock were recorded in the central and northern part of investigated area in ICES rectangles 44H1. The distribution of the high density sprat concentrations in October 2019 was similar to October of the years previous 2010-2016 and 2018, when sprat concentrations with high density had found mostly in the central and northern parts of the investigated area. In 2013 sprat distribution pattern more-less was emulating pattern observed in years till 1992 [Hoziosky et al. 1988, Shvetsov et al. 1988, 1989, 1992, 2002], but not so evident as it was in 2010. In 2014 sprat had scattered distribution of concentrations mostly made from specimens of new generation and in 2015 distribution was scattered too, but with relatively high rate of concentrations in separate points. In 2016 the main sprat stock resides between 50 and 100 m depth isolines and the geographical distribution shows different pattern as it was recent two years before when it was very scattered with several concentration points of high abundance [Svecovs et al. 2010, 2011, 2012, 2013, 2014, 2015, 2016]. In October 2018 sprat stock had relatively large aggregations over 40-70m of the sea depth as in 2016 and 2018, but in 2017 sprat aggregates over different depths in northern part - <40m, over 70m and over 100m.

The herring stock density was significantly lower in comparison to sprat stock density, but evidently higher than herring densities in previous recent years. The highest density value in 2019 was 7.1 $n\times10^6/nm^2$ in ICES rectangle 42H0 in Sub-division 28.2. The highest average density value were 1.4 $n\times10^6/nm^2$ and noted in ICES rectangles 43H0 in Sub-division 28.2, in 2013 highest density values were not over 8.8 $n\times10^6/nm^2$ and observed in rectangle 44H0, in 2014 values over 10.0 $n\times10^6/nm^2$ were recorded in two rectangles 43H0 and 45H0, but in 2015 highest density values was 10.2 $n\times10^6/nm^2$ and noted in ICES rectangle 44H0.

Comparison of the acoustic results from October of 2005-2016 indicated that investigated sprat stock abundance and biomass had decreasing tendency, but herring stock had a slight increase. In 2016 sprat stock has increased significantly due to very abundant generation of 2014. Herring stock remains at the same level as previous years. In October 2018 sprat stock decreased, but herring stock significantly Increased, especially biomass. In 2019 sprat stock increased but herring stock decreased.

The mean length distributions of dominant fish species (sprat, herring and sticklebacks) by hauls in the ICES Sub-divisions 26 and 28 are shown in Figures 8, 9 and 10 respectively. The total length and mean weight in control hauls of sprat, herring and stickleback ranged as follows:

- sprat – 6.5÷14.5 cm (average TL = 11.28 cm), 1.8÷15.9 g (average W = 8.75 g)
- herring – 8.5÷24.5 cm (average TL = 16.57 cm), 3.6÷75.2 g (average W = 26.65 g)
- stickleback – 4.5÷8.0 cm (average TL = 6.27 cm), 0.7÷3.6 g (average W = 2.04 g)

The sprat length distribution curves for Sub-division 28.2 have a bimodal character. The first small length frequency pick takes place at 8 cm length class and represents young fish (year-class born in 2018). The second higher one at length classes 11,5- 12 cm represents adult sprats.

The modal frequency representing adult herring corresponded to 16 and 17 cm length classes in SDs 28.2 and 26 respectively. The fish representing 8.5-12 cm length class range, belonging to the herring year-class born in 2019, had very low frequency and mainly were noted in SD 28.2.

Three-spine stickleback length distributions show one mode character with frequency picks at 6 cm length class for both SDs 26 and 28.2.

Sprat at the smallest length classes had even composition of mean weights and lengths in whole area, but by increasing age the differences of mean weights appears in the investigated area – towards the south-southwest sprat became heavier, the same tendency was observed in previous years. Herring had more evident differences at length classes than it was observed at sprat. Sprat stock was composed dominantly of year class 0 specimens from new generation of 2019 – 3.3 % in SD 26N, 45.9 % in SD 28.2 and 41.9 % overall. Herring stock was composed mainly of year class 5 specimens – 45.8 % in SD 26N, 47.7 % in SD 28.2 and 47.3 % overall.

The year-class 0 of sprat was represented by length-classes 7.0÷8.5 cm in SD 26N, 6.5÷8.5 cm in SD 28.2 and 8.4 cm on average with mean weights 2.2÷3.8 g, 1.6÷3.7 g and 3.0 g on average respectively.

2.2. METEOROLOGICAL AND HYDROLOGICAL DATA

2.2.1. WEATHER CONDITIONS

The most frequent winds were from directions: SSW-WSW. The average (10 min) wind speed varied from 0.7 m/s to 16.4 m/s (wind gusts up to 28.1 m/s). The strongest wind was recorded simultaneously with the highest temperature and it was associated with the low pressure and the weather front passage. The air temperature ranged from 8.8 °C to 16.2 °C and average temperature was 12.6°C (Fig. 11).

2.2.2. HYDROLOGY OF THE GOTLAND DEEP

The hydrological conditions of Gotland Deep during BIAS survey in October 2019 are shown in Figures 12-14.

The seawater temperature in the surface layer varied from 12.04 to 14.40 °C. The lowest values were observed at the hydrological station 37/J1 while the highest - at the vicinity of the trawl no. 4. The average value equalled 12.75°C. The average surface salinity was 7.12 PSU. The minimum value was 6.72 PSU (again hydrological station 37/J1) and maximum 7.38 PSU (trawl no. 2). The highest oxygen content in surface layer was 7.12 ml/l (trawl no. 5) while the lowest one 6.59 ml/l (trawl no. 4). Mean value of dissolved oxygen equalled 6.93 ml/l. The variability range of all surface water parameters was low (Fig. 12).

Water temperature in the near-bottom layer varied from 5.00 °C (trawl no. 15) to 14.39 °C (trawl no. 4 the shallowest station, where warm autumn water from above the thermocline could be found near the bottom). The mean temperature value was 7.59 °C. The highest salinity was found at the deepest hydrological station – 37/J1 (13.26 PSU); the lowest salinity - 7.34 PSU – trawl no. 9. The average salinity in the close-to-the-bottom water layers was 10.52 PSU. The dissolved oxygen content varied from 0.00 ml/l to 6.66 ml/l (trawl no. 8, shallow station, 38m with strong mixing to the bottom). The lack of oxygen was observed at seven stations in the deepest areas (over 130m deep) but on another five stations, just a little bit shallower, situation was also bad – oxygen content less than 1 ml/l. The mean value of the oxygen content was 2.47 ml/l.

To sum up, the highest temperature and oxygen content as well as the lowest salinity in the near-bottom waters were observed in the shallower part of the research area. With the depth, and thus the distance from the shore, the salinity increased and the oxygen content decreased. The temperature reached a minimum in the area of contact of the winter water layer with the bottom (about 50-60m).

In comparison to May 2019, the situation at the bottom has deteriorated: the spatial extent of the anoxic zone has increased and at the same time salinity has decreased. Unfortunately, the deterioration concerns not only the bottom zone. Generally, below the halocline, a layer of hypoxia extends into the layer of anoxia..

The temperature at the hauls (trawling) layer changed in the range from 4.96 (haul 6) to 14.32 °C (haul 3), the mean was 6.74 °C. Salinity at this layer varied from 7.28 (haul 3) to 10.47 PSU (haul 7/station 43), and the mean was 8.70 PSU. Oxygen content varied from 0.18 ml/l (haul 7/station 43) to 6.64 ml/l (haul 2), the mean was 3.67 ml/l (Tab. 3).

3. DISCUSSION

The data of the Latvian-Polish BIAS in the 4th quarter of 2019 were considered by the ICES BIFS Working Group as representative for the central-eastern Baltic for the estimation of abundance and spatial distribution of pelagic fishes (herring and sprat) recruiting year classes and were provided to the Baltic Fisheries Assessment Working Group (WGBFAS) as the input data for fish stocks resources calculation. The acoustic, catch, biological and hydrological data, collected during reported survey were uploaded to the BAD1 and to the emerging international databases managed by the ICES Secretariat.

The collected data shows that sprat population in ICES SD 26N and 28.2 till the 2014 had overall decreasing tendency of abundance, but in 2015 had increased due to very abundant sprat generation of 2014. The next recent generations of sprat was on low abundance level and stock abundance in both SDs had decreased evidently. The mean length and weight of adult sprat had minor increasing tendency in 2019 compared to previous years. The geographical distribution of sprat densities in the October 2019 had similar pattern as in recent years before and shows dense aggregations over the 40-70m of water depth in a relatively narrow layer located 50 to 60m deep. The overall estimated good feeding conditions should ensure increasing of individual fish body condition and young fish surviving of pelagic fish species in future.

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ANNEX. TABLES AND FIGURES

Table 1. Fish control-catch statistics in the Baltic Sea ICES SD 26N and 28.2 from the Latvian-Polish BIAS survey conducted by r/v "Baltica" in the period of 11-20.10.2019

Haul number	Date	ICES rectangle	ICES SD	Mean bottom depth [m]	Headrope depth [m]	Vertical opening [m]	Trawling speed [knt]	Trawling direction [°]	Geographical position: Start Latitude 00°00.0'N	Start Longitude 00°00.0'E	End Latitude 00°00.0'N	End Longitude 00°00.0'E	Time Start	Haul duration [min]	Total catch [kg]
1	2019-10-12	41G9	26	124	50	18	3.2	90	56°07.1'	19°02.4'	56°07.1'	19°04.9'	16:30	30	178.100
2	2019-10-13	41G9	26	57	34	18	3.0	90	56°06.9'	19°47.4'	56°06.9'	19°49.9'	08:20	30	657.060
3	2019-10-13	41H0	26	53	32	17	3.2	70	56°07.1'	20°03.4'	56°07.9'	20°04.9'	10:20	20	858.490
4	2019-10-13	41H0	26	34	16	15	3.2	90	56°07.0'	20°31.1'	56°07.0'	20°33.8'	13:55	30	5.619
5	2019-10-15	42G9	28	130	30	18	3.2	90	56°36.9'	19°19.8'	56°36.9'	19°22.6'	07:30	30	142.407
6	2019-10-15	42G9	28	156	35	17	3.0	105	56°41.9'	19°51.5'	56°41.5'	19°53.8'	11:00	30	29.510
7	2019-10-15	42H0	28	73	48	20	3.2	105	56°37.0'	20°27.7'	56°36.8'	20°30.3'	14:40	30	372.470
8	2019-10-15	42H0	28	41	20	20	3.3	0	56°40.3'	20°45.9'	56°41.8'	20°45.9'	17:10	30	60.470
9	2019-10-16	42H0	28	56	25	18	3.2	265	56°52.3'	20°29.6'	56°52.3'	20°28.2'	08:00	15	649.974
10	2019-10-16	42G9	28	167	40	20	3.2	265	56°52.0'	19°50.5'	56°51.9'	19°47.6'	11:35	30	14.511
11	2019-10-16	43G9	28	156	60	18	3.2	30	57°01.2'	19°08.8'	57°02.6'	19°09.9'	17:10	30	77.320
12	2019-10-17	43G9	28	217	60	20	3.2	90	57°07.1'	19°53.3'	57°07.0'	19°56.2'	08:05	30	349.587
13	2019-10-17	43H0	28	92	60	19	3.0	90	57°07.0'	20°31.5'	57°07.0'	20°34.2'	11:40	30	410.140
14	2019-10-17	43H1	28	67	45	19	3.3	90	57°22.3'	21°03.1'	57°22.2'	21°05.8'	17:00	30	205.450
15	2019-10-18	43H0	28	72	40	20	3.4	15	57°21.2'	20°42.5'	57°22.2'	20°43.0'	07:50	20	587.072
16	2019-10-18	43G9	28	116	60	18	3.1	5	57°25.7'	19°31.6'	57°27.1'	19°31.8'	15:05	30	224.080
17	2019-10-19	44H0	28	141	60	18	3.3	60	57°37.9'	20°36.7'	57°38.6'	20°39.0'	07:30	30	40.398
18	2019-10-19	44H1	28	68	40	19	3.3	55	57°48.3'	21°15.0'	57°49.1'	21°17.2'	12:15	30	1138.811
19	2019-10-19	44H0	28	98	60	19	3.3	40	57°53.0'	20°36.3'	57°54.1'	20°38.1'	16:55	30	33.314
												SD26			1699.269
												SD28.2			4335.514
												SD26+28.2			6034.783

Table 2. Number of measured and aged fish individuals in the Baltic Sea ICES SD 26N and 28.2 from the Latvian-Polish BIAS survey conducted by r/v "Baltica" in the period of 11-20.10.2019

SD 26		Sprat	Herring	Cod	Flounder	Three spine stickleback	Nine spine stickleback	Anchovy	Shorthorn sculpin	Lumpfish	Total
Samples	measurements	4	3	1		2	1	1		1	13
taken	analyses	4	3								7
Fish measured		662	313	1		73	1	1		1	1052
Fish analysed		267	183								450
SD 28.2		Sprat	Herring	Cod	Flounder	Three spine stickleback	Nine spine stickleback	Anchovy	Shorthorn sculpin	Lumpfish	Total
Samples	measurements	14	11	3	3	8	4	1	1	2	47
taken	analyses	14	11								25
Fish measured		2619	1948	17	4	412	7	1	1	2	5011
Fish analysed		1169	918								2087
SUM		Sprat	Herring	Cod	Flounder	Three spine stickleback	Nine spine stickleback	Anchovy	Shorthorn sculpin	Lumpfish	Total
Samples	measurements	18	14	4	3	10	5	2	1	3	60
taken	analyses	18	14								32
Fish measured		3281	2261	18	4	485	8	2	1	3	6063
Fish analysed		1436	1101								2537

Table 3. The values of meteorological and hydrological parameters registered at the trawling stations in the Baltic Sea ICES SD 26N and 28.2 from the Latvian-Polish BIAS survey conducted by r/v "Baltica" in the period of 11-20.10.2019

Haul number	Date of catch	Mean headrope depth, m	Meteorological parameters: Wind direction	Wind force [°B]	Sea state	Water surface t° [°C]	Hydrological parameters at trawling depth: Temperature [°C]	Salinity [PSU]	Oxygen [ml/l]
1	2019-10-12	50	W	6	4	12.25	4.99	7.68	6.85
2	2019-10-13	34	W	6	4	12.65	12.64	7.38	6.90
3	2019-10-13	32	W	5	3	12.97	12.95	7.32	6.91
4	2019-10-13	16	W	5	3	14.40	14.40	7.35	6.59
5	2019-10-15	30	E	5	3	12.41	4.37	7.95	4.52
6	2019-10-15	35	E	5	3	12.46	5.10	7.50	6.51
7	2019-10-15	48	E	5	3	12.80	4.84	7.68	6.21
8	2019-10-15	20	E	5	3	13.82	13.82	7.34	6.72
9	2019-10-16	25	E	4	2	12.86	13.09	7.32	6.56
10	2019-10-16	40	SE	3	2	12.32	5.20	7.49	6.79
11	2019-10-16	60	SE	4	2	12.17	4.61	8.01	4.13
12	2019-10-17	60	SE	3	2	12.04	4.36	8.04	4.13
13	2019-10-17	60	WNW	6	3	12.79	4.90	8.60	3.98
14	2019-10-17	45	W	6	3	13.61	13.61	7.28	6.44
15	2019-10-18	40	SW	4	2	13.19	12.74	7.31	6.51
16	2019-10-18	60	SW	4	2	12.14	4.79	8.71	1.41
17	2019-10-19	60	SW	5	3	12.59	4.83	8.20	5.05
18	2019-10-19	40	SW	5	3	12.94	12.21	7.36	6.37
19	2019-10-19	60	SW	6	3	12.69	4.67	8.16	4.46

Table 4. Fish control-catch results by species in the Baltic Sea ICES SD 26N and 28.2 from the Latvian-Polish BIAS survey conducted by r/v "Baltica" in the period of 11-20.10.2019

					Catch per species [kg]								
Haul number	Date	ICES rectangle	ICES SD	Total cactch [kg]	Sprat	Herring	Cod	Flounder	Threespine stickleback	Ninespine stickleback	Anchovy	Shorthorne sculpin	Lumpfish
					126425	126417	126436	127141	126505	126507	126426	127203	127214
1	2019-10-12	41G9	26	178.100	128.531	46.696	0.156		2.271	0.012			0.434
2	2019-10-13	41G9	26	657.060	617.734	39.271			0.055				
3	2019-10-13	41H0	26	858.490	858.490								
4	2019-10-13	41H0	26	5.547	5.080	0.459					0.008		
5	2019-10-15	42G9	28	142.407	58.609	69.790	1.376		12.611	0.021			
6	2019-10-15	42G9	28	29.510	15.661				13.849				
7	2019-10-15	42H0	28	372.470	312.414	59.916		0.140					
8	2019-10-15	42H0	28	60.470	45.604	14.866							
9	2019-10-16	42H0	28	649.974	649.820			0.154					
10	2019-10-16	42G9	28	14.511					14.510	0.001			
11	2019-10-16	43G9	28	77.320	1.983	63.721			11.616				
12	2019-10-17	43G9	28	349.587	112.784	220.411	1.247		15.132	0.013			
13	2019-10-17	43H0	28	410.140	327.743	82.397							
14	2019-10-17	43H1	28	205.450	183.314	21.926		0.210					
15	2019-10-18	43H0	28	587.072	356.197	230.343						0.162	0.370
16	2019-10-18	43G9	28	224.080	37.842	184.788			1.450				
17	2019-10-19	44H0	28	40.398	31.026	8.425			0.927	0.020			
18	2019-10-19	44H1	28	1138.811	1138.810						0.001		
19	2019-10-19	44H0	28	33.314	22.597	9.461	0.914		0.202				0.140
SD26				1699.197	1609.835	86.426	0.156		2.326	0.012	0.008		0.434
SD28.2				4335.514	3294.404	966.044	3.537	0.504	70.297	0.055	0.001	0.162	0.510
SD26+28.2				6034.711	4904.239	1052.470	3.693	0.504	72.623	0.067	0.009	0.162	0.944

Table 5. Hydroacoustic survey statistics of pelagic fish species from the Latvian-Polish BIAS survey in the Baltic Sea ICES SD 26N and 28.2 conducted by r/v "Baltica" in the period of 11-20.10.2019 (SPR = Sprat, HER = Herring, GTA = Threespine stickleback, GPT = Ninespine stickleback)

Table 5A

ICES SD	ICES Rect.	Area nm^2	Hauls No	NASC Pel m^2nm^{-2}	σ m^210^4	ρ $n10^6nm^{-2}$	TS db	Abundance $n10^6$	Biomass $kg10^3$
26	41G9	1000.0	1,2,5	376.40	1.42	2.64	-39.51	2642.003	29286.797
	41H0	953.3	3,4,7	263.81	1.40	1.88	-39.57	1790.342	18969.855
28.2	42G9	986.9	5,6,10,11	254.15	0.84	3.03	-41.81	2991.435	18912.584
	42H0	968.5	7,8,9	689.14	1.07	6.47	-40.77	6265.111	45303.721
	43G9	973.7	11,12,16	373.33	1.61	2.32	-38.98	2256.314	31903.407
	43H0	973.7	12,13,15	1266.39	1.43	8.86	-39.50	8628.798	97707.251
	43H1	412.7	13,14	646.15	1.32	4.89	-39.84	2016.913	19667.868
	44H0	960.5	17,18,19	827.01	0.93	8.93	-41.38	8579.222	50058.260
	44H1	824.6	14,18	1629.79	0.95	17.23	-41.29	14209.057	85309.534

Table 5B

ICES	ICES	Abundance, $n10^6$				Abundance, %			
SD	Rect.	SPR	HER	GTA	GPT	SPR	HER	GTA	GPT
26	41G9	2266.253	156.456	218.438	0.856	85.778	5.922	8.268	0.032
	41H0	1767.700	22.642			98.735	1.265		
28.2	42G9	786.226	355.241	1848.382	1.586	26.283	11.875	61.789	0.053
	42H0	6180.562	84.548			98.650	1.350		
	43G9	739.121	836.918	679.636	0.638	32.758	37.092	30.122	0.028
	43H0	6729.149	1321.940	576.764	0.944	77.985	15.320	6.684	0.011
	43H1	1900.398	116.515			94.223	5.777		
	44H0	8529.421	26.337	22.775	0.689	99.420	0.307	0.265	0.008
	44H1	14156.274	52.783			99.629	0.371		

Table 5C

ICES	ICES	Biomass, $kg10^3$				Biomass, %			
SD	Rect.	SPR	HER	GTA	GPT	SPR	HER	GTA	GPT
26	41G9	24161.703	4675.706	448.397	0.991	914.522	176.976	16.972	0.037
	41H0	18282.234	687.621			1021.159	38.407		
28.2	42G9	5496.552	9623.885	3790.561	1.586	183.743	321.715	126.714	0.053
	42H0	43348.154	1955.567			691.898	31.214		
	43G9	7493.377	23024.818	1384.573	0.638	332.107	1020.462	61.364	0.028
	43H0	57876.992	38730.070	1099.245	0.944	670.742	448.847	12.739	0.011
	43H1	16333.650	3334.218			809.834	165.313		
	44H0	49271.728	739.055	46.651	0.826	574.315	8.614	0.544	0.010
	44H1	83917.848	1391.686			590.594	9.794		

Table 5D

ICES	ICES	SPR		HER		GTA		GPT	
SD	Rect.	L, cm	w, g	L, cm	w, g	L, cm	w, g	L, cm	w, g
26	41G9	12.19	10.66	17.39	29.89	6.25	2.05	5.57	1.16
	41H0	12.03	10.34	17.19	30.37				
28.2	42G9	10.28	6.99	17.43	27.09	6.29	2.05	5.49	1.00
	42H0	10.28	7.01	15.22	23.13				
	43G9	12.14	10.14	17.05	27.51	6.35	2.04	5.25	1.00
	43H0	11.30	8.60	17.14	29.30	6.28	1.91	5.25	1.00
	43H1	11.26	8.59	16.91	28.62				
	44G9	9.63	5.78	17.00	28.06	6.39	2.05	5.75	1.20
	44H1	9.74	5.93	16.13	26.37				

Table 6. Sprat stock characteristics in the Baltic Sea ICES SD 26N and 28.2
from the Latvian-Polish BIAS survey conducted by r/v "Baltica" in the period of 11-20.10.2019

Table 6A CANUM		Age group									Σ
ICES SD	ICES Rect.	0	1	2	3	4	5	6	7	8+	
26	41G9	5412	6607	41527	28637	16677	46808	2178	1807	1332	150987
	41H0	9398	25402	97657	65024	28935	74759	9241			310418
28.2	42G9	10611	1362	1971	1969	1182	4177	181	243	118	21814
	42H0	221891	36683	64671	46105	26947	64914	2753	8621	111	472696
	43G9	1144	2273	6245	5349	3035	10797	421	374	469	30106
	43H0	40129	17060	35806	13778	15071	57139	1773	1085	3425	185264
	43H1	23271	12910	27658	13310	4619	34216	1505	728	704	118922
	44H0	241100	29577	49670	29928	15129	42425	2186	2752	77	412844
	44H1	245062	37270	61000	35821	16738	45411	2284	2478		446064

Table 6B n × 10^6		Age group									Σ
ICES SD	ICES Rect.	0	1	2	3	4	5	6	7	8+	
26	41G9	81.24	99.17	623.31	429.83	250.32	702.58	32.70	27.12	19.99	2266.25
	41H0	53.52	144.65	556.12	370.29	164.77	425.72	52.62			1767.70
28.2	42G9	382.42	49.08	71.03	70.97	42.61	150.55	6.53	8.77	4.25	786.23
	42H0	2901.25	479.64	845.58	602.83	352.33	848.76	36.00	112.72	1.46	6180.56
	43G9	28.09	55.80	153.31	131.33	74.51	265.07	10.33	9.18	11.51	739.12
	43H0	1457.55	619.65	1300.55	500.44	547.40	2075.38	64.38	39.40	124.39	6729.15
	43H1	371.87	206.31	441.99	212.70	73.82	546.78	24.05	11.63	11.25	1900.40
	44H0	4981.17	611.06	1026.20	618.32	312.56	876.50	45.17	56.86	1.59	8529.42
	44H1	7777.28	1182.79	1935.90	1136.82	531.21	1441.16	72.47	78.64		14156.27

Table 6C n, %		Age group									Σ
ICES SD	ICES Rect.	0	1	2	3	4	5	6	7	8+	
26	41G9	3.58	4.38	27.50	18.97	11.05	31.00	1.44	1.20	0.88	100.00
	41H0	3.03	8.18	31.46	20.95	9.32	24.08	2.98			100.00
28.2	42G9	48.64	6.24	9.03	9.03	5.42	19.15	0.83	1.12	0.54	100.00
	42H0	46.94	7.76	13.68	9.75	5.70	13.73	0.58	1.82	0.02	100.00
	43G9	3.80	7.55	20.74	17.77	10.08	35.86	1.40	1.24	1.56	100.00
	43H0	21.66	9.21	19.33	7.44	8.13	30.84	0.96	0.59	1.85	
	43H1	19.57	10.86	23.26	11.19	3.88	28.77	1.27	0.61	0.59	
	44H0	58.40	7.16	12.03	7.25	3.66	10.28	0.53	0.67	0.02	
	44H1	54.94	8.36	13.68	8.03	3.75	10.18	0.51	0.56		100.00

Table 6D W, kg × 10^3		Age group									Σ
ICES SD	ICES Rect.	0	1	2	3	4	5	6	7	8+	
26	41G9	290.32	889.11	6449.77	4649.38	2828.43	8019.08	432.26	351.53	251.82	24161.70
	41H0	153.77	1403.20	5638.59	3869.37	1847.52	4796.96	572.83			18282.23
28.2	42G9	1225.47	469.60	717.46	732.95	472.95	1640.17	79.28	102.49	56.19	5496.55
	42H0	9057.20	4373.10	8471.91	6456.06	3933.41	9339.97	403.43	1300.05	13.02	43348.15
	43G9	92.92	488.13	1483.46	1356.63	811.98	2897.27	120.16	110.23	132.60	7493.38
	43H0	4410.04	5329.09	12728.0	5145.20	5589.17	22062.07	747.75	454.00	1411.62	57876.99
	43H1	1124.17	1686.95	4247.47	2114.36	740.12	5851.87	281.75	131.07	155.87	16333.65
	44H0	14482.10	5527.70	9510.64	6193.14	3077.98	9237.95	620.68	601.36	20.18	49271.73
	44H1	22586.29	10336.84	17801.8	11221.00	5183.82	14969.60	999.03	819.46		83917.85

Table 6E W, %		Age group									Σ
ICES SD	ICES Rect.	0	1	2	3	4	5	6	7	8+	
26	41G9	1.20	3.68	26.69	19.24	11.71	33.19	1.79	1.45	1.04	100.00
	41H0	0.84	7.68	30.84	21.16	10.11	26.24	3.13			100.00
28.2	42G9	22.30	8.54	13.05	13.33	8.60	29.84	1.44	1.86	1.02	100.00
	42H0	20.89	10.09	19.54	14.89	9.07	21.55	0.93	3.00	0.03	100.00
	43G9	1.24	6.51	19.80	18.10	10.84	38.66	1.60	1.47	1.77	
	43H0	7.62	9.21	21.99	8.89	9.66	38.12	1.29	0.78	2.44	
	43H1	6.88	10.33	26.00	12.94	4.53	35.83	1.72	0.80	0.95	
	44H0	29.39	11.22	19.30	12.57	6.25	18.75	1.26	1.22	0.04	100.00
	44H1	26.91	12.32	21.21	13.37	6.18	17.84	1.19	0.98		100.00

Table 6F w, g		Age group									Total
ICES	ICES Rect.	0	1	2	3	4	5	6	7	8+	
26	41G9	3.57	8.97	10.35	10.82	11.30	11.41	13.22	12.96	12.60	10.66
	41H0	2.87	9.70	10.14	10.45	11.21	11.27	10.89			10.34
28.2	42G9	3.20	9.57	10.10	10.33	11.10	10.89	12.13	11.68	13.21	6.99
	42H0	3.12	9.12	10.02	10.71	11.16	11.00	11.21	11.53	8.95	7.01
	43G9	3.31	8.75	9.68	10.33	10.90	10.93	11.63	12.01	11.52	10.14
	43H0	3.03	8.60	9.79	10.28	10.21	10.63	11.61	11.52	11.35	8.60
	43H1	3.02	8.18	9.61	9.94	10.03	10.70	11.72	11.27	13.85	8.59
	44H0	2.91	9.05	9.27	10.02	9.85	10.54	13.74	10.58	12.69	5.78
	44H1	2.90	8.74	9.20	9.87	9.76	10.39	13.79	10.42		5.93

Table 6G L, cm		Age group									Total
ICES	ICES Rect.	0	1	2	3	4	5	6	7	8+	
26	41G9	8.51	11.41	12.01	12.26	12.53	12.59	13.52	13.37	13.17	12.19
	41H0	7.94	11.70	11.93	12.10	12.47	12.51	12.26			12.03
28.2	42G9	8.17	11.70	11.96	12.12	12.63	12.49	13.31	12.98	13.82	10.28
	42H0	8.15	11.38	11.90	12.32	12.59	12.50	12.62	12.80	11.75	10.28
	43G9	8.30	11.36	11.86	12.26	12.58	12.59	12.94	13.23	12.90	12.14
	43H0	8.16	11.31	11.95	12.19	12.22	12.47	12.97	12.91	12.95	11.30
	43H1	8.12	11.05	11.82	12.02	11.91	12.45	13.01	12.75	14.25	11.26
	44H0	8.02	11.52	11.62	12.04	11.97	12.29	13.18	12.34	13.61	9.63
	44H1	8.02	11.39	11.61	11.99	11.94	12.24	13.25	12.25		9.74

Table 8. Herring stock characteristics in the Baltic Sea ICES SD 26N and 28.2
from the Latvian-Polish BIAS survey conducted by r/v "Baltica" in the period of 11-20.10.2019

Table 7A CANUM		Age group									Σ
ICES SD	ICES Rect.	0	1	2	3	4	5	6	7	8+	
26	41G9		99	1078	1500	1328	5062	212	598	518	10424
	41H0	150	118	594	1053	816	1062	118	67		3976
28.2	42G9		48	774	1066	1255	4913	491	473	769	9856
	42H0	2147	228	696	1192	867	1126	130	80		6466
	43G9		662	2260	5372	4759	17440	1300	629	1089	34089
	43H0	168	294	3872	4392	4521	17672	2079	2110	623	36395
	43H1	227	116	1387	1084	556	2837	433	312	205	7291
	44H0	40	11	58	116	168	577	98	116	77	1275
	44H1	59	88	502	244	371	194	29	138	37	1663

Table 7B n × 10^6		Age group									Σ
ICES SD	ICES Rect.	0	1	2	3	4	5	6	7	8+	
26	41G9		1.48	16.19	22.52	19.93	75.98	3.18	8.97	8.21	156.46
	41H0	0.85	0.67	3.38	6.00	4.65	6.05	0.67	0.38		22.64
28.2	42G9		1.75	27.89	38.42	45.22	177.06	17.68	17.04	30.18	355.24
	42H0	28.07	2.98	9.10	15.59	11.34	14.72	1.71	1.04		84.55
	43G9		16.24	55.50	131.88	116.84	428.16	31.91	15.45	40.93	836.92
	43H0	6.10	10.66	140.62	159.54	164.22	641.87	75.52	76.65	46.74	1321.94
	43H1	3.63	1.86	22.16	17.33	8.88	45.34	6.91	4.99	5.42	116.51
	44H0	0.83	0.23	1.20	2.39	3.47	11.92	2.03	2.39	1.88	26.34
	44H1	1.87	2.80	15.93	7.75	11.77	6.17	0.93	4.39	1.17	52.78

Table 7C n, %		Age group									Σ
ICES SD	ICES Rect.	0	1	2	3	4	5	6	7	8+	
26	41G9		0.95	10.35	14.39	12.74	48.56	2.03	5.73	5.25	100.00
	41H0	3.76	2.96	14.93	26.49	20.52	26.70	2.96	1.68		100.00
28.2	42G9		0.49	7.85	10.82	12.73	49.84	4.98	4.80	8.50	100.00
	42H0	33.21	3.52	10.77	18.43	13.41	17.41	2.02	1.23		100.00
	43G9		1.94	6.63	15.76	13.96	51.16	3.81	1.85	4.89	
	43H0	0.46	0.81	10.64	12.07	12.42	48.56	5.71	5.80	3.54	
	43H1	3.11	1.60	19.02	14.87	7.62	38.92	5.93	4.28	4.65	
	44H0	3.16	0.86	4.56	9.07	13.19	45.27	7.69	9.07	7.12	100.00
	44H1	3.54	5.31	30.18	14.69	22.30	11.68	1.77	8.32	2.21	100.00

Table 7D W, kg × 10^3		Age group									Σ
ICES SD	ICES Rect.	0	1	2	3	4	5	6	7	8+	
26	41G9		33.50	420.05	607.24	583.46	2322.18	109.68	314.01	285.59	4675.71
	41H0	8.00	17.42	100.96	183.54	148.64	191.19	24.34	13.54		687.62
28.2	42G9		29.18	694.39	1007.09	1012.89	4624.79	641.78	601.40	1012.36	9623.89
	42H0	230.25	58.58	267.02	470.64	361.43	468.10	60.93	38.63		1955.57
	43G9	0.00	356.04	1368.69	3514.85	3055.78	11782.0	1008.89	561.11	1377.37	23024.82
	43H0	55.33	221.28	3645.97	4379.32	4732.76	18906.2	2333.85	2566.70	1888.60	38730.07
	43H1	32.86	35.58	545.00	470.74	254.05	1378.77	220.38	182.99	213.86	3334.22
	44H0	6.12	3.49	29.05	60.16	96.45	342.22	63.54	78.25	59.77	739.05
	44H1	16.91	58.03	404.09	204.31	305.66	182.64	38.90	146.04	35.10	1391.69

Table 7E W, %		Age group									Σ
ICES SD	ICES Rect.	0	1	2	3	4	5	6	7	8+	
26	41G9		0.72	8.98	12.99	12.48	49.66	2.35	6.72	6.11	100.00
	41H0	1.16	2.53	14.68	26.69	21.62	27.80	3.54	1.97		100.00
28.2	42G9		0.30	7.22	10.46	10.52	48.06	6.67	6.25	10.52	100.00
	42H0	11.77	3.00	13.65	24.07	18.48	23.94	3.12	1.98		100.00
	43G9		1.55	5.94	15.27	13.27	51.17	4.38	2.44	5.98	
	43H0	0.14	0.57	9.41	11.31	12.22	48.82	6.03	6.63	4.88	
	43H1	0.99	1.07	16.35	14.12	7.62	41.35	6.61	5.49	6.41	
	44H0	0.83	0.47	3.93	8.14	13.05	46.31	8.60	10.59	8.09	100.00
	44H1	1.22	4.17	29.04	14.68	21.96	13.12	2.80	10.49	2.52	100.00

Table 7F w, g		Age group									
ICES	ICES	0	1	2	3	4	5	6	7	8+	Total
26	41G9		22.59	25.95	26.96	29.27	30.56	34.54	35.01	34.78	29.89
	41H0	9.40	26.00	29.86	30.61	32.00	31.62	36.32	35.56		30.37
28.2	42G9		16.70	24.90	26.21	22.40	26.12	36.29	35.29	33.54	27.09
	42H0	8.20	19.66	29.33	30.20	31.88	31.80	35.71	37.08		23.13
	43G9	0.00	21.92	24.66	26.65	26.15	27.52	31.62	36.32	33.65	27.51
	43H0	9.07	20.75	25.93	27.45	28.82	29.45	30.90	33.48	40.41	29.30
	43H1	9.06	19.14	24.59	27.17	28.61	30.41	31.88	36.71	39.45	28.62
	44H0	7.35	15.33	24.21	25.18	27.76	28.70	31.36	32.76	31.87	28.06
	44H1	9.05	20.71	25.37	26.35	25.97	29.62	41.64	33.26	30.06	26.37

Table 7G L, cm		Age group									
ICES	ICES Rect.	0	1	2	3	4	5	6	7	8+	Total
26	41G9		15.65	16.40	16.73	17.25	17.57	18.53	18.50	18.45	17.39
	41H0	11.63	16.18	17.14	17.28	17.56	17.51	18.66	18.25		17.19
28.2	42G9		14.50	16.11	16.51	17.30	17.52	18.93	18.53	18.22	17.43
	42H0	11.15	14.62	17.01	17.18	17.55	17.52	18.52	18.41		15.22
	43G9		15.53	16.01	16.60	16.94	17.15	17.91	18.95	18.34	17.05
	43H0	11.83	15.17	16.31	16.73	17.04	17.20	17.53	18.04	19.60	17.14
	43H1	11.75	14.57	16.01	16.65	16.73	17.41	17.68	18.63	19.34	16.91
	44H0	10.89	14.08	15.97	16.18	16.89	17.23	17.97	18.22	17.95	17.00
	44H1	11.50	14.83	15.89	16.19	16.09	17.05	18.75	17.68	17.15	16.13

Table 8. Survey statistics related to cod from the Latvian-Polish BIAS
in the Baltic Sea ICES SD 26N and 28.2 conducted by r/v "Baltica" in the period of 11-20.10.2019

Table 5A									
ICES	ICES			$NASC_{PEL}$	σ 10^4	TS calc.	ρ	Abundance	Biomass
SD	Rect.	L, cm	w, g	m^2nm^{-2}	m^2	dB	$n10^6nm^{-2}$	$n10^6$	$kg10^3$
26	41G9	27.00	156.00	0.0043	6.95	-32.63	3.76	3764	0.587
	41H0								
28.2	42G9	27.88	172.00	0.0490	7.49	-32.30	2.54	2509	0.431
	42H0								
	43G9	32.88	311.75	0.0325	10.83	-30.70	3.73	3635	1.133
	43H0								
	43H1								
	44H0	27.80	182.80	0.0199	7.68	-32.20	8.27	7944	1.452
	44H1								

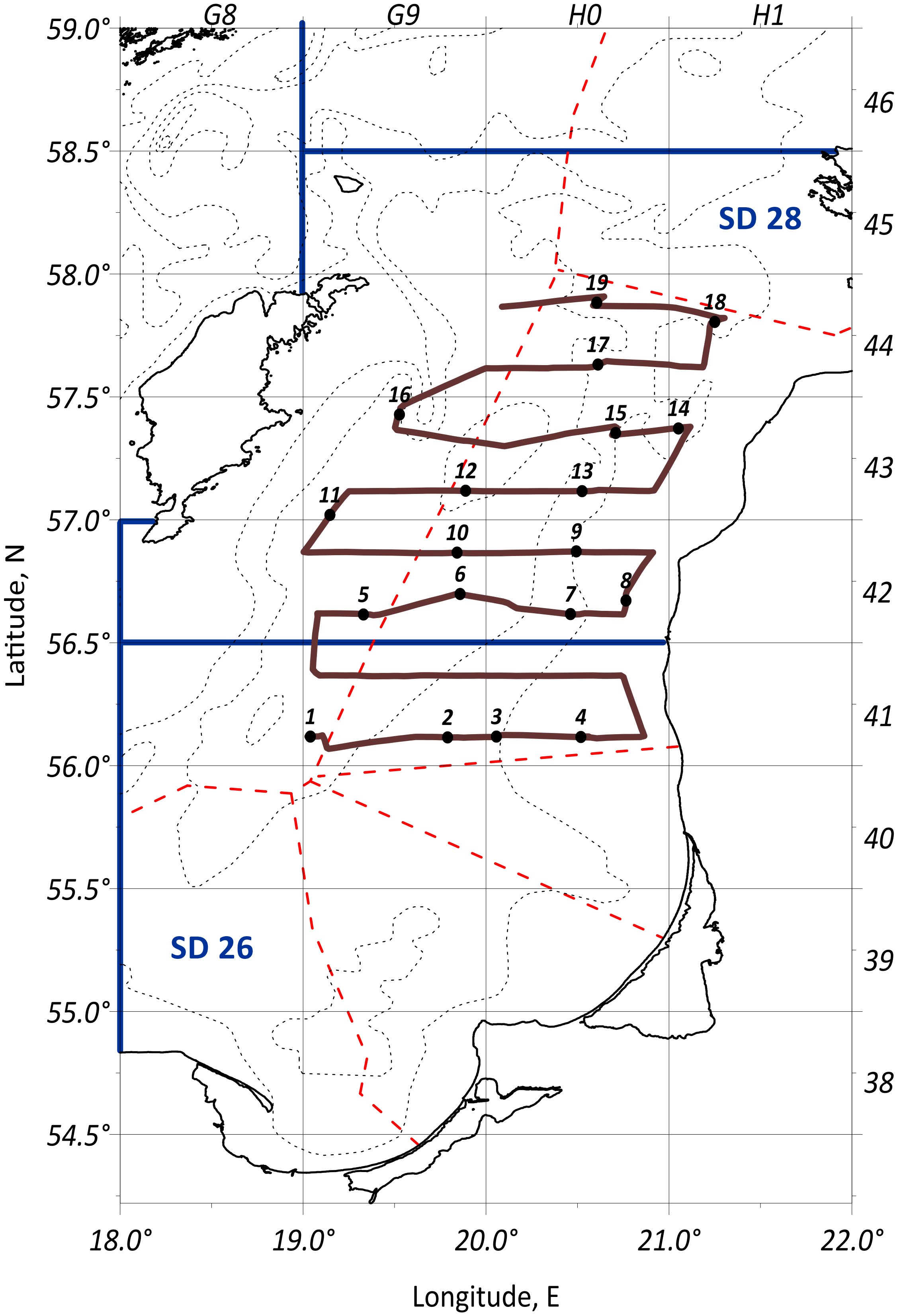

Figure 1: Cruise track design and trawling positions of the Latvian-Polish hydroacoustic survey on the r/v "Baltica" in the period of 11-20.10.2019.

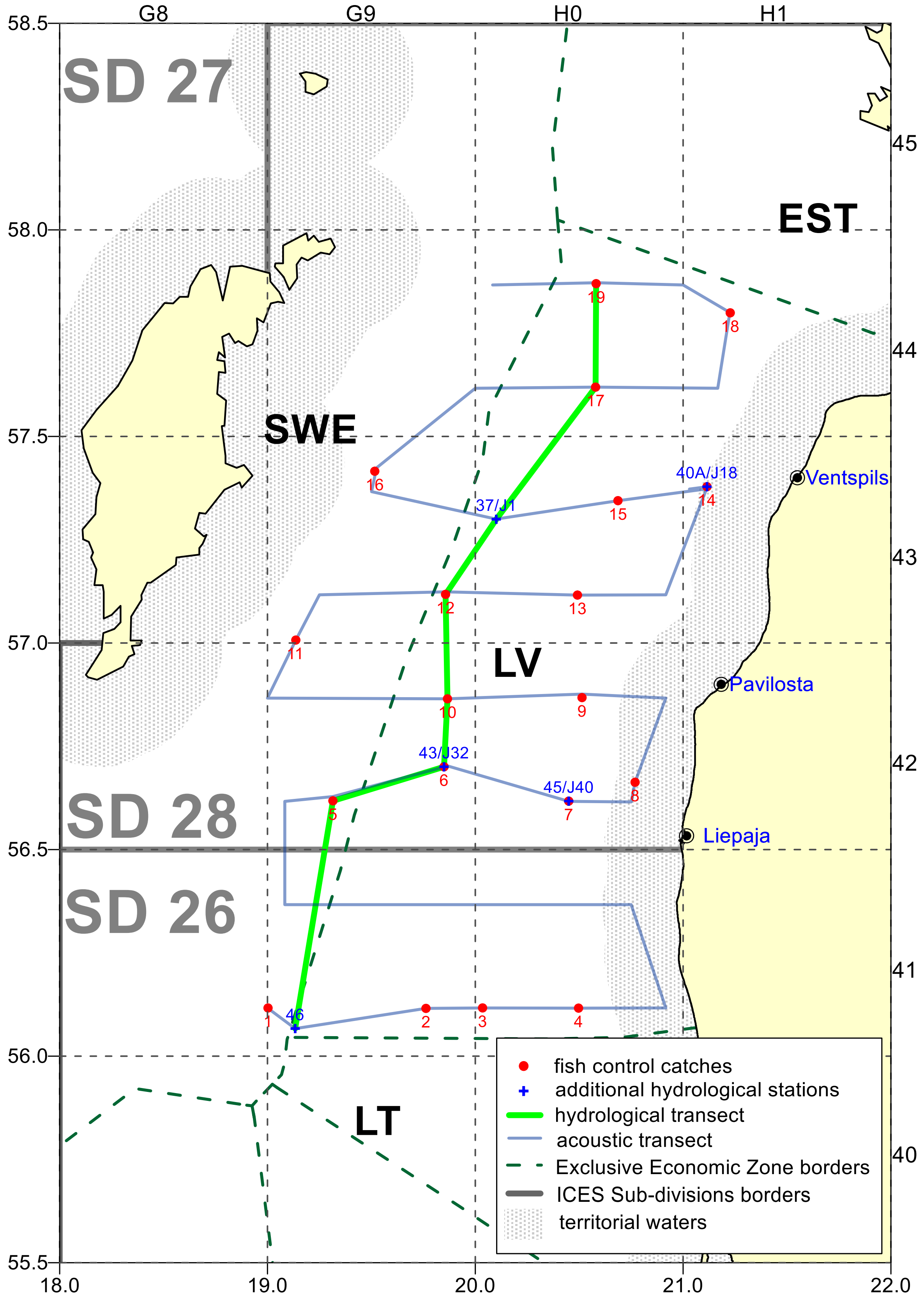

Figure 2: Locations of the hydrological stations and hydrological profile performed during the Latvian-Polish hydroacoustic survey on the r/v "Baltica" in the period of 11-20.10.2019.

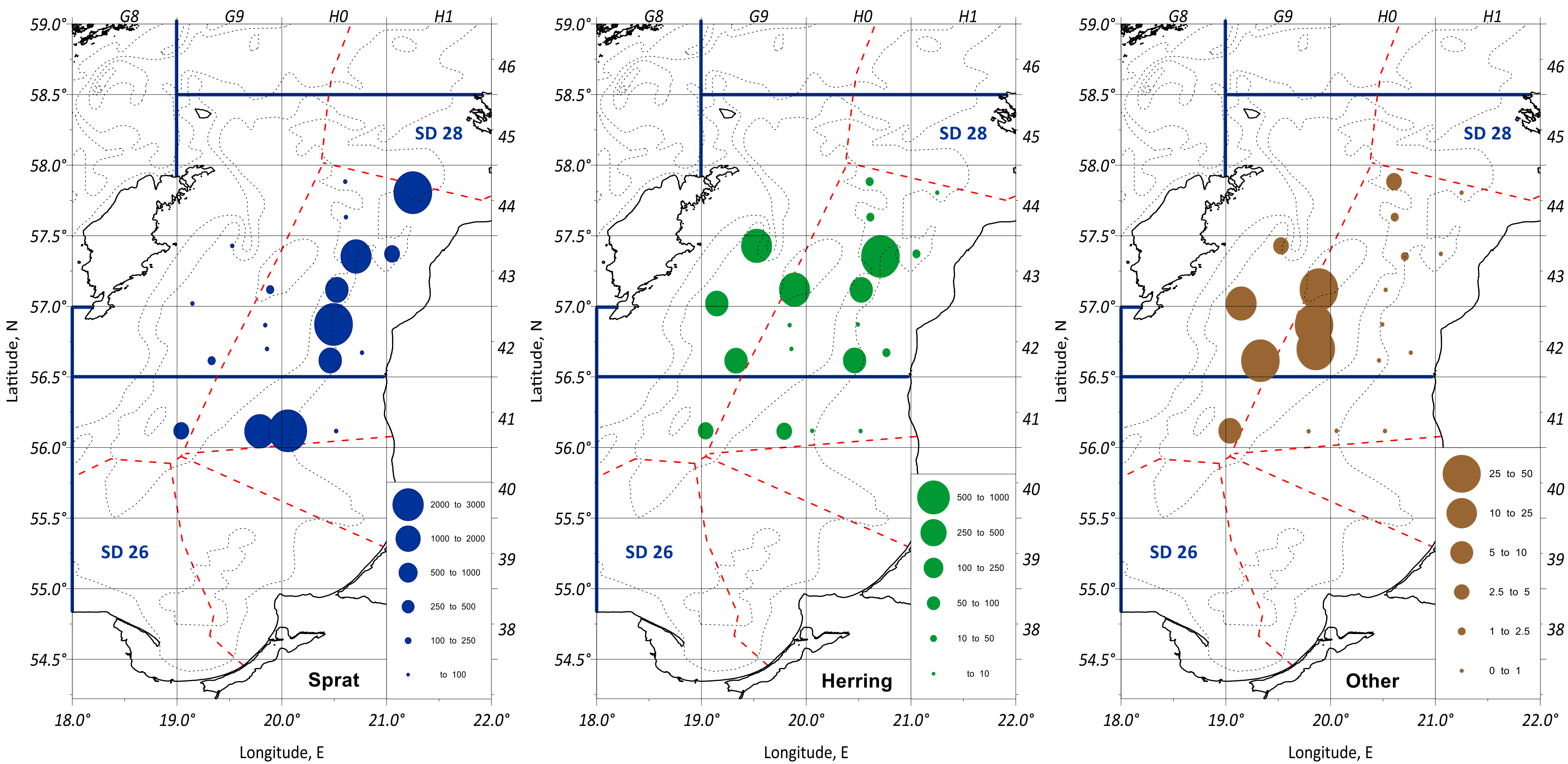

Figure 3: CPUE [kg/h] ranges distribution of fish in the catch hauls in the Baltic Sea ICES SD 26N and 28.2 from the Latvian-Polish BIAS survey conducted by r/v "Baltica" in the period of 11-20.10.2017.

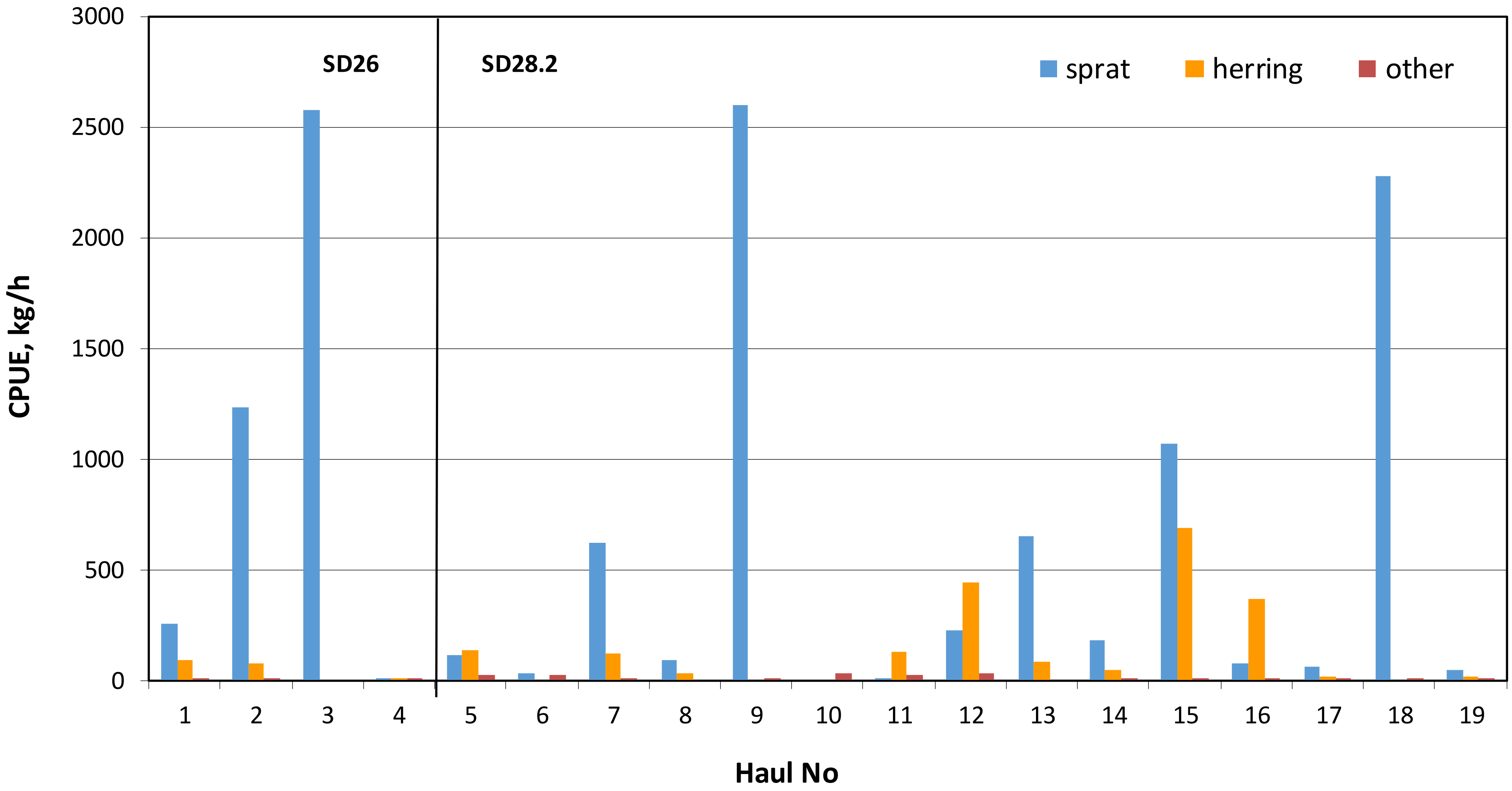

Figure 4: CPUE [kg/h] of dominant pelagic fish and by-catch in the hauls in the Baltic Sea ICES SD 26N and 28.2 from the Latvian-Polish BIAS survey conducted by r/v "Baltica" in the period of 11-20.10.2019.

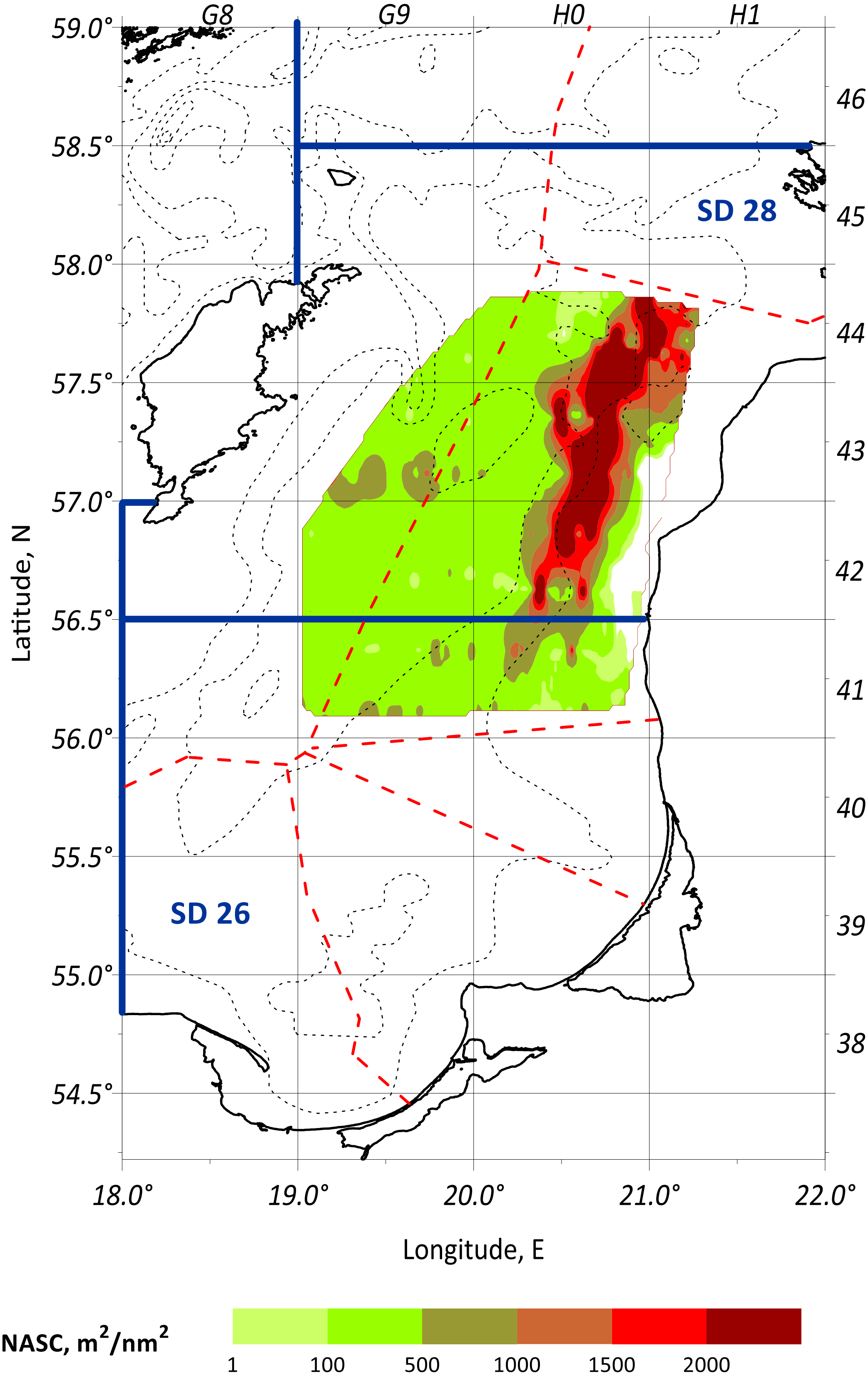

Figure 5: Acoustic parameter NASC distribution in the Baltic Sea ICES SD 26N and 28.2 from the Latvian-Polish BIAS survey conducted by r/v "Baltica" in the period of 11-20.10.2019.

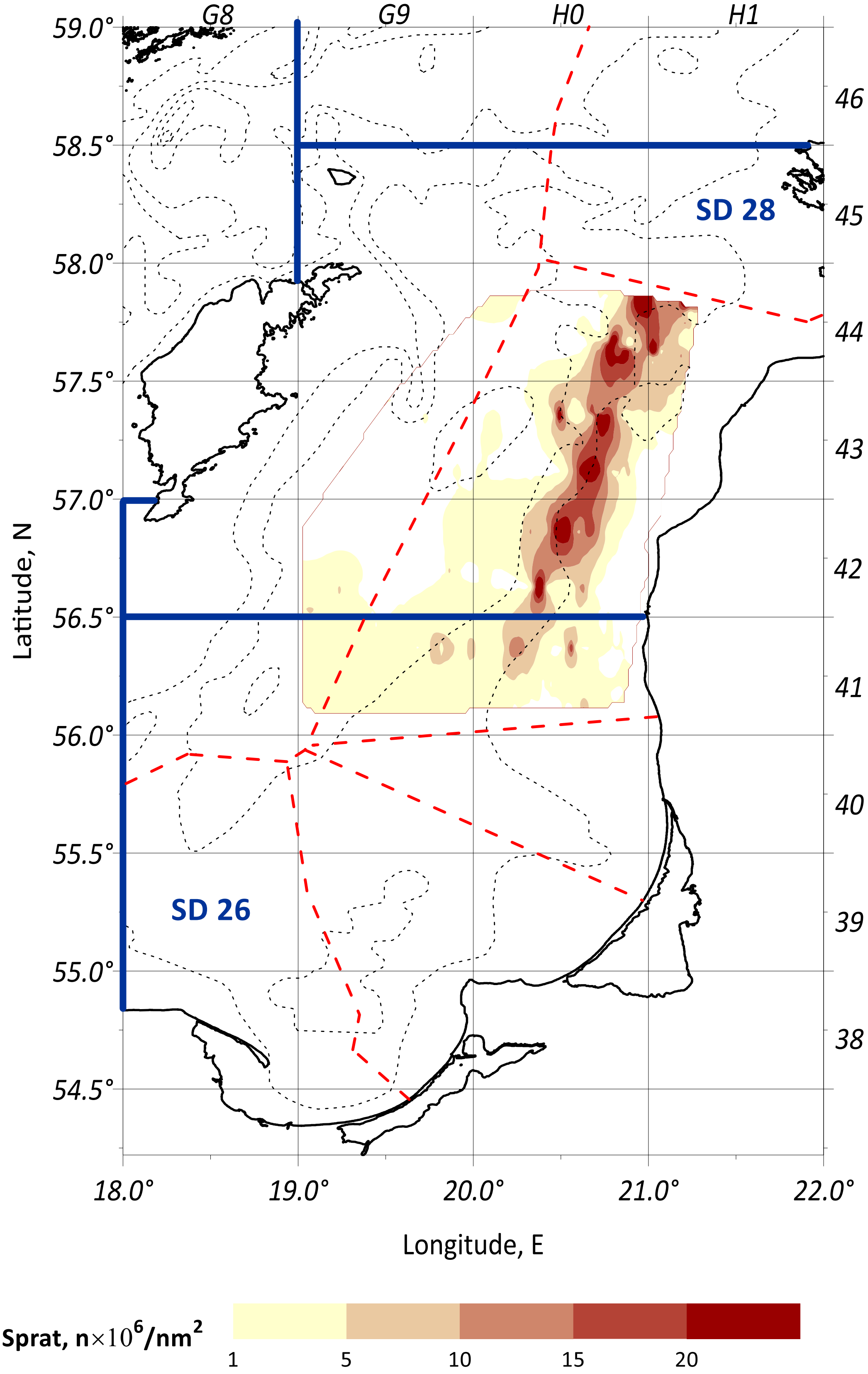

Figure 6: Sprat distribution in the Baltic Sea ICES SD 26N and 28.2 from the Latvian-Polish BIAS survey conducted by r/v "Baltica" in the period of 11-20.10.2019.

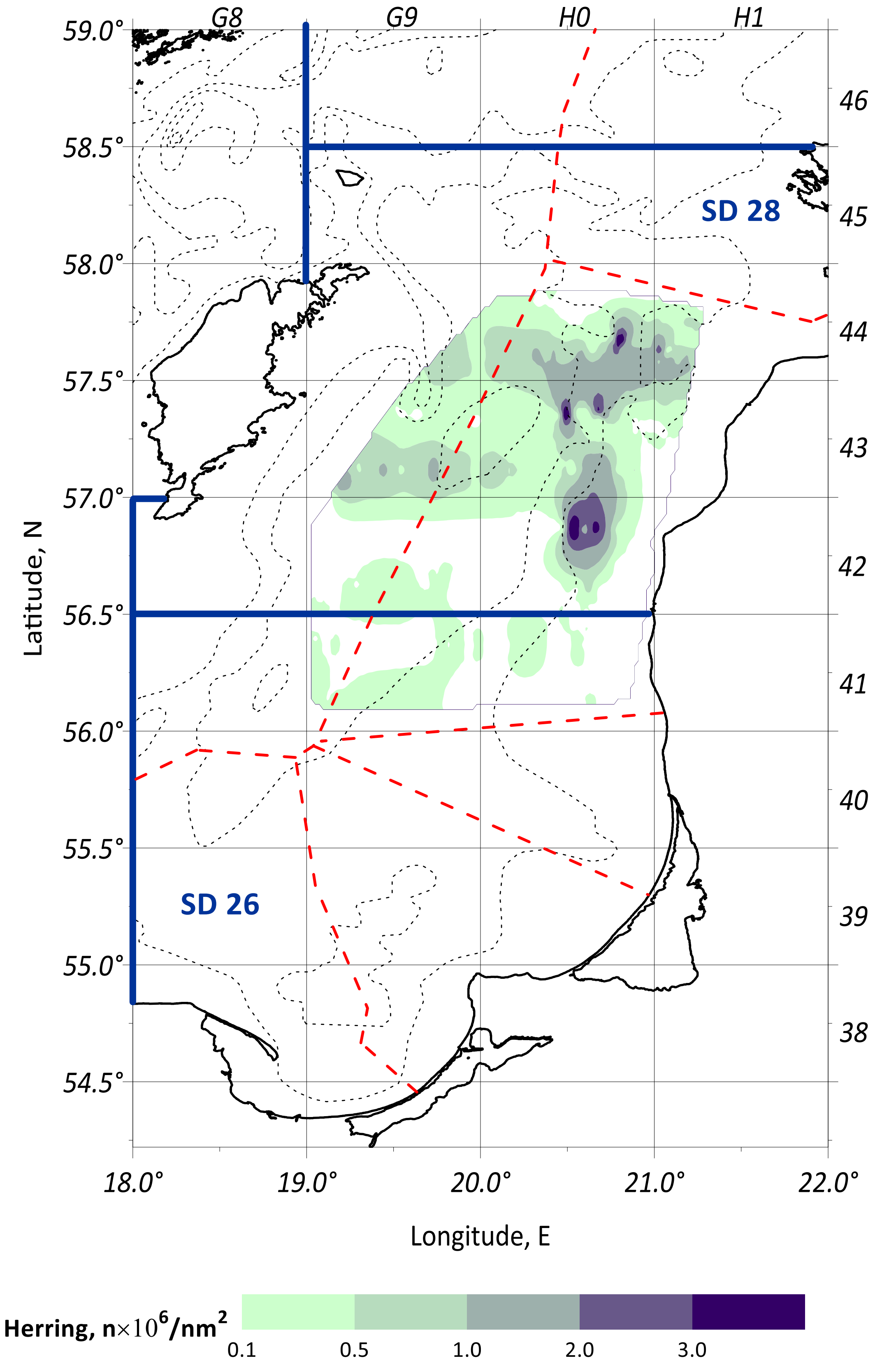

Figure 7: Herring distribution in the Baltic Sea ICES SD 26N and 28.2 from the Latvian-Polish BIAS survey conducted by r/v "Baltica" in the period of 11-20.10.2019.

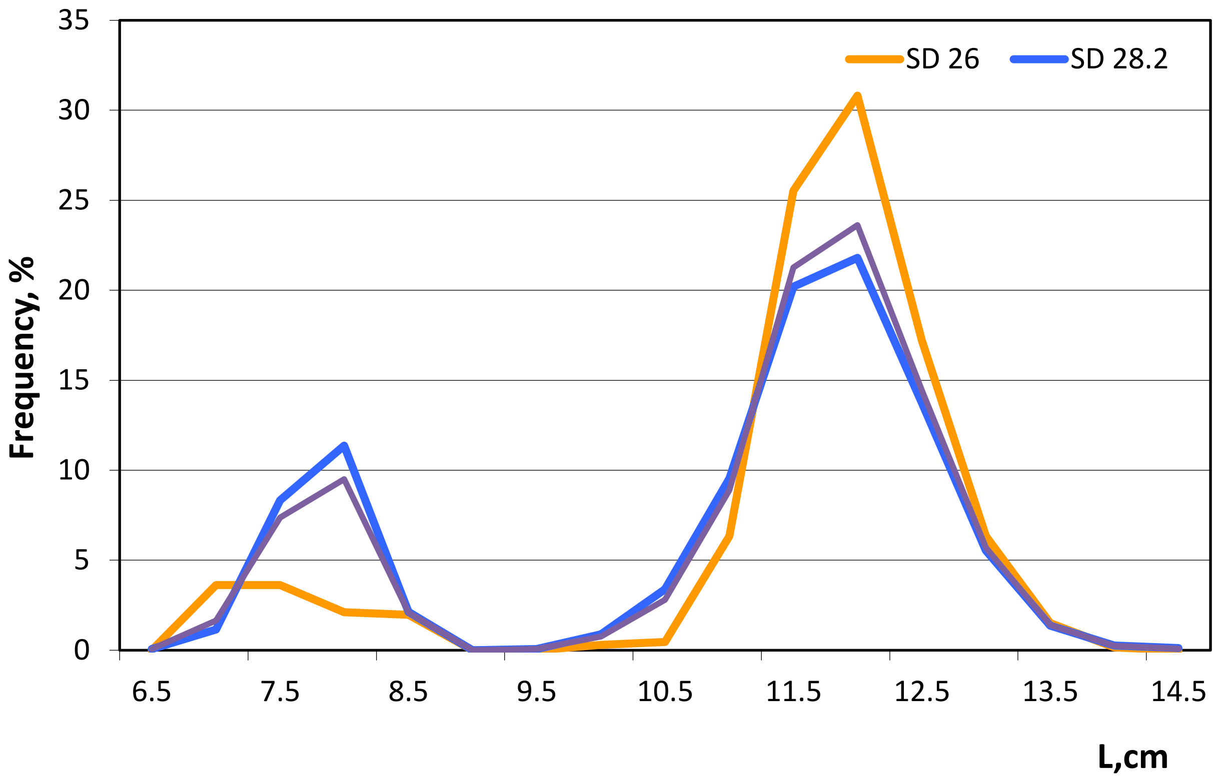

Figure 8: Sprat length distributions in control catches in the Baltic Sea ICES SD 26N and 28.2 from the Latvian-Polish BIAS survey conducted by r/v "Baltica" in the period of 11-20.10.2019.

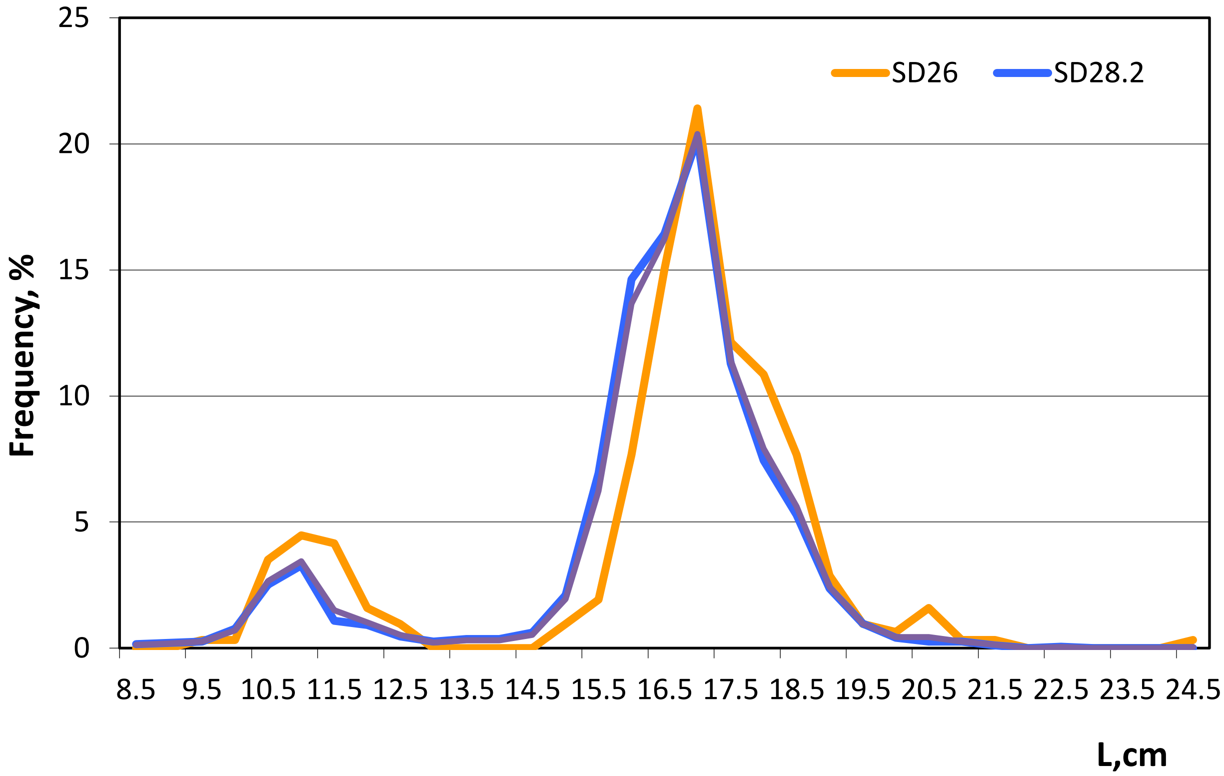

Figure 9: Herring length distributions in control catches in the Baltic Sea ICES SD 26N and 28.2 from the Latvian-Polish BIAS survey conducted by r/v "Baltica" in the period of 11-20.10.2019.

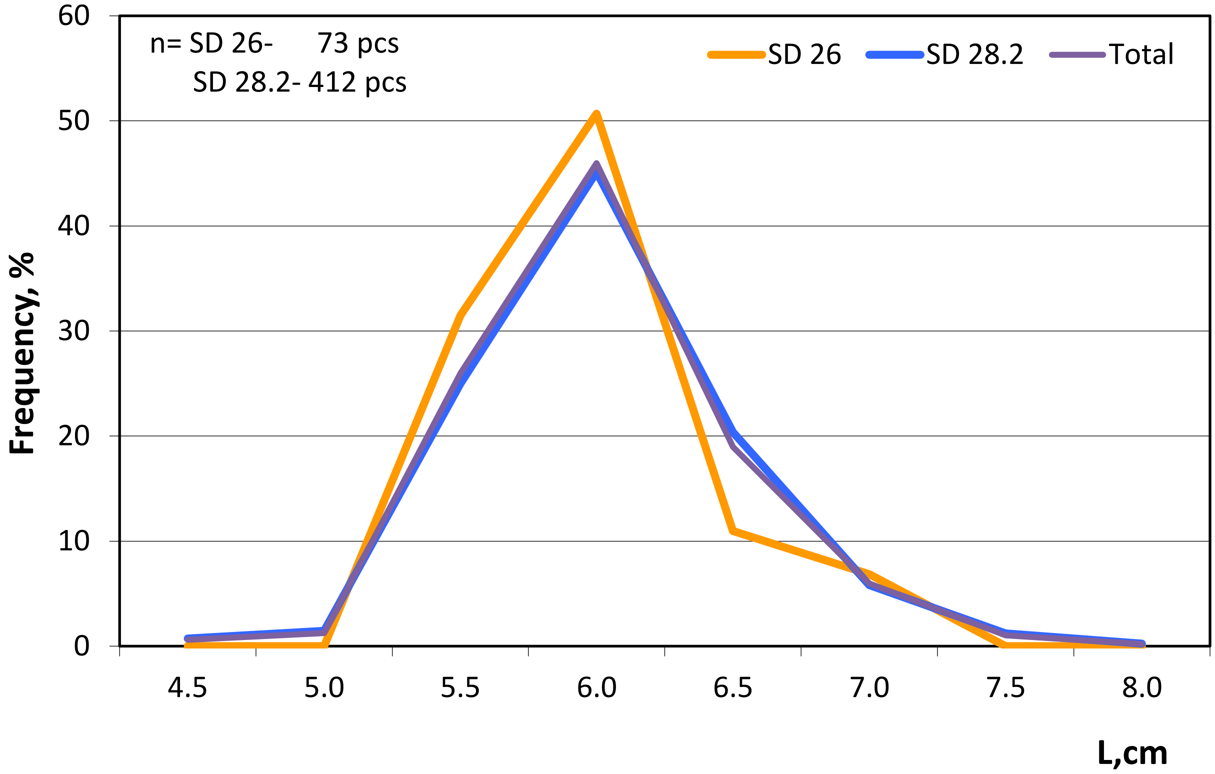

Figure 10: Stickleback length distributions in control catches in the Baltic Sea ICES SD 26N and 28.2 from the Latvian-Polish BIAS survey conducted by r/v "Baltica" in the period of 11-20.10.2019.

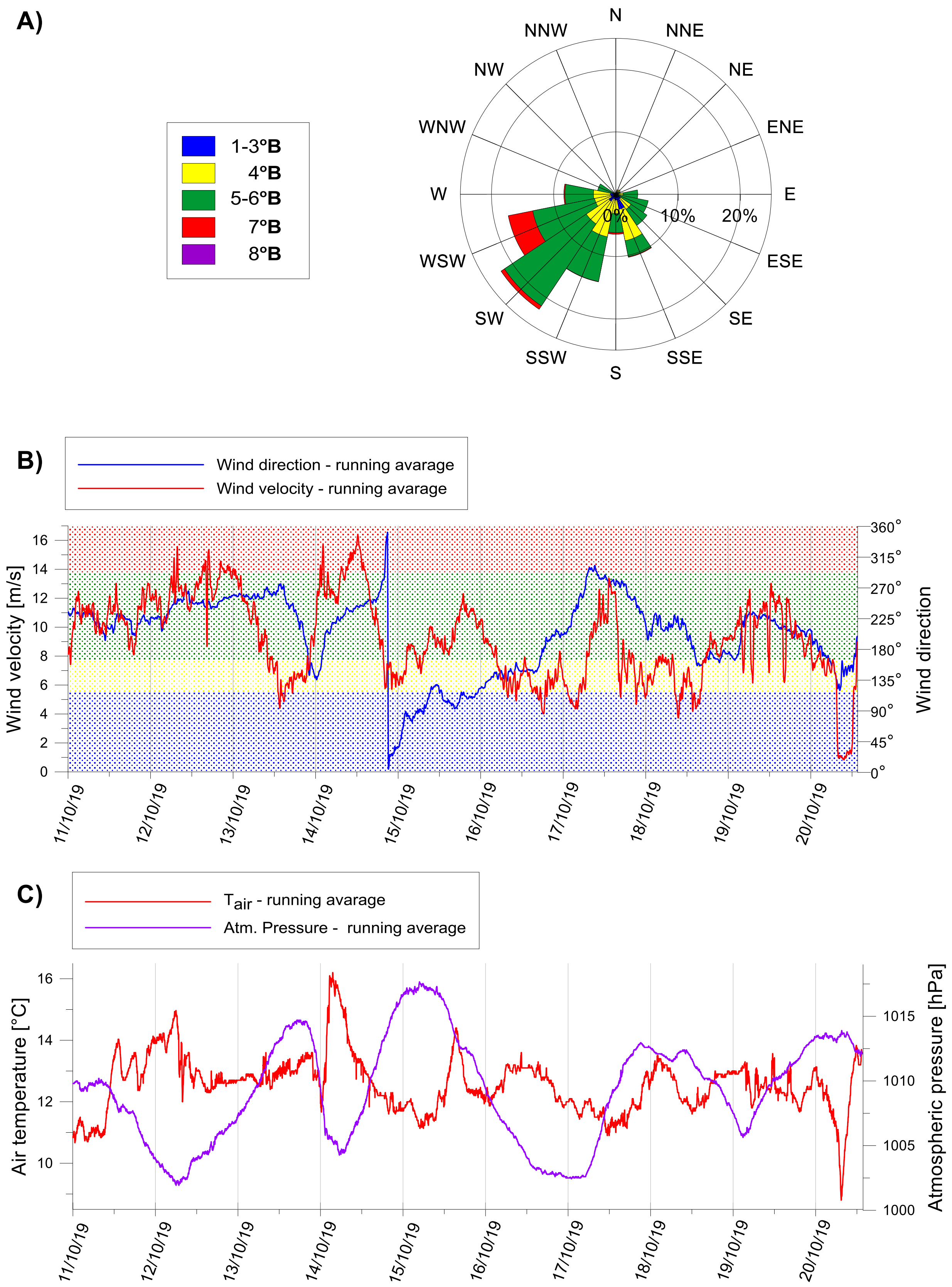

Figure 11: Changes of the main meteorological parameters (wind force, direction and the daily air temperature) during the Latvian-Polish BIAS survey in the Baltic Sea ICES SD 26N and 28.2 conducted by r/v "Baltica" in the period of 11-20.10.2019

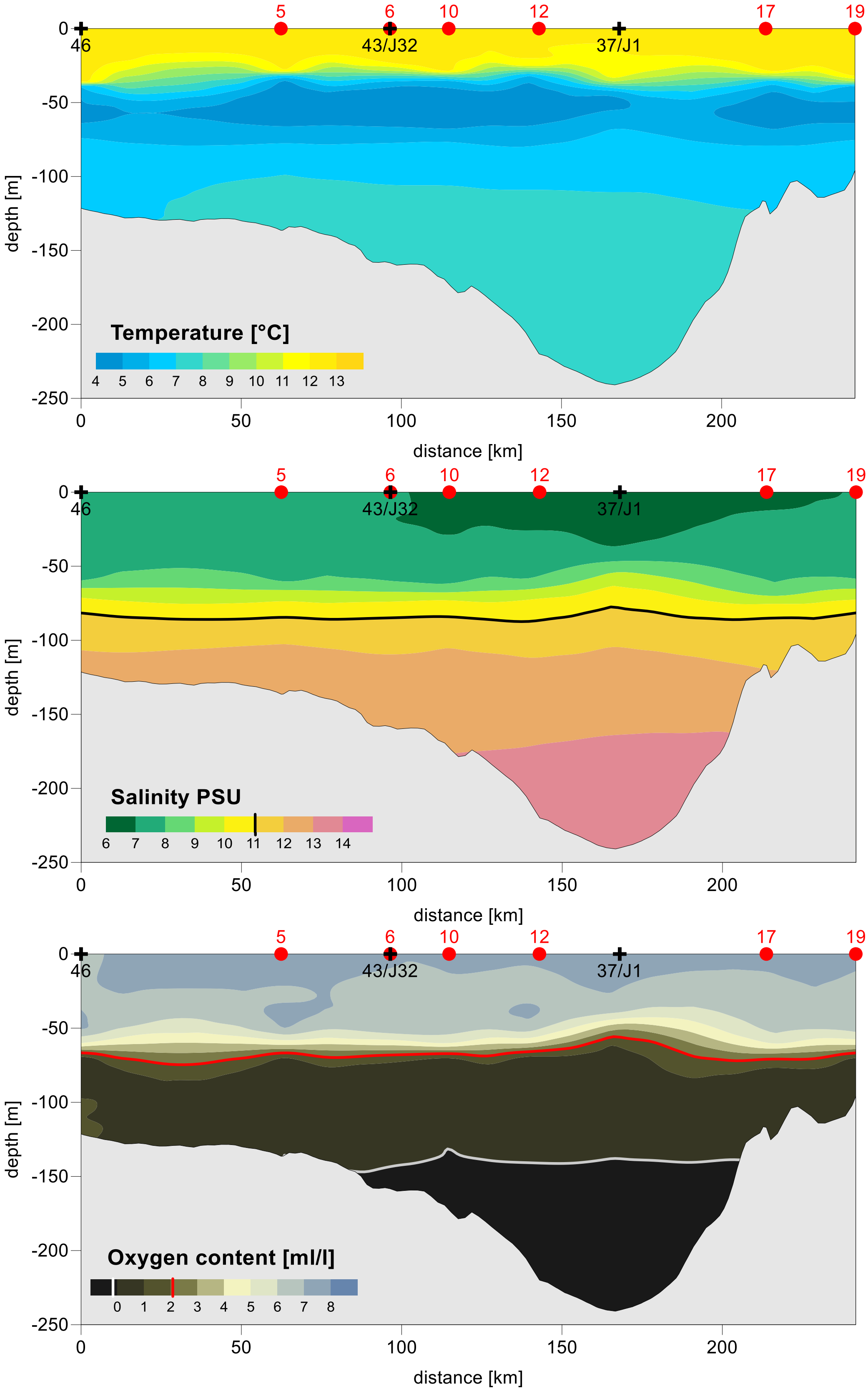

Figure 12: *Vertical distribution of the seawater temperature, salinity and oxygen content along the hydrological profile in the Baltic Sea ICES SD 26N and 28.2 from the Latvian-Polish BIAS survey conducted by r/v "Baltica" in October in the period of 11-20.10.2019.*

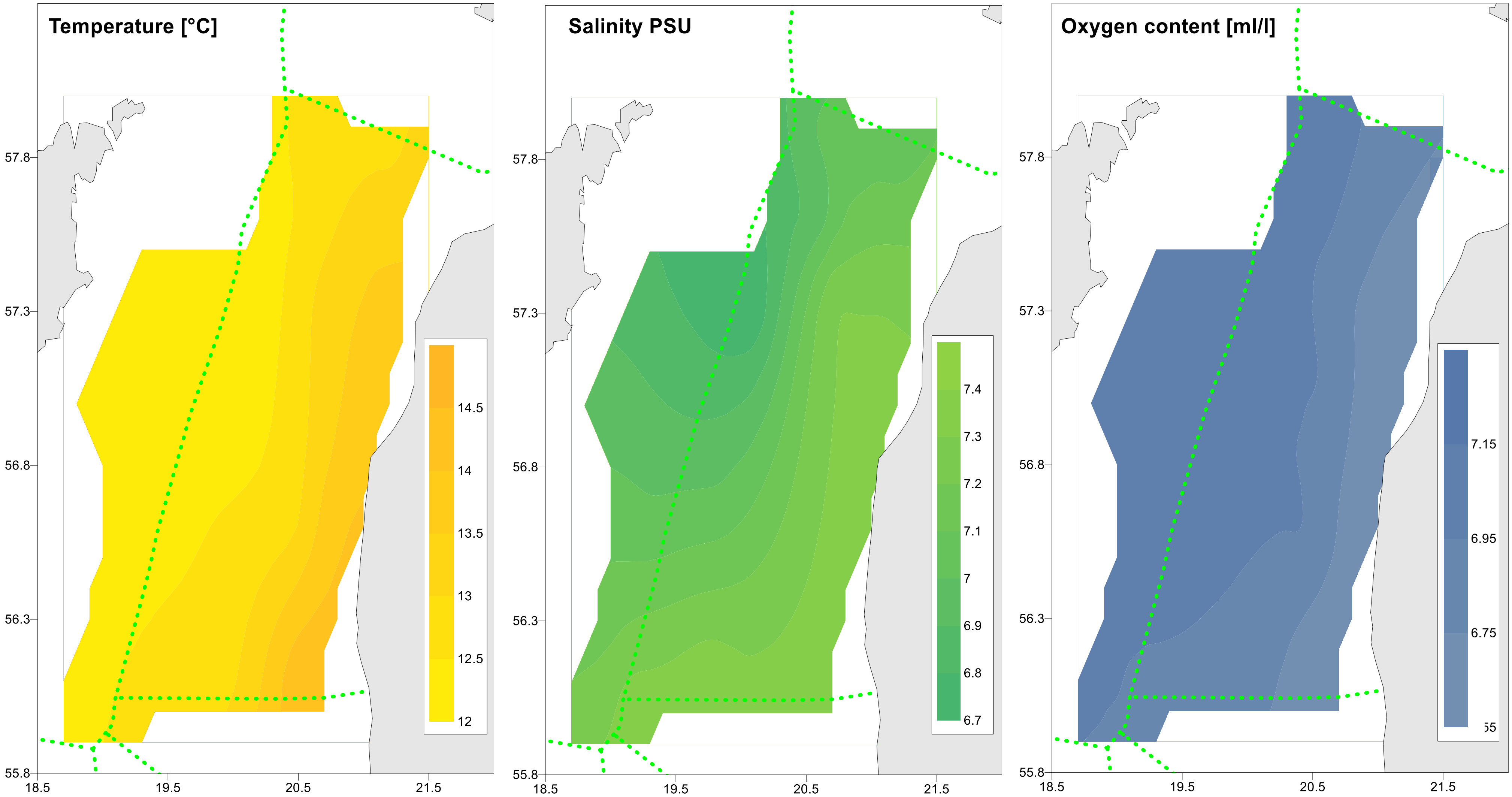

Figure 13: Horizontal distribution of the main hydrological parameters (temperature, salinity, oxygen content) measured in the surface water layer of the Gotland Deep in the Baltic Sea ICES SD 26N and 28.2 from the Latvian-Polish BIAS survey conducted by r/v "Baltica" in the period of 11-20.10.2019.

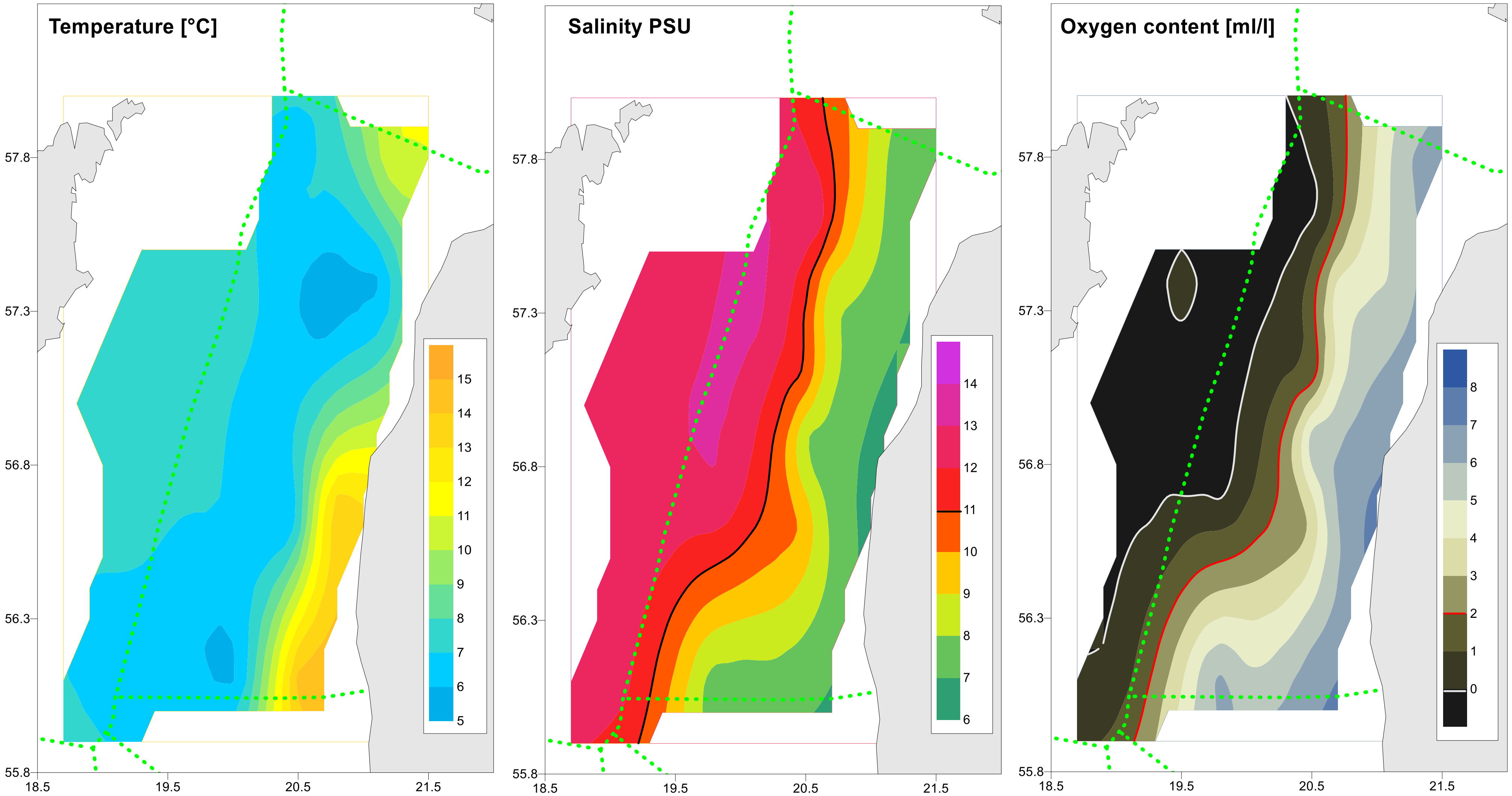

Figure 14: Horizontal distribution of the main hydrological parameters (temperature, salinity, oxygen content) measured in the bottom water layer of the Gotland Deep in the Baltic Sea ICES SD 26N and 28.2 from the Latvian-Polish BIAS survey conducted by r/v "Baltica" in the period of 11-20.10.2019.

MARINE RESEARCH INSTITUTE, KLAIPEDA UNIVERSITY

RESEARCH REPORT FROM THE BALTIC INTERNATIONAL ACOUSTIC SURVEY (BIAS) IN THE ICES SUBDIVISION 26 (LITHUANIAN EXCLUSIVE ECONOMIC ZONE) OF THE BALTIC SEA

(Vessel “ATLANT”; 30.10. - 31.10.2019)

Working paper on the WGBIFS meeting in Cadis, Spain, 30.03-03.04.2020

Klaipeda, October, 2019
Lithuania

1. INTRODUCTION

The main objective is to assess clupeid resources in the Baltic Sea. The international acoustic survey in October is traditionally coordinated within the frame of the **Baltic International Acoustic Survey (BIAS).** The reported acoustic survey is conducted every year to supply the ICES: Baltic Fisheries Assessment Working Group (WGBFAS) and Fisheries Service under the Ministry of Agriculture of The Republic of Lithuania (FS) with an index value for the stock size of herring, sprat and other species in the Subdivision 26 of the Baltic area.

Lithuanian BIAS surveys organized and realized by the Marine Research Institute delegates on board of the vessel “ATLANT”. Annual verification of herring, sprat and cod stocks size and their spatial distribution in the pelagic zone of the Lithuanian Exclusive Economic Zone (LEEZ) waters with applied an acoustic method, along preselected:

- determination of herring, sprat and cod (usually dominants in catches) proportion by numbers and by mass in pelagic control-catches and an evaluation of their fishing efficiency, i.e. catch per unit effort (CPUE) in the investigated area,
- characteristics of dominants age-length-mass structure, sex, sexual maturation, feeding intensity,
- a preliminary evaluation of herring and sprat new recruiting year-class strength,
- analysis of the vertical and horizontal changes of the basic hydrological parameters (seawater temperature, salinity, oxygen content) in areas inspected by the vessel “Darius”.

2. MATERIALS AND METHODS

2.1. Personnel

The main research tasks of the BIAS survey on board of the vessel "ATLANT" were realized by the Marine Research Institute two members of the scientific team. The group of researchers was composed of:

M. Špėgys, MRI KU, Klaipeda - cruise leader and acoustics;

T.Zolubas MRI KU, Klaipeda – scientific staff and fish sampling.

2.2. Narrative

The cruise of BIAS survey took place from 30 to 31-t of October 2020. The cruise was intended to cover parts of ICES subdivisions (SD) 26, constituting the Lithuanian Exclusive Economic zone in 40H0 and 40G9 rectangles.

2.3. Survey design

The statistical rectangles were used as strata (ICES 2016). The area is limited by the 20 m depth line. The scheme of transects is defined as the regular. The average speed of a vessel for the period of acoustic survey was 8 knots. The average speed of the vessel with a trawl was 2.8 knots. Duration of trawling was 30 minutes. The survey was conducted in the daytime from 08.00 up to 20.00. The survey area was 1520 nm2 and the distance used for acoustic estimates was 123 nm. The entire cruise track with positions of the trawling is shown in Fig. 1.

2.4. Calibration

The SIMRAD EK60 echo sounder with split beam transducer ES38 - 12 was calibrated (17 of October 2018) at the site of 30 m depth, located 3.5 nm northwest of Klaipeda harbour according to the BIAS manual (ICES 2016). Sv correction after calibration was set to 21.94 dB.

THE RESULTS OF CALIBRATION PROCEDURE FOR EK60 SCIENTIFIC ECHOSOUNDER	
Date: 17.10.2018	Place : near Klaipeda port
Type of transducer	Split – beam for 38 kHz
Gain (38 kHz)	21.94 dB
Athw. Angle Sens	12.5
Along. Angle Sens	12.5
Athw. Beam Angle	12.06
Along. Beam Angle	11.96
Athw. Offset Angle	-0.15
Along. Offset Angle	-0.15
SA Correction (38 kHz)	0.0dB

2.5. Acoustic data collection

The acoustic sampling was performed around the clock. The main pelagic species of interest were herring and sprat. The SIMRAD EK60 echo sounder with hull mounted 38 kHz transducer ES38-12 was used during the cruise. The specific settings of the hydro acoustic equipment were used as described in the BIAS manual (ICES 2016). The post-processing of the stored echo signals was made using the Sonar4 (Balk & Lindem, 2005). The mean volume back scattering values Sv, were integrated over 1 nm intervals, from 10 m below the surface 1 m to the bottom. Contributions from air bubbles, bottom structures and noise scattering layers were removed from the echogram using Sonar4.

2.6. Biological data – fishing stations

All trawling was done with the pelagic gear in the midwater as well as near the bottom. The mesh size in the cod end was 10 mm. The intention was to carry out at least two hauls per ICES statistical rectangle. The trawling depth was chosen by the echogram, in accordance to the characteristic of echo records from the fish. Normally, the trawl had vertical opening of about 12 m. The trawling time lasted 30 minutes. Caught fishes, before the length measurements, were separated by species and weighed, and the species catches proportion as well as the CPUE was determined for given species from each haul. The sample of fish from each catch-station was taken for the length-mass structure analyses. Fish sampling of the total length distribution and the mean mass at the 0.5-cm classes - in the case of clupeids and 1-cm classes in the case of cod were determined. From each haul sub-samples were taken to determine length and weight composition of fish. Samples of herring and sprat were analyzed for further investigations on the board of vessel (i.e. sex, maturity, age).

2.7. Data analysis

The pelagic target species sprat and herring are usually distributed in mixed layers in combination with other species, so that it is impossible to allocate the integrator readings to a single species. Therefore, the species composition was based on the trawl catch results. For each rectangle the species composition and length distribution were determined as the mean - weighted of all trawl results in this rectangle. From these distributions the mean acoustic cross section was calculated according to the following target strength-length (TS) relationships:

Clupeoids TS = 20 log L (cm) - 71.2 (ICES 1983/H:12)

Gadoids TS = 20 log L (cm) - 67.5 (Foote et al. 1986)

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

3. RESULTS

3.1. Biological data

713 herrings, 1639 sprats, 3 three-spined stickleback and 6 cods were measured in 5 hauls. Totally 305 individuals of sprat and 358 of herring were biologically analyzed (age, sex, maturity, stomach fullness). The results of the catch composition are presented in Table 1. Ichthyologic analyses were performed directly on board of surveying vessel, according to the ICES WGBIFS standard procedures. The numerical share of juvenile, undersized (below minimum landing/protective size) sprat and herring in the samples was determined based on fish length distribution results. For sprat, the minimum commercial size (the separate length) is equal to 10.0 cm, for herring is equal to 16.0 cm.

The length distributions of herring and sprat in BIAS survey show in Fig. 2 and 3. Sprat dominated only in 1,2 and 4-th trawl catch – 94-100%. Most of herring were fish 3-6 years and 16.8 -20.3 length classes in the both rectangles.

In the rectangle 40H0 more than 85% of sprat was represented by fish of last year generation (0 years and 7.0-7.5 cm). In the western part of LEEZ (40G9 rectangle ICES) 77.7% of sprat was adult fish 11.0-12.0 cm length and 3-5 ages. In the 40G9 rectangle young fish of was only about 4.1%.

3.2. Acoustic data

The survey statistics concerning the survey area, the mean Sa, the mean scattering cross-section σ, the estimated total number of fishes, the percentages of herring, sprat per rectangle are shown in Table 2-12.

3.3. Abundance estimates

BIAS survey statistics (aggregated data for herring and sprat) of total abundance herrings and sprats are presented in Tables 2-4. The estimated age composition of sprat and herring are given in Tables 5, 10. The estimated number sprat and herring by age group and rectangle are given in Table 6, 11. The estimates of sprat and herring biomass by age group and rectangle are summarised in Table 7, 12. The corresponding mean weights and mean length by age group and rectangle for each species are shown in Table 8-9 and 13-14.

The herring stock was estimated to be $640.6*10^6$ fish or about 25063.7 tones. (Fig. 2 and Table 8).

The sprat stock was estimated $1533.4*10^6$ fish or about 8164.2 tones. (Fig. 3 and Table 5).

4. REFERENCES

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

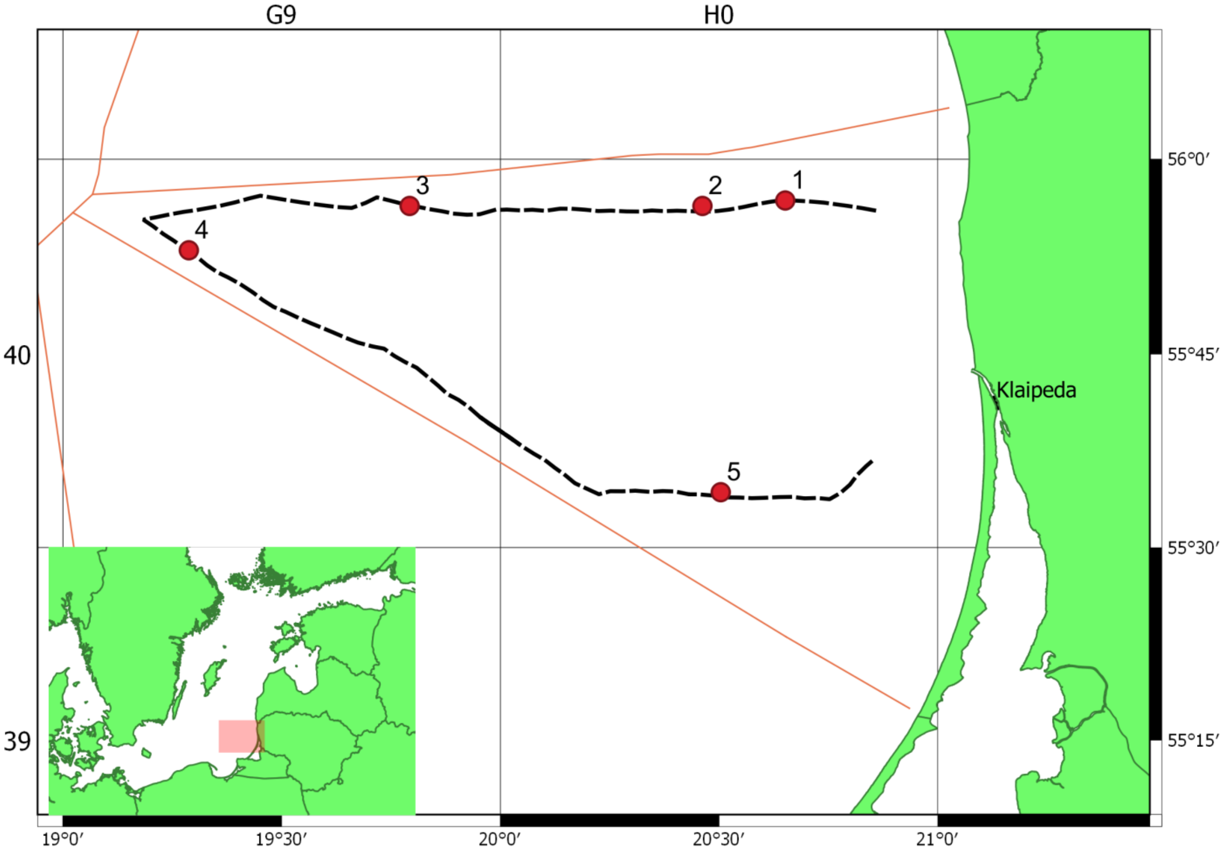

Figure 1. The survey grid and trawl hauls position of F/V "Atlant" (30-31 October 2019)

Table 1 Catch composition (kg/1hour) per haul (F/V "Atlant", 30.10- 31.10.2019)

ICES Subdivision					
Haul No	1	2	3	4	5
Date	30.10.2019	30.10.2019	30.10.2019	31.10.2019	31.10.2019
Validity	Valid	31.10.2019	31.10.2019	31.10.2019	31.10.2019
Species/ICES rectangle	40H0	40H0	40G9	40G9	40H0
Clupea harengus			236.10	30.03	715.0
Sprattus sprattus	50.0	60.0	173.48	469.92	285.0
Gasterosteus aculeatus				0.05	
Baltic cod			0.42		
Total	50.0	60.0	420.0	500.0	1000.0

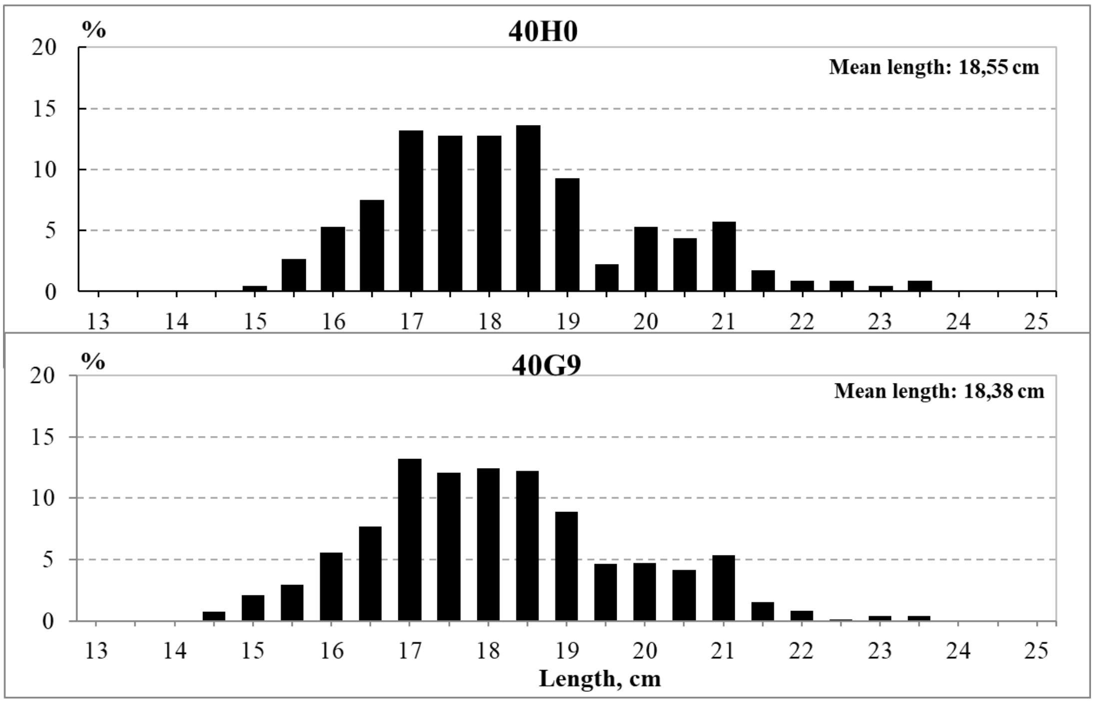

Figure 2 Length distribution of herring (%) (BIAS, 30.10- 31.10.2019

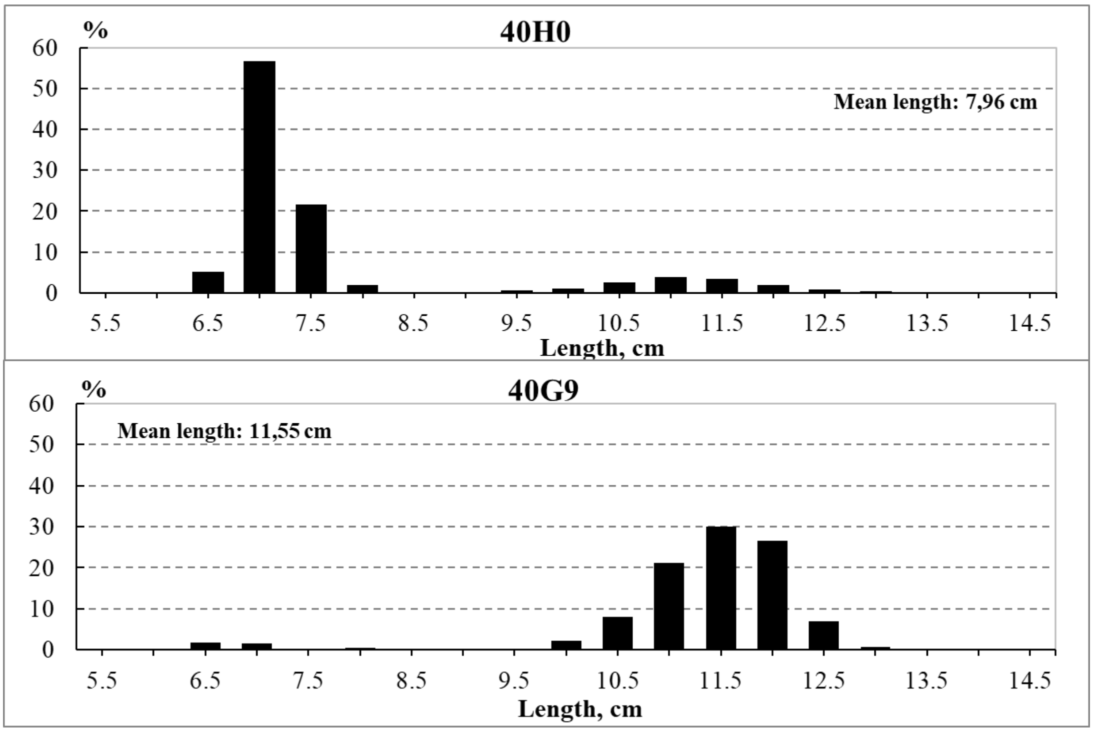

Figure 3 Length distribution of sprat (%) (BIAS, 30.10- 31.10.2019)

Table 2 BIAS survey statistics (abundance of herring and sprat), 30.10- 31.10.2019

ICES SD	ICES Rect.	Area nm^2	ρ mln/nm^2	Abundance, mln			Biomass, tonn		
				N sum	N her	N spr	W sum	W her	W spr
26	40H0	1012,1	1.72	1741.8	597.9	1143.9	27534	23415.8	4118.2
	40G9	1013,0	0.43	432.2	42.8	389.4	5694	1647.9	4046.0

Table 3 BIAS survey statistics (aggregated data of herring and sprat), 30.10- 31.10.20198

ICES SD	ICES Rect.	No trawl	Herring			Sprat			SA m^2/nm^2	TS calc. dB
			L, cm	w, g	Numb.,%	L, cm	w, g	Numb.,%		
26	40H0	1,2,5	18.55	39.17	34.32	7.96	3.60	65.68	265.8	-49.1
	40G9	3,4	18.38	38.54	9.89	11.55	10.39	90.11	63.1	-49.3

Table 4 BIAS survey statistics (herring and sprat), 30.10- 31.10.2019

ICES SD	ICES Rect.	Area nm^2	SA m^2/nm^2	σ *10^4 nm^2	Abundance mln.	Species composition (%)	
						herring	sprat
26	40H0	1012	265.8	1.54442	1741.8	34.32	65.68
	40G9	1013	63.1	1.47791	432.2	9.89	90.11

Table 5 BIAS survey estimated age composition (%) of sprat, 30.10- 31.10.2019

SD	Rect.	Age									
		Total	0	1	2	3	4	5	6	7	8
26	40H0	100,0	85.4	1.7	1.6	5.6	5.1	0.4	0.2	0.0	0.0
	40G9	100,0	4.1	1.5	5.1	30.4	49.1	9.7	0.0	0.0	0.0

Table 6 BIAS survey estimated number (millions) of sprat, 30.10- 31.10.2019

SD	Rect.	Age									
		Total	0	1	2	3	4	5	6	7	8
26	40H0	1143.9	977.2	19.2	17.8	63.9	58.6	5.0	2.2	0.0	0.0
	40G9	389.4	16.1	5.8	20.1	118.3	191.3	37.9	0.0	0.0	0.0

Table 7 BIAS survey estimated biomass (in tons) of sprat, 30.10- 31.10.2019

SD	Rect.	Age									
		Total	0	1	2	3	4	5	6	7	8
26	40H0	4118	2525	135	142	598	625	63	30	0	0
	40G9	4046	38	46	174	1184	2155	450	0	0	0

Table 8 BIAS estimated mean weights (g) of sprat, 30.10- 31.10.2019

SD	Rect.	Age									
		Mean	0	1	2	3	4	5	6	7	8
26	40H0	3.60	2.6	7.0	7.9	9.4	10.7	12.7	13.6		
	40G9	10.39	2.4	7.8	8.7	10.0	11.3	11.9			

Table 9 BIAS estimated mean length (cm) of sprat, 30.10- 31.10.2019

SD	Rect.	Age								
		Total	0	1	2	3	4	5	6	7	8
26	40H0	8.0	7.1	9.9	10.5	11.1	11.7	12.6	13.0		
	40G9	11.6	7.0	10.0	10.4	11.1	11.8	12.0			

Table 10 BIAS estimated age composition (%) of herring, 30.10- 31.10.2019

SD	Rect.	Age									
		Total	0	1	2	3	4	5	6	7	8
26	40H0	100.0	0.0	1.7	11.6	16.3	34.7	21.6	7.3	6.9	0.0
	40G9	100.0	0.0	0.0	4.4	8.8	39.5	31.3	10.8	4.2	1.1

Table 11 BIAS survey estimated number (millions) of herring, 30.10- 31.10.2019

SD	Rect.	Age									
		Total	0	1	2	3	4	5	6	7	8
26	40H0	597.9	0.0	10.3	69.2	97.3	207.5	128.9	43.6	41.1	0.0
	40G9	42.8	0.0	0.0	1.9	3.8	16.9	13.4	4.6	1.8	0.5

Table 12 BIAS survey estimated biomass (in tons) of herring, 30.10- 31.10.2019

SD	Rect.	Age									
		Total	0	1	2	3	4	5	6	7	8
26	40H0	23416	0	342	2238	3408	8045	5102	2160	2121	0
	40G9	1648	0	0	58	120	640	508	203	87	32

Table 13 BIAS survey estimated mean weights (g) of herring, 30.10- 31.10.2019

SD	Rect.	Age									
		Total	0	1	2	3	4	5	6	7	8
26	40H0	39.2		33.2	32.3	35.0	38.8	39.6	49.5	51.6	
	40G9	38.5			31.1	31.9	37.9	38.0	44.1	48.2	67.2

Table 14 BIAS survey estimated mean length (cm) of herring, 30.10- 31.10.2019

SD	Rect.	Age									
		Total	0	1	2	3	4	5	6	7	8
26	40H0	18.55		17.2	17.0	17.5	18.2	18.4	20.3	20.4	
	40G9	18.38			16.5	16.8	18.1	18.0	19.2	20.0	22.2

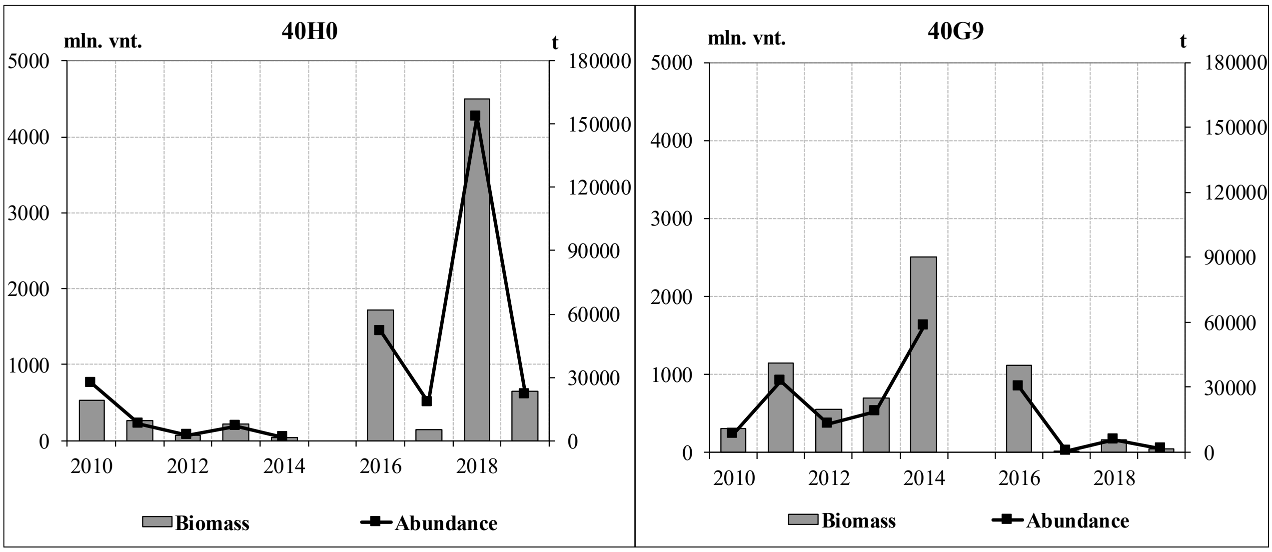

Figure 4 Biomass and abundance of herring by acoustic survey results from October of 2010 – 2019 in ICES rectangles 40H0 and 40G9

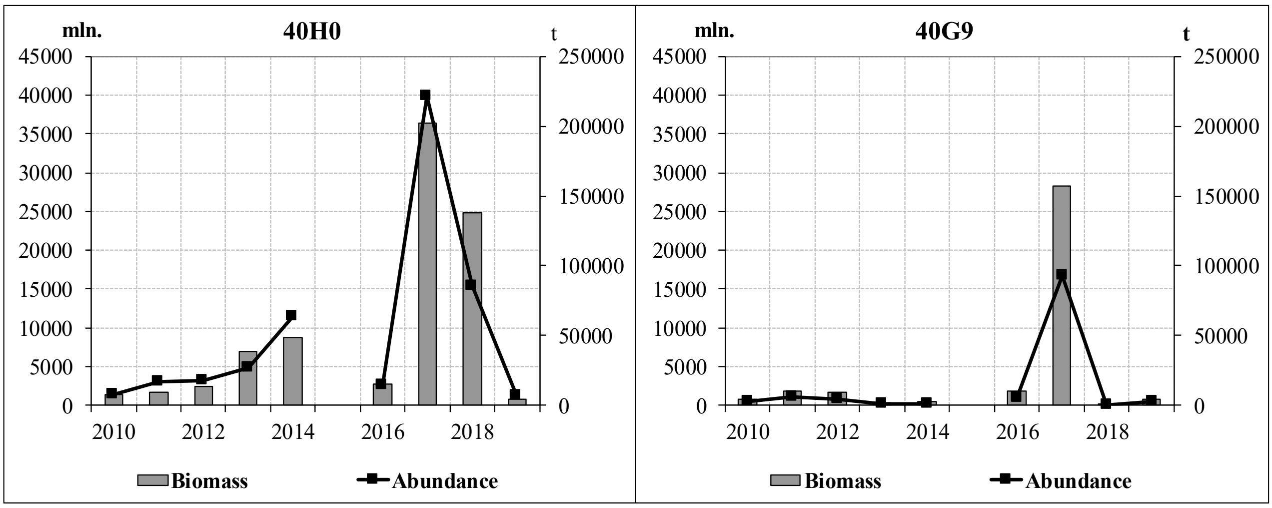

Figure 5. Biomass and abundance of sprat by acoustic survey results from October of 2010 – 2019 in ICES rectangles 40H0 and 40G9

Working paper on the WGBIFS meeting in Cadiz (Spain), 30.03-03.04.2020

Research report from the Polish part of the Baltic International Acoustic Survey on board of the r.v. "Baltica" (15-30.09.2019)

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INTRODUCTION

The Polish BIAS/2019 survey was conducted in the framework of the ICES International Baltic Acoustic Surveys (IBAS) long-term programme including spring (Sprat Acoustic Survey SPRAS) and autumn (Baltic International Acoustic Survey BIAS) acoustic surveys. The ICES Baltic International Fish Survey Working Group (WGBIFS) coordinates methods of investigations, the timing of surveys, spatial allocation of vessels and the general pattern of pelagic control-hauls distribution in the Baltic, regarding both types of acoustic surveys, i.e. SPRAS and BIAS. The above-mentioned working group is also responsible for the compilation of international results needed for assessment of clupeids stocks size in the Baltic. The set of input data and recommendations are next transferred to the ICES Baltic Fisheries Assessment Working Group (WGBFAS) for the final evaluation of fish stocks size.

The reported Polish BIAS/2019 survey was conducted on board of the r.v. "Baltica" inside the Polish and partly the Danish EEZ, in the period of 15-30.09.2019. The Polish Fisheries Data Collection Programme for 2019 and the European Union (the Regulation (EU) 2017/1004 of the European Parliament and of the Council of 17 May 2017) financially supported the Polish BIAS survey marked with internal No. 18/2019/MIR-PIB.

The survey was focused on monitoring of clupeids and cod spatial-seasonal distribution in the pelagic zone of the southern Baltic (parts of the ICES Sub-divisions 25 and 26), and preliminary estimation of herring and sprat 2019 recruiting year-class abundance. The EK60 SIMRAD acoustic system with newly determined calibration parameters was applied to completing the BIAS survey tasks.

The main goal of the current paper is a brief description of results of analysis focused on sprat, herring and cod stocks size (biomass, abundance) changes and their spatial distribution as well as the CPUE variation within the surveyed part of the southern Baltic in autumn 2019. Moreover, the paper contains a description of sprat, herring and cod selected biological parameters variation. The principal hydrological parameters fluctuation in the water column of the southern Baltic are also described.

MATERIAL AND METHODS

Research team personnel

The main research tasks of the Polish BIAS/2019 survey on board of the r.v. "Baltica" were realized by the NMFRI (Gdynia) nine members of the scientific team, with Beata Schmidt as a cruise leader. The group of researchers was composed of:
Beata Schmidt – hydroacoustician,
Krzysztof Koszarowski - hydroacoustician,
Julia Gutkowska – ichthyologist, sprat analyses,
Grzegorz Modrzejewski – technician, sprat analyses,
Wojciech Deluga – technician, herring analyses,
Paweł Rosa - technician, herring analyses,
Krzysztof Radtke - ichthyologist, cod and other fish species analyses,
Ireneusz Wybierala – technician, cod and other fish species analyses,
Anetta Ameryk – hydrologist.

The course of the cruise

The r.v. "Baltica" left Gdynia port on 15.09.2019 at 07:35 a.m. and was navigated in the south-east direction. At the mouth of the Vistula River an attempt to perform calibration of the acoustic system SIMRAD EK60, installed on the vessel, was made. Unfortunately, due to strong wind and a large drift of the ship, the calibration failed. On the same day, acoustic integration and control pelagic hauls were started on transects located in the southern part of the Gulf of Gdansk. Deterioration of weather conditions prevented the implementation of research tasks on the 16th and 17th of September. In the following days, work was continued on transects in the Gulf of Gdansk and the eastern part of the Polish EEZ. On the 22nd of September, the successful calibration of the 38 kHz frequencies of EK60 acoustic system was performed at the position of the hydrological station B3 (λ = 018°00.0'E, ϕ = 55°20.0'N). Due to deteriorating weather conditions in the Eastern Baltic, on the 23rd of September, at 10:30, the measurements were completed at the position λ = 017°40,0'E, ϕ = 55°00,0'N and the ship was moved west. On the 24th of September, at the most west position (λ = 015°00.0'E, ϕ = 54°30.0'N), the acoustic integration and control hauls were resumed in the east direction. An acoustic integration was completed on the 29th of September. The r.v. "Baltica" returned to the Gdynia port on the 30th of September 2019 at 07:00 a.m.

Survey design and realization – sampling description

The ICES statistical rectangles, designated by the ICES-WGBIFS as mandatory to Poland, were fully covered with the standard acoustic-biotic researches during BIAS 2019 cruise (Fig. 2). However, due to changes in the demarcation of sea areas at the Baltic Sea, (signed in Brussels on November 19, 2018) the echosounding was not performed in the 38G4 and 39G5 ICES rectangles (ICES SD 24 and 25 respectively), which as optional were allocated to Poland (ICES, 2019).

The SIMRAD EK60 version 2.2.0, a split-beam scientific echosounder, linked with the GPT transceivers, operating at 38 and 120 kHz frequencies, as in the previous years, was used in the recent Polish BIAS 2019 survey. Calibration of the vessel's acoustic system was performed on the 22nd of September 2019 at the following location: λ = 018°00.0'E, ϕ = 55°20.0'N over seabed depth of 77 m (Fig. 2). The echosounder calibration was performed as described in Simrad (2012) using the copper spheres of diameters 60 mm and 23 mm for 38 kHz and 120 kHz frequencies respectively as reference targets. However, calibration results obtained in September 2019 were considered as good for 38 kHz (RMS=0.12). However, due to the deteriorating weather conditions during the calibration of the 120 kHz transducer, the work was discontinued. For acoustic estimation of pelagic fish abundance, only 38 kHz recording is used, therefore only new values of calibration constants for this frequency were introduced into the acoustic system. Calibration results for the 38 kHz transducer are given in Fig. 1.

The acoustic sampling was performed along the pre-selected acoustic transects on the distance of 777 NM. The echo-integration data were collected in a daytime regime at the shipping speed of 7 kn. Because of the historical comparability of data, pre-selected echo-integration transects were planned in a similar pattern as in recent years. The survey effort was comparable to previous years.

The settings of the hydroacoustic equipment were as described in the IBAS Manual (ICES, 2017). The post-processing of the stored raw data was done using the Echoview software (www.echoview.com). Only 38 kHz transmitter's data were taken into further processing because that frequency is recommended for fish trace recording. The acoustic analysis was carried out taking into account the new calibration constants determined during the calibration (for the data recorded before the successful calibration, the calibrations constants were corrected in Echoview software). In the first step of acoustic data checking, all visible interferences from the sea surface, turbulences and bottom structures visible on echogram were excluded from further analysis. The minimum threshold on mean volume backscattering strength S_v was set to -60 dB. Calculation of parameter S_A [m^2NM^{-2}] (hereinafter called NASC) for 1 nautical mile elementary standard distance units (ESDUs) was carried out by integrating S_v values (in a linear domain) from 10 m below the sea surface to about 0.5 m over the seafloor and then averaged within 1 NM interval. Then the mean NASC (Nautical Area Scattering Coefficient) per ICES rectangles were calculated. Also, weighted mean NASC per ICES SDs were calculated with the use of the size of investigated areas as weight.

Overall 27 catch-stations (14 in the ICES SD 25 and 13 in the ICES SD 26) were conducted by the r.v. "Baltica" in the period of 15-30.09.2019 (Fig. 2, Table 3), using the herring small-meshed pelagic trawl type WP53/64x4, with 6 mm mesh bar length in the codend (Table 3). All control-catches were accepted as representative from a technical point of view. The trawling depth was chosen by echo distribution, visible on the screen of echosounder. Because of a relatively high vertical opening (up to 20 m) of applied pelagic trawl and the technical-acoustics disturbances from a set vessel-trawl, the areas shallower than 30m were not controlled by the trawls. The trawling time for many hauls was 30 minutes, however, it was shortened when echogram and net-sounder indicated a large concentration of fishes in the operation area of fishing gear. The mean speed of the surveying vessel during trawling ranged from 3.0 to 3.5 knots. Fish catches were localized at the depth ranged from 10 to 75 m from the sea surface (position of the headrope of trawl). At trawling positions, depth to the bottom varied from 30 to 108 m.

Fish caught in each control-haul were separated by species and weighted. The results of catch per unit effort (CPUE) of dominated fish species and their average share in the r.v. "Baltica" pelagic catches are presented in Table 3 and Figs 5-7. The samples for sprat, herring, and cod were taken for length, age, and mass measurements. Fish total length distribution (Fig. 8) and the mean mass were determined in the 0.5-cm classes - in the case of clupeids and 1-cm classes in the case of cod. The numerical share of juvenile, undersized (below minimum landing/protective size) sprat, herring and cod in samples was determined (Table 4) based on fish length distribution results. For sprat, the minimum commercial size (the separate length) is equal to 10.0 cm, for herring is equal to 16.0 cm and for cod is 35.0 cm.

Detailed ichthyological analyses were made according to standard procedures (Anon., 2012), directly on board of surveying vessel. Overall, 27, 25 and 11 representative samples were taken for the length and mass determination of sprat, herring and cod, respectively. The length and mass were measured for 5562 sprat, 5466 herring and 126 cod individuals. Respectively, 456, 848 and 126 individuals of the above-mentioned species were biologically analysed (sex, maturity, stomach fullness and age).

Before each haul and at the standard hydrological stations located within the Polish EEZ, the seawater temperature, salinity, and oxygen content were measured continuously from the sea surface to the seabed. In total 37 hydrological stations were inspected using the CTD SeaBird 911+ probe combined with the rosette sampler. Oxygen content was determined applying standard Winkler's method. The hydrological raw data, aggregated to the 1-m depth stratum, were the source of information about the abiotic factors potentially influencing spatial distribution of fish.

The basic meteorological parameters i.e. air temperature, air pressure, wind direction, and force, and sea state were registered at each catch-station with the automatic station MILOS 500.

Data analysis

Due to inability to distinguish herring and sprat from other species by visual inspection of the echogram, therefore species composition and fish length distributions from trawl catch results are used to aid acoustic species identification. Such data analysis is sectioned according to the ICES statistical rectangles. For each ICES rectangle, based on trawl results performed within, the share of all fish species numbers and its length distribution, as the unweighted mean, were calculated. Our intention was to carry out at least two control-hauls per ICES rectangle, according to the guidelines in the “SISP Manual of International Baltic Acoustic Surveys (IBAS)” (ICES, 2017). Hauls with low level of catch and/or non-representative species composition were excluded from the analysis. This included hauls no. 25 (see Table 3). In the case of missing hauls within individual ICES rectangle, haul results from neighbouring rectangles were used. The assignment of hauls carried out during BIAS 2019 cruise to ICES Sub-divisions and rectangles are presented below:

Sub-division (SD)	ICES rectangle	Haul no.
25	37G5	14,17
25	38G5	15,16,18
25	38G6	19,21,22
25	38G7	26
25	39G6	23,23
25	39G7	24,26,27
26	37G8	3
26	37G9	1,2
26	38G8	4,10
26	38G9	5,6
26	39G8	9,11
26	39G9	7
26	40G8	8,12,13

Based on species distributions the mean acoustic cross section σ was calculated according to the following target strength-length (TS) relation:

	TS	References
Clupeoids	= 20 log L (cm) - 71.2	ICES 1983
Gadoids	= 20 log L (cm) - 67.5	Foote et al. 1986
Scomber scombrus	= 20 log L (cm) - 84.9	ICES 2017

The total number of fish in each the ICES rectangle was estimated as a product of the mean NASCs from scrutinized acoustic data and a rectangle area, divided by the corresponding mean acoustic cross-section σ. Clupeids abundance was separated as sprat or herring according to their mean share in catches of given ICES rectangle. In case when the mean numerical share of sprat herring and cod in ICES rectangle exceeded 99%, then other species were excluded from further calculations. Thus, fish species considered in this report are as follows: *Clupea harengus*, *Sprattus sprattus*, *Gadus morhua* and *Gasterosteus aculeatus*.

RESULTS

Acoustic results

The spatial distribution of mean NASC values (5 NM intervals), predominantly derived from clupeids, measured on hydroacoustic transects during BIAS 2019 survey is presented in Fig. 3. The highest NASC values were recorded in the southern part of the Gulf of Gdansk (SD26). The mean NASC values per ICES Sub-divisions and rectangles are presented in Tables 1 and 2. Overall NASC values recorded during the Polish BIAS 2019 survey remain at a lower level as recorded during BIAS 2018 cruise. In both ICES Sub-divisions, the NASC value decreased, in SD25 by about 25% and in SD 26 by about 18% compared to the previous year. In almost all ICES rectangles, mean NASC values were lower or comparable to the previous year (Table 2). Only in the Gulf of Gdańsk, in ICES rectangles 37G8 and 37G9, mean NASC values exceeded 1000 m^2Nm^2 and were higher than in the previous year - in ICES rectangle 37G8 the average NASC value was almost four times higher than recorded in 2018. The highest NASC value per 1 mile equal to 8022 m^2/Nm^2 was recorded in rectangle 37G9 (Fig. 4). The largest decrease in the mean NASC value was observed in rectangle 39G7 (the Słupsk Furrow) and 38G8 - in both rectangles the mean NASC value was almost three times lower than recorded in 2018.

Fish catches, biological parameters and stocks size

In September 2019, overall, 19 fish species were recorded in 27 scrutinized pelagic hauls taking place in the Polish and Danish parts of the ICES Sub-divisions 25 and 26 (Table 3, Fig. 2). In total, 5127 kg of fish were caught, and the mean share of sprat, herring, cod and all other species was 55.8, 42.4, 0.7 and 1.1%, respectively. In the last 14 years, the dominance of sprat in total catches from BIAS surveys (carried out during the summer and/or autumn) was observed only in 2009 and 2017. In 2006-2008, 2012 and 2018, the share of sprat and herring was similar, while in 2010-2011 and 2013-2016 herring dominated in the catches (Smoliński et al., 2018). Catches without fish in a single haul did not occur. Neither sea-mammals nor any sea-birds were detected in the catches. Sprat dominated by mass in hauls and herring was the second species in terms of mass with the mean CPUE in the entire study area amounted 228.17 and 173.37 kg h^{-1}, respectively. Sprat and herring occurred in each pelagic haul. Cod can be considered as a significant bycatch in accomplished pelagic trawl catches (Table 3, Figs. 5-7). The appearance of cod was noticed in 44% of performed hauls. The mean CPUE of cod in all investigated marine waters was 2.71 kg h^{-1}.

In the ICES Sub-division 26, sprat did not markedly dominated by the total mass (1011.5 kg), the mean CPUE (196 kg h^{-1}) and the mean share (55.5%) in 13 hauls realised inside the Polish part of the mentioned Sub-division. The above-mentioned exploitation parameters were somewhat lower for sprat caught in the ICES Sub-division 25 and amounted 1871.5 kg, 267 kg·h^{-1} and 56.1%, respectively in 14 hauls. Sprat highest CPUE (Fig. 5) was obtained in a few single research catches conducted, e.g.: in the north-western part of the Polish EEZ (953.6 kg h^{-1}), in the ICES rectangle 38G8 (576.7 kg h^{-1}) and the Gulf of Gdańsk close to the border of Polish and Russian EEZ (487.3 kg h^{-1}).

Herring was the second in a row regarding CPUE and mean share in the total weight of caught fishes (Figs. 5-7). The mean share of herring in the ICES SD 26 and 25 was 41.1% and 43.3%, respectively. The mean CPUE of this species in above-mentioned areas was 138 and 207 kg h^{-1}. In ICES Sub-division 25, the larger concentration of herring was observed in ICES rectangles 39G7 (540.9 kg h^{-1}) and 37G5 (504.1 kg h^{-1}). In the area of ICES Sub-division 26 only in the Gulf of Gdańsk (ICES rectangle 37G9) the CPUE reached 389.0 kg h^{-1}.

The highest CPUE of cod, amounted 33.9 kg h^{-1}, was achieved in a haul accomplished in the Gotland Deep (ICES rectangle 40G8).

The results of sprat, herring and cod some biological features investigations in September 2019 are presented in Figure 8 and Tables 4, 8, 11, 14. The total length of species dominated in hauls conducted in all the investigated areas ranged as follows:

- sprat – 6.5 ÷ 16.0 cm (avg. l.t. = 12.3 cm, avg. W = 11.6 g),
- herring – 9.0 ÷ 29.5 cm (avg. l.t. = 16.2 cm, avg. W = 28.0 g),
- cod – 3.0 ÷ 53.0 cm (avg. l.t. = 32.8 cm, avg. W = 290.8 g).

The unimodal length distribution curves for sprat in September 2019 differed from bimodal curves characteristic for samples from BIAS/2018 (Fig. 8). However, in both years the main frequency apex, according to given ICES Sub-division was distinguished in the same length class (Fig. 8). In samples from the ICES Sub-division 26 specimens from class 11.5 cm dominated and in the ICES Sub-division 25 - from class 12.5 cm, representing adults, commercially sized sprat. In samples from September-October 2018 the second, minor frequency apex, representing young, undersized specimens is visible for sprat from the length classes of 8.0 and 9.0 cm, in the case of the ICES Sub-divisions 26 and 25, respectively. In the same survey, the mean numerical share of undersized sprat (in Poland determined as <10.0 cm total length) in given ICES Sub-division was significantly higher than during the same type of survey in 2019 (Table 4). For example, in the ICES Sub-division 25 values of the mentioned parameter were 18.6 and 1.9% adequately, in autumn 2018 and 2019. The mean bycatch of undersized sprat in the entire study area in 2018 and 2019 was 21.3 and 4.6%, respectively.

For herring collected in September 2019, the bimodal shape of length distribution curve was characteristic for samples originated from the ICES Sub-divisions 25 and 26 (Fig. 8). In samples from the ICES Sub-division 25, the first apex was noticed for the length class 17.0 - 17.5 cm, representing adults, commercially sized herring and the second one for 12.0 cm. For herring from ICES Sub-division 26, the share of undersize herring was more noticeable. The first pick of the curve was for length classes 10.5-11.0 cm and the second for 17.0-19.0 cm. The different situation was observed for herring samples from BIAS/2018. One apex was detected for the length class 17.5 cm for both ICES Sub-divisions. In the same BIAS survey, the mean numerical share of undersized herring (in Poland determined as <16.0 cm total length) in given ICES Sub-division was significantly lower than during the same type of survey in 2019 (Table 4). For example, in the ICES Sub-division 26 values of the mentioned parameter were 14.9 and 46.1% adequately, in autumn 2018 and 2019. The mean bycatch of undersized herring in the entire study area was 54.5 and 73.8%, respectively in 2018 and 2019.

The length distribution curves for cod sampled in the ICES Sub-divisions 25 and 26 in BIAS/2018 and BIAS/2019 were multimodal, without one specific length class dominated by frequency (Fig. 8). However, in 2019 in both Sub-divisions, similarly to cod catches in ICES SD 25 in 2018, cod with the length class 33 cm was more frequent in the catches than cod from other length classes. The mean numerical share of undersized cod caught during the BIAS/2019 (determined as <35.0 cm total length) was different for cod from ICES SD 25 and ICES SD 26. The mean bycatch of undersized cod was 63.8 and 79.8%, respectively (Table 4). Compared to the BIAS/2018, the share of undersized cod increased significantly. However, the number of sampled cod in 2019 was lower than in 2018.

Data reflects changes of the mean weight of sprat, herring and cod per age groups according to ICES rectangles inspected during the BIAS/2019 survey are presented in Tables 8, 11 and 14.

The basic data evaluated in September 2019, including data on Baltic sprat, herring and cod stocks total abundance and biomass per age groups and the ICES rectangles, adequately to echosounding under frequency of 38 kHz are given in Tables 6, 7, 9, 10, 12 and 13. The above-mentioned materials are strongly linked with data on the Polish BIAS/2019 cruise statistics and average NASC values for acoustically covered ICES rectangles (Table 5). The mean biomass surface density of sprat, herring and cod, per ICES Sub-divisions and ICES rectangles, located within the Polish marine waters is reflected in Figs 9, 11, 12. The abundance of above-mentioned species per age groups, according to inspected in autumn 2018 and 2019 parts of the ICES Sub-divisions 25 and 26 is demonstrated in Fig. 10.

In September 2019, the highest mean biomass surface density of sprat stock was estimated for the ICES rectangles: 37G9 and 37G8 (both located in the southern part of the Gulf of Gdańsk) and amounted: 212.1 and 168.2 t NM^{-2}, respectively (Fig. 11). The minimum value of this parameter was noticed in the eastern parts of the investigated marine waters, in ICES rectangle 39G9 and amounted 0.1 t NM^{-2}. The recent pattern of sprat surface biomass density distribution per ICES rectangles can be considered as almost a mirror picture from autumn 2018 (Fig. 11). In 2018 the mean biomass density of sprat in the ICES SD 25 was higher than in 2018 (6.5 and 5.3 t NM^{-2} in 2019 and 2018 respectively), and was lower in the ICES SD 26 in 2019 (17.6 t NM^{-2}) than in 2018 (21.2 t NM^{-2}) (Fig. 9).

In September 2019, the highest mean biomass surface density of herring stock was estimated for the ICES rectangles 37G9 (116.5 t NM^{-2}) and 37G8 (75.2 t NM^{-2}) – located in the southern part of the Gulf of Gdansk (Fig. 11). The recent pattern of herring surface biomass density distribution per ICES rectangles can be considered as quite similar to that observed in autumn 2018 (Fig. 11). In 2019 the mean biomass density of herring in both ICES Sub-divisions was much lower than in 2018, in SD25 it dropped from 14.8 t NM^{-2} in 2018 to 6.4 t NM^{-2} in 2019, and in SD 26 it amounted 29.0 and 20.7 t NM^{-2} in 2018 and 2019 respectively (Fig. 9).

During the BIAS 2019 cruise, the highest mean biomass surface density of cod was estimated for the ICES rectangles: 40G8 (5.7 t NM^{-2}) – located in the southern part of the Gotland Basin (Fig. 12). In other rectangles, the mean biomass surface density of cod fluctuated from 0.01 to 0.9 t NM^{-2}. However, in five ICES rectangles, namely: 38G7, 39G7, 37G8, 37G9 and 39G9 the appearance of cod was not detected (Tables 3, 13, Fig 12). In 2019 the biomass density of Baltic cod in SD25 was much lower than in SD26 and amounted 0.1 and 1.4 t NM^{-2} respectively (Fig. 9). Comparing to 2018 data, in 2019 mean biomass surface density of cod was lower in ICES SD25 (0.9 t NM^{-2} in 2018 and 0.1 t NM^{-2} in 2019) and on a similar level in SD26 (1.2 t NM^{-2} in 2018 and 1.4 t NM^{-2} in 2019).

Meteorological and hydrological characteristics of the southern Baltic

Changes of the main meteorological parameters – wind velocity and direction, and air temperature in consecutive days of the Polish BIAS survey carried out in 2019 are illustrated in Fig. 13. The air temperature during the reported survey varied from 8.6 to 19.8°C (avg. was 13.8°C). The wind force changed from 1 to 7°B, and winds from the west direction prevailed. During fishing operations prevailed the moderate wind (5°B) mostly from west directions (Table 15).

The main hydrological parameters at the depths of fish pelagic catches (Table 15), i.e. in the range of 19-79 m (with 18 m vertical net opening on average) changed in the relatively broad ranges. The seawater temperature fluctuated from 4.3 to 16.9°C (the mean was 9.1°C), salinity from 7.4 to 15.1 PSU (the mean was 9.3 PSU) and oxygen content from 1.3 ml l^{-1} at haul No. 20 (the Bornholm Basin) to 10.1 ml l^{-1} (the mean was 5.2).

The surface water hydrological parameters changed in relatively narrow ranges: 14.5-17.3°C, 7.2-7.6 PSU and 6.3-6.9 ml l^{-1} for temperature, salinity, and oxygen content respectively. Horizontal distribution of the seawater temperature, salinity, and oxygen content in the near bottom zone of the southern Baltic (within the Polish waters) is illustrated in Fig. 14. The temperature in the near-bottom layer was changing horizontally within the range of 5.5-16.8°C and the mean was 9.4°C. The lowest seawater temperature was recorded at the catch-station No. 13 and the highest at the catch-station No. 3, i.e. southern part of the Gulf of Gdansk (Fig. 2). Salinity in the bottom waters varied from 7.4 PSU – noticed at the catch-station No. 4 (southern part of the Gdańsk Gulf), to the maximum of 16.7 PSU - noticed at the hydrographical station No. IBY5 (the Bornholm Basin). Oxygen content near the bottom of deep waters varied from 0.00 ml l^{-1} – measured at the catch-station No. 6 and hydrological station G2 (in the Gdansk Deep at depth 103 and 106 m respectively) to the maximum of 6.7 ml l^{-1} – calculated at the hydrological station No. 46 (at depth 31m).

The vertical distribution of the seawater temperature, salinity, and oxygen content, along the hydrological research profile determined in the southern Baltic during BIAS 2019 survey is presented in Fig. 15. During the survey period, the waters with oxygen content below 2 ml l^{-1} occurred at depth just below 70 m at the Gdańsk Deep (with anoxic bottom condition) and below 60 m at the Bornholm Basin. The Słupsk Furrow was well-oxygenated.

DISCUSSION

Compared to autumn 2018, the present estimates show a decrease in sprat, herring and cod biomass: -9.5, -37.0 and -40.1%, respectively. The abundance of sprat and cod has also dropped. However, these changes differ between ICES Sub-divisions:

ICES SD	Difference comparing to 2018					
	abundance [%]			biomass [%]		
	sprat	herring	cod	sprat	herring	cod
SD25	-9.0	-39.5	-95.1	+17.5	-53.5	-94.9
SD26	-22.9	+29.6	+32.4	-16.9	-28.8	+12.6

Nevertheless, overall estimated abundances and biomass per ICES Sub-divisions for sprat, herring and cod indicate that the centre of fish resources temporal distribution during reported the BIAS/2019 survey, in the case of sprat, herring and cod, was located mostly in the ICES Sub-division 26 (Figs. 9, 11, 12).

Compared to BIAS/2018, the abundance of sprat changed in both ICES Sub-divisions. In Sub-division 26 the number of individuals of sprat from all age groups decreased. Similar situation was in ICES SD 25. The abundance did not decrease as much as in the ICES SD 26 because in case of some age groups the number of individuals of sprat increased. Considering the total biomass of sprat in each Sub-division, the biomass and abundance of new-borns – sprat from age group 0 (year class 2019) were not significant. Similarly to the results from the BIAS survey from 2018, the sprat abundance and total biomass were higher in the ICES Sub-division 26 than in ICES Sub-division 25. It indicates that in ICES SD 26 more sprat was distributed compared to ICES SD 25. Moreover, in the catches in September 2019, in the stomachs almost 66% of males and 90% of females contained some food, which provides the fact that during this time of the year is the feeding season of sprat.

During the BIAS in 2018, the biomass of herring was larger than during the latest BIAS/2019. For both ICES Sub-divisions, 25 and 26, this parameter decreased. Except for age group 6 (year class 2013), the abundance and biomass increased compared to September/October 2018. Opposite to ICES SD 25, in the ICES SD 26 abundance of herring increased. It was caused by a high abundance of the herring from age group 0 (year class 2019) which was noticed in the Polish coastal areas in the ICES rectangle 38G8 and 38G9. In May 2019, during the SPRAS/2019, a slight increase in the abundance and biomass of the herring from age group 2-4 (year classes 2017-2015) was observed in the same area. Moreover, most of those fish were the spawning. It indicates that the region is a spawning area for herring in spring and also constitutes nursery grounds for juveniles in autumn.

Compared to September/October 2018, the abundance and biomass of cod significantly decreased in ICES Sub-division 25 - by 94%. In ICES Sub-division 26, both abundance and biomass of cod increased, 30% and 13%, respectively. However, as already mentioned, the number of sampled cod in 2019 was lower than in 2018.

Additionally, it is worth to mention that in one haul in the Gotland Deep area (ICES rectangle 40G8) the CPUE of three-spined stickleback (*Gasterosteus aculeatus*) was almost 100 kg h^{-1}.

CONCLUSION

The ICES Baltic International Fish Survey Working Group and the Baltic Fisheries Assessment Working Group for the Baltic clupeids and cod stocks size analysis and their spatial distribution characteristics can apply the Polish BIAS/2019 survey data obtained by the r.v. “Baltica” scientific team for stock assessment purposes. Results presented in this paper can be considered as representative for the Polish part of the southern Baltic, namely for the ICES Sub-divisions 25 and 26. The base acoustic, fisheries, biological and hydrological data collected during reported survey will be stored in the ICES Data-Centre international databases, managed by the ICES Secretariat and designated experts from WGBIFS.

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Table 1. Weighted mean NASC values (m^2 NM^{-2}) for the Polish/Danish parts of the ICES SDs 25 and 26, calculated with use of areas of ICES rectangles as weight, for BIAS 2018 and 2019 cruises.

ICES SDs	< NASC > BIAS 2018	< NASC > BIAS 2019
25	197.5	139.0
26	558.3	460.0

Table 2. Average NASC values (m^2 NM^{-2}) for the acoustically covered ICES rectangles, within the Polish and part of Danish EEZ, in 2018 and 2019 BIAS cruises.

ICES SDs	ICES rectangles	Area [NM^2]	< NASC > BIAS 2018	< NASC > BIAS 2019
25	37G5	642.2	208.1	127.6
25	38G5	1035.7	175.4	170.5
25	38G6	940.2	133.6	138.4
25	38G7	471.7	85.6	57.1
25	39G6	1026.0	222.1	183.1
25	39G7	1026.0	298.5	108.5
26	37G8	86.0	1021.7	4085.2
26	37G9	151.6	2121.4	3878.7
26	38G8	624.6	927.0	331.0
26	38G9	918.2	1024.8	617.5
26	39G8	1026.0	367.4	208.4
26	39G9	1026.0	159.9	83.7
26	40G8	1013.0	231.8	213.5

Table 3. Fish control-catches data from the Polish BIAS survey conducted on board of the r.v. "Baltica" in September 2019.

Haul number	Date of catch	ICES rectangles	ICES SDs	Geographical position of the catch-station: start latitude N	start longitude E	end latitude N	end longitude E	Mean depth to the bottom [m]	Headrope depth from the sea surface [m]	Vertical net opening [m]	Trawling speed [w]	The ship's course during fishing [°]	Local time of shutting net	Trawling duration [min]	Total catch [kg]	CPUE of all species [kg·h^{-1}]	Catch per species [kg]: sprat	herring	cod	flounder	salmon	lumpfish	atlantic mackerel	greater sand eel	three spined stickleback	lesser sand eel	anchovy	whiting	plaice	four bearded rockling	river lumprey	shorthorn scuplin	smelt	broad nosed pipefish	straight nose pipefish
1	2019-09-15	37G9	26	54°28.3'	19°09.4'	54°29.0'	19°10.6'	70	30	18	3.0	30	14:15	20	292.10	876.30	162.4	129.7																	
2	2019-09-15	37G9	26	54°27.2'	19°25.9'	54°27.5'	19°27.6'	53	28	18	3.1	70	18:05	20	143.81	431.43	89.1	54.7							0.003										
3	2019-09-18	37G8	26	54°29.3'	18°53.6'	54°28.7'	18°54.8'	62	30	18	3.1	125	12:55	20	191.61	574.84	141.0	50.5							0.001	0.141									
4	2019-09-18	38G8	26	54°32.2'	18°54.2'	54°31.6'	18°55.5'	65	30	15	3.5	130	15:10	20	23.44	70.31	2.1	21.2								0.011					0.1		0.0026	0.001	0.001
5	2019-09-19	38G9	26	54°35.0'	19°09.5'	54°33.9'	19°11.3'	80	55	19	3.3	135	08:05	30	140.71	281.41	38.9	101.5	0.193												0.147				
6	2019-09-19	38G9	26	54°49.4'	19°11.3'	54°48.6'	19°13.5'	107	40	18	3.2	115	12:00	30	59.52	119.04	53.8	5.8																	
7	2019-09-19	39G9	26	55°06.1'	19°06.3'	55°04.8'	19°07.0'	97	33	19	3.2	165	17:55	30	91.15	182.30	1.0	90.2																	
8	2019-09-20	40G8	26	55°49.7'	18°40.0'	55°51.3'	18°40.2'	108	30	20	3.1	360	15:30	30	110.82	221.63	58.6	0.5			2.705				48.975										
9	2019-09-21	39G8	26	55°09.6'	18°41.5'	55°09.2'	18°43.9'	92	60	19	3.0	110	08:00	30	82.69	165.39	4.0	74.2	4.515																
10	2019-09-21	38G8	26	54°57.8'	18°41.7'	54°57.6'	18°44.3'	93	50	18	3.1	100	11:15	30	322.20	644.41	288.3	32.4	0.269	0.879									0.095			0.19			
11	2019-09-21	39G8	26	55°05.8'	18°21.3'	55°05.3'	18°23.7'	75	40	18	3.2	105	18:00	30	42.20	84.39	16.7	25.2														0.286			
12	2019-09-22	40G8	26	55°35.6'	18°27.8'	55°35.0'	18°30.4'	95	70	17	3.0	105	08:00	30	45.88	91.76	5.4	23.1	16.938						0.008					0.396					
13	2019-09-22	40G8	26	55°37.5'	18°01.6'	55°37.6'	18°04.4'	71	45	18	3.1	90	14:15	30	260.04	520.08	150.2	109.7				0.141													
14	2019-09-24	37G5	25	54°29.1'	15°20.8'	54°29.2'	15°22.6'	47	25	18	3.0	125	09:25	30	97.33	194.67	67.7	29.3				0.178	0.216												
15	2019-09-24	38G5	25	54°44.4'	15°19.9'	54°42.9'	15°20.3'	68	46	19	3	175	12:50	30	302.47	604.94	124.5	174.3	2.119									1.53							
16	2019-09-24	38G5	25	54°58.0'	15°28.2'	54°58.1'	15°30.9'	78	50	19	3.1	90	16:40	30	239.61	479.22	173.0	65.0	1.500										0.111						
17	2019-09-25	37G5	25	54°28.4'	15°38.8'	54°28.5'	15°36.4'	54	35	17	3.1	275	07:30	30	316.47	632.94	61.2	252.1	3.025									0.183							
18	2019-09-25	38G5	25	54°31.0'	15°58.9'	54°31.7'	15°56.6'	46	22	16	3.1	300	11:45	30	101.40	202.80	65.5	33.2	2.545									0.135							
19	2019-09-25	38G6	25	54°49.0'	16°00.9'	54°50.1'	16°02.3'	53	32	18	3.1	35	15:45	30	286.08	572.16	250.4	34.0	1.079			0.684													
20	2019-09-26	39G6	25	55°15.3'	16°18.7'	55°15.3'	16°16.0'	69	48	18	3.1	270	08:05	30	718.93	1437.86	476.8	237.9	4.130	0.112															
21	2019-09-26	38G6	25	54°59.1'	16°18.3'	54°58.5'	16°15.4'	52	30	18	3.1	250	11:45	30	240.88	481.76	214.9	25.4					0.540					0.0522							
22	2019-09-26	38G6	25	54°43.4'	16°20.1'	54°43.9'	16°17.6'	39	17	17	3.3	285	15:35	30	54.24	108.47	52.5	1.3	0.001				0.380												
23	2019-09-27	39G6	25	55°10.5'	16°41.4'	55°10.8'	16°43.9'	78	50	18	3.0	85	09:05	30	249.98	499.95	37.2	212.8																	
24	2019-09-27	39G7	25	55°13.5'	17°03.0'	55°14.6'	17°01.3'	89	45	18	3.1	310	16:05	30	85.08	170.16	13.0	72.1																	
25	2019-09-28	38G7	25	54°59.1'	17°23.3'	54°59.0'	17°25.9'	30	10	15	3.1	90	07:25	30	3.86	7.72	1.3	2.2	0.331					0.0726											
26	2019-09-28	39G7	25	55°05.6'	17°21.1'	55°06.5'	17°23.3'	46	25	17	3.0	60	10:10	30	588.89	1177.78	317.9	270.4						0.1176			0.0876			0.322					
27	2019-09-28	39G7	25	55°14.7'	17°21.6'	55°15.5'	17°24.2'	90	60	18	3.2	60	13:00	30	51.52	103.04	15.7	35.8																	

Table 4. The mean numerical share of young, undersized fishes per ICES SDs (the Polish BIAS/2018 and BIAS/2019).

Species	Fish length	BIAS 2018: Mean share in % numbers SD25	SD26	Mean	BIAS 2019: Mean share in % numbers SD25	SD26	Mean
sprat	< 10 cm	18.6	25.1	21.3	1.9	7.5	4.6
herring	< 16 cm	8.5	14.9	11.0	32.9	46.1	38.9
cod	< 35 cm	58.0	53.1	54.5	63.8	79.8	73.8

Table 5. Cruise statistics of the Polish BIAS survey on board of the r.v. "Baltica", 15-30.09.2019.

ICES SDs	ICES rectangles	EDSU [NM]	<σ> $[m^2 \cdot 10^{-4}]$	$< S_A >$ $[m^2 \cdot NM^{-2}]$	Area $[NM^2]$	species composition [%]			Abundance $\cdot 10^6$			
						sprat	herring	cod	total	sprat	herring	cod
25	37G5	44	2.18	127.6	642.2	59.23	40.74	0.03	375.1	222.2	152.8	0.1
25	38G5	74	2.00	170.5	1035.7	78.32	21.62	0.06	883.2	691.7	191.0	0.5
25	38G6	75	1.68	138.4	940.2	94.93	5.05	0.02	776.0	736.7	39.2	0.1
25	38G7	23	1.46	57.1	471.7	56.81	43.19	0.00	184.9	105.0	79.9	0.0
25	39G6	86	2.14	183.1	1026	58.42	41.56	0.02	879.4	513.8	365.5	0.1
25	39G7	100	2.02	108.5	1026	50.38	49.62	0.00	551.8	278.0	273.8	0.0
Sum SD25		**402**							**3650.4**	**2547.3**	**1102.2**	**0.9**
26	37G8	8	1.00	4085.2	86	76.12	23.87	0.00	3523.9	2682.5	841.3	0.0
26	37G9	26	1.18	3878.7	151.6	57.30	42.69	0.00	4984.4	2855.9	2128.1	0.0
26	38G8	55	1.73	331.0	624.6	58.95	41.05	0.00	1192.9	703.2	489.7	0.0
26	38G9	51	1.84	617.5	918.2	70.90	29.09	0.01	3075.4	2180.6	894.6	0.2
26	39G8	84	2.60	208.4	1026	42.10	57.60	0.30	823.0	346.4	474.0	2.5
26	39G9	34	3.34	83.7	1026	3.31	96.69	0.00	257.0	8.5	248.5	0.0
26	40G8	98	2.00	213.5	1013	47.22	23.63	2.01	1083.6	511.7	256.0	21.8
Sum SD26		**356**							**14940.3**	**9288.8**	**5332.4**	**24.6**

Table 6. Abundance of sprat (in millions of individuals) per age groups, ICES rectangles and ICES SDs, estimated using acoustic method, based on data collected during the Polish BIAS survey on board of the r.v. “Baltica”, 15-30.09.2019.

ICES SDs	ICES rectangles	Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8+	Total sprat abundance [mln indiv.]
25	37G5	0.0	7.3	16.3	35.8	90.2	53.5	16.5	0.5	2.1	**222.2**
25	38G5	1.3	28.2	58.2	115.4	284.2	161.6	38.8	0.9	3.0	**691.7**
25	38G6	0.0	36.3	71.5	123.5	298.5	164.3	39.2	1.0	2.3	**736.7**
25	38G7	10.6	14.7	16.0	16.6	30.3	15.7	1.0	0.0	0.1	**105.0**
25	39G6	15.5	51.8	71.5	87.0	177.3	95.1	15.2	0.1	0.3	**513.8**
25	39G7	16.0	44.6	48.1	45.4	80.3	40.2	3.0	0.1	0.4	**278.0**
Sum SD25		**43.4**	**182.9**	**281.6**	**423.8**	**960.7**	**530.5**	**113.7**	**2.6**	**8.2**	**2547.3**
26	37G8	835.0	1035.6	460.1	153.9	163.4	33.1	1.4	0.0	0.0	**2682.5**
26	37G9	173.7	879.2	811.5	429.5	457.1	99.9	4.9	0.0	0.0	**2855.9**
26	38G8	80.6	148.1	152.3	133.5	150.6	36.6	1.3	0.0	0.0	**703.2**
26	38G9	0.0	88.2	224.8	537.5	913.9	381.9	33.2	0.0	1.0	**2180.6**
26	39G8	2.4	23.1	61.0	94.4	120.1	39.4	4.2	1.0	0.8	**346.4**
26	39G9	0.0	0.1	0.4	2.2	4.0	1.7	0.1	0.0	0.0	**8.5**
26	40G8	0.0	14.9	49.9	136.6	216.1	85.9	7.8	0.0	0.6	**511.7**
Sum SD26		**1091.7**	**2189.2**	**1760.2**	**1487.6**	**2025.1**	**678.6**	**53.0**	**1.0**	**2.4**	**9288.8**

Table 7. Biomass of sprat (in tons) per age groups, ICES rectangles and ICES SDs, estimated using acoustic method, based on data collected during the Polish BIAS survey on board of the r.v. “Baltica”, 15-30.09.2019.

ICES SDs	ICES rectangles	Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8+	Total sprat biomass [t]
25	37G5	0.0	86.5	212.0	495.1	1271.8	769.3	264.0	8.5	39.0	**3146.2**
25	38G5	6.6	333.1	745.9	1552.2	3914.4	2254.7	609.6	15.9	55.4	**9487.9**
25	38G6	0.0	415.2	886.8	1641.1	4089.4	2286.7	613.2	17.2	41.6	**9991.2**
25	38G7	50.8	150.0	175.3	199.6	379.5	200.0	16.3	0.0	1.6	**1173.0**
25	39G6	62.0	556.0	812.3	1080.1	2300.3	1257.8	243.3	2.4	4.9	**6319.2**
25	39G7	74.1	452.1	518.5	535.4	996.5	513.3	46.7	2.2	7.4	**3146.3**
Sum SD25		**193.5**	**1992.9**	**3350.8**	**5503.6**	**12951.9**	**7281.8**	**1793.2**	**46.3**	**149.8**	**33263.8**
26	37G8	2588.8	8047.7	3888.8	1598.9	1735.9	364.3	19.5	0.0	0.0	**18243.9**
26	37G9	642.4	7217.8	7274.1	4441.6	4769.1	1074.8	78.4	0.0	0.0	**25498.2**
26	38G8	269.4	1228.3	1393.6	1410.2	1642.4	420.4	18.4	0.0	0.0	**6382.6**
26	38G9	0.0	804.4	2218.8	6020.0	10939.5	4733.4	477.5	0.0	15.5	**25209.1**
26	39G8	11.4	213.2	588.5	1016.5	1363.0	490.2	62.6	16.4	13.1	**3775.0**
26	39G9	0.0	0.6	4.6	25.0	48.3	21.5	1.3	0.0	0.0	**101.2**
26	40G8	0.0	139.9	503.2	1522.0	2569.3	1068.8	112.0	0.0	8.8	**5924.0**
Sum SD26		**3512.0**	**17651.9**	**15871.5**	**16034.4**	**23067.4**	**8173.4**	**769.6**	**16.4**	**37.4**	**85134.0**

Table 8. Mean weight of sprat (in grams) per age groups, ICES rectangles and ICES SDs, based on data collected during the Polish BIAS survey on board of the r.v. “Baltica”, 15-30.09.2019.

ICES SDs	ICES rectangles	Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8+	Mean W sprat [g]
25	37G5	-	11.89	13.05	13.83	14.10	14.37	15.99	17.82	18.47	**14.16**
25	38G5	4.92	11.83	12.82	13.45	13.77	13.95	15.70	17.82	18.31	**13.72**
25	38G6	-	11.4	12.40	13.28	13.70	13.92	15.66	17.82	18.02	**13.56**
25	38G7	4.79	10.21	10.95	12.00	12.53	12.74	15.60	-	19.02	**11.17**
25	39G6	4.00	10.73	11.36	12.41	12.98	13.23	16.04	17.82	17.82	**12.30**
25	39G7	4.64	10.14	10.77	11.80	12.41	12.77	15.83	17.82	18.27	**11.32**
MW SD25		**4.46**	**10.90**	**11.90**	**12.99**	**13.48**	**13.73**	**15.78**	**17.82**	**18.26**	**13.06**
26	37G8	3.10	7.77	8.45	10.39	10.62	11.00	14.09	-	-	**6.80**
26	37G9	3.70	8.21	8.96	10.34	10.43	10.76	15.84	-	-	**8.93**
26	38G8	3.34	8.29	9.15	10.56	10.90	11.49	13.72	-	-	**9.08**
26	38G9	-	9.12	9.87	11.20	11.97	12.39	14.37	-	15.49	**11.56**
26	39G8	4.85	9.22	9.64	10.77	11.35	12.45	14.85	16.60	15.5	**10.90**
26	39G9	-	10.13	10.79	11.44	12.08	12.33	13.25	-	-	**11.90**
26	40G8	-	9.39	10.08	11.14	11.89	12.44	14.43	-	15.5	**11.58**
MW SD26		**3.22**	**8.06**	**9.02**	**10.78**	**11.39**	**12.04**	**14.53**	**16.60**	**15.49**	**9.17**

Table 9. Abundance of herring (in millions of individuals) per age groups, ICES rectangles and ICES SDs, estimated using acoustic method, based on data collected during the Polish BIAS survey on board of the r.v. “Baltica”, 15-30.09.2019.

ICES SDs	ICES rectangles	Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8+	Total herring abundance [mln indiv.]
25	37G5	30.1	4.8	21.1	19.7	16.3	42.8	8.8	7.0	2.2	**152.8**
25	38G5	41.7	4.2	21.4	21.2	20.4	47.2	12.6	11.2	11.1	**191.0**
25	38G6	23.1	1.0	2.7	2.1	2.0	5.5	1.3	1.0	0.5	**39.2**
25	38G7	71.3	0.6	1.3	1.6	1.0	2.8	0.8	0.4	0.1	**79.9**
25	39G6	31.7	18.4	58.4	55.0	44.2	112.2	22.0	17.8	5.9	**365.5**
25	39G7	95.6	5.0	27.3	24.2	23.3	67.2	17.0	11.0	3.2	**273.8**
Sum SD25		**293.5**	**33.9**	**132.3**	**123.8**	**107.1**	**277.7**	**62.5**	**48.5**	**22.9**	**1102.2**
26	37G8	837.4	3.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**841.3**
26	37G9	2040.9	46.8	9.5	8.7	4.7	11.6	3.2	1.1	1.6	**2128.1**
26	38G8	204.5	30.4	35.1	24.7	33.1	75.6	36.0	24.6	25.6	**489.7**
26	38G9	334.2	20.8	62.8	49.6	61.2	168.0	88.2	46.5	63.4	**894.6**
26	39G8	45.1	18.0	52.4	33.9	52.4	126.8	62.6	37.8	45.0	**474.0**
26	39G9	0.0	11.2	33.2	23.7	32.5	78.6	32.4	17.4	19.5	**248.5**
26	40G8	47.9	6.6	28.8	18.3	25.4	65.9	27.6	17.9	17.7	**256.0**
Sum SD26		**3510.1**	**137.6**	**221.7**	**158.9**	**209.3**	**526.6**	**250.0**	**145.3**	**172.8**	**5332.4**

Table 10. Biomass of herring (in tons) per age groups, ICES rectangles and ICES SDs, estimated using acoustic method, based on data collected during the Polish BIAS survey on board of the r.v. "Baltica", 15-30.09.2019.

ICES SDs	ICES rectangles	Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8+	Total herring biomass [t]
25	37G5	363.4	130.5	702.2	624.3	549.9	1498.5	356.8	290.4	129.3	**4645.5**
25	38G5	496.4	116.2	814.1	796.2	853.7	1868.1	568.0	567.2	785.7	**6865.6**
25	38G6	266.4	23.6	92.8	70.3	72.0	200.6	56.3	45.8	31.0	**858.7**
25	38G7	700.8	12.6	41.0	54.6	33.9	99.8	32.6	15.6	5.9	**996.8**
25	39G6	377.0	460.1	1875.4	1716.3	1510.0	3912.0	884.4	743.4	381.1	**11859.8**
25	39G7	929.9	151.5	995.1	847.4	827.5	2455.1	705.3	471.6	194.4	**7577.6**
Sum SD25		**3134.0**	**894.5**	**4520.5**	**4109.2**	**3847.0**	**10034.1**	**2603.4**	**2133.9**	**1527.4**	**32803.9**
26	37G8	6402.4	60.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**6463.1**
26	37G9	15479.4	903.2	270.0	242.4	152.0	366.7	128.0	47.8	69.5	**17659.0**
26	38G8	1723.0	651.3	1253.2	932.3	1272.1	2810.5	1620.8	1193.7	1421.0	**12877.8**
26	38G9	2821.8	544.2	2427.9	2027.4	2598.7	6614.3	3961.1	2191.3	3478.2	**26664.9**
26	39G8	431.5	444.2	1954.6	1368.9	2103.3	4819.7	2741.8	1771.4	2397.9	**18033.4**
26	39G9	0.0	324.4	1183.2	875.2	1206.4	2920.9	1376.4	754.8	1040.5	**9681.9**
26	40G8	436.2	189.3	1056.2	717.3	976.3	2439.9	1170.1	820.5	890.8	**8696.7**
Sum SD26		**27294.3**	**3117.4**	**8145.2**	**6163.5**	**8308.8**	**19972.0**	**10998.2**	**6779.5**	**9297.8**	**100076.7**

Table 11. Mean weight of herring (in grams) per age groups, ICES rectangles and ICES SDs, based on data collected during the Polish BIAS survey on board of the r.v. "Baltica", 15-30.09.2019.

ICES SDs	ICES rectangles	Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8+	Mean W herring [g]
25	37G5	12.08	27.28	33.21	31.74	33.70	35.02	40.60	41.24	59.58	**30.40**
25	38G5	11.91	27.90	38.04	37.48	41.91	39.57	45.06	50.42	71.03	**35.95**
25	38G6	11.52	22.83	34.20	33.95	36.50	36.56	42.18	45.07	64.79	**21.89**
25	38G7	9.83	22.41	31.55	33.50	34.63	35.28	41.38	42.53	56.61	**12.48**
25	39G6	11.90	25.05	32.13	31.22	34.19	34.86	40.17	41.77	64.71	**32.45**
25	39G7	9.72	30.44	36.41	34.97	35.53	36.54	41.51	42.75	61.41	**27.67**
MW SD25		**10.68**	**26.40**	**34.18**	**33.19**	**35.92**	**36.13**	**41.64**	**44.00**	**66.79**	**29.76**
26	37G8	7.65	15.79	-	-	-	-	-	-	-	**7.68**
26	37G9	7.58	19.31	28.45	27.95	32.38	31.60	39.80	43.55	43.62	**8.30**
26	38G8	8.43	21.39	35.73	37.67	38.37	37.16	44.98	48.60	55.55	**26.30**
26	38G9	8.44	26.18	38.65	40.90	42.46	39.37	44.91	47.13	54.87	**29.81**
26	39G8	9.57	24.67	37.32	40.41	40.14	38.00	43.79	46.84	53.29	**38.04**
26	39G9	-	28.97	35.62	36.91	37.13	37.14	42.53	43.33	53.38	**38.96**
26	40G8	9.11	28.80	36.72	39.22	38.43	37.01	42.41	45.93	50.24	**33.97**
MW SD26		**7.78**	**22.65**	**36.73**	**38.80**	**39.69**	**37.92**	**43.99**	**46.67**	**53.81**	**18.77**

Table 12. Abundance of cod (in millions of individuals) per age groups, ICES rectangles and ICES SDs, estimated using acoustic method, based on data collected during the Polish BIAS survey on board of the r.v. "Baltica", 15-30.09.2019.

ICES SDs	ICES rectangles	Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8+	Total cod abundance [mln indiv.]
25	37G5	0.00	0.00	0.01	0.10	0.01	0.00	0.00	0.00	0.00	**0.12**
25	38G5	0.00	0.00	0.10	0.40	0.02	0.00	0.00	0.00	0.00	**0.52**
25	38G6	0.07	0.01	0.01	0.04	0.00	0.00	0.00	0.00	0.00	**0.14**
25	38G7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**
25	39G6	0.00	0.00	0.03	0.10	0.02	0.00	0.00	0.00	0.00	**0.15**
25	39G7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**
Sum SD25		**0.07**	**0.01**	**0.15**	**0.64**	**0.05**	**0.00**	**0.00**	**0.00**	**0.00**	**0.92**
26	37G8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**
26	37G9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**
26	38G8	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00	**0.02**
26	38G9	0.00	0.00	0.04	0.15	0.00	0.00	0.00	0.00	0.00	**0.20**
26	39G8	0.00	0.00	0.60	1.52	0.19	0.10	0.10	0.00	0.00	**2.51**
26	39G9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**
26	40G8	0.00	0.00	9.63	11.52	0.34	0.17	0.17	0.00	0.00	**21.83**
Sum SD26		**0.00**	**0.00**	**10.28**	**13.20**	**0.53**	**0.27**	**0.27**	**0.00**	**0.00**	**24.56**

Table 13. Biomass of cod (in tons) per age groups, ICES rectangles and ICES SDs, estimated using acoustic method, based on data collected during the Polish BIAS survey on board of the r.v. "Baltica", 15-30.09.2019.

ICES SDs	ICES rectangles	Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8+	Total cod biomass [t]
25	37G5	0.00	0.00	2.45	36.86	3.43	0.00	0.00	0.00	0.00	**42.73**
25	38G5	0.00	0.00	28.43	159.71	7.11	0.00	0.00	0.00	0.00	**195.25**
25	38G6	0.04	0.12	2.79	13.43	0.00	0.00	0.00	0.00	0.00	**16.39**
25	38G7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**
25	39G6	0.00	0.00	6.36	27.95	5.04	0.00	0.00	0.00	0.00	**39.34**
25	39G7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**
Sum SD25		**0.04**	**0.12**	**40.02**	**237.95**	**15.58**	**0.00**	**0.00**	**0.00**	**0.00**	**293.71**
26	37G8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**
26	37G9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**
26	38G8	0.00	0.00	2.14	2.86	0.00	0.00	0.00	0.00	0.00	**5.00**
26	38G9	0.00	0.00	11.21	41.11	0.00	0.00	0.00	0.00	0.00	**52.33**
26	39G8	0.00	0.00	127.88	453.00	209.42	43.67	43.67	0.00	0.00	**877.63**
26	39G9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**
26	40G8	0.00	0.00	1989.66	3420.65	186.75	77.17	77.17	0.00	0.00	**5751.40**
Sum SD26		**0.00**	**0.00**	**2130.90**	**3917.62**	**396.16**	**120.84**	**120.84**	**0.00**	**0.00**	**6686.36**

Table 14. Mean weight of cod (in grams) per age groups, ICES rectangles and ICES SDs, based on data collected during the Polish BIAS survey on board of the r.v. “Baltica”, 15-30.09.2019.

ICES SDs	ICES rectangles	Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8+	Mean W cod [g]
25	37G5	-	-	223.39	373.62	344.17	-	-	-	-	**357.40**
25	38G5	-	-	293.25	401.71	309.17	-	-	-	-	**377.28**
25	38G6	0.60	9.00	234.28	316.35	-	-	-	-	-	**120.55**
25	38G7	-	-	-	-	-	-	-	-	-	
25	39G6	-	-	228.25	269.79	329.67	-	-	-	-	**268.14**
25	39G7	-	-	-	-	-	-	-	-	-	
MW SD25		**0.60**	**9.00**	**271.04**	**370.48**	**322.89**					**319.34**
26	37G8	-	-	-	-	-	-	-	-	-	
26	37G9	-	-	-	-	-	-	-	-	-	
26	38G8	-	-	239.14	239.14	-	-	-	-	-	**239.14**
26	38G9	-	-	267.00	267.00	-	-	-	-	-	**267.00**
26	39G8	-	-	212.42	297.81	1085.00	452.50	452.50	-	-	**349.77**
26	39G9	-	-	-	-	-	-	-	-	-	
26	40G8	-	-	206.57	297.04	547.50	452.50	452.50	-	-	**263.47**
MW SD26				**211.08**	**314.75**	**770.91**	**452.50**	**452.50**			**284.25**

Table 15. Values of the basic meteorological and hydrological parameters recorded in October 2019 at the positions of the r.v. "Baltica" fish control catches.

Haul no	Date of catch	Haul start time	Meterological parameters					Parametry hydrologiczne*			Depth of measurement [m]
			Atmospheric pressure [hPa]	Air temperature [°C]	Wind direction	Wind force [°B]	Sea state [°B]	Temperature [°C]	Salinity [PSU]	Oxygen [ml/l]	
1	2019-09-15	14:15	1011.6	18.4	SW	6	3	15.8	7.4	6.0	44
2	2019-09-15	18:05	1010.9	17.4	W	6	3	16.9	7.4	6.3	37
3	2019-09-18	12:55	1012.8	12.8	NW	6	3	16.8	7.4	6.3	39
4	2019-09-18	15:10	1013.6	13.1	NW	6	3	16.5	7.4	6.5	47
5	2019-09-19	08:05	1018.4	13.2	NNW	5	3	11.7	7.5	6.0	64
6	2019-09-19	12:00	1020.2	14.0	NW	6	3	5.2	7.6	7.2	49
7	2019-09-19	17:55	1021.9	13.2	NW	6	3/4	7.0	7.6	6.7	41
8	2019-09-20	15:30	1021.5	12.6	W	4	2	4.3	7.5	7.7	40
9	2019-09-21	08:00	1018.2	15.0	WNW	5/6	3/4	6.2	10.8	1.5	73
10	2019-09-21	11:15	1018.9	15.2	WNW	6	3/4	5.3	7.9	5.9	59
11	2019-09-21	18:00	1018.6	15.3	W	5/6	3/4	6.6	7.6	6.5	49
12	2019-09-22	08:00	1015.5	13.5	W	5	3	6.3	11.1	2.1	79
13	2019-09-22	14:15	1015	13.5	W	5	3	4.6	7.8	6.2	56
14	2019-09-24	09:25	1014.5	12.5	SE	3/4	1/2	6.4	7.8	10.1	34
15	2019-09-24	12:50	1013.5	13.6	SE	4	2	9.6	13.3	3.6	55
16	2019-09-24	16:40	1012.1	15.5	SE	4	2	10.9	13.8	3.0	61
17	2019-09-25	07:30	1007.3	12.8	SE	4	2	7.8	11.5	4.0	43
18	2019-09-25	11:45	1007.4	14.7	E	2	1	6.8	9.0	5.2	34
19	2019-09-25	15:45	1006.7	15.2	E	3	1	6.0	9.5	4.0	41
20	2019-09-26	08:05	1009.7	15.0	E	4	2	8.1	15.1	1.3	58
21	2019-09-26	11:45	1011.4	15.0	ESE	4	2	6.1	9.0	4.7	39
22	2019-09-26	15:35	1011.7	16.1	E	3	1	16.2	7.7	4.5	28
23	2019-09-27	09:05	1010.7	15.3	SSE	5	2/3	8.1	13.3	3.0	60
24	2019-09-27	16:05	1008.4	15.0	SE	5	3	5.5	8.9	4.3	54
25	2019-09-28	07:25	1006.8	15.3	W	4/5	2	15.6	7.4	6.5	19
26	2019-09-28	10:10	1007.3	16.1	SW	6	3/4	7.4	7.8	6.2	33
27	2019-09-28	13:00	1007.7	16.2	SW	6	3/4	7.0	11.2	3.9	61

*date of the mean of the control-catches (in the middle of trawl vertical opening)

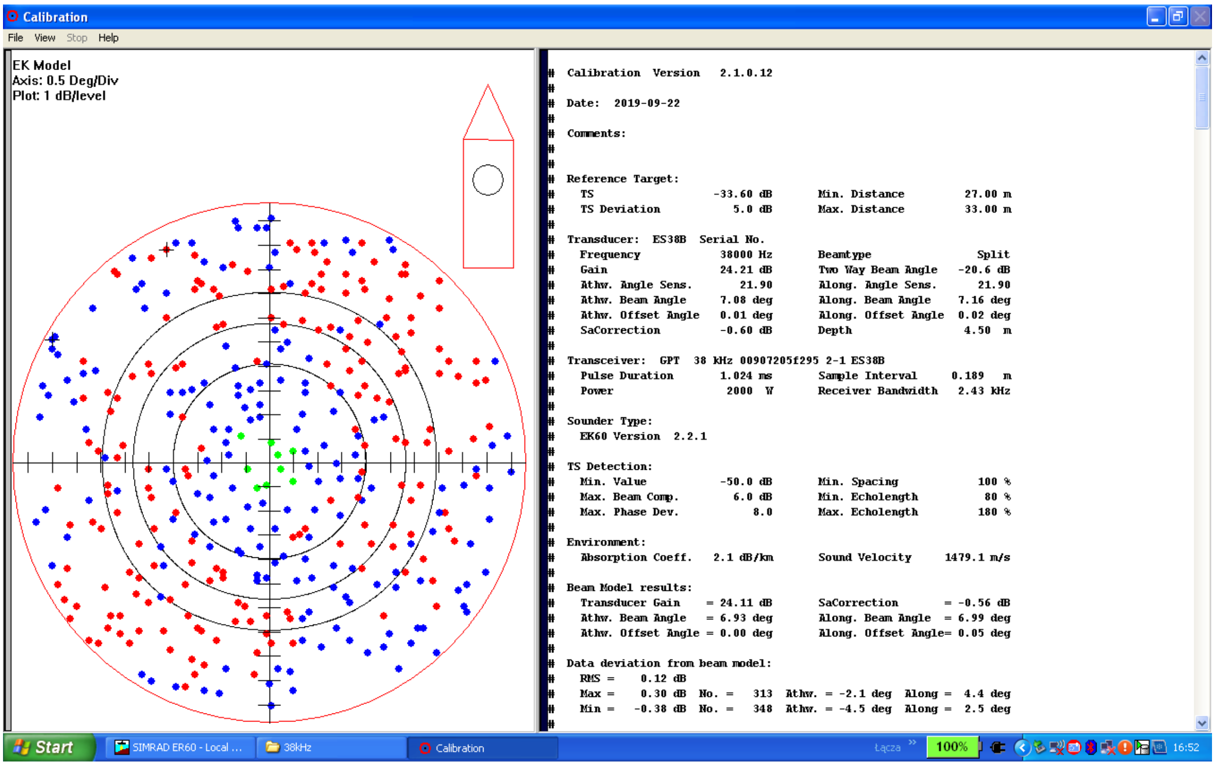


Fig. 1. R.v. "Baltica" cruise BIAS 2019: Simrad EK60 calibration report (38 kHz transducer).

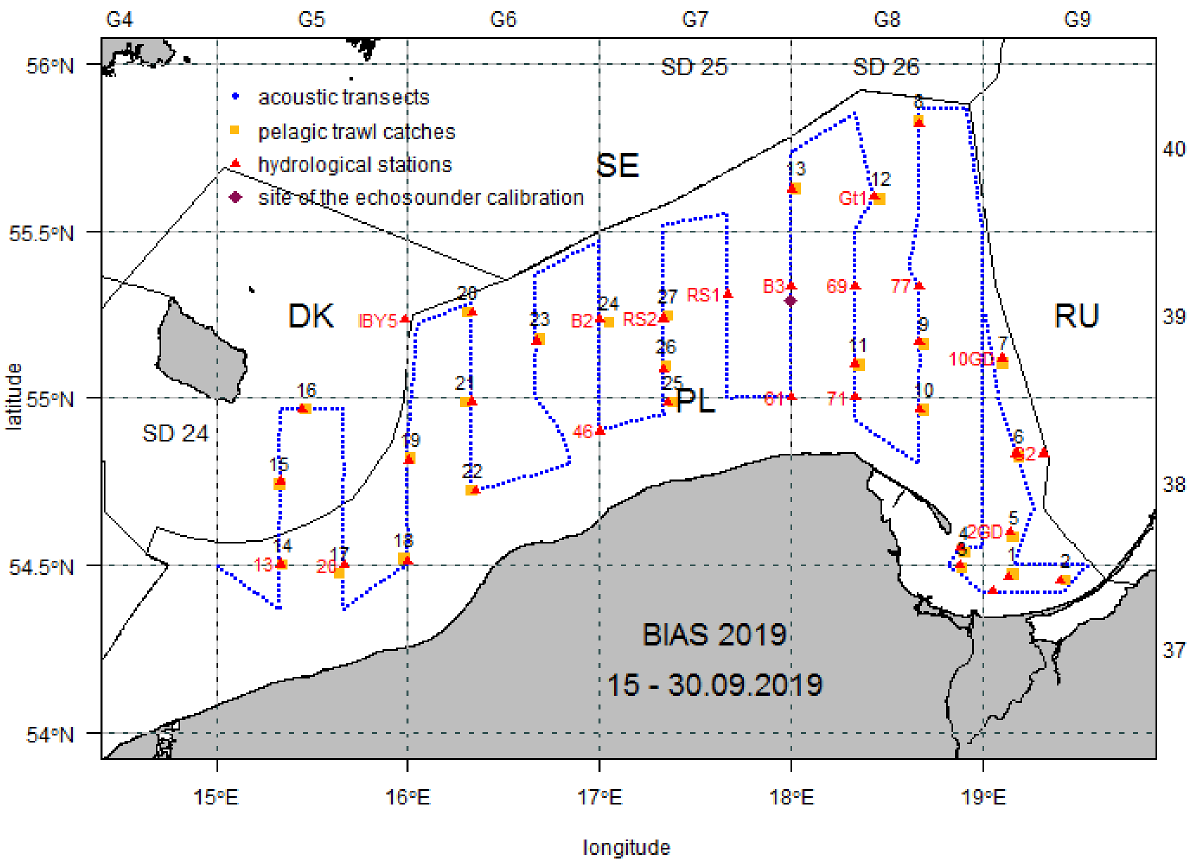


Fig. 2. Location of realized investigations during the Polish BIAS survey on board of the r.v. "Baltica", 15-30.09.2019.

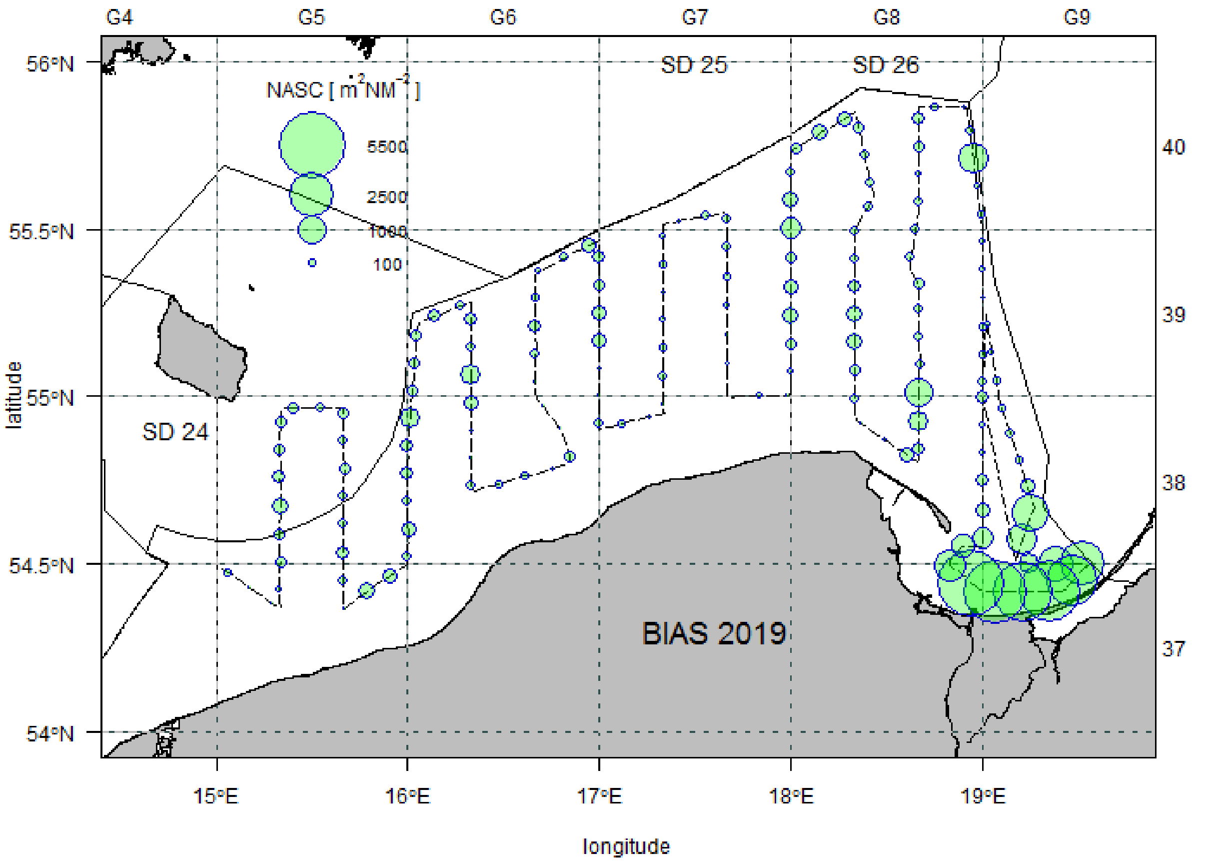


Fig. 3. Cruise track (thin dashed line) and the mean NASC (5 NM intervals, bubbles) recorded during BIAS 2019 cruise.

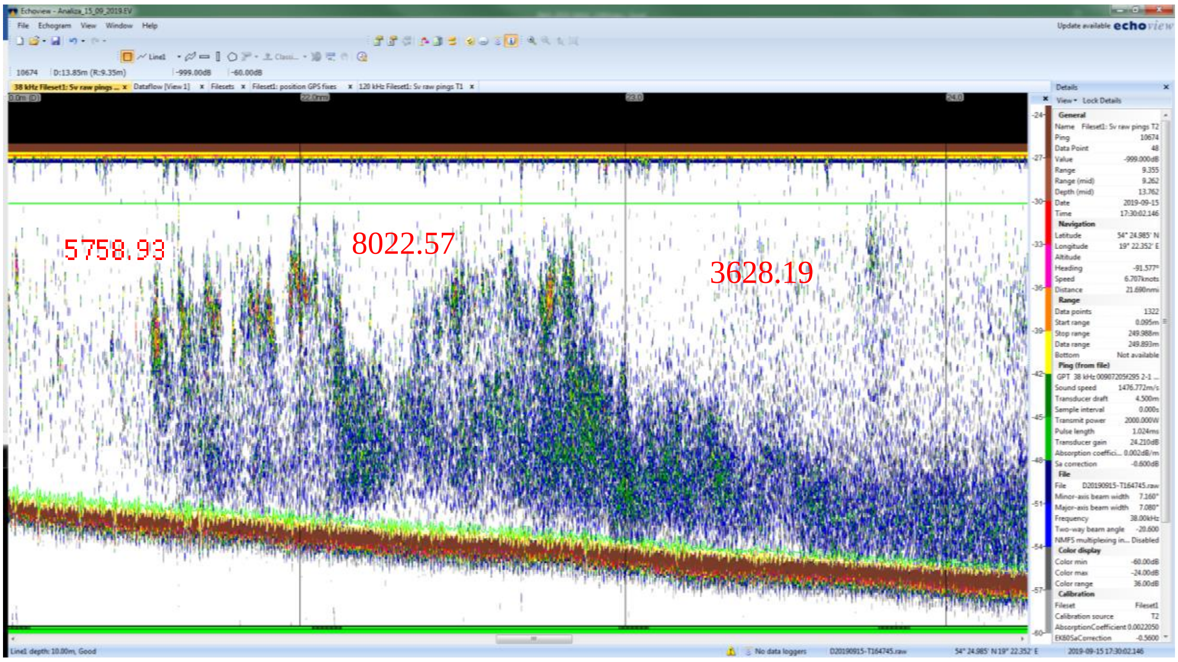


Fig. 4. An example of an echogram analysis for 23rd mile of the integration, NASC = 8022 m^2 NM^{-2} (ICES rectangle 37G9, bottom depth 40 m; 15.09.2019).

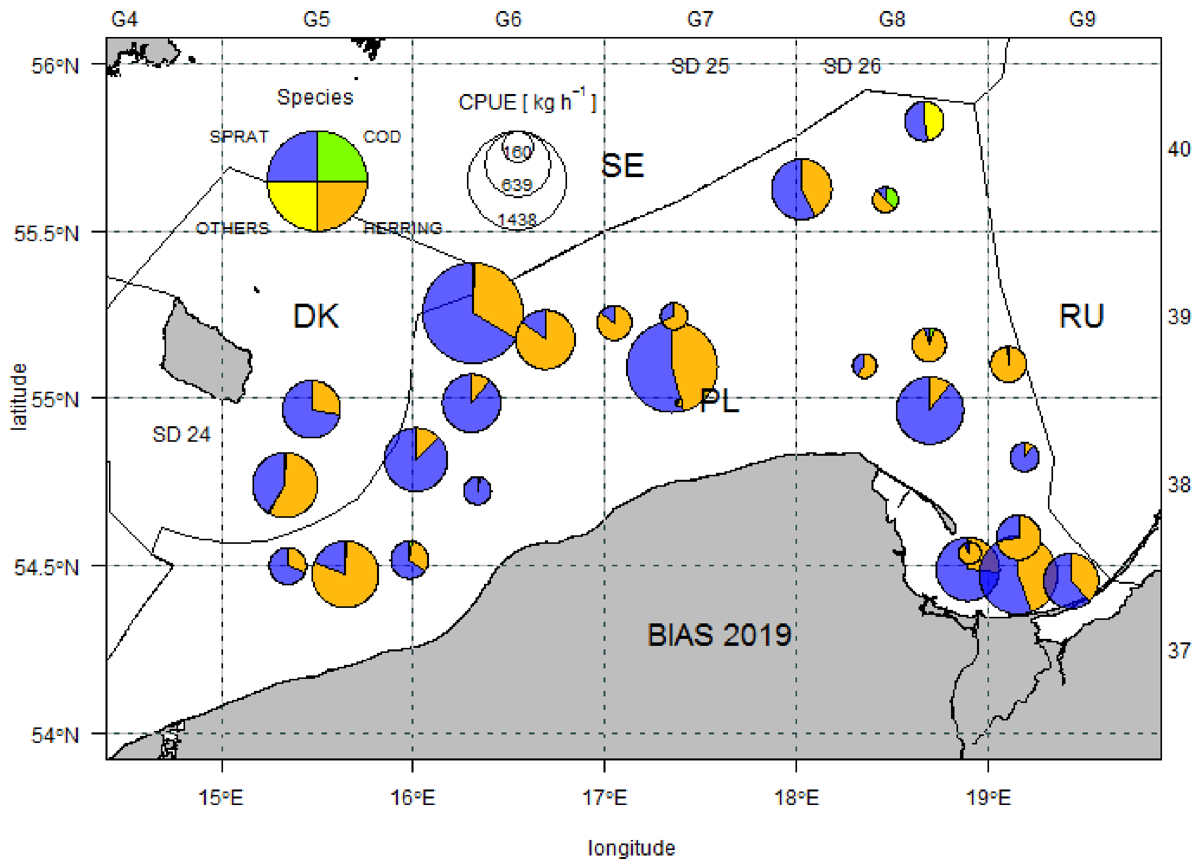


Fig. 5. CPUE [kg h-1] of fish species per single pelagic hauls conducted during the Polish BIAS 2019 survey.

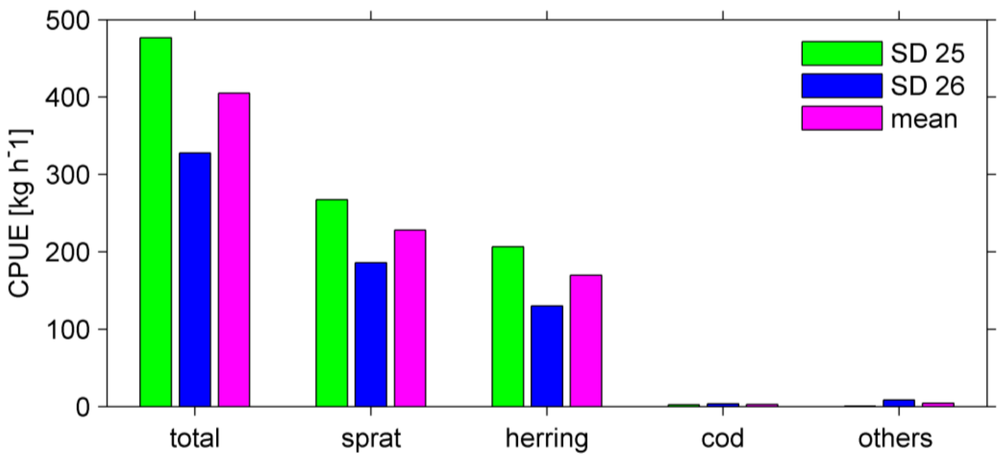


Fig. 6. Mean CPUE [kg h-1] per fish species and the ICES SDs (the Polish BIAS/2019 survey).

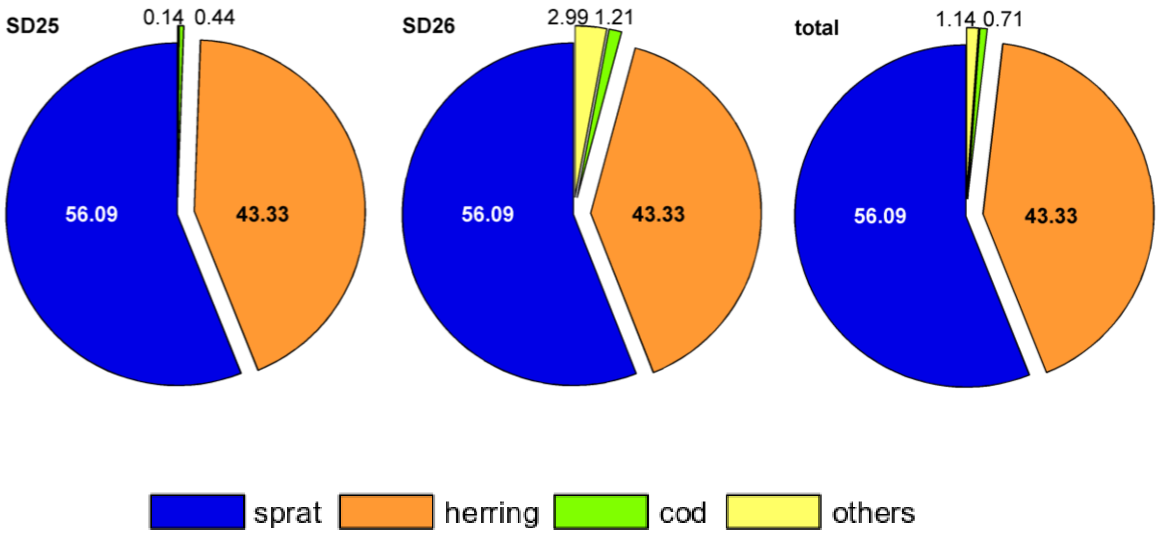


Fig. 7. Share (%) of sprat, herring, cod and other fishes in the mass of total catches per the ICES SDs (the Polish BIAS/2019).

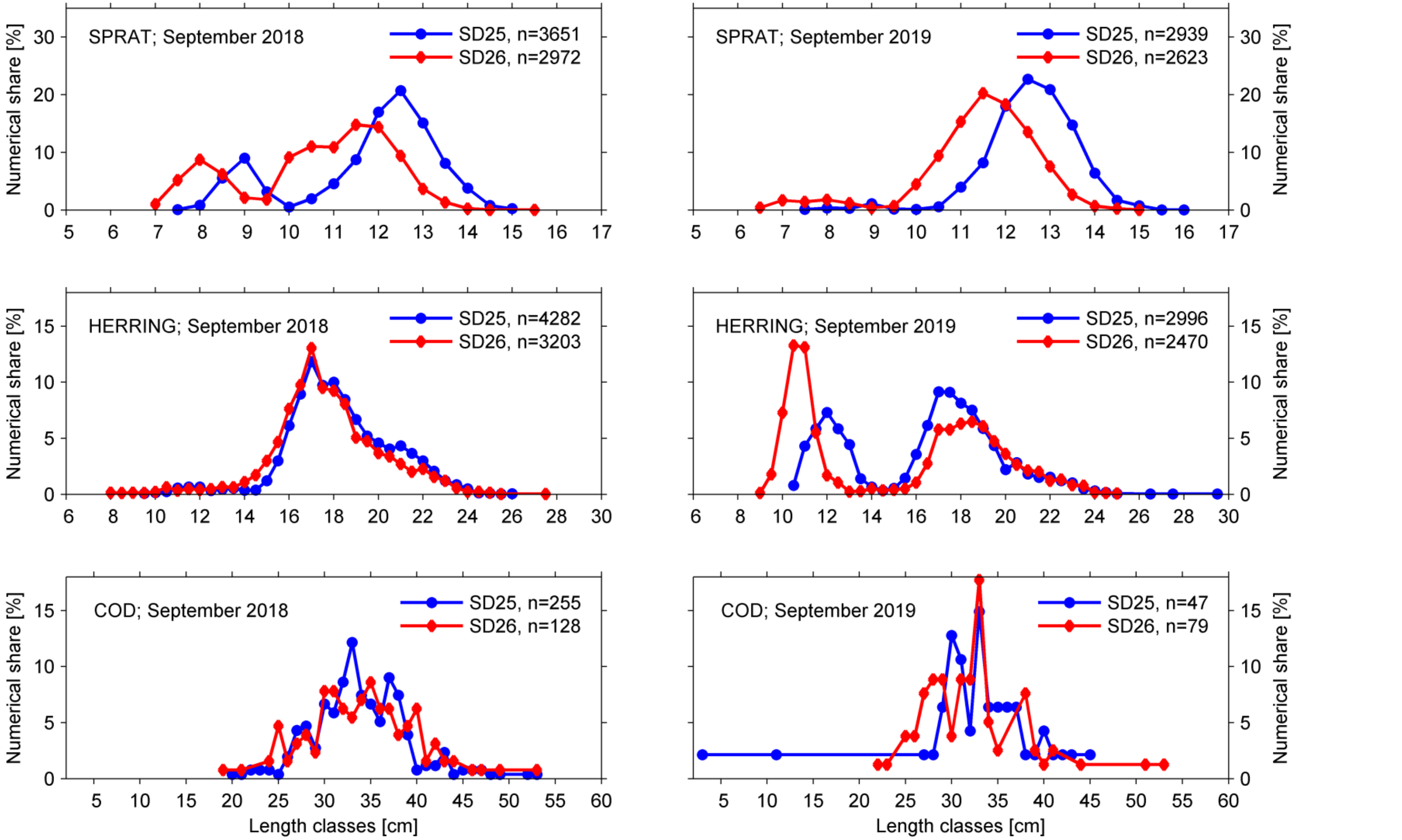


Fig. 8. Length distribution of sprat, herring and cod in samples taken from the control-catches conducted during the Polish BIAS/2018 and BIAS2019 surveys.

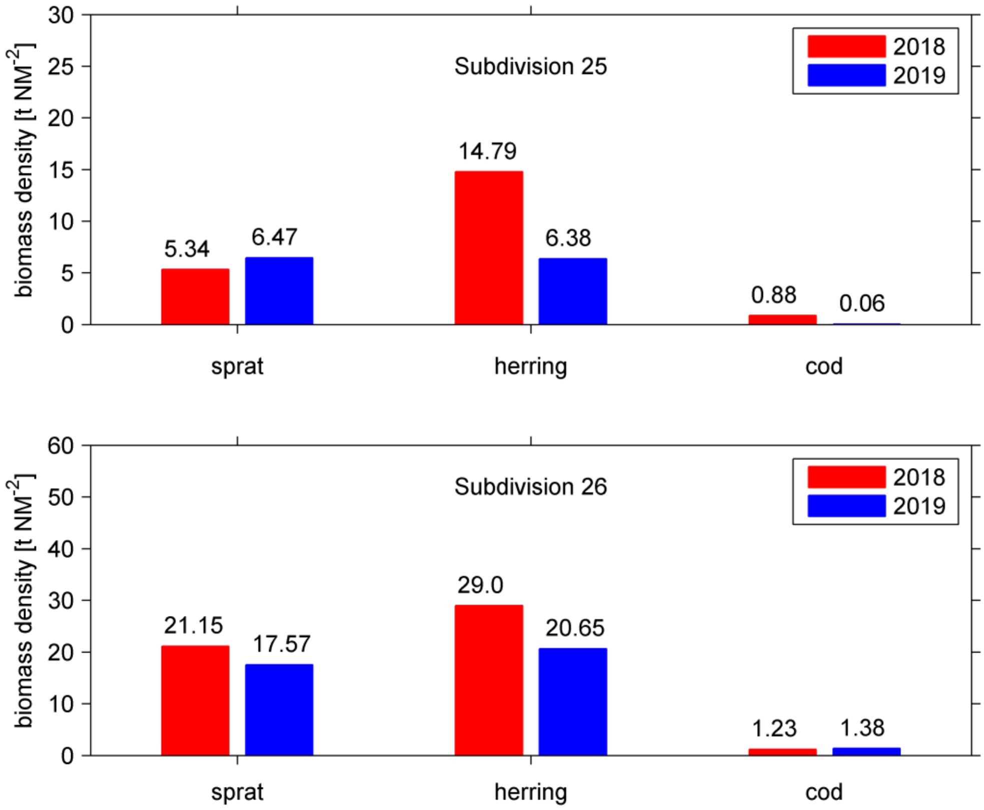


Fig. 9. Mean biomass surface density [t NM^{-2}] of sprat, herring and cod in the ICES Sub-divisions 25 and 26 in the Polish BIAS 2018 and 2019 surveys.

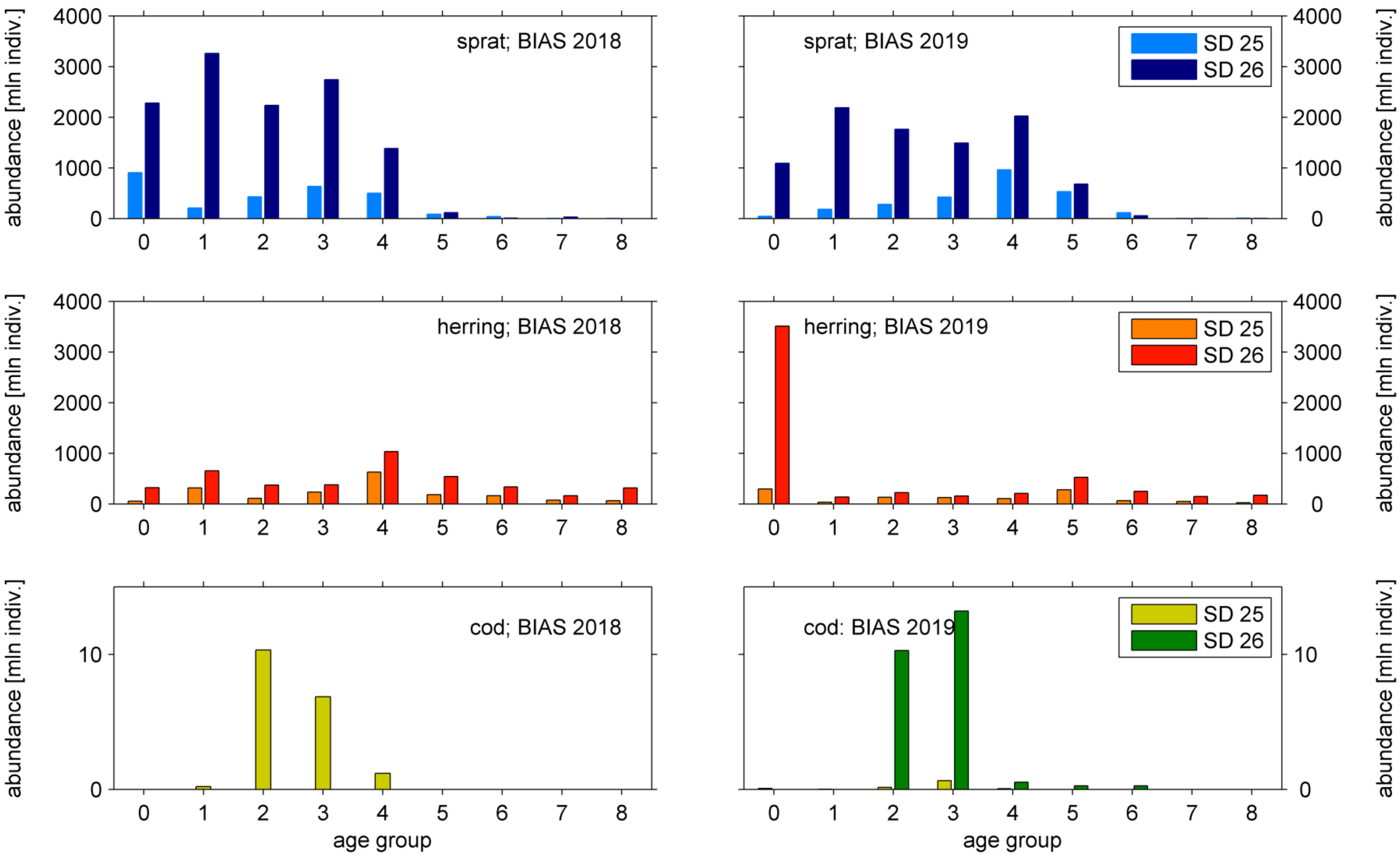


Fig. 10. Abundance (in mln indiv.) of sprat, herring and cod stocks per age groups, according to the ICES Sub-divisions 25 and 26, based on data from the Polish BIAS surveys in 2018 and 2019.

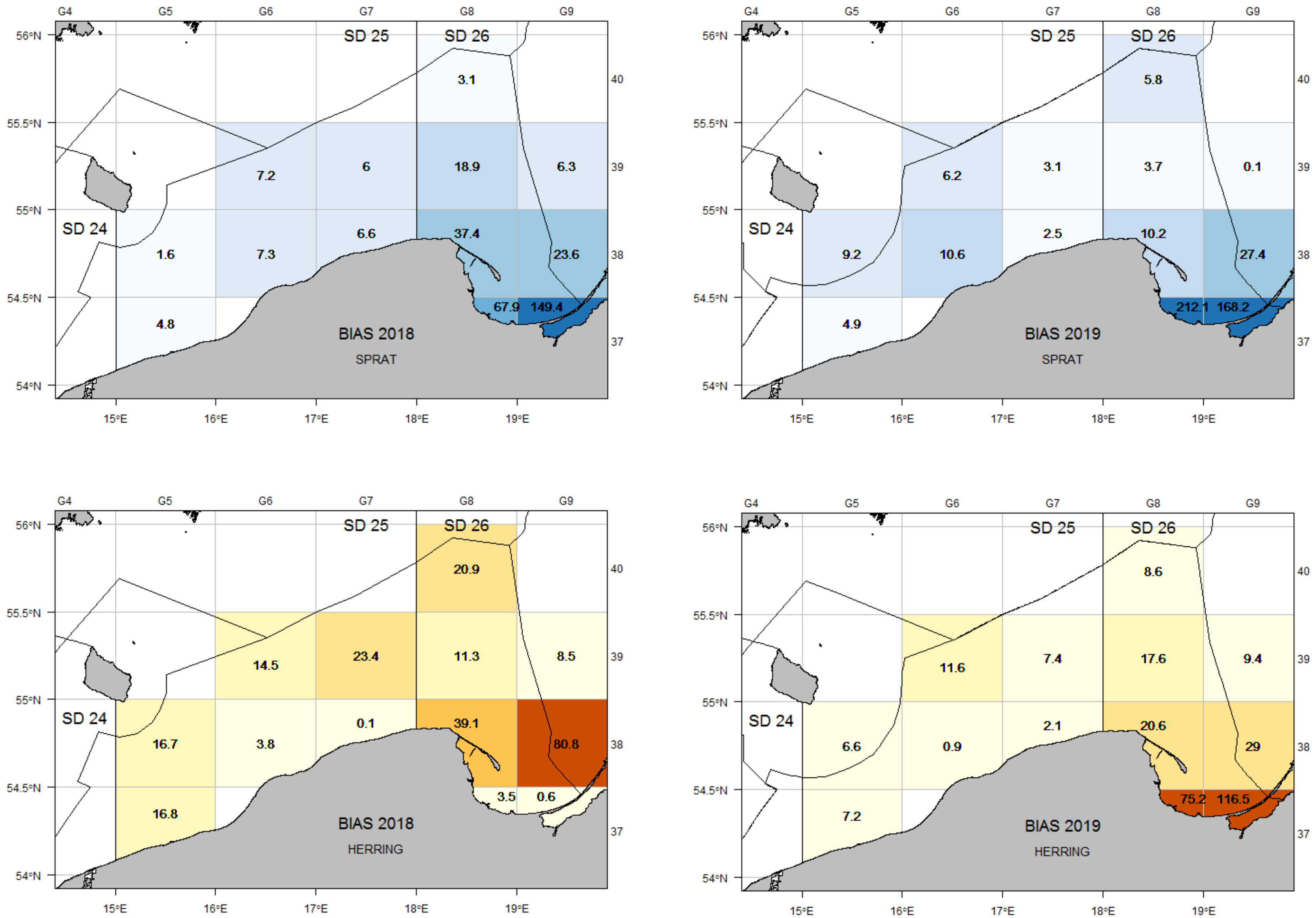
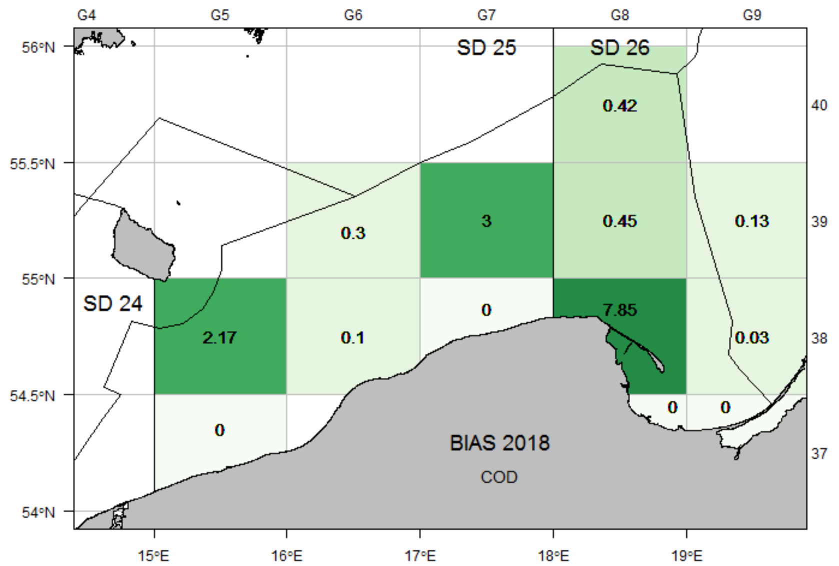


Fig. 11. Biomass surface density of sprat and herring [t NM^{-2}] per ICES rectangles, estimated using acoustic method, and based on data collected during the Polish BIAS 2018 and 2019 surveys.



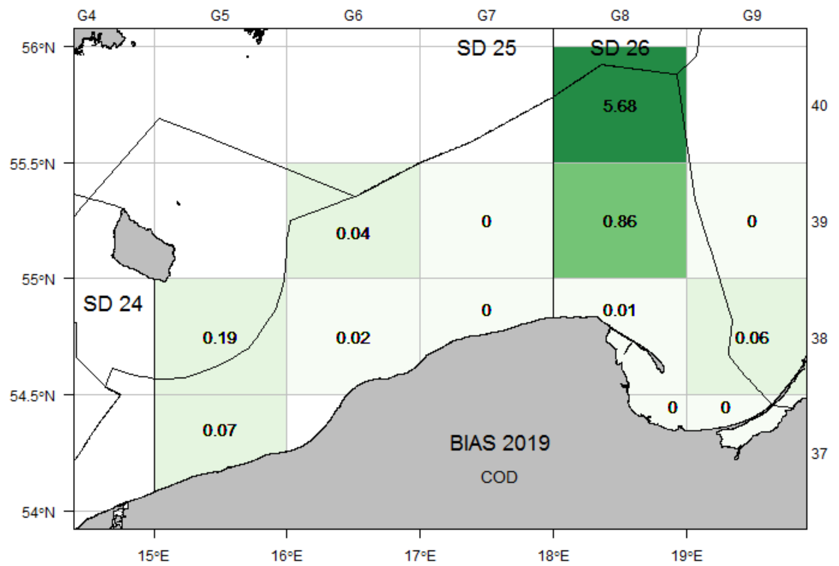


Fig. 12. Biomass surface density of cod [t NM^{-2}] per ICES rectangles, estimated using acoustic method, and based on data collected during the Polish BIAS 2018 and 2019 surveys.

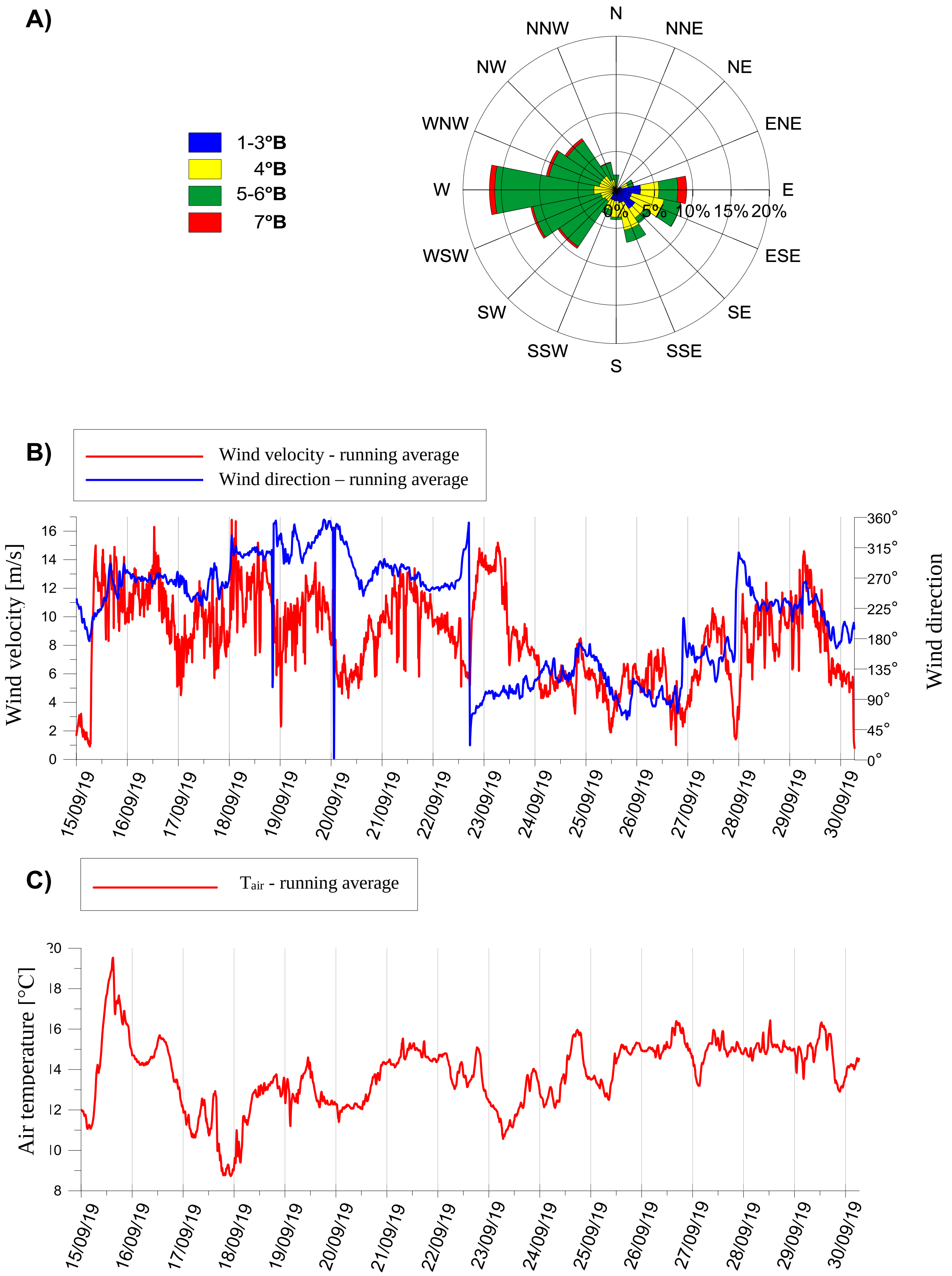


Fig. 13. Changes of meteorological parameters during consecutive days of the Polish BIAS survey in September 2019 (fig. Wodzinowski after Schmidt et al., 2019).

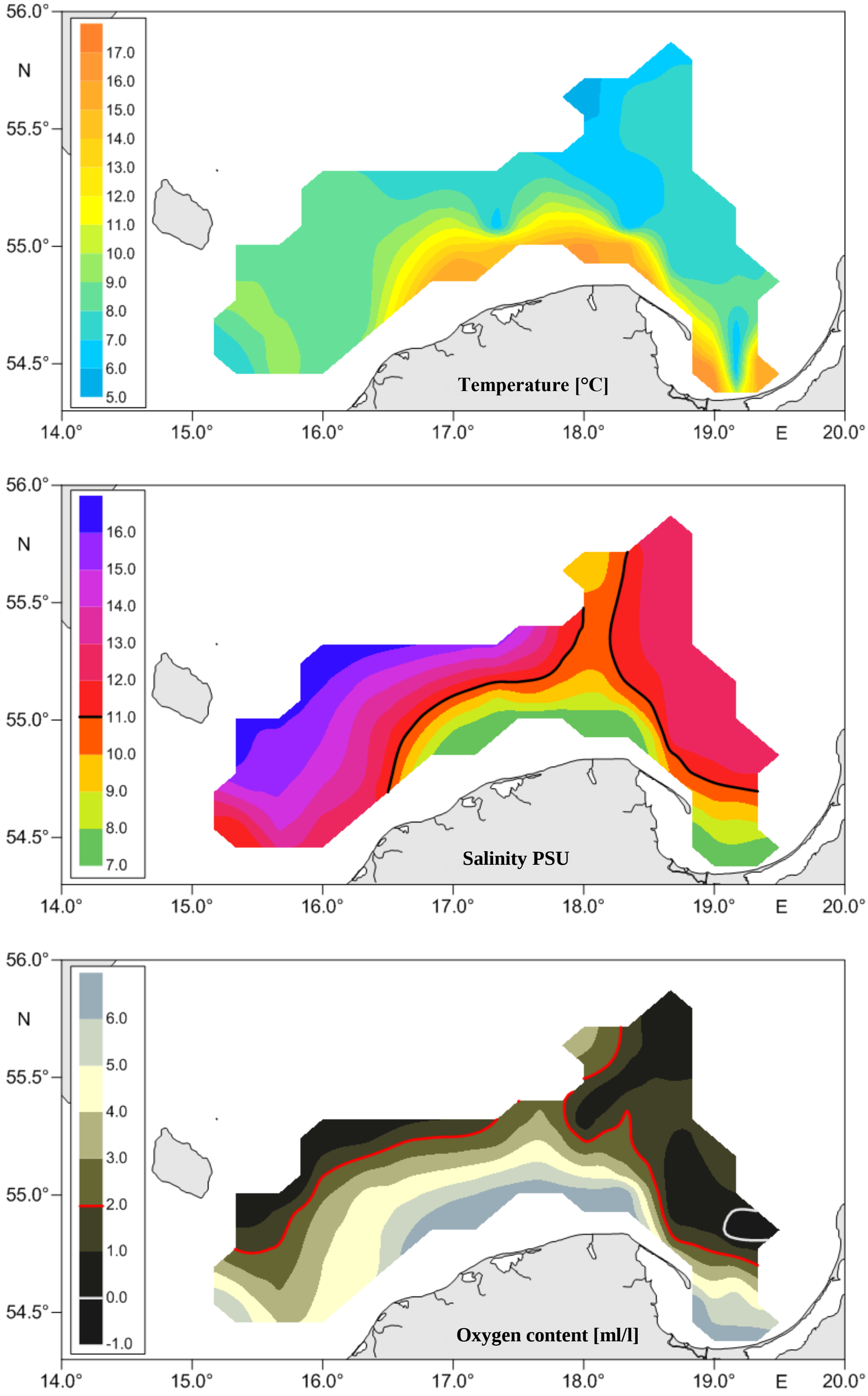


Fig. 14. Horizontal distribution of the seawater temperature, salinity and oxygen content in the near seabed layer of the southern Baltic in September 2019 (fig. Wodzinowski after Schmidt et al., 2019).

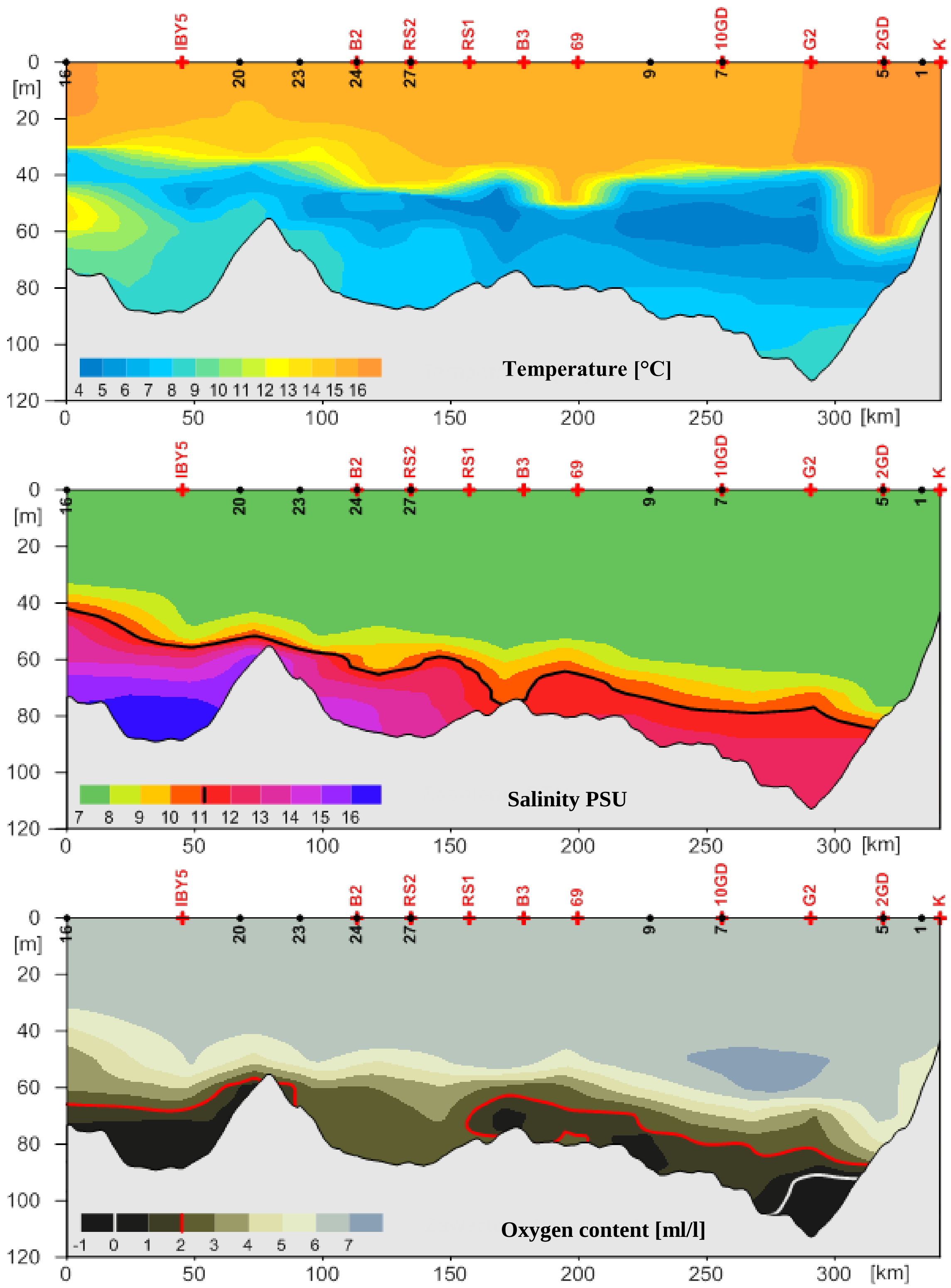


Fig. 15. Vertical distribution of the seawater temperature, salinity and oxygen content, along the hydrological research profile determined in the southern Baltic (September 2019); X- and Y-axes reflects distance (in kilometres) and depth (in meters) from the sea surface to the seabed, respectively (fig. Wodzinowski after Schmidt et al., 2019).

Survey Report for RV "ATLANTIDA"
20.10-07.11.2019

RUSSIAN FEDERAL RESEARCH INSTITUTE OF FISHERIES AND OCEANOGRAPHY
«VNIRO»
Atlantic branch of VNIRO («AtlantNIRO»)

1 INTRODUCTION

The main objective is to assess clupeids resources in the Baltic Sea. The autumn international acoustic survey is traditionally coordinated within the frame of the **International Baltic Acoustic Survey (IBAS).** The reported acoustic survey conducted every year to estimate abundance and biomass of herring and sprat for assessment purposes of Baltic Fisheries Assessment Working Group (WGBFAS).

2 METHODS

2.1 Personnel

A. Zezera	AtlantNIRO, Kaliningrad, Russia - cruise leader
I. Trufanova	AtlantNIRO, Kaliningrad, Russia - scientific leader
A. Malyshko	AtlantNIRO, Kaliningrad, Russia - acoustic
A. Abramov	AtlantNIRO, Kaliningrad, Russia - acoustic
D. Churin	AtlantNIRO, Kaliningrad, Russia - hydrologist
A. Gusev	AtlantNIRO, Kaliningrad, Russia - hydrobiologist
S. Ivanov	AtlantNIRO, Kaliningrad, Russia - ichthyologist
V. Shopov	AtlantNIRO, Kaliningrad, Russia - ichthyologist
Yu. Priemko	AtlantNIRO, Kaliningrad, Russia - ichthyologist
N. Kalinina	AtlantNIRO, Kaliningrad, Russia - ichthyologist
S. Popov	AtlantNIRO, Kaliningrad, Russia - ichthyologist

2.2 Narrative

The RV'ATLANTIDA' cruise, number 68, of 2019 year, was started from port Kaliningrad, on the 24 of October and continued to 05 November of 2019. The cruise covered the ICES Subdivision 26 and included only Russia economic zone. Acoustic equipment calibration carried out on 25 October 2019.

2.3 Survey design

The area of international acoustic survey is limited by the 10 m depth line. The statistical rectangles of Subdivision 26 (zone of Russia), were used as strata (IBAS, ver. 0.82, ICES CM 2017/SSGIEOM:07). The scheme of transects has been defined as the regular, of rectangular form, with the distance between transects of 15 nm. The average speed of a vessel for the all period of acoustic survey was 7.9-8.2 knots. The average speed of the vessel with a trawl was 3.8 knots; the trawling duration was standard 30 minutes. The survey conducted in the daytime from 7.30 up to 17.30 of local time. All investigated area of survey constitutes the 3838.8 nm^2. The full cruise track with positions of the trawling shown in the Figure 1.

2.4 Calibration

The Simrad EK80 echosounder with transducers ES38B and ES120–7 were calibrated in the Baltic Sea shore area, near the port Pionerskiy (Russia), on the 25.10.2019, in 55°09.50'N; 20°25.08'E position. The ship fixed on the two anchors and one trawl door on the 36.0 meters of depth. The calibration procedure was carried out with a Standard Reference Target (*Tungsten WC-Co_38.1mm)*, in accordance with the 'SISP Manual of International Baltic Acoustic Surveys (IBAS) ("Manual of International Baltic Acoustic Surveys (IBAS)", Series of ICES Survey Protocols SISP 8 – IBAS, Version 2.0, WGBIFS 2017)

THE RESULTS OF CALIBRATION PROCEDURE FOR EK80 SCIENTIFIC ECHOSOUNDER	
Date: 25.10.2019	Place : 55°09.50' N; 20°25.08' E (Russia)
Type of transducer	Split – beam for 38 and 120 kHz
Gain (38 kHz)	26.53 dB
SA Correction (38 kHz)	-0.63 dB
Gain (120 kHz)	25.56 dB
Sa Correction (120 kHz)	-0.32 dB

2.5 Acoustic data collection

The acoustic investigations performed during daytime only. The acoustic equipment was an echosounder EK80 with the 38/120 kHz working frequencies. Both transducers are stationary installed in the bottom of the ship, in special blister, for air bubbles noise level decreasing. The specific settings of the hydroacoustic equipment were as described in the "Manual of International Baltic Acoustic Surveys (IBAS)", (Series of ICES Survey Protocols SISP 8 – IBAS, Version 2.0, WGBIFS 2017. ICES CM 2017). The post-processing of the stored echodata done with the SonarData Echoview ver. 10.0.283, Surfer 8.0 and Excel software's. The mean volume backscattering values Sv, were integrated over 1 nm intervals, from 5 m below the surface to the bottom. Contributions from air bubbles, trawling and on oceanology stations maneuvers, bottom structures and scattering layers removed from the echograms by using the SonarData Echoview software. The map of fish density distribution built on base NASC values with Surfer 8.0 software.

2.6 Biological data – fishing stations

All trawlings were done with the same pelagic gear "RT/TM 70/300" in the midwater and close to bottom. The mesh size in the codend was 6.5 mm. The intention was to carry out at least three hauls per ICES statistical rectangle. The trawling depth and the trawl opening defined with a trawl sonar monitoring system SI-110. The trawling depth was chosen on base the echogram, in accordance with echo records from the fish. The trawl had vertical opening of about 20–35 m. The trawling time lasted 30 minutes. From each haul, the samples were taken, in order to determine length and weight composition of fish. For further investigations in the laboratory (i.e. sex, maturity, age) sub-samples of herring, cod and sprat was taken. For further biological additional investigations, stomachs of sprat, cod and herring was sampled. The positions of trawling shown in the Figure 1. Fish control-catch results from the Russian RV 'Atlantida' IBAS survey shown in the Table 1.

2.7 Data analysis

The pelagic target species sprat and herring usually distributed in mixed layers in combination with other species, so that it is impossible to define the integrator readings for a single species. Therefore, the species composition based on the trawl catch results. For each rectangle, the species composition and length distribution were determined as the mean-weighted of all trawl results in this rectangle. From these distributions, the mean acoustic cross section σ calculated according to the following target strength-length (TS) relationships:

Clupeids	TS = 20 log L (cm) - 71.2	(ICES 1983/H:12)
Gadoids	TS = 20 log L (cm) - 67.5	(Foote *et al.,* 1986)

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

2.8 Hydrographic data

Hydrographic measurement executed after finalization of each trawling. The vertical profiles of hydrographical parameters, (temperature, salinity of water and the oxygen dissolved in water) taken with a "SBE-19 plus" probe.

Samples of water on different depth selected with the complex “SBE-19 Plus S/N 7524”. Concentration of the dissolved oxygen in samples defined on method Winkler, by means of the stand for titration "Dosimat 715" (Hydrobios, Germany).

3 RESULTS

3.1 Biological data

In total 13 trawl hauls carried out in Subdivision 26 (Russian zone). During the survey the 3486 herring, 2612 sprat and 25 cod measured and 1116 herring, 1164 sprat and 25 cod were aged. The results of the catch composition by ICES Subdivision presented in the Table 2. The average catch amounted to 166.9 kg per half hour of trawling. The average biomass fraction was 43.7% for sprat, 55.5% for herring and 0.4% for cod. In four trawling stations, the fraction of a sprat exceeded 85%, in nine about 30%. The length compositions of sprat and herring in subdivision 26 (Russian zone) of the year 2019, are presented in the Figure 2.

3.2 Acoustic data

The survey statistics concerning the survey area, the mean NASC, the mean scattering cross section σ, the estimated total number of fish, the percentages of herring and sprat per Sub-division/rectangle shown in the Table 3. The map of surface density distribution in NASC [m^2/nm^2] – values, shown in the Figure 3.

3.3 Abundance estimates

The total abundance of sprat and herring presented in Table 4. The estimated summary acoustic survey of sprat and herring (mean length and weights) by Subdivision/rectangle given in the Table 5. The estimates of sprat and herring biomass by Subdivision/rectangle shown in the Tables 6-11.

4 DISCUSSION

Oxygen deficiency remained a characteristic feature of the deep-sea gas regime. Hypoxia conditions (oxygen less than 2 ml/l) were typical for a significant part of the water at depths greater than 65-80 m.

A young sprat in length of 9.5 cm and less (the generation 2018), was met in 12 trawling stations. Its share ranged from 0.5 to 93.5%, on the average on survey – 19.4%. It is close to the generation level of 2017 (the share of young sprat was 14.0%) and the annual class of 2017 estimated above the average within the entire stock unit.

A young herring in length of 13.0 cm and less (the generation 2018), was met in nine trawling stations. On the average, the share of young herring on survey has reached to 3.9% that is lower than the corresponding indicators of medium-yielding generations.

The data collected during the survey should be representative for the abundance of the pelagic species during the IBAS in 2019.

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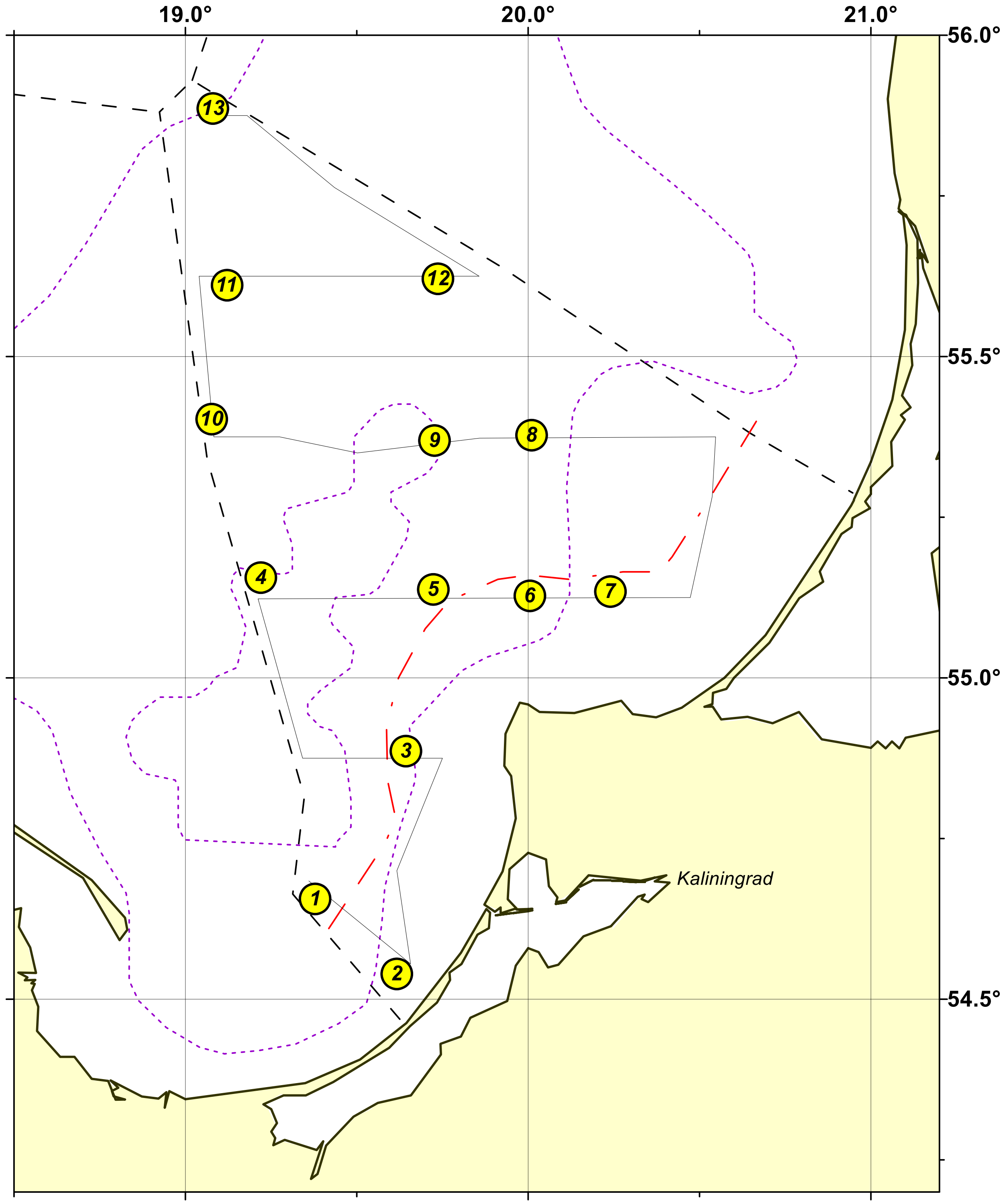


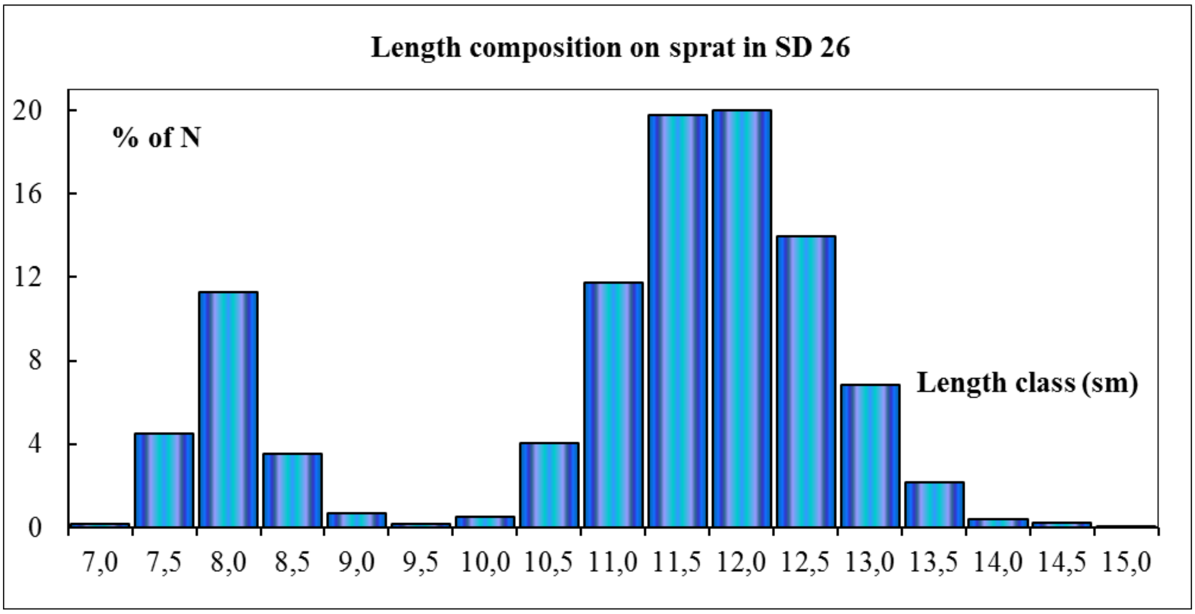
Figure 1. The scheme of cruise track and trawl stations for Russian part of survey (RV "ATLANTIDA", 26.10-04.11. 2019)

Table 1. Fish control-catch results in the Baltic Sea ICES SD 26 from Russian IBAS survey. (RV "ATLANTIDA", 26.10–04.11.2019)

Haul number	DATE	ICES rect.	ICES SD	Mean bottom depth [m]	Head-rope depth [m]	Hor. open [m]	Ver. open [m]	Trawl. speed [knt]	Trawl. direct [°]	Geographical position				Time Start	Haul dur. [min]	Total catch [kg]
										start		end				
										Lontitude 00°00.0' N	Longitude 00°00.0' E	Lontitude 00°00.0' N	Longitude 00°00.0' E			
1	26.10.2019	38G9	26	91	32	93	29	3,9	30	54 39.4	19 22.7	54 41.4	19 24.7	9,22	30	281,7
2	26.10.2019	38G9	26	46	24	90	20	4,5	30	54 32.4	19 37.0	54 34.4	19 38.9	14,46	30	80,9
3	29.10.2019	38G9	26	68	31	91	31	3,8	160	54 53.2	19 38.6	54 51.3	19 39.8	6,53	30	417,2
4	30.10.2019	39G9	26	97	50	94	32	3,6	170	55 09.4	19 13.2	55 07.3	19 13.9	6,30	30	85,5
5	30.10.2019	39G9	26	78	40	91	34	3,7	170	55 08.3	19 43.4	55 06.4	19 43.7	12,04	30	400,8
6	31.10.2019	39H0	26	60	28	89	30	3,7	88	55 07.7	20 00.3	55 07.7	20 03.4	6,36	30	175,9
7	31.10.2019	39H0	26	45	19	88	26	4,2	110	55 08.1	20 14.4	55 07.5	20 17.8	13,26	30	21,3
8	01.11.2019	39H0	26	62	22	89	35	3,6	93	55 22.7	20 00.6	55 22.6	20 03.8	10,45	30	41,5
9	01.11.2019	39G9	26	96	55	95	35	3,7	79	55 22.2	19 43.6	55 22.4	19 46.7	14,30	30	159,1
10	03.11.2019	39G9	26	85	50	94	32	3,7	21	55 24.2	19 04.6	55 26.0	19 05.8	6,45	30	192,6
11	03.11.2019	40G9	26	88	47	92	31	3,9	351	55 36.7	19 07.3	55 38.6	19 06.7	10,51	30	79,8
12	04.11.2019	40G9	26	83	49	92	30	3,7	268	55 37.3	19 44.2	55 37.2	19 40.8	8,58	30	161,9
13	04.11.2019	40G9	26	105	35	90	31	3,8	226	55 53.2	19 04.8	55 51.8	19 02.2	14,26	30	71,0
				SD26	37	91	30	3,8	138							2169

Table 2. Catch composition (kg/half an hour) per haul by ICES Subdivision and ICES rectangles (RV "ATLANTIDA", 26.10–04.11.2019)

ICES_Subdivision	**26**	**26**	**26**	**26**	**26**
Haul_No	***1***	***2***	***3***	***4***	***5***
Date	26.10.2019	26.10.2019	29.10.2019	30.10.2019	30.10.2019
Validity	Valid	Valid	Valid	Valid	Valid
Species/ICES rectangle	38G9(64)	38G9(64)	38G9(64)	39G9(64)	39G9(64)
CLUPEA HARENGUS	265.4	6.9	221.6	52.0	57.3
SPRATTUS SPRATTUS	13.7	73.3	192.4	32.6	343.1
GADUS MORHUA	1.9	-	1.5	0.7	0.2
ANOTHER	0.7	0.7	1.8	0.2	0.2
Total	281.7	80.9	417.2	85.5	400.8
ICES_Subdivision	**26**	**26**	**26**	**26**	**26**
Haul_No	***6***	***7***	***8***	***9***	***10***
Date	31.10.2019	31.10.2019	01.11.2019	01.11.2019	03.11.2019
Validity	Valid	Valid	Valid	Valid	Valid
Species/ICES rectangle	39HO(65)	39HO(65)	39HO(65)	39G9(64)	39G9(64)
CLUPEA HARENGUS	163.2	0.9	3.0	95.6	143.0
SPRATTUS SPRATTUS	12.4	20.4	38.0	61.8	48.6
GADUS MORHUA	-	-	-	1.7	1.0
ANOTHER	0.3	-	0.5	-	-
Total	175.9	21.3	41.5	159.1	192.6
ICES_Subdivision	**26**	**26**	**26**		
Haul_No	***11***	***12***	***13***		
Date	03.11.2019	04.11.2019	04.11.2019		
Validity	Valid	Valid	Valid		
Species/ICES rectangle	40G9(64)	40G9(64)	40G9(64)		
CLUPEA HARENGUS	50.6	92.9	50.6		
SPRATTUS SPRATTUS	28.3	66.8	16.3		
GADUS MORHUA	0.9	1.8	0.0		
ANOTHER		0.4	4.0		
Total	79.8	161.9	70.9		



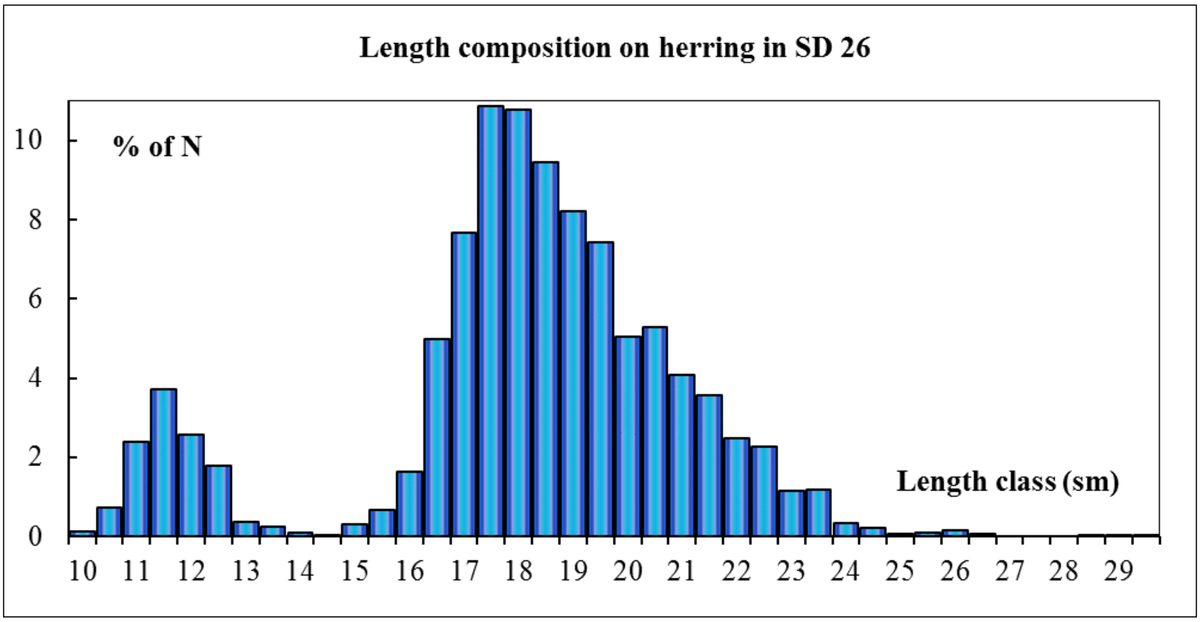


Figure 2. Length composition of sprat and herring (%)
RV "ATLANTIDA", 26.10–04.11.2019

Table 3. Survey statistics, RV "ATLANTIDA", 26.10–04.11.2019

ICES SD	ICES Rect.	Area nm^2	SA m^2/nm^2	$\sigma*10^4$ m^2	N total mln	Species composition (%)		
						herring	sprat	cod
26	40G9	1013	126.9	2.11	604.5	33.27	66.69	0.04
	39H0	881.6	300.7	1.71	1554.4	29.26	70.74	0.00
	39G9	1026	159.2	1.73	944.0	15.18	84.80	0.02
	38G9	918.2	1556.9	1.68	8506.8	25.00	74.98	0.02

Table 4. Summary acoustic survey of sprat and herring, RV "ATLANTIDA", 26.10–04.11.2019

ICES SD	ICES Rect.	No trawl	HERRING			SPRAT			SA	TS calc.
			L, cm	W, g	Numb.,%	L, cm	W, g	Numb.,%	m^2/nm^2	dB
26	40G9	11,12,13	18.96	39.63	33.28	12.28	11.35	66.72	126.1	-47.7
	39H0	6,7,8	18.50	39.74	29.26	10.21	6.97	70.74	300.7	-48.7
	39G9	4,5,9,10	19.34	42.35	15.19	12.04	10.59	84.81	158.7	-48.6
	38G9	1,2,3	18.80	40.63	25.00	10.53	7.66	75.00	1551.6	-48.8

Table 5. Characteristics of sprat and herring stocks of acoustic survey data, RV "ATLANTIDA", 26.10–04.11.2019

ICES SD	ICES Rect.	Area nm^2	r mln/nm^2	Quantity, mln			Biomass, tonn		
				N sum	N her	N spr	W sum	W her	W spr
26	40G9	1013.0	0.60	604.2	201.1	403.1	12543.3	7969.4	4573.9
	39H0	881.6	1.76	1554.4	454.8	1099.6	25734.6	18075.4	7659.2
	39G9	1026.0	0.92	943.9	143.3	800.5	14551.1	6069.5	8481.5
	38G9	918.2	9.26	8505.0	2126.5	6378.5	135288.6	86406.2	48882.4
SD26		**3 838.8**		**11 607.6**	**2 925.8**	**8 681.8**	**188 117.6**	**118 520.5**	**69 597.1**

Table 6. Estimated number (millions) of herring (RV "ATLANTIDA", 26.10–04.11.2019)

SD	ICES RECT	NHTOT	Age								
			0	1	2	3	4	5	6	7	8+
26	38G9	2126.50	116.81	53.52	363.72	230.68	399.65	391.14	319.16	164.16	87.68
	39G9	143.33	0.66	1.70	17.44	13.23	15.59	40.21	21.41	18.36	14.72
	39HO	454.83	44.87	1.15	57.89	63.54	85.67	95.49	40.18	29.24	36.80
	40G9	201.12	1.59	2.37	9.81	15.58	31.93	58.02	43.36	30.08	8.39
	Sum	**2925.78**	**163.93**	**58.75**	**448.84**	**323.04**	**532.84**	**584.86**	**424.11**	**241.83**	**147.58**

Table 7. Estimated mean weights (g) of herring (RV "ATLANTIDA", 26.10–04.11.2019)

SD	ICES RECT	WHTOT	Age								
			0	1	2	3	4	5	6	7	8+
26	38G9	40.63	10.06	30.15	38.74	40.04	40.21	40.84	47.87	47.67	58.73
	39G9	42.35	12.24	30.14	36.32	39.45	38.48	37.29	45.15	50.41	58.63
	39HO	39.74	8.91	24.07	35.86	37.60	41.13	42.07	52.37	44.18	61.03
	40G9	39.63	10.62	24.52	33.31	36.50	40.08	36.23	41.56	45.72	52.46

Table 8. Estimated biomass (in tonnes) of herring (RV "ATLANTIDA", 26.10–04.11.2019)

SD	ICES RECT	WHTOT	Age								
			0	1	2	3	4	5	6	7	8+
26	38G9	86406.2	1174.6	1613.5	14088.8	9236.4	16068.3	15972.7	15277.1	7826.0	5149.0
	39G9	6069.5	8.1	51.4	633.3	521.9	600.0	1499.5	966.8	925.6	863.0
	39HO	18075.4	399.7	27.8	2075.7	2389.1	3523.8	4017.6	2104.2	1291.6	2246.0
	40G9	7969.4	16.9	58.2	326.6	568.7	1279.6	2102.1	1802.1	1375.2	440.1
	SUM	**118520.5**	**1599.2**	**1750.8**	**17124.3**	**12716.2**	**21471.7**	**23591.9**	**20150.1**	**11418.3**	**8698.0**

Table 9. Estimated number (millions) of sprat (RV "ATLANTIDA", 26.10–04.11.2019)

ICES SD	ICES RECT	NSTOT	Age								
			0	1	2	3	4	5	6	7	8+
26	38G9	6378.5	2518.9	397.2	1277.5	997.4	617.9	457.5	84.0	28.2	-
	39G9	800.5	17.1	94.3	259.6	142.6	145.3	133.2	5.2	3.1	-
	39HO	1099.6	466.9	150.3	271.4	107.3	53.5	44.5	3.40	2.4	-
	40G9	403.1	6.0	16.0	99.6	95.4	93.6	78.5	5.5	6.95	1.6
	SUM	**8681.8**	**3008.9**	**657.7**	**1908.1**	**1342.7**	**910.3**	**713.7**	**98.1**	**40.6**	**1.6**

Table 10. Estimated mean weights (g) of sprat (RV "ATLANTIDA", 26.10–04.11.2019)

ICES SD	ICES RECT	WSTOT	Age								
			0	1	2	3	4	5	6	7	8+
26	38G9	7.7	3.5	8.3	10.0	10.5	11.2	11.5	12.2	11.6	-
	39G9	10.6	3.3	8.6	9.9	11.4	11.8	11.9	11.9	14.2	-
	39HO	7.0	3.3	8.0	9.5	10.8	11.6	11.8	11.4	10.3	-
	40G9	11.3	4.7	9.2	10.2	11.4	12.3	12.3	12.7	13.9	10.6

Table 11. Estimated biomass (in tons) of sprat (RV "ATLANTIDA", 26.10–04.11.2019)

ICES SD	ICES RECT	WSTOT	Age								
			0	1	2	3	4	5	6	7	8+
26	38G9	48882.4	8859.0	3304.9	12760.2	10435.0	6916.8	5259.5	1021.2	325.8	0.0
	39G9	8481.5	56.0	811.5	2576.0	1630.9	1710.8	1589.9	61.7	44.7	0.0
	39HO	7659.2	1525.6	1203.3	2567.8	1157.3	619.0	522.8	38.8	24.6	0.0
	40G9	4573.9	28.2	146.2	1017.8	1084.2	1149.1	966.0	69.4	96.6	16.4
	SUM	**69580.7**	**10468.8**	**5465.9**	**18921.8**	**14307.4**	**10395.7**	**8338.2**	**1191.2**	**491.7**	**16.4**

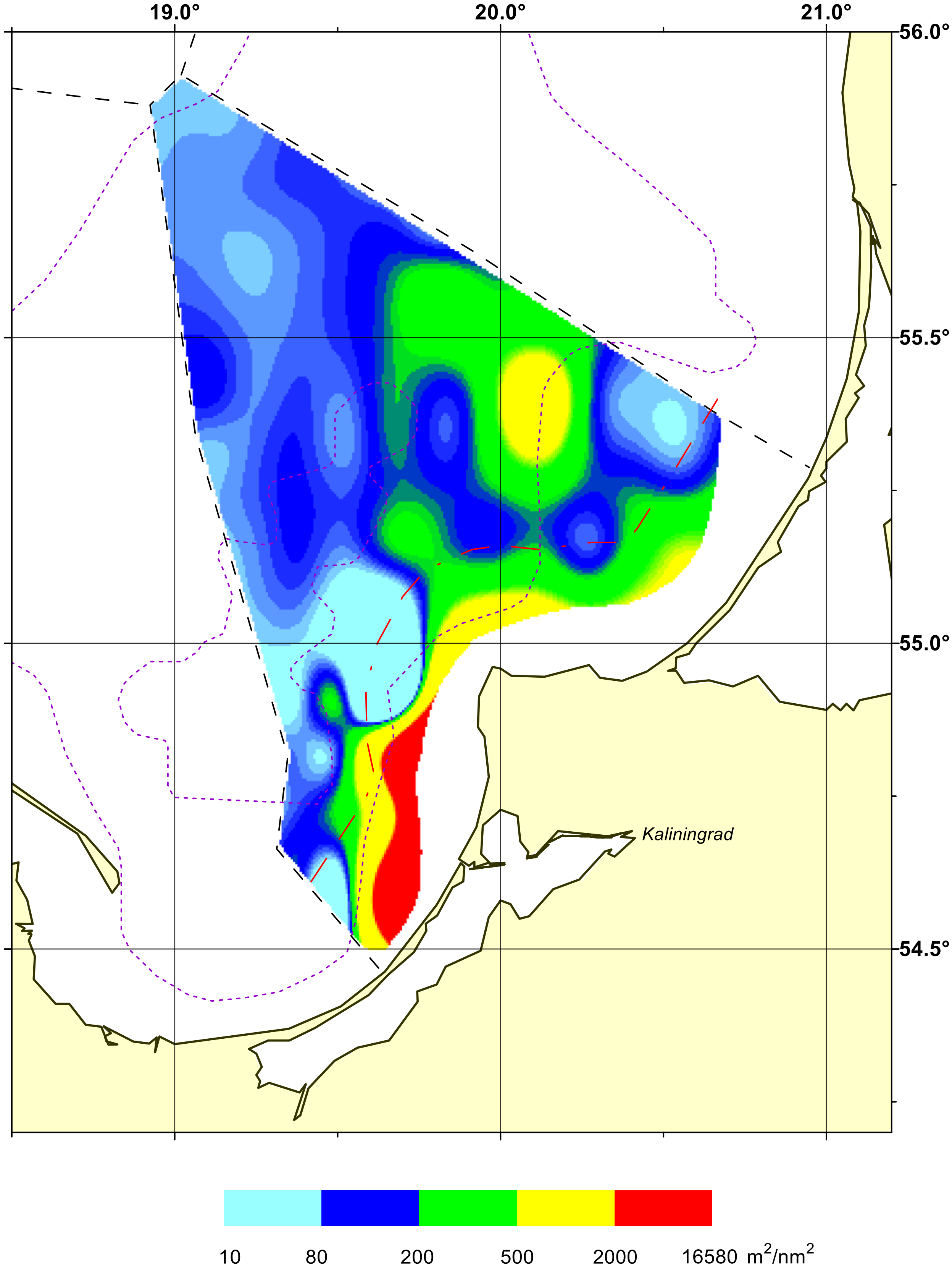


Figure 3. The map of NASC values distribution on the Russian area of international acoustic survey IBAS (RV "ATLANTIDA", 26.10-04.11.2019)

Baltic International Acoustic Survey Report

for

R/V Svea

Survey 2019-10-08 - 2019-10-20

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

Contents

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

2 Methods

2.1 Narrative

Sweden recently has built a new Fisheries Research Ship,R/V Svea that was used in the BIAS survey. . This year's calibration of the SIMRAD EK60 sounder was made at Gullmarsfjorden on the Swedish west coast. The total cruise covered SD 27 and parts of 25, 26, 28 and 29.

2.2 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[2]. 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 1359 nautical miles. The cruise track and positions of trawl hauls are shown in figure 2.

2.3 Calibration

The SIMRAD EK80 echo sounder with 6 transducers was calibrated at Bornö in Gullmarssfjorden 2019-10-08 according to the BIAS manual.[3] Values from the calibration were within required accuracy. 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)

2.4 Acoustic data collection

The acoustic sampling was performed around the clock. SIMRAD EK80[4] echo sounder with the 38 kHz transducer mounted on a retracteable keel was used for the acoustic transect data collection. . The post processing of the stored raw data was made using the software LSSS[6]. 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.

2.5 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] ICES CM 2011/SSGESST:05 Addendum 2
[3] See footnote 5
[4] http://www.simrad.com/ek60
[5] See footnote 5
[6] 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.

2.6 Hydrographic data

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

2.7 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
Ovegård, Mikael	IMR, Lysekil, Sweden	Acoustics
Wickström, Peter	IMR, Lysekil, Sweden	Technician at calibration
Svensson, Matilda	IMR, Lysekil, Sweden	Fish sampling
Tell, Anna-Kerstin	SMHI, Gothenburg	Oceanography

Table 2 – Participating scientific crew

3 Results

3.1 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. 1622 herrings and 1232 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.

3.2 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.

3.3 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.

4 Discussion

The data collected during the survey should be considered as representative for the abundance of the pelagic species during the BIAS in 2019 for SD25 to 29 and thus can be used in the assessment done by WGBFAS.

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

6 Tables, map and figures

SD	RECT	AREA	SA	SIGMA	NTOT	HHer	HSpr	HCod
25	39G4	287.3	256.8	2.634	280.04	38.29	59.16	0.705
25	39G5	979.0	216.4	1.593	1329.41	2.92	96.49	0.124
25	40G4	677.2	642.3	2.332	1865.24	41.84	56.13	0.471
25	40G5	1012.9	481.6	1.056	4619.83	4.42	50.81	1.218
25	40G6	1013.0	614.0	2.260	2752.13	64.73	10.09	0.583
25	40G7	1013.0	600.1	1.396	4354.23	10.70	86.24	0.000
25	41G6	764.4	720.1	0.932	5908.43	16.57	18.38	0.037
25	41G7	1000.0	456.5	1.119	4080.24	7.84	61.06	0.000
26	41G8	1000.0	843.0	1.118	7537.90	4.46	60.87	0.120
27	42G6	266.0	496.7	0.561	2354.00	5.29	10.06	0.072
27	42G7	986.9	673.0	0.559	11891.91	4.75	9.14	0.033
27	43G7	913.8	505.6	0.473	9759.12	6.73	12.18	0.000
27	44G7	960.5	380.3	0.595	6140.98	8.24	61.63	0.000
27	44G8	456.6	522.0	0.586	4066.70	1.53	19.18	0.000
27	45G7	908.7	272.5	0.509	4867.64	9.21	30.14	0.000
27	45G8	947.2	252.3	0.434	5500.58	1.00	6.98	0.000
27	46G8	884.8	273.2	0.486	4973.15	2.66	26.07	0.000
28	42G8	945.4	889.8	1.212	6940.84	11.35	67.80	0.001
28	43G8	296.2	705.9	0.841	2487.50	16.93	18.42	0.000
28	43G9	973.7	271.9	0.525	5040.17	1.40	14.45	0.000
28	44G9	876.6	260.6	0.602	3796.68	3.58	54.54	0.000
28	45G9	924.5	430.7	0.588	6773.72	5.67	11.04	0.005
29	46G9	933.8	430.6	0.414	9707.79	1.62	2.11	0.003
29	46H0	933.8	489.8	0.500	9155.93	4.16	20.00	0.000
29	47G9	876.2	581.9	0.565	9027.27	2.70	52.30	0.000

Table 3 – Survey statistics

SD	RECT	NSprTOT	NSpr0	NSpr1	NSpr2	NSpr3	NSpr4	NSpr5	NSpr6	NSpr7	NSpr8
25	39G4	165.65	0.00	5.03	25.13	38.34	36.48	41.13	2.23	8.19	9.12
25	39G5	1282.79	0.00	173.78	0.00	186.60	153.89	670.32	38.70	59.50	0.00
25	40G4	1046.94	0.00	149.56	60.26	139.92	219.61	316.21	60.80	95.74	4.83
25	40G5	2347.45	5.70	185.58	344.86	354.58	463.21	595.57	307.51	85.98	4.47
25	40G6	277.58	9.10	37.17	72.47	54.95	20.64	70.29	8.09	0.00	4.87
25	40G7	3754.97	717.26	374.29	269.28	527.11	734.70	956.34	75.05	92.76	8.17
25	41G6	1085.88	167.75	168.67	48.32	328.83	159.74	129.01	13.11	9.90	60.53
25	41G7	2491.19	378.06	289.23	148.30	250.15	616.50	803.75	0.00	5.19	0.00
26	41G8	4588.65	30.27	835.12	499.17	1340.12	539.38	950.77	52.84	202.27	138.70
27	42G6	236.90	34.95	22.52	28.74	22.01	24.60	76.12	16.83	1.29	9.84
27	42G7	1087.19	22.95	25.62	96.52	93.08	235.57	490.61	34.35	12.94	75.54
28	42G8	4705.98	852.23	738.35	346.67	841.38	306.47	1464.06	78.87	20.81	57.14
27	43G7	1188.69	760.54	125.02	37.89	71.85	48.40	114.41	15.14	11.80	3.62
28	43G8	458.26	354.78	0.00	4.14	23.06	27.79	48.49	0.00	0.00	0.00
28	43G9	728.37	189.20	187.99	121.86	70.70	103.42	55.19	0.00	0.00	0.00
27	44G7	3784.41	3711.42	20.35	10.17	0.00	0.00	21.23	11.95	9.29	0.00
27	44G8	779.82	104.85	95.02	122.54	96.99	134.99	169.07	30.80	25.56	0.00
28	44G9	2070.87	1975.55	7.34	14.23	16.38	36.52	19.51	1.34	0.00	0.00
27	45G7	1467.13	1435.64	13.71	0.00	4.11	4.11	9.57	0.00	0.00	0.00
27	45G8	384.20	238.13	28.46	48.72	19.23	18.43	27.34	1.27	1.27	1.36
28	45G9	747.67	129.47	130.09	115.56	49.23	76.35	167.49	62.61	5.62	11.24
27	46G8	1296.51	1276.67	7.44	0.00	2.48	0.00	9.92	0.00	0.00	0.00
29	46G9	205.08	139.23	4.41	4.37	23.03	8.04	20.48	4.00	1.52	0.00
29	46H0	1831.06	1617.19	55.49	9.94	37.26	40.09	48.64	5.20	0.00	17.27
29	47G9	4721.43	4150.74	83.94	59.29	71.06	0.00	334.94	0.00	21.47	0.00

Table 4 – Estimated number (millions) of sprat

SD	RECT	WSpr0	WSpr1	WSpr2	WSpr3	WSpr4	WSpr5	WSpr6	WSpr7	WSpr8
25	39G4		9.95	13.93	12.89	14.85	13.60	18.09	15.07	14.09
25	39G5		8.84		11.45	13.17	13.23	14.88	13.97	
25	40G4		9.16	10.31	12.36	13.86	13.12	17.02	13.76	15.92
25	40G5	3.33	7.97	10.35	13.19	11.99	15.79	13.52	16.15	15.37
25	40G6	3.63	8.59	10.80	10.83	13.96	12.65	13.16		13.36
25	40G7	3.62	7.74	10.05	10.71	11.21	12.46	13.64	13.81	16.83
25	41G6	3.50	8.40	9.27	11.27	12.28	12.55	15.14	12.74	15.03
25	41G7	3.25	8.47	8.49	10.71	10.22	12.63		14.84	
26	41G8	3.41	7.97	8.97	10.21	12.03	11.90	12.77	11.47	13.69
27	42G6	3.36	8.68	9.20	10.94	10.99	11.48	12.20	11.95	14.19
27	42G7	2.10	9.17	10.59	9.32	11.02	11.87	13.59	13.48	13.93
28	42G8	3.27	7.96	8.36	9.75	11.33	10.51	13.00	13.99	12.33
27	43G7	2.78	8.98	9.77	11.13	11.21	11.38	13.04	10.89	11.87
28	43G8	3.11		8.57	9.42	11.25	10.89			
28	43G9	2.93	8.65	8.97	11.04	11.09	12.44			
27	44G7	2.87	7.32	6.36			12.21	10.82	13.38	
27	44G8	3.70	9.39	11.71	10.11	12.74	13.00	15.02	11.67	
28	44G9	3.02	8.17	9.37	10.72	10.17	11.46	13.87		
27	45G7	2.23	6.20		11.88	11.55	10.78			
27	45G8	3.13	9.09	10.66	11.78	11.13	11.49	13.14	12.66	17.55
28	45G9	3.21	9.67	10.50	9.77	10.96	11.03	12.97	15.42	14.77
27	46G8	2.56	8.76		9.20		10.34			
29	46G9	2.84	8.04	10.71	10.31	8.67	10.30	12.44	11.19	
29	46H0	2.65	8.00	10.06	9.64	11.18	11.92	9.14		11.54
29	47G9	3.02	9.37	10.02	10.68		11.05		13.09	

Table 5 – Estimated mean weights (g) of sprat

SD	RECT	NHerTOT	NHer0	NHer1	NHer2	NHer3	NHer4	NHer5	NHer6	NHer7	NHer8
25	39G4	107.21	2.54	10.94	31.94	23.43	20.56	14.81	1.88	0.00	1.11
25	39G5	38.85	5.79	5.60	8.28	2.56	3.32	10.72	1.47	1.13	0.00
25	40G4	780.39	21.77	103.16	151.18	115.69	56.55	220.27	91.83	19.95	0.00
25	40G5	204.11	29.66	28.43	16.14	19.12	25.82	75.22	7.17	0.52	2.02
25	40G6	1781.52	9.26	83.92	122.15	309.62	173.34	973.20	63.40	44.15	2.46
25	40G7	465.91	1.48	2.61	92.71	40.35	162.29	151.86	5.22	9.39	0.00
25	41G6	978.97	11.73	111.89	114.87	170.82	270.36	285.43	9.60	1.06	3.21
25	41G7	319.83	5.18	1.44	29.63	55.69	44.76	170.66	8.50	3.10	0.86
26	41G8	336.16	7.86	3.05	42.44	20.19	49.25	186.39	10.41	16.58	0.00
27	42G6	124.59	13.65	4.55	19.57	16.04	16.61	51.88	1.71	0.00	0.57
27	42G7	564.83	17.66	20.91	76.17	30.18	139.22	274.20	0.00	6.49	0.00
28	42G8	787.76	20.04	0.00	189.85	161.85	180.57	223.72	7.65	0.00	4.07
27	43G7	656.54	635.61	1.40	3.54	5.95	2.23	5.86	1.95	0.00	0.00
28	43G8	421.25	5.05	22.20	35.82	56.00	66.59	211.38	19.17	5.04	0.00
28	43G9	70.64	1.21	0.60	20.89	9.78	12.80	22.58	2.78	0.00	0.00
27	44G7	505.86	423.07	22.82	24.67	5.94	8.96	19.02	1.38	0.00	0.00
27	44G8	62.26	55.71	0.00	0.00	0.00	6.55	0.00	0.00	0.00	0.00
28	44G9	135.76	25.81	3.86	11.15	34.35	17.35	42.47	0.00	0.77	0.00
27	45G7	448.42	392.72	10.68	21.10	3.37	2.25	11.88	6.42	0.00	0.00
27	45G8	55.08	48.37	1.34	0.90	0.00	1.65	2.83	0.00	0.00	0.00
28	45G9	384.28	71.24	31.98	43.75	71.37	69.51	82.27	14.16	0.00	0.00
27	46G8	132.47	22.73	9.50	24.03	14.33	25.91	23.34	12.62	0.00	0.00
29	46G9	157.19	30.93	2.64	20.12	20.50	13.61	61.40	5.27	0.00	2.72
29	46H0	380.85	102.71	16.46	19.11	52.13	47.91	102.34	38.05	2.13	0.00
29	47G9	244.11	201.48	1.15	15.90	9.97	4.45	6.74	2.93	0.00	1.49

Table 6 – Estimated number (millions) of herring

SD	RECT	WHer0	WHer1	WHer2	WHer3	WHer4	WHer5	WHer6	WHer7	WHer8
25	39G4	11.13	21.71	39.84	62.17	57.72	62.72	129.99		181.64
25	39G5	11.78	15.23	35.31	30.49	25.90	33.51	34.16	34.67	
25	40G4	12.20	18.75	37.11	47.29	47.02	41.04	47.79	64.72	
25	40G5	12.31	17.68	43.40	42.46	46.75	36.35	43.66	77.56	43.69
25	40G6	11.21	22.69	36.77	29.49	32.83	39.82	46.55	43.89	57.44
25	40G7	10.55	19.25	30.63	32.37	30.19	33.75	39.53	39.57	
25	41G6	6.95	19.09	21.53	24.40	34.30	32.22	40.06	42.52	50.02
25	41G7	4.10	15.98	21.14	25.56	29.41	33.71	47.07	31.98	59.24
26	41G8	5.66	16.12	22.72	22.99	33.17	32.45	41.19	35.87	
27	42G6	6.60	15.65	24.68	24.60	30.66	30.76	31.46		32.10
27	42G7	7.01	16.95	23.97	23.70	30.48	32.00		33.19	
28	42G8	5.53		24.22	24.95	31.32	31.96	39.96		34.18
27	43G7	5.24	17.63	26.33	26.42	30.80	30.10	31.09		
28	43G8	4.75	20.56	22.02	25.44	29.70	30.82	37.61	40.27	
28	43G9	5.25	14.90	23.82	27.70	27.66	30.59	32.23		
27	44G7	4.28	18.46	24.99	24.31	30.58	28.45	30.71		
27	44G8	5.79				29.01				
28	44G9	4.87	17.70	25.70	26.96	25.60	31.48		39.61	
27	45G7	5.07	17.39	22.84	26.88	26.85	27.36	33.70		
27	45G8	5.88	18.18	21.19		27.31	28.49			
28	45G9	5.81	18.67	21.71	26.00	32.10	32.64	32.37		
27	46G8	4.66	18.00	23.94	27.33	26.31	28.46	30.43		
29	46G9	4.62	17.00	22.08	27.21	23.48	26.97	31.30		27.28
29	46H0	5.23	16.71	23.66	28.38	27.23	28.01	29.98	34.84	
29	47G9	4.43	16.16	24.31	25.10	27.12	25.89	24.91		36.95

Table 7 – Estimated mean weights (g) of herring

	Species	5	6	8	9	10	11	12	19
1	Ammodytidae								
2	Anguilla anguilla								
3	Clupea harengus	97.94	64.24	16.36	168.51	46.05	25.31	2.07	35.12
4	Cyclopterus lumpus	0.35	0.13	0.24			0.16		
5	Enchelyopus cimbrius								
6	Gadus morhua	10.33	1.99	0.90			0.01		
7	Gasterosteus aculeatus			25.68	10.04	6.07	18.87	39.97	43.97
8	Hyperoplus lanceolatus						0.01		
9	Lumpenus lampretaeformis								
10	Myoxocephalus scorpius							0.07	
11	Nerophis ophidion						0.01		
12	Platichthys flesus	0.72					0.10		
13	Pleuronectes platessa	0.53							
14	Pomatoschistus	0.03							
15	Pungitius pungitius	0.01		0.12	0.07	0.08	0.13	0.21	
16	Scophthalmus maximus			0.13		0.06			
17	Sprattus sprattus	42.68	234.55	207.20	19.93	16.69	15.08	7.42	55.58
18	Zoarces viviparus								

Table 8 – Catch composition per haul.

	Species	23	25	26	27	29	31	32	33
1	Ammodytidae				0.01			0.01	0.03
2	Anguilla anguilla								
3	Clupea harengus	20.93	2.63	4.86	18.81	10.22	2.39	2.23	60.40
4	Cyclopterus lumpus		0.15					0.29	0.04
5	Enchelyopus cimbrius								
6	Gadus morhua								
7	Gasterosteus aculeatus	4.77	34.31	118.91	44.00	11.14	60.75	48.93	74.60
8	Hyperoplus lanceolatus			0.79					
9	Lumpenus lampretaeformis								
10	Myoxocephalus scorpius								
11	Nerophis ophidion			0.03	0.02	0.01	0.00		0.03
12	Platichthys flesus							0.22	0.15
13	Pleuronectes platessa								
14	Pomatoschistus								
15	Pungitius pungitius	0.03	0.09	0.24	0.02	0.05	0.28	0.07	0.10
16	Scophthalmus maximus								
17	Sprattus sprattus	106.41	40.97	46.64	7.64	25.98	3.61	25.97	41.10
18	Zoarces viviparus							0.00	

Table 8 (continued): Catch composition per haul

	Species	34	35	36	37	38	39	40	41
1	Ammodytidae								
2	Anguilla anguilla								
3	Clupea harengus	11.26	11.06	4.26	48.64	20.00	2.48	3.07	28.80
4	Cyclopterus lumpus				0.34	0.57		0.18	
5	Enchelyopus cimbrius								
6	Gadus morhua	0.00							0.24
7	Gasterosteus aculeatus	32.10	6.28	47.98	42.99	67.56	77.83	104.88	16.07
8	Hyperoplus lanceolatus				0.03				
9	Lumpenus lampretaeformis								0.02
10	Myoxocephalus scorpius								0.17
11	Nerophis ophidion	0.01	0.03	0.01		0.01	0.01	0.01	
12	Platichthys flesus							0.11	
13	Pleuronectes platessa								
14	Pomatoschistus								
15	Pungitius pungitius	0.08		0.10	0.05	0.23	0.05	0.16	0.10
16	Scophthalmus maximus								
17	Sprattus sprattus	2.66	127.13	17.91	57.15	5.05	3.04	26.18	18.33
18	Zoarces viviparus								

Table 8 (continued): Catch composition per haul

	Species	43	44	45	46	47	48	49	50
1	Ammodytidae								
2	Anguilla anguilla						0.11		
3	Clupea harengus	33.26	3.27		83.19	139.27	228.48	10.70	13.38
4	Cyclopterus lumpus	0.36			0.14	0.26		0.25	
5	Enchelyopus cimbrius							0.03	
6	Gadus morhua				0.07			0.34	
7	Gasterosteus aculeatus	32.61	8.09	74.96	170.42	40.39	19.45	15.71	28.40
8	Hyperoplus lanceolatus	0.04							
9	Lumpenus lampretaeformis								
10	Myoxocephalus scorpius	0.12							
11	Nerophis ophidion		0.04						0.01
12	Platichthys flesus	0.38				0.91			0.08
13	Pleuronectes platessa								
14	Pomatoschistus								
15	Pungitius pungitius	0.02	0.04	0.02				0.14	0.13
16	Scophthalmus maximus								
17	Sprattus sprattus	14.37	264.69	9.40	247.18	28.71	204.01	329.13	20.51
18	Zoarces viviparus								

Table 8 (continued): Catch composition per haul

	Species	51	52	53	54	55	56	57	58
1	Ammodytidae								
2	Anguilla anguilla								
3	Clupea harengus	97.96	29.33	78.48	90.27	13.47	25.34	36.72	51.02
4	Cyclopterus lumpus					0.14		0.28	
5	Enchelyopus cimbrius	0.00			0.02				
6	Gadus morhua	0.04		0.03				0.01	
7	Gasterosteus aculeatus	100.71	62.62	97.26	13.71	10.03	13.25	19.20	0.83
8	Hyperoplus lanceolatus				0.02			0.14	
9	Lumpenus lampretaeformis								
10	Myoxocephalus scorpius			0.05			0.30		
11	Nerophis ophidion			0.01					
12	Platichthys flesus		0.38	0.39					
13	Pleuronectes platessa								
14	Pomatoschistus								
15	Pungitius pungitius	0.10	0.10	0.01	0.04	0.08			
16	Scophthalmus maximus								
17	Sprattus sprattus	112.76	2.94	58.61	149.31	83.65	1216.40	45.93	64.72
18	Zoarces viviparus								

Table 8 (continued): Catch composition per haul

	Species	59	60	61	62	63
1	Ammodytidae					
2	Anguilla anguilla					
3	Clupea harengus	0.18	141.49	12.73	7.50	3.73
4	Cyclopterus lumpus	1.03	0.54	0.66		0.37
5	Enchelyopus cimbrius					
6	Gadus morhua		3.22	0.08	0.01	0.02
7	Gasterosteus aculeatus	0.76	0.37	4.50	0.07	0.03
8	Hyperoplus lanceolatus					
9	Lumpenus lampretaeformis					
10	Myoxocephalus scorpius					
11	Nerophis ophidion					
12	Platichthys flesus		0.15	0.54		
13	Pleuronectes platessa					0.18
14	Pomatoschistus		0.00			
15	Pungitius pungitius			0.08	0.01	
16	Scophthalmus maximus					
17	Sprattus sprattus	217.52	3.71	36.44	61.56	402.68
18	Zoarces viviparus					

Table 8 (continued): Catch composition per haul

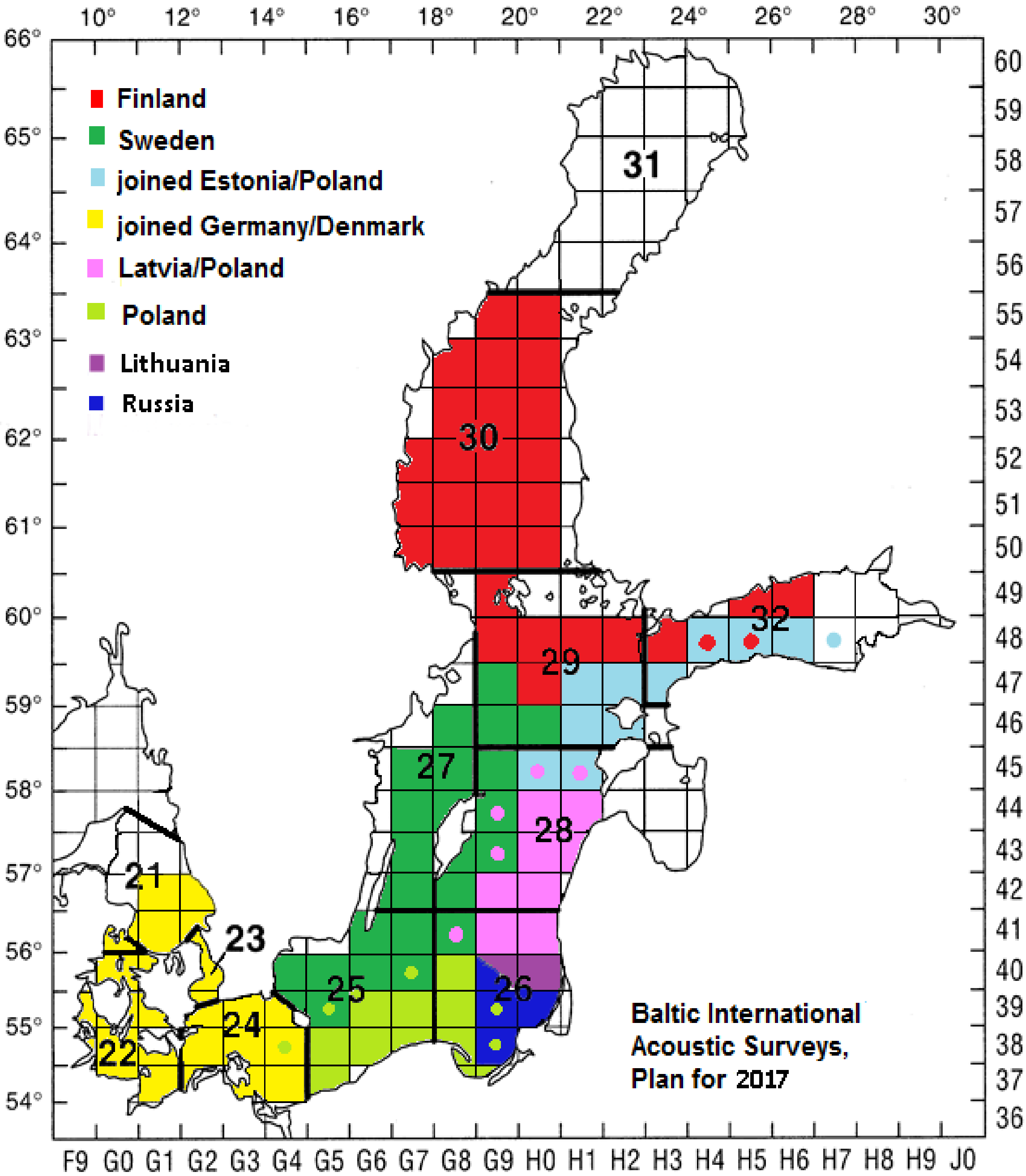

Figure 1 – Map over which ICES square are allocated to each country (On axes: longitude, latitude and ICES name of square eg:41G8)

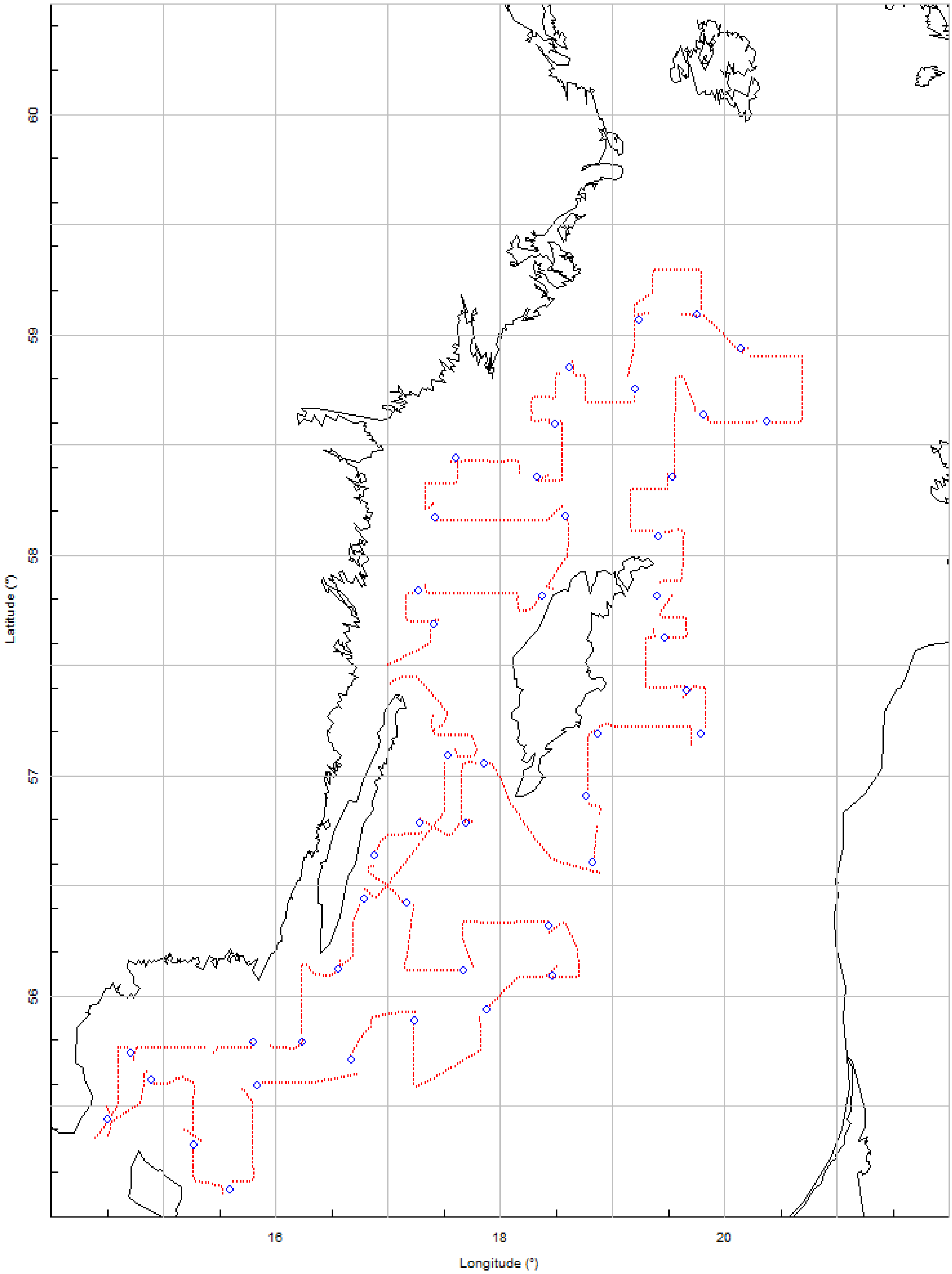

Figure 2 – cruise track(red), positions of trawl hauls (blue) and survey grid (ICES squares)(grey)

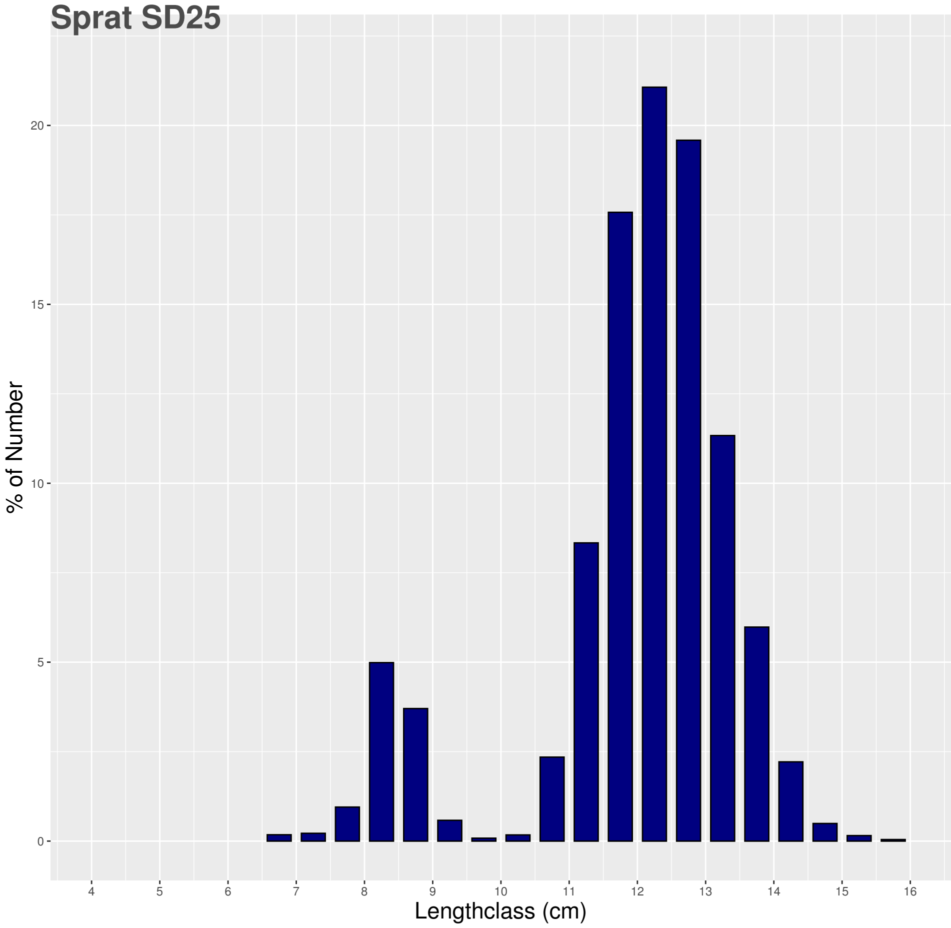

Figure 3 – Length distribution of sprat from subdivision 25

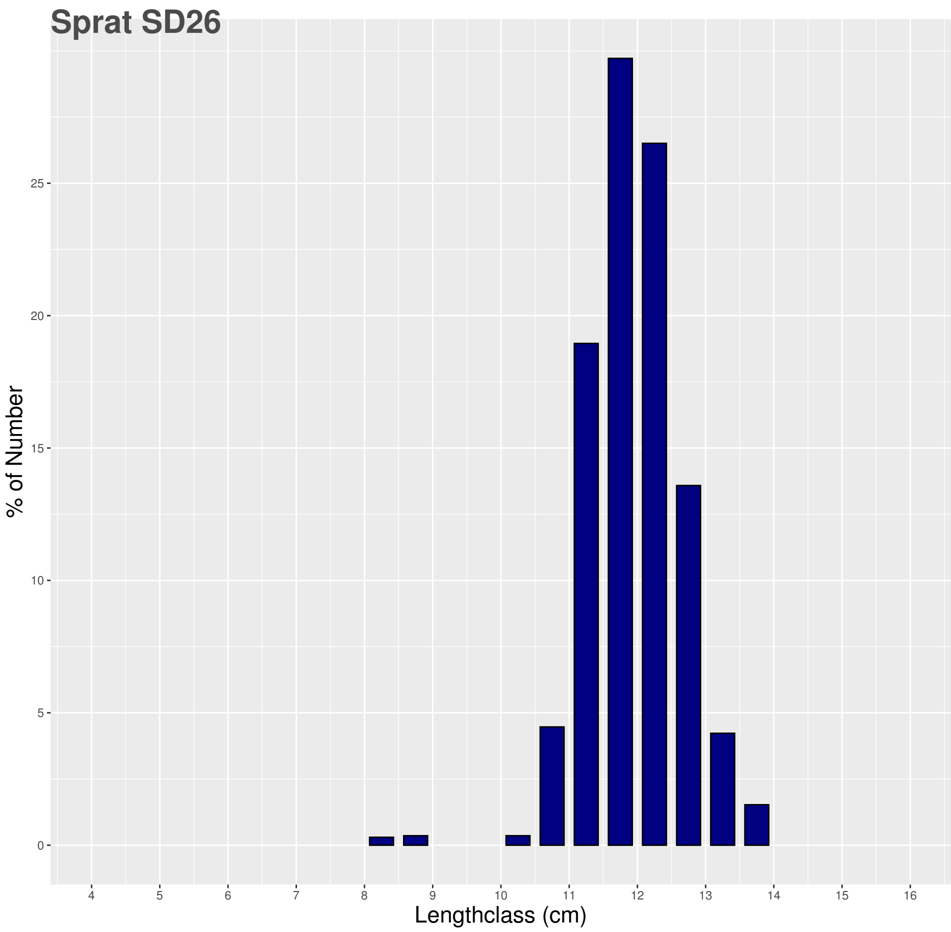

Figure 4 – Length distribution of sprat from subdivision 26

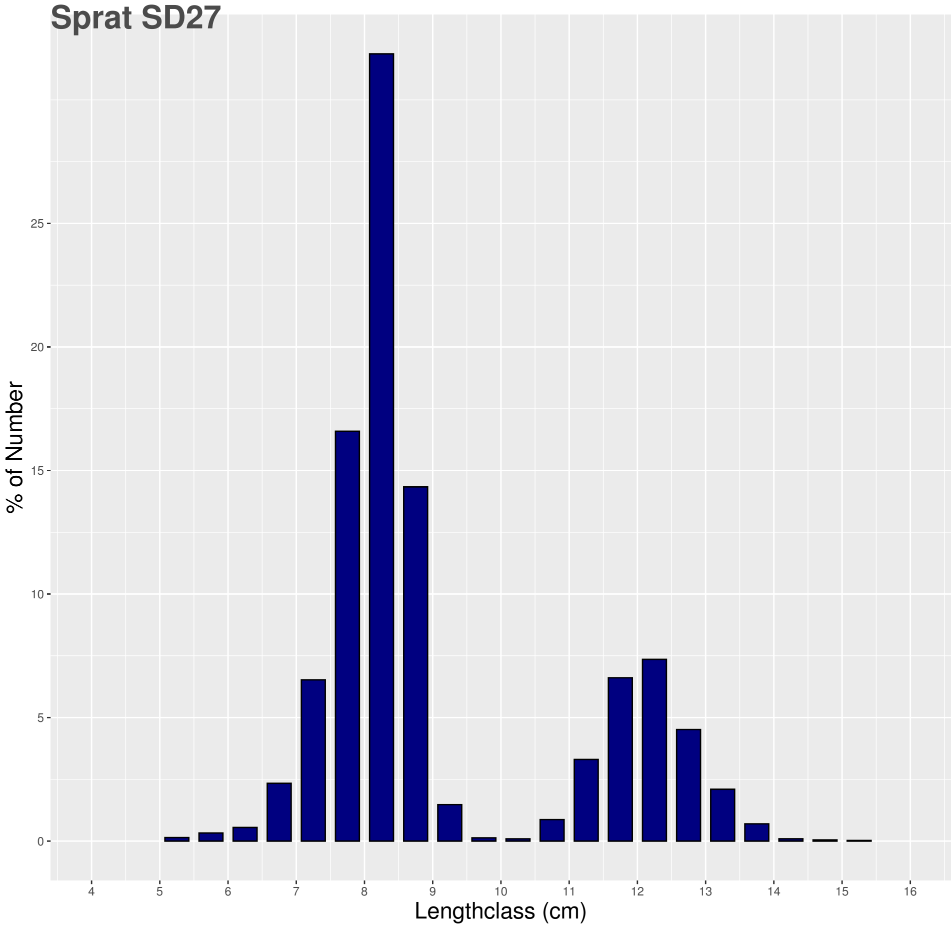

Figure 5 – Length distribution of sprat from subdivision 27

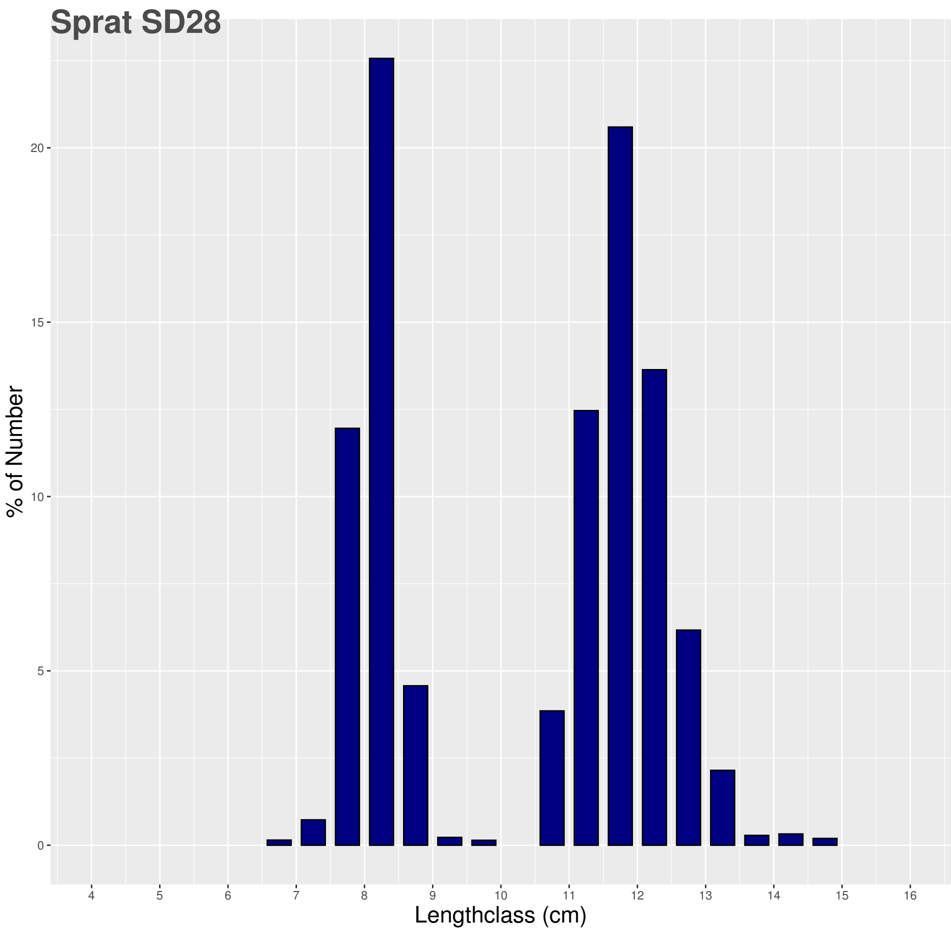

Figure 6 – Length distribution of sprat from subdivision 28

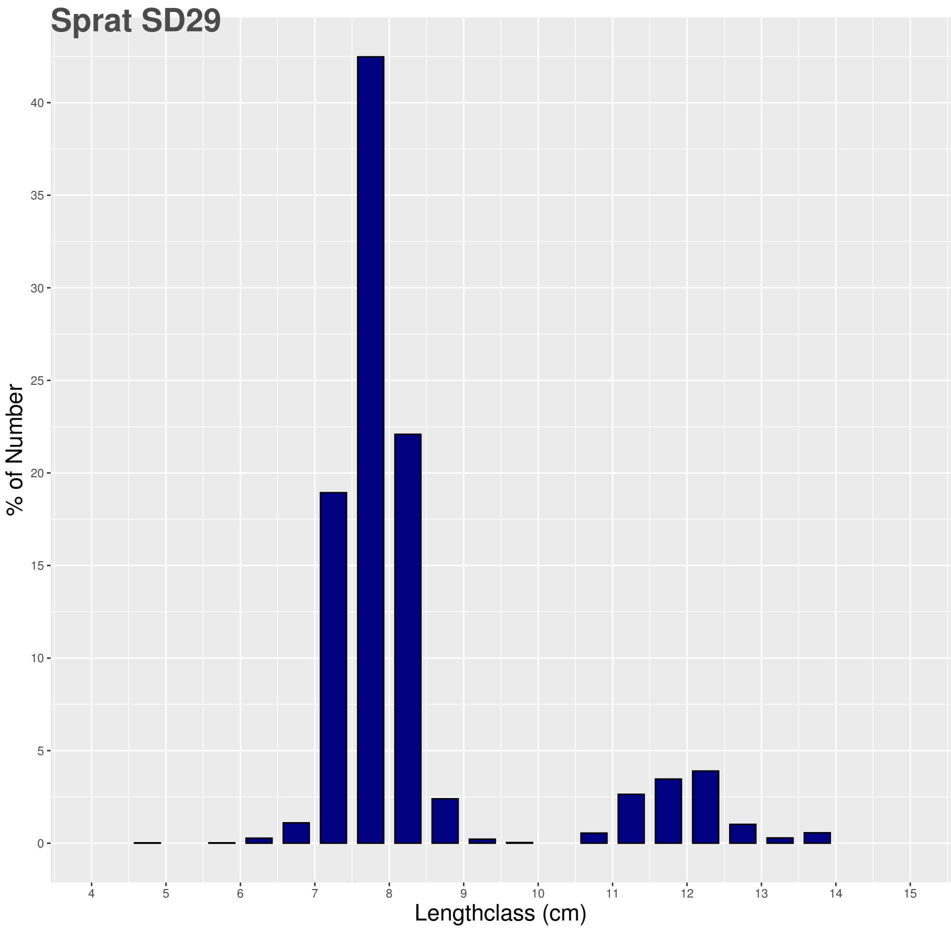

Figure 7 – Length distribution of sprat from subdivision 29

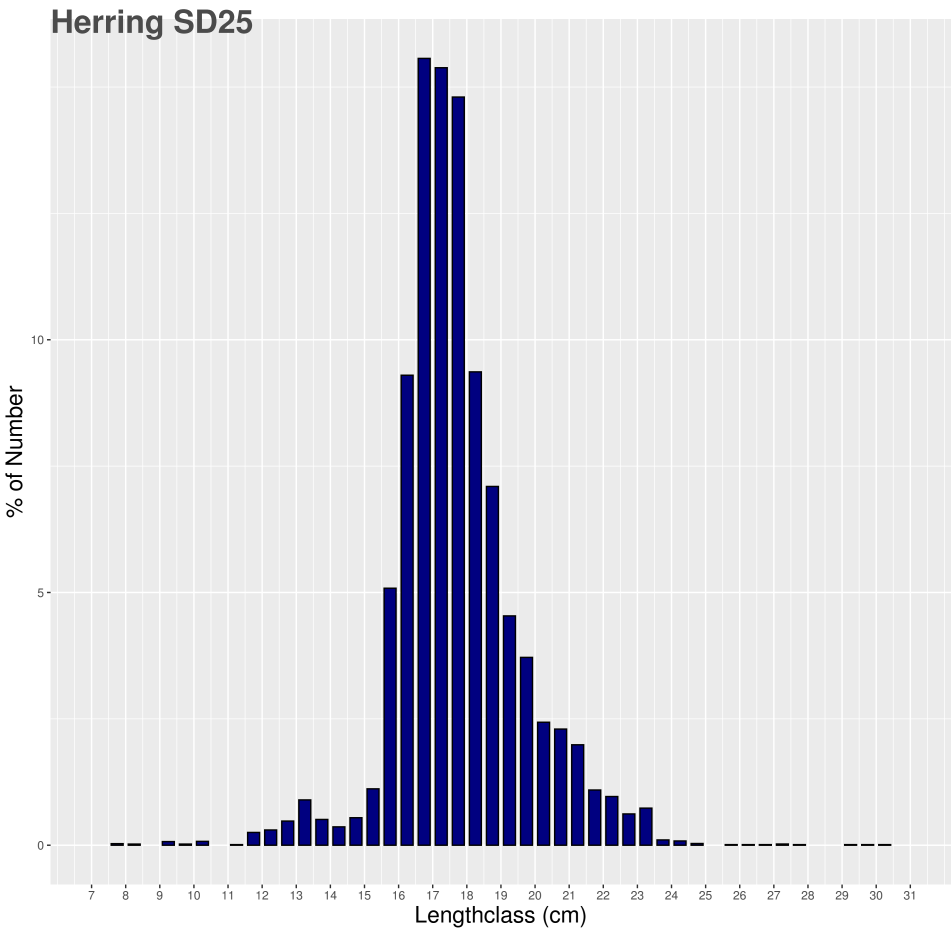

Figure 8 – Length distribution of herring from subdivision 25

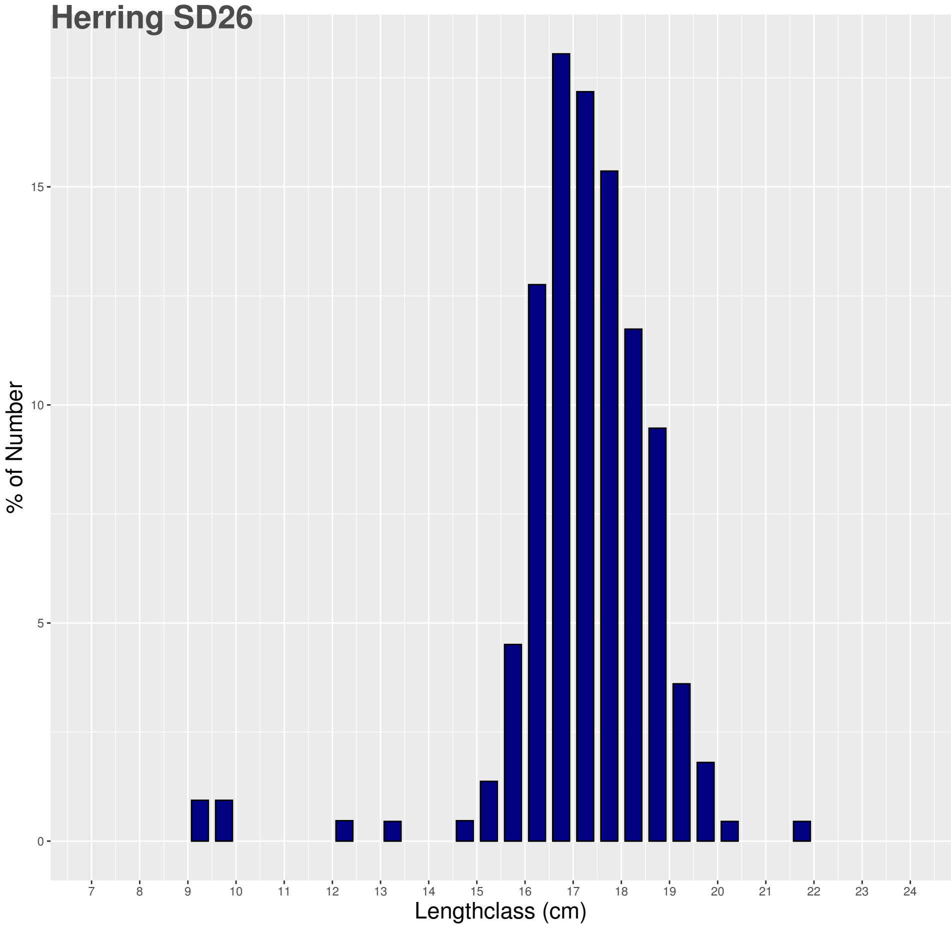

Figure 9 – Length distribution of herring from subdivision 26

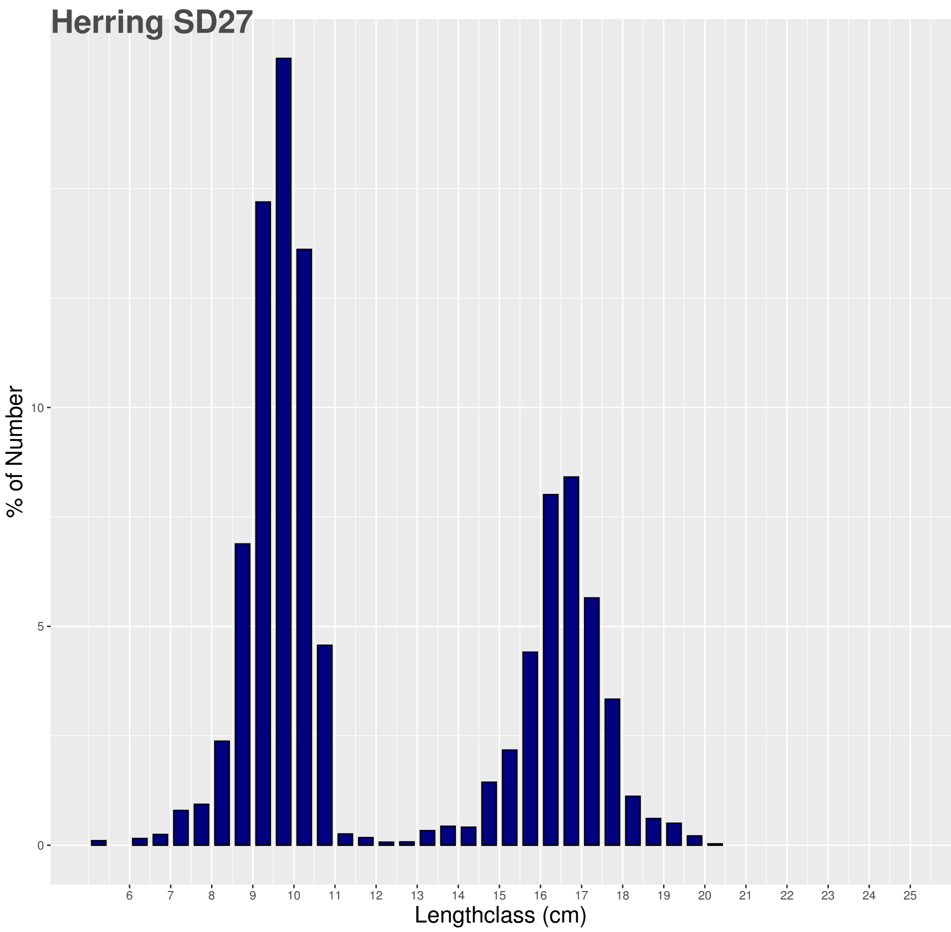

Figure 10 – Length distribution of herring from subdivision 27

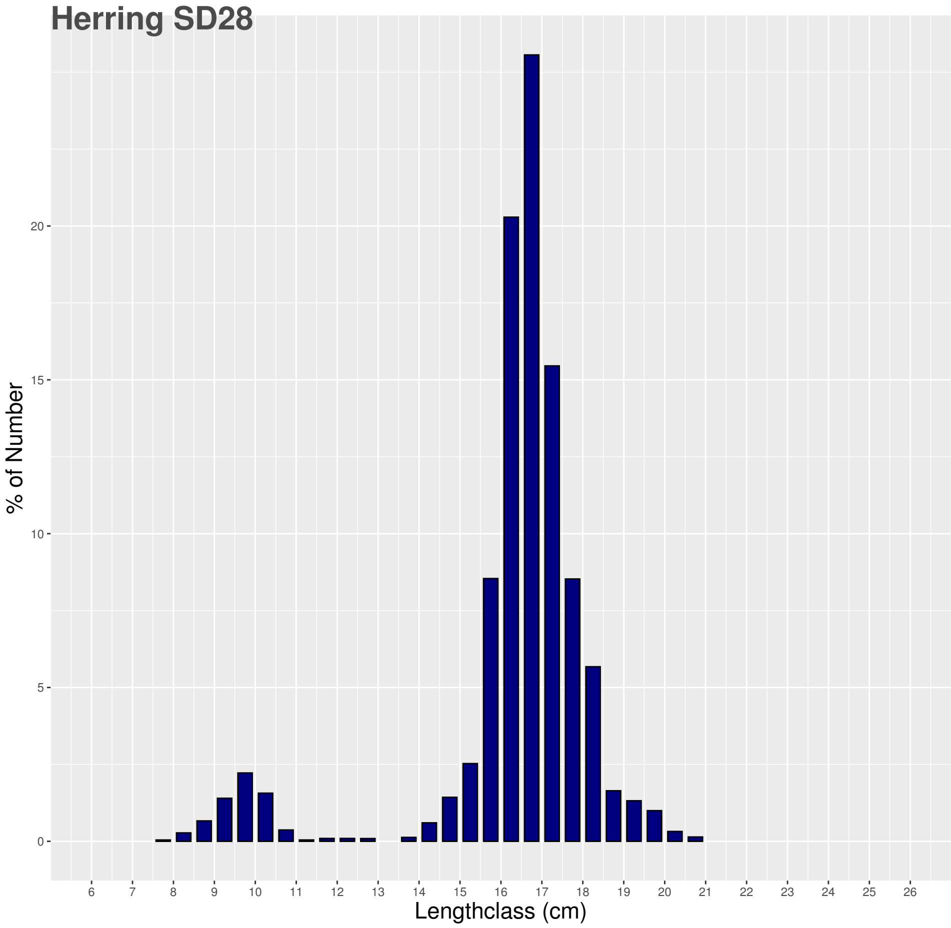

Figure 11 – Length distribution of herring from subdivision 28

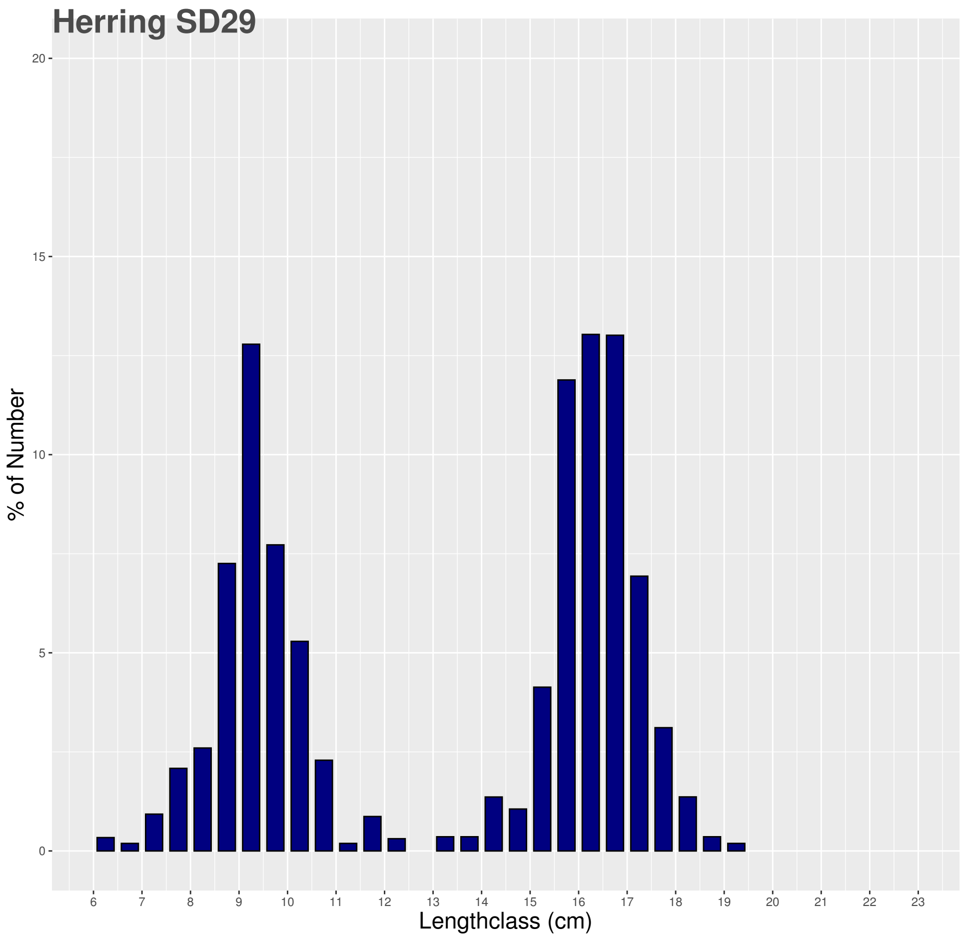

Figure 12 – Length distribution of herring from subdivision 29

Annex 8: List of presentations made at the WGBIFS 2020 meeting

1. BASS presentation of Estonia, made by Guntars Strods (Latvia);
2. BASS presentation of Latvia, made by Elor Sepp (Estonia);
3. BASS presentation of Lithuania, made by Marijus Spegys (Lithuania);
4. BASS presentation of Poland, made by Beata Schmidt (Poland);
5. BASS presentation of Germany, made by Paco Rodriguez-Tress (Germany);
6. BIAS presentation of Latvia, made by Guntars Strods (Latvia);
7. BIAS presentation of Estonia, made by Elor Sepp (Estonia);
8. BIAS presentation of Lithuania, made by Marijus Spegys (Lithuania);
9. BIAS presentation of Finland, made by Juha Lilja (Finland);
10. BIAS presentation of Poland, made by Beata Schmidt (Poland);
11. BIAS presentation of Sweden, made by Niklas Larson (Sweden);
12. BIAS presentation of Russia, made by Vladimir Severin (Russia);
13. BIAS presentation of Germany, made by Matthias Schaber (Germany);
14. GRAHS presentation of Latvia, made by Guntars Strods (Latvia);
15. BITS presentation of Latvia, made by Ivo Sics (Latvia);
16. BITS presentation of Estonia, made by Elor Sepp (Estonia);
17. BITS presentation of Lithuania, made by Marijus Spegys (Lithuania);
18. BITS presentation of Poland (1st q 2020), made by Krzysztof Radtke (Poland);
19. BITS presentation of Poland (4th q 2019), made by Krzysztof Radtke (Poland);
20. BITS presentation of Sweden, made by Olof Lövgren (Sweden);
21. BITS presentation of Germany, made by Andrés Velasco (Germany);
22. Presetation: DATRAS team status and updates, made by Adriana (ICES);
23. Presentation: Swedish plans for BASS 2020, made by Anders Svensson (Sweden);
24. Presentation: Comparison of day and night acoustics, made by Elor Sepp (Estonia);
25. Presentation about ToR a outcomes, made by Beata Schmidt (Poland);
26. Presentation: Comparison between StoX and traditional Excel spreadsheet calculations for herring stock in SD30, made by Juha Lilja (Finland);
27. Presentation: Comparison between tradidional BIAS calculations and StoX (BIAS 2019 data as example), made by Elor Sepp (Estonia);
28. Presentation about WGBIFS 2020 acoustic tuning series, made by Olavi Kaljuste (Sweden);

29. Presentation about vessel bias exploration regarding SD 30 herring index, made by Olavi Kaljuste (Sweden);
30. Presentation about exploration of the SD 30 BIAS data, made by Michael O'Malley (Ireland).

All these presentations are available in the folder "Presentations" in the WGBIFS 2020 SharePoint site.