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WORKING GROUP ON BALTIC INTERNATIONAL FISH SURVEY (WGBIFS)

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ICES CIEM International Council for the Exploration of the Sea Conseil International pour l'Exploration de la Mer

Contents

i Executive summary

The International Council for the Exploration of the Sea (ICES) Baltic International Fish Sur-vey Working Group (WGBIFS) met in the Marine Research Institute, Klaipeda University in Kaipeda, Lithuania, on 25–29 March 2019. A total of 21 participants, representing all countries around the Baltic Sea, attended in the meeting (see Annex 1). Olavi Kaljuste, Sweden chaired the group.

The main aim of the WGBIFS is the planning, coordination, and implementation of demersal trawl surveys and hydroacoustic surveys in the Baltic Sea. It compiles results from, coordinates and plans the schedule for 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 provides the herring, sprat and cod abundance indices for the Baltic Fisheries Assessment Working Group (WGBFAS) to use as tuning fleets. The common survey manuals are also updated according to decisions made during the meeting.

Survey results from 2018 and the first half of 2019 were compiled. The schedule for surveys in the second half of 2019 and the first half of 2020 were planned and coordinated. All Baltic fish stocks assessment relevant surveys were internationally coordinated.

The area coverage and the number of control hauls in the BASS and in the BIAS in 2018 were considered to be appropriate for 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 2018 and 1st quarter 2019 BITS were considered by the group as appropriate for tuning series and the data can be used for the assessment of Baltic and Kattegat cod and flatfish stocks.

Data from the recent BITS has been uploaded to ICES DATRAS database. Tow-Database which allows planning the spatial distribution of hauls in the areas, where the seabed is suit-able for safety trawling, was corrected and updated. Access-databases for aggregated acoustic data were updated. ICES database of acoustic-trawl surveys for disaggregated data was updated as well.

All countries also registered collected litter materials to the DATRAS database.

Inquiries from other ICES expert groups were discussed and addressed.

1 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	2/3
Chair(s)	Olavi Kaljuste, Sweden
Meeting venue(s) and dates	24-28 March 2018, Lyngby, Denmark
	25-29 March 2019, Klaipeda, Lithuania

2 Terms of References

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)

3 Summary of the Work Plan for Year 2

- Combined survey results from 2018 and the first quarter of 2019 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 2019 and first half of 2020, updated and corrected Tow Database (ToR c and e).
- Progress in estimation of the uncertainty in the BIAS and BASS surveys (ToR f).
- Progress towards a comparison exercise 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 (ToR h).
- 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).
- Progress in review and update procedure of the IBAS and BITS manuals (ToR k and l).

4 List of outcomes and achievements of the WG in this delivery period

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 for Baltic herring in SD 30 (abundance per age in the age groups 0-8+).
- Uploaded data from the 4th quarter 2018 and the 1st quarter 2019 BITS surveys to the DATRAS data base to be used for the calculation of survey indices for the relevant cod and flatfish stocks

Other survey-derived products:

- Maps of BASS and BIAS area coverage in 2018.
- Geographical distribution maps of sprat abundance in the Baltic Sea (May-June 2018; BASS surveys).
- Geographical distribution maps of sprat, herring and cod abundance in the Baltic Sea (September-October 2018; 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.

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 BITS surveys to be conducted in autumn 2019 and spring 2020.
- 5 recommendations (Annex 4) was made to ICES Data Centre and to other ICES working groups.
- Action list (Annex 5) for WGBIFS members was updated.

5 Progress report on ToRs and Work Plan

5.1 ToR a) Combine and analyse the results of spring (BASS) and autumn (BIAS) 2018 acoustic surveys and report to WGBFAS

In September – October 2018 six research vessels (representing seven national research institutes) participated in the accomplishment of autumn acoustic survey (BIAS). The survey was conducted in the ICES Subdivisions 21-32 (excl. ICES SD 31) however, some Subdivisions were only partly covered. Russia did not participate in 2018 BIAS. Echointegration was recorded at totally of 5967 NM linear distance moreover, 218 and 246 catch and hydrological stations, respectively were inspected too. Totally, three statistical ICES-rectangles were controlled by more than one country. The extended reports from BIAS 2018 cruises are available in Annex 7. The whole time-series of the area-corrected BIAS survey data of sprat and herring are presented in Annex ToR a.

In May 2018, three research vessels participated in the accomplishment of five spring acoustic surveys (German, Latvian-Polish, Estonian-Polish, Polish and Lithuanian BASS survey; Annex ToR a). The BASS 2018 survey was realised in the ICES Subdivisions 24-32 (excl. ICES SD 30, 31). It should be underlined that the ICES SD 29 was monitored with acoustic-trawl investigations only in the southern and middle parts moreover, only one ICES rectangle (47H3) was inspected in the ICES Subdivision 32. The part of ICES SD 26 (the ICES rect. 39H0) was not investigated as Russia did not take part in BASS 2018 cruises. Overall 54 the ICES rectangles were covered with acoustic-biotic monitoring, what is comparable with 96.5% of area coverage. Four ICES rectangles were inspected by two countries. Echointegration was recorded at totally of 3321 NM linear distance moreover, 124 and 319 catch and hydrological stations, respectively were inspected too. The extended reports from the above-mentioned BASS cruises are presented in Annex 7. The complete time-series of the area-corrected BASS sprat abundance is given in Annex ToR a.

The area coverage and the number of control hauls in the BASS and BIAS surveys in 2018 were considered to be appropriate for the calculation of tuning indices and the data can be used for the assessment of Baltic herring and sprat stocks.

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

An error was discovered shortly before WGBIFS 2019 meeting in the queries that calculate herring and sprat biomass per ICES Sub-division. The algorithms in both queries were corrected just before the meeting (see Annex ToR b).

Few errors in reported cod abundance in some rectangles were found during the WGBIFS 2019 meeting. All values of cod abundance were checked and corrected. Shortly after meeting the faulty query was corrected and improved BIAS_DB.mdl access-database was uploaded into the folder "Data" of the WGBIFS 2019 SharePoint.

A marginal change in BASS time series was done during the WGBIFS 2019 meeting. The value for sprat age 1 in 2002 was changed from 27412.12 to 27412.11.

After validation, the aggregated data from BIAS and BASS surveys from 2018 were added to the BIAS_DB.mdb and the BASS_DB.mdb Access-databases, respectively. The updated versions of the databases are located in the folder "Data" of the ICES WGBIFS 2019 SharePoint site.

The disaggregated data from BIAS and BASS surveys were also uploaded to the recently created ICES data base for acoustic-trawl data (http://ices.dk/marine-data/data-portals/Pages/acoustic.aspx).

5.3 ToR c) Plan and decide on acoustic surveys to be conducted in autumn 2019 and spring 2019-2020

All the Baltic Sea countries intend to take part in the autumn BIAS acoustic surveys and experiments in 2019. Cooperation between Germany and Denmark, Latvia and Poland and Estonia and Poland in the BIAS survey realisation is planned. Germany, Lithuania, Poland and the joint Latvian-Polish and Estonian-Polish BASS surveys will be continued in May 2019-2020 too. Russia is not planning to participate in these BASS surveys. There is also an intention to conduct a Latvian-Estonian survey on the Gulf of Riga in July 2019 and 2020. The list of participating research vessels and initially planned periods of particular surveys are given in Annex ToR c.

5.4 ToR d) Discuss the results from BITS surveys performed in autumn 2018 and spring 2019 and evaluate the characteristics of TVL and TVS standard gears used in BITS

During the BITS-Q4/2018 surveys the level of realized valid ground trawl hauls represented 102% of the total planned catch-stations (see Annex ToR d). The survey was accomplished by Denmark, Germany, Sweden, Poland, Estonia, Latvia and Lithuania in the ICES Subdivisions 20-29. Russia did not participate in BITS-Q4/2018 survey. The coverage in all Sub-divisions and all depth strata is in general quite good. In SD 24, the achieved number of hauls is smaller than planned due to the trawling restrictions enforced by the Swedish military. The differences in numbers of planned and index-valid fishing stations for each monitored ICES subdivision is presented in the Annex ToR d. The coverage by depth stratum is as follows (depth stratum, coverage in %): 1, 100; 2, 83.6; 3, 94.5; 4, 117.8; 5, 131.3 and 6, 128.6. The lower coverage in depth strata 2 and 3 is due to the restrictions enforced by the Swedish military.

In the 1st quarter 2019 the areas coverage with designated catch-stations was on similar level than in 2018, i.e. 97 % (Annex ToR d). The BITS Q1 2019 surveys were realized by Denmark, Germany, Sweden, Poland, Latvia and Lithuania in the ICES Subdivisions 22-28. Russia did not participate in BITS-Q1/2019 survey. The coverage with control-hauls by the depth stratum is as follow (depth stratum, coverage in %): 1, 100; 2, 95.5; 3, 92.6; 4, 101.9; 5, 81.1; 6, 162.5. The depth stratum 2 and 3 has significantly lower coverage because of the stations in the south-eastern Swedish waters which were not performed due to abrupt termination of the survey resulting from sickness on board of the RV „Solea“.

The number of valid hauls accomplished during the BITS-Q4/2018 and BITS-Q1/2019 were considered by WGBIFS 2019 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.

Standard reports from participating countries giving overviews of the BITS Q4 2018 and BITS Q1 2019 results can be found in Annex 6.

NB! Due to a technical mistake, all standard reports from BITS-Q4/2017 cruises in the Annex 6 of the WGBIFS 2018 report were incorrectly dated to 2018.

WGBIFS has implemented a complete and smaller scale measurement of the technical parameters of the exploited demersal trawls (type TV-3L and TV-3S) as a standard procedure. The complete measurement procedure has to be performed at least once a year by each country involved in the BITS surveys realization. The smaller scale measurement procedure should be made prior to each BITS survey. Standard protocols with the results of these measurements from all countries are available in the WGBIFS SharePoint.

5.5 ToR e) Plan and decide on demersal trawl surveys and experiments to be conducted in autumn 2019 and spring 2020, and update, and correct the Tow-Database and DATRAS

The most of the WGBIFS member countries, who intend to participate in the BITS-Q4/2019 and BITS-Q1/2020 surveys, have nearly the same plans regarding the numbers of hauls as in the previous years. The total number of stations committed by the countries and available is given in the Annex ToR e.

According to preliminary information, Russia is not planning to participate in the BITS surveys in autumn 2019 and in spring 2020. Since other ICES member countries will not be able to get permission to work in the EEZ of Russia, the negative effect on the quality of the survey results based on BITS survey would be eminent.

Two hauls were deleted from the Tow-Database. For four tracks the depth were adjusted, for six tracks the positions were adjusted and one new track was added to the database.

During the WGBIFS 2019, meeting no any essential changes of the data in the Database of Trawl Surveys (DATRAS) was made.

5.6 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 the WGBIFS meeting 2016 it was decided that a bootstrap method should be used to present the survey sampling variance. That method was based on recalculations of the survey results by resampling of acoustic data and trawl hauls. On the Workshop on Sampling Design and Optimization (WKSDO) in Lysekil, Sweden in 2016, the method was discussed with Jon Helge Vølstad and Mary Christman and they suggested to do a bootstrap on the survey results from the covered area. At 2017 year's WGBIFS meeting the two bootstrapping methods were discussed and it was decided that WGBIFS should move forward and try to evaluate the results from the bootstrap method recommended at WKSDO. This evaluation will be presented in the final report of the Baltic International Fish Survey Working Group in 2020.

In the Annex ToR f is presented an example about the estimation of the uncertainties in the acoustic survey estimates using the bootstrap method.

5.7 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

During the WGBIFS 2018 meeting a StoX task sub-group was created for the implementation of the StoX software for the calculation of WGBIFS acoustic stock estimates.

StoX task sub-group 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, with data uploading, deletion and downloading in the ICES database for acoustic trawl surveys and with StoX software were discovered before and during that meeting. Several of them were solved due to the meeting time and the rest was solved afterwards.

During the WGBIFS 2019 meeting a WebEX-meeting was held together with StoX developers 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. During this meeting it was demonstrated that the latest version of StoX software is able to perform the calculation procedure according to IBAS methods.

It was decided that members of WGBIFS StoX task sub-group will:

- analyse their national survey data with StoX software and compare the results with their official results,
- 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.

5.8 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 food webs 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.

ICES Workshop on methods to develop swept-area based effort indexes (WKSABI) was held in January 2019. WGBIFS was represented there by Henrik Degel, who was also co-chair of that workshop. One of the goals of that workshop was to define and describe a size-based indicator based on the swept-area index. During the workshop, the nature of the gaps of knowledge were discussed and number recommendations (four of them to WGBIFS) were formulated. These recommendations were addressed during the WGBIFS 2019 meeting and are summarized in chapters 6.10-6.13.

5.9 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. Almost all countries, who realized the BITS-Q4/2018 and BITS-Q1/2019 surveys and submitted the data, have also registered collected litter materials into the DATRAS Litter database. Only two countries had not yet done so.

Following the WGML request, WGBIFS adopted proposed rules (checklist) for formatting and reporting of litter data (see Annex ToR i).

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

During the WGBIFS 2018 meeting a WebEX-meeting was held with two representatives of WGFTFB to discuss the issues related to survey gear standardization. Based on the discussions, the needs for the possible standard pelagic trawl gear where identified and the next steps in the gear standardisation 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.

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

5.11 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 IBAS manual was reviewed during the WGBIFS 2019 meeting and several suggestions about the possible changes and corrections were listed. The updated manual will be presented as an Addendum to the final report of the Baltic International Fish Survey Working Group in 2020.

5.12 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 BITS manual was reviewed during the WGBIFS 2019 meeting and several suggestions about the possible changes and corrections were listed. The updated manual will be presented as an Addendum to the final report of the Baltic International Fish Survey Working Group in 2020.

6 Inquiries Besides of the Fixed ToRs

6.1 Adopt the ICES metadata convention for processed acoustic data and the ICES data portal for acoustic trawl surveys (WGFAST request)

WGBIFS found that we have already adopted the recommendation from WGFAST. Currently, WGBIFS coordinated acoustics surveys BASS and BIAS have already started to upload it into ICES Acoustic database, where the acoustic part of the format is based on the SISP 4 – A metadata convention for processed acoustic data from active acoustic systems developed by the ICES Working Group on Fisheries Acoustics, Science and Technology (WGFAST), while the biotic part of the format is based on the ICES Database of Trawl Surveys (DATRAS). Before the ICES Acoustic database, WGBIFS have not had a common database for disaggregated acoustic data.

6.2 Adopt the 'WKMATCH 2012 maturity scale revised' and approve the implementation plan (presented in chapter 7). Approval should be sent to WGBIOP. (WKASMSF request)

WGBIFS discussed this request during the meeting. As each of the National laboratories has their own scale to determine maturity, it was decided to continue report the original maturity scale data to the ICES databases in order to minimize the risk of conversion errors and to keep the historic national data series. The group decided to provide ICES with the conversion tables of the national maturity scales. In most situations it is very easy to convert maturity data from national scale to the ICES scale.

6.3 Update their manuals with the correct references and include or update the conversion table for the national maturity scales. (WKASMSF request)

WGBIFS is currently reviewing the manual and this review will also update the conversion table for the national maturity scales. The updated manual will be presented as an Addendum to the final report of the Baltic International Fish Survey Working Group in 2020.

6.4 Collect, count, and report litter data according to the two guidance documents produced by WGML-2018. a) Distribution of the manual on sampling, identification and registration of sea floor litter caught in bottom trawl surveys. b) Distribution of the document on suggestions for quality assurance/quality control measures for studies on micro litter. (WGML request)

WGBIFS has communicated this request to the relevant national data submitters. WGBIFS is currently reviewing the BITS manual and this review will also update the marine litter sampling, identification and registration instructions there. The updated manual will be presented as an Addendum to the final report of the Baltic International Fish Survey Working Group in 2020. None of the countries participating in BITS has so far reported collection of samples for micro litter identification. However, during the process of reviewing the BITS manual, also guidance for the micro litter studies will be added.

6.5 Follow Litter Data Collection Guidelines by WGML. a) Seafloor litter data requested via DATRAS b) All microplastic data requested via DOME c) Other litter data requested via DOME. (WGML request)

WGML addressed this request to relevant national data submitters associated with WGBIFS. WGBIFS has communicated this request to the relevant national data submitters.

6.6 Contact ICES Data Centre with data reporting issues (accessions@ices.dk). (WGML request)

WGML addressed this request to relevant national data submitters associated with WGBIFS. WGBIFS has communicated this request to the relevant national data submitters.

6.7 National submitters to correct historic data. (WGML request)

WGML addressed this request to relevant national data submitters associated with WGBIFS. WGBIFS has communicated this request to the relevant national data submitters.

6.8 WGBIOP recommends the collection of gonad samples (images of gonads and gonads for histology) during regular sampling to ensure a basic set of samples is available for maturity exchanges and workshops. This will be followed up with an email with a protocol with instructions on how to collect the samples. (WGBIOP request)

Similarly to WGIPS, also WGBIFS recognises the potential importance of the collection of such samples and the benefits of the availability of such a library of samples. Through the maturity estimation exchanges and workshops it would possible lead to an improvement of the assessments of stocks surveyed by WGBIFS coordinated surveys. Although, sometimes additional person might be required in the surveys to collect these samples, but unfortunately not all vessels have vacancies on board. More detailed instructions on number of gonad samples required per survey, area, species, sex, maturity stage, season and year would be necessary. Additionally, before any sampling will be initiated by the national institutions, it must be clarified, who will be responsible for the coordination of this sampling, where and how the samples will be stored and how curated.

6.9 The IBPCluB recommends the Baltic International Fish Survey Working Group (WGBIFS) to evaluate whether the annual variation in the predicted average TS density patterns in different water depths impact the survey numbers that are used in the Gulf of Bothnia herring stock assessments. (IBPCluB request)

The acoustic sub-group of the WGBIFS tried to figure out the meaning of this recommendation. It was not totally understood, which parameters were used behind the functions (Figure 2, in ICES IBPCluB report 2018). Therefore, the average TS predictions by depth layer should be selected from small subareas that have more or less equal water depths. By this way it would be easier to quantify whether or not these vertical patterns have an impact on abundance indices of Bothnian Sea herring.

6.10 Conduct data cleaning and provide algorithms for estimating missing values of variables needed for the calculation of swept area for the period 2000 to present (for WGBIFS) and for the period after 2014 (for IBTSWG if necessary e.g. in case of vessel changes or changes of trawl netting material). (WKSABI request)

WGBIFS found that particularly for the door spread, it is necessary to establish an algorithm for filling in data gaps. Unfortunately, the group had no time during the meeting to decide on which algorithms would be the most appropriate model to use for that purpose. It was agreed that the work should be done intersessionally before the next meeting.

6.11 Encourage survey participants to continue collecting door and wing spread data (ideally both variables on each tow but preferably at least door spread) during NS-IBTS, NeAtl-IBTS and BITS. (WKSABI request)

Based on the data uploaded to DATRAS the status of upload of variables related to swept area estimates (Haul duration, Trawling speed, Distance, Door spread, Wing spread) were investigated.

The upload format (exchange format) includes all relevant variables for calculating the swept area estimate. Not all variables are mandatory and therefore data gaps for the calculation of the swept area exists. Furthermore, scrutinizing the swept area relevant data reveals some errors in the data already entered in DATRAS. The errors include upload of invalid fixed constant values (not observed), and probably erroneous values. The data gaps are due to lack of availability of gear geometry monitoring devices on the research vessels and to less extent omission to uploading certain variables even though the values are recorded during the survey. Nevertheless, almost complete data series are available from three countries (Denmark, Germany and Sweden) operating in Sub-division 22- 26 (western Baltic).

Initiatives between ICES and the countries involved to BITS to correct the errors and to investigate if additional values are available for filling data gaps have been initiated and it is expected that the data are updated in due time before the next survey working group (WGBIFS) meeting in March 2020.

All countries were encouraged to submit as many data as possible for all the swept area relevant variables even though they not all are categorized as mandatory in the DATRAS exchange format.

6.12 Identify other variables than swept area which are potentially important for improving survey estimates (e.g. bottom current speed and direction in areas with strong tides, wind speed and direction in shallow waters). (WKSABI request)

Considering the complex environmental situation caused by the fluctuating hydrographic conditions in the Baltic Sea due to the fluctuating inflow of new salty water from the North Sea, the group found that linking the catch results to the CTD profiles potentially was the most important element in order to improve the survey estimates. Therefore, it was stressed out that the link to the CTD station number always should be filled in in the HH-record in the DATRAS exchange format. A check showed that this parameter almost always has been filled in by all countries in the past.

6.13 Submit size category information for Marine Litter in all cases in future surveys. (WKSABI request)

WGBIFS has communicated this request to the relevant national data submitters. WGBIFS is currently reviewing the manual and this review will also update the marine litter reporting instructions there. The updated manual will be presented as an Addendum to the final report of the Baltic International Fish Survey Working Group in 2020.

7 Revisions to the work plan and justification

No changes in ToRs have been proposed.

Not any significant revisions to the work plan were made.

8 Next meeting

There was one proposal for the venue of the next WGBIFS meeting, i.e. Cadiz, Spain. Majority of WGBIFS members supported the idea to organize the next meeting at the University of Cadiz in the period of 30 March – 3 April 2020.

Annex: ToR a) Combine and analyse the results of spring (BASS) and autumn (BIAS) 2018 acoustic surveys and report to WGBFAS

5.1.1. Combined results of the Baltic International Acoustic Survey (BIAS)

In September - October 2018, 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	ACOUSTIC TRANSECTS LENGTH [NM]	NUMBER OF HAULS	NUMBER OF HYDROLOGICAL STATIONS
Finland	29.09-11.10.2018	Aranda	30, parts of 29	1214	31	32
Poland	28.09-13.10.2018	Baltica	Parts of 24, 25 and 26	829	38	50
Latvia	17-26.10.2018	Ulrika	Parts of 26 and 28	513	16	19
Estonia-Poland	21-31.10.2018	Baltica	Parts of 28, 29 and 32	842	19	19
Sweden	02-14.10.2018	Dana	27, parts of 25, 26, 28 and 29	1247	46	46
Lithuania	18-19.10.2018	F/V 169	Part of 26	111	6	6
Germany	01-19.10.2018	Solea	22, 23, 24 and parts of 21	1211	62	106

5.1.1.1. 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.

Totally, three statistical ICES rectangles were inspected by more than one country during BIAS cruises in 2018 (Fig. 5.1.1.1.1), precisely the following rectangles:

- 38G4 by GER and POL,
- 39G5 by SWE and POL,
- 40G7 by SWE and POL.

The Figure 5.1.1.1.1 illustrates that the coverage of the Baltic Sea during the BIAS-2018 survey, was only slightly less as it was planned during the WGBIFS 2018 meeting. The part of ICES SD 26 (the ICES rct.39H0) was not investigated as Russia did not take part in BIAS 2018 cruises. The part of ICES SD 32 (the ICES rct. 48H3, 48H4) and 29 (the ICES rct. 47H0, 48H0,48H1, 48H2) were designed to Finland and were only investigated acoustically, without any biological sampling, as the weather condition prevented to perform any pelagic trawl. During the meeting the calculations for rectangles 47H0, 48H1, 48H1, 48H2, 48H3 and 48H4 ware performed using Sweden and Estonian biological data from neighbouring rectangles. For rectangle 48H4, that was investigated by Estonia during BIAS 2018 cruise in half, the fish abundance and fish mean weight were calculated based on Finish acoustic data and Estonian trawl data (the data for rectangle 41H4 reported by Estonia in BAD1 format were not included into the BIAS_DB.mdb access-database). Investigations in the eastern part of the ICES SD 32 (the Russian zone) were not planned and remain not realised.

Additionally, the Estonian-Latvian acoustic survey in the Gulf of Riga was conducted in July-August 2018, as was planned during WGBIFS 2018 meeting. The survey results from the recent years are accessible at the national level, however, were not uploaded to the WGBIFS database.

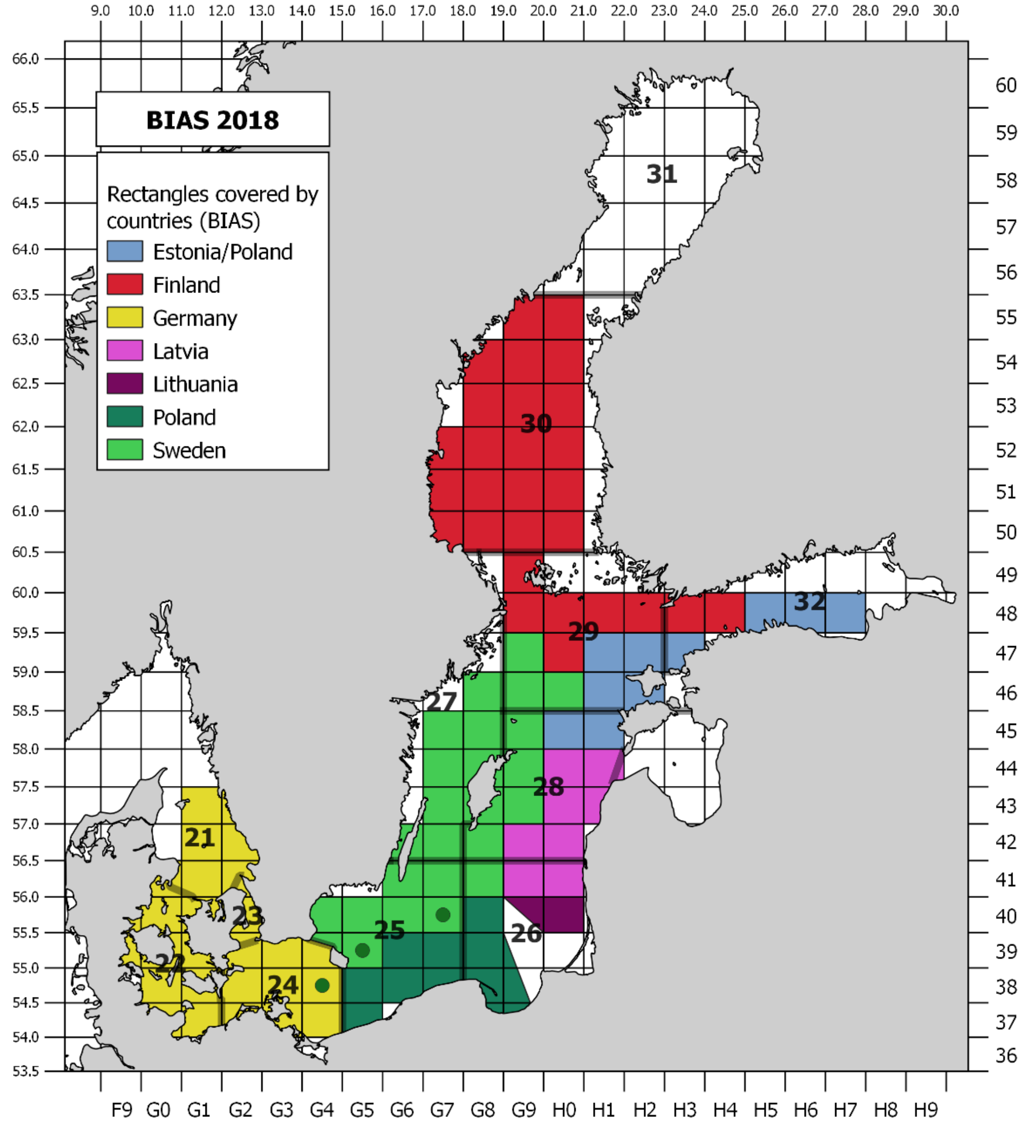


Figure 5.1.1.1.1. Map of the BIAS survey conducted in September-October 2018. Various colours indicate the countries, which covered specific ICES rectangles and delivered data to BIAS-database, thus was responsible for this rectangle. Dot with different colour within a rectangle explain additional data in BIAS-database partly or totally covered by other countries.

5.1.1.2. Total results

Geographical distribution of herring, sprat and cod abundance in the Baltic Sea, accordingly to the ICES rectangles inspected in September-October 2018 is illustrated in Figures 5.1.1.2.1 - 5.1.1.2.5.

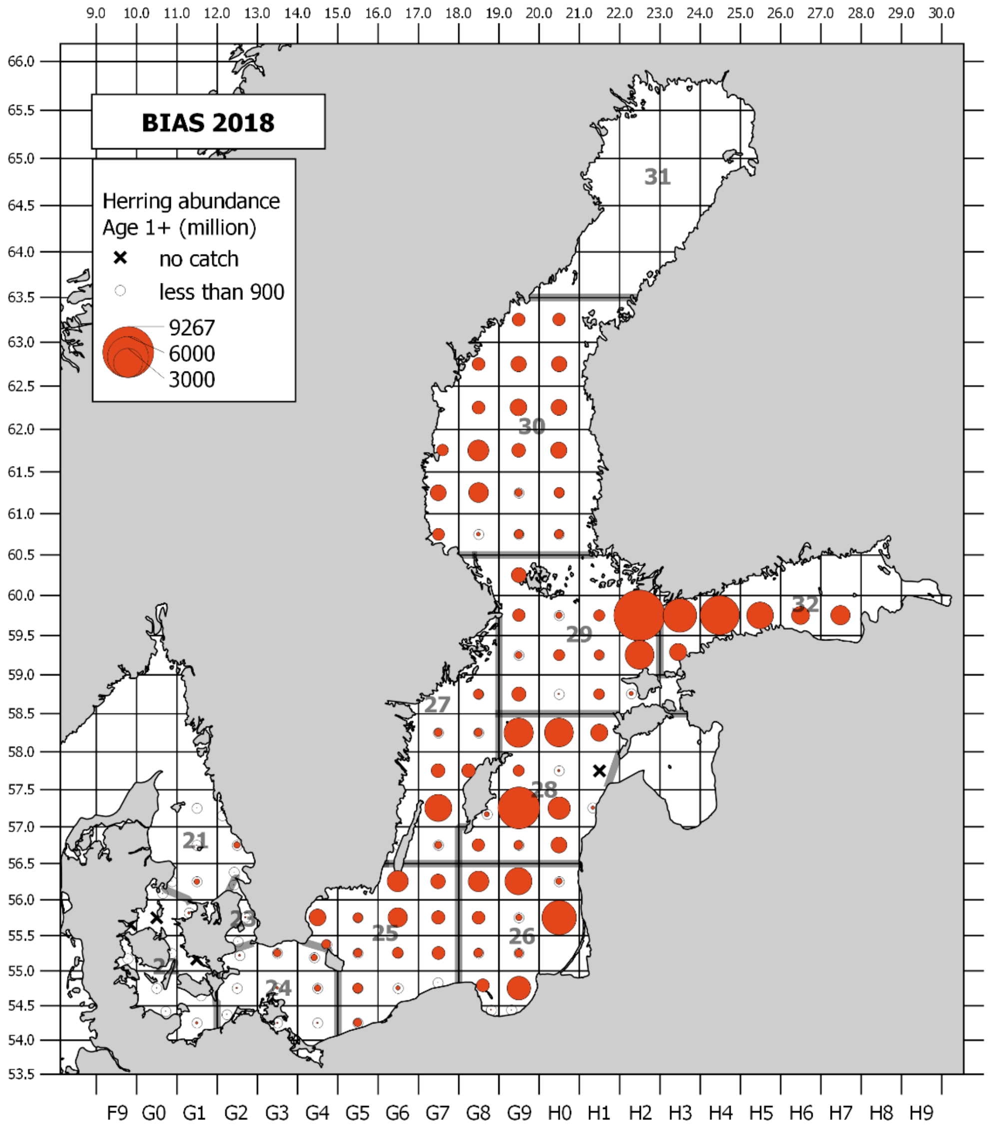


Figure 5.1.1.2.1. The abundance of herring (age 1+) per ICES rectangles monitored in September-October 2018 (the area of circles indicates estimated numbers of specimens x10^6 in given rectangle).

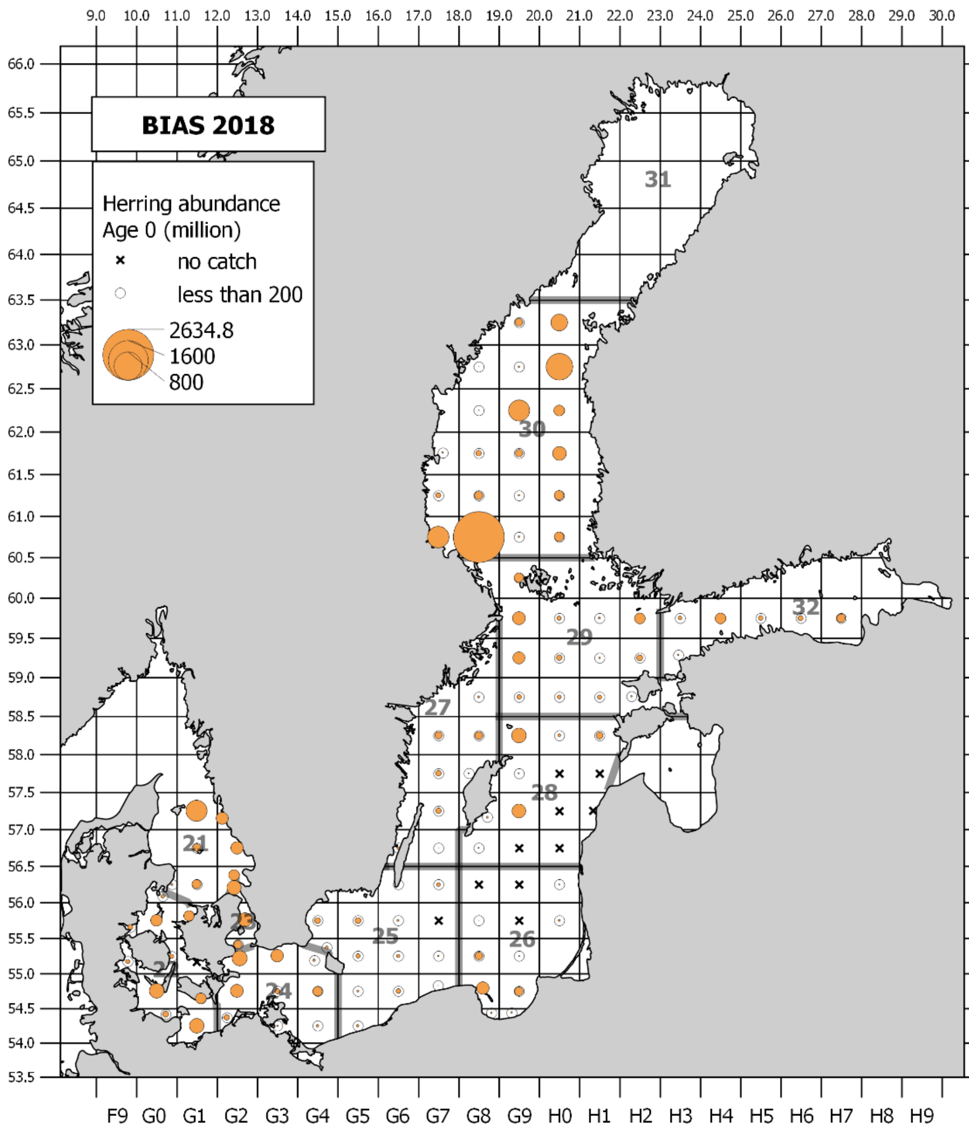


Figure 5.1.1.2.2. The abundance of herring (age 0) per ICES rectangles monitored in September-October 2018 (the area of circles indicates estimated numbers of specimens x10^6 in given rectangle).

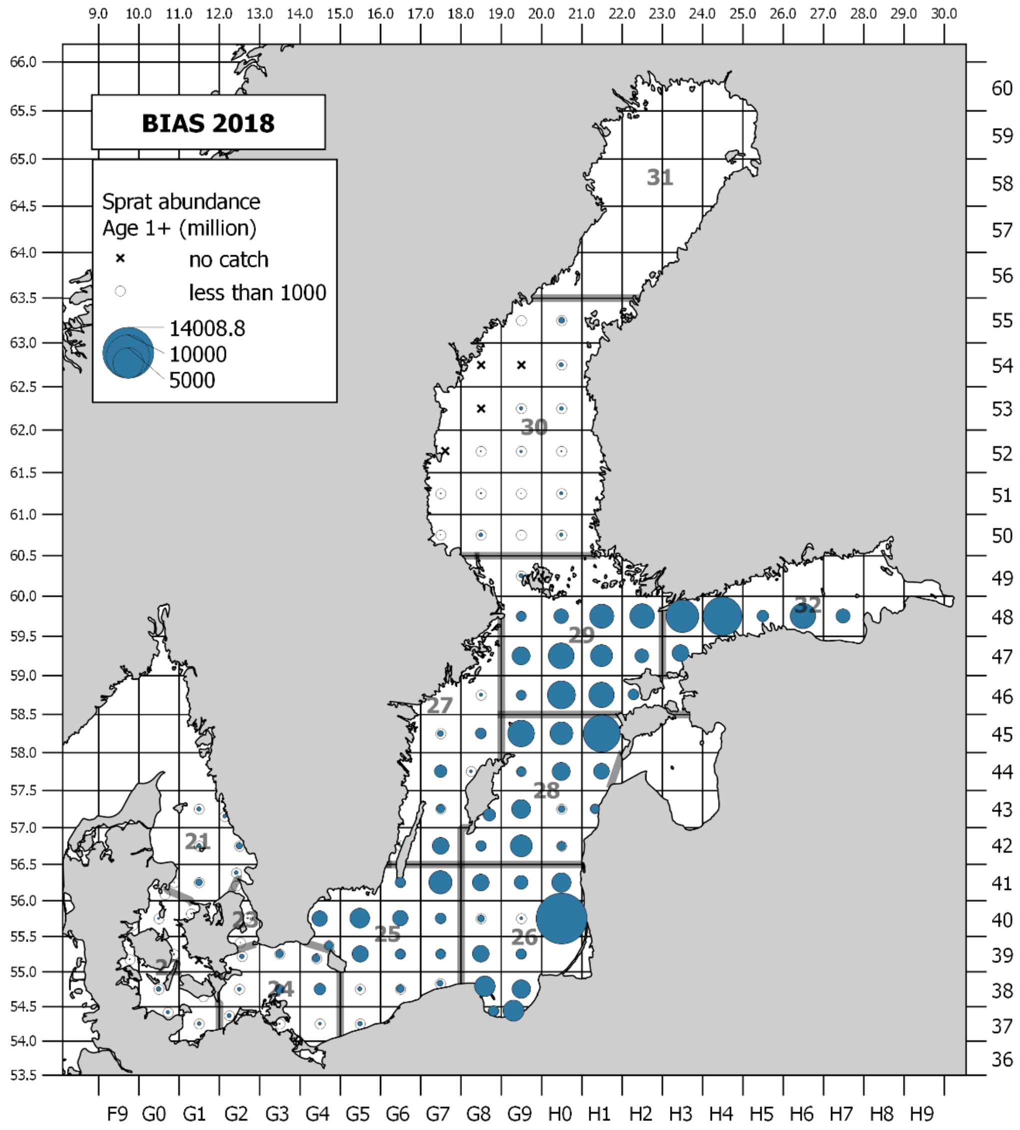


Figure 5.1.1.2.3. The abundance of sprat (age 1+) per ICES rectangles monitored in September-October 2018 (the area of circles indicates estimated numbers of specimens x10^6 in given rectangle).

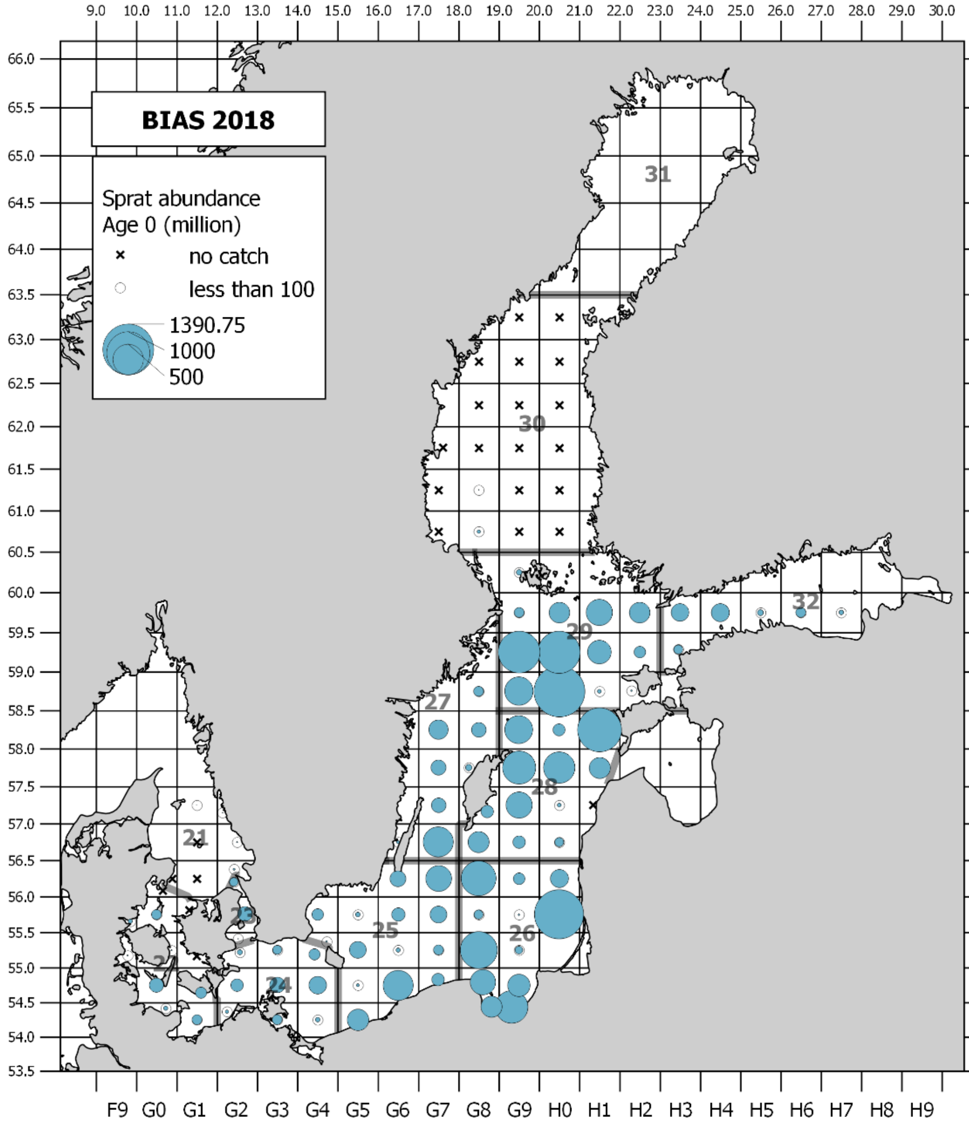


Figure 5.1.1.2.4. The abundance of sprat (age 0) per ICES rectangles monitored in September-October 2018 (the area of circles indicates estimated numbers of specimens x10^6 in given rectangle).

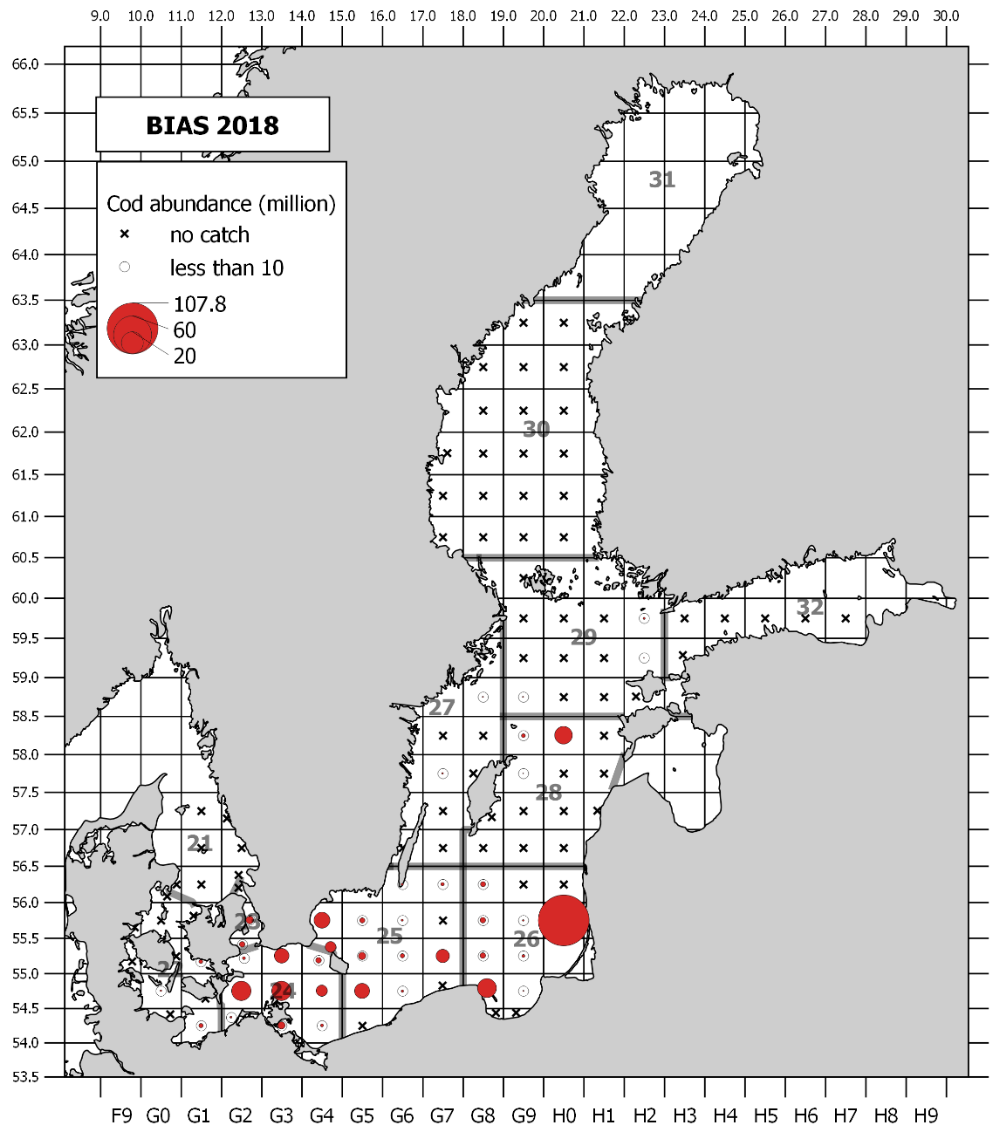


Figure 5.1.1.2.5. The abundance of cod (age 1+) per the ICES rectangles monitored in September-October 2018 (the area of circles indicates estimated numbers of specimens x10^6 in given rectangle).

The fish abundance estimates, which are based on the BIAS survey in September-October 2018, are presented per the ICES rectangles and age groups and are specified in Tables 5.1.1.2.1, 5.1.1.2.2 and 5.1.1.2.3 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 5.1.1.2.4 and 5.1.1.2.5.

The highest herring (age 1+) stock abundance was observed in the eastern part of the ICES SD 29 and western part of the ICES SD 32 (the Gulf of Finland), Fig. 5.1.1.2.1. Somewhat lower, however also significant abundance of herring stock was assessed in the ICES SDs 26 and 28. Herring (age 1+) was distributed in all except one (the ICES rec. 44H1) inspected areas of the Baltic, however with various abundances. The highest concentration of YOY herring (age group 0, year-class 2018) was detected in the ICES rectangle 50G8 (south part of the Bothnian Sea; Fig. 5.1.1.2.4). Somewhat smaller 0-age group herring concentration was detected in the north part of the ICES SD 30 (the Bothnian Sea) and the ICES SDs 21, 22 and 23. YOY herring occurred also in others inspected waters of the Baltic, however on the very low level (Fig. 5.1.1.2.2).

The highest sprat (age 1+) stock abundance was observed in the eastern Baltic, particularly in the ICES SDs 29 and 32 (the western part of the Gulf of Finland), the north part of the ICES SD 26 (the Estonian coast) and the east part of the ICES SD 26 (the Lithuanian inshore waters) (Fig. 5.1.1.2.3). The highest concentration of YOY sprat (year-class 2018) was detected in the ICES SDs 29, 28 and 26. YOY sprat was distributed in all ICES subdivisions except the ICES SD 30, where occurred only in two ICES rectangles (50G8 and 51G8) on the very low level (Fig. 5.1.1.2.4).

The highest cod stock abundance (age 1+) was detected in the ICES rectangle 40H0 (the Lithuanian inshore waters), Fig. 5.1.1.2.5. Cod with low abundance was detected in many others areas of the Baltic, with exception of the ICES SDs 31 and 32 and inspected part of the ICES SD 21. It should be underlined that cod stock abundance was several times lower than herring and sprat stocks abundance.

Table 5.1.1.2.1. Estimated numbers (millions) of herring in September-October 2018, 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+
2018	21	41G0	6.80	5.10	1.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2018	21	41G1	213.04	91.20	90.35	24.18	4.74	1.62	0.95	0.00	0.00	0.00
2018	21	41G2	123.39	122.39	0.83	0.06	0.11	0.00	0.00	0.00	0.00	0.00
2018	21	42G1	68.04	64.74	3.05	0.25	0.00	0.00	0.00	0.00	0.00	0.00
2018	21	42G2	325.43	162.53	144.11	15.72	1.78	0.67	0.62	0.00	0.00	0.00
2018	21	43G1	470.00	468.92	1.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2018	21	43G2	156.80	156.48	0.32	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2018	22	37G0	44.20	41.12	2.66	0.13	0.07	0.15	0.07	0.00	0.00	0.00
2018	22	37G1	254.68	229.70	21.86	0.56	1.07	1.39	0.10	0.00	0.00	0.00
2018	22	38G0	228.42	223.66	4.09	0.36	0.09	0.22	0.00	0.00	0.00	0.00
2018	22	38G1	120.42	120.11	0.06	0.19	0.06	0.00	0.00	0.00	0.00	0.00
2018	22	39F9	19.96	19.07	0.70	0.13	0.03	0.03	0.00	0.00	0.00	0.00
2018	22	39G0	22.33	21.35	0.78	0.14	0.03	0.03	0.00	0.00	0.00	0.00
2018	22	39G1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2018	22	40F9	28.77	28.77	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2018	22	40G0	143.76	143.76	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2018	22	40G1	140.11	113.75	14.93	10.25	0.90	0.28	0.00	0.00	0.00	0.00
2018	22	41G0	15.92	12.25	2.69	0.72	0.03	0.23	0.00	0.00	0.00	0.00
2018	23	39G2	76.87	74.71	0.71	0.19	0.32	0.64	0.15	0.11	0.00	0.04
2018	23	40G2	217.37	204.19	8.11	1.29	0.66	2.24	0.75	0.13	0.00	0.00
2018	23	41G2	212.87	209.84	1.55	0.71	0.19	0.37	0.18	0.03	0.00	0.00
2018	24	37G2	42.49	36.63	2.00	0.64	0.97	1.79	0.30	0.12	0.02	0.02
2018	24	37G3	17.14	3.30	0.94	2.28	3.06	3.20	2.16	0.95	0.36	0.89
2018	24	37G4	20.49	7.41	2.49	1.18	2.37	3.96	1.87	0.57	0.28	0.36
2018	24	38G2	194.18	177.60	5.74	0.51	2.05	6.23	1.23	0.60	0.11	0.11
2018	24	38G3	58.50	27.44	4.67	3.41	5.77	9.12	4.50	1.63	0.64	1.32
2018	24	38G4	256.23	92.61	31.09	14.71	29.63	49.56	23.43	7.16	3.51	4.53
2018	24	39G2	254.11	234.24	6.64	1.13	2.66	6.76	1.58	0.76	0.17	0.17
2018	24	39G3	391.83	169.98	55.86	14.87	36.25	73.55	26.79	8.03	3.21	3.29
2018	24	39G4	171.19	9.09	25.49	11.82	28.75	46.53	30.02	10.15	4.29	5.05
2018	25	37G5	270.17	8.79	38.15	12.62	36.06	95.35	30.26	26.95	12.13	9.85
2018	25	38G5	380.09	5.13	40.44	15.76	54.72	124.94	45.14	45.46	27.17	21.32
2018	25	38G6	100.57	23.23	11.47	4.69	9.44	26.66	8.17	8.00	4.90	4.01
2018	25	38G7	2.30	0.69	0.39	0.17	0.15	0.56	0.15	0.13	0.02	0.03
2018	25	39G4	330.40	11.20	24.19	51.97	19.49	135.07	51.52	23.07	10.98	2.91
2018	25	39G5	303.09	20.43	33.71	34.59	41.91	149.32	11.00	6.02	4.23	1.89
2018	25	39G6	461.52	12.71	125.12	46.33	48.54	159.06	31.76	23.37	7.83	6.81
2018	25	39G7	607.31	4.21	98.11	33.19	83.52	220.74	64.16	56.96	24.69	21.74
2018	25	40G4	1 068.84	37.87	88.93	155.12	124.34	469.88	94.92	93.65	4.11	0.00
2018	25	40G5	372.91	37.17	58.78	63.25	30.54	152.93	10.65	12.50	3.83	3.27
2018	25	40G6	1 399.93	6.66	99.84	159.31	118.80	821.80	96.35	89.86	7.33	0.00
2018	25	40G7	673.74	0.00	10.06	28.96	116.41	355.80	136.08	23.14	0.00	3.29
2018	25	41G6	1 657.10	1.68	22.78	65.31	151.91	1 115.52	224.72	36.35	35.43	3.41
2018	25	41G7	813.43	16.79	28.76	92.59	129.23	412.40	112.45	11.09	2.95	7.16
2018	26	37G8	14.71	4.18	5.71	0.91	0.97	1.48	0.74	0.41	0.12	0.20
2018	26	37G9	7.01	4.31	1.44	0.24	0.38	0.37	0.20	0.06	0.00	0.00
2018	26	38G8	771.10	168.22	118.98	54.26	49.63	149.30	75.42	54.27	35.92	65.10
2018	26	38G9	2 090.69	77.06	373.53	195.44	197.36	532.01	274.67	177.88	84.55	178.20
2018	26	39G8	378.33	64.54	48.00	30.43	31.98	90.38	49.09	28.72	12.32	22.87
2018	26	39G9	248.99	1.91	35.25	25.20	26.57	71.90	39.33	22.41	9.17	17.24
2018	26	40G8	604.16	0.22	73.23	66.87	71.46	188.59	99.04	51.57	19.38	33.80
2018	26	40G9	155.36	0.00	9.78	9.66	22.91	54.62	29.82	20.46	4.49	3.61
2018	26	40H0	4 265.00	4.99	554.68	333.65	751.88	995.21	639.37	584.19	200.61	200.43
2018	26	41G8	1 534.44	0.00	7.38	57.08	249.66	747.15	283.13	132.84	53.48	3.72
2018	26	41G9	2 707.20	0.00	253.10	270.00	331.00	1 065.60	288.50	422.00	52.00	25.00
2018	26	41H0	171.96	2.04	45.20	12.21	22.39	27.10	24.30	15.30	12.21	11.20
2018	27	42G6	9.92	7.06	2.86	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2018	27	42G7	197.04	0.71	10.06	14.02	29.78	107.26	29.91	4.48	0.82	0.00
2018	27	43G7	2 687.49	32.73	169.04	431.62	519.23	1 327.42	173.60	13.59	20.26	0.00
2018	27	44G7	730.39	36.97	32.14	191.12	145.00	267.15	51.91	4.06	2.03	0.00
2018	27	44G8	687.67	2.63	34.37	220.86	65.07	351.91	10.54	0.00	2.29	0.00
2018	27	45G7	315.98	57.62	24.83	72.03	68.26	63.73	26.68	0.00	2.83	0.00
2018	27	45G8	311.61	63.52	25.68	50.47	40.69	120.15	8.95	1.08	1.08	0.00
2018	27	46G8	377.34	6.58	21.77	32.80	40.05	212.62	52.98	7.71	2.89	0.00

Continued

Table 5.1.1.2.1. Estimated numbers (millions) of herring in September-October 2018, 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+
2018	28_2	42G8	594.00	2.74	23.84	111.88	91.64	340.65	8.08	9.52	4.32	1.33
2018	28_2	42G9	319.23	0.00	24.56	35.89	49.11	143.56	17.00	32.11	7.56	9.44
2018	28_2	42H0	924.57	0.00	6.31	50.49	123.07	296.62	85.20	201.95	85.20	75.73
2018	28_2	43G8	113.88	5.13	32.01	18.26	13.95	39.60	3.90	1.03	0.00	0.00
2018	28_2	43G9	6 508.81	197.91	53.08	843.39	566.41	3 360.02	532.22	644.46	311.31	0.00
2018	28_2	43H0	1 807.65	0.00	52.59	118.32	230.06	591.59	157.76	295.80	190.62	170.90
2018	28_2	43H1	42.94	0.00	0.00	1.70	5.95	13.60	2.98	8.93	4.68	5.10
2018	28_2	44G9	478.40	2.86	1.63	42.03	40.08	198.08	151.33	16.42	8.47	17.48
2018	28_2	44H0	30.01	0.00	3.62	5.42	3.62	10.85	1.45	3.62	0.72	0.72
2018	28_2	44H1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2018	28_2	45G9	3 343.48	223.84	365.13	662.42	283.60	1 498.54	282.59	0.00	27.35	0.00
2018	28_2	45H0	3 005.70	10.59	109.69	471.83	316.35	1 550.20	65.69	317.55	97.83	65.96
2018	28_2	45H1	1 152.10	50.82	163.06	232.09	108.00	469.03	16.09	80.80	19.91	12.29
2018	29	46G9	768.95	24.69	113.85	167.20	25.81	336.93	94.77	2.85	0.00	2.85
2018	29	46H0	32.89	16.46	8.05	4.79	0.00	3.59	0.00	0.00	0.00	0.00
2018	29	46H1	439.38	19.38	50.70	59.41	58.94	167.62	20.10	26.51	21.58	15.13
2018	29	46H2	78.83	3.48	9.10	10.66	10.57	30.07	3.61	4.76	3.87	2.71
2018	29	47G9	329.92	156.28	47.91	69.51	12.47	42.82	0.92	0.00	0.00	0.00
2018	29	47H0	490.97	35.52	55.86	83.68	52.84	200.27	30.07	15.34	10.88	6.52
2018	29	47H1	379.66	4.28	35.71	52.16	59.60	159.33	19.71	22.83	16.97	9.06
2018	29	47H2	3 060.72	38.51	437.98	548.38	472.13	1 139.88	147.97	151.21	96.52	28.13
2018	29	48G9	747.73	172.18	225.06	130.36	57.20	86.86	17.81	22.86	11.27	24.14
2018	29	48H0	181.42	21.73	19.24	28.05	23.41	63.80	7.33	8.35	6.21	3.31
2018	29	48H1	466.88	5.26	43.91	64.15	73.29	195.94	24.24	28.07	20.87	11.15
2018	29	48H2	9 385.05	118.08	1 342.99	1 681.50	1447.69	3 495.21	453.72	463.64	295.95	86.27
2018	29	49G9	932.71	98.58	186.92	234.44	113.00	158.33	38.69	40.57	20.39	41.79
2018	30	50G7	1 000.99	477.64	251.02	124.56	46.76	47.41	13.00	10.12	5.49	25.00
2018	30	50G8	2 689.93	2 634.81	27.78	14.81	6.02	4.12	0.79	0.98	0.28	0.33
2018	30	50G9	306.80	4.31	58.87	97.29	42.53	47.89	14.57	12.24	6.74	22.36
2018	30	50H0	405.25	98.51	113.36	92.54	33.33	33.99	8.98	7.58	4.19	12.75
2018	30	51G7	969.78	31.78	78.01	253.95	144.67	172.75	53.84	48.97	35.20	150.61
2018	30	51G8	1 498.20	73.64	54.15	388.55	272.51	360.74	112.73	90.62	42.04	103.23
2018	30	51G9	229.46	4.40	26.70	60.48	34.94	49.86	15.44	12.59	6.27	18.79
2018	30	51H0	483.75	96.09	91.41	100.19	45.29	61.57	19.99	16.43	10.64	42.13
2018	30	52G7	509.30	3.99	6.92	101.83	91.99	145.98	47.95	37.39	19.01	54.24
2018	30	52G8	1 647.22	36.55	57.53	443.11	313.40	399.50	118.56	89.39	41.95	147.23
2018	30	52G9	775.68	56.92	72.18	164.34	111.63	163.16	53.37	43.12	24.93	86.01
2018	30	52H0	1 197.68	195.61	476.58	257.01	92.89	95.13	25.85	21.08	9.73	23.80
2018	30	53G8	626.86	1.58	13.98	126.16	95.67	149.68	49.83	40.95	28.19	120.83
2018	30	53G9	1 504.72	458.28	298.96	265.64	137.15	175.02	53.28	42.72	20.19	53.47
2018	30	53H0	1 074.62	121.53	273.49	219.40	112.36	145.28	46.86	40.75	23.25	91.70
2018	30	54G8	631.57	0.52	26.51	163.79	115.57	159.87	50.52	38.96	18.79	57.04
2018	30	54G9	890.84	3.30	93.47	272.67	153.83	190.04	56.23	43.67	20.69	56.94
2018	30	54H0	1 602.41	727.06	488.75	144.17	48.75	70.95	24.28	19.60	14.38	64.46
2018	30	55G9	675.20	61.73	60.24	190.87	104.22	117.66	34.57	29.91	16.41	59.59
2018	30	55H0	886.73	294.36	200.62	161.84	71.98	72.54	19.56	18.47	10.73	36.64
2018	32	47H3	1 092.10	4.28	70.42	210.87	289.27	277.18	140.85	84.06	15.16	0.00
2018	32	48H3	4 089.13	16.03	263.68	789.57	1083.11	1 037.83	527.38	314.75	56.78	0.00
2018	32	48H4	5 678.91	118.93	648.74	1 661.15	1383.61	1 115.08	458.06	253.76	39.57	0.00
2018	32	48H5	2 620.13	26.95	258.92	668.66	712.25	604.29	208.48	114.37	26.21	0.00
2018	32	48H6	1 208.45	31.78	248.95	268.71	292.84	228.74	89.34	42.95	5.14	0.00
2018	32	48H7	1 462.32	77.93	967.90	182.79	101.82	78.63	29.27	19.78	4.20	0.00

Table 5.1.1.2.2. Estimated numbers (millions) of sprat in September-October 2018, 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+
2018	21	41G0	5.10	0.00	2.13	1.27	1.36	0.23	0.11	0.00	0.00	0.00
2018	21	41G1	266.97	0.00	107.64	44.24	63.62	40.74	9.80	0.00	0.93	0.00
2018	21	41G2	100.66	2.76	95.15	2.15	0.48	0.07	0.05	0.00	0.00	0.00
2018	21	42G1	114.47	0.00	104.95	6.08	2.18	0.80	0.30	0.00	0.16	0.00
2018	21	42G2	257.49	1.29	152.89	23.71	45.14	27.57	6.89	0.00	0.00	0.00
2018	21	43G1	121.81	0.33	114.65	5.68	0.70	0.36	0.09	0.00	0.00	0.00
2018	21	43G2	95.81	0.44	90.48	4.09	0.51	0.23	0.06	0.00	0.00	0.00
2018	22	37G0	87.83	10.27	16.12	38.92	9.98	11.65	0.73	0.00	0.16	0.00
2018	22	37G1	139.15	54.51	35.43	23.55	6.59	10.20	6.22	0.00	2.65	0.00
2018	22	38G0	248.67	113.11	30.40	65.46	17.48	20.42	1.42	0.00	0.38	0.00
2018	22	38G1	69.41	69.22	0.19	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2018	22	39F9	15.89	0.96	4.49	6.65	1.65	1.99	0.15	0.00	0.00	0.00
2018	22	39G0	17.81	1.08	5.03	7.45	1.85	2.23	0.17	0.00	0.00	0.00
2018	22	39G1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2018	22	40F9	18.02	10.98	0.50	3.57	1.36	1.41	0.20	0.00	0.00	0.00
2018	22	40G0	90.12	54.89	2.52	17.83	6.82	7.04	1.02	0.00	0.00	0.00
2018	22	40G1	9.05	0.00	0.00	5.11	1.97	1.97	0.00	0.00	0.00	0.00
2018	22	41G0	0.85	0.00	0.33	0.34	0.09	0.09	0.00	0.00	0.00	0.00
2018	23	39G2	5.50	0.62	2.10	1.67	0.58	0.45	0.07	0.01	0.00	0.00
2018	23	40G2	139.56	121.04	12.10	2.49	0.53	3.08	0.16	0.16	0.00	0.00
2018	23	41G2	45.29	43.45	1.66	0.14	0.01	0.03	0.00	0.00	0.00	0.00
2018	24	37G2	110.30	6.77	48.04	32.96	11.35	9.36	1.23	0.51	0.04	0.04
2018	24	37G3	77.75	55.46	18.62	2.35	0.66	0.56	0.07	0.03	0.00	0.00
2018	24	37G4	74.30	13.82	18.71	20.54	10.18	8.71	1.48	0.74	0.06	0.06
2018	24	38G2	173.22	83.98	47.88	25.98	8.21	6.65	0.13	0.39	0.00	0.00
2018	24	38G3	539.87	134.72	208.91	117.87	39.73	32.26	4.41	1.69	0.14	0.14
2018	24	38G4	929.16	172.82	233.97	256.83	127.34	108.95	18.48	9.21	0.78	0.78
2018	24	39G2	150.15	16.43	48.30	46.34	19.52	15.70	2.77	0.91	0.09	0.09
2018	24	39G3	397.32	46.02	136.02	124.09	45.14	37.11	6.27	2.21	0.23	0.23
2018	24	39G4	429.29	70.30	117.64	120.44	58.06	49.78	7.97	4.64	0.23	0.23
2018	25	37G5	396.91	253.90	25.32	29.50	44.21	34.22	6.98	2.70	0.00	0.07
2018	25	38G5	125.19	5.39	4.87	22.54	42.42	35.96	11.01	2.86	0.07	0.07
2018	25	38G6	851.30	491.71	31.73	83.70	125.24	96.75	14.81	6.79	0.40	0.16
2018	25	38G7	306.86	86.89	39.37	51.50	65.64	53.72	7.05	2.69	0.00	0.00
2018	25	39G4	394.20	2.15	6.46	58.59	15.51	235.66	50.41	0.00	25.42	0.00
2018	25	39G5	1 628.09	157.92	118.54	76.97	258.07	645.60	158.47	89.22	8.48	114.81
2018	25	39G6	562.08	10.40	18.30	116.88	201.60	166.49	33.63	13.54	0.77	0.46
2018	25	39G7	555.81	57.11	89.95	124.81	152.65	110.59	13.11	7.44	0.10	0.07
2018	25	40G4	1 407.15	73.83	60.88	33.53	254.06	699.50	93.74	163.38	0.00	28.23
2018	25	40G5	2 206.37	12.11	137.77	266.61	839.70	372.26	11.99	334.27	185.86	45.79
2018	25	40G6	1 455.62	98.33	22.78	113.02	141.60	767.02	103.48	127.40	82.00	0.00
2018	25	40G7	790.32	157.49	62.55	43.40	71.70	366.84	32.35	48.15	7.85	0.00
2018	25	41G6	740.64	140.45	24.27	22.58	129.76	352.69	51.08	6.60	13.21	0.00
2018	25	41G7	3 324.11	360.86	175.86	197.67	773.13	1 353.05	336.34	68.43	29.38	29.38
2018	26	37G8	861.71	242.23	389.36	119.33	84.98	25.61	0.20	0.00	0.00	0.00
2018	26	37G9	3 032.91	583.06	1 337.51	534.61	412.61	158.76	4.95	0.00	1.42	0.00
2018	26	38G8	2 710.35	352.99	853.09	588.18	623.65	271.99	15.43	2.35	2.67	0.00
2018	26	38G9	2 158.15	270.10	317.05	356.45	700.72	443.55	53.70	3.00	13.60	0.00
2018	26	39G8	2 350.13	752.56	272.61	421.27	581.55	292.89	23.53	0.42	5.30	0.00
2018	26	39G9	628.77	33.77	72.38	159.57	231.18	118.69	10.73	0.28	2.17	0.00
2018	26	40G8	303.87	45.34	19.13	51.63	107.73	68.24	9.15	0.66	2.00	0.00
2018	26	40G9	57.45	1.96	3.92	20.19	16.29	10.95	1.79	1.64	0.43	0.29
2018	26	40H0	15 322.31	1 313.54	6 946.86	5 560.41	1 120.63	376.12	4.76	0.00	0.00	0.00
2018	26	41G8	2 212.21	665.50	200.51	149.76	136.03	935.44	43.60	48.22	22.70	10.45
2018	26	41G9	1 149.56	72.69	239.35	130.75	103.00	414.43	115.04	39.20	13.26	21.84
2018	26	41H0	2 240.96	177.83	575.17	287.98	339.63	657.87	70.15	60.40	35.52	36.42
2018	27	42G6	34.46	5.74	2.15	0.00	10.41	10.62	2.44	0.86	1.54	0.68
2018	27	42G7	2 073.53	499.27	154.33	158.75	277.11	906.60	45.56	0.00	9.76	22.18
2018	27	43G7	483.24	115.97	8.00	23.89	92.38	197.61	5.42	32.46	0.00	7.51
2018	27	44G7	1 003.65	128.66	154.76	183.00	43.59	484.09	9.55	0.00	0.00	0.00
2018	27	44G8	77.26	24.88	6.55	0.00	1.57	20.69	8.38	0.00	9.17	6.02
2018	27	45G7	419.61	209.16	58.55	13.54	6.98	125.99	1.51	1.98	0.95	0.95
2018	27	45G8	763.66	116.21	145.68	73.57	67.25	258.33	44.24	37.91	18.92	1.56
2018	27	46G8	128.33	56.17	14.22	1.85	7.25	28.90	9.88	4.09	2.31	3.66

Continued

Table 5.1.1.2.2. Estimated numbers (millions) of sprat in September-October 2018, 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+
2018	28_2	42G8	854.58	245.47	241.60	0.00	50.09	277.19	32.34	6.20	0.00	1.68
2018	28_2	42G9	2 734.15	86.94	482.26	288.97	231.15	973.26	128.22	243.45	114.82	185.08
2018	28_2	42H0	454.78	44.04	86.18	59.03	36.97	162.35	19.65	26.94	7.34	12.28
2018	28_2	43G8	962.49	84.51	136.16	32.87	146.49	511.76	29.11	0.00	0.00	21.60
2018	28_2	43G9	2 335.88	374.45	314.64	0.00	195.96	1 123.09	199.73	22.88	40.38	64.76
2018	28_2	43H0	274.90	8.17	92.54	24.50	21.77	78.93	10.89	21.77	10.89	5.44
2018	28_2	43H1	443.65	0.00	158.43	58.12	47.52	169.03	0.00	0.00	5.28	5.28
2018	28_2	44G9	1 043.51	600.07	47.70	99.51	58.68	225.36	6.21	2.74	2.74	0.51
2018	28_2	44H0	2 362.80	543.00	575.96	200.73	234.16	575.96	116.14	46.67	23.51	46.67
2018	28_2	44H1	1 636.12	239.62	490.45	198.06	145.46	510.01	8.26	8.26	18.00	18.00
2018	28_2	45G9	4 297.98	430.66	376.25	73.74	802.83	2 069.23	391.06	81.62	50.39	22.21
2018	28_2	45H0	2 977.40	83.73	212.44	726.46	168.92	623.28	828.64	197.09	52.29	84.54
2018	28_2	45H1	8 626.16	1 043.35	1 389.67	2 228.28	512.87	1 548.47	1 412.38	277.68	81.76	131.70
2018	29	46G9	930.62	441.14	122.39	77.70	134.20	125.95	13.58	3.28	10.30	2.07
2018	29	46H0	5 661.10	1 390.75	1 705.63	187.53	693.19	1 449.91	86.94	60.22	20.07	66.86
2018	29	46H1	3 614.63	9.87	711.21	481.23	274.96	1 098.38	779.15	197.32	33.12	29.39
2018	29	46H2	648.47	1.77	127.59	86.33	49.33	197.05	139.78	35.40	5.94	5.27
2018	29	47G9	2 790.66	941.20	233.44	70.36	375.59	738.99	333.07	8.46	0.00	89.55
2018	29	47H0	4 685.70	975.05	1 050.87	444.96	553.66	1 092.06	426.43	83.64	26.21	32.82
2018	29	47H1	2 932.40	305.36	772.39	423.30	165.56	650.22	487.04	102.35	14.00	12.17
2018	29	47H2	1 145.59	75.75	212.69	130.99	81.77	291.25	238.38	72.40	21.05	21.31
2018	29	48G9	556.26	54.53	166.73	41.27	25.86	142.43	108.35	7.51	8.35	1.21
2018	29	48H0	1 432.58	233.14	312.61	163.89	109.02	333.17	221.10	38.52	5.12	16.01
2018	29	48H1	3 606.11	375.52	949.85	520.55	203.60	799.61	598.93	125.86	17.22	14.97
2018	29	48H2	3 512.70	232.28	652.18	401.67	250.72	893.06	730.93	222.00	64.54	65.33
2018	29	49G9	136.43	18.58	35.28	9.15	5.54	33.73	27.48	2.46	3.15	1.07
2018	30	50G7	8.65	0.00	1.55	0.91	0.45	1.25	3.52	0.19	0.20	0.58
2018	30	50G8	106.44	6.74	27.00	9.62	4.32	12.83	37.75	1.88	2.21	4.08
2018	30	50G9	3.78	0.00	0.01	0.19	0.16	0.64	1.97	0.12	0.24	0.46
2018	30	50H0	80.69	0.00	6.54	6.05	3.83	12.64	37.81	2.56	3.85	7.41
2018	30	51G7	11.40	0.00	1.81	1.02	0.64	1.88	5.45	0.08	0.15	0.36
2018	30	51G8	20.22	0.65	0.97	1.55	0.89	2.93	9.18	0.73	1.10	2.23
2018	30	51G9	6.81	0.00	0.63	0.60	0.36	1.09	3.19	0.19	0.26	0.50
2018	30	51H0	74.95	0.00	3.61	4.93	3.46	12.30	36.63	2.28	3.76	7.98
2018	30	52G7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2018	30	52G8	12.11	0.00	0.94	0.53	0.42	1.41	4.92	0.57	0.95	2.37
2018	30	52G9	40.54	0.00	1.02	1.47	1.38	5.73	19.35	1.95	3.40	6.24
2018	30	52H0	9.21	0.00	0.36	0.75	0.54	1.58	4.84	0.23	0.34	0.57
2018	30	53G8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2018	30	53G9	71.51	0.00	3.71	4.57	3.20	10.75	33.42	2.70	4.34	8.82
2018	30	53H0	81.56	0.00	4.62	5.65	3.89	12.70	38.94	2.76	4.34	8.65
2018	30	54G8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2018	30	54G9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2018	30	54H0	118.75	0.00	7.13	6.09	4.76	17.78	56.24	4.24	7.27	15.25
2018	30	55G9	1.47	0.00	0.00	0.05	0.05	0.28	0.83	0.05	0.09	0.13
2018	30	55H0	203.71	0.00	43.51	21.61	10.88	28.48	82.64	3.82	3.86	8.91
2018	32	47H3	1 598.38	45.60	587.64	261.54	67.95	471.59	122.71	7.65	10.06	23.64
2018	32	48H3	5 984.80	170.76	2 200.27	979.29	254.43	1 765.77	459.46	28.66	37.66	88.51
2018	32	48H4	8 362.66	179.96	3 482.39	1 176.26	365.85	2 336.59	645.57	23.11	48.73	104.20
2018	32	48H5	776.11	20.14	252.20	96.86	39.26	245.92	80.40	7.46	8.42	25.45
2018	32	48H6	3 666.17	55.07	1 880.60	495.60	117.20	817.62	223.47	10.92	22.43	43.27
2018	32	48H7	1 149.80	13.29	380.13	118.71	51.48	362.34	141.55	14.96	19.78	47.56

Table 5.1.1.2.3. Estimated numbers (millions) of cod in September-October 2005-2018, by ICES rectangles.

Sub_Div	RECT	Area	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
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
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
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
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
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
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
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
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
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
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
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	1.01	1.72	9.95
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
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
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
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
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	0.11	0.85	0.91
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
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
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
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
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
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
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
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
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	0.10	2.52	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
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
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	0.23	0.55	1.44
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
26	39H0	881.60					0.00	0.00	0.02					0.30	0.09	
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
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
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
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
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	
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	
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
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
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
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
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
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
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
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
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
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	
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	
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
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
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	
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		
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
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	
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		
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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

Note: During WGBIFS meeting in 2019 errors in reported cod abundances in some rectangles were found and corrected - red coloured numbers.

Table 5.1.1.2.4. Estimated numbers (millions) of herring by ICES subdivisions, accordingly to age groups; September-October 2018.

YEAR	Sub_Div	0	1	2	3	4	5	6	7	8
2018	21	1 071.36	241.44	40.21	6.63	2.29	1.57	0.00	0.00	0.00
2018	22	953.54	47.77	12.48	2.28	2.33	0.17	0.00	0.00	0.00
2018	23	488.74	10.37	2.19	1.17	3.25	1.08	0.27	0.00	0.04
2018	24	758.30	134.92	50.55	111.51	200.70	91.88	29.97	12.59	15.74
2018	25	186.56	680.73	763.85	965.04	4 240.02	917.33	456.56	145.61	85.70
2018	26	327.46	1 526.29	1 055.95	1 756.20	3 923.71	1 803.62	1 510.11	484.25	561.37
2018	27	207.82	320.74	1 012.92	908.09	2 450.24	354.51	30.91	32.20	0.00
2018	28_2	493.89	835.52	2 593.73	1 831.85	8 512.37	1 324.29	1 612.18	757.96	358.97
2018	29	714.43	2 577.28	3 134.30	2 406.96	6 080.65	858.94	786.97	504.52	231.07
2018	30	5 382.62	2 770.52	3 643.21	2 075.49	2 663.15	820.22	665.54	359.10	1 227.14
2018	32	275.91	2 458.61	3 781.76	3 862.89	3 341.74	1 453.38	829.66	147.06	0.00

Table 5.1.1.2.5. Estimated numbers (millions) of sprat by ICES subdivisions, accordingly to age groups; September-October 2018.

YEAR	Sub_Div	0	1	2	3	4	5	6	7	8
2018	21	4.82	667.89	87.22	113.99	70.00	17.30	0.00	1.09	0.00
2018	22	315.02	95.01	168.88	47.79	57.00	9.91	0.00	3.19	0.00
2018	23	165.11	15.86	4.30	1.12	3.56	0.23	0.17	0.00	0.00
2018	24	600.32	878.09	747.40	320.19	269.08	42.81	20.33	1.57	1.57
2018	25	1 908.55	818.64	1 241.31	3 115.28	5 290.37	924.44	873.48	353.54	219.05
2018	26	4 511.57	11 226.94	8 380.12	4 457.99	3 774.53	353.02	156.17	99.05	69.00
2018	27	1 156.06	544.24	454.58	506.53	2 032.84	126.97	77.30	42.64	42.56
2018	28_2	3 784.02	4 604.26	3 990.25	2 652.87	8 847.93	3 182.61	935.31	407.40	599.75
2018	29	5 054.95	7 052.87	3 038.95	2 923.01	7 845.80	4 191.15	959.41	229.07	358.03
2018	30	7.39	103.40	65.57	39.25	124.29	376.67	24.34	36.36	74.54
2018	32	484.81	8 783.23	3 128.26	896.16	5 999.83	1 673.16	92.76	147.08	332.62

5.1.1.3. 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 (see Addendum 2) 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 the ICES subdivisions kept their areas from the a.-m. Manual.

The area corrected abundance estimates for herring and sprat per the ICES subdivisions and age groups are summarized in Tables 5.1.1.3.1 and 5.1.1.3.2, respectively. Biomass for herring and sprat per the ICES subdivisions and age groups are summarized in Tables 5.1.1.3.3 and 5.1.1.3.4, respectively.

Table 5.1.1.3.1. Area corrected numbers (millions) of herring by ICES subdivisions and age groups (September-October 2018).

YEAR	Sub_Div	AREA_CORR_FACTOR	AGE 0	AGE 1	AGE 2	AGE 3	AGE 4	AGE 5	AGE 6	AGE 7	AGE 8+
2018	21	1.22	1 303.63	293.78	48.93	8.07	2.79	1.91	0.00	0.00	0.00
2018	22	1.02	973.20	48.76	12.74	2.33	2.38	0.17	0.00	0.00	0.00
2018	23	1.00	488.74	10.37	2.19	1.17	3.25	1.08	0.27	0.00	0.04
2018	24	1.00	758.30	134.92	50.55	111.51	200.70	91.88	29.97	12.59	15.74
2018	25	1.03	192.53	702.51	788.28	995.91	4 375.66	946.67	471.16	150.26	88.44
2018	26	1.10	360.97	1 682.44	1 163.99	1 935.89	4 325.16	1 988.15	1 664.61	533.80	618.81
2018	27	1.23	255.78	394.75	1 246.64	1 117.62	3 015.60	436.31	38.05	39.62	0.00
2018	28_2	1.01	500.36	846.47	2 627.72	1 855.86	8 623.94	1 341.64	1 633.31	767.90	363.68
2018	29	1.04	742.82	2 679.70	3 258.86	2 502.61	6 322.29	893.07	818.25	524.56	240.25
2018	30	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
2018	32	1.71	472.09	4 206.75	6 470.68	6 609.51	5 717.81	2 486.78	1 419.57	251.63	0.00

Table 5.1.1.3.2. Area corrected numbers (millions) of sprat by ICES subdivisions and age groups (September-October 2018).

YEAR	Sub_Div	AREA_CORR_FACTOR	AGE 0	AGE 1	AGE 2	AGE 3	AGE 4	AGE 5	AGE 6	AGE 7	AGE 8+
2018	21	1.22	5.86	812.69	106.13	138.70	85.18	21.05	0.00	1.33	0.00
2018	22	1.02	321.52	96.97	172.36	48.78	58.18	10.11	0.00	3.26	0.00
2018	23	1.00	165.11	15.86	4.30	1.12	3.56	0.23	0.17	0.00	0.00
2018	24	1.00	600.32	878.09	747.40	320.19	269.08	42.81	20.33	1.57	1.57
2018	25	1.03	1 969.60	844.83	1 281.02	3 214.94	5 459.60	954.01	901.42	364.85	226.06
2018	26	1.10	4 973.17	12 375.60	9 237.51	4 914.10	4 160.71	389.14	172.15	109.19	76.06
2018	27	1.23	1 422.80	669.81	559.47	623.41	2 501.89	156.27	95.14	52.48	52.38
2018	28_2	1.01	3 833.61	4 664.61	4 042.56	2 687.64	8 963.90	3 224.32	947.56	412.74	607.61
2018	29	1.04	5 255.83	7 333.15	3 159.72	3 039.17	8 157.59	4 357.71	997.53	238.18	372.26
2018	30	1.08	7.99	111.76	70.87	42.42	134.34	407.12	26.31	39.30	80.56
2018	32	1.71	829.53	15 028.33	5 352.54	1 533.36	10 265.86	2 862.82	158.72	251.65	569.12

Table 5.1.1.3.3. Estimated biomass (in tons) of herring in September-October 2018.

YEAR	Sub_Div	AREA_CORR_FACTOR	AGE 0	AGE 1	AGE 2	AGE 3	AGE 4	AGE 5	AGE 6	AGE 7	AGE 8+
2018	21	1.22	18.78	10 287.58	1 871.72	2 695.19	1 747.14	426.72		31.34	
2018	22	1.02	1 807.19	1 251.33	2 657.64	806.89	961.69	213.20		66.74	
2018	23	1.00	911.39	180.80	68.49	18.16	68.09	5.17	4.18		
2018	24	1.00	2 857.88	10 098.51	10 741.72	5 078.44	4 308.36	744.92	367.28	31.04	31.04
2018	25	1.03	8 448.19	7 639.69	14 862.95	39 981.30	70 552.12	13 688.57	13 980.69	5 532.22	3 670.61
2018	26	1.10	20 489.69	99 322.51	92 682.40	54 738.29	47 482.16	4 896.05	2 229.69	1 414.01	1 005.27
2018	27	1.23	5 242.93	5 493.54	5 622.43	6 713.57	27 986.56	1 928.01	1 202.77	678.76	676.57
2018	28_2	1.01	14 451.33	36 577.22	35 721.70	25 361.83	90 558.85	34 321.34	10 988.18	5 102.99	7 500.65
2018	29	1.04	20 316.34	55 870.53	25 451.69	29 418.47	76 134.85	42 947.05	10 451.26	2 727.20	4 478.95
2018	30	1.08	26.10	1 095.02	826.35	534.04	1 728.69	5 327.05	369.70	580.26	1 218.44
2018	32	1.71	3 407.69	103 899.87	41 440.63	13 307.16	88 839.71	26 431.43	1 762.10	2 553.79	6 133.45

Table 5.1.1.3.4. Estimated biomass (in tons) of sprat in September-October 2018.

YEAR	Sub_Div	AREA_CORR_FACTOR	AGE 0	AGE 1	AGE 2	AGE 3	AGE 4	AGE 5	AGE 6	AGE 7	AGE 8+
2018	21	1.22	17 241.47	14 916.27	3 486.61	677.22	235.38	203.87			
2018	22	1.02	11 105.72	1 834.04	838.72	122.46	83.37	9.02			
2018	23	1.00	5 353.25	424.01	114.68	49.26	122.14	37.02	11.89		2.37
2018	24	1.00	8 994.67	4 547.02	2 534.31	5 822.11	8 618.27	5 575.64	1 964.90	830.31	1 095.47
2018	25	1.03	2 117.85	17 589.89	23 787.08	41 044.89	159 329.00	47 170.64	23 919.83	8 907.41	5 029.43
2018	26	1.10	3 050.90	37 565.17	30 998.19	59 479.38	144 809.67	78 008.39	74 361.60	27 942.02	36 016.60
2018	27	1.23	1 123.88	5 731.24	24 848.92	28 055.85	80 837.01	14 171.91	1 362.55	1 539.09	
2018	28_2	1.01	2 071.75	12 768.93	52 837.34	46 514.22	230 220.52	43 146.92	52 111.98	27 380.04	15 281.95
2018	29	1.04	2 808.41	35 398.66	58 737.54	52 127.93	137 894.74	21 193.17	20 014.48	12 834.82	7 111.37
2018	30	1.08	29 489.95	44 237.92	91 285.82	59 071.60	83 224.41	27 117.64	22 642.45	14 018.84	58 382.62
2018	32	1.71	1 841.32	45 704.28	106 544.64	126 920.66	115 835.80	55 186.37	34 641.65	7 061.56	

5.1.1.4. Tuning fleets for WGBFAS

5.1.1.4.1. 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 1991-2018 (BIAS) is presented in Figure 5.1.1.4.1.1, 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 5.1.1.4.1.1. The recruitment index for herring (age 0) in the ICES Subdivisions 25-29 is presented in Table 5.1.1.4.1.2.

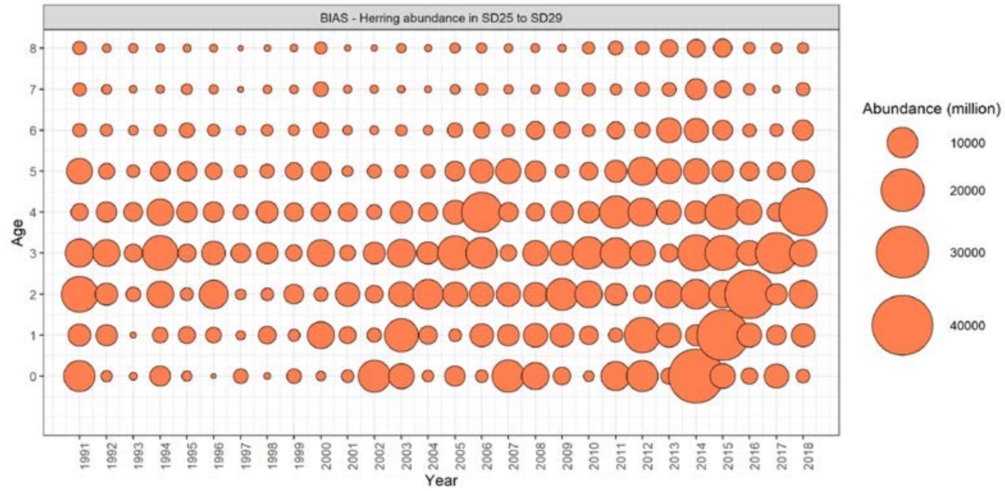


Figure 5.1.1.4.1.1. Autumn (BIAS) tuning fleet index (abundance per age groups and years 1991-2018) for herring in the ICES Subdivisions 25-29.

Table 5.1.1.4.1.1. ***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	2280.03	2452.71
1992	45 994.83	7 416.92	9 155.99	13 177.55	7 156.18	4 107.91	2 273.74	1539.52	1167.03
1993	28 396.39	709.95	4 539.70	6 809.39	7 830.70	3 619.01	2 054.43	1089.66	1743.56
1994	57 157.97	3 924.41	11 881.25	20 303.84	11 526.53	5 653.24	2 098.90	940.75	829.04
1995	28 048.83	4 663.87	2 235.90	4 464.12	5 908.26	5 286.76	3 156.91	1503.95	829.06
1996	43 944.57	3 985.13	13 761.96	9 989.35	7 360.96	4 532.76	2 358.59	1178.87	776.94
1997	15 438.37	1 447.81	1 544.65	5 182.71	3 237.17	2 156.86	1 091.15	466.71	311.32
1998	24 922.96	4 285.08	2 170.72	6 617.17	6 520.67	2 584.07	1 523.58	791.27	430.41
1999	20 511.86	1 754.15	4 741.92	3 193.65	4 251.46	3 679.73	1 427.81	833.2	629.96
2000	40 924.36	10 151.18	2 560.04	9 873.66	4 837.59	5 200.35	3 234.04	3006.83	2060.67
2001	24 300.57	4 028.51	8 194.34	3 286.15	4 660.79	1 567.36	1 238.05	861.26	464.12
2002	20 672.28	2 686.92	4 242.02	6 508.41	2 842.26	2 326.29	869.78	741.28	455.3
2003	49 161.77	16 704.18	9 115.70	10 643.33	6 689.95	2 319.57	1 777.96	755.07	1156
2004	34 519.87	4 913.56	13 229.49	6 788.89	4 672.24	2 500.08	1 132.10	603.52	679.98
2005	41 760.33	1 920.24	8 250.78	15 344.88	7 123.19	4 355.80	2 540.70	1095.95	1128.8
2006	62 514.29	7 316.60	8 059.84	12 700.27	21 120.77	7 336.31	3 068.12	1700.65	1211.72
2007	29 634.05	5 400.70	6 587.26	2 974.88	4 191.03	7 092.91	1 696.87	882.93	807.46
2008	35 039.19	6 841.54	6 822.40	7 588.80	3 612.67	4 926.52	3 563.14	877.07	807.05
2009	38 653.24	6 408.78	12 141.39	6 820.28	5 551.44	2 058.64	2 969.48	2089.22	614
2010	37 891.76	3 829.47	8 278.75	12 047.60	5 006.24	3 542.80	1 684.71	1901.9	1600.3
2011	44 141.66	2 338.71	5 667.81	10 992.95	12 668.94	5 525.30	3 257.40	1448.43	2242.12
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	46 887.63	6 895.68	9 160.08	3 855.08	6 934.01	7 127.08	7 272.45	2 154.28	3 488.96
2014	59 146.09	5 086.33	10 113.93	15 408.71	5 916.49	7 369.87	6 664.24	4 933.46	3 653.07
2015	95 183.53	36 179.38	9 812.43	15 272.96	15 548.98	5 486.39	4 873.36	3 648.14	4 361.89
2016	58 119.58	6 830.44	27 754.78	7 212.29	7 276.68	4 049.76	2 031.87	1 493.15	1 470.62
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

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.

Table 5.1.1.4.1.2. 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	3 068.44
2014	35 060.67
2015	7 661.72
2016	2 956.58
2017	7 183.88
2018	2 052.46

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.

5.1.1.4.2. 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 1991-2018 (BIAS) is presented in Figure 5.1.1.4.2.1. The area corrected combined results (for age 1+ sprat) of the above-mentioned ICES subdivisions are presented in Table 5.1.1.4.2.1. The recruitment index for sprat (age 0) in the ICES Subdivisions 22-29 is presented in Table 5.1.1.4.2.2.

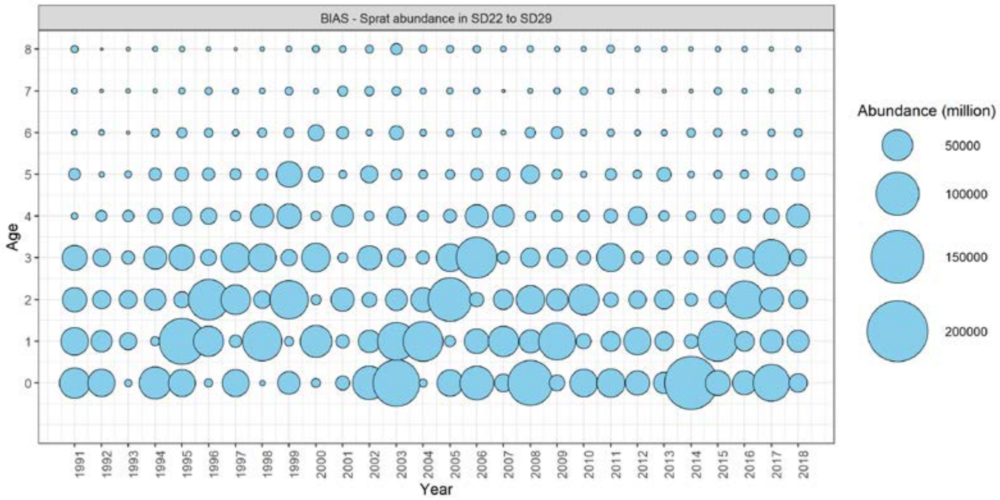


Figure 5.1.1.4.2.1. Autumn (BIAS) tuning fleet index (abundance per age groups and years 1991-2018) for sprat in the ICES Subdivisions 22-29.

Table 5.1.1.4.2.1 ***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	560.2
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	416.8
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	2678.2
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	213 176.57	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	8 174.54	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	71 926.85	19 407.84	20 363.57	11 448.00	5 683.54	11 219.11	1 771.30	759.48	1274.02
2014	40 768.24	10 447.80	8 623.21	9 735.00	4 695.08	2 033.89	3 778.55	681.04	773.67
2015	158 980.65	99 618.14	17 315.45	19 727.94	11 041.13	3 426.39	3 552.12	2 771.69	1 527.78
2016	142 927.58	20 593.04	80 929.70	24 268.59	9 416.64	3 774.99	1 496.16	1 196.02	1 252.44
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	1 335.94

Note: In the years, 1993, 1995 and 1997 the coverage was very poor. It is recommended that these data should not be used.

Table 5.1.1.4.2.2. 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	24 694.37
2014	162 714.99
2015	36 900.25
2016	30 765.04
2017	78 166.60
2018	18 541.96

Note: In the years, 1993, 1995 and 1997 the coverage was very poor. It is recommended that these data should not be used.

5.1.1.4.3. 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 2018, the Finnish BIAS survey was realised on board of the r/v "Aranda".

Tuning fleet data from the October 1991, 2000, 2007-2018 BIAS surveys are accessible for the assessment of the Gulf of Bothnian herring stock (the ICES Subdivisions 30-31), the area corrected combined results are presented in Table 5.1.1.4.3.1 and Figure 5.1.1.4.3.1.

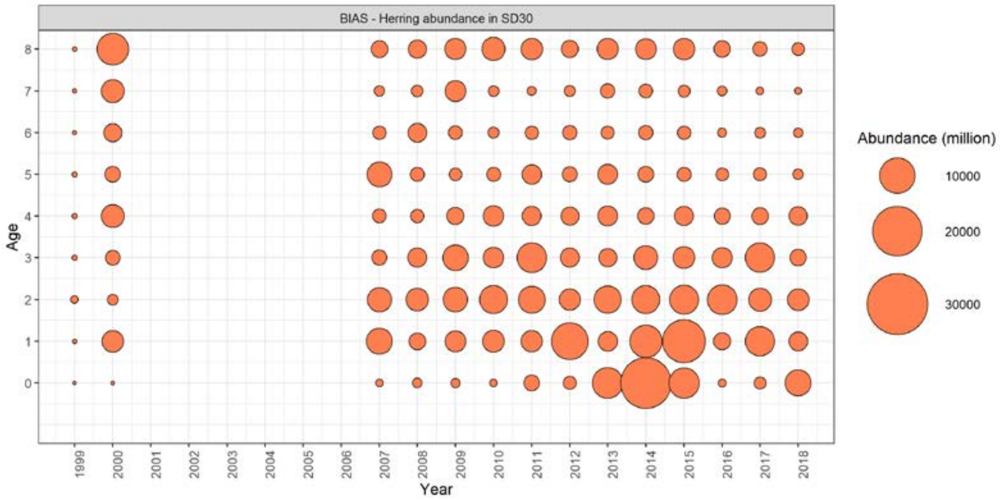


Figure 5.1.1.4.3.1. Autumn (BIAS) tuning fleet index (abundance per age groups and years 1999-2000 and 2007-2018) for herring in the ICES Subdivision 30.

Table 5.1.1.4.3.1. Correction factor and area corrected numbers (millions) of herring per age groups in the ICES Subdivision 30 (1999, 2000, 2007-2018).

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	1.2	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	8 358.81	3 306.48	6 645.52	2 843.18	3 486.22	3 386.11	1 434.66	1 771.46	3 946.95
2014	1.08	22 393.65	9 007.65	6 686.09	4 905.35	2 234.93	2 126.82	1 691.66	1 550.85	3 642.34
2015	1.21	8 949.47	17 996.57	8 079.44	4 637.48	3 507.45	1 844.19	1 681.52	1 331.19	4 362.95
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

5.1.2. Combined results of the Baltic Acoustic Spring Survey (BASS)

In May–June 2018, the following acoustic surveys were conducted:

COUNTRY	DATA	VESSEL	ICES SDs	ACOUSTIC TRANSECTS LENGTH [NM]	NUMBER OF HAULS	NUMBER OF HYDROLOGICAL STATIONS
Latvia-Poland	18-25.05.2018	Baltica	Parts of 26, 28,	858	19	23
Estonia-Poland	26-31.05.2018	Baltica	Parts of 28, 29, 32	392	15	15
Lithuania	08-09.05.2018	Darius	Part of 26	125	6	6
Poland	02-13.05.2018	Baltica	Parts of 25, 26	734	25	39
Germany	30.04-25.05.2018	Solea	Part of 24, 25, 26, 27, 28, 29	1212	59	236

5.1.2.1. Area under investigation and overlapping areas

The BASS surveys were realised in May 2018 by the above-mentioned five countries in the ICES Subdivisions 24-32 (excl. ICES SD 30, 31) however, in some ICES subdivisions only fragmentary (Fig. 5.1.2.1.1). The area coverage of the Baltic Sea with the BASS/2018 survey was very broad and 96.5% of planned area was monitored with acoustic and trawling. 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. The part of ICES SD 26 (the ICES rct.39H0) was not investigated as Russia did not take part in BASS 2018 cruises. In May 2018, overall 54 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 3321 NM linear distance moreover, 124 and 319 catch and hydrological stations, respectively were inspected too. The estimated numbers of sprat per age groups and the ICES rectangles are presented in Table 5.1.2.2.1. The geographical distribution of sprat abundance is demonstrated in Figure 5.1.2.1.2. Because of relatively small portion of herring (<10%) in comparison with sprat (>86%) in most of areas monitored during the BASS 2018 surveys only the distribution of sprat is further examined. It should be mentioned, that in some ICES rectangles the great share of abundance of stickback were observed e.g. in rect. 41G6 its numerical contribution to the total abundance was above 97%.

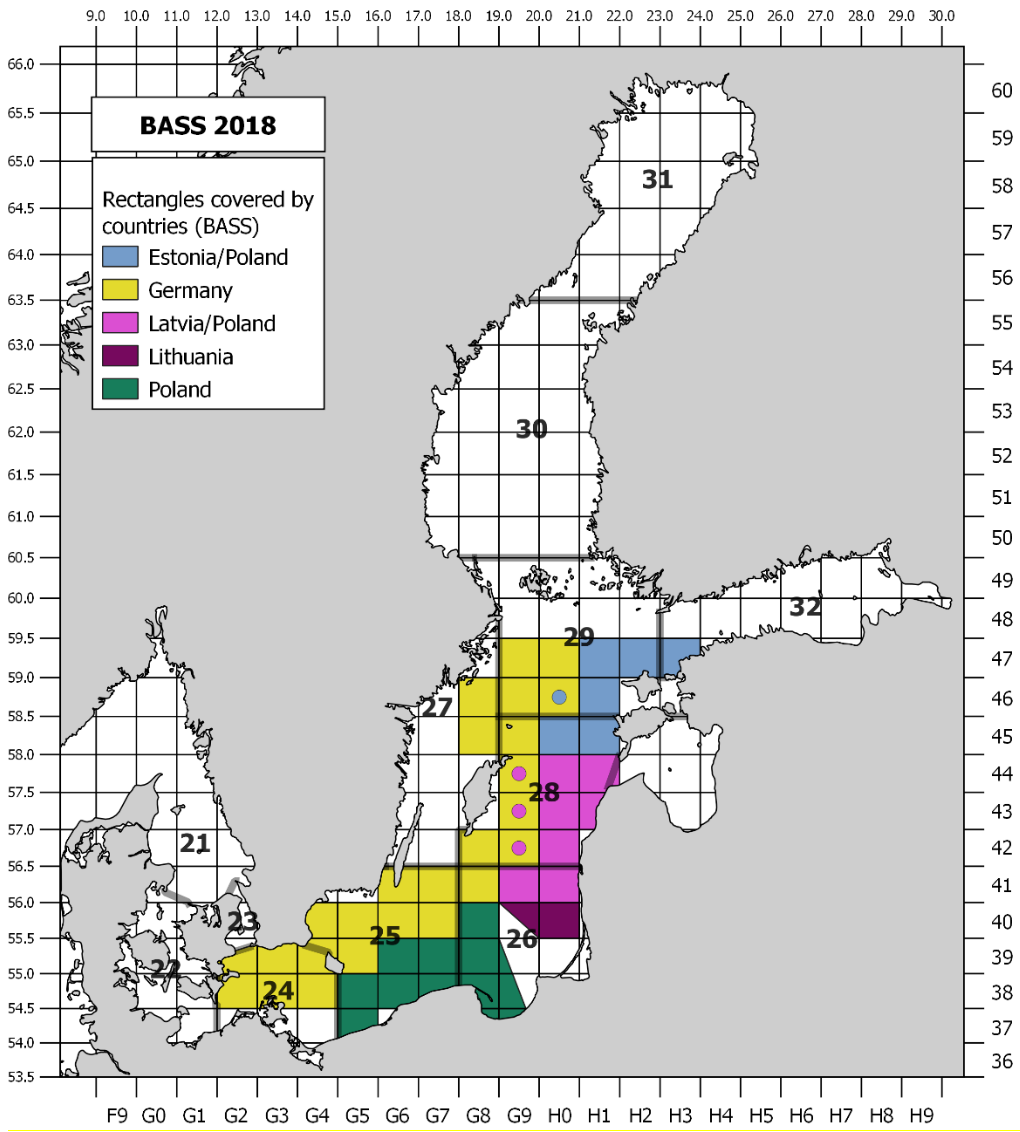


Figure 5.1.2.1.1. Map of the BASS survey conducted in May 2018. Various colours indicate the countries, which covered specific ICES rectangles and delivered data to the BASS-database, thus was responsible for this rectangle. Dot with different colour within a rectangle explain additional data in the BASS-database partly or totally covered by other countries.

5.1.2.2. Combined results and area corrected data

The geographical distribution of the sprat abundance per ICES rectangles monitored in May 2018 is demonstrated in Figure 5.1.2.2.1. The Baltic sprat stock abundance estimates per ICES rectangles and ICES subdivisions according to age groups are presented in Tables 5.1.2.2.1 and 5.1.2.2.2. 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 2016 are included.

In May 2018 sprat was very widely distributed in the Baltic Sea, it occurred in the each monitored ICES rectangle (Fig. 5.1.2.2.1). The highest sprat (age 1+) stock abundance was observed in the ICES SD 26 (the Gdansk Basin) and in the eastern part of the ICES SD 25.

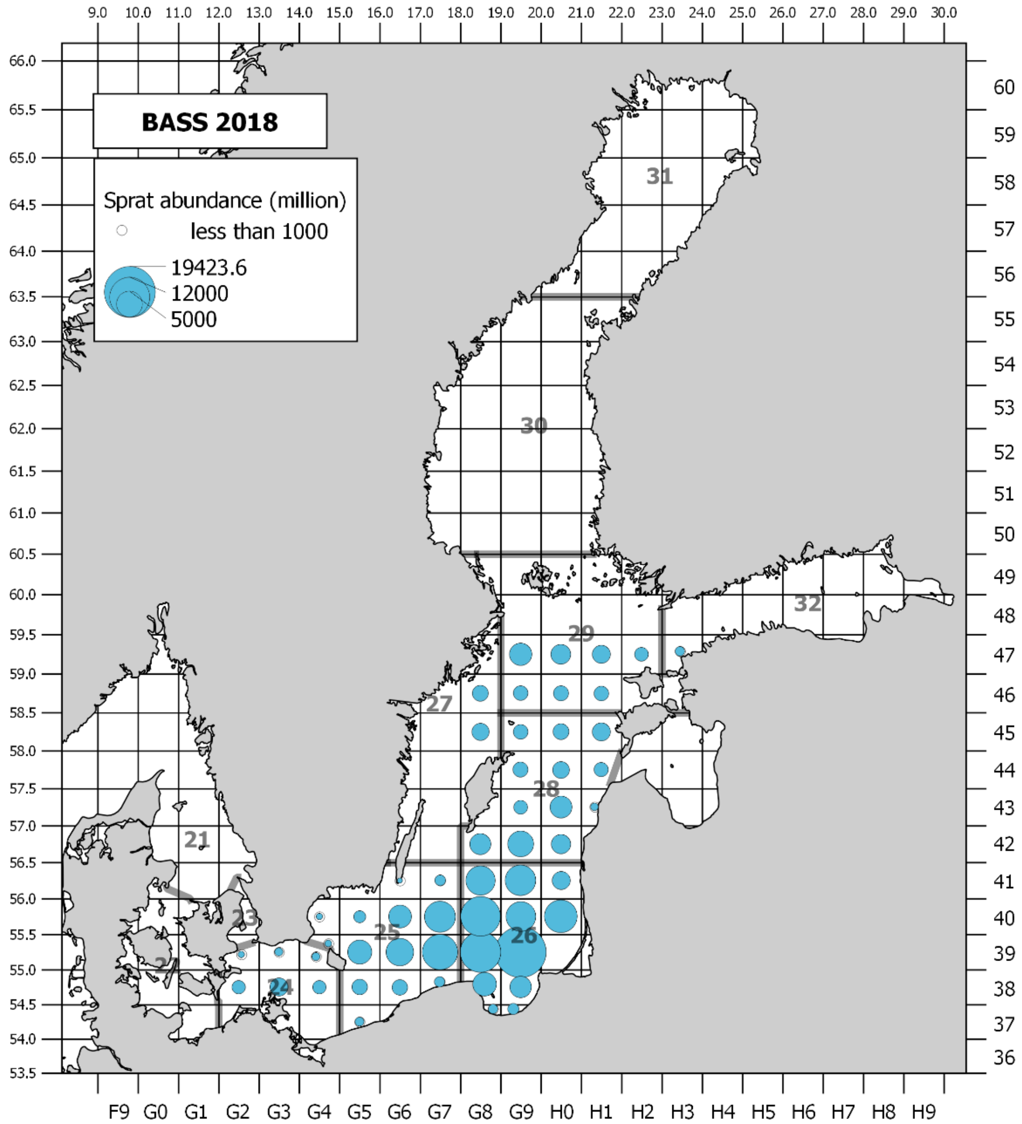


Figure 5.1.2.2.1. The abundance of sprat per ICES rectangles monitored in May 2018 (the area of circles indicates estimated numbers of specimens x10^6 in given rectangle).

Table 5.1.2.2.1. Estimated abundance (millions) of sprat in May 2018 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+
2018	24	38G2	1 343.73	387.92	471.53	277.23	185.77	14.15	3.58	3.26	0.29
2018	24	38G3	2 507.89	31.63	778.72	915.67	673.54	73.87	19.89	14.57	
2018	24	38G4	1 383.06	233.90	485.99	374.00	258.21	21.21	5.15	4.15	0.45
2018	24	39G2	337.69	45.61	141.11	84.61	58.87	4.82	1.39	1.22	0.06
2018	24	39G3	534.59	27.89	221.38	159.19	113.72	8.42	2.18	1.81	
2018	24	39G4	509.90	55.32	209.86	140.11	94.43	6.73	1.85	1.52	0.08
2018	25	37G5	619.73	8.40	32.41	49.53	346.07	111.25	47.87	19.33	4.86
2018	25	38G5	1 867.26	79.58	125.52	273.23	1 137.36	178.63	42.61	24.16	6.16
2018	25	38G6	1 809.04		74.43	229.09	1 153.22	235.14	67.07	38.77	11.33
2018	25	38G7	824.88	1.98	29.13	94.47	514.14	120.67	39.48	19.36	5.65
2018	25	39G4	382.45	59.51	30.48	66.70	172.72	38.92	4.66	9.46	
2018	25	39G5	4 452.59	178.64	553.13	1 011.88	2 370.75	279.30	26.22	32.67	
2018	25	39G6	5 799.38	856.87	953.41	992.47	2 746.92	186.97	34.59	22.01	6.14
2018	25	39G7	9 450.20	3 545.88	1 663.11	1 185.35	2 937.51	111.54	2.16	4.10	0.54
2018	25	40G4	328.72	73.79	29.32	58.94	133.36	29.19	1.70	2.42	
2018	25	40G5	1 110.05	41.53	129.61	249.75	593.48	78.01	7.20	10.47	
2018	25	40G6	3 972.91	258.69	532.54	951.27	2 029.48	165.76	16.01	19.16	
2018	25	40G7	7 280.05	1 058.16	950.40	1 476.25	3 331.69	392.33	34.69	36.53	
2018	25	41G6	218.63	20.45	46.31	60.51	87.18	3.70	0.24	0.24	
2018	25	41G7	922.45	42.47	104.47	203.53	500.82	53.13	8.39	9.64	
2018	26	37G8	679.34	189.76	85.80	177.68	209.10	15.69	1.14	0.16	
2018	26	37G9	951.96	199.33	118.66	262.61	340.46	27.54	2.65	0.72	
2018	26	38G8	4 352.00	407.63	570.86	1 430.58	1 784.72	143.07	13.41	1.75	
2018	26	38G9	3 559.97	471.31	382.04	1 062.57	1 484.12	138.78	17.18	3.97	
2018	26	39G8	12 303.66	2 000.00	1 256.07	3 800.47	4 782.26	407.39	49.51	7.96	
2018	26	39G9	19 423.58	1 893.01	2 398.25	6 366.34	8 010.92	661.01	82.88	11.18	
2018	26	40G8	12 015.43	447.15	2 293.62	3 856.53	4 947.24	416.17	49.88	4.84	
2018	26	40G9	6 730.63	667.68	815.29	1 058.02	2 151.72	1 299.46	531.27	149.00	58.18
2018	26	40H0	8 202.82	3 580.06	620.73	1 033.78	1 699.39	616.24	327.27	257.43	67.91
2018	26	41G8	6 458.11	135.68	1 502.48	1 957.80	2 728.56	119.28			14.31
2018	26	41G9	7 216.64	1 219.27	1 202.41	980.60	3 379.61	147.33	102.03	41.13	144.26
2018	26	41H0	2 490.29	234.00	201.61	420.47	1 338.75	102.14	100.04	30.52	62.75
2018	27	45G8	2 244.93	321.88	553.80	639.89	685.57	35.52	5.84	1.62	0.81
2018	27	46G8	2 001.68	230.54	520.12	579.68	632.78	31.37	3.90	1.16	2.13
2018	28_2	42G8	3 411.91	179.81	528.51	718.25	1 879.39	55.43	32.39	8.10	10.03
2018	28_2	42G9	5 148.83	294.55	1 166.45	934.99	2 711.94	19.41	14.33	3.58	3.58
2018	28_2	42H0	2 942.57	1 107.97	258.29	297.16	1 080.33	92.71	64.22	28.94	12.94
2018	28_2	43G9	1 476.79	64.98	355.90	267.18	782.03	4.28	1.62	0.40	0.40
2018	28_2	43H0	3 685.60	444.71	481.20	652.05	1 727.62	189.65	72.57	59.72	58.09
2018	28_2	43H1	474.20	400.18	6.94	13.88	41.64	9.25	2.31		
2018	28_2	44G9	1 776.52	141.38	438.51	300.38	888.72	4.69	1.52	0.38	0.94
2018	28_2	44H0	2 123.49	792.46	333.93	159.71	723.73	35.70	26.23	10.25	41.49
2018	28_2	44H1	1 584.07	982.88	90.93	165.16	279.91	8.73	24.58	16.70	15.18
2018	28_2	45G9	1 699.73	104.98	398.18	313.87	874.35	5.57	1.47	0.37	0.94
2018	28_2	45H0	1 923.68	789.66	225.77	173.75	628.54	41.11	21.75	20.47	22.62
2018	28_2	45H1	2 518.60	1 579.24	178.66	146.03	517.82	37.16	16.58	18.45	24.66
2018	29	46G9	1 646.50	110.17	261.13	442.30	786.21	35.29	4.73	6.32	0.35
2018	29	46H0	1 803.95	149.07	248.32	448.61	883.68	51.08	11.59	9.94	1.66
2018	29	46H1	1 632.31	562.89	82.44	115.42	645.19	76.27	49.83	46.39	53.87
2018	29	47G9	3 862.17	537.65	550.57	937.13	1 708.13	92.73	17.16	17.37	1.43
2018	29	47H0	3 051.62	194.98	429.77	826.95	1 460.71	100.99	17.21	18.88	2.13
2018	29	47H1	2 483.92	974.69	156.70	173.67	1 016.36	72.99	29.14	28.08	32.30
2018	29	47H2	1 426.33	403.34	70.17	107.67	636.92	64.94	45.58	45.59	52.12
2018	32	47H3	715.55	134.71	63.32	81.86	326.46	34.62	21.49	23.59	29.51

Table 5.1.2.2.2. Estimated numbers of sprat (millions) by ICES subdivisions, according to age groups (May 2018).

ANNUS	Sub_Div	AGE1	AGE2	AGE3	AGE4	AGE5	AGE6	AGE7	AGE8
2018	24	782.27	2 308.59	1 950.81	1 384.54	129.20	34.04	26.53	0.88
2018	25	6 225.95	5 254.28	6 902.97	18 054.70	1 984.54	332.89	248.31	34.69
2018	26	11 444.89	11 447.81	22 407.45	32 856.85	4 094.11	1 277.25	508.65	347.42
2018	27	552.42	1 073.92	1 219.57	1 318.35	66.89	9.74	2.78	2.94
2018	28_2	6 882.80	4 463.27	4 142.41	12 136.03	503.69	279.56	167.36	190.87
2018	29	2 932.79	1 799.10	3 051.75	7 137.20	494.29	175.24	172.58	143.86
2018	32	134.71	63.32	81.86	326.46	34.62	21.49	23.59	29.51

5.1.2.2.1. 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 5.1.2.2.1.1. The corresponding biomass estimates of sprat are given in the Table 5.1.2.2.1.2. The complete time-series (2001 - 2018) of the area-corrected sprat abundance in the ICES Subdivisions 24, 25 26 and 28_2 is given in the Table 5.1.2.2.1.3.

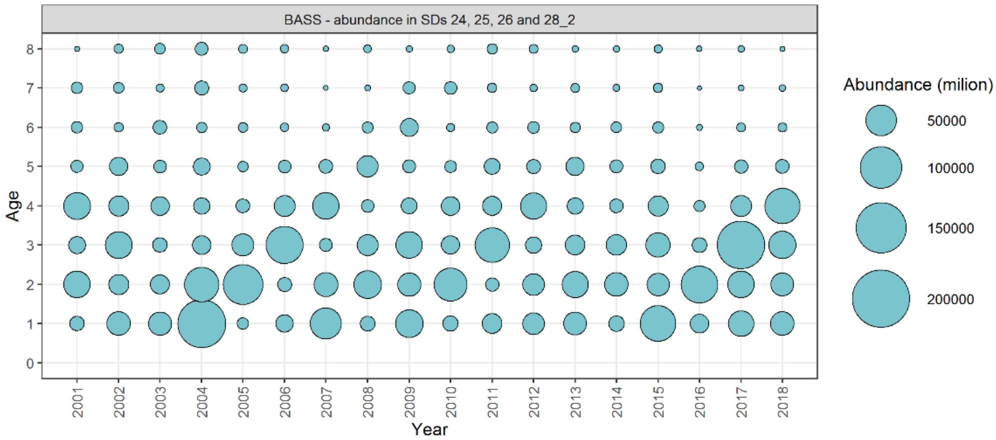


Figure 5.1.2.2.1.1. Spring (BASS) tuning fleet index (abundance per age groups and years 2001-2018) for sprat in the ICES Subdivisions 24, 25, 26 and 28_2.

Table 5.1.2.2.1.1. Area corrected numbers (millions) of sprat by ICES subdivisions and age groups (May 2018).

ANNUS	Sub_Div	AREA_CORR_FACTOR	AGE1	AGE2	AGE3	AGE4	AGE5	AGE6	AGE7	AGE8+
2018	24	1.28	1 000.42	2 952.39	2 494.83	1 770.65	165.23	43.53	33.93	1.13
2018	25	1.03	6 425.11	5 422.35	7 123.79	18 632.25	2 048.02	343.54	256.26	35.80
2018	26	1.10	12 615.85	12 619.07	24 700.02	36 218.52	4 512.99	1 407.93	560.69	382.97
2018	27	4.25	2 347.12	4 562.87	5 181.71	5 601.40	284.20	41.38	11.81	12.49
2018	28_2	1.04	7 167.48	4 647.87	4 313.74	12 637.97	524.52	291.13	174.28	198.77
2018	29	1.61	4 727.15	2 899.84	4 918.89	11 503.94	796.71	282.46	278.16	231.88
2018	32	13.98	1 883.56	885.29	1 144.51	4 564.56	484.05	300.50	329.83	412.65

Table 5.1.2.2.1.2. Corrected sprat biomass (in tonnes) according to ICES subdivisions and age groups (May 2018).

ANNUS	Sub_Div	AREA_CORR_FACTOR	AGE1	AGE2	AGE3	AGE4	AGE5	AGE6	AGE7	AGE8+
2018	24	1.28	6297.44	38656.60	39374.79	29414.42	3396.03	944.95	725.38	26.73
2018	25	1.03	25805.37	47652.23	72789.50	205456.56	27662.64	5386.29	3915.84	554.50
2018	26	1.10	41616.92	97613.52	218057.54	335556.43	45433.64	15700.74	6287.84	4488.02
2018	27	4.25	7262.21	34408.34	45836.04	51228.21	3337.94	534.09	160.99	179.22
2018	28_2	1.04	22644.63	35848.13	37571.23	109105.11	5487.79	3141.76	1870.57	2183.61
2018	29	1.61	13469.76	21927.00	41234.91	95341.51	8249.62	3111.92	2942.51	2438.26
2018	32	13.98	4888.13	6806.75	8754.52	36960.98	4823.56	3001.34	2843.83	4386.84

Table 5.1.2.2.1.3. *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

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

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

5.2 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 2018 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 2019 SharePoint.

Before the WGBIFS 2019 meeting the errors in BIAS_DB.mdl access-database in queries 149_B_Report_SD_AREA_COR and 649_B_Report_SD_AREA_COR were found. In query 149_B_Report_SD_AREA_COR (which calculates corrected SPRAT biomass per SD) the herring mean weights were used in calculations and vice versa, in query 649_B_Report_SD_AREA_COR (which calculates corrected HERRING biomass per SD) the sprat mean weights were used. The algorithms in both queries were corrected just before the meeting.

Errors in reported cod abundance in some rectangles were found during WGBIFS-2019 meeting (Table 5.1.1.2.3 calculated by query '902_Report_COD per_rect' in BIAS_DB.mdl access-database). All values of cod abundance were checked and corrected – all corrected values are marked by red in table 5.1.1.2.3 in this report). Shortly after meeting the algorithm in query '902_Report_COD per_rect' was corrected and improved BIAS_DB.mdl access-database was uploaded in the folder "Data" of the ICES WGBIFS 2019 SharePoint. In Table 5, there has been found one inconsistency with table generated by BASS_DB.mdl access-databases (query 110). The value for sprat age 1 in 2002 reported in Table 5 in WGBIFS 2018 report was 27412.12 and it changed to 27412.11 in this report.

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 and N. Larson from Sweden 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 from Poland 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, before the next WGBIFS meeting the acoustic-trawl data from BIAS and BASS surveys should be uploaded also to the database for Acoustic trawl surveys in the ICES data portal (http://ices.dk/marine-data/data-portals/Pages/acoustic.aspx). Furthermore, O. Kaljuste (Sweden) and J. Lilja (Finland) were assigned as the data coordinators of the acoustic-trawl data in the ICES data portal.

Annex: ToR c) Plan and decide on acoustic surveys to be conducted in autumn 2019 and spring 2019-2020

5.3.1. Planned acoustic survey activities

All the Baltic Sea countries intend to take part in the autumn BIAS acoustic surveys and experiments in 2019 (Fig. 5.3.2). Germany, Lithuania, Poland, Latvia and Estonia intend to take part in the BASS surveys in May 2019 and 2020 (Figs. 5.3.1 and 5.3.3). Russia is not planning to participate in these BASS surveys. There is also an intention to conduct a Latvian/Estonian survey on the Gulf of Riga in July 2019 and 2020. The list of participating research vessels and initially planned periods of particular surveys are given in the following tables:

BASS/2019 surveys

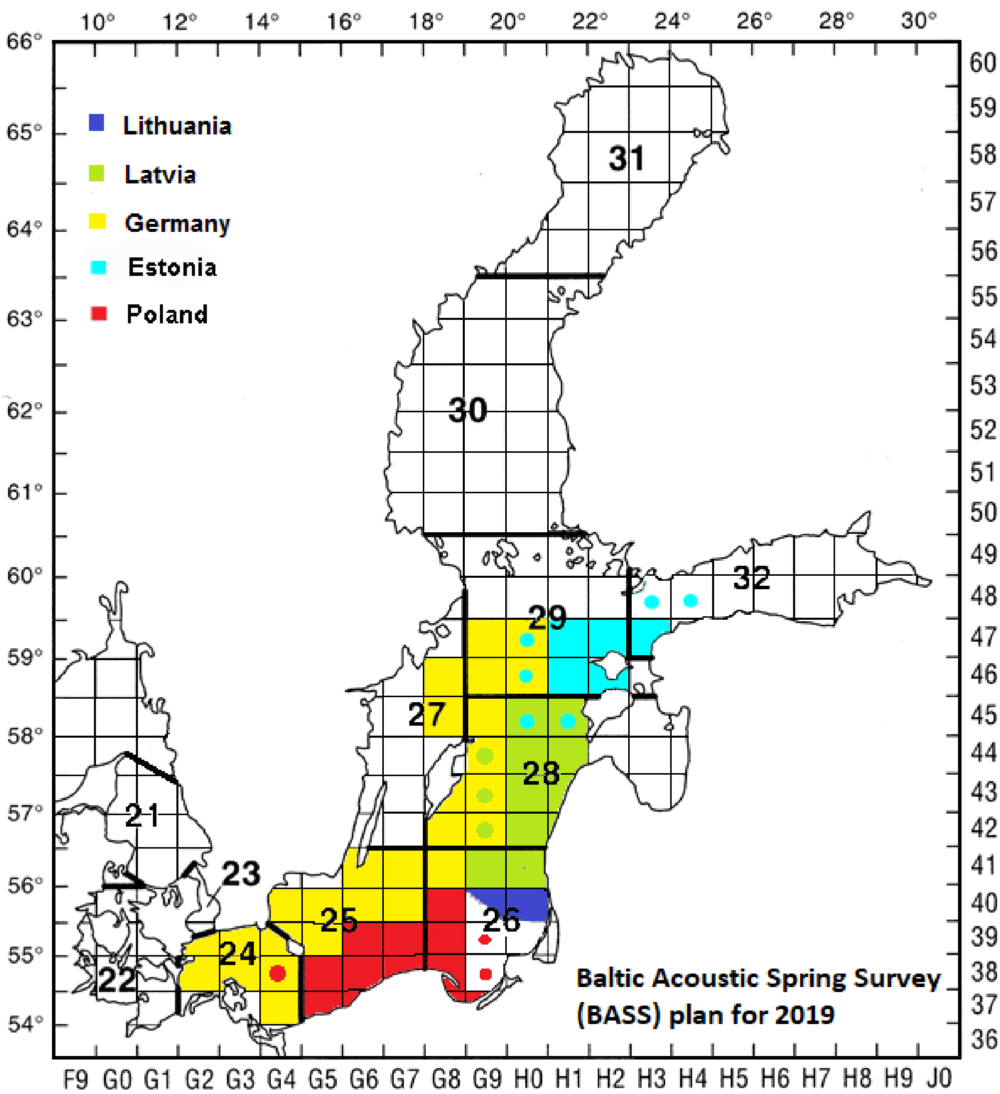
Vessel	Country	Area of Investigation (ICES Subdivisions)	(Preliminary) Period of Investigations	Duration (Days)
Solea	Germany	24, 25, 26, 27, 28 (part), 29S	03-28.05.2019	25
Baltica	Latvia/Poland	26N, 28 (part)	18-25.05.2019	8
Baltica	Estonia/Poland	28N, 29E	26-31.05.2019	6
unknown	Lithuania	26 (the Lithuanian EEZ)	07-08.05.2019	2
Baltica	Poland	24 (part), 25, 26 (in the Polish EEZ)	02-13.05.2019	13

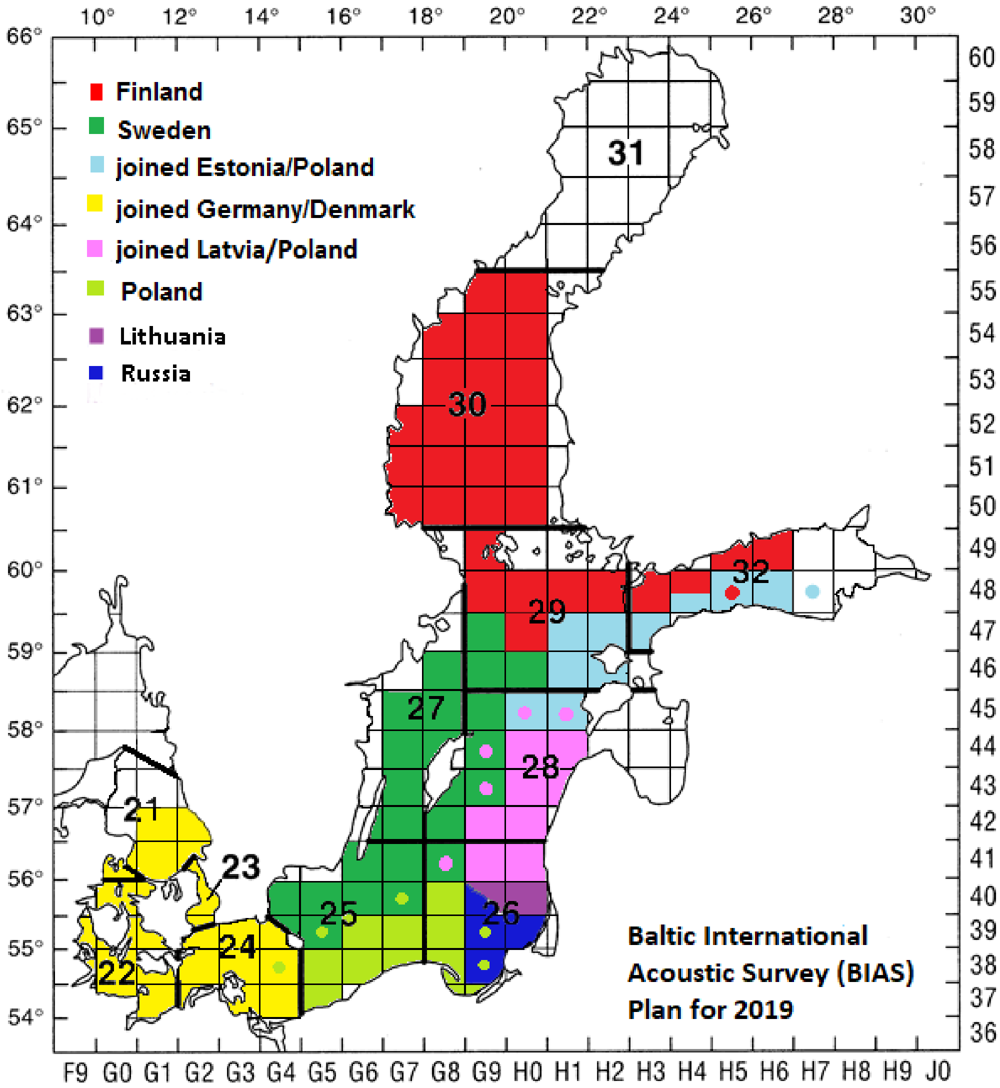
BIAS/2019 surveys

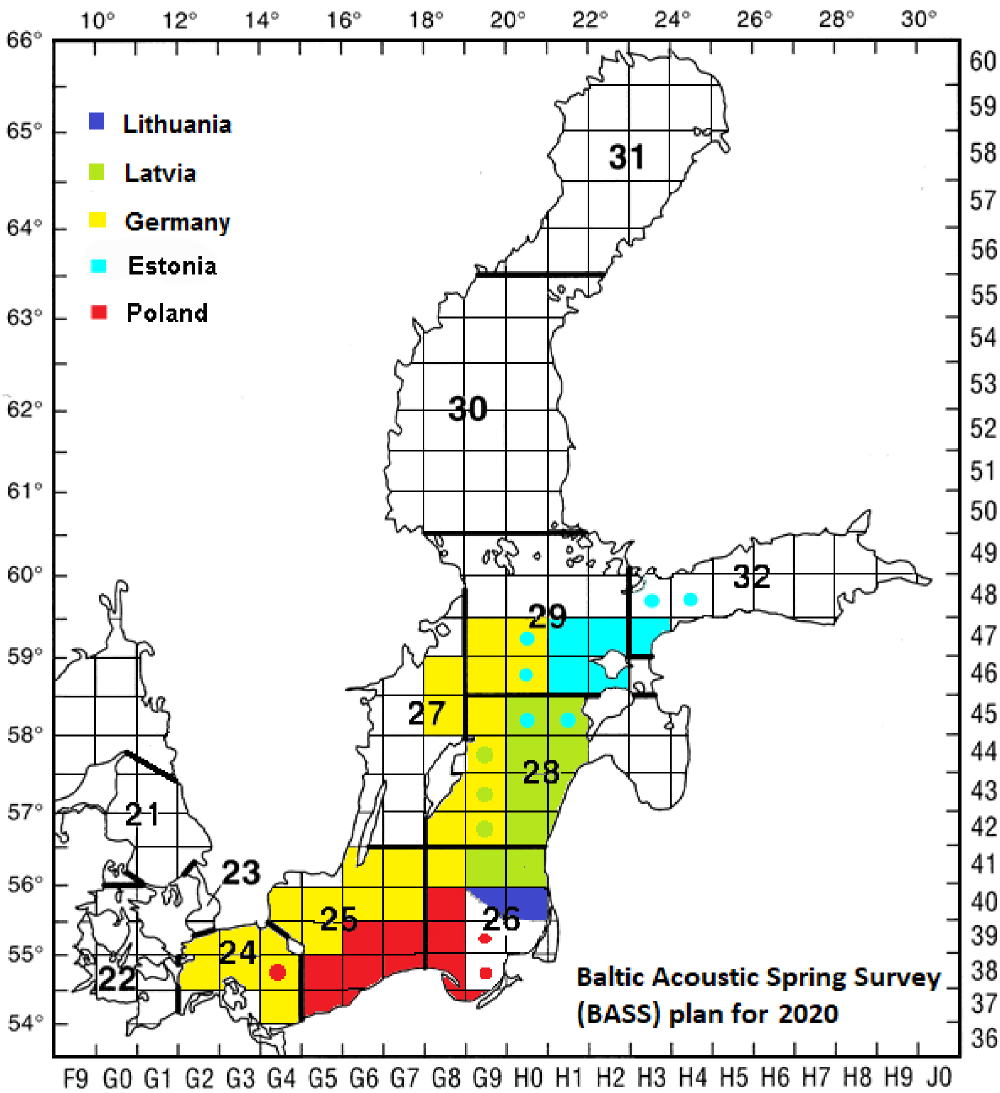
Vessel	Country	Area of Investigation (ICES Subdivisions)	(Preliminary) Period of Investigations	Duration (Days)
Solea	Germany	21, 22, 23, 24	01-21.10.2019	21
unknown	Lithuania	26 (the Lithuanian EEZ)	08-09.10.2019	2
Baltica	Latvia/Poland	26N, 28 (part)	11-20.10.2019	10
Baltica	Poland	24(part), 25, 26 (in the Polish EEZ)	15-30.09.2019	16
Svea	Sweden	25, 26, 27, 28, 29	Calibration: 22-28.10.2019 Survey: 01-20.10.2019	7 20
Baltica	Estonia/Poland	28N, 29E, 32S	21-31.10.2019	11
Aranda	Finland	29N, 30, 32N	25.09.- 09.10.2019	14
AtlantNIRO or Atlantida	Russia	26 (the Russian EEZ)	04-18.10.2019	15

BASS/2020 surveys

Vessel	Country	Area of Investigation (ICES Subdivisions)	(Preliminary) Period of Investigations	Duration (Days)
Solea	Germany	24, 25, 26, 27, 28 (part), 29S	May 2020	25
Baltica	Poland	24(part), 25, 26 (in the Polish EEZ)	May 2020	13
Baltica	Estonia/Poland	28N, 29	May 2020	6
Baltica	Latvia/Poland	26(part), 28(part)	May 2020	9
unknown	Lithuania	26 (the Lithuanian EEZ)	May 2020	2




Finland
Sweden
joined Estonia/Poland
joined Germany/Denmark
joined Latvia/Poland
Poland
Lithuania
Russia
Baltic International
Acoustic Survey (BIAS)
Plan for 2019
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 J0
21 22 23 24 25 26 27 28 29 30 31 32



Figures 5.3.1–5.3.3. The planned coverage of the Baltic Sea and the assignment of the national/joint acoustic surveys to the ICES rectangles during the May 2019, September/October-2019 and May 2020 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).

Annex: ToR d) Discuss the results from BITS surveys performed in autumn 2018 and spring 2019 and evaluate the characteristics of TVL and TVS standard gears used in BITS

5.4.1 BITS 4th quarter 2018

During quarter 4th BITS in 2018, the level of realized valid hauls represented 102% of the total planned stations (Figure 5.4.1.1). The number of 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, 100; 2, 83.6; 3, 94.5; 4, 117.8; 5, 131.3 and 6, 128.6). Again, the lower coverage in depth strata 2 and 3 were induced by the restrictions by the Swedish military preventing sampling in south-eastern part of Swedish waters.

Russia did not perform neither the spring survey 2019 nor the autumn survey 2018 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 Baltic and Kattegat cod and flatfish stocks.

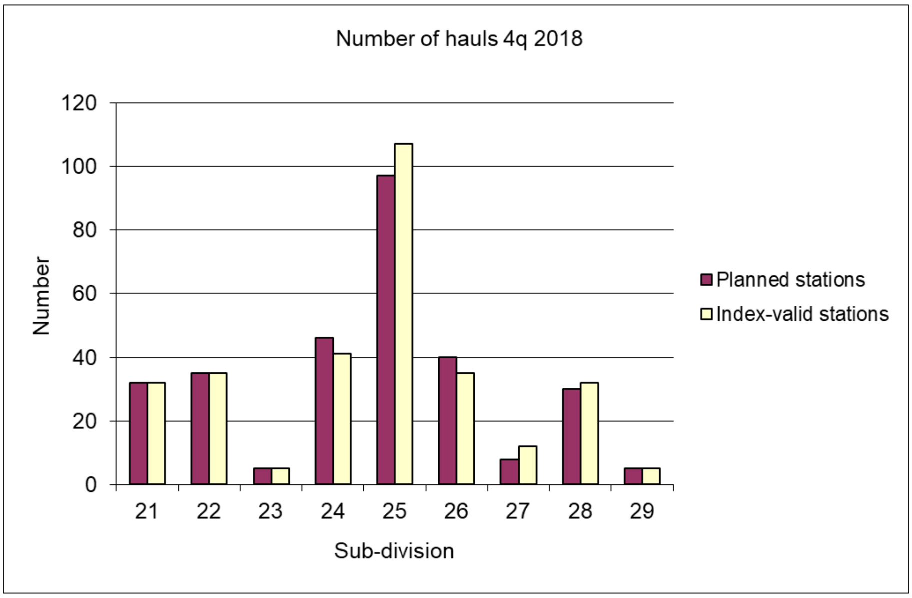


Figure 5.4.1.1. Comparison of the planned and the index-valid fishing stations by ICES Subdivisions and depth layers during BITS 4th quarter 2018.

5.4.2 BITS 1st quarter 2019

The overall coverage in this quarter is 97% (Figure 5.4.2.1). The coverage by depth stratum is (depth stratum, coverage %): 1, 100; 2, 95.5; 3, 92.6; 4, 101.9; 5, 81.1; 6, 162.5. The depth stratum 2 and 3 has significantly lower coverage because of the stations in the south-eastern Swedish waters which were not performed due to abrupt termination of the survey resulting from sickness on board of the RV „Solea“.

The number of valid hauls accomplished during the BITS-Q1/2019 was considered by WGBIFS 2019 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.

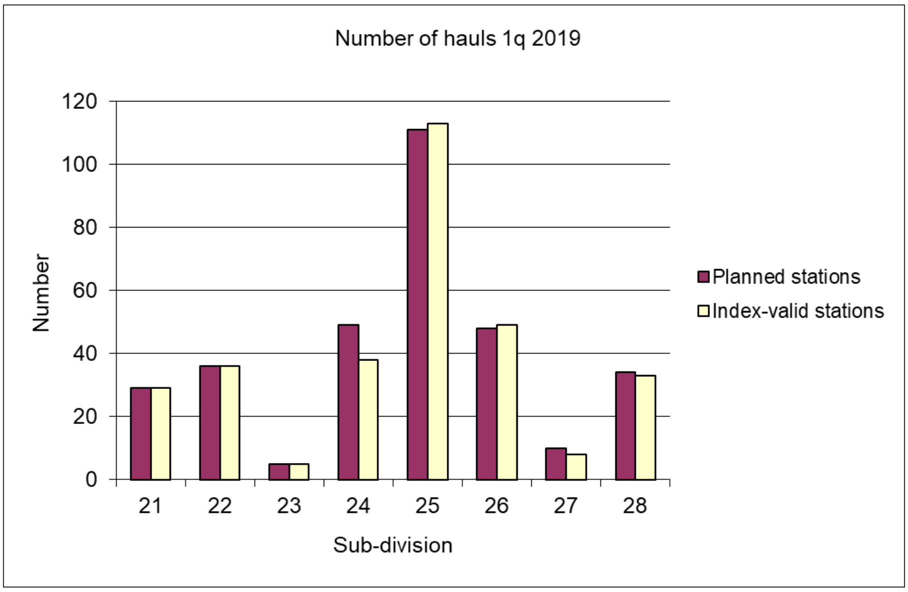


Figure 5.4.2.1. Comparison of the planned and the index-valid fishing stations by ICES Sub-divisions and depth layers during BITS 1q 2019.

5.4.3 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 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 2019. Poland has not made measurements of standard gear parameters due to time constrains resulting from the very intensive sea exploitation of the RV "Baltica" in different projects. The same refers to Latvia as the fishing gear and vessel is chartered by the Latvian Institute BIOR. Presented reports did not show any values, which were outside of the acceptable percentage deviation from the standard reference values of the two trawls. All reports can be found in WGBIFS SharePoint. One example of filled report of the standard bottom fishing gear-checking is given below in Table 5.4.3.1.

Table 5.4.3.1. Results of the Lithuanian (FV "LBB-1010") bottom, standard fishing gear-checking exercise.

Table 2. Check list for trawl and for frame ropes of trawl		Country:	Year:	Quarter:	Date:	Remarks:
Tag no. TV3-520 #	Trawl no./name:	LTU	2018	4	06.11.2018	

Check list for trawl TV3-520 #

Section	Manual TV3-520 # page 42	Standard			Tag no. TV3-520 # -				Relative error [%]		Remarks
		Measured distance [m]	Mesh size [mm]	Number of meshes	Measured distance [m]	Mesh size [mm]	Mesh size	Number of meshes	Mesh size [mm]	Number of meshes	
1	1B1	**8,22**	**120**	**69**	8,2	**120**	120	68,3	0,0	-0,2	
	1A1	**8,10**	**200**	**41**	8	**200**	200	40,0	0,0	-1,2	
	1A2	**8,10**	**200**	**41**	8	**200**	200	40,0	0,0	-1,2	
	1B2	**8,22**	**120**	**69**	8,2	**120**	120	68,3	0,0	-0,2	
	1C1	**8,28**	**120**	**69**	8,2	**120**	120	68,3	0,0	-1,0	
	1C2	**8,28**	**120**	**69**	8,2	**120**	120	68,3	0,0	-1,0	
2	2B1	**2,04**	**80**	**26**	2,05	**80**	80	25,6	0,0	0,5	
	2A	**2,04**	**120**	**17**	2	**120**	120	16,7	0,0	-2,0	
	2B2	**2,04**	**80**	**26**	2,05	**80**	80	25,6	0,0	0,5	
	2C1	**2,12**	**80**	**27**	2,1	**80**	80	26,3	0,0	-0,9	
	2C2	**2,12**	**80**	**27**	2,1	**80**	80	26,3	0,0	-0,9	
3	3B1	**1,96**	**80**	**25**	2	**80**	80	25,0	0,0	2,0	
	3A	**1,96**	**80**	**25**	1,95	**80**	80	24,4	0,0	-0,5	
	3B2	**1,96**	**80**	**25**	2	**80**	80	25,0	0,0	2,0	
	3C	**2,12**	**80**	**27**	2,1	**80**	80	26,3	0,0	-0,9	
4	4B1	**7,92**	**80**	**99**	7,8	**80**	80	97,5	0,0	-1,5	
	4A	**7,92**	**80**	**99**	7,8	**80**	80	97,5	0,0	-1,5	
	4B2	**7,92**	**80**	**99**	7,9	**79**	79	100,0	-1,3	1,0	
	4C	**8,00**	**80**	**100**	8	**82**	82	97,6	2,5	-2,4	
5	5B1	**3,96**	**80**	**50**	3,95	**80**	80	49,4	0,0	-1,3	
	5A	**3,96**	**80**	**50**	3,95	**80**	80	49,4	0,0	-1,3	
	5B2	**3,96**	**80**	**50**	3,95	**80**	80	49,4	0,0	-1,3	
	5C	**4,00**	**80**	**50**	3,92	**80**	80	49,0	0,0	-2,0	
6	6B1	**3,92**	**80**	**50**	3,9	**80**	80	48,8	0,0	-2,5	
	6A	**3,92**	**80**	**50**	3,9	**81**	81	48,1	1,3	-3,7	
	6B2	**3,92**	**80**	**50**	3,9	**80**	80	48,8	0,0	-2,5	
	6C	**3,96**	**80**	**50**	4	**82**	82	48,8	2,5	-2,4	
Codend			**40**			**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 TV3-520 #

Manual TV3-520 # page 43	Measured distance [m]		Remarks
	Standard	TV3-520 #	
Head line extension Port.	**3,00**	3	
Head line extension Stbd.	**3,00**	3,00	
Head line wing section Port.	**12,68**	12,7	
Head line wing section Stbd.	**12,68**	12,70	
Head line bosom section	**2,80**	2,8	
Fishing line extension Port.	**0,80**	0,8	
Fishing line extension Stbd.	**0,80**	0,8	
Fishing line wing section Port.	**14,41**	14,4	
Fishing line wing section Stbd.	**14,41**	14,4	
Fishing line bosom section	**2,80**	2,8	
Lower wing line Port.	**3,73**	3,7	
Lower wing line Stbd.	**3,73**	3,7	
Upper wing line Port.	**3,83**	3,8	
Upper wing line Stbd.	**3,80**	3,8	

Type of fishing gear:	TV3-520 #
Nation:	LTU
Date of measurements:	20.02.2018
Name of operators:	Marijus Spegys
Number of realized hauls:	6
Comments concerning the use:	

Annex: ToR e) Plan and decide on demersal trawl surveys and experiments to be conducted in autumn 2019 and spring 2020, and update, and correct the Tow-Database and DATRAS

5.5.1. Plan and decide on demersal trawl surveys and experiments

The most of the participating institutes plan the same numbers of hauls during BITS surveys in autumn 2019 and spring 2020 as in the year before. The total number of stations committed by the countries and available is given in Table 5.5.1.1.

Table 5.5.1.1. Total numbers of catch-stations planned by particular country during BITS in autumn 2019 and spring 2020.

COUNTRY	VESSEL	NUMBER OF PLANNED STATIONS IN AUTUMN 2019	NUMBER OF PLANNED STATIONS IN SPRING 2020
Denmark	Havfisken	21	21
	Total 21	**21**	**21**
Germany	Solea	57	60
Denmark	Havfisken	27	27
Poland	Baltica	3	5
	Total 22 + 24	**87**	**92**
Denmark	Dana	55	55
Estonia	Commercial vessel	5*	0
Finland	Aranda	0	0
Latvia	Chartered vessel	25	25
Lithuania	Chartered vessel	6	6
Poland	Baltica	57	64
Russia	Atlantniro/Atlantida	0	0
Sweden	Svea	50	50
	Total 25 - 28	**198**	**200**
	Total 22 - 28	**285**	**292**

* Only in Estonian EEZ.

WGBIFS acknowledges that Russia re-established its participation in BITS surveys in 2020. However, according to preliminary information from the Member Country, the participation of Russia in the BITS surveys in spring 2020 cannot be confirmed yet. Since other ICES Member Countries will not be able to get permission to work in the EEZ of Russia, the negative effect on the quality of the survey results based on BITS survey would be eminent.

5.5.2. Update and correct the Tow-Database

Feedbacks of the recent BITS surveys (Q4 2018 and Q1 2019) were used to update the Tow-Database (TD). Changes of the TD structure were not proposed. The current used structure of the TD was described in the WGBIFS 2005 report and in the BITS Manual.

The following changes have been made to the TD based on input from users:

- One haul was deleted from the database because it was situated in a dumping area.
- Another haul was deleted because it was identical to another haul in TD.
- In four tracks the depth were adjusted
- In six tracks the positions were adjusted.
- One new track was added to the database.

Furthermore, the TD is still subject to continuous clean-up of the structure and minor mistakes discovered during working with the database.

More than 95% of the stations, which are stored in the Tow Database, have already successfully been used at least one time. On the other hand, trawls were damaged at stations, which were already successfully used at least one time. Those hauls were further used in the Tow Database, but the datasets are marked. The stations are deleted if similar problems were found during the next surveys.

It is necessary that all countries submit the feedback according to the instructions given in the action list (Annex 5). The structure of required feedback is demonstrated in Table 8.1.1 in the WGBIFS 2014 report.

5.5.3. Reworking of the Database of Trawl Surveys (DATRAS)

During the WGBIFS 2019, meeting no any essential changes of the data in the Database of Trawl Surveys (DATRAS) was made.

Annex: 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 the WGBIFS meeting 2016 it was decided that a bootstrap method should be used to present the survey sampling variance. The method was based on recalculations of the survey results by resampling of acoustic data and trawl hauls. On the workshop WKSDO "Workshop on Sampling Design and Optimization" in Lysekil, Sweden, the method was discussed with Jon Helge Vølstad and Mary Christman and they suggested to do a bootstrap on the survey results from the covered area. At 2017 year's WGBIFS meeting the two bootstrapping methods was discussed and it was decided that WGBIFS should at first move forward and try to evaluate the results from the bootstrap method recommended at WKSDO. Below are the figures (5.6.1-5.6.8) produced at the WGBIFS meeting in Klaipeda 2019, which are based on the BIAS and BASS 2018 survey data.

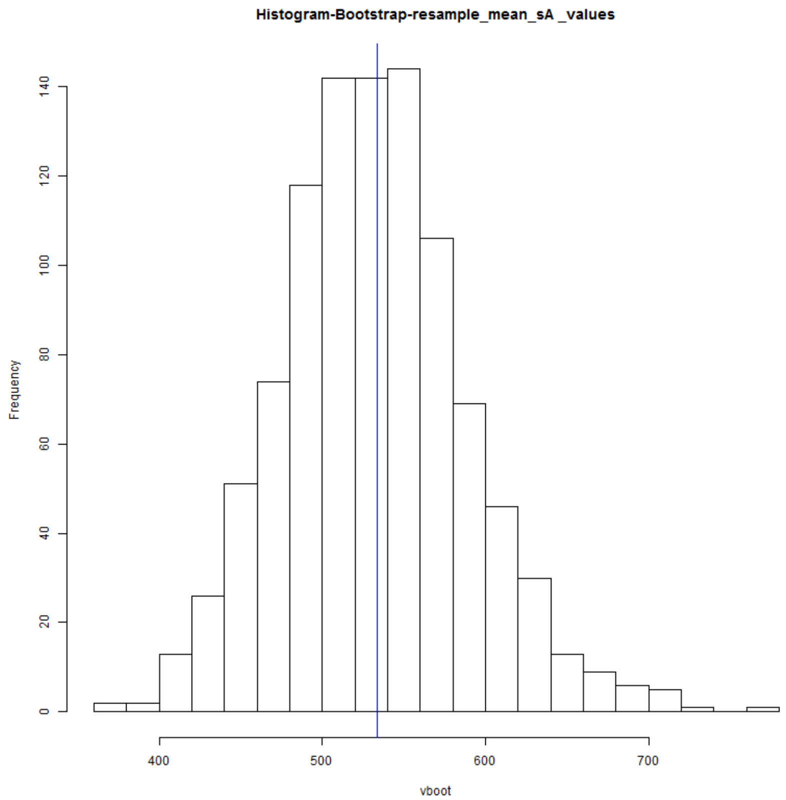


Figure 5.6.1 Histogram of bootstrap of mean sA value for BIAS 2018. Blue line is the original result from the survey.

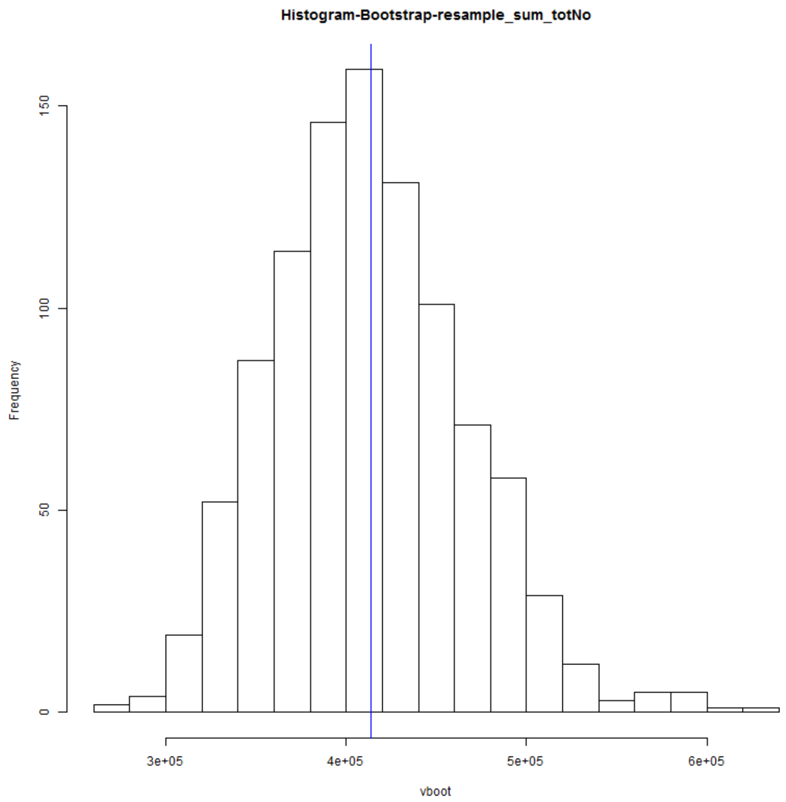


Figure 5.6.2 Histogram of bootstrap of sum of total numbers of fish for BIAS 2018. Blue line is the original result from the survey.

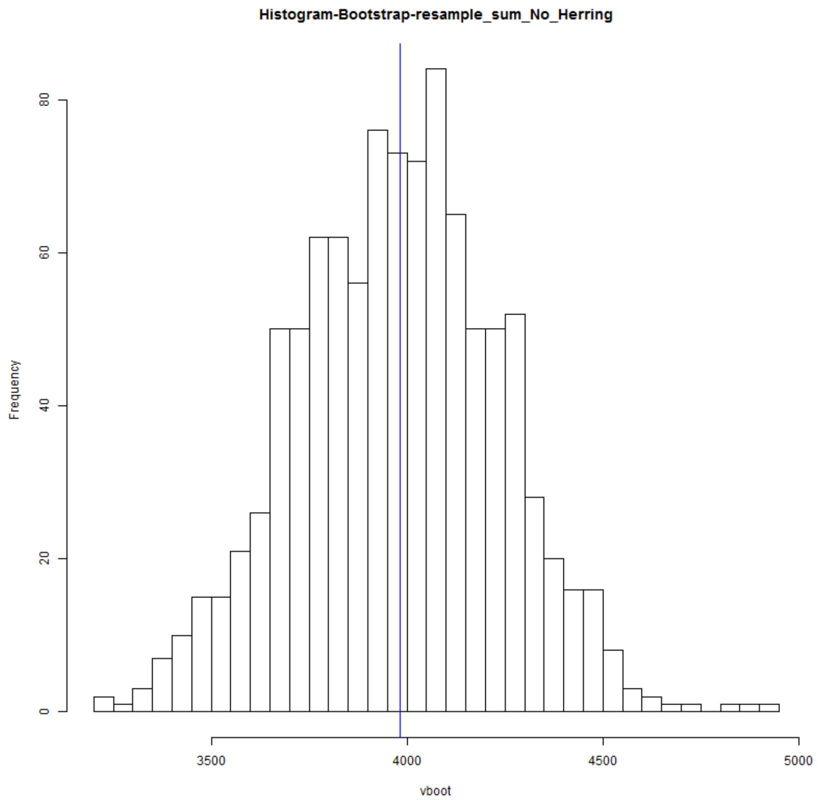


Figure 5.6.3 Histogram of bootstrap of Herring numbers for BIAS 2018. Blue line is the original result from the survey.

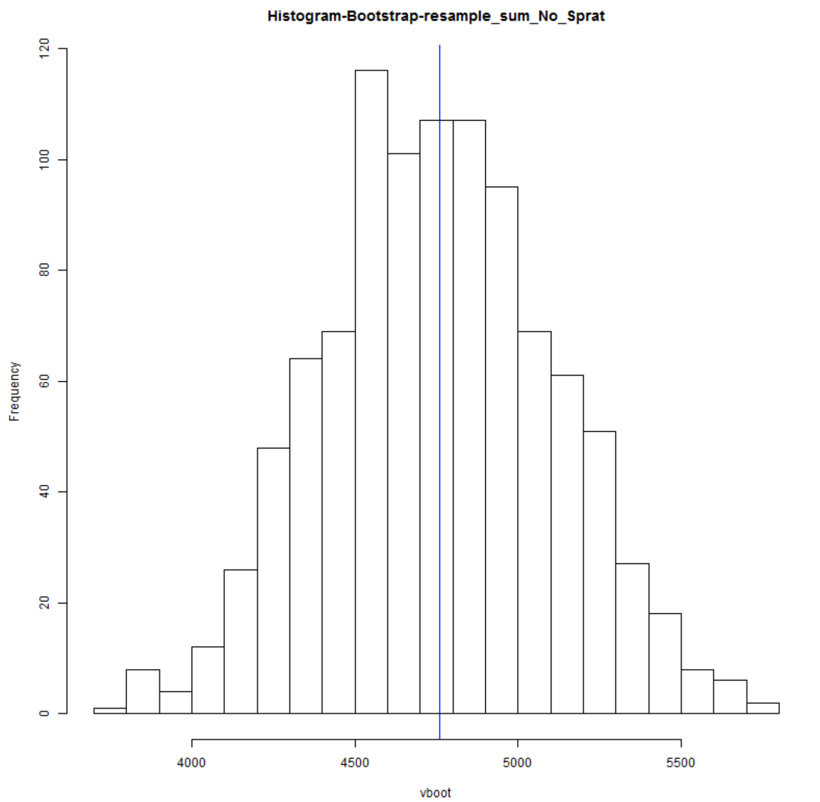


Figure 5.6.4 Histogram of bootstrap of Sprat numbers for BIAS 2018. Blue line is the original result from the survey.

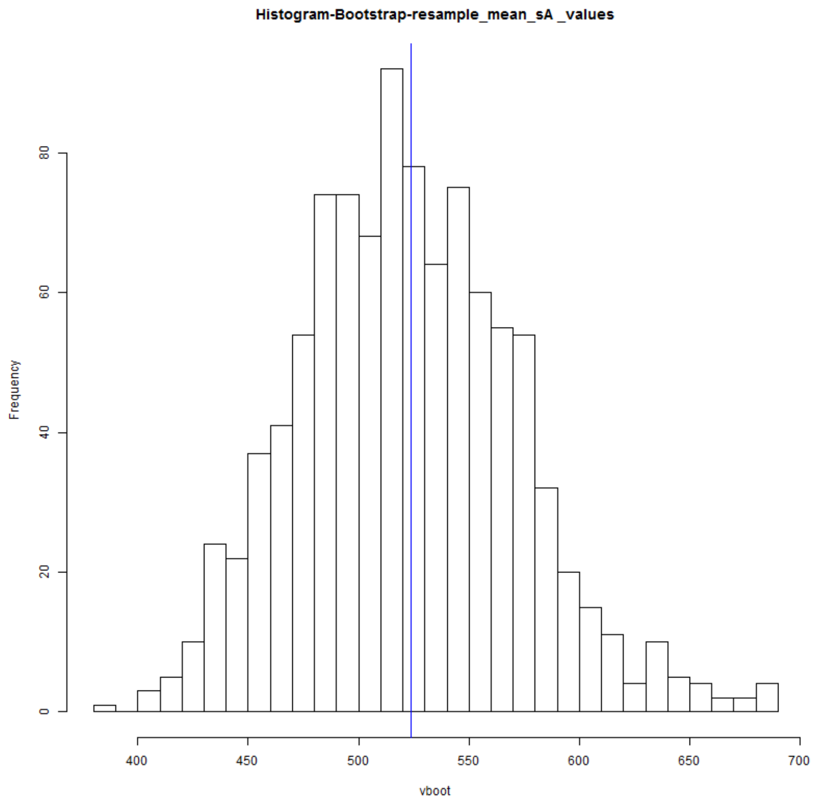


Figure 5.6.5 Histogram of bootstrap of mean sA value for BASS 2018. Blue line is the original result from the survey.

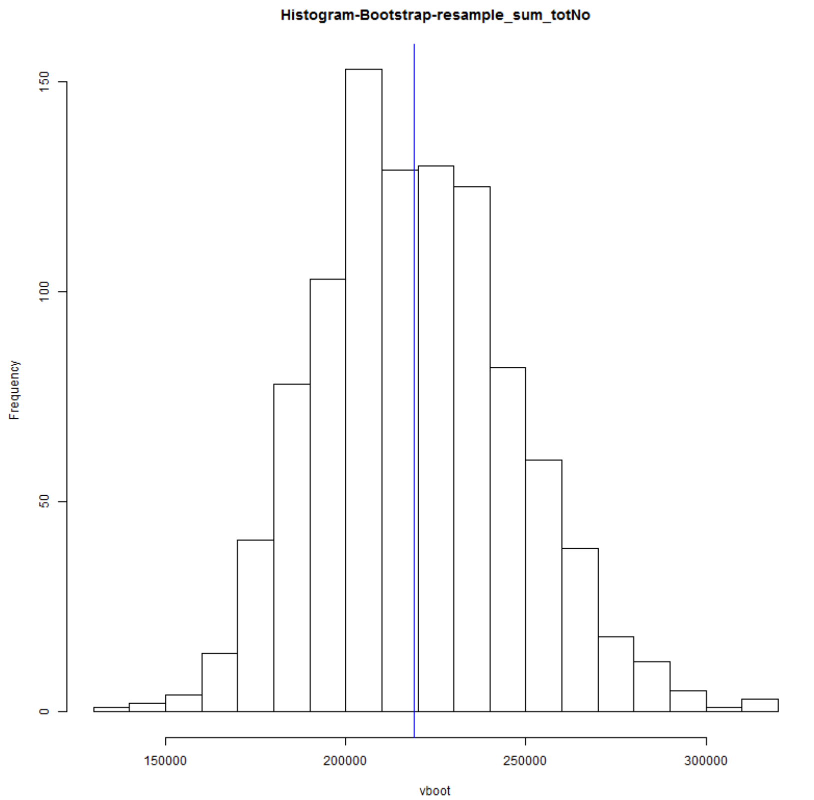


Figure 5.6.6 Histogram of bootstrap of sum of total numbers of fish for BASS 2018. Blue line is the original result from the survey.

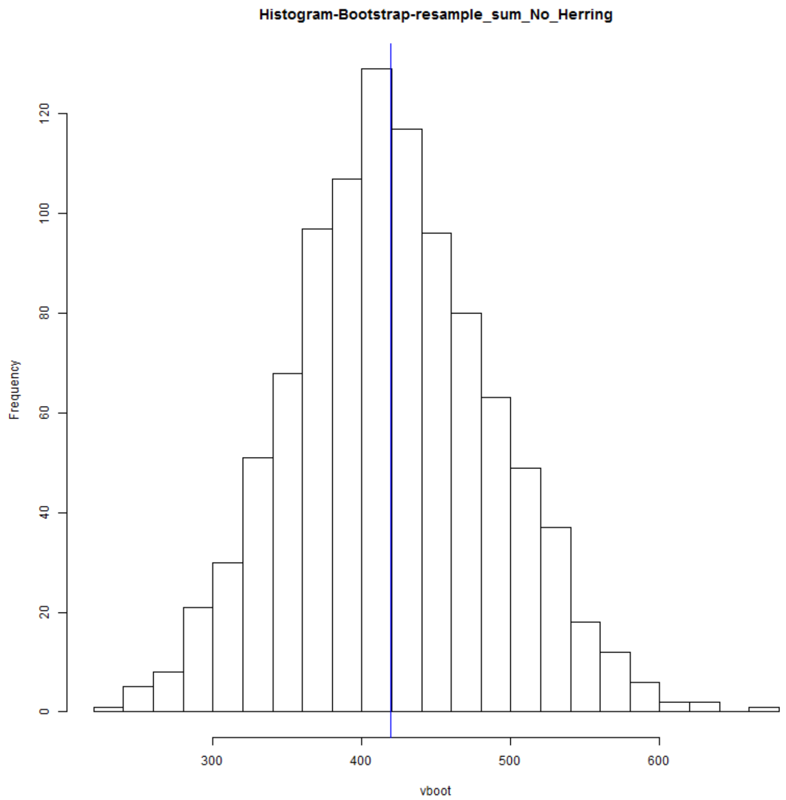


Figure 5.6.7 Histogram of bootstrap of Herring numbers for BASS 2018. Blue line is the original result from the survey.

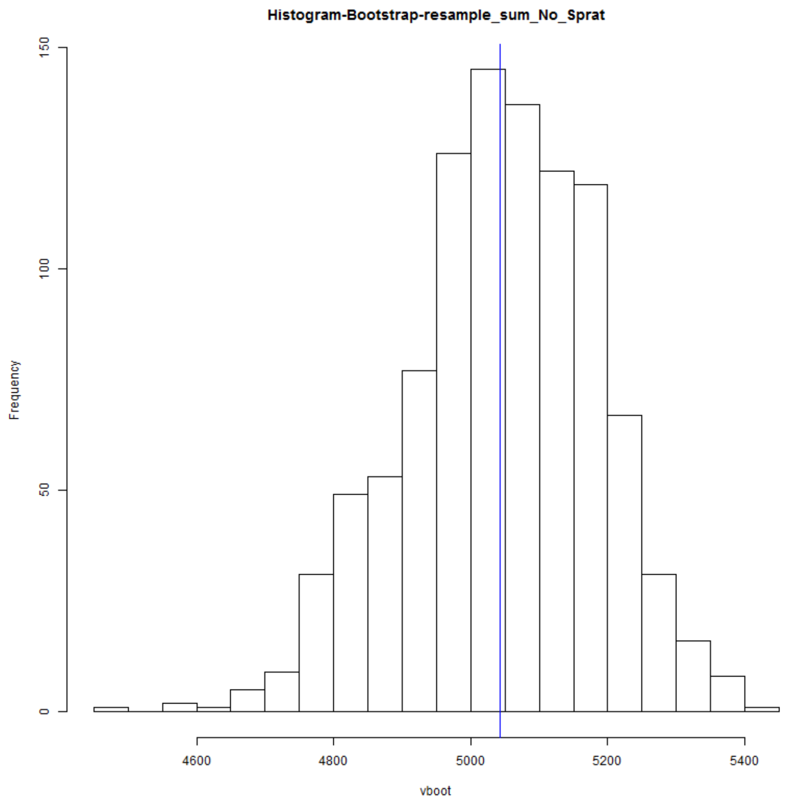


Figure 5.6.8 Histogram of bootstrap of Sprat numbers for BASS 2018. Blue line is the original result from the survey.

Annex: 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

During the WGBIFS 2018 meeting a StoX task sub-group was created 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.

StoX task sub-group 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 according to IBAS methods based on the BIAS 2017 data downloaded from the ICES database for acoustic trawl surveys.

During the discussions a 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 recommends to ICES Data Centre to add a new field into the biotic data format of ICES data base for acoustic survey data. This new field would specify whether the values given in the "BiologyIn-dividualWeight" field are measured as individual weights or as mean weights of current length-class.

It was decided that StoX task sub-group 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 sub-group 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.

Annex: 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

Vaishav Soni (ICES Data Centre) and Henrik Degel (member of WGBIFS, co-chair of WKSABI) participated in Workshop on methods to develop swept-area based effort indexes (WKSABI) in January 2019.

The goals of WKSABI were:

1) Adopt and agree on an effort estimate based in trawl swept-area, valid for all surveys available in DATRAS, independent of ecoregion and survey
    a. a) to check and validate the **calculations of missing data of the variables** related to the swept-area effort estimates submitted by the different countries and surveys;
    b. propose common strategies to reduce missing data in the crucial variables
    c. define **common calculations**, when possible, across surveys and countries,

    ….

    e. BITS and NeAtl IBTS: Define by survey the first possible year for which the required data checking and interpolation of missing values can be done with a reasonable effort and draft a realistic time line to finish this task; (**From 2000)**
2) Define and describe i) a size-based indicator, and ii) a marine litter indicator based on this swept-area index.

During the workshop, the nature of these gaps of knowledge were discussed and none of these ToRs were fully accomplished, but instead they became recommendations, most of them for the survey groups (WGBIFS, IBTSWG and WGBEAM), but also for the Marine Litter Working Group (WGML).

Recommendation: Encourage survey participants to continue collecting **door and wing spread** data (ideally both variables on each tow but preferably at least door spread).

As shown in Figure 1, five out of 8 countries submitting data to BITS in DATRAS have never reported DoorSpread, due to lack of the adequate equipment for this measurement.

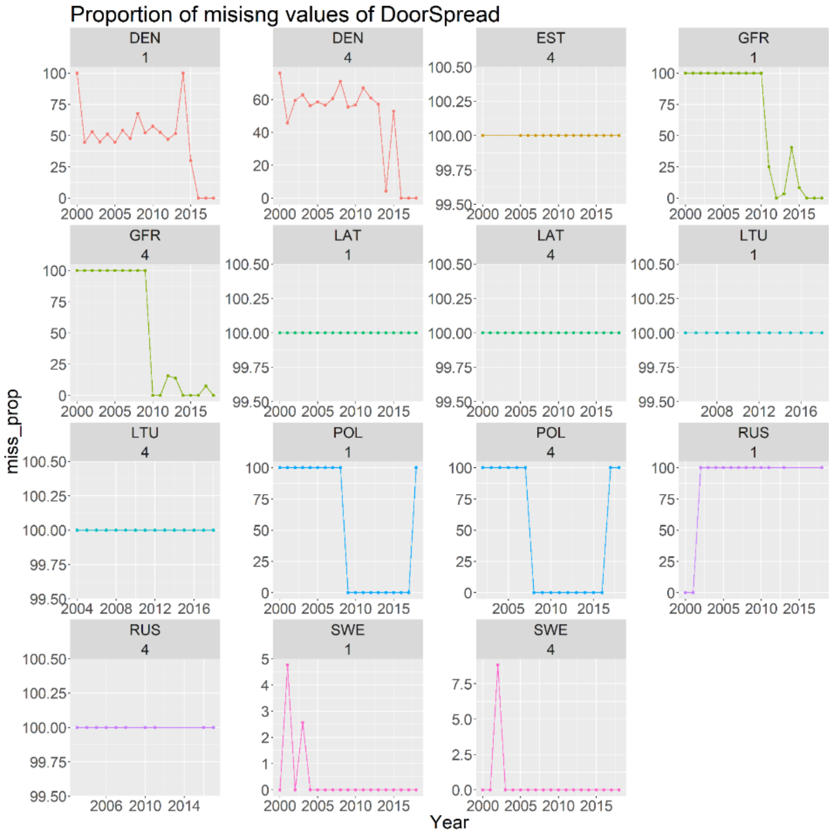


Figure 5.8.1 Proportion of missing values for DoorSpread in BITS 2000:2018 by country.

Given the wide interest of achieving a swept-area calculation also for BITS survey (this calculation is already existing and available for WGBEAM and NS-IBTS, not free of issues), it would be desirable to prioritize in the national institutions the need of this kind of equipment, or alternative solutions.

Recommendation: *Conduct data cleaning and provide* ***algorithms for estimating missing values*** *of variables needed for the calculation of swept area for the period 2000 to present (for WGBIFS).*

During WKSABI, it was agreed with one of the chairs (Henrik Degel, also member of WGBIFS), that the missing data calculation algorithms could only be required to those countries with the adequate equipment of measuring DoorSpread and/or WingSpread, i.e. Denmark, Sweden and Germany.

These 3 countries, in the near future will have to commit to send to the DATRAS Administration the adequate algorithms for each of these variables: DoorSpread, WingSpread and Distance, the most important for the swept-area calculation.

For helping them out, they have as reference, the work done by IBTSWG

http://www.ices.dk/marine-data/Documents/DATRAS/NS-IBTS_swept_area_km2_algorithms.pdf

DATRAS Administration, also during WKSABI, 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, etc.).

Action point for ICES Data Centre: *Provide gear geometry plots (with confidence intervals) for NS-IBTS, NeAtl-IBTS and BITS in cooperation with area coordinators for identifying limits of values of door spread, wing spread and vertical net opening for submission of survey data to DATRAS*

During 2018, ICES Data Centre has detected a large amount of data outliers, which would greatly compromise the swept-area calculation. In order to avoid this, the definition of ranges for several variables is requested to the group, in order to fix these ranges in the submission. As guidance, plots of the variables of interest for BITS 2000:2018 are provided:

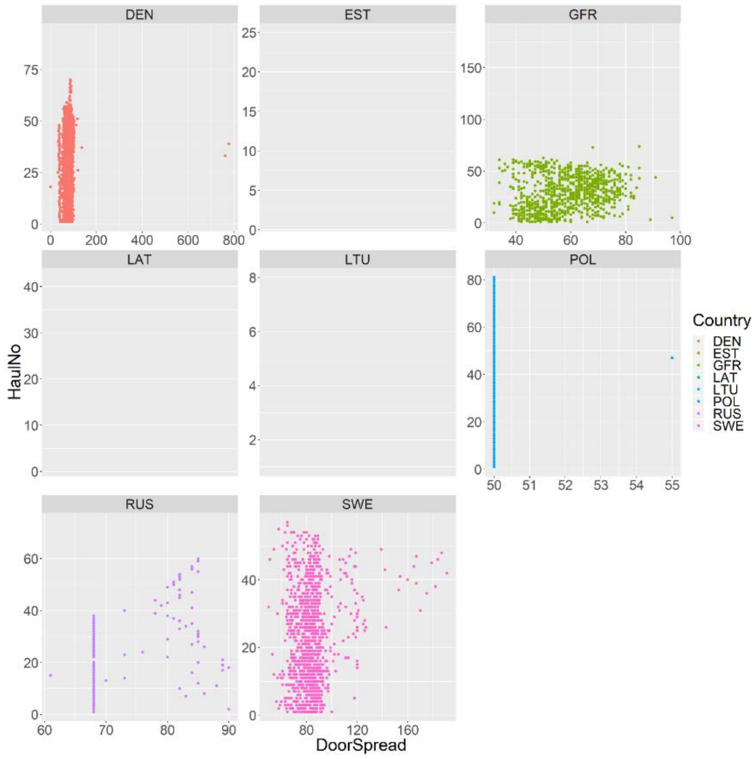


Figure 5.8.2 Data distribution of DoorSpread in BITS 2000:2018 by country.

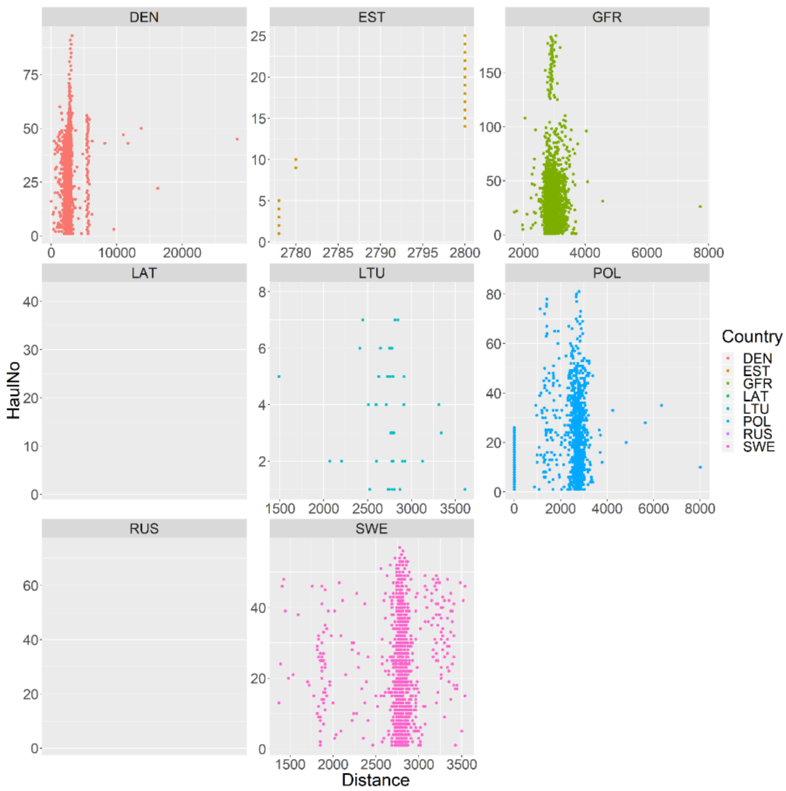


Figure 5.8.4 Data distribution of Distance in BITS 2000:2018 by country.

The goal of the request would be to provide ICES data centre with a table similar to this:

Variable	Upper limit	Lower limit
Door Spread		
Wing Spread		
Netopening		
Haul duration		
Ground speed		
Distance		

Other recommendations:

*Submit **size category** information for **Marine Litter** in all cases in future surveys*

*Identify **other variables** than swept-area, which are potentially important for improving survey estimates (e.g. bottom current speed and direction in areas with strong tides, wind speed and direction in shallow waters)*

This recommendation to *WGBIODIV:*

Provide survey specific species list and lists of missing/additional data such as length-weight relationships to be collected from surveys for the calculation of MSFD indicators to the respective survey groups.

could not be communicated before WGBIODIV 2019 so, in order to avoid wasting one whole year of data, we fast-tracked this recommendation to the survey groups. For the indexes calculation, length-weight relationships should be collected at least for standard species.

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

The WGBIFS at the meeting in 2014 agreed on systematically monitoring and reporting the findings of marine litter (anthropogenic origin), occurred in the bottom trawl during the BITS surveys. Submission of the marine litter data from the BITS surveys into DATRAS is uploaded routinely and fully functional. The Group inspected marine litter data submission status for 2018. All countries participating in BITS-Q1/2018 surveys submitted the data, while the litter data from BITS-Q4/2018 has not been uploaded yet by Denmark and Lithuania. Marine litter data is uploaded in the format C-TS-REV of the DATRAS Litter database (Table 5.2.2.1 in the BITS Manual 2017).

Following the WGML request to verify application of guidances in marine litter data collection, the WGBIFS inspected BITS countries for the application of proposed rules specified in litter data formatting and reporting rules (checklist) for DATRAS presented in WGML report 2018 (Table 5.7.1). Survey across the WGBIFS countries clearly indicated full applicability of the rules by countries. The guidance for reporting litter data from environmental (DOME) surveys in the Northeast Atlantic has not been inspected by the WGBIFS as none of the Baltic countries participated in these surveys. None of the Baltic countries has reported collecting samples for microplastic identification.

Marine litter data submitters will transfer data using the DATRAS Trawl litter standard format, implementing ICES vocabulary and classification coding (Tables 5.2.2.1 and 5.2.2.2 in the Manual for the Baltic International Trawls Surveys (BITS). Series of ICES Survey Protocols SISP7 – BITS. 95 pp. http://doi.org/10.17895/ices.pub.2883), described in the suitable manual, or via the Litter Reporting Format (ERF3.2; vide Annex 12), downloadable here: http://www.ices.dk/marine-data/data-portals/Pages/DATRAS-Docs.aspx.

References

ICES. 2018. Interim Report of the Working Group on Marine Litter (WGML), 23-27 April, 2018, ICES Headquarters, Copenhagen, Denmark. ICES CM 2018/HAPISG:10. 90 pp.

Table 5.7.1. Litter data formatting and reporting rules (checklist). (ICES 2018).

Rule
DATRAS Litter submission files should contain only 1 type of records – LT (Litter)
The files should use extension csv (or txt)
Each of the submitted files must contain unique key fields: survey, country, ship, gear, year, and quarter. Submissions with these key values will overwrite the previously submitted data, which also means that partial data submissions are not allowed.
Reported key fields must have previously submitted 'parent' HH records.
Each record should be reported in a separate row, while fields within a record should be separated by commas. Objects belonging to the same subcategory A1 etc. and size might be reported on the same row.
Remove header lines before submitting your files
Fields should be reported in a specific order identified in http://datsu.ices.dk/web/selRep.aspx?Dataset=122
Empty fields are not allowed. Report -9 instead
For numbers requiring decimals, report with decimal points, not decimal commas
Codes can be found in the respective code lists in ICES vocabulary at vocab.ices .dk. If additional codes are required, contact accessions@ices.dk
Hauls with 0 litter must be reported. For reporting zero litter catches, report LTREF = RECO-LT, PARAM = LT-TOT, UnitItem = items/haul, LT_Items = 0
Litter categories in hauls with litter should only be based on the LTREF = C-TS-REV
Litter size categories should be reported on CEFAS litter size categories.
The field LT_Items should be used for reporting the number of litter items of the same type/category. Preferably, items should be weighed individually. If the items are weighed together, the total weight for (multiple) items of the same litter type/category should be reported in the LT_Weight field. More details about counting and weighing litter can be found in Seafloor Litter Data Collection Guidelines (WGML, Annex 9c, 2018).
Field LTPRP allows simultaneous reporting of several codes, which should be separated with ~. No other fields allow the reporting of multiple codes
Submit data online at https://datras.ices.dk/Data%20submission/Default.aspx by following the instructions on the screen for the dataset "Litter data from DATRAS trawl surveys"
Contact accessions@ices.dk for log-in or any additional information

Annex 1: List of Participants

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Annex 2: Terms of reference for the next meeting

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

	Meeting dates	Venue	Reporting details	Comments (change in Chair, etc.)
Year 2018	24–28 March 2018	Lyngby-Copenhagen, Denmark	The first interim report by 15 May 2018 to, SCICOM and ACOM	Olavi Kaljuste appointed as chair
Year 2019	25–29 March 2019	Klaipeda, Lithuania	The second interim report by 15 May 2019 to SCICOM and ACOM	
Year 2020	30 March-03 April 2020	Cadiz, Spain	Final report by 15 May 2020 to SCICOM and ACOM	

ToR descriptors

TOR	Description	Background	Science plan topics addressed	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	1	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.	31	Year 1, 2 and 3	Updated databases with acoustic and biotic data for WGBIFS
c	Plan and decide on acoustic surveys and experiments to be conducted	Acoustic surveys provide important fishery-independent stock estimates for Baltic herring and sprat stocks	27	Year 1, 2 and 3	Finalized planning for the surveys for WGBIFS
d	Discuss the results 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	1	Year 1, 2 and 3	Updated BITS data in DATRAS database for ICES Data Centre and WGBFAS
e	Plan and decide on 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	27	Year 1, 2 and 3	Finalized planning for the surveys for WGBIFS, updated and corrected Tow Database

f	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	31	Year 1, 2 and 3	Improved quality of acoustic indices with estimates of the uncertainty for WGBFAS
g	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	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. Exercises 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.	31	Year 1, 2 and 3	Improved transparency and reproducibility of acoustic indices, improved pace of work on the level of national data compilation and verification
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	9, 31	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.	1	Year 1, 2 and 3	Coordinated the marine litter sampling programme in the Baltic International Trawl Survey (BITS).
j	An attempt to make standardization of the pelagic fishing 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	31	Year 1, 2 and 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	Acoustic surveys provide important fishery-independent	31	Year 3	Updated IBAS manual for WGBIFS (SISP 8)

	question raised at the last review of the SISP	stock estimates for Baltic herring and sprat stocks			
I	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	31	Year 3	Updated BITS manual for WGBIFS (SISP 7)

	Summary of the Work Plan
Year 1	Compilation the survey results from 2017 and the first quarter of 2018 and reporting to WGBFAS. Coordination and planning the schedule for surveys in 2018 and first half of 2019. Review the development and validation progress of the StoX software. Coordinate the marine litter-sampling programme in the BITS surveys and registering the data in the ICES database. 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 approach to designing the standard pelagic fishing gear used in BIAS and BASS surveys.
Year 2	Compilation the survey results from 2018 and first quarter of 2019 and reporting to WGBFAS. Coordination and planning the schedule for surveys in 2019 and first half of 2020. Review the development and validation progress of the StoX software. Coordinate the marine litter-sampling programme in the BITS surveys and registering the data in the ICES database. 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 approach to designing the standard pelagic fishing gear used in BIAS and BASS surveys.
Year 3	Compilation the survey results from 2019 and first quarter of 2020 and reporting to WGBFAS. Coordination and planning the schedule for surveys 2020 and first half of 2021. Implementation of the StoX software linked with the ICES acoustic-trawl survey database for the calculation of stock estimates for Baltic herring and sprat. Coordinate the marine litter-sampling programme in the BITS surveys and registering the data in the ICES database. An attempt to calculate the LFI and MML indicators based on the Baltic research surveys (e.g. BITS). Reviewing and updating the BITS and IBAS survey manuals according to SISP standards. Final decision concerning the possible implementation of the standard pelagic fishing gear for control-catches in BIAS and BASS surveys and assignment of the intercalibration exercises between the new and old fishing gears.

Supporting information	
Priority	The scientific surveys coordinated by this Group provide major fishery-independent tuning information for the assessment of several fish stocks in the Baltic Sea. 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 SSGESST and WGFAST.

Linkages to other organizations	No direct linkage to other organizations.

Annex 3: Agenda of WGBIFS 2019

Introduction

1. Opening of the meeting (25.03 2019 at 10:00)
   - Welcome and introduction (presentation made by chair)
   - Households remarks (info from local organizers of the meeting, Marijus Spegys and Jūranda Savukynienė)
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 2018 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 2019 and spring 2020. (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 2018 and spring 2019 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 2019 and spring 2020, 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. 15. Recommendations from other Expert Groups

15.1. Adopt the ICES metadata convention for processed acoustic data and the ICES data portal for acoustic trawl surveys. (Rec. by WGFAST)

15.2. Adopt the 'WKMATCH 2012 maturity scale revised' and approve the implementation plan (presented in chapter 7). Approval should be sent to WGBIOP. (Rec. by WKASMSF)

15.3. Update their manuals with the correct references and include or update the conversion table for the national maturity scales. (Rec. by WKASMSF)

15.4. Collect, count, and report litter data according to the two guidance documents produced by WGML-2018. a) Distribution of the manual on sampling, identification and registration of sea floor litter caught in bottom trawl surveys. b) Distribution of the document on suggestions for quality assurance/quality control measures for studies on micro litter. (Rec. by WGML)

15.5. Follow Litter Data Collection Guidelines by WGML. a) Seafloor litter data requested via DATRAS b) All microplastic data requested via DOME c) Other litter data requested via DOME. (Rec. by WGML)

15.6. Contact ICES Data Centre with data reporting issues (accessions@ices.dk). (Rec. by WGML)

15.7. National submitters to correct historic data. (Rec. by WGML)

15.8. WGBIOP recommends the collection of gonad samples (images of gonads and gonads for histology) during regular sampling to ensure a basic set of samples is available for maturity exchanges and workshops. This will be followed up with an email with a protocol with instructions on how to collect the samples. (Rec. by WGBIOP)

15.9. The IBPCluB recommends the Baltic International Fish Survey Working Group (WGBIFS) to evaluate whether the annual variation in the predicted average TS density patterns in different water depths impact the survey numbers that are used in the Gulf of Bothnia herring stock assessments. (Rec. by IBPCluB)

15.10. Conduct data cleaning and provide algorithms for estimating missing values of variables needed for the calculation of swept area for the period 2000 to present (for WGBIFS) and for the period after 2014 (for IBTSWG if necessary e.g. in case of vessel changes or changes of trawl netting material). (Rec. by WKSABI)

15.11. Encourage survey participants to continue collecting door and wing spread data (ideally both variables on each tow but preferably at least door spread) during NS-IBTS, NeAtl-IBTS and BITS. (Rec. by WKSABI)

15.12. Identify other variables than swept area which are potentially important for improving survey estimates (e.g. bottom current speed and direction in areas with strong tides, wind speed and direction in shallow waters). (Rec. by WKSABI)

15.13. Submit size category information for Marine Litter in all cases in future surveys. (Rec. by WKSABI)

Final issues

16. Going through the recommendations
17. Going through the action plan
18. Selection of time and venue for the next meeting

Closing of the meeting (29.03.2019 at 13:30).

Annex 4: Recommendations

Recommendation	Responsible	Deadline	Recipients	Section from report this relates to
WGBIFS recommends that, the BIAS-dataset, including the valid data from 2018 can be used in the assessment of the CBH (herring) 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 2019 meeting.	WGBFAS	Annex ToR a), chapter 5.1.1.4.
WGBIFS recommends that, the current BIAS index series can be used in assessment of the Gulf of Bothnia herring stock size with the restriction that the year 1999 is excluded from the dataset. The abundance indices for age groups 0 and 1 should be handled with caution.	WGBIFS	Before WGBFAS 2019 meeting.	WGBFAS	Annex ToR a), chapter 5.1.1.4.
WGBIFS recommends that, the BASS-dataset 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 2019 meeting.	WGBFAS	Annex ToR a), chapter 5.1.2.2.1.
WGBIFS recommends that the data obtained and uploaded to DATRAS for both the 4th quarter 2018 and the 1st quarter 2019 BITS are used for calculating survey indices for the relevant cod and flatfish stocks.	WGBIFS	Before WGBFAS 2019 meeting.	WGBFAS	Annex ToR d), chapter 5.4.1 and 5.4.2.
WGBIFS recommends to ICES Data Centre to add a new field into the biotic data format of ICES data base 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. This would allow countries, which perform biological sampling during the surveys and are unable to measure fish individual weights with sufficient accuracy, to upload measured mean weight at length information into the data base.	WGBIFS	As soon as possible	ICES Data Centre	Annex ToR g), chapter 5.7

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 data base will be made available after submission the full set of data from the current BITS surveys by all countries.

2) Olavi Kaljuste (Sweden) and Juha Lilja (Finland) 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 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 Center). 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 analyzed 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) For action during the next WGBIFS meeting (March 2020) 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 StoX task sub-group [including Juha Lilja (Finland), Olavi Kaljuste (Sweden), Elor Sepp (Estonia), Niklas Larson (Sweden), Paco Rodriguez-Tress (Germany) and Beata Schmidt (Poland)] 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;
- organize a net-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.

8) WGBIFS recommends national laboratories to collect, whenever possible, the data requested by WKQUAD:

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 nmi in an hour, but in inclement weather one may only be able to cover 2-3 nmi. 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.

2. Compile seabed substrate 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.

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.

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

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.

9) 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

10) WGBIFS recommends to adopt the 'WKMATCH 2012 maturity scale revised' update the conversion tables and update surveys manual (Rec. by WKASMSF).

Annex 6: Standard and Cruise Reports of BITS surveys at the WGBIFS 2019 annual meeting

Please see Annex 6 below.

Annex 6: Standard and Cruise Reports of BITS surveys at the WGBIFS 2019 annual meeting

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

I List of standard reports:

- 1. BITS 2018 Quarter 4 Standard Report of Lithuania;
- 2. BITS 2018 Quarter 4 Standard Report of Germany;
- 3. BITS 2018 Quarter 4 Standard Report of Estonia;
- 4. BITS 2018 Quarter 4 Standard Report of Poland;
- 5. BITS 2018 Quarter 4 Standard Report of Latvia;
- 6. BITS 2018 Quarter 4 Standard Report of Denmark
- 7. BITS 2018 Quarter 4 Standard Report of Sweden;
- 8. BITS 2018 Quarter 1 Standard Report of Germany;
- 9. BITS 2018 Quarter 1 Standard Report of Poland;
- 10. BITS 2018 Quarter 1 Standard Report of Latvia;
- 11. BITS 2018 Quarter 1 Standard Report of Lithuania;
- 12. BITS 2018 Quarter 1 Standard Report of Denmark
- 13. BITS 2018 Quarter 1 Standard Report of Sweden

II List of cruise reports:

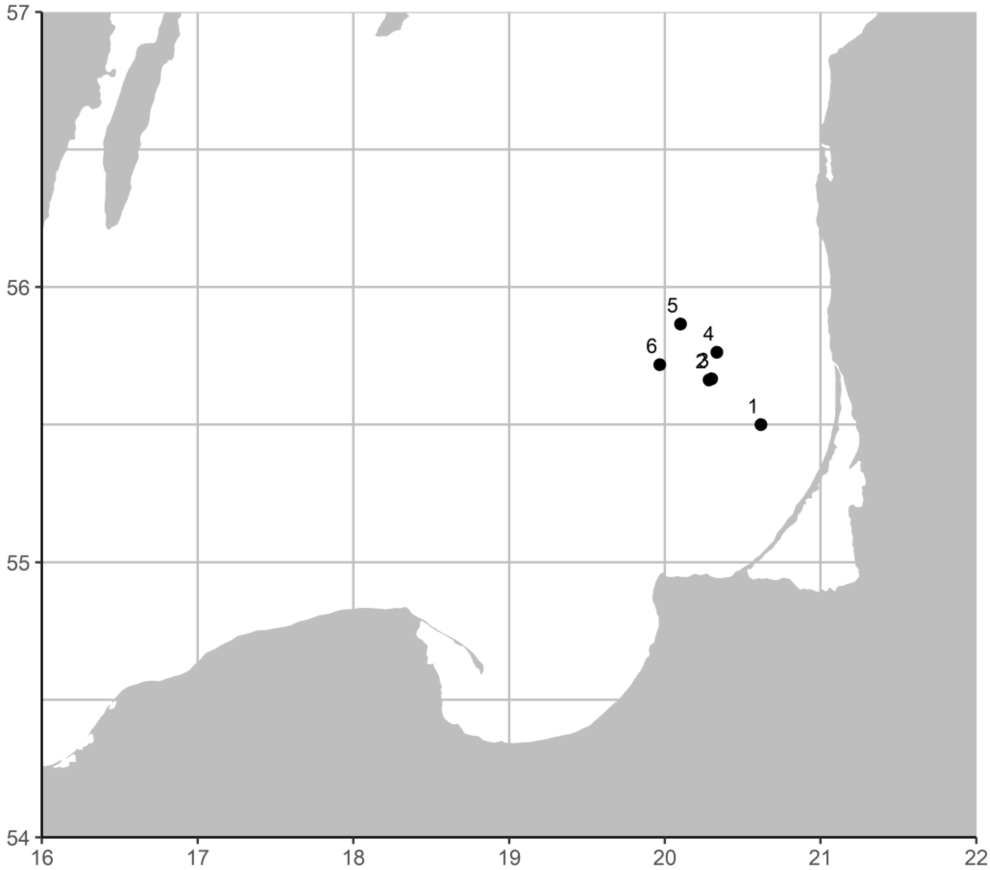
- 1. BITS 2018 Quarter 4 Cruise Report of Latvia.
- 2. BITS 2018 Quarter 4 Cruise Report of Poland.
- 3. BITS 2018 Quarter 4 Cruise Report of Germany
- 4. BITS 2018 Quarter 4 Cruise Report of Lithuania
- 5. BITS 2018 Quarter 1 Cruise Report of Poland

Nation:	**Lithuania**	**Vessel:**	**LBB-1010**
Survey:	BITS2018Q4	Dates:	08th – 09th November 2018

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-1010. Total 6 fishing hauls was performed.
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
26	TVS	2	1	1	-	-	-	-	100
26	TVS	3	5	5	-	1	-	-	100

Number of biological samples (maturity and age material, *maturity only):		
Species	**Length**	**Age**
Clupea harengus	607	
Gadus morhua	1009	293
Myoxocephalus scorpius	46	
Osmerus eperlanus	5	
Platichthys flesus	394	229
Pleuronectes platessa	14	14
Sprattus sprattus	12	

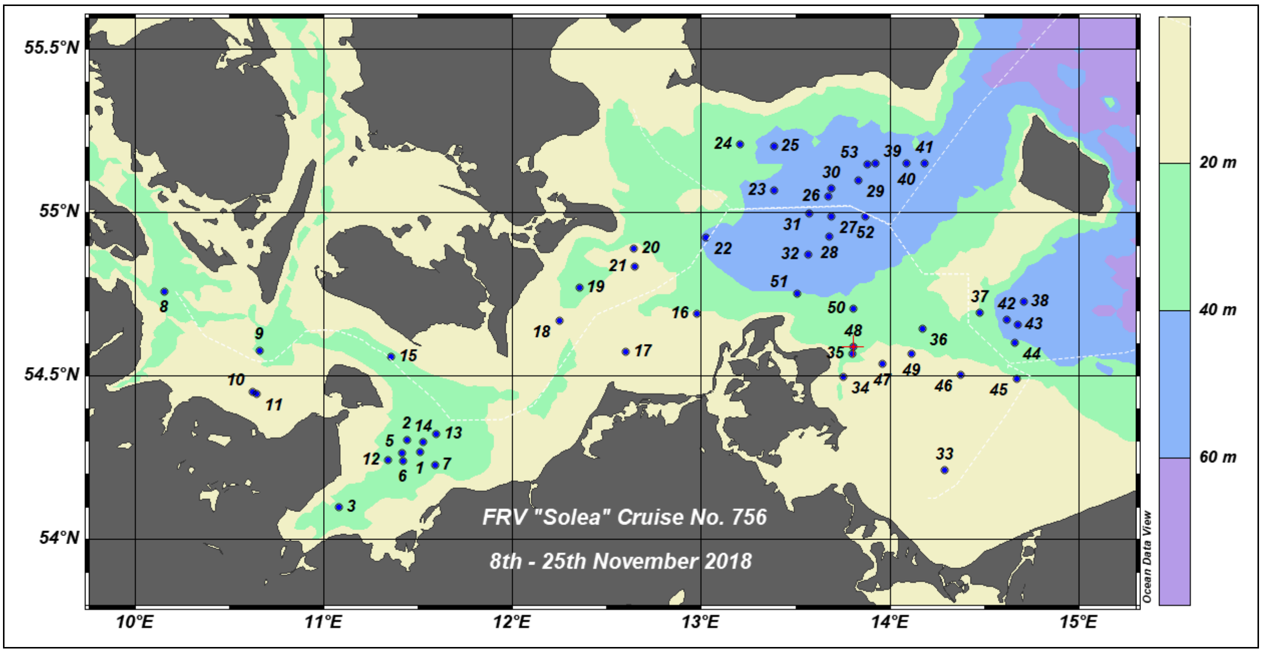


Nation:	**Germany**	**Vessel:**	**FRV "Solea"**
Survey:	BITS 2018, quarter 4	Dates:	8th – 25th November 2018

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. 4 stations in Swedish territorial waters were not allowed to carry out. The survey had three days daowntime due to bad weather.
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	2	2	-		-	-	100
22	TVS	2	12	12	-		-	-	100
24	TVS	1	8	8	-		-	-	95
24	TVS	2	13	10	-		1	-	77
24	TVS	3	22	20	-		1	-	91

Number of biological samples (maturity and age material, *maturity only):		
Species	**Length**	**Age**
Gadus morhua	4047	787
Platichthys flesus	4859	574
Pleuronectes platessa	6602	831
Limanda limanda	4666	594
Psetta maxima	216	211
Scophthalmus rhombus	34	34
Clupea harengus	4423	-
Sprattus sprattus	4736	-

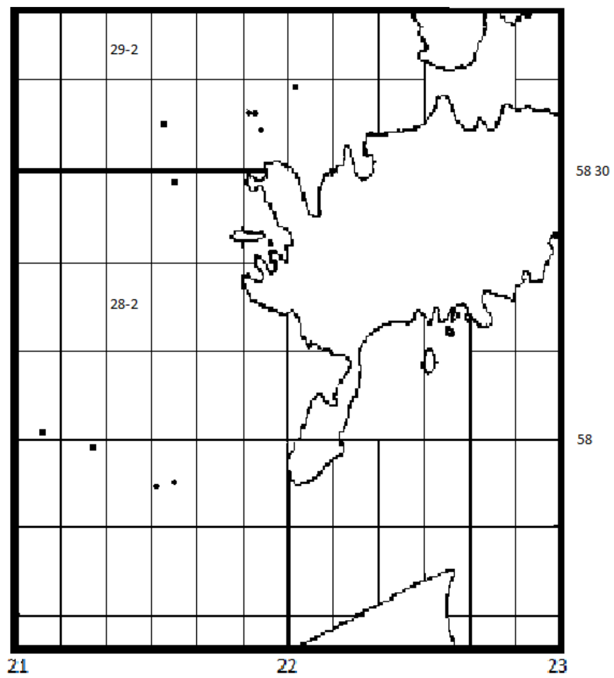


NATION:	ESTONIA	VESSEL:	CEV
Survey:	BITS18IVQRT	Dates:	18-21 November 2018

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 19 November 2018 from the Port of Haapsalu , steaming to the Sub-division 28-2. The weather conditions were good: light NE-E wind. Therefore, it was possible to carry out all 5 assigned for Estonia trawl hauls on November, 20th, as planned. Since the weather forecast for next days was bad, it was decided to continue with the rest of survey in the Sub-division 29. 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 early hours of 21 November 2018 in the Port of Haapsalu. No technical problems were observed during the survey this year. All catches were analysed at the Pärnu field 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	3	2	2	0	0	0	0	100
28	TVS	4	3	3	0	0	0	0	100
28	TVS	5	0	0	0	0	0	0	Na
29	TVS	2	1	1	0	0	0	0	100
29	TVS	3	3	3	0	0	0	0	100
29	TVS	4	1	1	0	0	0	0	100
29	TVS	5	0	0	0	0	0	0	Na

Number of biological samples (maturity and age material, *maturity only):		
Species	Age	Length
Gadus morhua	39	39
Sprattus sprattus	0	414
Clupea harengus	0	386
Platichthys flesus	434	808



Approximate positions of realised hauls during Estonian BITS survey in 4 QRT 2018

Estonian BITS IV Quarter 2018: Overview of catches.

2018				Catches, kg							
	1	2	3	4	5	6	7	8	9	10	
Haul ID.	28030	28029	28192	28191	28061	2902	2901	2903	2904	2905	
Sd	28	28	28	28	28	29	29	29	29	29	
Depth, m	50	59	67	71	71	74	47	46	38	42	
Date	20.11.2018	20.11.2018	20.11.2018	20.11.2018	20.11.2018	20.11.2018	20.11.2018	20.11.2018	20.11.2018	20.11.2018	
Coordinates	5755_2135	5755_2131	5759_2117	5802_2106	5828_2135	5835_2133	5837_2151	5837_2152	2834_2154	5839_2201	**Total**
Clupea harengus	1,46	0,42	0,03	0,08	7,75	0,25	3,86	1,52	0,38	0,30	**16,05**
Sprattus sprattus	0,16	0,12	0,01	0,05	11,59	1,64	0,45	1,52	0,12	0,03	**15,67**
Platichthys flesus	34,33	16,65	0,19	0,09	0,24	11,49		10,13	11,19	12,99	**97,3**
Gadus morhua	0,85	1,79						1,28			**4**
Osmerus eperlanus	0,12		0,01			0,02	1,89	1,56	2,26	1,07	**7**
Scophthalmus maximus								0,193	0,099		**0,292**
Neogobius melanostomus	0,197	0,05	0,05					0,08	0,03	0,12	**0,52**
Gobius sp.							0,03	0,02	0,13	0,03	**0,20**
Gasterosteus aculeatus	0,002			0,01	0,02	0,002		0,007	0,003	0,003	**0,05**
Pungitius pungitius											**0**
Myoxocephalus scorpius	0,473	0,82					0,26	0,36	0,28	0,37	**2,56**
Zoarces viviparus	0,041						0,004	0,03	0,14	0,17	**0,38**
Cyclopterus lumpus	0,299										**0,30**
Myxocephalys quadricornis							0,21	0,18		0,47	**0,86**
Taurulus bubalis											**0**
Lumpenus lampretaeformis											**0**
Enchelyopus cimbrius		0,042									**0,042**
	37,92	**19,89**	**0,29**	**0,23**	**19,61**	**13,40**	**6,70**	**16,88**	**14,61**	**15,55**	**145,1**

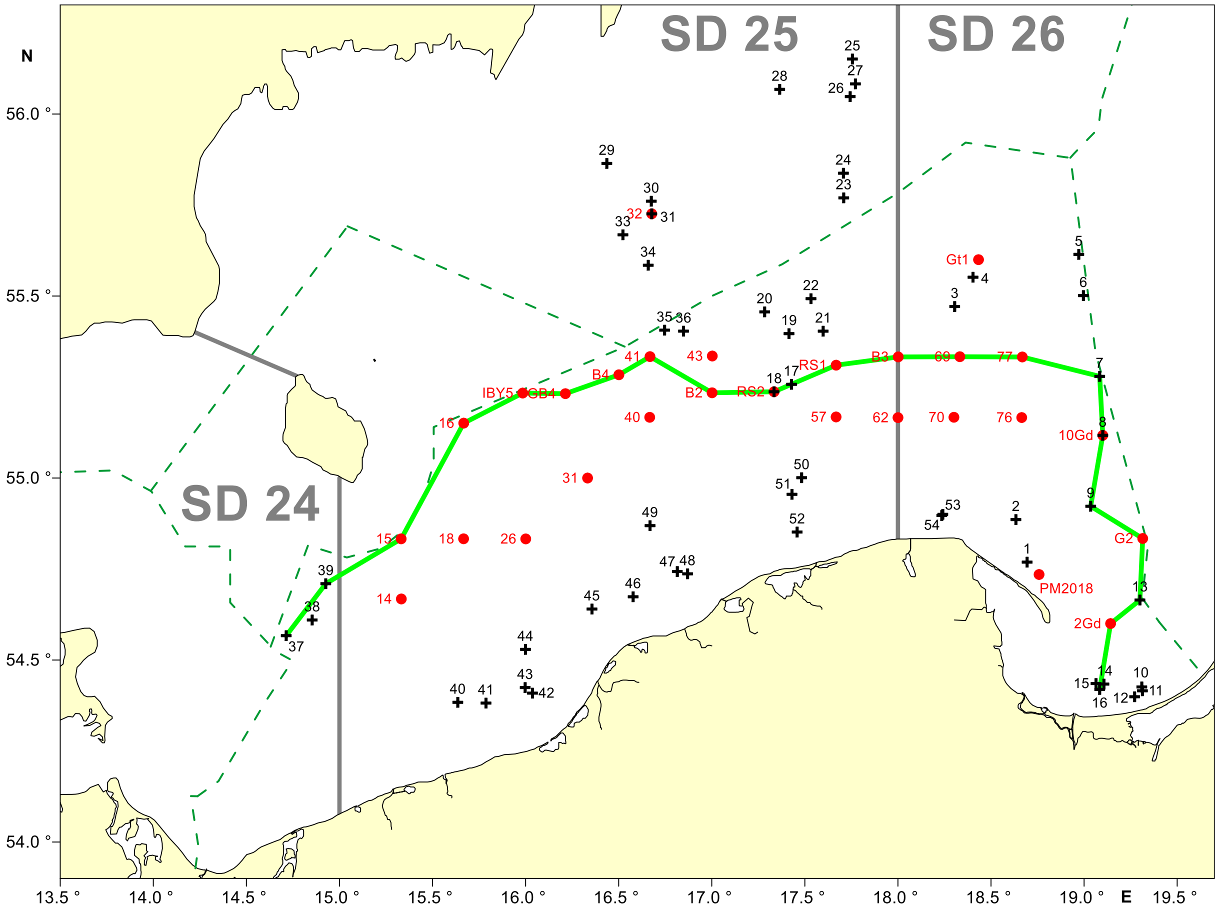
NATION:	**POLAND**	**VESSEL:**	**RV "BALTICA"**
Survey:	BITS-Q4/2018	Dates:	14/11-03/12/2018

Cruise	No. 22/2018/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 2018) recommendations, the vessel "Baltica" was designated to cover in November/December 2018 survey, the Polish part of ICES Sub-divisions 24, 25 and 26 with 3, 21 and 18, respectively randomly selected bottom control-hauls and also in Swedish EEZ to cover Swedish part of ICES Sub-division 25 with 12 control-hauls. The R/V Baltica realized 54 of the 60 planned hauls for this survey. Due to the ships technical problems with engine the cruise was shortened by two days and six hauls planned in Gdańsk Bay was not realized (No 26007, 26277, 26267, 26183, 26270, 26131). Totally, 54 fish catch-stations can be accepted as representative. Due to stormy weather, rocky bottom and large fish concentrations observed in echosounder – 5 and 6 hauls was shortened to 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, 54 fish catch-stations starting positions and 26 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
24	TVL	2	1	1	0	0	0	0	100
24	TVL	3	2	2	0	0	0	0	100
25	TVL	2	13	13	0	0	0	0	100
25	TVL	3	12	12	0	0	0	0	100
25	TVL	4	6	6	0	0	0	0	100
25	TVL	5	2	2	0	0	0	0	100
26	TVL	2	7	4	0	0	0	0	57
26	TVL	3	7	6	0	0	0	0	86
26	TVL	4	3	1	0	0	0	0	33
26	TVL	5	6	6	0	0	0	0	100
26	TVL	6	1	1	0	0	0	0	100

NUMBER OF BIOLOGICAL SAMPLES (MATURITY AND AGE MATERIAL, *MATURITY ONLY):		
SPECIES (LATIN NAME)	**Length**	**Age and maturity**
Neogobius melanostomus	1	
Pomatoschistus minutus	1	
Mullus surmuletus	1	
Pungitius pungitius	1	
Gasterosteus aculeatus	4	
Hyperoplus lanceolatus	148	2
Gadus morhua	4339	435
Pleuronectes platessa	565	455
Myoxocephalus scorpius	173	5
Agonus cataphractus	3	
Lampetra fluviatilis	4	
Enchelyopus cimbrius	288	17
Alosa fallax	17	
Engraulis encrasicolus	4	
Scophthalmus maximus	22	22

Platichthys flesus	3413	776
Osmerus eperlanus	451	4
Sprattus sprattus	6551	584
Clupea harengus	8066	1105
Cyclopterus lumpus	4	
Zoarces viviparus	10	
Merlangius merlangus	36	



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

NATION:	**LATVIA**	**VESSEL:**	**RV "BALTICA"**
Survey:	BITS-Q4/2018	Dates:	11-21/12/2018

Cruise	No. 2/2018
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 (9 trawls in SD 26, 15 trawls in SD 28) and 1 control-hauls in the Lithuania EEZ (SD 26). Five additional trawls were planned in the SD 26 (5 trawls in the Lithuanian EEZ). The r.v."Baltica" realized 31 bottom trawl control-hauls including the Latvian territorial waters (Fig.1). Trawl with track number 28084 was not in the correct depth zone as it was indicated in track database. This track with number 28084 was realized. Later, new track position in this area were find within correct depth zone. Information about new track will be sent to track database administrator. Fifteen 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. Five additional trawls were realized in the Lithuanian EEZ (SD 26). 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 5 hauls, their duration was shortened to 15-20 minutes, due to dense clupeids concentrations observed on the echosounder or bad fishing ground. The length measurements in the 1.0-cm classes were realised for all 945 cod and 1519 flounder. Length measurements in the 0.5-cm classes were realized for 1653 herring and 1580 sprat. In total, 457 cod and 409 flounder individuals were taken for biological analysis. Stomachs from the 350 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, 36 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:	

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	3		3				100
26	TVL	4	1		1				100
26	TVL	5	3		1	2			100
26	TVL	6	3			3			100
28	TVL	2	4		2				50
28	TVL	3	2		4				150
28	TVL	4	3		2	1			100
28	TVL	5	5			6			120
28	TVL	6	1						0

Number of biological samples (maturity and age material, *maturity only):		
Species	**Length**	**Age**
Clupea harengus	1653	0
Sprattus sprattus	1580	0
Platichthys flesus	1519	409
Gadus morhua	945	457
Myoxocephalus scorpius	87	0
Zoarces viviparus	22	0
Osmerus eperlanus	19	0
Hyperoplus lanceolatus	11	0
Cyclopterus lumpus	5	0
Gasterosteus aculeatus	4	0
Scophthalmus maximus	1	0
Pleuronectes platessa	1	0
Alosa alosa	1	0
Lumpenus lampretaeformis	1	0

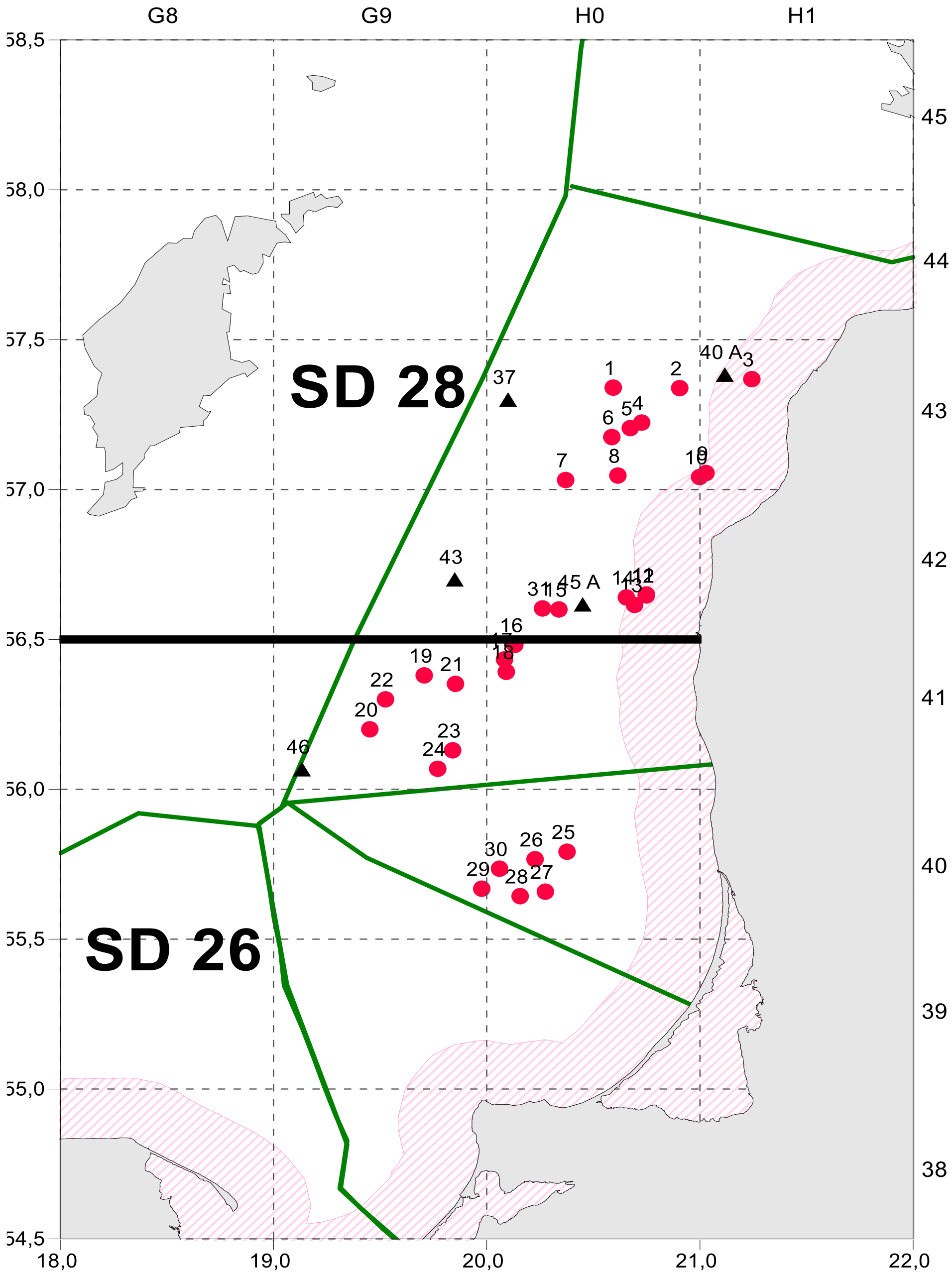


Figure 1. Location of the realized fish control-hauls (marked with red dots) and the HELCOM standard hydrological stations (marked with black triangles), green lines - national fishing zone borders.

Nation:	Denmark	Vessel:	Dana
Survey:	BITS	Dates:	01/11-18/11 - 2018

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	Stomack 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	21	15	0	0	0	1	71.4
4	TVL	20	23	0	4	0	0	135.0
5	TVL	12	16	0	4	0	0	166.7
6	TVL	0	1					
24	TVL							
3	TVL	1	1	0	0	0	0	100.0
		55	57	0	8	0	1	118.2

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

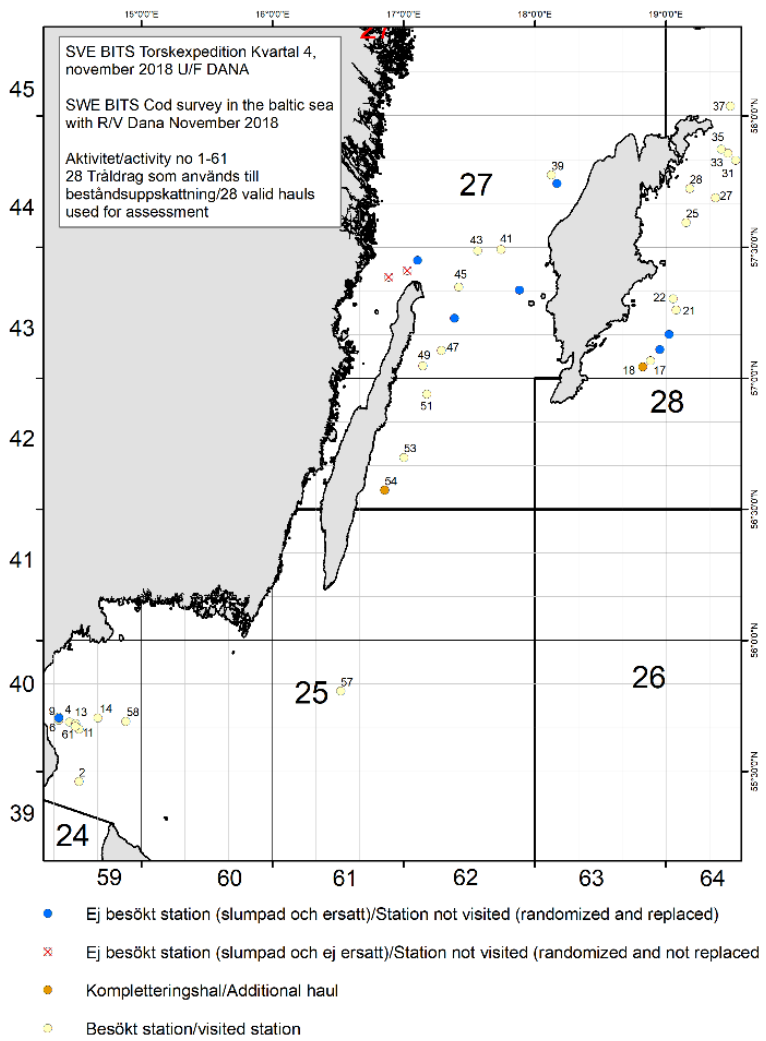
NATION:	**SWEDEN**	**VESSEL:**	**RV "DANA"**
Survey:	BITS Q4 2018	Dates:	19-28 November 2018

Cruise	
Gear details:	The large (930#) standard TV3 trawl was used. No tows are done with the rock hopper ground gear 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.):	30 stations were allocated, 28 of these were trawled. Six hauls were cancelled in SD 27 and two in SD 28 because the Swedish Armed Forces (SAF) did not grant us permission. Six of those could be replaced. Two complementary haul, not included here. Four hauls in SD 27 and 28 had oxygen deficiency.
Additional comments:	Depth strata 2 SD 25 where planned 3 hauls but only two where made due to close proximity to next haul, (cluster haul), 1 additional haul where made in depth strata 3. Depth strata 4 and 5 in SD 28 deviates because one haul is randomized as depth layer 5 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 %**	**Remarks**
25	TVL	2	3	2	-	0	0	0	66	2
25	TVL	3	7	8	-	0	2	0	114	2
27	TVL	3	1	1	-	0	0	0	100	
27	TVL	4	5	5	-	2	2	0	100	
27	TVL	6	2	2	-	2	2	0	100	
28	TVL	3	3	3	-	0	0	0	100	
28	TVL	4	3	4	-	0	0	0	125	
28	TVL	5	4	3	-	2	0	0	75	

Remark 1. The % number deviates from 100 because we were prohibited by Swedish Armed Forces to visit some of the stations.
Remark 2. The % number deviates from 100 because we don't have any replacement stations at that depth and area.

Number of biological samples (maturity and age material, *maturity only):			
Specname sci.	**Lenght**	**Age**	**Stomachs**
Agonus cataphractus	1		
Anguilla anguilla	1		
Clupea harengus	6 478		
Cyclopterus lumpus	15		
Enchelyopus cimbrius	29		
Gadus morhua	3 897	490	101
Gasterosteus aculeatus	120		
Hyperoplus lanceolatus	1		
Limanda limanda	51		
Lumpenus lampretaeformis	7		
Merlangius merlangus	24		
Myoxocephalus quadricornis	452		
Myoxocephalus scorpius	437		
Osmerus eperlanus	4		
Platichthys flesus	2 839	788	-
Pleuronectes platessa	495		
Pollachius virens	1		
Pomatoschistus	5		
Saduria entomon	26		
Sander lucioperca	1		
Scophthalmus maximus	75		
Sprattus sprattus	4 676		
Trachurus trachurus	1		
Zoarces viviparus	160		

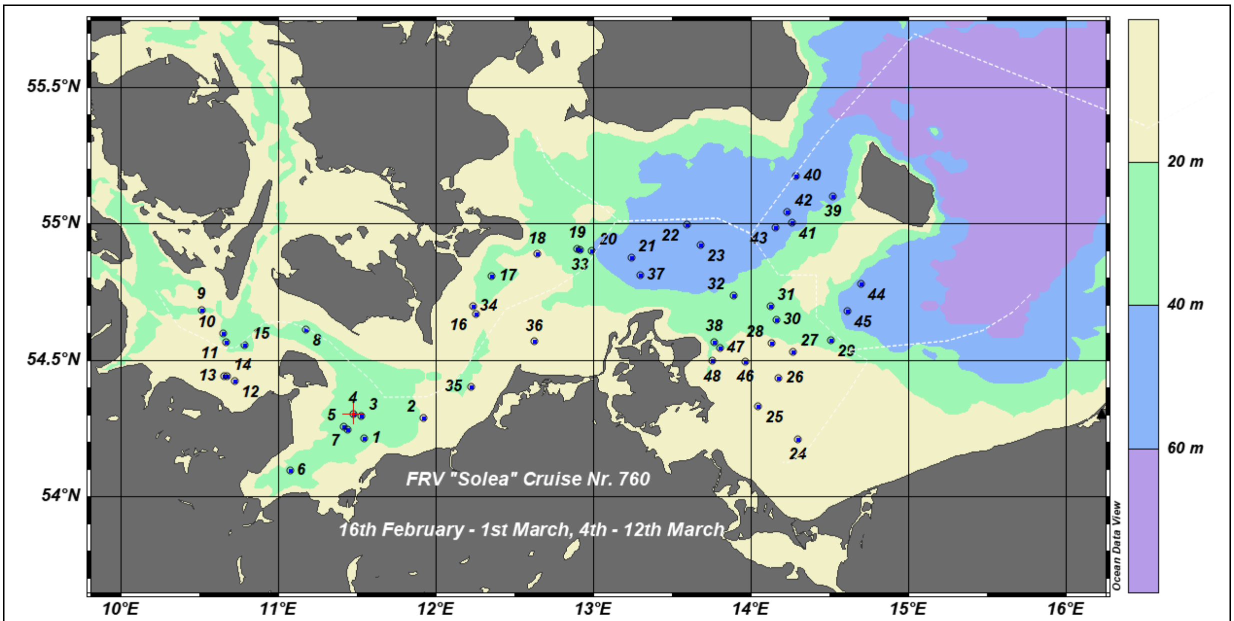


Nation:	**Germany**	**Vessel:**	**FRV "Solea"**
Survey:	BITS 2019, quarter 1	Dates:	16[th] February to 1[st] March, 4[th] to 12[th] March 2019

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 48 fishing hauls and 48 hydrographical stations were performed. Technical problems, bad weather and sickness caused 9 days downtime. Fishing activities had to be interrupted 3 days before the end of the cruise because of a highly contagious norovirus, which have teared through the vessel. Therefore was not possible to carry out 8 of 10 planned stations (2 of them were prohibited by the armed forces) in Swedish waters.
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	2	2	-		1	-	100
22	TVS	2	13	13	-		-	1	100
24	TVS	1	8	8	-		-	-	100
24	TVS	2	15	10	-		-	-	67
24	TVS	3	21	15	-		1	-	71

Number of biological samples (maturity and age material, *maturity only):		
Species	**Length**	**Age**
Gadus morhua	7872	1084
Platichthys flesus	2756	652
Pleuronectes platessa	4763	843
Limanda limanda	3405	609
Psetta maxima	156	154
Scophthalmus rhombus	198	17
Clupea harengus	2935	-
Sprattus sprattus	3810	-



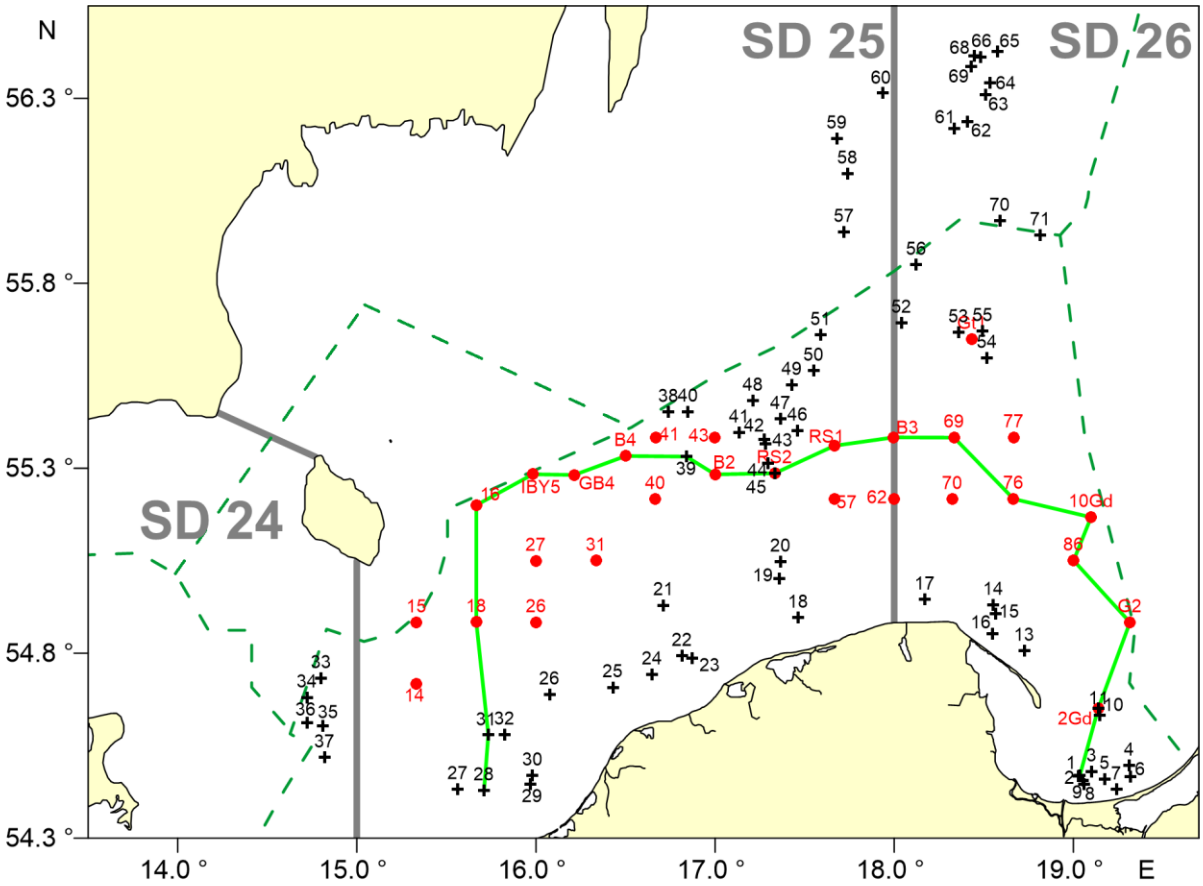
NATION:	POLAND	VESSEL:	RV "BALTICA"
Survey:	BITS-Q1/2019	Dates:	12/02-06/03/2019

Cruise	No. 3/2018/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 2018) recommendations, the vessel "Baltica" was designated to cover parts of the ICES Sub-divisions 24, 25 and 26 with 5, 29 and 22, respectively randomly selected bottom control-hauls, and also in Swedish EEZ to cover Swedish part of ICES Sub-division 25 and 26 with 4 and 9 control-hauls, respectively. The R/V Baltica realized 71 of the 69 planned hauls for this survey. Two hauls (ICES no 26020 and ICES no 26224) were considered as „Invalid" due to technical problems associated with gear performance observed during trawling. Both hauls were repeated successfully in the places as assigned in the survey plan. One haul (ICES no 26221) was not realized due to oxygen level on the bottom below 0.5 ml/l. Totally, 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 and 11 hauls were shortened to 10 min and 20 min, respectively. Haul No. 26221 was classified as "no oxygen". Every control-haul was preceded by the seawater temperature, salinity and oxygen content measurements, made continuously from the sea-surface to a bottom. Overall, 69 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
24	TVL	2	3	3	0	0	0	0	100
24	TVL	3	2	2	0	0	0	0	100
25	TVL	2	13	13	0	2	0	0	100
25	TVL	3	11	11	0	2	0	0	100
25	TVL	4	7	7	0	0	0	0	100
25	TVL	5	2	2	0	0	0	0	100
26	TVL	2	9	9	0	0	0	0	100
26	TVL	3	7	7	0	0	0	0	100
26	TVL	4	6	6	0	0	0	0	100
26	TVL	5	6	6	0	0	0	0	100
26	TVL	6	3	3	0	1	0	0	100

NUMBER OF BIOLOGICAL SAMPLES (MATURITY AND AGE MATERIAL, *MATURITY ONLY):		
SPECIES (LATIN NAME)	Length	Age and maturity
Neogobius melanostomus	2	
Pomatoschistus minutus	2	
Pomatoschistus microps	2	
Vimba vimba	1	
Gasterosteus aculeatus	15	
Pollachius virens	1	1
Hyperoplus lanceolatus	9	
Gadus morhua	14349	800
Pleuronectes platessa	1726	742
Gymnocephalus cernuus	2	

Myoxocephalus scorpius	884	16
Agonus cataphractus	2	
Salmo salar	1	1
Enchelyopus cimbrius	261	30
Scophthalmus rhombus	1	1
Perca fluviatilis	3	
Trachurus trachurus	5	1
Alosa fallax	25	1
Scophthalmus maximus	75	75
Platichthys flesus	8234	983
Osmerus eperlanus	18	
Sprattus sprattus	6028	548
Clupea harengus	9362	1045
Cyclopterus lumpus	45	4
Ammodytes tobianus	2	
Zoarces viviparus	93	
Merlangius merlangus	19	2



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

NATION:	**LATVIA**	**VESSEL:**	**RV "BALTICA"**
Survey:	BITS-Q1/2019	Dates:	13-21/03/2019

Cruise	No. 1/2019
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 (all trawls in SD 28) and 3 control-hauls in the Estonian EEZ (SD 26). Five additional trawls were planned in the SD 26, in the Latvian EEZ. The r.v."Baltica" realized 30 bottom trawl control-hauls including the Latvian territorial waters (Fig.1). Trawls with track number 28086, 28088, 28193 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. Five 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. Three additional trawls were realized in the Latvian EEZ (SD 26). 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 9 hauls, 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 all 503 cod and 5244 flounder. Length measurements in the 0.5-cm classes were realized for 2431 herring and 2510 sprat. In total, 352 cod and 446 flounder individuals were taken for biological analysis. Stomachs from the 237 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, 36 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 1 working day 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	2							
26	TVL	5							
26	TVL	6							
28	TVL	2	6		6				100
28	TVL	3	7		6				85.7
28	TVL	4	6		7				116.7
28	TVL	5	7		3	3			85.7
28	TVL	6	1			2			200

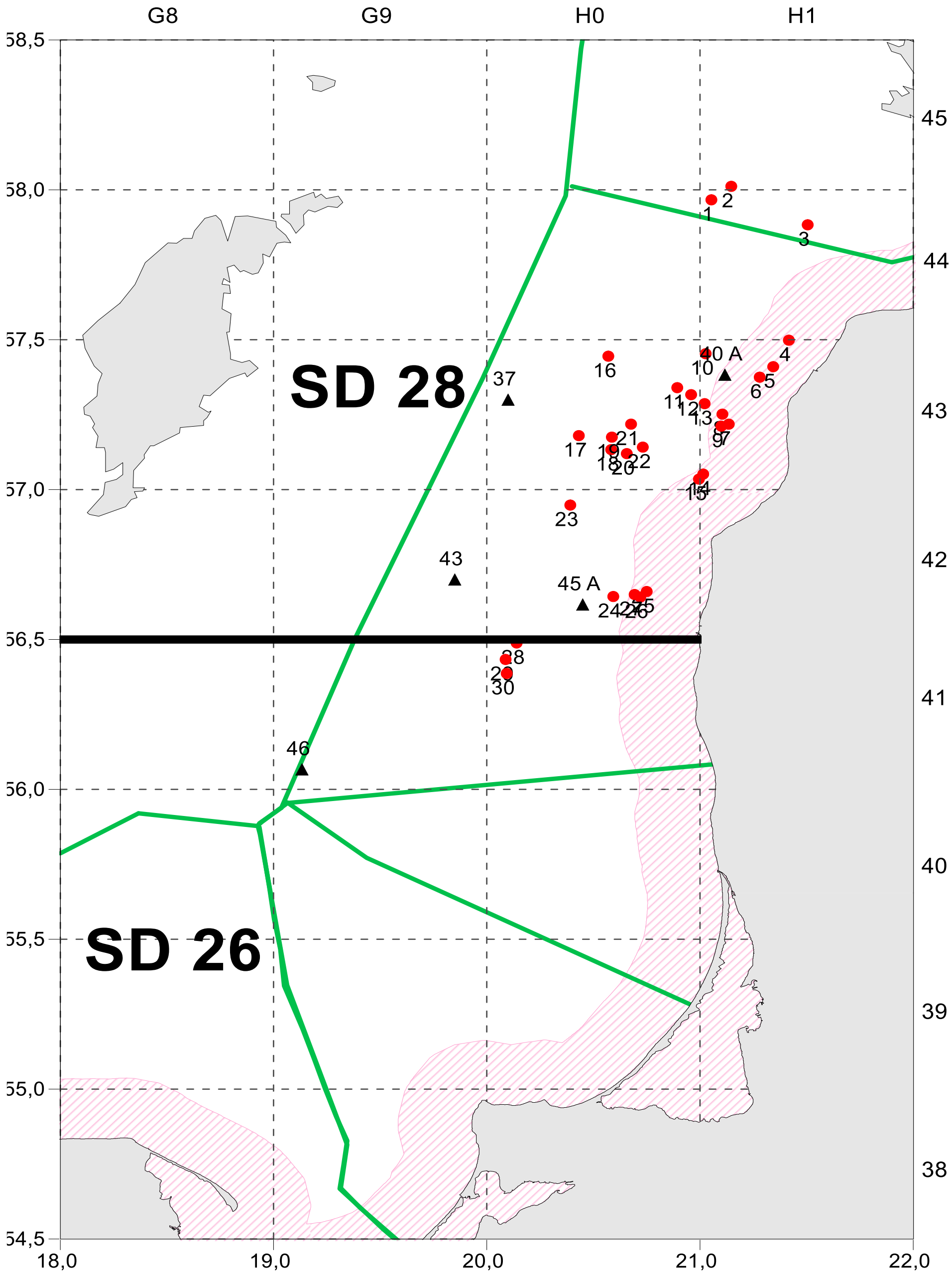


Figure 1. Location of the realized fish control-hauls (marked with red dots) and the HELCOM standard hydrological stations (marked with black triangles), green lines - national fishing zone borders.

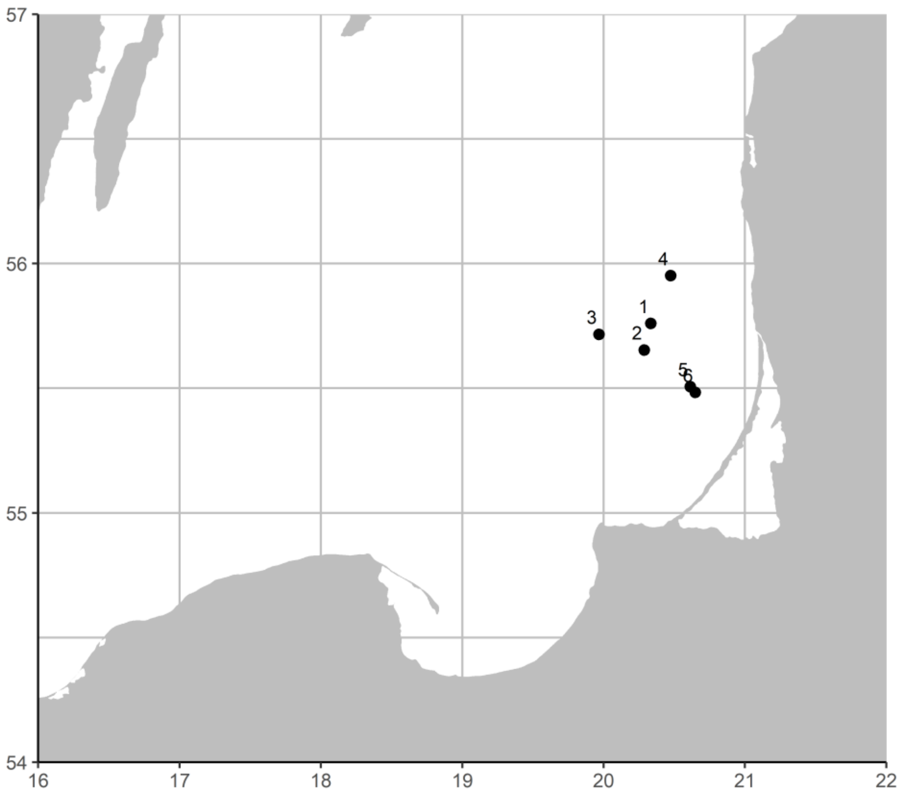
Number of biological samples (maturity and age material, *maturity only):		
Species	Length	Age
Platichthys flesus	5244	446
Sprattus sprattus	2510	
Clupea harengus	2431	
Gadus morhua	503	352
Myoxocephalus scorpius	491	
Zoarces viviparus	87	
Osmerus eperlanus	61	
Gasterosteus aculeatus	24	
Cyclopterus lumpus	23	
Pomatoschistus minutus	13	
Scophthalmus maximus	12	
Enchelyopus cimbrius	5	
Lumpenus lampretaeformis	3	
Gasterosteus pungitius	2	
Hyperoplus lanceolatus	2	
Neogobius melanostomus	2	
Pleuronectes platessa	1	
Triglopsis quadricornis	1	

Nation:	**Lithuania**	**Vessel:**	**LBB-1032**
Survey:	BITS2019Q1	Dates:	21th – 25th February 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-1032. Total 6 fishing hauls was performed. First three hauls was made November 21 and last three November 25.
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
26	TVS	2	3	3	-	-	-	-	100
26	TVS	3	3	3	-	-	-	-	100

Number of biological samples (maturity and age material, *maturity only):		
Species	**Length**	**Age**
Alosa fallax	2	
Clupea harengus	1068	
Cyclopterus lumpus	1	
Enchelyopus cimbrius	1	
Gadus morhua	1183	162
Myoxocephalus scorpius	130	
Osmerus eperlanus	2	
Platichthys flesus	768	335
Pleuronectes platessa	7	7
Psetta maxima	6	6
Sprattus sprattus	143	



Nation:	Denmark	Vessel:	Dana
Survey:	BITS	Dates:	11/3-26/3 - 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	Stomack 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					
3	TVL	20	22	0	0	0	0	110.0
4	TVL	20	20	0	0	0	0	100.0
5	TVL	14	8	0	0	0	0	57.1
6	TVL	0	3	0	0	0	0	#DIV/0!
		54	53	0	0	0	0	98.1

Number of biological samples (maturity and age material, *maturity only):			
Species	Age	Species	Age
Clupea harengus			
Gadus morhua			
Sprattus sprattus			

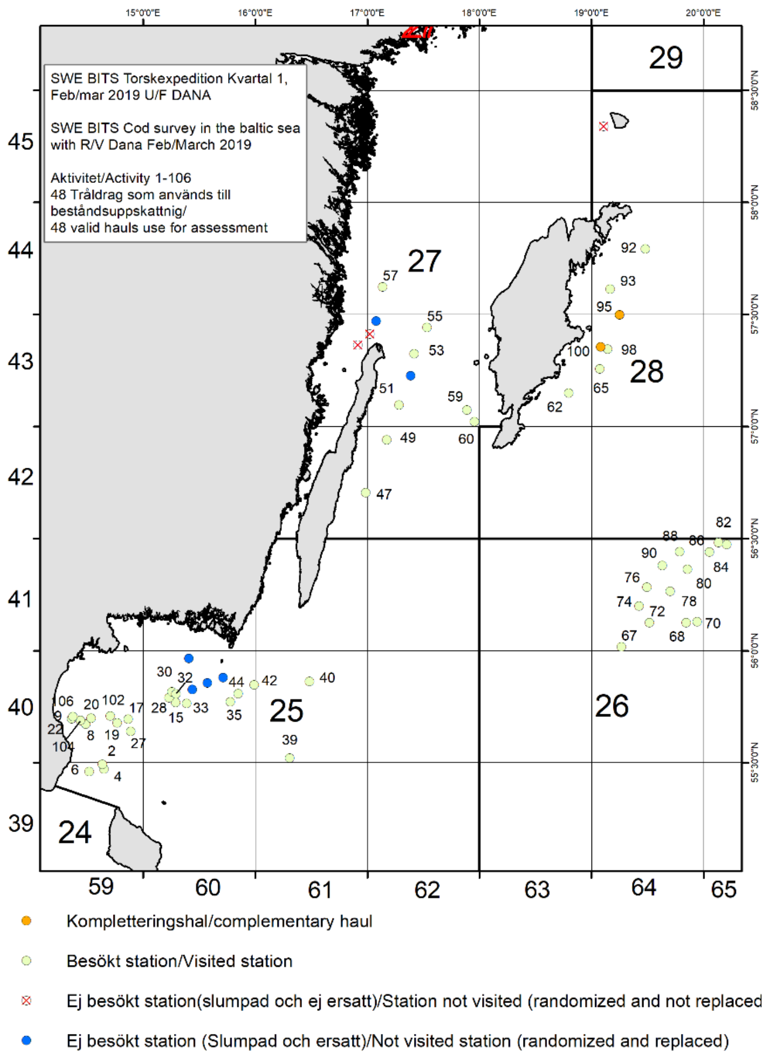
Nation:	**SWEDEN**	**Vessel:**	**RV "DANA"**
Survey:	BITS Q1 2019	Dates:	28 February - 10 Mars 2019

Cruise	
Gear details:	The large (930#) standard TV3 trawl was used. No tows are done with the rock hopper ground gear 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, whereof 32 were trawled. One invalid haul this time. Seven hauls in SD 26 and 27 had oxygen deficiency.
Additional comments:	The Swedish Armed Forces forbade nine stations. We could replace six stations this year.

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	3	-	0	0	0	100
25	TVL	3	17	16	-	0	6	1	100
25	TVL	4	3	3	-	0	0	0	100
26	TVL	3	2	1	-	0	0	0	50
26	TVL	4	2	3	-	0	1	0	150
26	TVL	5	3	3		0	0	0	100
26	TVL	6	4	0	-	4	0	0	100
27	TVL	3	2	0	-	0	0	0	0
27	TVL	4	7	5	-	2	2	0	100
27	TVL	5	1	0	-	1	0	0	100
28	TVL	3	2	2	-	0	0	0	100
28	TVL	4	1	0	-	0	0	0	0
28	TVL	5	4	4	-	0	0	0	100

Remark. Stations fished shows a low percentage mostly because of the Swedish armed forces prohibition.

Number of biological samples (maturity and age material, *maturity only):			
Specname sci.	***Lenght***	***Age***	***Stomach***
Agonus cataphractus	1		
Alosa fallax	1		
Ammodytes tobianus	1		
Aphia minuta	43		
Clupea harengus	51 197		
Cyclopterus lumpus	9		
Enchelyopus cimbrius	8		
Eutrigla gurnardus	1		
Gadus morhua	7 854	704	691
Gasterosteus aculeatus	267		
Hyperoplus lanceolatus	1		
Limanda limanda	63		
Lumpenus lampretaeformis	1		
Merlangius merlangus	699		
Myoxocephalus quadricornis	119		
Myoxocephalus scorpius	179		
Osmerus eperlanus	2		
Platichthys flesus	5 970		
Pleuronectes platessa	1 939		
Pollachius virens	76		



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 (11-21 December 2018)

by
Ivo Sics*, Radosław Zaporowski** and Lena Szymanek **

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** National Marine Fisheries Research Institute (NMFRI), Gdynia, Poland

Gdynia - Riga, January 2019

Introduction

The joint Latvian-Polish BITS survey, conducted in the period of 11-21.12.2018 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 and Lithuanian EEZs (the ICES Sub-divisions 26 and 28). It was part of the Baltic International Trawl Survey (BITS) programme, which was coordinated by the ICES Baltic International Fish Survey Working Group (WGBIFS) (Anon. 2018).

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 - 2018 survey scientific staff was composed of nine persons, i.e.:
Radosław Zaporowski, NMFRI, Poland - cruise leader,
Bartłomiej Nurek, NMFRI, Poland - acoustician,
Lena Szymanek, NMFRI, Poland - hydrologist,
Władysław Gaweł, NMFRI, Poland - ichthyologist,
Ivo Šics, BIOR, Latvia – scientific leader,
Janis Aizups, BIOR, Latvia - ichthyologist,
Guntars Strods, 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 11-21 December 2018 and overall eleven full days was devoted to survey plan accomplishment. The at sea investigations were conducted within the Latvian and Lithuanian EEZs (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 11.12.2018 at 00.05 o'clock and was navigated towards the south-western corner of the Latvian EEZs (Fig. 1). The direct at sea inestigations began on 11.12.2018 and ended on 19.12.2018. Due to the very bad weather forecast, in 19.12.2018 the ship left the working area and began return journey to home port. On 21.12.2018 r.v. "Baltica" returned to homeport.

Survey design and realization

The original survey plan provided that 24 control-hauls will be realized in the Latvian EEZ (9 trawls in SD 26, 15 trawls in SD 28) and 1 control-hauls in the Lithuania EEZ (SD 26). Five additional trawls were planned in the SD 26 (5 trawls in the Lithuanian EEZ).

The r.v. "Baltica" realized 31 bottom trawl control-hauls including the Latvian territorial waters (Fig.1). Trawl with track number 28084 was not in the correct depth zone as it was indicated in track database. This track with number 28084 was realized however with new track position in this area which was found within correct depth zone. Supplementary information on new track will be sent to track database administrator. Fifteen catch-stations were only initiated by hydrological parameters measurement and due to very low oxygen content (below 0.5 ml/l) near bottom, fishing was omitted. Five additional trawls were realized in the Lithuanian EEZ (SD 26).

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 5 hauls, their duration was shortened to 15-20 minutes, due to dense clupeids concentrations observed on the echosounder or bad fishing ground.

The length measurements in the 1.0-cm classes were realised for all 945 cod and 1519 flounder. Length measurements in the 0.5-cm classes were realized for 1653 herring and 1580 sprat. In total, 457 cod and 409 flounder individuals were taken for biological analysis. Stomachs from the 350 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 routes 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 bottom. The seawater samples were taken also at the standard HELCOM stations. Totally, 36 hydrological stations were inspected with the automatic CTD probe SeaBird 911 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 conducted at the actual geographic position of each control-haul.

Results

Fish catches and biological data

The control-catches basic results collected in December 2018 during the Latvian-Polish BITS-4Q survey are presented in Table 1. Overall, 14 fish species were recognised in hauls performed in the central-eastern Baltic. Herring dominated by mass in the ICES Sub-division 26 with the average share of 49.6%. Sprat was the next species most frequently represented in terms of mass, i.e. 42.9%. The share of cod and flounder in control-catches made up in the ICES SD 26 - 6.3 and 1.0%, respectively. By-catch of other fishes was insignificant.

Herring dominated by mass in the ICES Sub-division 28 with the average share of 63.1%. Flounder was the next species most frequently represented in terms of mass, i.e. 21.6%. Sprat was the third species most frequently represented in terms of mass in the ICES SD 28 (12.1%). The share of cod in control-catches made up 2.3% in the ICES SD 28. By-catch of other fishes was insignificant.

The mean CPUE for all species in ICES SD 26 amounted 160.6 kg/h, and in this 395.4, 355.1, 45.2 and 6.8 kg/h were for herring, sprat, cod and flounder, respectively.

The mean CPUE for all species in SD 28 amounted to 65.6 kg/h, and in this 275.0, 64.7, 96.6 and 10.7 kg/h were for herring, sprat, flounder and cod, respectively.

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

EEZ	Number of hauls	Total catch (kg)				
		Cod	Herring	Sprat	Flounder	Others
Latvian	25	56.1	1771.0	643.9	366.4	16.3
Lithuanian	6	138.6	497.4	612.3	17.7	0.2

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

Cod

The total length of cod in scrutinized samples from the ICES Sub-division 26 ranged from 14 to 47 cm and specimens from the length classes of 22 - 36 cm dominated in catches.. In total 732 cod was measured from hauls in ICES Sub-division 26.

The total length of cod in scrutinized samples from the ICES Sub-division 28 ranged from 15 to 42 cm and specimens from the length classes of 19 - 32 cm dominated in catches (Fig. 2, Table 3). In total 213 cod was measured from hauls in ICES Sub-division 28.

Flounder

The total length of flounder in samples from the ICES Sub-division 26 ranged from 19 to 33 cm. . In total 144 flounder was measured from hauls in ICES Sub-division 26.

The total length of flounder in scrutinized samples from the ICES Sub-division 28 ranged from 12 to 35 cm and specimens from the length classes of 12 - 35 cm dominated in catches (Fig. 3, Table 4).

Herring

The length range of herring collected in samples from the ICES Sub-divisions 26 was 12-25 cm, and specimens from the length classes of 15-22 cm were most the frequently represented (Fig. 4, Table 5).

The length range of herring collected in samples from the ICES Sub-divisions 28 was 9-26 cm, and specimens from the length classes of 15-22 cm were the most frequently represented (Fig. 4, Table 5).

Sprat

The length range of collected sprat was 7-14.5 cm. The length frequency apexes of 7.5-9.5 cm and 10-13.5 cm were characteristically for sprat samples from the ICES Sub-division 26 and the length frequency apexes of 7.0-9.0 cm and 10.0-12.5 cm were clearly visible for sprat samples from the ICES Sub-division 28 (Fig. 5, Table 6).

Hydrological situation in December 2018

Graphic illustration of the main hydrological parameters is shown in the figures 7 and 8. Hydrological parameters were measured at each trawling (31) and hydrological stations (5) (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 CTD 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) were observed from directions: ENE and NE. The average (10 min) wind speed varied from 1.0 m/s to 12.5 m/s (wind gusts up to 24.7 m/s). The air temperature ranged from -1.6 °C to 6.2 °C, and average temperature was 2.2°C.

The seawater temperature in the surface layer varied from 5.31 to 7.15 °C. The lowest values were observed at the vicinity of the trawl no. 9, while the warmest surface water was at the hydrological station 46. The average value equalled 6.54°C. The average surface salinity was 7.29 PSU. The minimum value was 7.05 PSU (trawl no. 9) and maximum 7.41 PSU (trawl no. 27). The highest oxygen content in surface layer was 8.40 ml/l (trawl no. 6), while the lowest one 7.07 ml/l (trawl no. 15A). Mean value of dissolved oxygen equalled 7.96 ml/l.

Near - bottom water layer conditions are presented in Fig. 7. Water temperature varied from 5.14 °C (trawl no. 26) to 9.39 °C (hydrological station 43). The mean value calculated for the whole area covered during the cruise was 6.43 °C. The average salinity in the close-to-the-bottom water layers was 9.98 PSU. The highest value was measured at the hydrological station 43 (13.88 PSU). The lowest one was 7.26 PSU (trawl no. 3). The dissolved oxygen varied from 0.00 ml/l (hydrological station 37) to 8.07 ml/l (trawl no. 10).The mean value was 2.56 ml/l.

In comparison to March 2018, the thickness of the low oxygen layer (less than 2 m/l) significantly increased. Currently, the hypoxia zone begins at about 70 m, which could be spotted in the vertical diagram of parameters from deepest hydrological station (37) (Fig. 8) Oxygen content in this water layer very quickly reaches a value close to zero, indicating anoxia-like state. The consequence of this is the increase of the spatial extent of the anoxic zone.

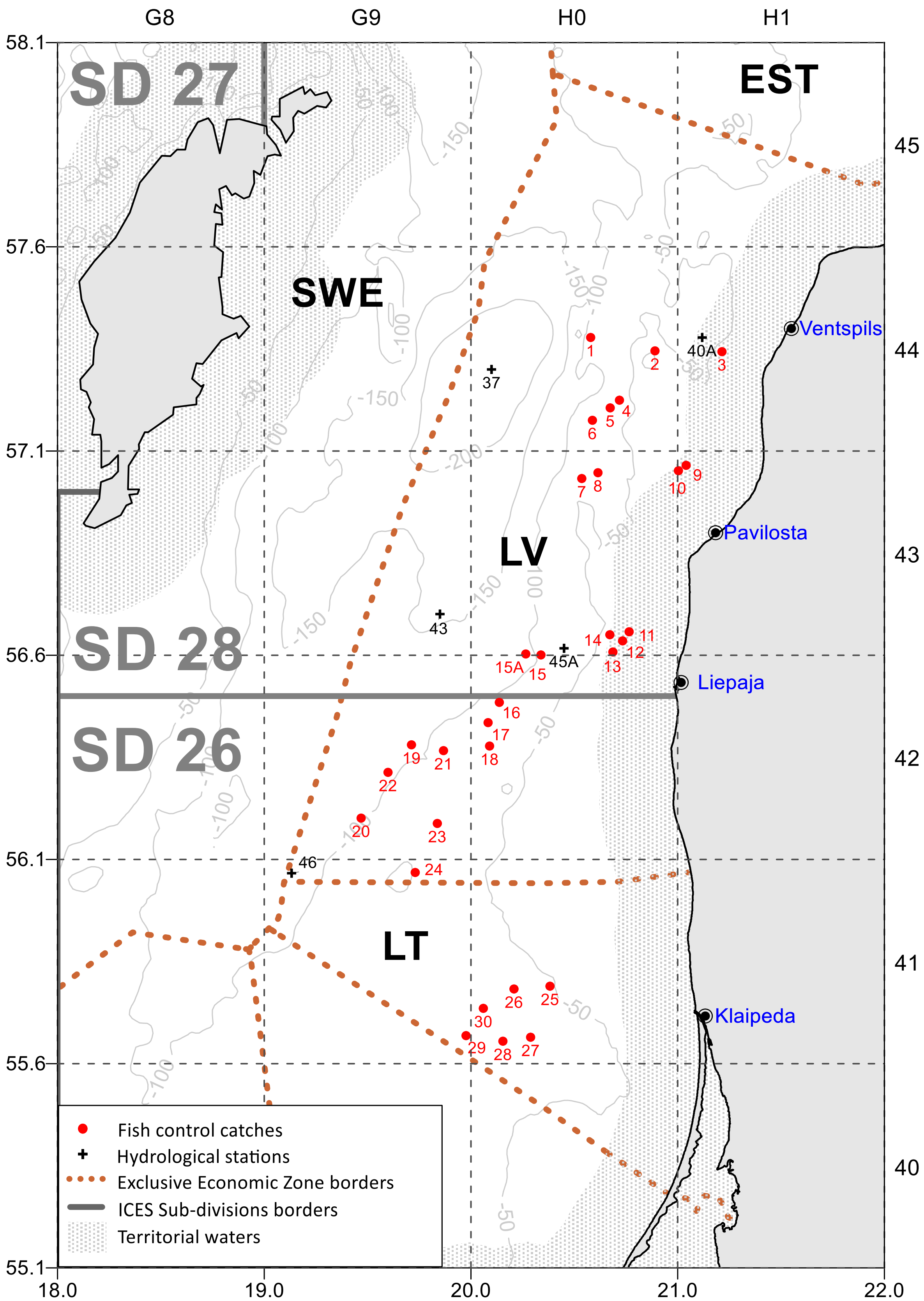

Figure 1. Locations of the fish bottom control catches and hydrological stations during the survey (December 2018).

Table 1. Catch results from the Latvian-Polish BITS 4Q survey; r.v. "Baltica", 11-21 December 2018

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	2018-12-12	LAT	43H0	28	95	000	57°20.4	20°35.6	57°20.4	20°35.6	07:35	07:40	5	0	0	0	0	0	0	0
2	2018-12-12	LAT	43H0	28	62	115	57°20.3	20°54.3	57°19.4	20°56.8	09:50	10:20	30	296.331	296.331	6.963	279.367	6.675	3.21	0.116
3	2018-12-12	LAT	43H1	28	63	210	57°22.1	21°14.6	57°22.6	21°14.0	12:35	12:50	15	142.003	284.006	58.017	52.134	3.6	27.64	0.612
4	2018-12-13	LAT	43H0	28	77	220	57°13.4	20°43.6	57°13.4	20°43.6	07:50	07:55	5	0	0	0	0	0	0	0
5	2018-12-13	LAT	43H0	28	84	220	57°12.3	20°40.4	57°12.3	20°40.4	08:20	08:25	5	0	0	0	0	0	0	0
6	2018-12-13	LAT	43H0	28	95	190	57°10.5	20°35.2	57°10.5	20°35.2	09:05	09:10	5	0	0	0	0	0	0	0
7	2018-12-13	LAT	43H0	28	86	308	57°01.9	20°22.2	57°01.9	20°22.2	10:45	10:50	5	0	0	0	0	0	0	0
8	2018-12-13	LAT	43H0	28	86	090	57°02.8	20°36.9	57°02.8	20°36.9	11:25	11:30	5	0	0	0	0	0	0	0
9	2018-12-14	LAT	43H1	28	31	200	57°03.3	21°01.7	57°01.9	21°00.6	08:20	08:50	30	166.498	166.498	37.262	85.324	3.23	39.7	0.982
10	2018-12-14	LAT	43H0	28	29	195	57°02.5	20°59.9	57°01.0	20°59.0	09:30	10:00	30	115.526	115.526	23.188	69.671	3.141	18.83	0.696
11	2018-12-14	LAT	42H0	28	40	225	56°39.0	20°44.9	56°37.9	20°43.1	13:30	14:00	30	494.405	494.405	30.263	438.567	6.95	18.54	0.085
12	2018-12-15	LAT	42H0	28	41	225	56°38.8	20°44.9	56°37.8	20°43.0	08:20	08:50	30	202.59	202.59	27.392	109.009	9.48	53.2	3.509
13	2018-12-15	LAT	42H0	28	40	045	56°36.9	20°41.6	56°38.0	20°43.2	09:30	10:00	30	66.043	66.043	2.983	7.12	2.205	51.78	1.955
14	2018-12-15	LAT	42H0	28	49	210	56°38.4	20°39.3	56°37.2	20°37.7	10:50	11:20	30	177.66	177.66	14.824	6.681	3.74	145.66	6.755
15	2018-12-15	LAT	42H0	28	91	210	56°36.0	20°20.3	56°36.0	20°20.3	12:55	13:00	5	0	0	0	0	0	0	0
15A	2018-12-15	LAT	42H0	28	116	000	56°36.2	20°15.7	56°36.2	20°15.7	13:40	13:45	5	0	0	0	0	0	0	0
16	2018-12-16	LAT	41H0	26	88	055	56°28.9	20°07.9	56°28.9	20°07.9	07:50	07:55	5	0	0	0	0	0	0	0
17	2018-12-16	LAT	41H0	26	83	215	56°26.0	20°05.0	56°26.0	20°05.0	08:40	08:45	5	0	0	0	0	0	0	0
18	2018-12-16	LAT	41H0	26	77	30	56°23.5	20°05.5	56°24.7	20°06.3	10:20	10:50	30	302.835	302.835	99.532	196.988	1.65	4.665	0
19	2018-12-16	LAT	41G9	26	110	275	56°22.8	19°42.4	56°22.8	19°42.4	13:00	13:05	5	0	0	0	0	0	0	0
20	2018-12-16	LAT	41G9	26	102	195	56°12.0	19°27.1	56°12.0	19°27.1	15:50	15:55	5	0	0	0	0	0	0	0
21	2018-12-17	LAT	41G9	26	83	025	56°21.1	19°51.2	56°22.4	19°52.6	08:30	09:00	30	145.798	145.798	70.43	69.57	4.425	1.37	0.003
22	2018-12-17	LAT	41G9	26	107	250	56°18.0	19°31.5	56°18.0	19°31.5	10:35	10:40	5	0	0	0	0	0	0	0
23	2018-12-17	LAT	41G9	26	58	180	56°07.8	19°50.4	56°10.0	19°50.4	12:40	13:00	20	397.563	596.3445	242.6	152.12	1.203	0.99	0.65
24	2018-12-17	LAT	41G9	26	55	260	56°04.1	19°46.2	56°04.1	19°44.5	14:10	14:30	20	346.444	519.666	30.492	304.458	9.77	0.835	0.889
25	2018-12-18	LIT	40H0	26	51	305	55°47.5	20°22.6	55°48.4	20°20.5	08:20	08:50	30	190.929	190.929	0.896	81.914	92.64	15.31	0.169
26	2018-12-18	LIT	40H0	26	62	170	55°46.0	20°13.6	55°45.1	20°13.3	10:00	10:20	20	373.214	559.821	197.039	154.611	21.42	0.144	0
27	2018-12-18	LIT	40H0	26	71	225	55°39.5	20°16.5	55°38.9	20°15.3	11:45	12:05	20	389.8	584.7	259.86	110.59	17.59	1.76	0
28	2018-12-18	LIT	40H0	26	75	185	55°38.6	20°09.4	55°37.2	20°09.4	13:25	13:55	30	312.23	312.23	154.478	150.322	6.99	0.44	0
29	2018-12-19	LIT	40G9	26	79	030	55°40.1	19°58.6	55°40.1	19°58.6	07:55	08:00	5	0	0	0	0	0	0	0
30	2018-12-19	LIT	40H0	26	71	035	55°44.1	20°03.6	55°44.1	20°03.6	08:45	08:50	5	0	0	0	0	0	0	0

Table 2. Number of fish biologically analysed during the BITS 4Q survey; r.v. "Baltica" (11-21 December 2018).

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	8	8	16	481	7	488	251	206	457	192	158	350
Flounder	8	8	16	29	1081	1110	115	294	409			
Herring	8	8	16	825	828	1653						
Sprat	8	8	16	766	814	1580						
Turbot	0	1	1	0	1	1						
Eelpout	0	4	4	0	22	22						
Snake Blenny	1	0	1	1	0	1						
Greater Sandeel	0	2	2	0	11	11						
Smelt	1	5	6	1	18	19						
Three-spined Stickleback	1	2	3	1	3	4						
Lumpfish	1	3	4	1	4	5						
Sea Scorpion	2	6	8	9	78	87						
Plaice	1	0	1	1	0	1						
Twaite Shad	1	0	1	1	0	1						
Total	40	55	95	2116	2867	4983	366	500	866	192	158	350

Fig. 2. Length frequency of cod from Sub-Divisions 26 and 28 in the control catches during the r/v "Baltica" BITS survey, 11-21 December 2018

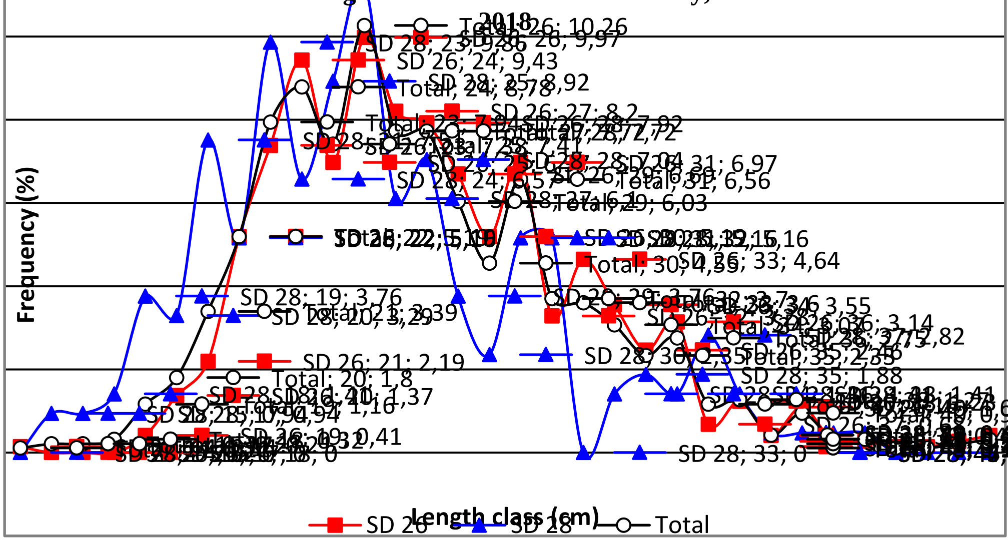

Fig. 3. Length frequency of flounder from Sub-Divisions 26 and 28 in the control catches during the r/v "Baltica" BITS survey, 11-21 December 2018

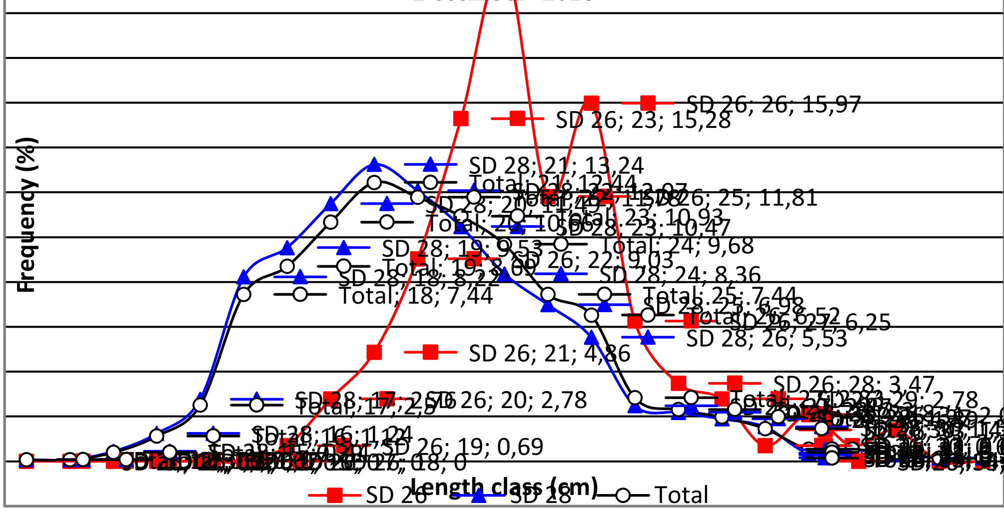

Fig. 4. Length frequency of herring from Sub-Divisions 26 and 28 in the control catches during the r/v "Baltica" BITS survey, 11-21 December 2018

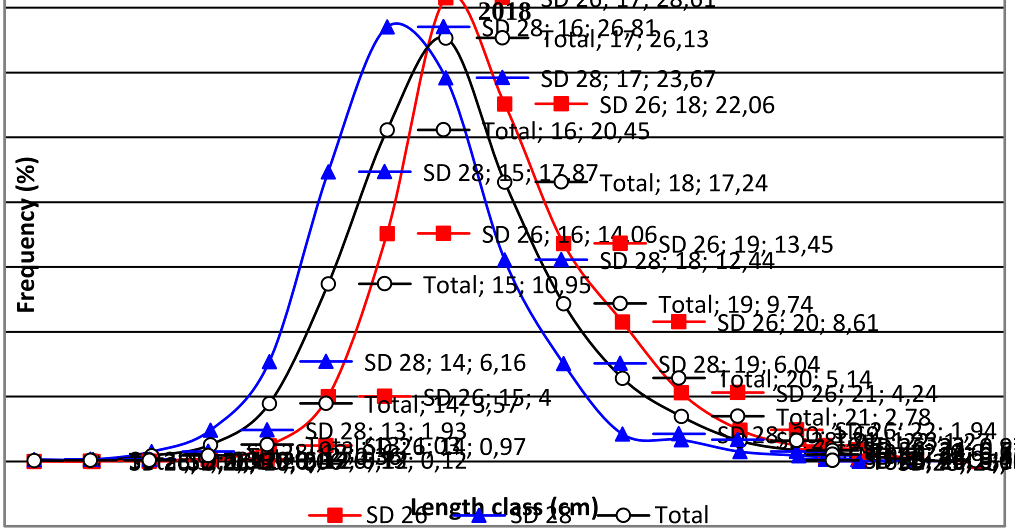

Fig. 5. Length frequency of sprat from Sub-Divisions 26 and 28 in the control catches during the r/v "Baltica" BITS survey, 11-21 December 2018

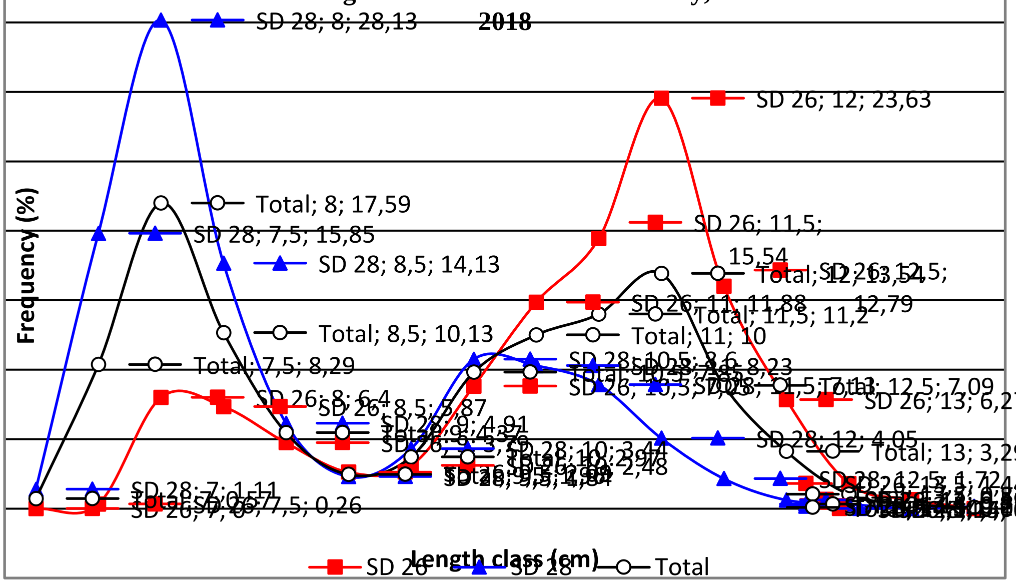

Table 3. Cod length measurements by consecutive hauls in the r.v. “Baltica” Latvian - Polish BITS 4Q survey (11-21 December 2018); specimens grouped by 1 cm length classes.

		cm_group																															
Haul no	SD	14	15	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	44	45	46	47	Sum
2	28				1			3	3	5	3	3	3	1	3	2	1	3	1		1	1		1	1									36
3	28		1	2	1	2	1	3	1	3	2	5	3	1	2	2																		29
9	28							2	2		1	2			1		2	1	2				1	1										15
10	28									1	1				4	2		2	2			1												13
11	28					2		3	1	3	2	3	7	1	3		1	1	1		1		1	2	1			1						34
12	28					2	2		1	5	4	4	4	6	2	1	1	2	3		1	2	1	1	1		1		1					45
13	28						1		1	4		1	1					1	1					1		1								12
14	28		1		1	2	3	5	2		1	1	6	4		1		1	1															29
18	26								1				1									2	2											6
21	26						1	1	5	7	3	2	2	2	2	4			1					1										31
23	26								1		2		1	1											1									6
24	26					2	1	5	6	8	4	8	12	4	4		1	3	1		1	1										1		62
25	26	1				1	5	7	18	21	31	27	36	30	32	32	25	38	15	24	17	10	17	4	6	2	4	1	2		1		1	408
26	26						3	2	4	10	17	6	12	14	10	9	7	6	2	4	3	2	2			1	2							116
27	26							1	2	5	6	5	5	8	7	1	2	4	4	4	4	2	2		2		1	1		1			2	69
28	26								1	3	6	3	4	1	3	3	3		1	2	1	1					1					1		34
SD 26		1				3	10	16	38	54	69	51	73	60	58	49	38	51	24	34	26	18	23	5	9	3	8	2	2	1	1	2	3	732
SD 28			2	2	3	8	7	16	11	21	14	19	24	13	15	8	5	11	11		3	4	3	6	3	1	1	1	1					213
Total		1	2	2	3	11	17	32	49	75	83	70	97	73	73	57	43	62	35	34	29	22	26	11	12	4	9	3	3	1	1	2	3	945

Table 4. Flounder length measurements by consecutive hauls in the r.v. “Baltica” Latvian - Polish BITS 4Q survey (11 - 21 March 2018); specimens grouped by 1 cm length classes.

		cm_group																						
Haul no	SD	12	13	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	Sum
2	28						2	1		2	4	3	3	1	3	2	1								22
3	28			1	6	10	30	21	35	33	19	25	23	8	10	6	6	1	1						235
9	28			2	6	18	32	50	34	46	50	29	19	14	14	3	6	10	5	1	1	1	1		342
10	28		1	1	2	5	23	19	19	17	18	10	7	5	5	4	4	1	4	1	3	1	1		151
11	28	1					5	7	11	16	14	19	16	15	11	6	1	3	3	1	1				130
12	28			1	1	3	9	15	20	23	27	18	20	19	11	1	3	5		1					177
13	28			1	2	2	11	16	33	27	22	22	15	20	12	5	7	1	3	1		1		1	202
14	28						1	2	6	18	12	18	12	14	10	7	2	5	5		2	1		1	116
18	26								3	3	2	3	6	4	4	2		1		1					29
21	26										1			1	4			1							7
23	26										1		1	1		1	1								5
24	26										1	2	2					1							6
25	26							1	1	3	8	14	20	11	10	6	4	1	1	2	1	1			84
26	26											1													1
27	26									1		2	1		4							1			9
28	26												2		1										3
SD 26								1	4	7	13	22	32	17	23	9	5	4	1	3	1	2			144
SD 28		1	1	6	17	38	113	131	158	182	166	144	115	96	76	34	30	26	21	5	7	4	2	2	1375
Total		1	1	6	17	38	113	132	162	189	179	166	147	113	99	43	35	30	22	8	8	6	2	2	1519

Table 5. Herring length measurements by consecutive hauls in the r.v. "Baltica" Latvian-Polish BITS 4Q survey (11- 21 December 2018); specimens grouped by 0.5 cm length classes.

		cm_group																														
Haul no	SD	9.5	10	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	22.5	23	23.5	24	24.5	25	26	Sum
2	28	1	1				1		3	4	13	13	14	13	15	6	7	8	1	1	1	2										104
3	28					1		3	4	5	12	17	8	20	11	8	1	6	2	1	1		1		1							102
9	28			3			1	5	4	12	15	10	12	7	7	7	5	3	1	2	2	2	1	1		1	1				1	103
10	28				1	5	4	6	8	6	13	15	18	12	7	3	3	1	2				1									105
11	28							1	1	5	6	12	14	10	19	17	8	3	3	1	1	1			1		1					104
12	28					1	1	2	2	5	10	15	19	16	7	13	2	5	2	2	1		1	1								105
13	28				1		2	5	2	6	6	12	13	11	18	11	1	4	7	1		1	1					1				103
14	28							2	3	13	17	13	17	18	5	5	6	2						1								102
18	26							2		2	5	4	16	16	13	13	7	9	8	7		2	1		1							106
21	26					1					2	2	9	18	17	16	8	10	4	5	3	4		2				1				102
23	26							1	1		1	7	16	21	10	15	6	10	3	5	2	4	2			1						105
24	26								2		3	2	10	13	12	14	12	9	3	9	2	4	1	5		1						102
25	26								1	3	10	4	11	19	12	6	9	6	2	3	3	4	1		3	1		1	1	1		101
26	26				1					2		6	8	15	13	19	5	6	6	6	9	1	1		2		1	1				102
27	26										2	8	5	19	13	14	11	9	8	3	3	2	3	2		1						103
28	26							1			3	4	4	12	13	17	10	12	6	8	3	2	3	1		2	1	2				104
SD 26					1	1		4	4	7	26	37	79	133	103	114	68	71	40	46	25	23	12	10	6	6	2	5	1	1		825
SD 28		1	1	3	2	7	9	24	27	56	92	107	115	107	89	70	33	32	18	8	6	6	5	3	2	1	2	1			1	828
Total		1	1	3	3	8	9	28	31	63	118	144	194	240	192	184	101	103	58	54	31	29	17	13	8	7	4	6	1	1	1	1653

Table 6. Sprat length measurements by consecutive hauls in the r.v. "Baltica" Latvian-Polish BITS 4Q survey (11- 21 December 2018); specimens grouped by 0.5 cm length classes.

		cm_group															
Haul no	SD	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
2	28		2	6	10	10	3	5	17	16	15	7	3	2				96
3	28		7	18	13	11	5	4	11	20	12	5	1					107
9	28	1	22	41	16	3	1	1	4	6	4	3	1					103
10	28	1	18	29	15	3	1	2	4	4	15	6	3		1			102
11	28		10	39	22	4	2	5	7	3	3	2	2	1				100
12	28	1	4	29	26	4	2	6	12	7	7	3	2				1	104
13	28	6	19	25	6	2		5	15	11	2	7	2	1				101
14	28		47	42	7	3	1								1			101
18	26			4	4	4	5	7	9	16	14	25	9	3		1		101
21	26				3	3	2	1	12	13	16	31	14	6	1			102
23	26			12	10	8	2	2	10	17	21	17	6	3	1			109
24	26			1	3	2	1	4	6	14	19	27	16	6	1	2		102
25	26		1	10	2	1			2		2	6	3	2	6			35
26	26			8	5	3	2	2	5	8	17	29	18	11	1	1		110
27	26		1	11	12	4	3	2	7	18	15	16	9	5	1			104
28	26			3	6	4	1	1	3	5	15	30	23	12				103
SD 26			2	49	45	29	16	19	54	91	119	181	98	48	11	4		766
SD 28		9	129	229	115	40	15	28	70	67	58	33	14	4	2		1	814
Total		9	131	278	160	69	31	47	124	158	177	214	112	52	13	4	1	1580

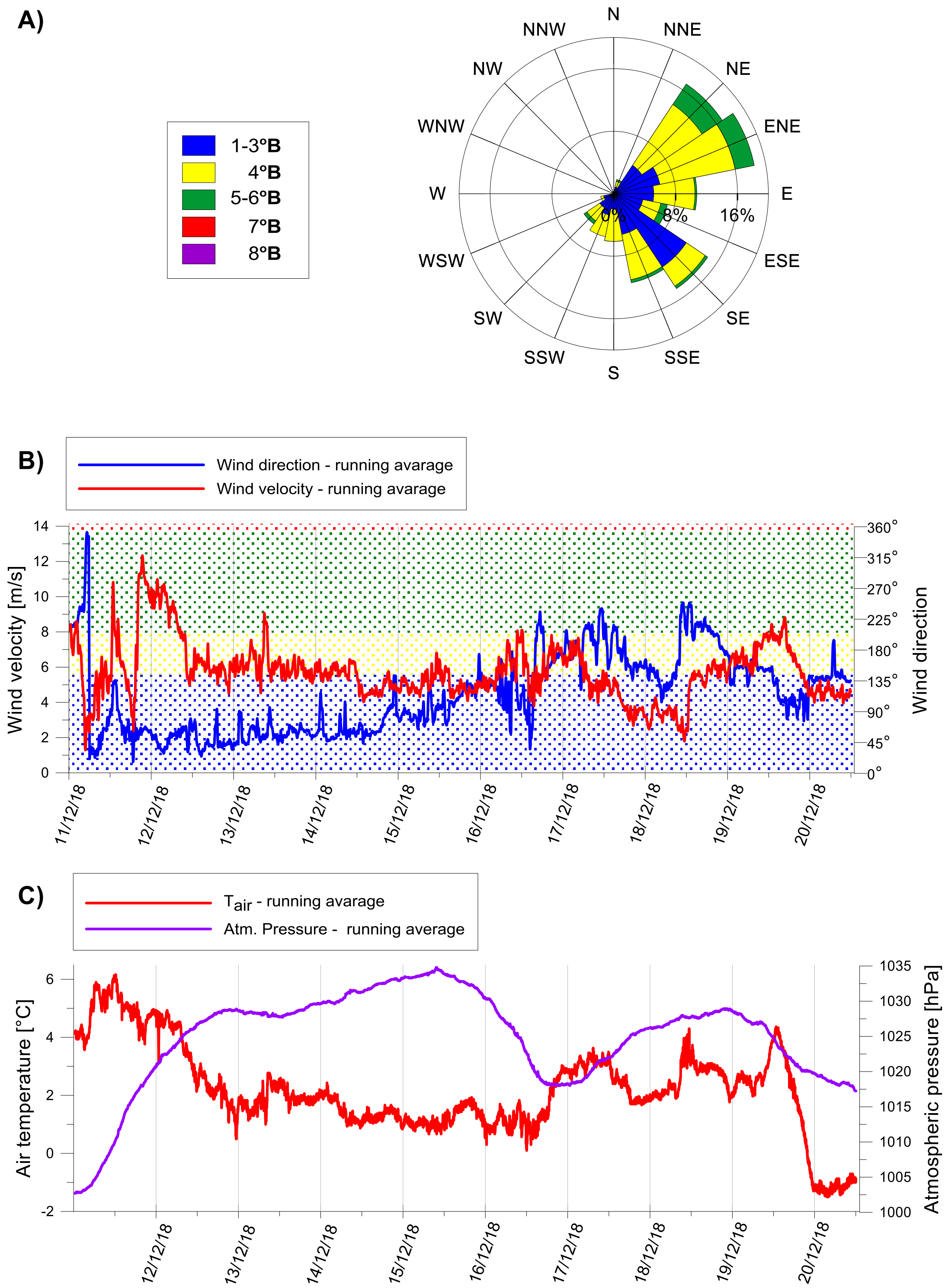

Figure 6. Changes of the main meteorological parameters (December 2018).

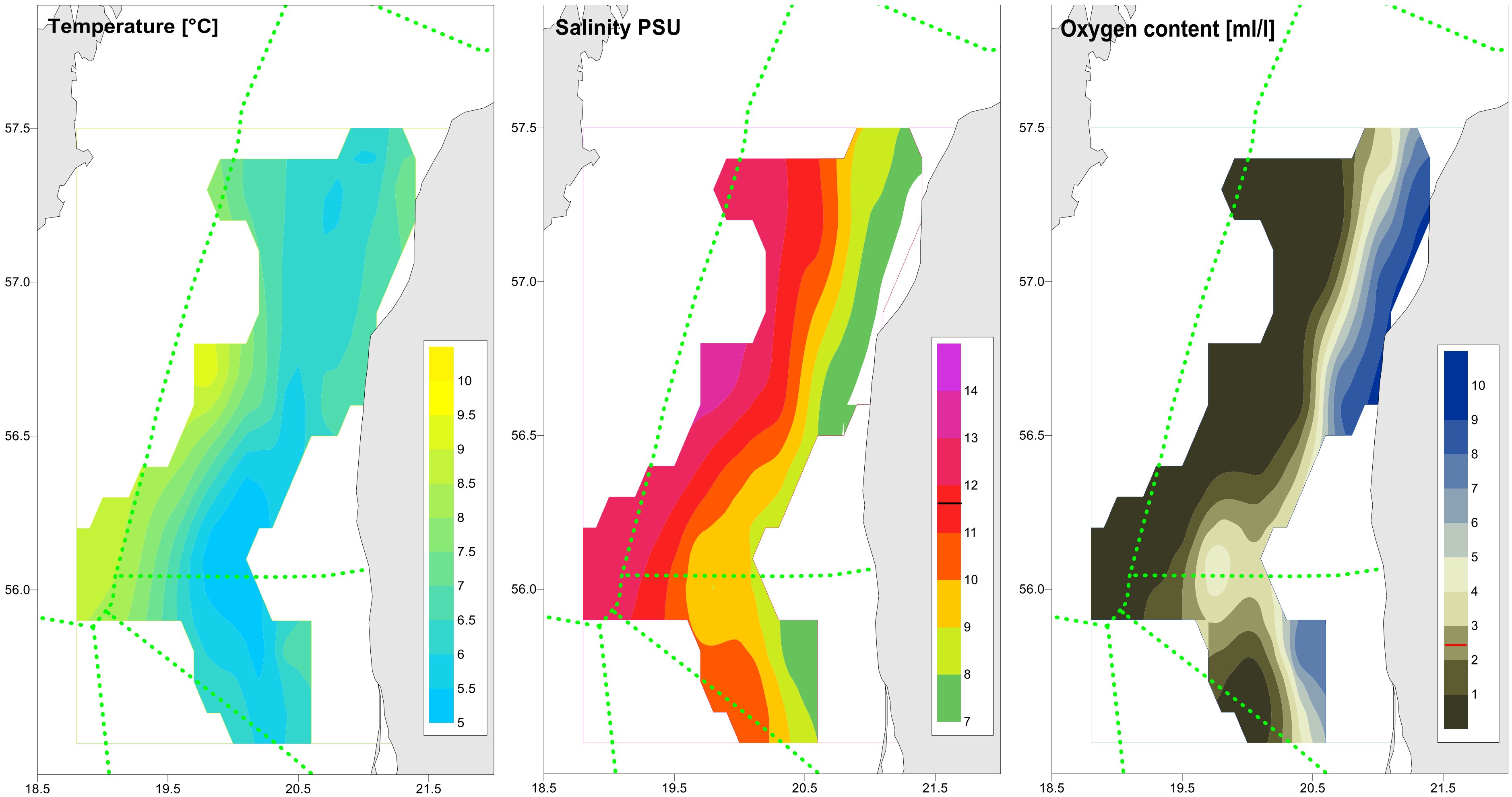

Figure 7. Distribution of the seawater temperature, salinity and oxygen content in the near bottom waters (December 2018).

Figure 8.Vertical distribution of the seawater temperature, salinity and oxygen content at the hydrological profile 37 (December 2018).

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CRUISE REPORT

FROM THE POLISH R/V BALTICA BITS 4Q 2018 SURVEY
IN THE SOUTHERN BALTIC
(14 November - 01 December 2018)

by

Krzysztof Radtke and Tycjan Wodzinowski

Gdynia, 15 January 2019

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. 2018). The main aim of the BITS-4Q survey planned in autumn 2018 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 2018 survey, which was realized in the Polish part of the ICES Sub-divisions 24, 25, 26 and Swedish part of the ICES Sub-division 25, 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 2018 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.

MATERIAL AND METHODS

The above purposes of the November 2018 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 meteorological monitoring.

Narrative

The reported Polish ground-trawl survey on board of R/V Baltica, marked with the number 22/2018/MIR took place during the period of 14.11-01.12.2018 within the framework of the ICES Baltic International Trawl Surveys (BITS) long-term programme (Anon. 2018) and the Polish Fisheries Data Collection Programme for 2018. The vessel left the port of Gdynia on 14.11.2018 in the morning and at sea investigations began in the eastern part of the Gulf of Gdańsk (Fig. 1, Tab. 1). During the period of 21-24.11. 2018, the investigations were conducted in Swedish waters. The survey ended on 01.12.2018 (morning) in Gdynia harbour. The R/V Baltica operated mostly in the Polish EEZ. Overall, eighteen 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. The vessel technical fault resulting from failure of the engine cooling system was the reason of two days earlier survey termination than the planned schedule.

Survey design and realization – sampling description

According to the WGBIFS plan, the Polish vessel was recommended to cover in November/December 2018 survey, the Polish part of ICES Sub-divisions 24, 25 and 26 with 3, 21 and 18, respectively randomly selected bottom control-hauls. and also in Swedish EEZ to cover Swedish part of ICES Sub-division 25 with 12 control-hauls. The R/V Baltica realized 54 of the 60 planned hauls for this survey. Due to the ships technical problems with engine, six hauls planned in Gdańsk Bay was not realized. It can be concluded that the 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 5-7 m vertical net opening was achieved, which was monitored by the net echosounder. The catch stations were located on the depth range from 23 to 102 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 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, 4339 cod, 3413 flounder, 565 plaice, 22 turbot, 6551 sprat and 8066 herring were taken for the length and mass determination. In total, 435, 776, 455, 22, 584 and 1105, 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 4339 cod, 3413 flounder, 565 plaice, 6551 sprat and 8066 herring. Data on pathological symptoms were registered based on the visual inspection of fish taken to the length measurements.

Every control-haul was preceded by the measurements of basic hydrological parameters continuously from the sea surface to the bottom. Overall, 80 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 2018 is presented in Figure 1.

RESULTS

Fish catches and biological data

Twenty two species were recognized in 54 scrutinized bottom catches (Table 1). Only two fish species – red mullet and European anchovy represent fish species permanently inhabiting Atlantic Ocean.

Cod, herring, flounder and sprat were the most frequently occurring fish species in the catches - 96%, 91%, 81% and 79% of 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.

Cod catches were generally low. The highest average cod CPUE has been recorded in ICES SD 24 – 57 kg/1h (Fig. 2). Lower result of CPUE was observed in ICES SD 25 (48 kg/1h) and in ICES SD 26 – 30 kg/1h. In the same cruise from November 2017 r., CPUEs of cod in ICES SDs 24, 25 and 26 were markedly higher and amounted to 121, 143 and 244 kg/1h of cod, respectively.

Sprat, out of all fish species found in catches, predominated in terms of CPUE in ICES SDs 24, 25 and 26, respectively - 92, 189 and 114 kg/1h. In the last year's survey, the sprat CPUEs were significantly lower - 0.7, 107 and 11.7 kg/1h respectively.

The highest CPUE of herring was obtained in ICES SD 25 – 185 kg/1h. However, in ICES SDs 24 and 26 CPUEs of herring were markedly higher and amounted to 72 and 78 kg/1h, respectively. In comparison with the November 2017 cruise, the current year CPUEs were higher (by 50 kg/1h on average) in ICES SD 25 but in ICES SDs 24 and 26 lower CPUEs were noted – by 20 and 34 kg/1h, respectively.

CPUEs in ICES SDs 24 and 25 were characterized by the lowest values among the four fish species reported. The CPUEs in above mentioned SDs amounted to 51 and 15 kg/1h. The CPUE of flounder in ICES SD 26 amounted to 101 kg/1h and it was the second largest CPUE in this SD (higher for sprat, but lower for herring and cod). In comparison with the November 2017 cruise, the average CPUEs obtained this year were higher in ICES SDs 26 and 24 by 4 and 39 kg/1h, respectively, while in ICES SD 25 the CPUE this year was lower by 7 kg/1h.

Length distributions of main fish species according to the ICES Sub-divisions are illustrated in Figure 3. Similarly as in the cruise in November 2017, in the cruise of the current year, there was a slight variation in the length of cod in ICES SDs 25 and 26. In the ICES SD 25 there was a clearly marked single peak of cod frequency, which amounted 9.2%, and corresponded to length class 27 cm. Two cod length fractions in cod length distribution curve from ICES SD 24 were distinguished. Those with smaller sizes were concentrated around 17-19 cm length classes and larger cods, clustered around 31-37 cm length classes. Cod length distribution in ICES SD 24 indicated a smaller share of cod in the range of 20-29 cm length classes than in ICES SDs 25 and 26, and for the 31-39 cm length classes, the share of cod in the ICES SD 24 was larger. The curves of the length distributions of herring in ICES SDs 25 and 26 indicate the occurrence of two fish length fractions of this species in these SDs. Herring of smaller sizes in ICES SDs 25 and 26 contained fish with a range of length classes of 9.5-15 cm and 8.5-14 cm, respectively. Fish above the upper limit of the selected length ranges formed a larger size fish fraction. For herring from the ICES SD 24, three length fractions have been found. The smallest herring, in the range of length classes - 11.5-15 cm, herring with medium length - 16-20.5 cm and herring of the largest length - 21-28 cm. The length distribution of herring indicates that the fish of this species inhabiting in ICES SD 24 consisted of the most favourable length distribution, because the share of fish from the largest length classes - 21-28 cm was the highest.

In the length distributions of sprat obtained in the three ICES SDs investigated, there were found two peaks in each of length distributions observed. The first peak in length distribution curve (from the beginning of the horizontal axis on the chart) in ICES SDs 24, 25 and 26, corresponded to length classes - 9.5 cm (17.3%), 9.5 cm (14.0%) and 8.5 cm (7.2%), respectively. The second peak in the length distribution curve corresponded - in the above mentioned Subdivisions - to the following length classes - 13.5 cm (16.5%), 12.5 cm (16.9%) and 12.0 cm (19.4%). Sprat of the most favourable length distribution for commercially fishery was observed in ICES SD 24.

The smallest flounder were found in ICES SD 26 (modal length – 19-20 cm). In ICES SD 24 higher share of larger flounder was observed than in ICES SD 26. However, the highest share of larger flounder was noted in ICES SD 25. Length distribution of flounder in ICES SD 24 was characterized by well distinguished peak of frequency (18%), which corresponded to length class 25 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 86.4% and 72.8%, respectively. In ICES SD 24 the share of undersized fish amounted to 63.7%. In the same cruise in November 2017, the share of undersized cod was lower and amounted to 81.6%, 69% and 37%, respectively. The total share of undersized cod from the last survey was very high and amounted to 82.1%. Numerical share of undersized herring decreased westward. The share of the undersized fraction in ICES SDs 26, 25 and 24 amounted to 37.2%, 11.0% and 9.8%, respectively. The largest share of undersized sprat was observed in samples form ICES SD 25 (27.3%). Undersized sprat share in ICES SD 26 amounted to 21.7%, while in ICES SD 24 to 19.2%. The share of undersized flounder was low in ICES SDs 24 and 25 – 8.5% and 6.6%, respectively. In ICES SD 26 the undersized fraction of flounder was markedly higher and amounted to 54.1%.

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 2017 cruise):

ICES Sub-division	para-meter	sprat	herring	cod	flounder
24	mean length [cm]	12.1 (9.4)	20.2 (19.4)	31.6 (31.4)	26.3 (24.6)
25		11.5 (10.6)	18.7 (18.2)	29.3 (31.0)	28.0 (27.3)
26		11.4 (11.4)	17.0 (16.2)	31.0 (30.5)	21.0 (21.5)
whole survey		11.5 (10.7)	18.3 (17.7)	29.8 (30.9)	23.4 (24.6)
24	mean mass [g]	12.1 (5.3)	55.6 (45.5)	318.0 (316.7)	203.8 (157.9)
25		10.1 (8.1)	40.0 (39.7)	232.8 (298.3)	257.2 (222.2)
26		9.3 (9.9)	31.7 (30.6)	277.0 (302.4)	109.9 (119.8)
whole survey		9.9 (8.4)	38.7 (37.7)	247.3 (300.2)	158.0 (173.3)

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 (3.3%) and flounder (21%). With regard to cod, there was a slight increase in the share of cod with diseases compared to the results obtained in the cruise in 2017 (2.8%). The share of herring and sprat with observed pathological symptoms was insignificant and amounted to 0.33% and 0.031% respectively.

Hydrological situation in the southern Baltic

In the near-bottom water layer (Fig. 6) temperatures in the range from 12.08°C to 5.13°C were noted. The lowest temperature was noted in the control haul no 19, while the highest in hydrological station no 15. The highest salinity was recorded in hydrological station no 16 (Bornholm Deep) (17.87 on the PSU scale). In hydrological station IBY5, monitored permanently during BITS surveys in Bornholm Basin, the salininy at the bottom was 17.86 on the PSU scale. Salinity measured in Gdańsk Deep amounted to 13.78 in hydrological station (G2). The lowest oxygen content in the water was noted on the hydrological station IBY5 (1.48 ml/l), while in the neighbouring hydrological station no 16 oxygen was 0.91 ml/l. In Gdańsk Deep the oxygen content noted in hydrological station G2 was 1.72 ml/l.

Surface water temperature fluctuated from 11.11°C to 6.74°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 2018 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.

References:

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.

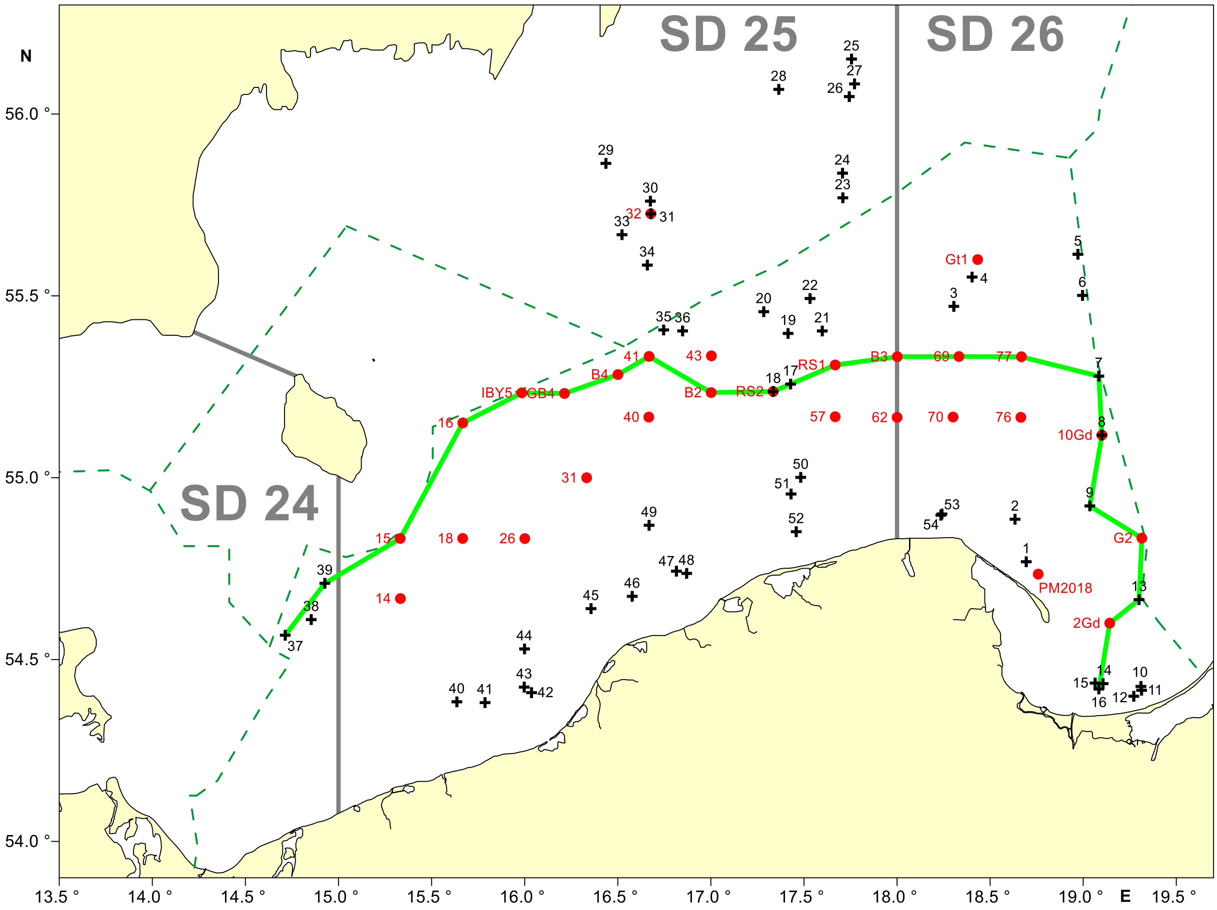

Fig. 1. Location of fish control-hauls (black crosses) and hydrological standard stations (red dots) realised during the r/v Baltica BITS-4Q survey (14.11-01.12. 2018). (green solid line indicates hydrological research profile).

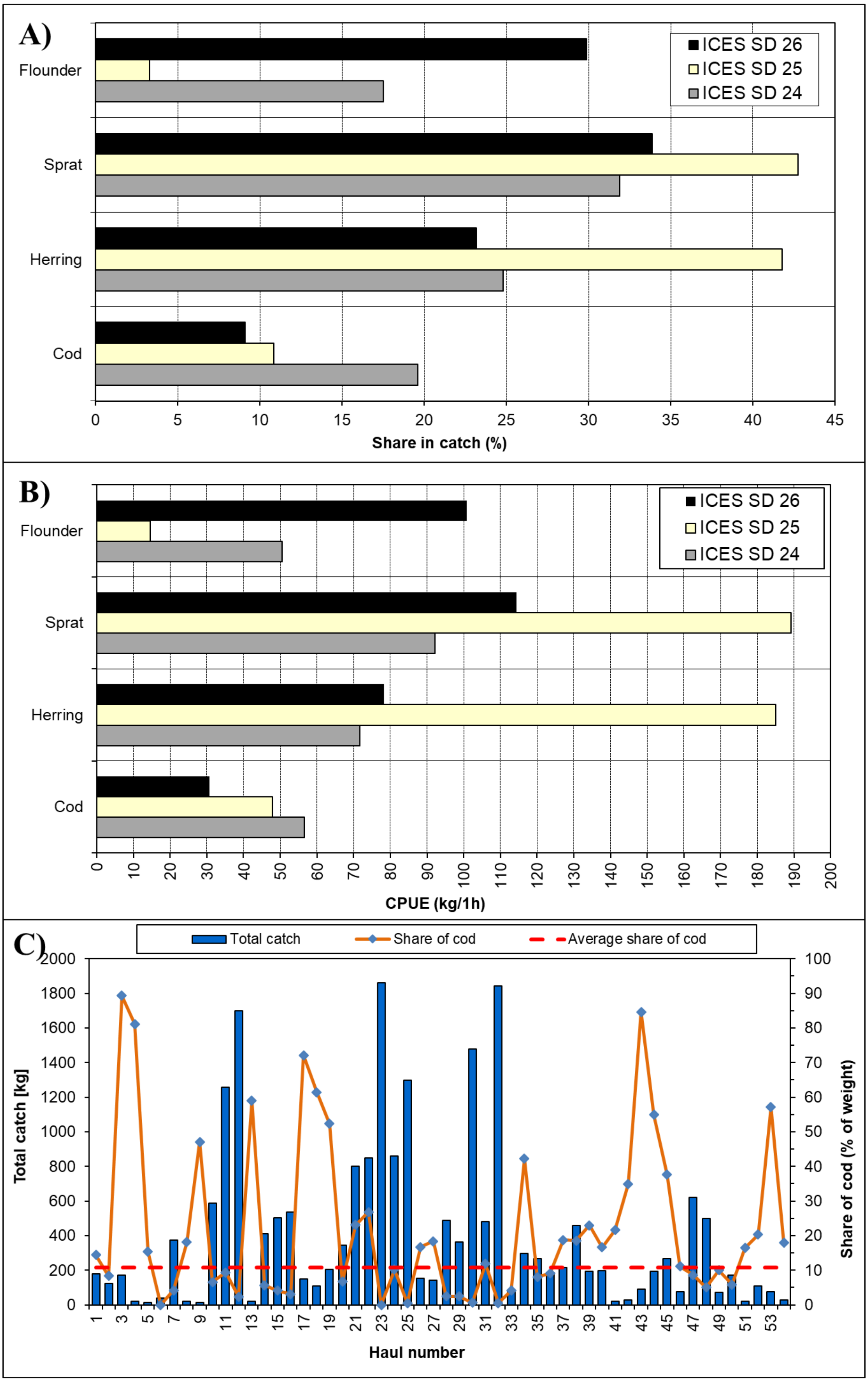

Fig. 2. Mean share in mass of control hauls (A), and mean CPUE (B) of dominant fish species, and share of cod (C) in particular catches conducted during r/v Baltica BITS-4Q survey (14.11-01.12. 2018).

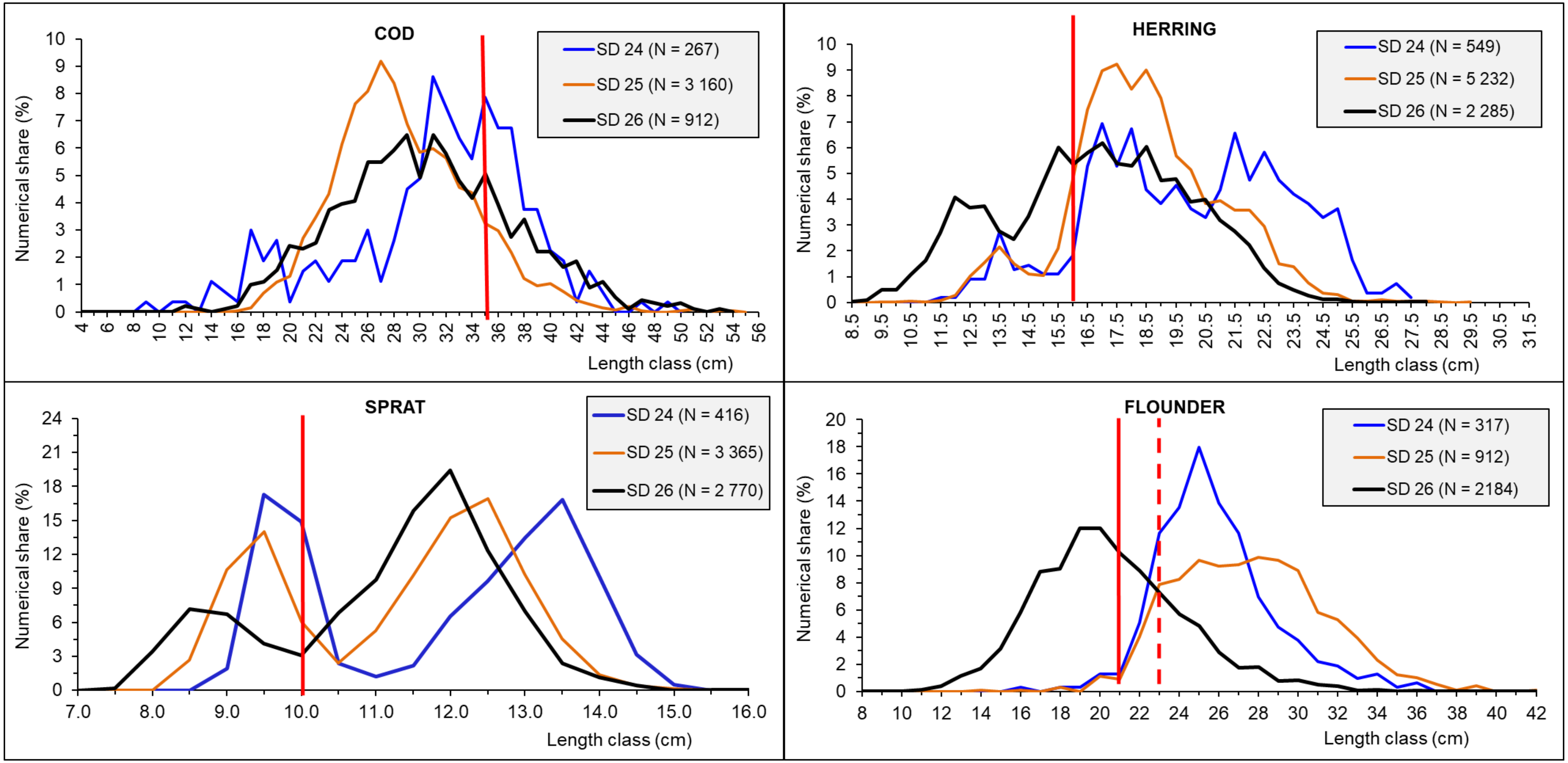

Fig. 3. Length distributions of cod, herring, sprat and flounder in samples from fish control hauls conducted during r/v Baltica BITS-4Q survey (14.11-01.12. 2018).

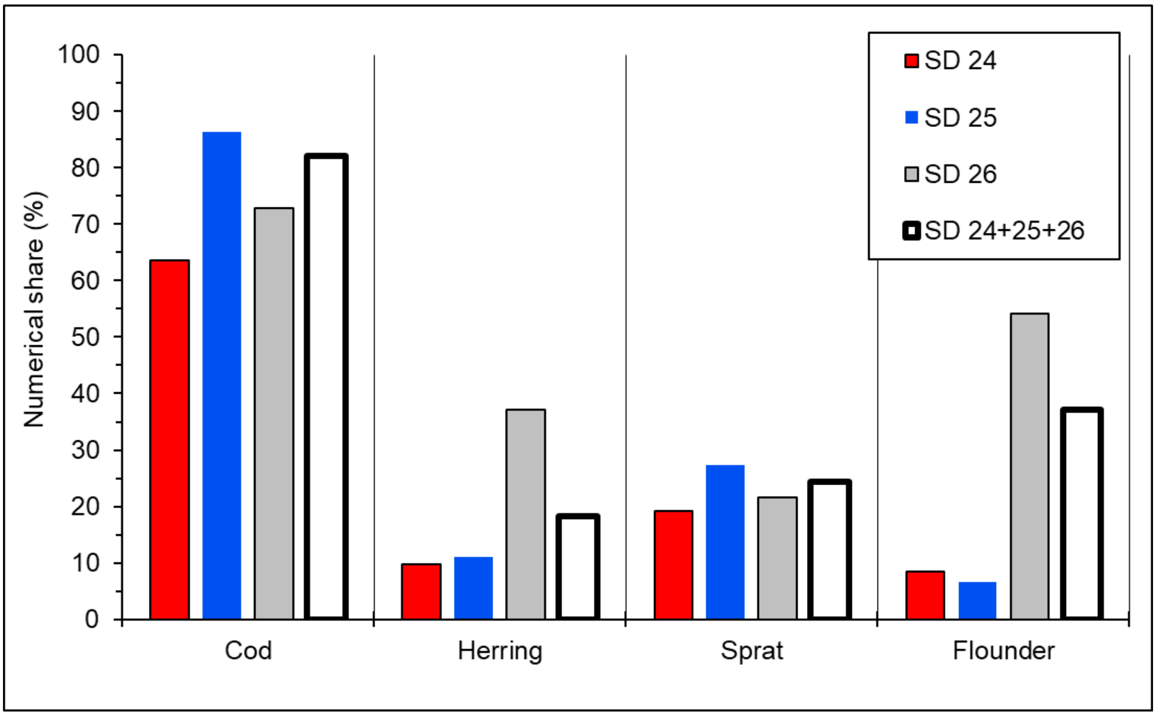

Fig. 4. Mean numerical share (in %) of undersized fish species in samples from fish control hauls conducted during r/v Baltica BITS-4Q survey (14.11-01.12. 2018).

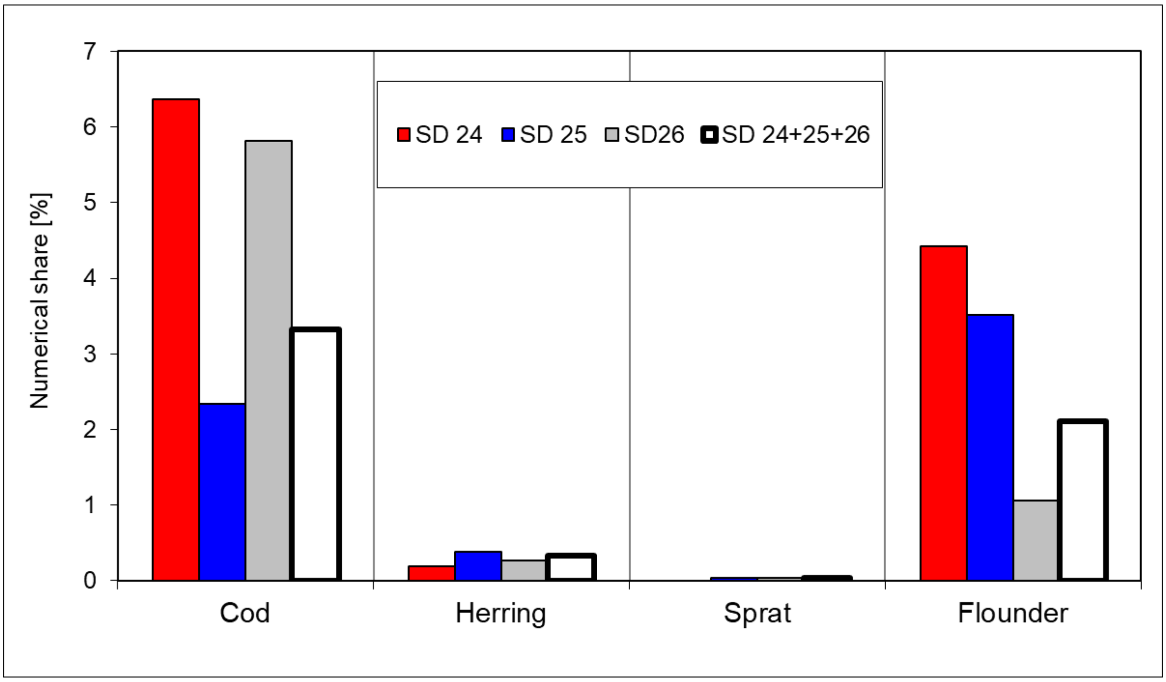

Fig. 5. Mean prevalence (in %-indiv.) of fish with externally visible diseases in samples from fish control hauls conducted during r/v Baltica BITS-4Q survey (14.11-01.12. 2018).

Tab. 1. Number of fish species individuals measured and aged during r/v Baltica BITS-4Q survey (14.11-01.12. 2018).

Species name	Number of fish mesured (l.t)				Numer of fish aged and weighed (g)			
	26 ICES Sub-division	25 ICES Sub-division	24 ICES Sub-division	total	26 ICES Sub-division	25 ICES Sub-division	24 ICES Sub-division	total
Round goby	0	0	1	1	0	0	0	0
Sand goby	0	0	1	1	0	0	0	0
Red mullet	0	1	0	1	0	0	0	0
Ninespine stickleback	0	1	0	1	0	0	0	0
Three-spined stickleback	0	4	0	4	0	0	0	0
Greater sandeel	0	144	4	148	2	0	0	2
Cod	267	3160	912	4339	151	154	130	435
Plaice	129	234	202	565	137	209	109	455
Short-horn scorpion	1	146	26	173	5	0	0	5
Hooknose	0	2	1	3	0	0	0	0
River lamprey	0	0	4	4	0	0	0	0
Fourbeard rockling	2	185	101	288	0	17	0	17
Twaite shad	0	1	16	17	0	0	0	0
Anchovy	0	4	0	4	0	0	0	0
Turbot	3	16	3	22	3	16	3	22
Flounder	317	912	2184	3413	355	266	155	776
Smelt	0	1	450	451	4	0	0	4
Sprat	416	3365	2770	6551	200	284	100	584
Baltic herring	549	5232	2285	8066	351	611	143	1105
Lumpfish	1	3	0	4	0	0	0	0
Eelpout	0	2	8	10	0	0	0	0
Whiting	34	1	1	36	0	0	0	0
TOTAL	1719	13414	8969	24102	1208	1557	640	3405

Tab. 2. Fish control-hauls data obtained during r/v Baltica BITS-4Q survey (14.11-01.12. 2018).

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	hauling up net	Trawling duration [min]	Total catch [kg]	Weight of the catch by fish species [kg]: Cod	Herring	Sprat	Flounder	Plaice	Turbot	Hooknose	Eelpout	Fourbeard rockling	Three-spined stickleback	Lumpfish	Short-horn scorpion	Round goby	Sand goby	Smelt	Twaite shad	Whiting	Greater sandeel	Ninespine stickleback	Anchovy	Red mullet	River lamprey
1	26169	2018-11-14	38G8	26	33	54°46.4'	18°41.5'	54°47.5'	18°40.4'	12:55	13:25	30	88.938	12.8	61.086	3.726	10.53	0.188							0.109			0.167		0.275	0.057				
2	26019	2018-11-14	38G8	26	48	54°53.5'	18°37.7'	54°54.8'	18°36.9'	14:50	15:20	30	62.356	5.221	31.289	1.131	23.32	0.705							0.622			0.068							
3	26099	2018-11-15	39G8	26	86	55°27.9'	18°19.5'	55°27'	18°21.8'	07:32	08:02	30	85.66	76.54	5.918	2.132		0.129				0.941													
4	26212	2018-11-15	40G8	26	92	55°34.6'	18°23.8'	55°35.9'	18°22.8'	09:45	10:15	30	11.017	8.94	0.977	1.1																			
5	26290	2018-11-15	40G8	26	87	55°36.1'	18°58.6'	55°34.7'	18°59.2'	14:30	15:00	30	6.641	1.02	5.314	0.307																			
6	26107	2018-11-16	40G8	26	87	55°30.5'	18°59.6'	55°29.8'	18°59.6'	07:30	07:45	15	9.745		2.495	7.25																			
7	26045	2018-11-16	39G9	26	82	55°16.4'	19°5.1'	55°14.9'	19°5.6'	10:16	10:46	30	187.634	7.915	117.4	61.94						0.379													
8	26091	2018-11-16	39G9	26	93	55°7.2'	19°4.3'	55°7.2'	19°1.9'	12:30	13;00	30	9.577	1.735	1.291	6.42						0.131													
9	26257	2018-11-16	38G9	26	102	54°57.2'	19°2.5'	54°55.8'	19°2.7'	14:41	15:11	30	6.121	2.88	1.229	1.901						0.111													
10	26261	2018-11-17	37G9	26	53	54°25.7'	19°18.2'	54°25.5'	19°15.7'	07:35	08:05	30	292.907	19.4	86.029	54.429	126.16	1.614				1.885			0.34	0.002		2.946							0.102
11	26163	2018-11-17	37G9	26	43	54°24.9'	19°18.3'	54°24.9'	19°16.6'	09:35	09:55	20	418.573	39.28	47.58	137.114	181.27	4.963	0.033		0.072	0.269			0.372			6.804	0.688						0.128
12	26216	2018-11-17	37G9	26	37	54°24.2'	19°16.2'	54°24.4'	19°18.5'	11:41	12:11	30	849.538	20.18	83.684	561.691	177.07	2.221	0.235		0.281				2.317			1.669	0.19						
13	26191	2018-11-17	38G9	26	88	54°38.1'	19°18.4'	54°39.4'	19°18'	14:15	15:15	30	11.066	6.52	2.309	1.833	0.373			0.03							0.001								
14	26289	2018-11-18	37G9	26	55	54°26.5'	19°5.9'	54°26.2'	19°8.2'	07:32	08:02	30	205.878	11.69	48.994	32.841	93.6	2.158				3.095						13.5							
15	26014	2018-11-18	37G9	26	52	54°26.3'	19°3.1'	54°26.2'	19°4.7'	09:17	09:37	20	167.738	6.82	45.585	7.822	97.63	0.762			0.068	3.779						5.133							0.139
16	26220	2018-11-18	37G9	26	44	54°25.3'	19°4.8'	54°25.3'	19°2.3'	10:45	11:15	30	268.714	8.354	113.649	67.432	31.02	0.579			0.131				0.701			46.47	0.26						0.118
17	25339	2018-11-20	39G7	25	87	55°15.8'	17°23.4'	55°15.9'	17°20.9'	08:00	08:30	30	74.823	53.93	6.701	1.004	6.071	3.691				3.426													
18	25463	2018-11-20	39G7	25	91	55°14.1'	17°18.1'	55°14.2'	17°15.7'	10:00	10:30	30	55.187	33.9	5.132	0.104	2.855	3.886				9.15								0.16					
19	25084	2018-11-20	39G7	25	60	55°23.7'	17°23.5'	55°23.2'	17°21.1'	12:50	13:20	30	101.635	53.21	41.634	5.241	0.702	0.155							0.693										
20	25455	2018-11-20	39G7	25	44	55°27.3'	17°15.8'	55°26.7'	17°13.3'	14:27	14:57	30	172.744	11.535	129.965	20.529	8.514	0.285	0.529						1.387										
21	25250	2018-11-21	39G7	25	68	55°24.2'	17°34.2'	55°24.1'	17°31.8'	07:50	08:20	30	399.75	92.08	296.235	0.282	8.491	0.868				1.6			0.194										
22	25030	2018-11-21	39G7	25	42	55°29.4'	17°30.7'	55°28.9'	17°28.3'	09:55	10:25	30	424.266	113.78	266.403	28.165	11.46	0.137	1.291						3.03										
23	25136	2018-11-21	40G7	25	58	55°46.8'	17°42.1'	55°47.5'	17°41.7'	13:45	14:00	15	464.86		0.469	464.391																			
24	25309	2018-11-21	40G7	25	60	55°50.7'	17°41.6'	55°51.3'	17°40.8'	15:00	15:15	15	215.167	21.87	190.519	2									0.778										
25	25038	2018-11-22	41G7	25	52	56°9'	17°45.8'	56°8.9'	17°44.5'	07:50	08:05	15	324.152	1.755	315.1	0.672	0.601						0.034		5.99										
26	25410	2018-11-22	41G7	25	64	56°3.4'	17°45'	56°4.7'	17°46.1'	09:31	10:01	30	76.016	12.681	58.109	3.122	1.733					0.2			0.171										
27	25504	2018-11-22	41G7	25	64	56°4.7'	17°45.9'	56°3.4'	17°45'	11:05	11:35	30	70.696	13	49.56	6.588	0.931					0.339	0.002		0.274							0.002			
28	25461	2018-11-22	41G7	25	41	56°4.3'	17°22.7'	56°4.9'	17°25.1'	13:46	14:16	30	244.694	5.96	224.29		11.42	0.747							2.277										
29	25403	2018-11-23	40G6	25	53	55°52'	16°26.8'	55°51.9'	16°29.3'	08:00	08:30	30	180.771	4.37	83.202	90.135	2.084	0.197				0.565	0.017		0.201										
30	25462	2018-11-23	40G6	25	55	55°46'	16°39.8'	55°46.7'	16°38.6'	10:22	10:42	20	492.944	2.795	86.682	403.209		0.258																	
31	25505	2018-11-23	40G6	25	53	55°43.5'	16°40.5'	55°43.9'	16°42'	12:00	12:20	20	160.06	18.93	54.664	85.596	0.49	0.38																	
32	25509	2018-11-23	40G6	25	53	55°44'	16°42.3'	55°43.5'	16°40.1'	12:50	13:20	30	921.402	4.595	69.097	845.444	1.482	0.722											0.062						
33	25450	2018-11-23	40G6	25	62	55°40.6'	16°32.4'	55°41.4'	16°34.4'	14:40	15:10	30	39.678	1.63	4.18	33.52	0.345						0.003												
34	25389	2018-11-24	40G6	25	54	55°35.6'	16°40'	55°37.1'	16°40.9'	07:50	08:20	30	148.077	62.48	80.713	1.91	1.606	1.159				0.209													
35	25080	2018-11-24	39G6	25	54	55°24.6'	16°45.8'	55°25.1'	16°48.1'	10:30	11:00	30	133.315	10.77	87.873	32.937	0.348				0.035				1.352										
36	25081	2018-11-24	39G6	25	56	55°24.3'	16°51.6'	55°24.6'	16°54'	11:45	12:15	30	93.495	8.47	71.369	8.331	1.375								3.95										
37	24055	2018-11-25	38G4	24	36	54°34'	14°43.6'	54°33.6'	14°46'	08:01	08:31	30	108.441	20.29	41.32		39.57	6.93	0.214						0.11					0.007					
38	24150	2018-11-25	38G4	24	47	54°36.9'	14°48.4'	54°36.8'	14°50.8'	09:45	10:15	30	228.428	42.43	52.945	98.165	28.32	2.402	1.073					0.448						2.645					
39	24162	2018-11-25	38G4	24	55	54°42'	14°54.8'	54°40.8'	14°53.5'	12:10	12:40	30	96.563	22.19	13.203	40.052	7.936	8.103				0.223								4.856					
40	25008	2018-11-26	37G5	25	30	54°23'	15°37.1'	54°23'	15°34.6'	08:00	08:30	30	98.494	16.36	59.76		17.1	3.154	0.699	0.01					1.396						0.015				
41	25009	2018-11-26	37G5	25	30	54°22.9'	15°46.3'	54°22.8'	15°43.7'	10:00	10:30	30	11.09	2.395	4.96		2.845	0.268							0.523			0.083			0.016				
42	25011	2018-11-26	37G6	25	27	54°24.5'	16°1.3'	54°24.4'	16°0.1'	12:25	12:40	15	6.839	2.39			2.856	0.658							0.506						0.429				
43	25010	2018-11-26	37G6	25	28	54°25.6'	16°0.5'	54°25.9'	16°1.6'	13:17	13:32	15	22.211	18.795			2.409	0.639	0.23						0.126						0.012				
44	25042	2018-11-26	38G6	25	46	54°32.3'	16°0'	54°33.8'	16°0'	14:51	15:21	30	96.625	53.02	32.547	1.995	6.365	1.751						0.947											
45	25013	2018-11-27	38G6	25	33	54°38.6'	16°22.1'	54°39.2'	16°24.4'	07:55	08:25	30	134.232	50.48	59.701	2.151	16.635	4.365	0.757	0.036					0.107										
46	25014	2018-11-27	38G6	25	28	54°40.6'	16°35.3'	54°41.3'	16°37.5'	09:37	10:07	30	37.412	4.145	8.858	0.086	20.02	2.573	0.309						1.126						0.243		0.052		
47	25016	2018-11-27	38G6	25	31	54°44.8'	16°49.5'	54°45.7'	16°51.3'	11:30	12:00	30	310.341	26.63	34.995	226.57	16.695	4.609							0.688						0.023			0.131	
48	25017	2018-11-27	38G6	25	29	54°44.7'	16°53.5'	54°45.9'	16°55.1'	13:00	13:30	30	248.692	12.405	61.179	146.898	25.915	1.277	0.574						0.321						0.123				
49	25004	2018-11-27	38G6	25	23	54°52.4'	16°43.2'	54°52.3'	16°40.8'	15:00	15:30	30	35.209	3.535	17.71		12.69	1.132			0.142														
50	25364	2018-11-28	39G7	25	33	55°0'	17°27.7'	54°59.9'	17°25.2'	08:00	08:30	30	85.307	4.98	53.41		24.82	1.905						0.192											
51	25022	2018-11-28	38G7	25	27	54°57.4'	17°24.9'	54°57.2'	17°22.3'	09:21	09:51	30	10.743	1.765		0.056	7.618	0.64	0.209												0.455				
52	25024	2018-11-28	38G7	25	24	54°51.2'	17°28.4'	54°51.3'	17°30.8'	11:15	11:45	30	54.271	11.03	21.37		18.06	0.321	0.514												2.976				
53	26274	2018-11-29	38G8	26	24	54°54.2'	18°13.3'	54°54'	18°10.4'	07:56	08:26	30	37.841	21.62			15.493	0.15							0.435			0.058			0.085				
54	26005	2018-11-29	38G8	26	23	54°53.9'	18°12.9'	54°53.9'	18°11.1'	09:21	09:41	20	9.45	1.7			7.75																		

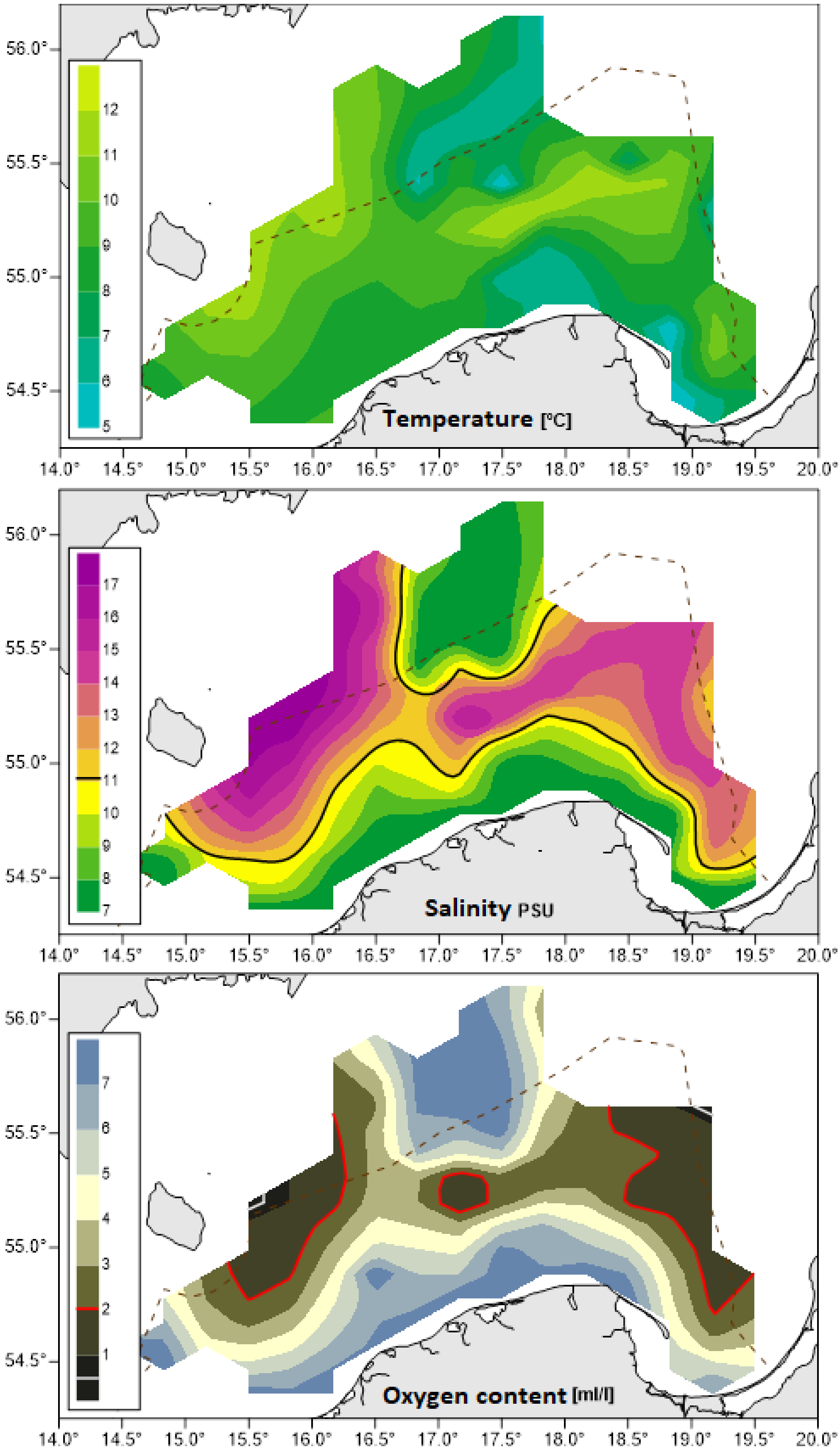

Fig. 6. Horizontal distribution of the seawater temperature, salinity and oxygen content in the near bottom layer during r/v Baltica BITS-4Q survey (14.11-01.12. 2018).

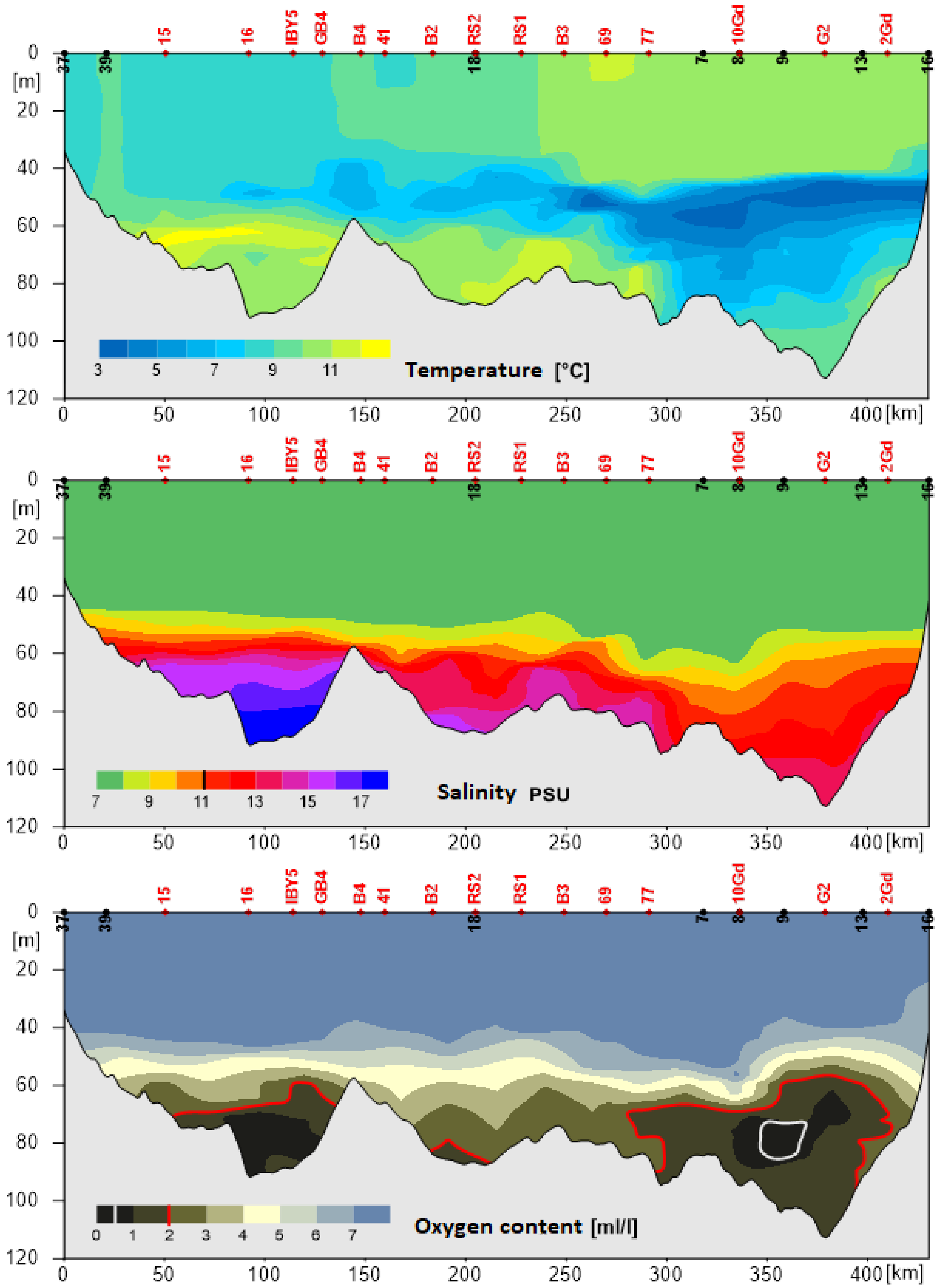

Fig. 7. Vertical distribution of the seawater temperaturę, salinity and oxygen content along the hydrological research profile during r/v Baltica BITS-4Q survey (14.11-01.12. 2018).

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Cruise report
Cruise number 756 FRV „SOLEA"
08/11/ - 25/11/2018

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 756th cruise of the FRV "SOLEA" is the 37st 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 weak year class of cod in 2018 as compared with the previous year class 2017 (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, with exception of the depth layer of 10–39 m in SD 24.

The abundance of flounder as compared to the previous year decreased in SD 22 and in SD 24.

The oxygen concentration close to the bottom was above 2.1 ml/l.

Verteiler:
BLE, Hamburg
Schiffsführung FFS „Solea"
BMELV, Ref. 614
TI, Präsidialbüro (M. Welling)
TI, OF TI
TI, FOE
TI, SF
TI, FIZ
Fahrtteilnehmer
Eurobaltic Mukran
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
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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 25th November 2018. 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 (45 in subdivision 24 and 14 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).

The positions of the trawl hauls are shown in Figure 1. 11 fishing hauls and 14 hydrographic stations were done in subdivision 22, and 38 fishing hauls and 38 hydrographical stations were realized in subdivision 24.

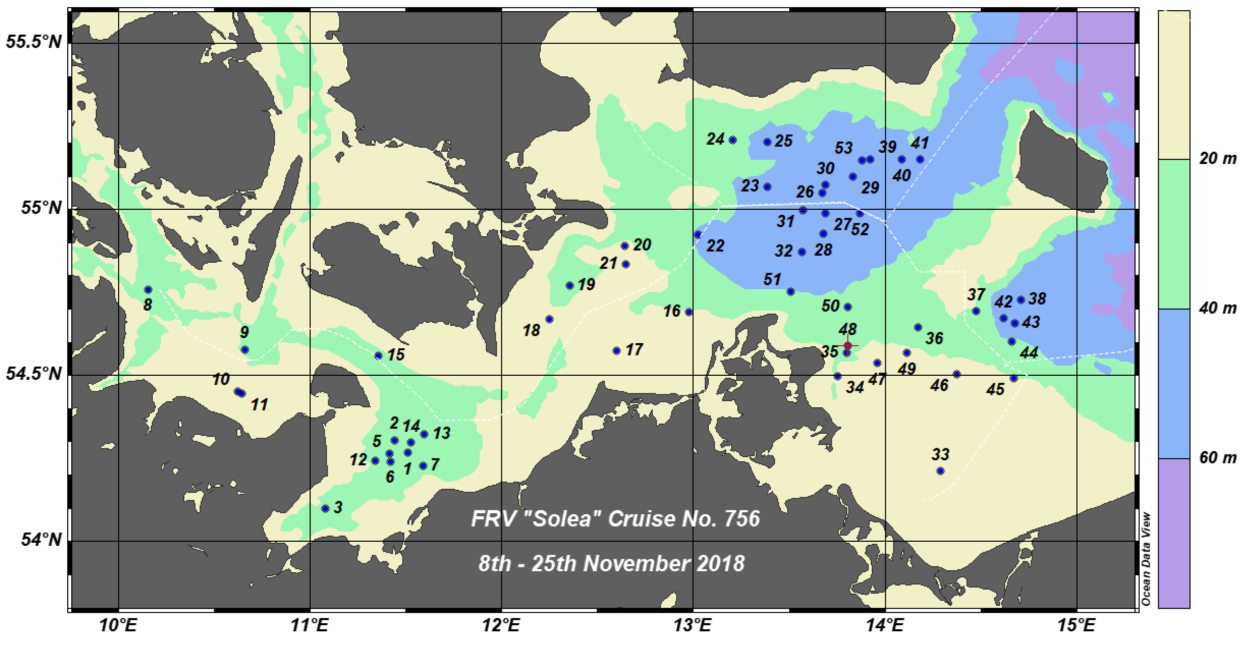

Fig. 1 Stations of the 756th FRV "SOLEA" cruise (Ocean Data View, R. Schlitzer, www.awi-bremerhaven.de/GEO/ODV)

The numbers of fishing hauls and hydrographic stations by subdivision and 10 m depth layers are given in Table 1. The 14 hauls in subdivision 22 were located at depths from 10 m to 29 m and 20 of 38 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]**	3.2	2	2
	2 [20-29]	20.6	12	12
24	**1 [10-19]**	12.2	8	8
	2 [20-39]	8.3	6	6
		5.4	4	4
	3 [40-59]	28.3	18	18
		3.1	2	2

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 after every fishing haul with a CTDO probe (Sea Bird 19 +).

4. Preliminary results

4.1. Biological data

In total 787 cod, 574 flounder, 831 plaice, 594 dab, 211 turbot and 34 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 and flounder by depth stratum and ICES subdivision

Area		Sample			
		Cod		Flounder	
Subdivision	**Depth [m]**	**Weight [kg]**	**Number [n]**	**Weight [kg]**	**Number [n]**
22	**10-29**	23.7	82	59.5	197
24	**10-19**	275.5	742	260.7	1063
	20-39	1642.6	3269	636.6	2675
	40-59	1578.2	4157	731.5	3256

Area		Sample			
		Plaice		Dab	
Subdivision	Depth [m]	Weight [kg]	Number [n]	Weight [kg]	Number [n]
22	10-29	468.3	2253	809.9	8176
24	10-19	83.2	349	100.3	761
	20-39	172.0	988	75.6	603
	40-59	1935.3	10045	44.2	273

The mean catch per hour (CPUE) was 86,8 kg of cod and 41,6 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 32,7 % and mean fraction of flounder, plaice and dab was 15,7 %, 24,7 % and 9,6 %, respectively. sprat and herring represented 6.5 % of the total biomass in mean.
The highest abundances in weight and number of cod and flounder were observed in subdivision 24 in depths between 20 - 59 m.
Mean CPUE of cod and flounder are given in Table 3 by subdivision and depth stratum.

Tab. 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	1	3	288.7	14	2.5	8	302.1	14
24	10-19	22.5	61	371.3	8	21.3	87	245.3	8
	20-39	119.6	238	502.5	10	46.3	195	238	10
	40-59	50.3	132	379.6	20	23.3	104	224.7	20

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	19.7	95	207.9	14	34.1	345	99.1	14
24	10-19	6.8	29	238.4	8	8.2	62	131.9	8
	20-39	12.5	72	174.1	10	5.5	44	125.4	10
	40-59	61.7	320	192.7	20	1.4	9	162.3	20

The frequencies of cod grouped by subdivision and depth strata are presented in Figures 2 to 4.

Noteworthy is the low abundance of young cod ranging in length from 10 to 25 cm in the subdivisions 24 and 22. 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 with exception of the depth layer 10-39 m in subdivision 24 (Table 4 and Figures 2 to 4).

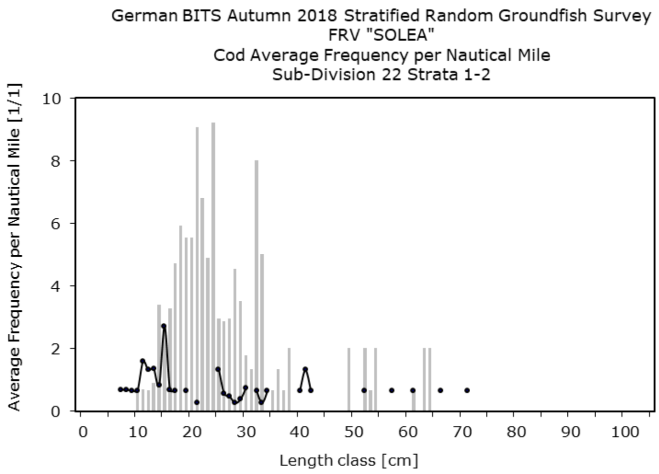

Fig. 2 Length frequencies of cod in number per mile in depth strata 10 m to 29 m in SD 22 2018 (line) and 2017 (bars), (14 Hauls)

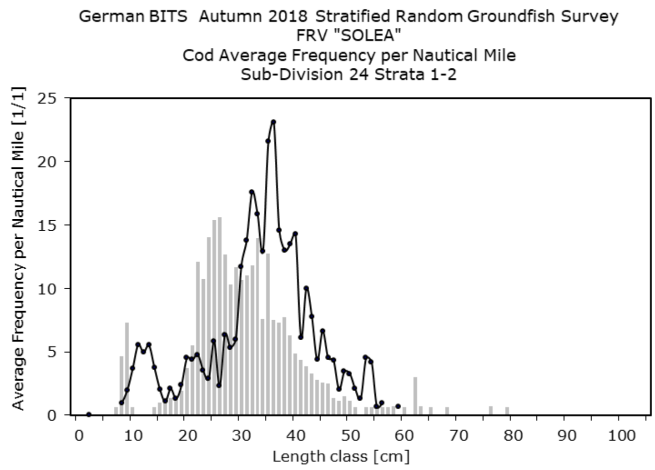

Fig. 3 Length frequencies of cod in number per mile in depth strata 10 m to 39 m in SD 24 2018 (line) and 2017 (bars), (18 Hauls)

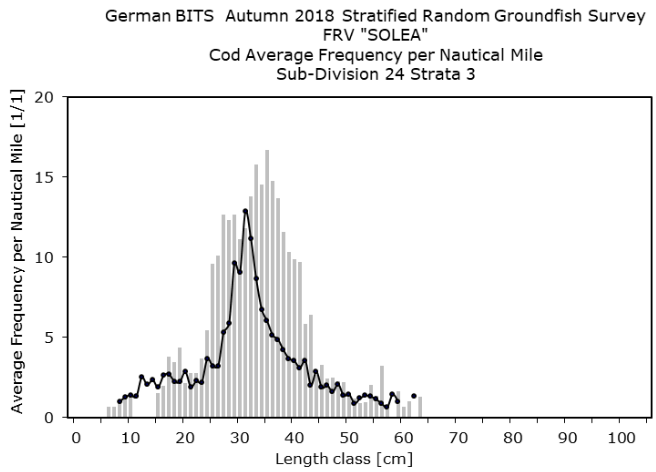

Fig. 4 Length frequencies of cod in number per mile in depth strata 40 m to 59 m in SD 24 2018 (line) and 2017 (bars), (20 Hauls)

Tab. 4 Recruitment of length groups of the year 2018 in comparison to the previous year

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

Area		Catch	2017		
Subdivision	Depth [m]	Length range [cm]	Number [n]	Number/ Mile [n/sm]	Trawl distance [sm]
22	10-29	26 - 40	147	9	16.4
24	10-19		342	29	12.0
	20-39		2288	139	16.5
	40-59		6878	190	36.1
22 - 24	10-59		9655	119	80.9
22	10-29	10 - 25	668	41	16.4
24	10-19		74	6	12.0
	20-39		1041	63	16.5
	40-59		842	23	36.1
22 - 24	10-59		2625	32	80.9

Under the assumption that the survey covered all nursery grounds of cod, a weak year class 2018 (top table) compared to the year class 2017 (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 7.7 °C and 11.4 °C. The salinity of the surface water decreased from 20.3 to 7.3 from west to east. The lowest temperature value was found in front of Møn at 7.7 °C. The salinity above the permanent halocline at a water depth of 23.6 m south of Bornholm was approx. 7.7 The salinity increased below the halocline at a depth of 45 m in the Arkona Basin up to 20.1
The oxygen concentration close to the bottom was between 2.1-11.8 ml/l.

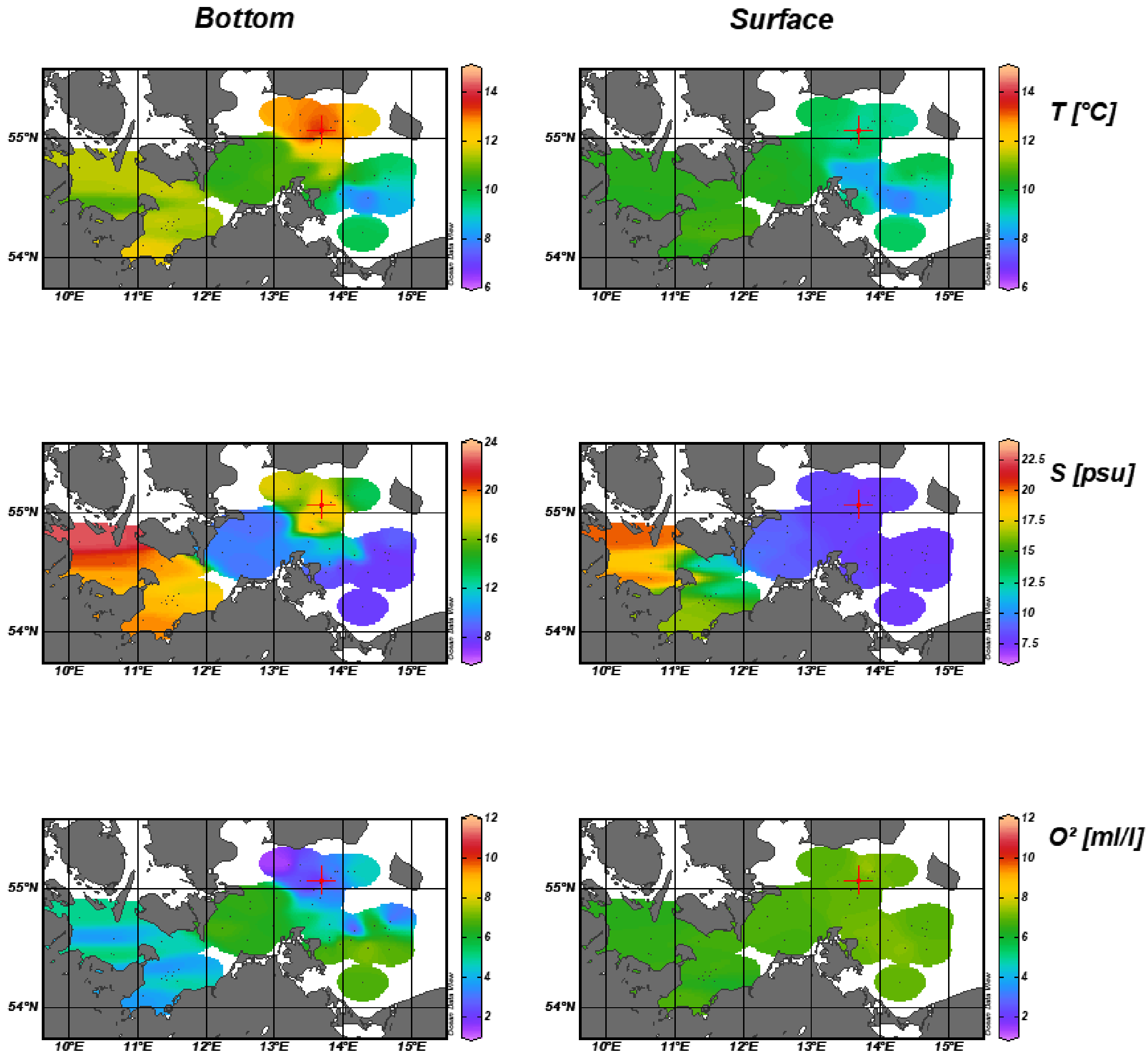

Fig. 5 Hydrography of the survey near the bottom (left) and at the surface (right)

5. Participants

A. Velasco	TI-OF	Scientist in charge
C. Albrecht	TI-OF	Technician
S. Dressler	TI-OF	Technician
S. Winning	TI-OF	Student helper
R. Wiechert	TI-OF	Technician
R. Klinger	University of Hamburg	Ph. D. Student
S. Eskildsen	DTU Aqua, DK	Technician
M. Bächtiger	University of Hamburg	Student helper

6. Acknowledgements

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

sgd. Scientist in charge

Lithuania BITS Q4 2018 cruise report

Marijus Špėgys

1. INTRODUCTION

The cruise of the FV "LBB-100" 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;
Deividas Norkus, Marine research institute, Klaipeda University –fish sampling.

2.2 Description

The cruise took place two days (08-09 November 2018). FV "LBB-1010" 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 2017. The hauls' positions were selected from the TOW Database by the coordinator of the BITS surveys (ICES 2017, WGBIFS report as reference). All 6 fishing stations were successfully realized. The fishing hauls were realized in the daylight, between 8:15 and 16:50 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.

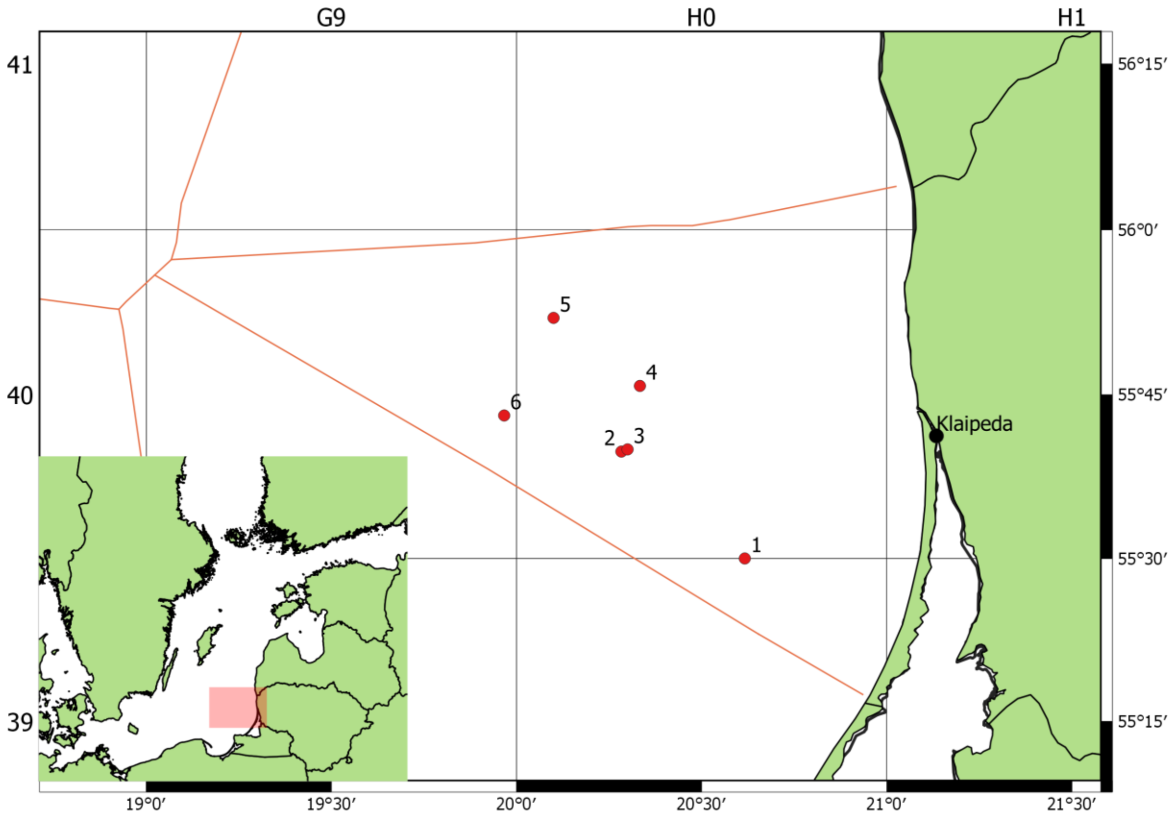

Figure 1. Trawl hauls position of C/V "LBB -1010" in BITS 2018 m. Q4 survey

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				Surface temperature	Surface salinity	Bot. Tempe-rature	Bot. salinity
			00.00 N	00.00 E	00.00 E	00.00 N				
26052	40H0 (26)	60	55.50	20.62	55.48	20.65	7,7	6,4	7,3	7,3
26193	40H0 (26)	70	55.67	20.28	55.65	20.25	6,6	6,7	7,3	7,3
26058	40H0 (26)	72	55.67	20.30	55.64	20.32	6,5	6,1	7,3	7,3
26206	40H0 (26)	56	55.76	20.33	55.74	20.33	7,0	6,8	7,3	7,3
26158	40H0 (26)	60	55.87	20.10	55.88	20.07	7,8	7,6	7,3	7,3
26057	40G9 (26)	75	55.72	19.97	55.72	20.01	8,0	7,2	7,3	7,3

Table 2 Fish catches results from the Lithuania BITS 2018 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	Herring	Others
26153	2018-11-08	40H0(26)	64	366.9	240.0	106.0	4.1	16.3	16.7
26052	2018-11-08	40H0(26)	66	3.2	0	3.2	0	0	0
26060	2018-11-08	40H0(26)	76	0	0	0	0	0	0
26205	2018-11-09	40H0(26)	54	64.7	40.0	5.3	0	0.9	19.4
26134	2018-11-09	40H0(26)	36	338.3	206.0	32.0	0	87.5	22.7
26011	2018-11-09	40G9(26)	34	0.6	4	0	0	0	0.2
Mean					81.1	24.4	0.7	17.5	5.3

3. RESULTS

In total 1009 cods, 394 flounders, 14 places, 607 herrings and 63 other species were collected for measuring and from that measurement sample 287 cods and 229 flounders and 14 place 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 22-39 dominated in samples. The fish with this length range constituted about 92.9% of all measured cod (Fig. 1). Moreover, 82.6% of all measured cods were undersized individuals (less than 35 cm).

The total length of flounder ranged from 11 to 37 cm, with dominating length classes of 20-33 cm. The fish with this length range constituted about 82.4% 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 2018 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	Herring	Sprat	Cod	Flounder
1	24.02.2015	40H0 (26)	58.2	524	321	14	224	3	226	189
2	24.02.2015	40H0 (26)	63.1	-	9	-	-	-	-	1
3	24.02.2015	40G9 (26)	65.8	-	-	-	-	-	-	-
4	25.02.2015	40H0 (26)	49.9	64	10	-	11	-	-	8
5	25.02.2015	40H0 (26)	37.3	420	54	-	372	-	16	31
6	25.02.2015	40H0 (26)	29.6	1	-	-	-	9	45	-
Sum				**1009**	**394**	**14**	**607**	**12**	**287**	**229**

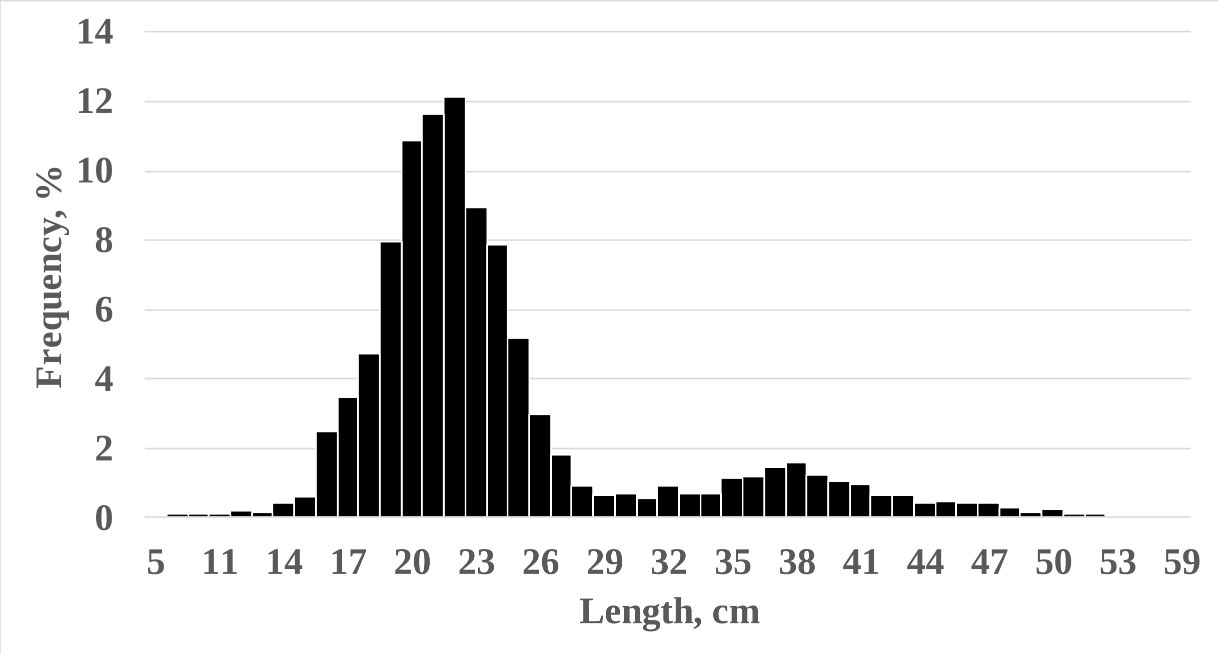

Figure 2. Cod length distribution from Lithuania BITS 2018 Q4 survey

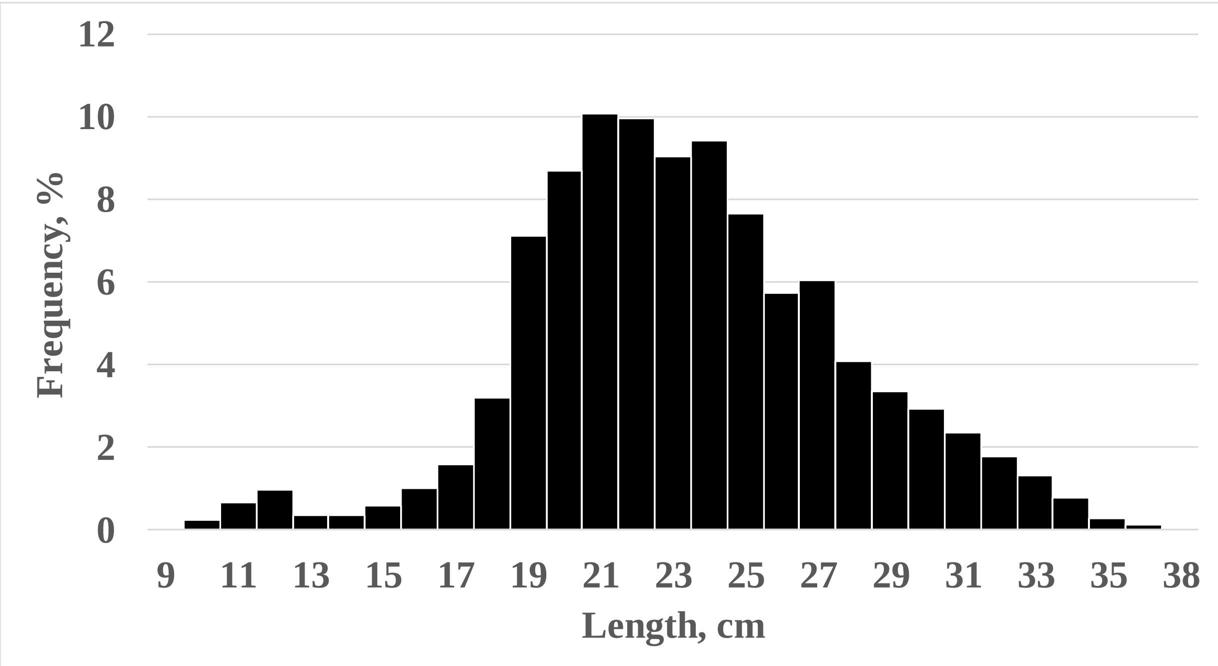

Figure 3. Flounder length distribution from Lithuania BITS 2018. 4Q survey

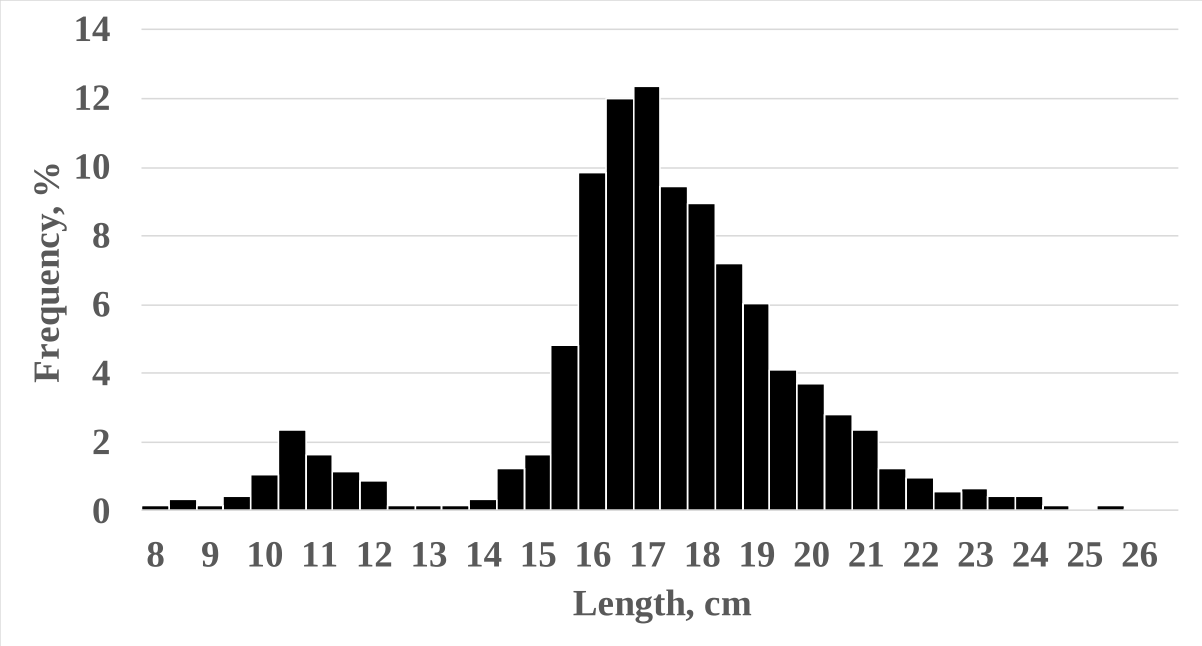

Figure 4. Herring length distribution from Lithuania BITS 2018 m. Q4 survey

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CRUISE REPORT
FROM THE POLISH R/V BALTICA BITS 1Q 2019 SURVEY
IN THE SOUTHERN BALTIC
(12 February - 07 March 2019)

by

Krzysztof Radtke and Tycjan Wodzinowski

Gdynia, 21 March 2019

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. 2018). The main aim of the BITS-1Q survey planned in winter 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-1Q 2019 survey, which was realized in the Polish part of the ICES Sub-divisions 24, 25, 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 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.

MATERIAL AND METHODS

The above purposes of the February/March 2019 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 3/2019/MIR took place during the period of 12.02-07.03.2019 within the framework of the ICES Baltic International Trawl Surveys (BITS) long-term programme (Anon. 2018) and the Polish Fisheries Data Collection Programme for 2019. The vessel left the port of Gdynia on 12.02.2019 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 01-06.03. 2019, the investigations were conducted in Swedish waters. The survey ended on 07.03.2019 (morning) in Gdynia harbour. The R/V Baltica operated mostly in the Polish EEZ. Overall, 24 days were utilized for fulfilling the BITS 1Q 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 February/March 2019 survey, the Polish part of ICES Sub-divisions 24, 25 and 26 with 5, 29 and 22, respectively randomly selected bottom control-hauls, and also in Swedish EEZ to cover Swedish part of ICES Sub-division 25 and 26 with 4 and 9 control-hauls, respectively. The R/V Baltica realized 71 of the 69 planned hauls for this survey. Two hauls (no 12 - ICES no 26020 and no 67 – ICES no 26224, see Table 3) were considered as „Invalid” due to technical problems associated with gear performance observed during trawling. Both hauls were repeated successfully in the places as assigned in the survey plan. One haul (no 70 – ICES no 26221) was not realized due to oxygen level on the bottom below 0.5 ml/l. The haul has a status „No oxygen” and the catch result is considered as „zero catch haul”. Finally, it can be concluded that the hauls realized during the survey correspond 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 19 to 113 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, 14349 cod, 8234 flounder, 1726 plaice, 75 turbot, 6028 sprat and 9362 herring were taken for the length and mass determination. In total, 800, 983, 742, 75, 548 and 1045 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 14349 cod, 8234 flounder, 1726 plaice, 6028 sprat and 9362 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, 97 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 2019 is presented in Figure 1.

RESULTS

Fish catches and biological data

In total, twenty seven species were recognized in 69 scrutinized valid bottom catches (Table 1). Only two fish species – horse mackerel and saithe represent fish species permanently inhabiting Atlantic Ocean.

The frequency of the most important commercial species occurrence in the hauls - flounder, cod, herring and sprat was - 98%, 93%, 84% and 65% 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 CPUEs of cod in ICES SDs 25 and 26 were lower than the CPUE of herring and sprat in the same SDs, but were higher than flounder CPUE (Fig. 2). In ICES SD 24 cod CPUE was only lower than herring CPUE. The highest cod average CPUE was noted in ICES SD 25 – 134,6 kg/1h. Markedly lower CPUE results were obtained in ICES SDs 26 and 24 – 93.3 and 78.6 kg/1h. Similarly to February 2018 r. cruise, cod CPUE in ICES SD 25 was comparable with the CPUE obtained in the current survey - 144 kg/1h. However in ICES SDs 26 and 24 in 2018, the CPUEs of cod were markedly lower than in the current cruise, and amounted to 44 and 21 kg/1h, respectively.

Herring definitely dominated among all the fish species in respect of CPUE. The CPUEs of herring were high and in ICES SDs 24, 25 and 26 amounted to 173.2, 347.6 and 344 kg/1h, respectively. During the last year’s survey, much lower herring CPUEs were obtained - 13, 197 and 214 kg/1h, respectively.

The highest sprat CPUE was obtained in ICES SD 26 – 251.7 kg/1h. Whereas in ICES SDs 24 and 25 the sprat CPUEs were considerably lower and amounted to 28.9 and 142.7 kg/1h, respectively. In comparison with the cruise from February 2018, the CPUEs in the current year were much higher in ICES SDs 25 and 26. Sprat CPUEs in 2018 amounted to 45 and 98 kg/1h, respectively. Sprat did not occur in ICES SD 24 in February 2018.

Flounder CPUEs in ICES SDs 25 and 26 were marked by the lowest values as compared to the CPUEs obtained for four important commercial species. Flounder CPUE amounted to 80.3 and 89.1 kg/1h, respectively in ICES SDs 25 and 26. Flounder CPUE in ICES SD 24 was 41,3 kg/1h and it was the third in row CPUE value in that ICES SD (higher than for sprat, lower than for herring and cod). As compared to the cruise from February 2018, the average CPUEs obtained in the current year were lower in ICES SDs 26 and 25, respectively by 25.9 and 20.7 kg/1h, while in the ICES SD 24 flounder CPUE was higher by 16.3 kg/1h.

Length distributions of main fish species according to the ICES Sub-divisions are illustrated in Figure 3. The curves of cod length distributions for all the ICES SDs were very similar, what indicates low cod length variety observed in all the three ICES SDs in the area of investigation. In respect of cod length distribution in ICES SD 26, slight shift of the length distribution curve to the left along the horizontal axis was noted as compared to length distribution curves from ICES SDs 25 and 24, what indicates that slightly higher share of smaller cod inhabited in that ICES SD. However there was only slightly difference between these ICES SDs. Length distributions clearly indicate that the area of investigation was occupied by the cod from the range of length classes 18-43 cm. Number of cod below the length of 20 cm was very low (probably mostly 2018 year-class). Small cod was most numerous in ICES SD 24. In the length distribution curve of cod in ICES SD 25 there was clearly distinguished single peak corresponding to length class 27 cm (9,4%) (similarly as in the cruise from November 2018). Peak in length distribution curve in ICES SD 26 corresponded to length class 24 cm (7,8%), while in ICES SD 25 the peak corresponded to length class 30 cm (9,3%).

Three herring length fractions in herring length distribution curve from ICES SD 24 were distinguished. Small size herring (12,5-16 cm), medium size herring (6,5-20,5 cm) and largest size herring (21-30,5 cm). Herring length distribution curves form ICES SDs 25 and 26 were of very similar shape. It indicates that the length of herring in these ICES SDs was homogeneous.

Also, in ICES SDs 25 and 26 clearly distinguished single peak in each of the length distributions was observed, corresponding to length class 18.5 cm (10.3%) and to 18 cm (8.5%), respectively.

Sprat length distribution curve in ICES SD 26 indicates that two sprat length fractions inhabited the ICES SD mentioned. Smaller size sprat (7.0-9.5 cm) and the larger sprat (10.0-14.5 cm). Sprat length distributions indicate relatively high variety of the fish length with respect to ICES SD. The smallest size sprat was caught in ICES SD 26. Towards west (ICES SDs 25 and 24) the length od sprat was smaller. Sprat of the most favourable length distribution for commercial fishery was observed in ICES SD 24.

Flounder of the smallest length was observed in ICES SD 26 (length classes – 18-20 cm, were the most abundant - 8% on average per length class). Slightly higher share of larger flounder (above 26 cm) was observed in ICES SD 25 than in ICES SD 24. Below the length of 26 cm the share of flounder in the length classes was in ICES SD 25 lower than in ICES SD 24. A clearly distinguished single peak corresponding to length class 27 cm (11%) was observed in flounder length distribution 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 82.8%, 84.3% and 87.4%, respectively. In the same cruise in February 2018, the share of undersized cod was lower and amounted to 81.6%, 69% and 37%, respectively. The total share of undersized cod from the last survey was very high and amounted to 85.4%. Numerical share of undersized herring decreased westward. The share of the undersized fraction in ICES SDs 26, 25 and 24 amounted to 14.6%, 6.0% and 4.6%, respectively. The largest share of undersized sprat was observed in samples from ICES SD 26 (25.6%). The share in ICES SD 25 was 1.9%, while in ICES SD 24 undersized sprat was not observed. Flounder undersized share was the highest in the ICES SD 26 (57.4%). The share of undersized flounder in the ICES SDs 25 and 24 was 10.9% and 20.4%, respectively.

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

ICES Subdivision	parameter	sprat	herring	cod	flounder
24	mean length [cm]	13,7 ()	20,9 (23,9)	29,8 (36,5)	26,1 (21,6)
25		12,3 (12,5)	19,6 (18,6)	29,8 (28,9)	27,4 (27,4)
26		10,9 (11,0)	18,8 (17,4)	28,3 (31,3)	20,6 (20,7)
whole cruise		11,5 (12,0)	19,3 (18,4)	29,2 (29,2)	22,7 (23,6)
24	mean mass [g]	15,4 ()	59,9 (101,3)	272,5 (451,5)	188,1 (110,3)
25		12,9 (11,9)	63,4 (42,1)	267,3 (254,0)	230,8 (265,5)
26		7,8 (8,1)	40,3 (34,4)	236,1 (344,4)	105,8 (121,3)
whole cruise		9,7 (10,6)	52,9 (41,8)	255,4 (267,1)	143,3 (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 (2.2%) and for cod (1.6%). With regard to cod a decrease in share of individuals with visible diseases was noted during the current survey as compared to February 2018 cruise - 2,8%. The share of herring and sprat with observed pathological symptoms was very low and amounted to 0.34% and 0.017% in the whole area investigated.

Hydrological situation in the southern Baltic

In the near-bottom water layer (Fig. 6) temperatures in the range from 9.51°C to 2.58°C were noted. The lowest temperature was noted in the control haul no 16, while the highest in hydrological station no 6. The highest salinity was recorded in hydrological station no IBY5 (Bornholm Deep) (17.32 on the PSU scale). The station IBY5 is monitored permanently during BITS surveys in Bornholm Basin. Salinity measured in Gdańsk Deep amounted to 13.11 in hydrological station (G2). The lowest oxygen content in the water was noted on the hydrological station Gt1 (0.12 ml/l. In the Gdańsk Deep (G2) the oxygen content noted in hydrological station G2 was 1.25 ml/l and in the hydrological station IBY5 the content amounted to 2.16 ml/l.

Surface water temperature fluctuated from 3.94 to 2.58°C (Fig. 7). The lowest temperature was recorded in control haul no. 33, and the highest in control haul no 16. Mean value of the surface water temperature was 3.58°C. The average salinity of surface water was 7.58 on the PSU scale. The lowest value - 6.41 was recorded in the control haul no 9. The highest salinity was recorded in the haul no 37 (8.16 on the PSU scale). Mean oxygen content was 8.74 ml/l. The highest level of oxygen was registered in control haul no 21 (9.216 ml/l). The lowest oxygen level was recorded in the hydrological station no Gt1 (8.46 ml/l).

CONCLUSIONS

The data collected during Polish BITS-1Q 2019 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:

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.

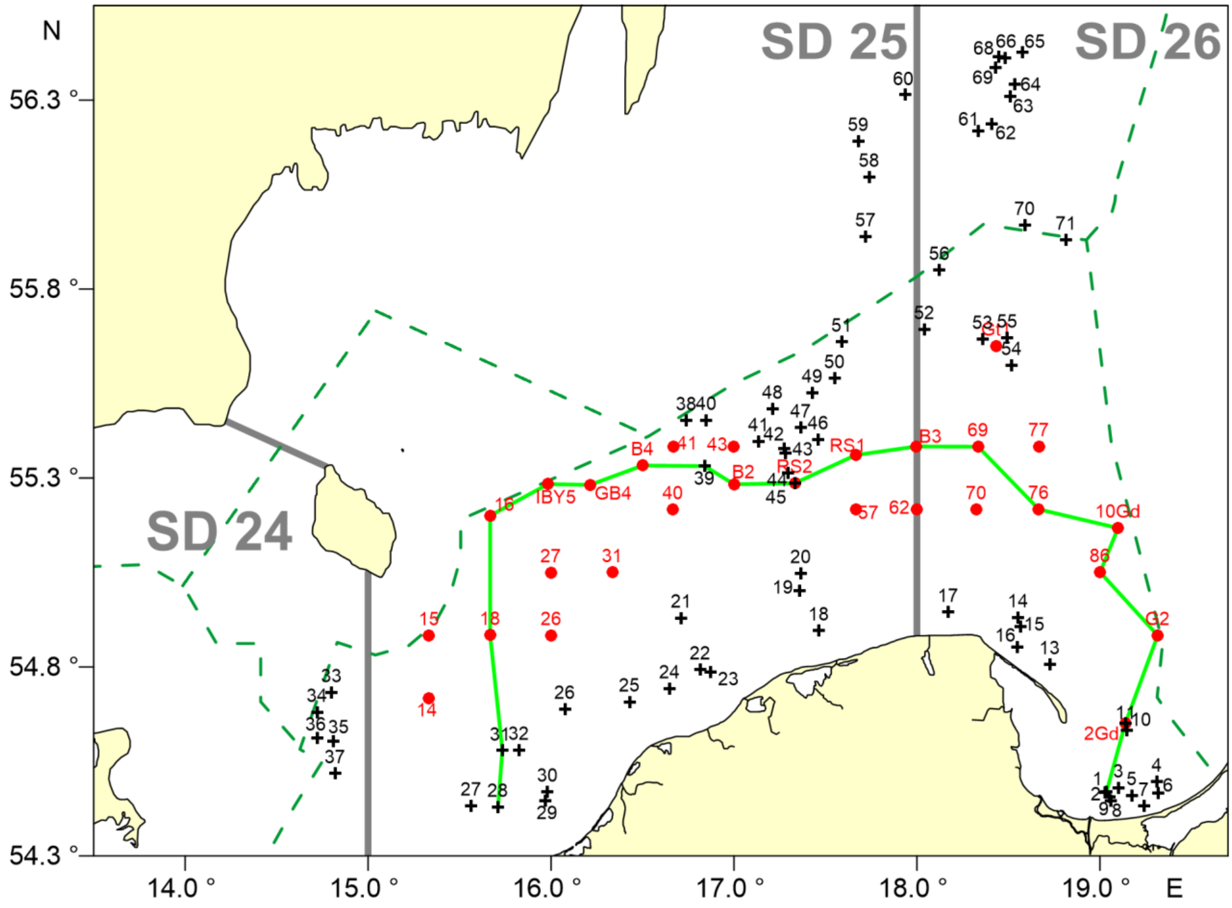

Fig. 1. Location of fish control-hauls (black crosses) and hydrological standard stations (red dots) realised during the r/v Baltica BITS-1Q cruise (12.02-07.03. 2019 r.). (green solid line indicates hydrological research profile).

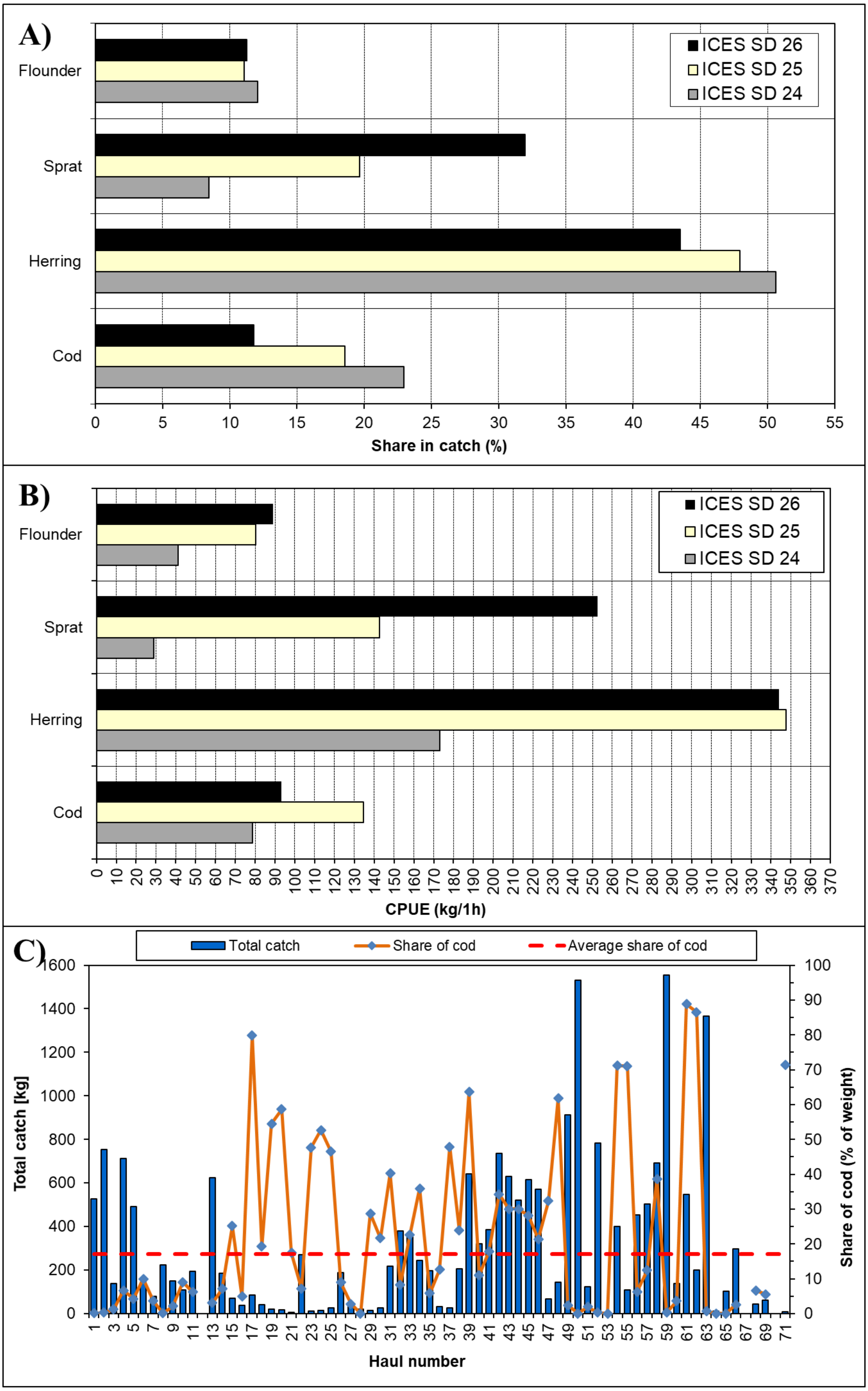

Fig. 2. Mean share in mass of control hauls (A), and mean CPUE (B) of dominant fish species, and share of cod (C) in particular catches conducted during r/v Baltica BITS-1Q cruise (12.02-07.03. 2019 r.).

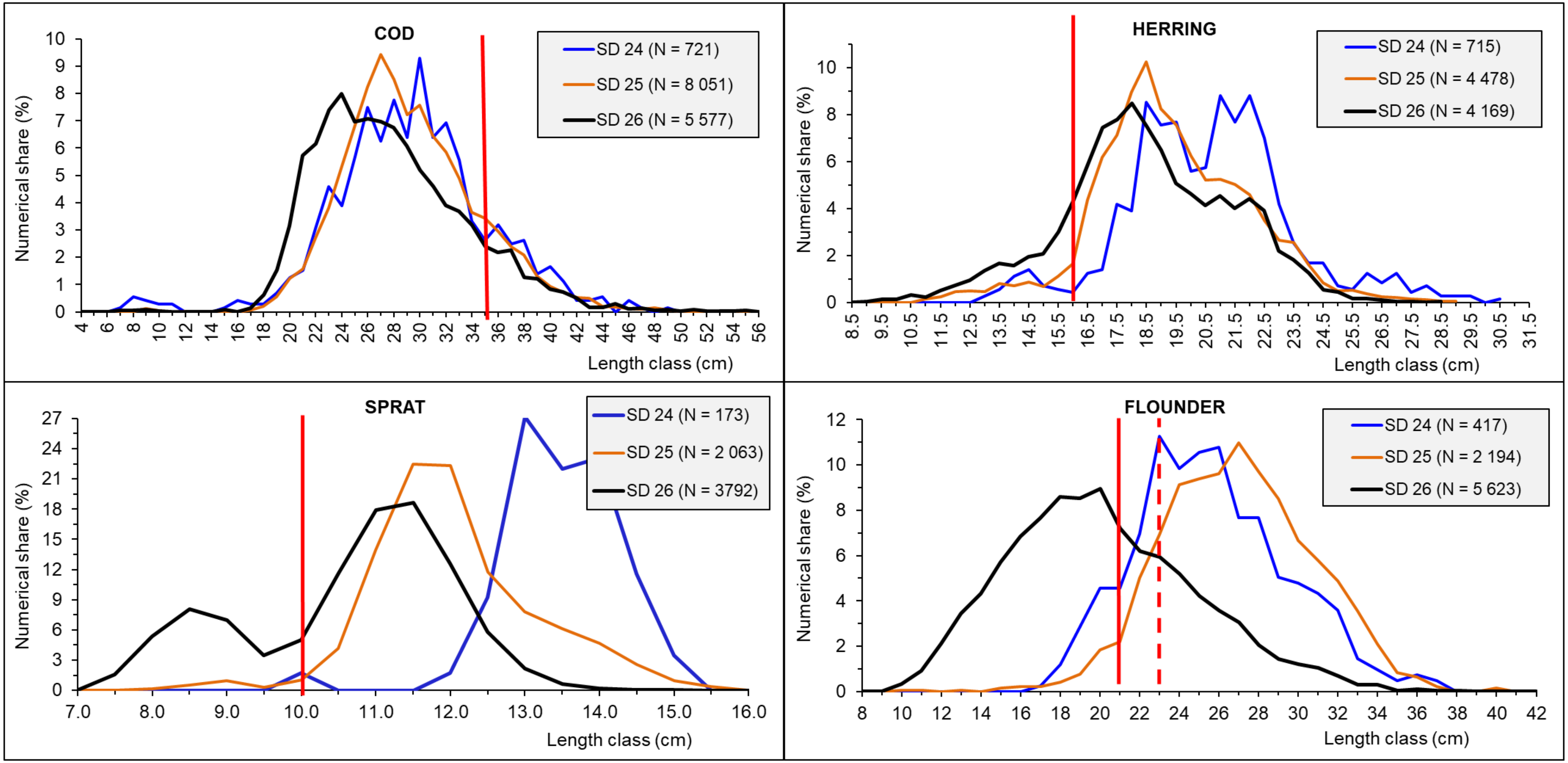

Fig. 3. Length distributions of cod, herring, sprat and flounder in samples from fish control hauls conducted during r/v Baltica BITS-1Q cruise (12.02-07.03. 2019 r.). (red horizontal lines indicate minimum landing size).

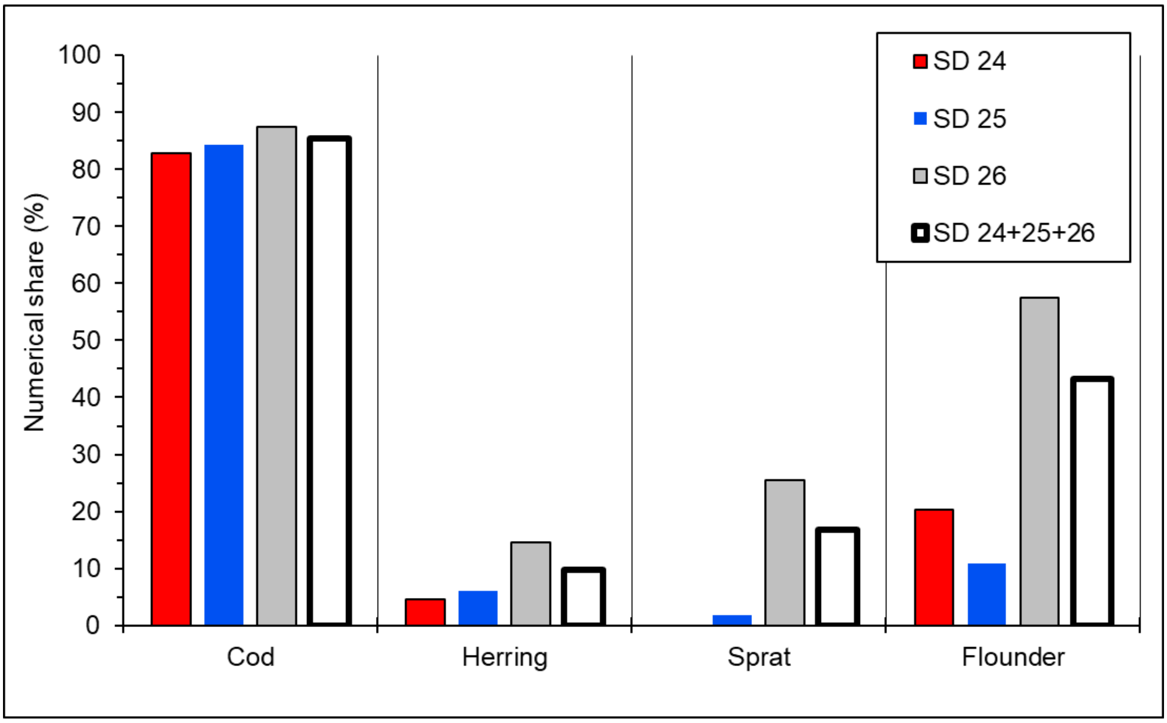

Fig. 4. Mean numerical share (in %) of undersized fish species in samples from fish control hauls conducted during r/v Baltica BITS-1Q cruise (12.02-07.03. 2019 r.).

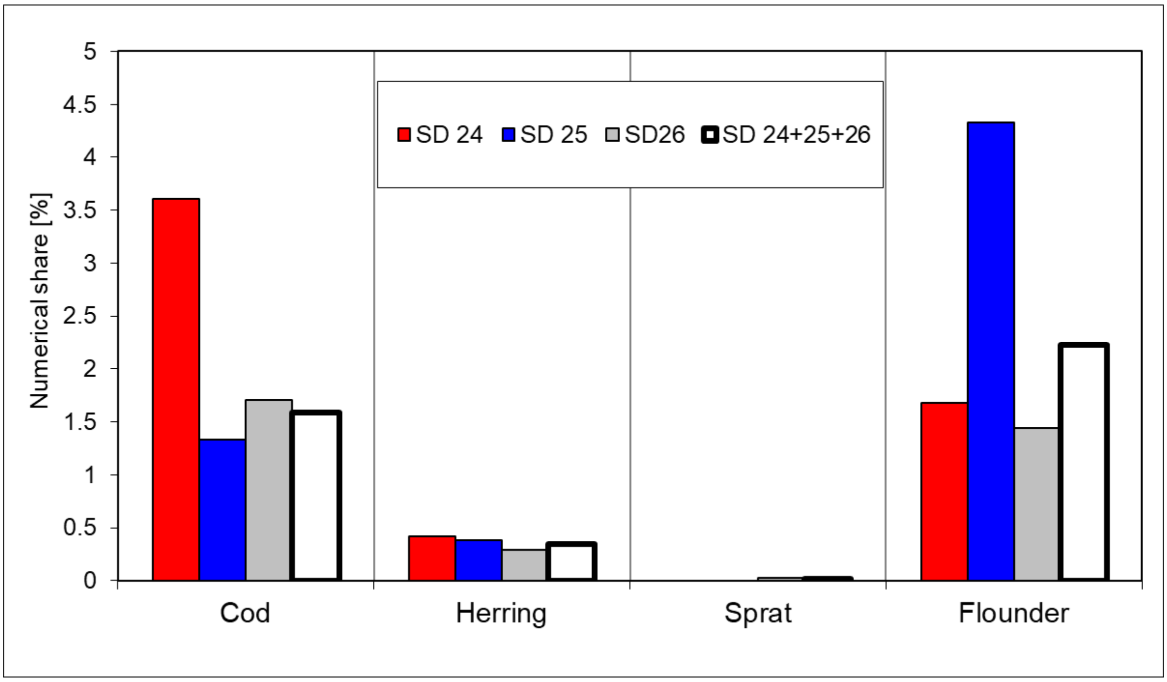

Fig. 5. Mean prevalence (in %-indiv.) of fish with externally visible diseases in samples from fish control hauls conducted during r/v Baltica BITS-1Q cruise (12.02-07.03. 2019 r.).

Tab. 1. Number of fish species individuals measured and aged during r/v Baltica BITS-1Q cruise (12.02-07.03. 2019 r.).

Species name	Number of fish mesured (l.t)				Numer of fish aged and weighed (g)			
	26 ICES Sub-division	25 ICES Sub-division	24 ICES Sub-division	total	26 ICES Sub-division	25 ICES Sub-division	24 ICES Sub-division	total
Round goby	2	0	0	2	0	0	0	0
Sand goby	2	0	0	2	0	0	0	0
Common goby	2	0	0	2	0	0	0	0
Vimba bream	1	0	0	1	0	0	0	0
Three-spined stickleback	15	0	0	15	0	0	0	0
Saithe	0	1	0	1	0	1	0	1
Greater sandeel	4	5	0	9	0	0	0	0
Cod	5577	8051	721	14349	233	382	185	800
Plaice	293	1164	269	1726	198	335	209	742
Ruffe	2	0	0	2	0	0	0	0
Short-horn scorpion	380	456	48	884	0	16	0	16
Hooknose	0	2	0	2	0	0	0	0
Atlantic salmon	0	1	0	1	0	1	0	1
Fourbeard rockling	33	228	0	261	0	30	0	30
Brill	0	1	0	1	0	1	0	1
European perch	3	0	0	3	0	0	0	0
Atlantic horse mackerel	0	2	3	5	0	1	0	1
Twaite shad	24	1	0	25	0	1	0	1
Turbot	35	30	10	75	35	30	10	75
Flounder	5623	2194	417	8234	453	307	223	983
Smelt	18	0	0	18	0	0	0	0
Sprat	3792	2063	173	6028	251	235	62	548
Baltic herring	4169	4478	715	9362	388	508	149	1045
Lumpfish	19	25	1	45	0	4	0	4
Small sandeel	2	0	0	2	0	0	0	0
Eelpout	92	1	0	93	0	0	0	0
Whiting	0	10	9	19	0	2	0	2
TOTAL	20088	18713	2366	41167	1558	1854	838	4250

Tab. 2. Fish control-hauls data obtained during r/v Baltica BITS-1Q cruise (12.02-07.03. 2019 r.) (**Hauls no. 1-35**)

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: 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	26264	2019-2-12	37G9	26	43	54°25.4'	19°2.9'	54°25.2'	19°4.7'	12:43	13:03	20	527.008
2	26282	2019-2-13	37G9	26	41	54°25.1'	19°3.1'	54°25.1'	19°5.1'	07:41	08:01	20	752.398
3	26265	2019-2-13	37G9	26	48	54°26'	19°4.4'	54°26'	19°6.3'	10:43	11:03	20	138.020
4	26256	2019-2-13	37G9	26	65	54°27.3'	19°13.5'	54°27'	19°16.3'	15:04	15:34	30	712.162
5	26217	2019-2-14	37G9	26	41	54°24.5'	19°11.6'	54°24.5'	19°13.4'	07:43	08:03	20	491.595
6	26163	2019-2-14	37G9	26	41	54°24.5'	19°15.9'	54°24.8'	19°18.6'	11:12	11:42	30	144.923
7	26001	2019-2-14	37G9	26	24	54°22.9'	19°13.3'	54°23.2'	19°15.8'	13:10	13:40	30	78.697
8	26263	2019-2-14	37G9	26	32	54°24'	19°3'	54°24.2'	19°1.3'	15:21	15:41	20	222.673
9	26219	2019-2-14	37G9	26	33	54°24.5'	19°0.7'	54°24.5'	19°2.4'	16:10	16:30	20	149.959
10	26269	2019-2-15	38G9	26	82	54°36'	19°10.1'	54°36.2'	19°12.5'	07:42	08:12	30	107.535
11	26287	2019-2-15	38G9	26	80	54°34.8'	19°10.5'	54°34.8'	19°12.9'	09:28	09:58	30	195.523
12	**26020**	**2019-2-15**	**38G8**	**26**	**47**	**54°45.8'**	**18°43.2'**	**54°46.4'**	**18°43'**	**13:11**	**13:26**	**15**	
13	26020	2019-2-15	38G8	26	49	54°47.9'	18°42.3'	54°46.8'	18°42.8'	14:13	14:33	20	623.401
14	26183	2019-2-16	38G8	26	31	54°52.5'	18°33.8'	54°51.4'	18°35.7'	07:34	08:04	30	184.363
15	26007	2019-2-16	38G8	26	30	54°51.4'	18°34.6'	54°50.3'	18°36.4'	09:35	10:05	30	71.604
16	26266	2019-2-16	38G8	26	19	54°49.9'	18°30.4'	54°48.6'	18°32'	11:47	12:17	30	37.428
17	26274	2019-2-16	38G8	26	22	54°53.6'	18°11.5'	54°53.8'	18°14.1'	14:34	15:04	30	84.307
18	25024	2019-2-17	38G7	25	23	54°50.7'	17°29'	54°50.9'	17°31.7'	07:29	07:59	30	41.560
19	25022	2019-2-17	38G7	25	27	54°57.1'	17°22.8'	54°57.3'	17°25.6'	09:40	10:10	30	18.921
20	25364	2019-2-17	38G7	25	31	54°59.8'	17°23.2'	54°59.9'	17°26'	11:19	11:49	30	16.850
21	25004	2019-2-17	38G6	25	20	54°52.7'	16°41.7'	54°52.5'	16°39.2'	15:35	16:05	30	5.770
22	25016	2019-2-18	38G6	25	30	54°45'	16°49.7'	54°46'	16°51.4'	07:32	08:02	30	269.553
23	25017	2019-2-18	38G6	25	28	54°44.4'	16°52.1'	54°43.8'	16°49.6'	10:11	10:41	30	11.292
24	25014	2019-2-18	38G6	25	29	54°41.5'	16°38'	54°41'	16°35.6'	12:03	12:33	30	15.077
25	25013	2019-2-18	38G6	25	32	54°39.2'	16°24.8'	54°38.5'	16°22.5'	13:51	14:21	30	27.028
26	25052	2019-2-18	38G6	25	48	54°37.7'	16°3.8'	54°36.9'	16°2.9'	16:08	16:28	20	188.986
27	25008	2019-2-19	37G5	25	30	54°23'	15°35'	54°23'	15°37.6'	07:32	08:02	30	37.762
28	25009	2019-2-19	37G5	25	30	54°22.7'	15°43.8'	54°23'	15°46.3'	08:57	09:27	30	21.057
29	25011	2019-2-19	37G5	25	27	54°24.1'	15°59.5'	54°24.5'	16°2'	11:20	11:50	30	14.930
30	25010	2019-2-19	37G6	25	28	54°25.4'	16°0.1'	54°26.1'	16°2.5'	12:43	13:13	30	25.069
31	25049	2019-2-19	38G5	25	56	54°32.1'	15°45.6'	54°32.1'	15°48.2'	15:33	16:03	30	217.936
32	25042	2019-2-20	38G5	25	53	54°31.6'	15°50.8'	54°31.4'	15°53.4'	12:20	12:50	30	380.224
33	24162	2019-2-21	38G4	24	53	54°40.9'	14°49.5'	54°40.7'	14°52.3'	07:41	08:11	30	353.891
34	24150	2019-2-21	38G4	24	47	54°37.6'	14°44.8'	54°37.5'	14°47.5'	15:09	15:39	30	244.112
35	24055	2019-2-22	38G4	24	36	54°33.4'	14°47.3'	54°33.7'	14°44.8'	07:44	08:14	30	197.791

Weight of the catch by fish species [kg]

Haul number according to survey order	Cod	Herring	Sprat	Flounder	Plaice	Turbot	Hooknose	Eelpout	Fourbeard rockling	Three-spined stickleback	Lumpfish	Short-horn scorpion	Round goby	Sand goby	Smelt	Twaite shad	Whiting	Greater sandeel	Common goby	Perch	Small sandeel	Atlantic salmon	Brill	Horse mackerel	Saithe	Ruffe	Vimba bream
1	0.710	91.710	372.489	59.450	0.157	0.040		0.924				1.483		0.003				0.042									
2	2.013	549.065	160.746	35.860	0.176			0.582		0.032	0.856	2.129			0.851			0.053	0.001							0.034	
3	1.675	20.468	21.969	90.600	1.217	0.389		0.393				1.116	0.027		0.166												
4	47.390	449.421	85.849	122.060	3.453	0.343			2.044			0.139				1.431				0.032							
5	20.780	322.442	69.148	76.960	0.793			0.499				0.891	0.034														0.048
6	14.460			125.810	2.040			0.796			0.244	1.549			0.024												
7	2.870	17.040	0.026	56.090	0.208	1.720				0.006	0.180	0.511			0.046												
8	0.373	182.457	0.528	38.380	0.201	0.052		0.200		0.004					0.478												
9	3.210	124.751	0.373	20.340		0.023		0.280		0.002		0.855			0.055					0.070							
10	9.740	38.184	37.383	21.230	0.299				0.640						0.059												
11	12.027	141.983	23.267	16.920	0.626				0.575							0.125											
12	**Haul technically unsuccessful (haul repeated)**																										
13	19.060	468.549	56.946	72.651	4.845	0.333					0.333	0.684															
14	13.190	137.490		30.970	2.234				0.174		0.305																
15	17.987	25.901	0.048	23.560	2.108			0.152			1.515	0.333															
16	1.854	15.010	0.160	18.190	0.938	1.231								0.002				0.019			0.024						
17	67.310	1.737		14.410	0.324							0.466			0.060												
18	8.015	15.637		11.368	1.471	0.359																4.710					
19	10.306	0.315		4.010	2.888	0.252					0.712	0.438															
20	9.886			2.676	2.847						0.232	1.209															
21	1.007			3.107	0.598	0.208					0.618	0.232															
22	19.292	246.299	0.400	1.526	1.320	0.389					0.327																
23	5.385	0.843		2.771	1.729							0.564															
24	7.936			2.486	3.391	0.352						0.861						0.051									
25	12.572	8.134		1.905	3.432	0.401					0.544							0.040									
26	16.980	147.852	3.719	17.000	3.435																						
27	1.048	8.592	0.028	6.259	15.115		0.035				0.200	6.465						0.020									
28		0.278		4.105	10.781	0.023					0.260	5.610															
29	4.287			2.677	4.399	0.266					0.952	2.349															
30	5.440	8.716		2.306	7.192	0.230					0.339	0.703											0.143				
31	87.770	28.746	74.658	21.304	3.193												2.265										
32	31.700	303.410	29.339	13.931	1.832		0.012																				
33	80.210	140.866	71.794	55.990	2.040	1.008											1.940							0.043			
34	87.740	131.510		18.315	6.093	0.252						0.196												0.006			
35	11.460	152.397	0.433	16.275	14.182	0.666						2.378															

Tab. 2. Fish control-hauls data obtained during r/v Baltica BITS-1Q cruise (12.02-07.03. 2019 r.) (**Hauls no. 36-71**)

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

Haul number according to survey order	Haul number according to ICES	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]
36	24295	2019-2-22	38G4	24	32	54°33.9'	14°43.3'	54°34.3'	14°40.8'	10:03	10:33	30	32.512
37	24004	2019-2-22	37G4	24	21	54°28.4'	14°48.6'	54°29'	14°46.1'	13:17	13:47	30	27.085
38	25080	2019-2-23	39G6	25	54	55°24.5'	16°45.2'	55°25'	16°47.5'	12:30	13:00	30	205.283
39	25229	2019-2-24	39G6	25	75	55°16.7'	16°51.4'	55°16.6'	16°54.1'	09:05	09:35	30	642.619
40	25081	2019-2-24	39G6	25	59	55°23.8'	16°47.6'	55°24'	16°50.2'	15:51	16:11	30	320.664
41	25247	2019-2-25	39G7	25	69	55°20.8'	17°9.2'	55°20.8'	17°11.8'	07:43	08:13	30	385.499
42	25231	2019-2-25	39G7	25	74	55°19.8'	17°17.9'	55°19.7'	17°20.6'	10:08	10:38	30	736.684
43	25232	2019-2-25	39G7	25	75	55°19.1'	17°16.1'	55°18.9'	17°18.6'	12:58	13:28	30	631.179
44	25463	2019-2-25	39G7	25	91	55°14.3'	17°15.3'	55°14.5'	17°17.9'	15:45	16:15	30	521.150
45	25339	2019-2-26	39G7	25	87	55°15.8'	17°18.8'	55°15.9'	17°21.5'	07:46	08:16	30	614.599
46	25248	2019-2-26	39G7	25	73	55°21.6'	17°24.9'	55°21.6'	17°26.7'	11:42	12:02	20	569.592
47	25084	2019-2-26	39G7	25	64	55°22.9'	17°21.5'	55°23'	17°24.1'	13:23	13:53	30	66.869
48	25455	2019-2-26	39G7	25	48	55°26.1'	17°13.2'	55°26.6'	17°15.7'	15:30	16:00	30	143.469
49	25030	2019-2-27	39G7	25	41	55°28.7'	17°26.8'	55°29.1'	17°29.3'	07:42	08:12	30	913.738
50	25107	2019-2-27	40G7	25	47	55°31'	17°33.8'	55°31.8'	17°36.2'	09:25	09:55	30	1530.814
51	25380	2019-2-27	40G7	25	40	55°37'	17°35.7'	55°38.2'	17°37.4'	11:43	12:13	30	124.383
52	26050	2019-2-27	40G8	26	70	55°38.8'	18°3.7'	55°38.9'	18°4.7'	14:36	14:46	10	783.166
53	26110	2019-2-28	40G8	26	93	55°36.3'	18°22.4'	55°34.9'	18°23.6'	07:55	08:25	30	5.433
54	26164	2019-2-28	40G8	26	88	55°32.3'	18°31.9'	55°31'	18°33.2'	09:48	10:18	30	399.603
55	26286	2019-2-28	40G8	26	98	55°37.7'	18°30.3'	55°37.8'	18°33'	13:41	14:11	30	109.059
56	26055	2019-3-1	40G8	26	65	55°47.9'	18°6.4'	55°47.3'	18°5.1'	07:49	08:09	20	453.87
57	25161	2019-3-1	40G7	25	62	55°53.3'	17°42.4'	55°52.5'	17°44.6'	11:19	11:49	30	502.822
58	25410	2019-3-1	41G7	25	63	56°2.4'	17°44.5'	56°0.9'	17°44.8'	13:56	14:26	30	692.961
59	25038	2019-3-1	41G7	25	52	56°8.9'	17°44.1'	56°8.6'	17°41.5'	16:00	16:30	30	1553.427
60	25167	2019-3-2	41G7	25	49	56°16'	17°57.3'	56°16'	18°0'	07:42	08:12	30	136.868
61	26170	2019-3-2	41G8	26	71	56°10.6'	18°21'	56°11.7'	18°23'	10:28	10:58	30	547.510
62	26069	2019-3-3	41G8	26	74	56°11.7'	18°25.4'	56°12.5'	18°26.6'	07:45	08:05	20	200.248
63	26124	2019-3-3	41G8	26	81	56°14.5'	18°29.6'	56°15.8'	18°30.9'	09:49	10:19	30	1366.800
64	26141	2019-3-4	41G8	26	84	56°18.1'	18°32.8'	56°19.3'	18°34.5'	07:23	07:53	30	11.052
65	26074	2019-3-4	41G8	26	75	56°23.1'	18°35.2'	56°24.3'	18°36.8'	09:01	09:31	30	101.605
66	26013	2019-3-4	41G8	26	44	56°22.2'	18°29.4'	56°23.5'	18°30.7'	11:16	11:46	30	296.729
67	**26224**	**2019-3-4**	**41G8**	**26**	**37**	**56°22.3'**	**18°27.4'**	**56°22.4'**	**18°27.5'**	**13:05**	**13:07**	**2**	
68	26224	2019-3-4	41G8	26	37	56°22.2'	18°27.3'	56°23.4'	18°28.6'	13:42	14:12	30	44.098
69	26225	2019-3-4	41G8	26	42	56°18.9'	18°23.5'	56°20.1'	18°25.2'	15:45	16:15	30	62.094
70	26221	2019-3-6	40G8	26	112	55°55'	18°35.4'			07:35			
71	26138	2019-3-6	40G8	26	113	55°53.3'	18°46.3'	55°53.5'	18°43.8'	09:43	10:13	30	8.237

Weight of the catch by fish species [kg]

Haul number according to survey order	Cod	Herring	Sprat	Flounder	Plaice	Turbot	Hooknose	Eelpout	Fourbeard rockling	Three-spined stickleback	Lumpfish	Short-horn scorpion	Round goby	Sand goby	Smelt	Twaite shad	Whiting	Greater sandeel	Common goby	Perch	Small sandeel	Atlantic salmon	Brill	Horse mackerel	Saithe	Ruffe	Vimba bream
36	4.115	8.227	0.090	9.251	7.653	0.671					0.387	2.118															
37	12.978			3.391	8.400	0.449						1.867															
38	48.980	142.299	0.867	5.347	2.824						0.196	4.770															
39	408.880	26.894	45.958	147.500	10.495				2.384							0.407	0.086							0.015			
40	35.650	273.176	0.379	8.800	1.457						0.390	0.812															
41	68.490	226.994	12.754	69.190	7.080				0.677		0.314																
42	252.470	252.969	147.631	71.050	11.691				0.873																		
43	189.270	141.186	210.314	78.460	11.040				0.909																		
44	156.420			337.760	4.826				22.010								0.134										
45	172.480	4.176	50.501	359.930	7.265				19.500								0.319							0.029	0.399		
46	121.740	34.622	356.858	51.330	4.384				0.658																		
47	21.650	17.570	0.151	24.760	0.477				0.141			2.120															
48	88.610	38.940		4.676	1.566	1.680					0.345	7.652															
49	21.760	874.890		3.843	2.144	1.692					0.669	8.740															
50	1.125	452.479	1067.443	2.150	0.267	1.805					0.145	5.400															
51	2.455	111.055	0.423	4.630		1.070						4.750															
52	2.425	353.190	421.000	6.551																							
53			4.050	1.383																							
54	284.450	16.360	2.315	95.360	1.014				0.104																		
55	77.51		7.22	23.91	0.419																						
56	28.54	356.849	57.626	10.66	0.195																						
57	62.4	284.893	152.327	2.518	0.131							0.553															
58	267.84	411.108	11.633	1.327	0.753							0.300															
59	4.981	1485.89	7.957	15.59	0.229						0.280	38.500															
60	4.931	96.841	0.798	4.536				0.060			0.732	28.970															
61	486.49	12.552	22.208	26.26																							
62	173.21	3.875		23.16						0.003																	
63	9.47	9.53	1276.933	70.78						0.001						0.086											
64		0.307	10.27	0.463						0.012																	
65		11.652	73.976	15.97						0.007																	
66	7.761	212.13		17.44		0.755		0.392			1.480	56.770							0.001								
67	**Haul technically unsuccessful (haul repeated)**																										
68	2.955	1.425		19.98				0.758				18.980															
69	3.43	1.541		16.19		0.515		0.628				39.790															
70																											
71	5.875			2.362																							

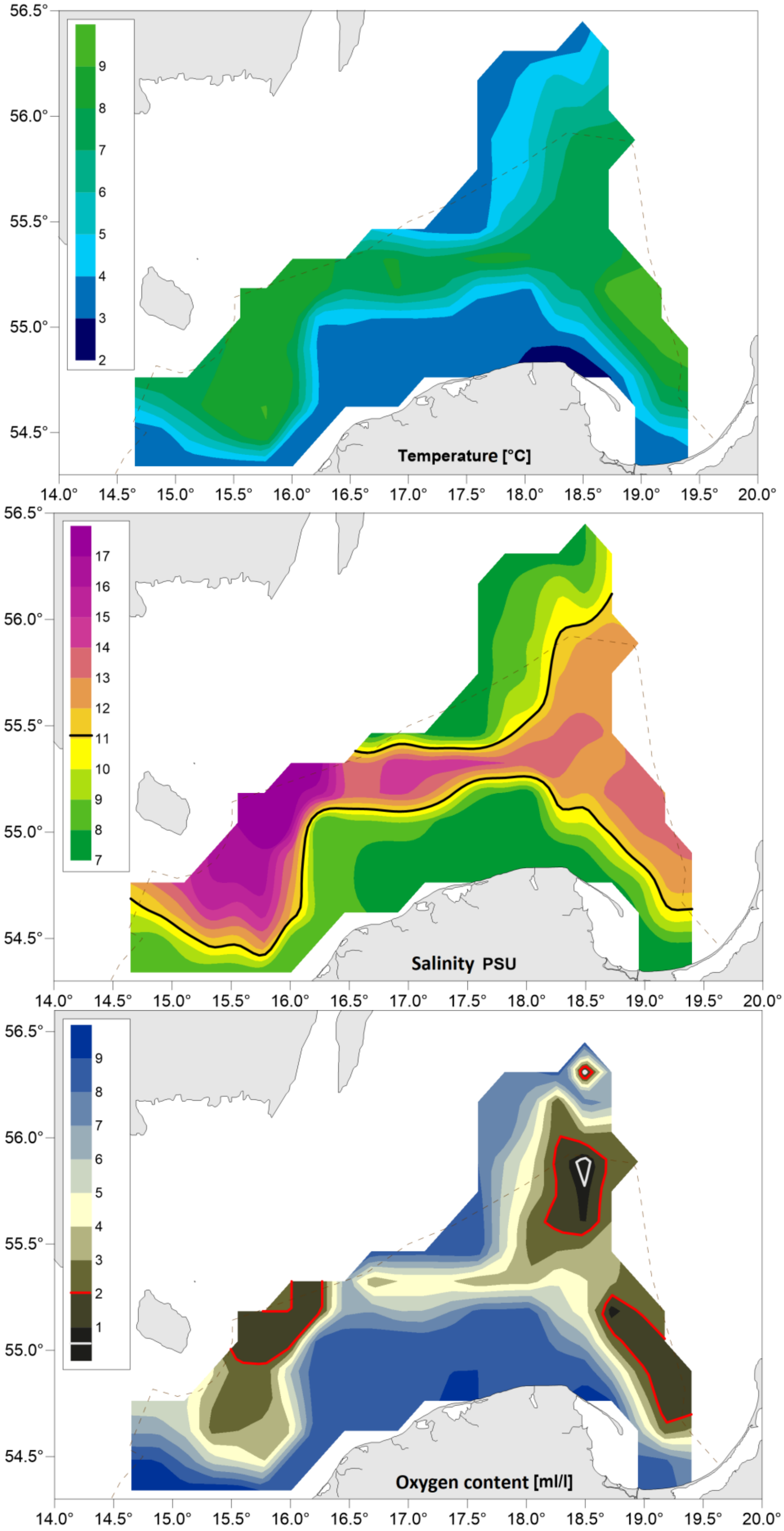

Fig. 6. Horizontal distribution of the seawater temperature, salinity and oxygen content in the near bottom layer during r/v Baltica BITS-1Q cruise (12.02-07.03. 2019 r.).

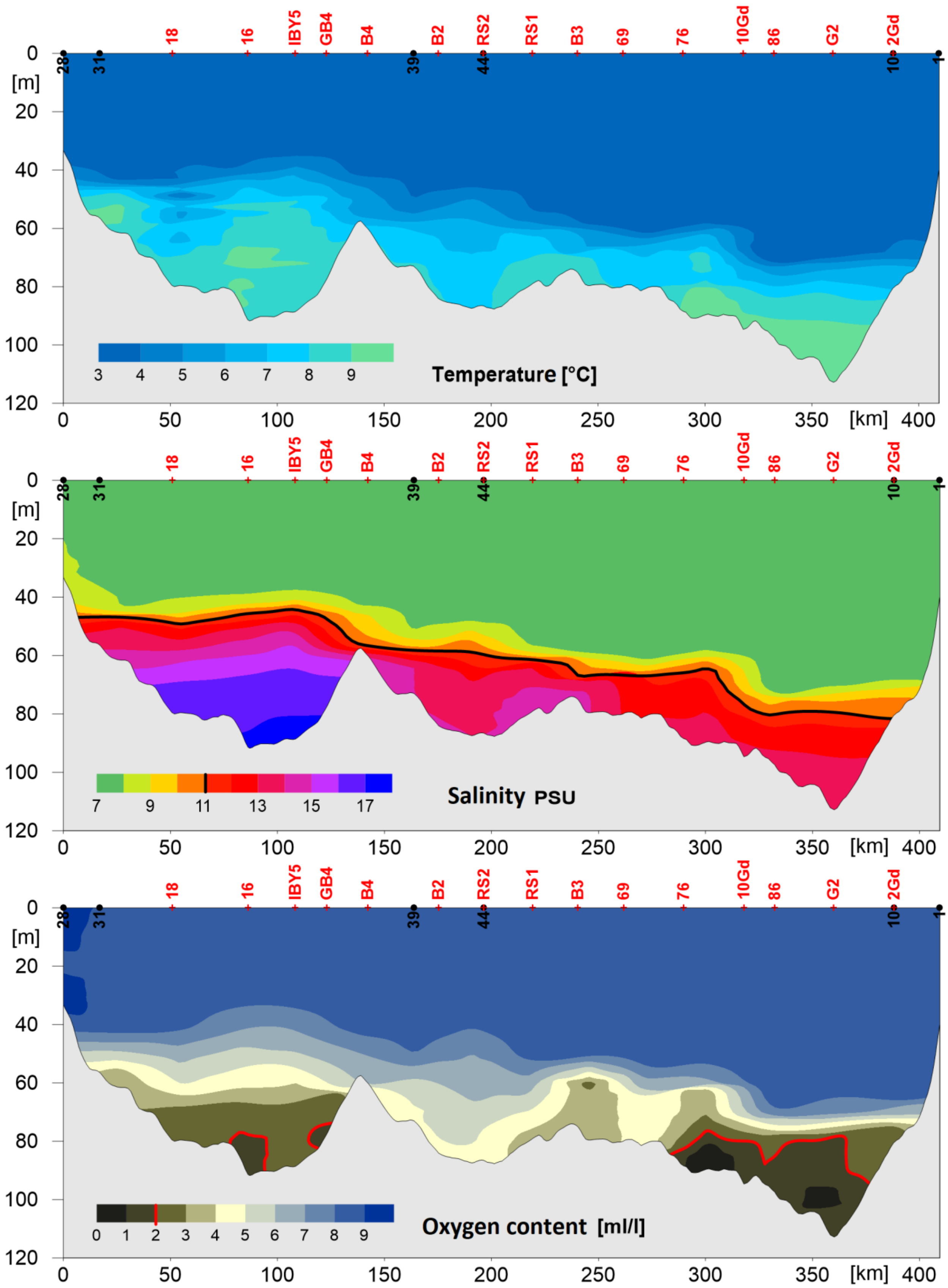

Fig. 7. Vertical distribution of the seawater temperature, salinity and oxygen content along the hydrological research profile during r/v Baltica BITS-1Q cruise (12.02-07.03. 2019 r.).

Annex 7: Cruise reports of acoustic surveys BASS and BIAS in 2018

Please see Annex 7 below.

Annex 7: Cruise reports of BASS and BIAS surveys at the WGBIFS 2019 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 Germany BASS 2018;
- 2. Cruise Report of Poland BASS 2018;
- 3. Cruise Report of Lithuania BASS 2018;
- 4. Cruise Report of Estonia-Poland joint BASS 2018;
- 5. Cruise Report of Latvia-Poland joint BASS 2018;
- 6. Cruise Report of Germany BIAS 2018.
- 7. Cruise Report of Germany BIAS 2018_Summary Table.
- 8. Cruise Report of Poland joint BIAS 2018;
- 9. Cruise Report of Lithuania BIAS 2018
- 10. Cruise Report of Estonia-Poland joint BIAS 2018;
- 11. Cruise Report of Finland BIAS 2018;
- 12. Cruise Report of Sweden BIAS 2018;
- 13. Cruise Report of Latvia BIAS 2018;

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Cruise Report FRV "Solea II" Cruise 747
30.04. – 25.05.2018

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. 747 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 2018 covered ICES subdivisions 24, 25, 26, 27, 28 and 29 (see Figure 1). Other areas in the Baltic Sea were covered by Estonia, Latvia, Lithuania, Estonia, Poland and Russia. Altogether 1212nmi of valid hydroacoustic transect were recorded and 60 control fishing hauls were carried out during the survey.

In addition to the BASS the last days of the cruise, from the 21th to the 24th May, were used to conduct hydroacoustic experiments in the Bornholm Basin with the aim to recorded additional wideband acoustic signature of clupeids and cod and to study their diel vertical migration.

2. Cruise narrative and methods

2.1. Narrative

The scientific gear was loaded on the FRV "Solea II" the 25th April in the harbour of Rostock Marienhe (Germany). Cruise started the 30th April after the ship left Rostock in the morning. Due to good weather conditions the 30th April, the day was used to calibrate the echosounder in front of Kühlungsborn, Germany.

Acoustic recording for the BASS started in the morning of the 1st May after reaching the area of investigation in ICES subdivision 24. The Trawl-Eye sensor mounted on the haul broke down the 2nd May. Fishing operations were stopped for the day as it proved too difficult to target fish in the water column without the system. Hydroacoustic data were still gathered for the day but the ship steamed to the harbour of Sassnitz (Germany) in the evening for technical assistance. The Trawl-Eye system from the FRV "Clupea" was retrieved and installed on the net the 3rd May in the morning and fishing tests were done in the afternoon in the Arkona area. The survey was resumed the 4th May in the morning and, although one of the two pelagic nets broke while fishing the 7th, it continued uninterrupted until the 16th May. Due to the long-time at sea a two days break was done the 17th and 18th May in the harbour of Visby, Gotland. The BASS ended the 20th May in the afternoon north west of Gotland in SD 27.

The last days of the cruise were then used to collect wideband echo data of monospecific fish schools and study their diel vertical migration in the Bornholm Basin from the 21th to the 24th in the evening, after what the ship steamed back to Rostock. The cruise ended the 25th May after a total of 17 days of hydroacoustic survey and 3 days of experiments when scientists disembarked in the morning in the harbour of Marienhe, Rostock. Despite some technical difficulties at the beginning of the cruise the good weather conditions allowed to fulfil the main objectives of the survey.

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 ~320m. 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 following this methodology.

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 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.

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).

The survey covered the whole subdivision 24 except the rectangle 37G4 where time constraint, shallow depth restricting fishing operation and partial cover by the Polish EEZ didn't allow any investigation (see Figure 1). With the exception of rectangle 43G8 (SD 28) -where fishing license were not granted- all rectangles assigned to German investigation in subdivisions 25 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 by authorities also forced some track changes, especially in rectangle 42G8 (SD 28) were transect was reduced.

In total, out of 1521 nmi long acoustic track 1212 nmi 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 catch observed with the Trawl Eye 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. While this setting was respected for most of the survey, net damage and replacement the 6th May (haul n°12) forced to revert back to a 20 mm codend for the day although still fishing in SD 25 (stations concerned: haul n°13, 14 and 15). The 12 mm codend was then available again for fishing the 7th May for the rest of the survey.

The trawling depth and the net opening were controlled by a Scanmar-net-probe. Generally the net opening was of ca. 8 m under usual operation. The trawl depth (headrope below the surface) was chosen regarding highest density of fish on the echogram and ranged from 10 m to 75 m. The bottom depth at the trawling positions varied from 21 m to 445 m.

Samples were taken from each haul 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 60 standard hauls (59 valid) were carried out for the BASS:

Subdivision	Hauls (n)
24	8
25	19
26	4
27	8
28	13
29	8

Altogether 39816 fish were measured and 1962 additional fish (773 sprats and 1189 herrings) 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:

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°11; 40G4/SD25: only 0.4 kg catch
- Haul n°12; 39G5/SD25: codend damaged while fishing

Although haul n°13, 14 and 15 were performed with bigger mesh size that recommended by the IBAS manual for subdivision 25 it was decided to keep the catch data from these hauls for the further analysis as no obvious effect on the species and length composition was observed.

Usage of neighbouring trawl information for investigated rectangles which contain only one or no haul:

- Haul n°3: 39G3/SD24 for 38G2/SD24
- Haul n°3: 39G3/SD24 for 39G2/SD24
- Haul n°4: 38G3/SD24 for 39G3/SD24
- Haul n°6: 38G4/SD24 for 39G4/SD24
- Haul n°8: 39G4/SD24 for 39G4/SD25
- Haul n°8: 40G4/SD25 for 39G4/SD25

Final results will be compared to those of the BASS 2017 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 14.9 °C at the surface to 2.0°C (recorded at 22.5 m depth). At the deepest CTD recording of the survey (309.5 m) temperature was measured at 6.3°C. Overall intermediate water masses (depth ranging from 6.5 to 74.0 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 5.2 psu at the surface layer up to a maximum of 17.9 psu at the bottom of the Bornholm. Regarding oxygen, concentration ranged from 5 to 13 $mL.L^{-1}$ in the intermediate water mass and dropped below 1 $mL.L^{-1}$ under this layer. Overall hypoxic conditions (<1.4 $mL.L^{-1}$, ~30% atmospheric saturation) were observed below 70 m depth all along the survey. No fish echoes were 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 1212 nautical miles. Overall mean NASC recorded through the survey is lower than previous year with a mean NASC of 439.2 m²/nm² versus 597.6 m²/nm² in 2017 were a similar ICES rectangles were covered. On an ICES subdivision scale the mean NASC per subdivision were comparable to those recorded in the past 10 years with the exception of SD26 were values were the highest of the decade (Figure 4). Mean NASC recorded in the subdivision SD26 were also relatively high in 2017. Map of the echo distributions (Figure 5) shows heterogeneous fish concentration along the hydroacoustic track.

3.3. Biological data

Catch statistics per fishing hauls and species and subdivision are presented in Table 4 and Table 5 respectively. Overall 9 fish species were recorded in 60 pelagic trawl hauls. Dismissing the invalid hauls, the CPUE ranged from 3.2 to 394.7 kg/0.5h. The mean CPUE reached 76.7 kg/0.5h, which is sensibly lower than the value calculated in the 2017 survey (286.7 kg/0.5h) but could be due to the difference in fishing gear. In terms of weight, catch was dominated by sprat (77.9%) followed by herring (17.1%) and stickleback (3.8%). Those three species were caught on the majority of the trawls through the survey, in respectively 55, 55 and 47 hauls. The numbers and biomass of species other than herring, sprat and stickleback was negligible.

Figure 6 show the length frequency distribution for sprat and herring per subdivision in 2017 and 2018. Overall, with the exception of herring in SD 24, length distribution of clupeids tended to be bigger than observed during the BASS 2017. Age distribution per length class is presented in Figure 7. Final age distribution by subdivision for 2018 (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 both sprat and herring and with the exception of SD 24, most of the individuals were in the 4 years age class. Incoming year class represented by 1 year old individuals was mostly comparable or lower (especially for sprat) in 2018 compared to 2017.

3.4. Abundance Estimate

The calculated abundance in number and weight of sprat and herring per rectangle and subdivision is presented in Table 6. Estimated abundances in all overlapping rectangle for herring and sprat are lower in 2018 compared to 2017 with respectively $3.99*10^9$ versus $7.11*10^9$ herrings (-44%) and $59.87*10^9$ versus $85.38*10^9$ sprats (-30%). Estimated biomass is also lower in 2018 for herring with $111.60*10^3$ tonnes versus $170.18*10^3$ tonnes estimated in 2017 (-34%). Estimated biomass of sprat was again lower in 2018 with $661.62*10^3$ tonnes versus $725.91*10^3$ tonnes in 2017(-8%).

Year	Species	n total (million)	total biomass (tonne)
2017	*Clupea Harengus*	7106.8	170178.1
2018		3990.1	111596.0
2017	*Sprattus sprattus*	85382.7	725911.0
2018		59867.5	661615.2

4. Survey participants

Name	Function	Institution
P. Rodriguez-Tress	Scientist in charge	TI-OF
B. Lüdke	Acoustics	TI-SF
L. Wietrzinsky	Fishery biology	TI-OF
K. Shöps	Fishery biology	TI-OF
M. Bächtiger	Fishery biology	TI-OF (student assistant)
N. Köstner	Fishery biology	TI-OF (student assistant)
S. Winning	Fishery biology	TI-OF (student assistant)

5. Acknowledgement

We hereby thank all participants, the crew of FRV "Solea" and Captain V. Koops 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 747/2018 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)
01.05.2018	04:10	16:40		11.05.2018	04:13	18:15
02.05.2018	04:12	17:21		12.05.2018	04:36	18:10
04.05.2018	04:00	16:40		13.05.2018	04:19	17:31
05.05.2018	04:10	17:56		14.05.2018	04:01	18:44
06.05.2018	04:04	17:30		15.05.2018	04:03	17:22
07.05.2018	04:01	18:25		16.05.2018	04:06	18:53
08.05.2018	04:01	17:55		19.05.2018	04:17	17:36
09.05.2018	04:04	18:49		20.05.2018	04:08	11:49
10.05.2018	04:03	18:34				

Table 2: FRV "Solea" cruise 747/2018 BASS: Hydroacoustic track length per ICES rectangle.

Subdivision	ICES rectangle	Valid acoustic track length (nmi)		Subdivision	ICES rectangle	Valid acoustic track length (nmi)
24	37G4	0		25	41G7	69
24	38G2	17		26	40G8*	21
24	38G3	46		26	41G8	54
24	38G4	58		27	42G7*	2
24	39G2	15		27	45G8	43
24	39G3	68		27	46G8	39
24	39G4	28		28	42G8	56
25	38G5*	10		28	42G9	42
25	39G4	21		28	43G8	0
25	39G5	44		28	43G9	61
25	39G6*	29		28	44G9	56
25	40G4	44		28	45G9	38
25	40G5	54		29	46G9	44
25	40G6	53		29	46H0	22
25	40G7	58		29	47G9	45
25	41G6	51		29	47H0	24

*ICES rectangle not assigned to German investigation

Table 3: FRV "Solea" cruise 747/2018 BASS: Survey statistics of the cruise

Subdivision	Rectangle	area (nmi²)	Sa (m²/nmi²)	sigma (m²) (*10e-4)	n total (million)	*Clupea harengus* (%)	*Sprattus sprattus* (%)	*Gadus morhua* (%)
24	38G2	832.9	270.6	1.612	1398.15	3.75	96.11	0.110
24	38G3	865.7	532.9	1.824	2529.22	0.84	99.16	0.000
24	38G4	1034.8	225.1	1.639	1421.19	2.68	97.32	0.000
24	39G2	406.1	146.9	1.699	351.12	3.77	96.18	0.030
24	39G3	765.0	125.4	1.754	546.92	2.20	97.74	0.030
24	39G4	524.8	164.3	1.647	523.52	2.60	97.40	0.000
25	39G4	287.3	350.3	1.961	513.21	25.39	74.61	0.000
25	39G5	979.0	695.5	1.521	4476.62	0.24	99.46	0.290
25	40G4	677.2	236.0	1.260	1268.40	24.23	25.92	0.000
25	40G5	1012.9	186.9	1.116	1696.33	1.12	65.44	0.050
25	40G6	1013.0	689.7	1.341	5210.03	4.93	76.25	0.270
25	40G7	1013.0	995.3	1.365	7386.36	0.23	98.56	0.000
25	41G6	764.4	510.3	0.370	10542.52	0.48	2.07	0.000
25	41G7	1000.0	218.2	0.724	3013.81	0.04	30.61	0.000
26	41G8	1000.0	826.9	1.272	6500.78	0.08	99.34	0.040
27	45G8	947.2	395.5	1.257	2980.25	13.59	75.33	0.020
27	46G8	884.8	494.2	1.504	2907.36	28.92	68.85	0.050
28	42G8	945.4	526.2	1.097	4534.81	0.75	75.24	0.020
28	42G9	986.9	659.7	1.237	5263.20	0.90	97.83	0.040
28	43G9	973.7	213.3	1.289	1611.25	5.09	91.66	0.110
28	44G9	876.6	259.7	1.188	1916.27	2.65	92.71	0.030
28	45G9	924.5	262.3	1.304	1859.63	7.54	91.40	0.080
29	46G9	933.8	285.6	1.369	1948.08	15.12	84.52	0.010
29	46H0	933.8	278.6	1.289	2018.28	10.31	89.38	0.000
29	47G9	876.2	605.9	1.224	4337.33	9.94	89.04	0.010
29	47H0	920.3	527.3	1.362	3562.95	14.28	85.65	0.010

Table 4: FRV "Solea" cruise 747/2018 BASS: 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	8.0	605	8.0		31	38.2	4345	57.3
2	10.9	730	10.9		32	90.5	10768	135.8
3	31.5	1822	31.5		33	10.8	1600	11.2
4	87.0	5611	87.0		34	12.6	1738	13.0
5	78.0	4517	78.0		35	33.2	3974	41.5
6	5.3	390	5.3		36	48.1	5798	48.1
7	139.5	9749	139.5		37	43.6	5173	43.6
8	10.7	830	10.7		38	54.0	6113	55.8
9	73.7	3054	73.7		39	50.0	5620	51.8
10	13.2	10168	13.2		40	36.8	3734	36.8
11*	0.4	290	0.4		41	39.2	5090	49.1
12*	141.4	14047	176.8		42	49.1	5886	50.8
13	357.1	32901	357.1		43	147.5	16859	147.5
14	72.5	5887	108.7		44	30.2	2995	31.2
15	9.1	6581	9.1		45	62.7	6537	62.7
16	83.5	7838	167.0		46	105.2	10407	166.1
17	66.4	5525	99.6		47	127.3	13111	131.7
18	112.2	10056	168.3		48	71.7	9328	86.1
19	263.1	26645	394.7		49	127.2	13524	200.8
20	33.7	19368	33.7		50	124.1	11563	128.4
21	3.2	1504	3.2		51	93.0	9625	93.0
22	21.1	7895	21.1		52	220.8	24095	220.8
23	12.1	1186	10.6		53	113.9	12231	117.8
24	56.4	4690	56.4		54	34.3	4720	34.3
25	52.7	21334	52.7		55	118.0	11182	122.1
26	13.3	5963	13.3		56	66.0	6453	68.3
27	24.9	2792	24.9		57	53.2	5527	55.0
28	28.1	3405	28.1		58	89.0	7257	92.0
29	44.1	4826	44.1		59	166.3	12611	172.0
30	46.2	5484	69.3		60	86.9	9536	89.9

* invalid haul

Table 5: FRV "Solea" cruise 747/2018 BASS: Catch statistics per species.

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 (%)
CLUPEA HARENGUS	55	11302	1180	705.259	16.68	6.88
GADUS MORHUA	31	202	186	39.794	0.94	0.1
GASTEROSTEUS ACULEATUS	47	2769	0	141.699	3.35	17.26
HYPEROPLUS LANCEOLATUS	2	2	0	0.033	0	0.02
MERLANGIUS MERLANGUS	6	16	0	3.471	0.08	0.18
PLATICHTHYS FLESUS	18	31	0	4.724	0.11	0.03
RHINONEMUS CIMBRIUS	1	1	0	0.155	0	0.01
SCOMBER SCOMBRUS	1	3	0	0.608	0.01	0.01
SPRATTUS SPRATTUS	55	24932	754	3333.344	78.82	83.74

Table 6: FRV "Solea" cruise 747/2018 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	38G2	52.49	3467.23	1343.73	22836.69
24	38G3	21.35	1397.46	2507.89	42257.95
24	38G4	37.88	1597.12	1383.06	23975.35
24	39G2	13.23	824.59	337.69	5772.39
24	39G3	12.04	816.81	534.59	8726.80
24	39G4	13.56	598.23	509.90	8761.99
25	39G4	130.10	4917.94	382.45	4600.33
25	39G5	10.88	441.29	4452.59	52241.60
25	40G4	306.89	10824.01	328.72	3817.85
25	40G5	19.03	647.97	1110.05	13089.08
25	40G6	256.60	8814.85	3972.91	44882.53
25	40G7	16.63	584.40	7280.05	81494.96
25	41G6	50.40	1682.48	218.63	2434.60
25	41G7	1.14	53.66	922.45	10647.71
26	41G8	5.12	195.06	6458.11	56088.69
27	45G8	404.90	10438.32	2244.93	22645.73
27	46G8	840.84	21867.10	2001.68	20352.08
28	42G8	33.92	1013.05	3411.91	35987.12
28	42G9	47.29	1310.05	5148.83	53116.62
28	43G9	81.95	2250.45	1476.79	15157.40
28	44G9	50.80	1398.97	1776.52	18307.04
28	45G9	140.21	3688.05	1699.73	17415.86
29	46G9	294.63	6988.26	1646.50	15359.79
29	46H0	208.07	4649.58	1803.95	16950.37
29	47G9	431.19	9622.54	3862.17	35971.29
29	47H0	508.94	11506.50	3051.62	28723.37

8. Figures

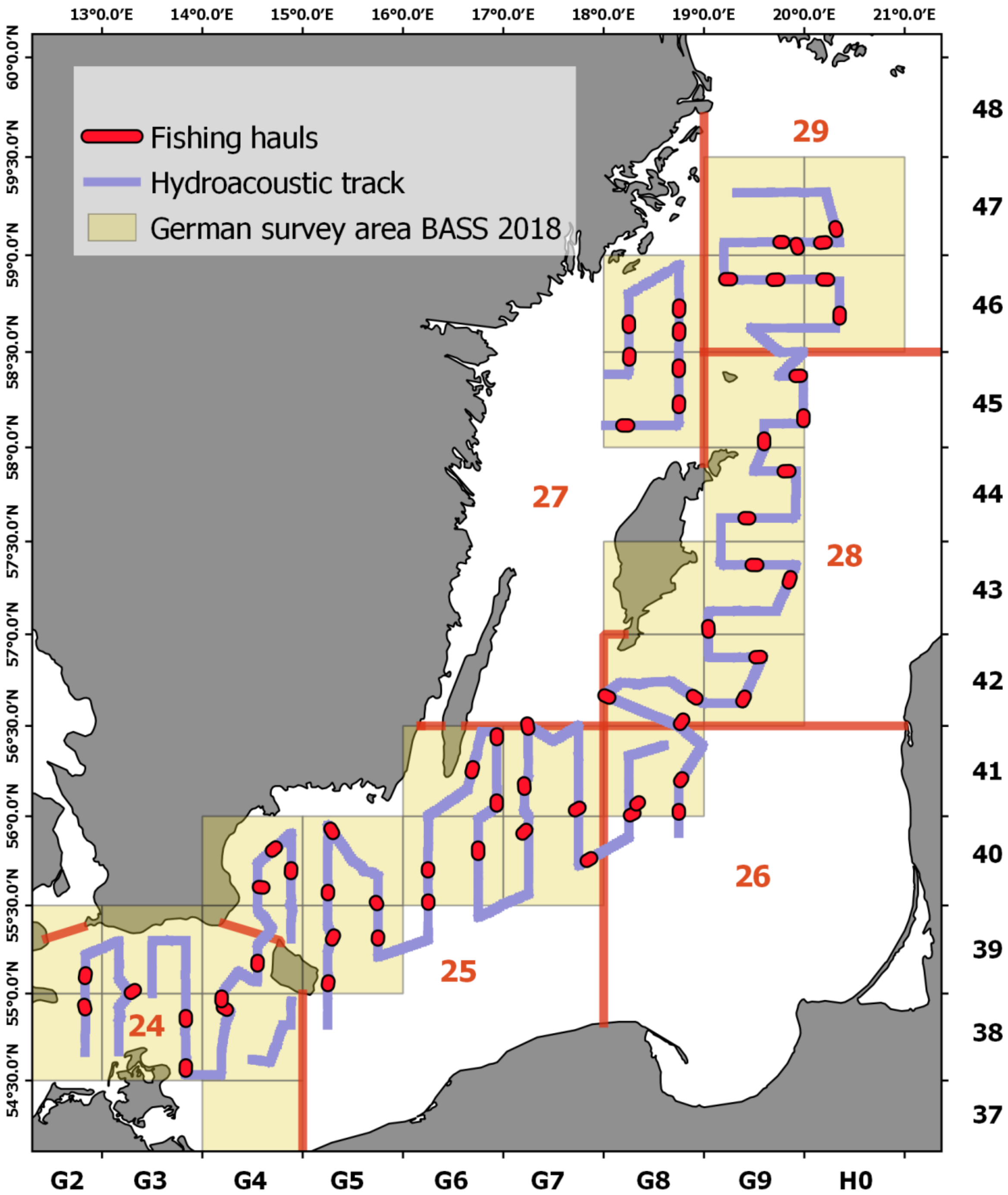

Figure 1: FRV "Solea" cruise 747/2018 BASS: Hydroacoustic track (purple line) and fishing hauls (red line) done during the BASS survey 2018.

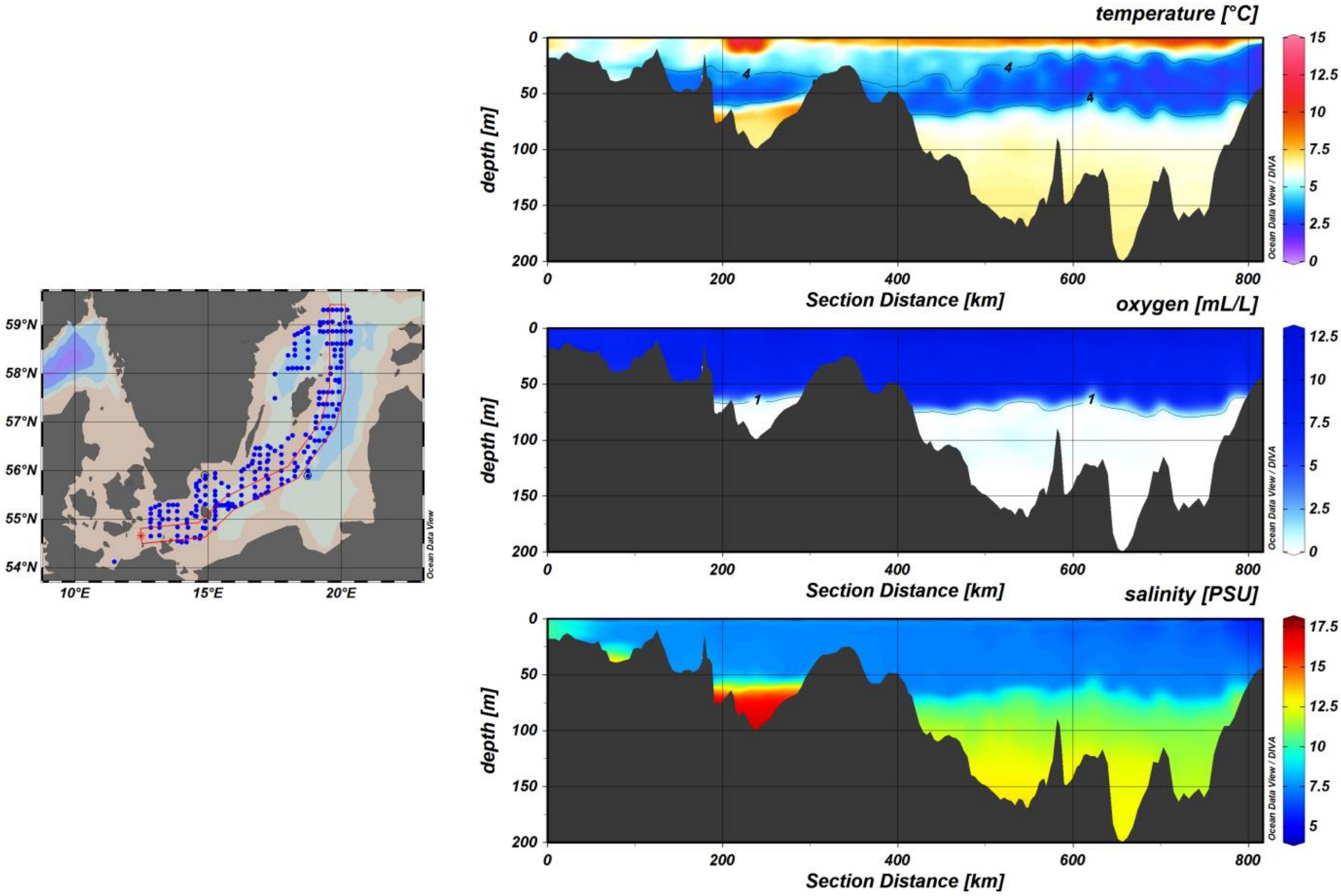

Figure 2: FRV "Solea" cruise 747/2018: Temperature (upper right panel), oxgen (middle right panel) and salinity (lower right panel) interpolated from CTD casts along a south/west - north/east transect as shown in the left panel (red line). CTD casts coordinates are display as blue dots on the map in the left panel.

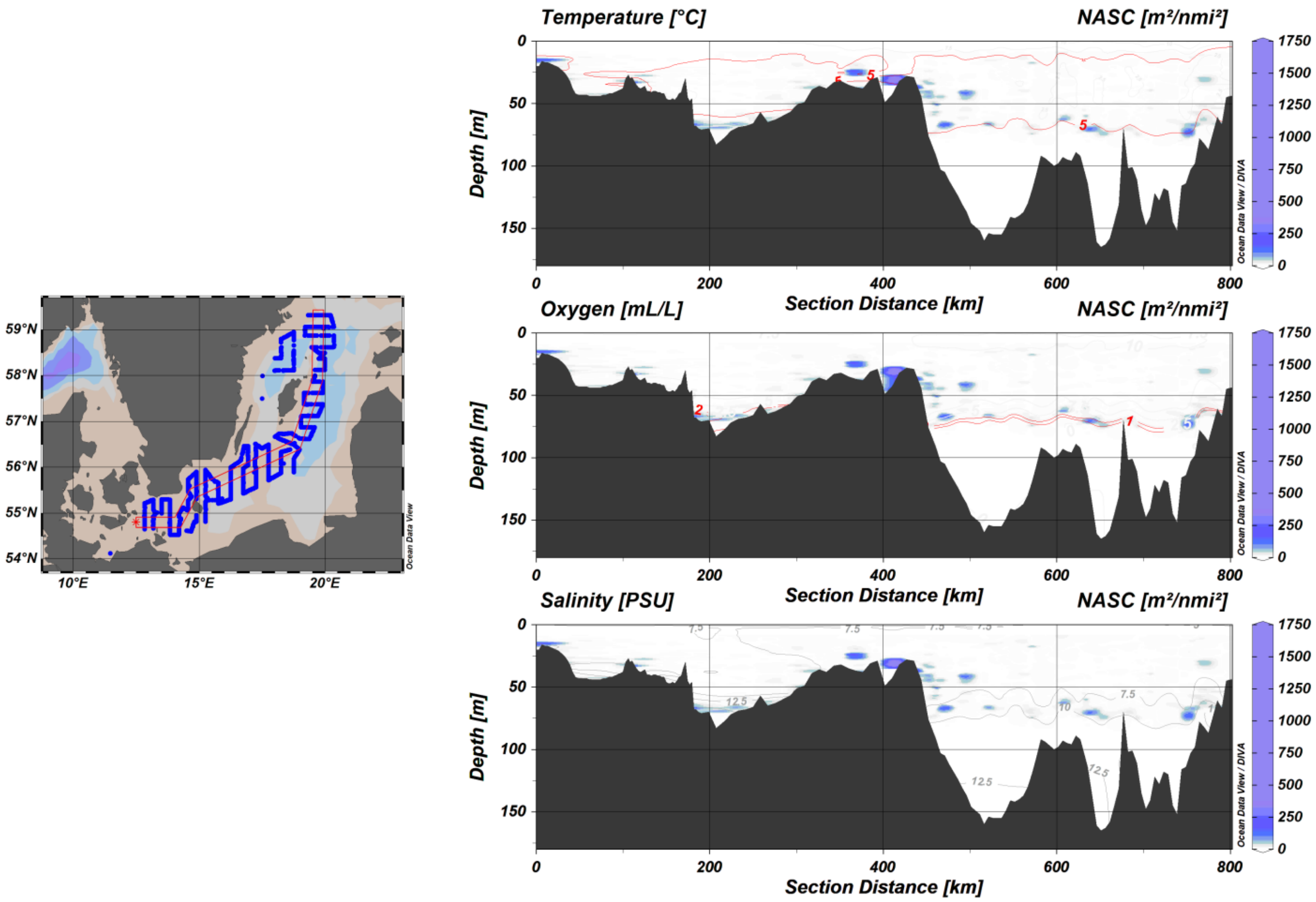

Figure 3: FRV "Solea" cruise 747/2018: Vertical distribution of salinity, temperature and oxygen related to the echogram of fish (blue clouds).

Figure 4 : FRV "Solea" cruise 747/2018: Mean NASC calculated per year and per subdivision (red bar correspond to 2018).

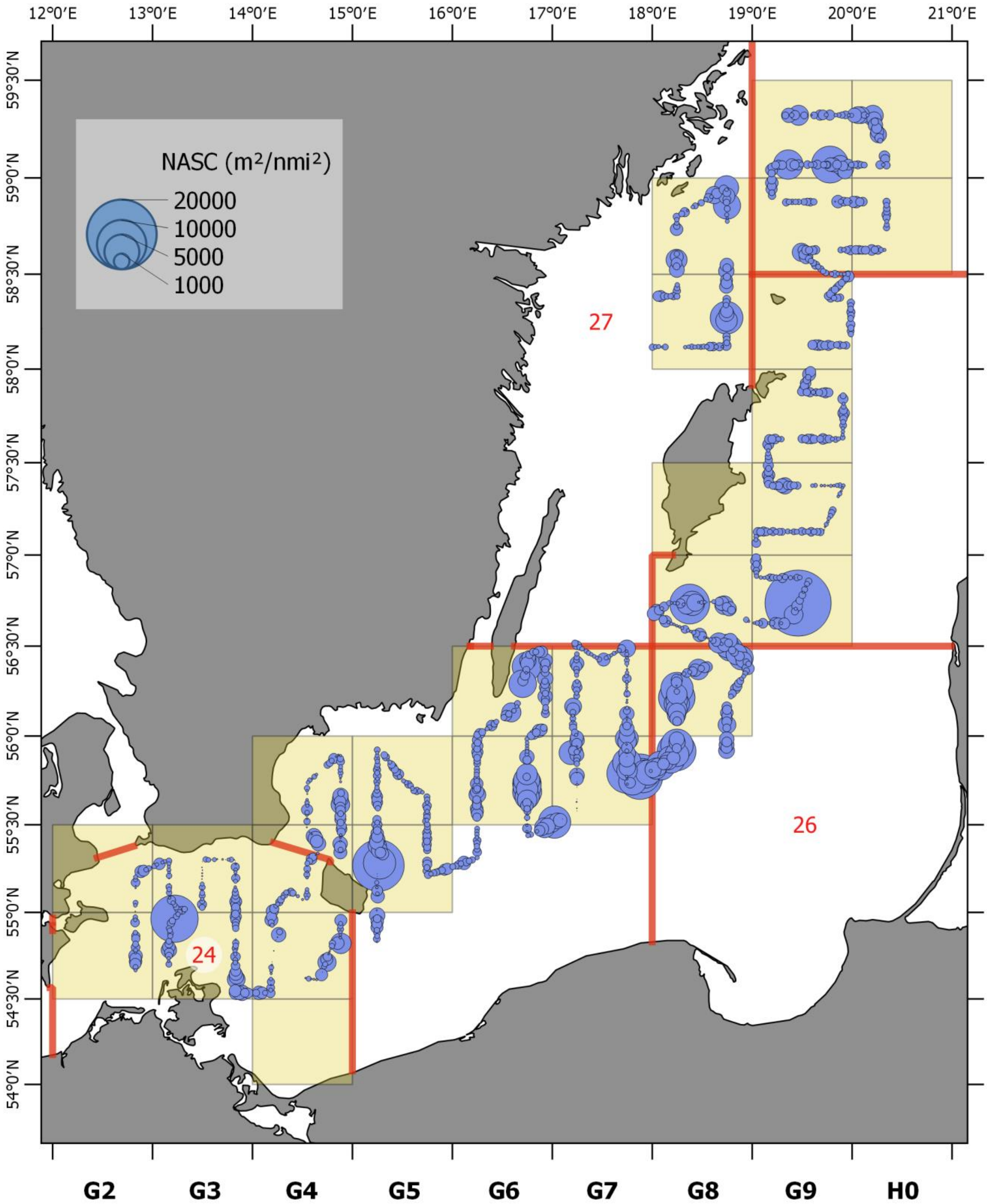

Figure 5: FRV "Solea" cruise 747/2018 BASS: hydroacoustic results: NASC (m²/nm²) per 1 nmi recorded during the survey.

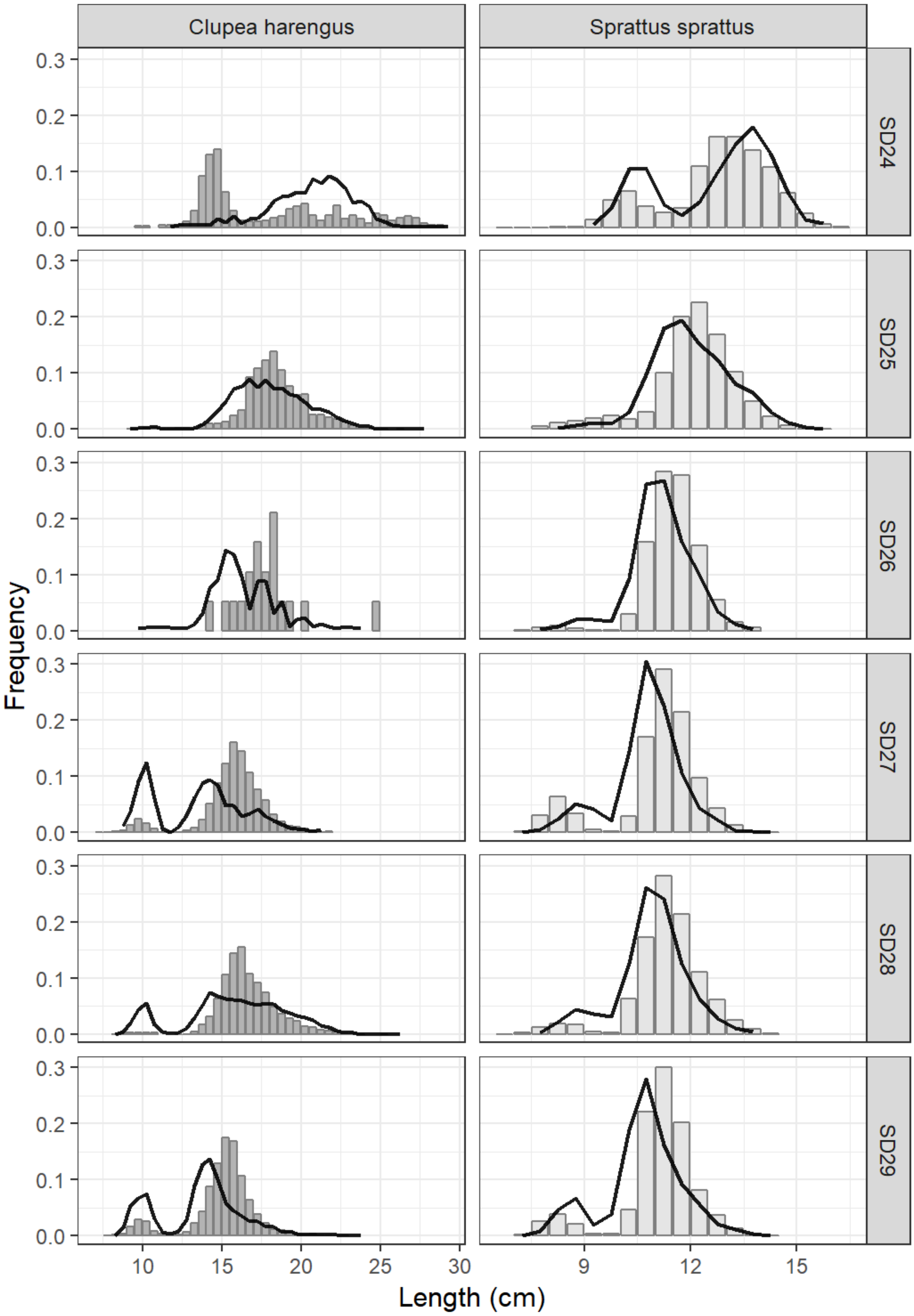

Figure 6: FRV "Solea" cruise 747/2018 BASS: Herring and sprat length distribution measured per ICES subdivision during BASS 2017 (black line) and BASS 2018 (bars).

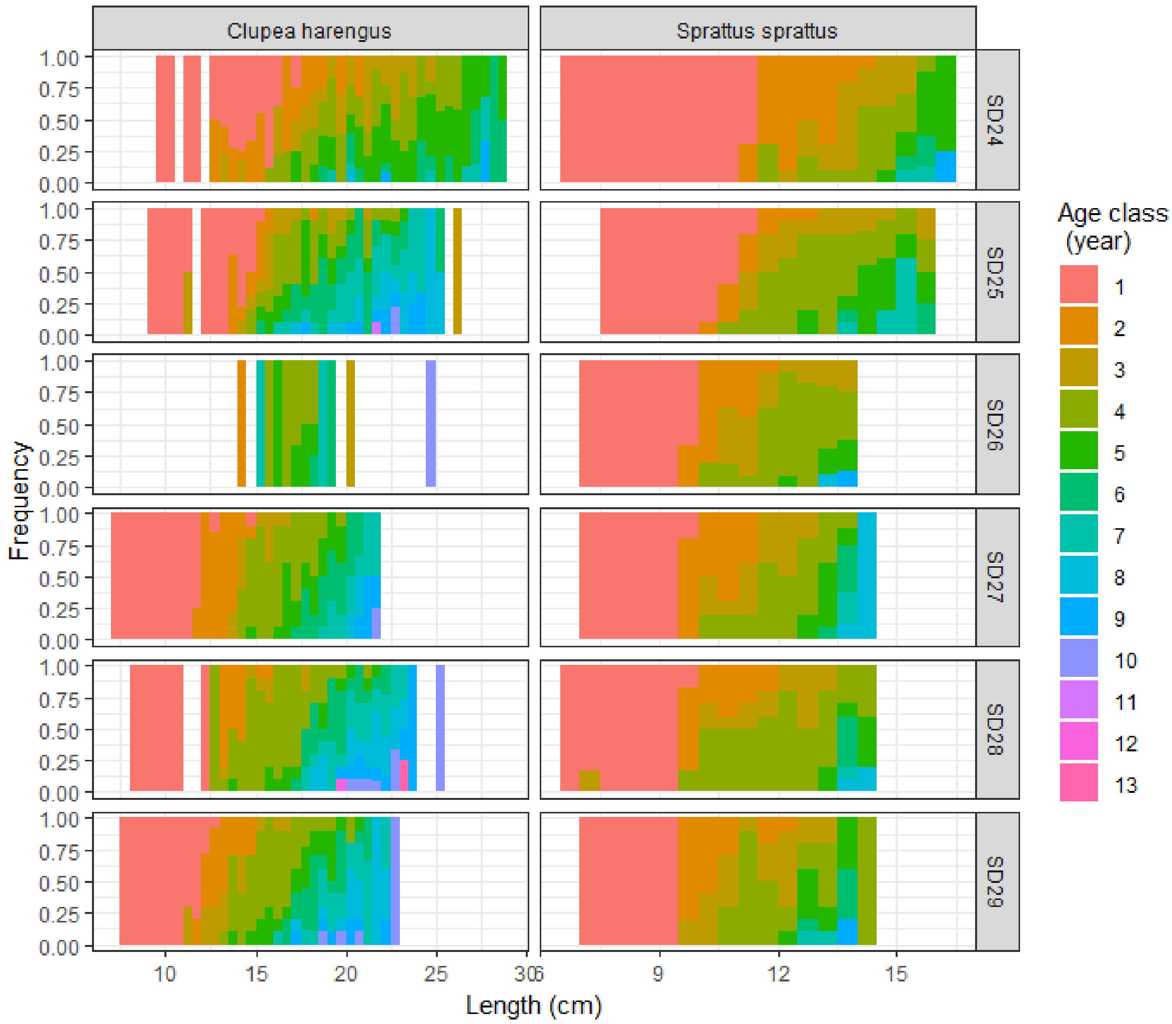

Figure 7: FRV "Solea" cruise 747/2018 BASS: Age distribution per length class, species and subdivision for 2018.

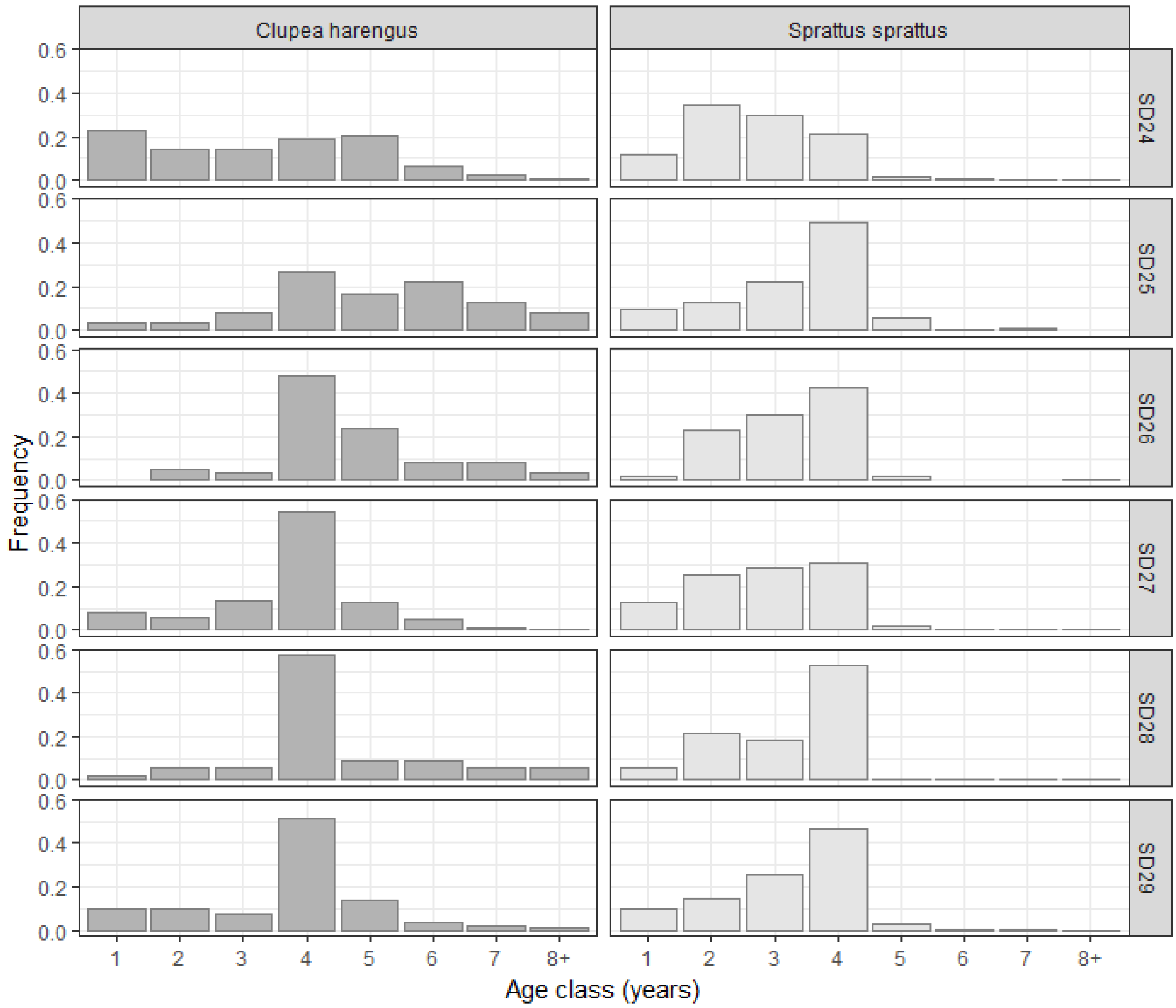

Figure 8: FRV "Solea" cruise 747/2018 BASS: Calculated age class distribution per species and subdivision in 2018.

Working paper on the WGBIFS meeting in Klaipeda (Lithuania) 25-29.03.2019

Research report from the Polish part of the Baltic Acoustic Spring Survey on board of the r.v. "Baltica" (02-13.05.2018)

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INTRODUCTION

The autumn acoustic-biotic surveys in the Baltic were realised much early back in time and most frequently, than the May acoustic surveys. The acoustic surveys in October has been carried out in the Baltic Proper since 1978, however on the very beginning as the Swedish-German (GDR) cruise, not fully coordinated by the ICES (Håkansson et al. 1979, Hagström et al. 1989). The spring acoustic-biotic survey in Baltic proper was inaugurated in May 1978 by the Latvian-German (GDR) scientific team on board of the r.v. "Zvezda Baltiki" (Shvetsov et al. 1986, 1992). In the next several years, both countries dominated in accomplishment of May acoustic surveys. The initial Polish acoustic survey in the southern Baltic was conducted in July 1981, on board of the r.v. "Profesor Siedlecki" (Orłowski 1982, 1991). In October 1982, the National Marine Fisheries Research Institute (NMFRI) began simultaneous the acoustic, biological and fisheries investigations of herring and sprat stocks size and distribution, mostly in the southern Baltic (Grzebielec et al. 1995). The above-mentioned survey can be accepted as the beginning of somewhat regular autumn acoustic surveys in the Polish EEZ. The above-mentioned Polish research institute began the spring acoustic surveys in May 1983 (Elwertowski and Orłowski 1984, Elwertowski et al. 1984).

In the 1980s, the NMFRI contribution to those surveys was limited to chartering of commercial stern cutter the m/t "HEL-100", which was designated for fish control-hauls realization. Moreover, the NMFRI delegates participated in several acoustic surveys on board of the Swedish r.v. "Argos" (Hagström et al. 1989). Sporadically, also the Polish r.v. "Profesor Siedlecki" participated in the Baltic acoustic surveys (May 1985, October 1989 and 1990). In the 1980s and at the beginning of 1990s, the ICES Planning Group for Hydroacoustic Surveys in the Baltic with close cooperation of the ICES Working Group on Assessment of Pelagic Stocks in the Baltic were responsible for logistically coordination of international acoustic surveys (Anon. 1991a) and implementation of collected international data to the final assessment of Baltic sprat and herring stocks biomass (Anon. 1991b).

Since 1994, the permanent participation of the Polish r.v. "Baltica", managed by the NMFRI in Gdynia, has took place in the framework of the ICES Baltic International Acoustic Surveys (BIAS) long-term programme. Poland join again the international spring acoustic-biotic surveys relatively late in time, i.e. in May 2017 (Kruk et al. 2018). The reported May/2018 survey is the second in order Polish survey realised in the framework of the Baltic Acoustic Spring Survey programme (BASS). The ICES Baltic International Fish Survey Working Group (WGBIFS) coordinates methods of investigations, timing of surveys, spatial allocation of vessels and general pattern of pelagic control-hauls distribution in the Baltic, regarding both types of acoustic surveys, i.e. BASS 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 final evaluation of fish stocks size.

The reported Polish BASS/2018 survey was conducted on board of the r.v. "Baltica" inside the Polish EEZ, in the period of 02-13 May 2018. The survey was focused on monitoring of clupeids and cod spatial-seasonal distribution in pelagic zone of the southern Baltic (parts of the ICES Subdivisions 25 and 26), giving high priority to assessment of sprat spawning stock size and distribution. The BASS 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 new determined calibration parameters were applied to completing the BASS survey tasks. The Polish Fisheries Data Collection Programme for 2018 and the European Union (the Commission Regulations Nos. 1639/2001, 1581/2005, 665/2008, 1078/2008, 2008/949/EC, 2010/93/EU) financially and logistically supported the Polish BASS survey marked with internal No. 7/2018/MIR-PIB.

The WGBFAS will use recently collected the BASS data for tuning clupeids stock biomass assessment and spatial distribution based on the data from commercial catches. The acoustic estimates are, until present time, the commercial fishery independent source of input data available to the WGBFAS.

The main goal of current paper is a brief description of result 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 at spring 2018. Moreover, the paper contains description of sprat, herring and cod some 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 BASS/2018 survey on board of the r.v. "Baltica" were realized by the NMFRI (Gdynia) nine members of the scientific team, with Kordian Trela as a cruise leader. The group of researchers was composed of:
Beata Schmidt – hydroacoustician,
Julia Gutkowska – intern, sprat analyses,
Grzegorz Modrzejewski – technician, sprat analyses,
Wojciech Deluga – technician, herring analyses,
Stanisław Trella - technician, herring analyses,
Zuzanna Mirny - 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 the Gdynia port on 02.05.2018 at 06:00 a.m. and was navigated in the south-eastern direction, where at the mouth of the Vistula River a successful calibration of the acoustic system SIMRAD EK60, installed on the vessel, was carried out. On 02.05.2018 at the evening, the ship was directed to the start point of a planned acoustic transects above the Gdansk Deep (Fig. 2). The acoustic integration started on the 3rd of May 2018 at about 7 a.m. and it finished on the 12th May 2018 in west part of Polish EEZ. The r.v. “Baltica” returned to the Gdynia port on the 13th of May 2018 around 9 a.m. Any strong winds and the stormy days not appeared during reported BASS survey.

Survey design and realization – sampling description

The ICES statistical rectangles, designated by the ICES-WGBIFS as mandatory to Poland, were full 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 rectangle (ICES SD 24), which as optional was allocated to Poland (ICES, 2018).
The SIMRAD EK-60 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 BASS 2018 survey. Calibration of the vessel’s acoustic system was performed on 02nd of May 2018 at following location: λ = 019°11.8'E and φ = 54°27.6'N over seabed depth of 65 m (Fig. 2). The echosounder calibration was performed as described in Simrad (2012) using copper spheres of diameters 60mm and 23mm for 38kHz and 120kHz frequency respectively as reference targets. Calibration results obtained in May 2018 were considered as good for 38 kHz

(RMS=0.18) and acceptable for 120 kHz (RMS=0.38). 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 734 NM. The echo-integration data were collected in a daytime regime at the ship speed of 7 kn. Because of historical comparability of data, pre-selected echo-integration transects were planned in a similar pattern as was in the recent years, i.e. since the autumn 2013 BIAS survey, when transects were reshaped comparing with the period of 2009-2012. A fragment of shallow southern parts of the Polish marine waters was omitted from the investigations.

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 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 linear domain) from 10 m below the surface to about 0.5 m over the seafloor and then averaged it within 1 NM interval. Than the mean NASC (Nautical Area Scattering Coefficient) per ICES rectangles were calculated.

Overall 25 catch-stations (11 in the ICES SD 25 and 14 in the ICES SD 26) were conducted by the r.v. "Baltica" in spring of 2018 (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 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 a pelagic trawl and the technical-acoustics disturbances from a set vessel-trawl, the areas shallower as 30-m were not controlled with the catch-stations. The trawling time for most hauls was 30 minutes, however it was shortened when echogram and net-sounder indicated large concentration of fishes in the area of operating a fishing gear. In the cases of two-layer fish concentrations appearing, the net was used for 15 minutes in each layer. The mean speed of surveying vessel during trawling was ranged from 3.1 to 3.5 knots. Fish catches were localized on the depth ranged from 6 to 70 m from the sea surface (position of the headrope). Depth to the bottom at trawling positions varied from 35 to 110 m.

Fish caught in each control-haul was 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 Figs. 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, 25, 25 and 13 samples were taken for the length and mass determination of sprat, herring and cod, respectively. Totally, the length and mass were measured for 5318 sprat, 1285 herring and 545 cod individuals. Respectively, 598, 583 and 129 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 IDRONAUT 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 stratums, 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 the each catch-station location with the automatic station MILOS 500.

Data 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 from trawl catch results are used to aid acoustic species identification. Such data analysis is sectioned according to the ICES statistical rectangles. For each rectangular, 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). However, during BASS cruise in 2018, in rectangles 37G5, 39G9 and 37G8 only one haul per rectangle was performed. In such cases, the haul made in an adjacent rectangular in similar hydrology condition and resulted with similar species share and length distribution were included into analysis in given rectangle. In this way, haul No. 5 and haul No. 10 were included into analysis in ICES rectangles 37G8 and 39G9 respectively. However analysis in ICES rectangle 37G5 were based on only one haul (the nearest haul in 38G5 rectangle were performed in different hydrological condition, and was assumed as unrepresentative for shallow 37G5 ICES rectangle). In case when the mean numerical share of sprat herring and cod in ICES rectangle exceeded 99%, other species were excluded from further calculations. 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

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 control-catches of given the ICES rectangle.

RESULTS

Acoustic results

The spatial distribution of mean NASC values (5 NM intervals), predominantly derived from clupeids, measured on hydroacoustic transects during BASS 2018 survey is presented on Fig. 3. The highest NASC values were recorded in SD26 (in the Gdańsk Deep and the southern part of the Gotland Deep), and in the area of the Slupsk Furrow in SD25. Overall NASC values recorded in the Polish EEZ during BASS 2018 survey remains at a similar level as recorded during BASS 2017 cruise (Kruk et al., 2018). However differences in mean NASC values on ICES subdivisions and rectangles scales exist (Tables 1, 2). The mean NASC values per ICES subdivisions presented in Table 1 were calculated with use of areas of ICES rectangles as weight. Also for comparison reasons, presented mean NASC for in the ICES SD25 (BASS 2017) was calculated without the ICES rectangles 39G5 and 40G7, because in May 2018 mentioned rectangles were acoustically not inspected. In 2018, the mean NASC values in SD25 increased by about 50% comparing to 2017, while in SD26 it decreased by about 20%. Similar to 2017, during BASS 2018 survey, the highest NASC values were recorded in SD26, in waters with a depth above 50 m - in rectangles 39G9, 40G8 and 39G8 – where mean NASC values per rectangle reached the value 2408.6, 1506.2

and 1477.1 m^2NM^{-2} respectively. The highest NASC value per 1 NM equal to 6148 m^2NM^{-2} was recorded in rectangle 39G8 (Fig. 4). The high integration values were also obtained for the southern part of the Gulf of Gdansk (rectangles 37G8 and 37G9). In SD25, comparing to previous year, the highest increase in the NASC value was recorded in the shallow waters, i.e. in rectangle 38G7 – five-fold increase in NASC value, and in rectangle 38G6 – two-fold increase.

Fish catches, biological parameters and stocks size

In May 2018, overall, nine fish species were recorded in 25 scrutinized pelagic control-hauls taking place in the Polish parts of the ICES Subdivisions 25 and 26 (Table 3, Fig. 2). Totally, 9467.4 kg of fish in 25 hauls were caught, and the mean share of sprat, herring, cod and all other species was adequately, 95.5: 2.5: 1.8 and 0.2%. Sprat distinctly dominated by mass in control-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 total catch of 15.1 kg in the entire study area was remarkable as component of bycatch. Sprat and herring occurred in each pelagic control-haul and cod in 52% of hauls number. Any sea-mammals and any sea-birds wasn't detected in the control-catches.

In the ICES Subdivision 26, sprat was dominated by the total mass (4862.9 kg), the mean CPUE (1144.4 kg h^{-1}) and the mean share (97%) in 14 hauls realised inside the Polish part of the mentioned subdivision. The above-mentioned exploitation parameters were somewhat lower for sprat caught in the ICES Subdivision 25, where amounted 4178.4 kg, 782.8 kg·h^{-1} and 94%, respectively in 11 hauls. Sprat highest CPUE was obtained in a few single research catches conducted, e.g.: on the border between the Gulf of Gdansk and the Gdansk Deep (3742.4 kg h^{-1}), in the south-western part of the Gulf of Gdansk (2158.9 kg h^{-1}), on the border between the Gdansk Deep and the Gotland Deep (2338.0 kg h^{-1}), and in the Slupsk Furrow (2592.9 and 2098.8 kg h^{-1}).

The total weight of catches, mean CPUE and a mean share of herring in hauls made at the same period in inspected the Polish part of the ICES Subdivision 25 was higher than in the ICES Subdivision 26. In the ICES SD25 values of above parameters was as follow: 170.3 kg, 31.1 kg h^{-1} and 3.8%, whereas in the ICES SD26 was: 64.1 kg; 14.4 kg·h^{-1} and 1.3%. The CPUE of herring was relatively high in the limited number of hauls, i.e. eastward from the Bornholm Deep (139.8 and 52.8 kg h^{-1}) and in eastern part of the Gdansk Deep (50.0 kg h^{-1}).

The mean share of cod in mass of the pelagic trawl control-catches conducted in the ICES SD25 was a bit higher than in the ICES SD26, where amounted 2.1 and 1.7%, respectively.

The results of sprat, herring and cod some biological features investigations in May 2018 are presented in Figure 8 and Tables 4, 8, 11, 14. The total length of species dominated in control-hauls conducted in the all investigated areas ranged as follows:

- sprat – 7.0 ÷ 15.5 cm (avg. l.t. = 11.6 cm, avg. W = 9.3 g),
- herring – 9.0 ÷ 27.0 cm (avg. l.t. = 17.3 cm, avg. W = 32.8 g),
- cod – 18.0 ÷ 59.0 cm (avg. l.t. = 32.0 cm, avg. W = 320.5 g).

The bimodal shape of length distribution curve for sprat in May 2017 was very similar to this one originated from May 2018 however, slightly difference between the ICES Subdivisions 25 and 26 is visible (Fig. 8). The main frequency apex is distinguished for adults, commercially sized fish collected in the ICES SD25, i.e. from the length classes of 11.5-cm (May 2017) and 12.5-cm (May 2018). In the length distribution of sprat originated from catches in the ICES SD26, in both BASS surveys prevailed specimens from the same 11.5-cm class. In the case of May 2017 and samples from the ICES SD26, the second, minor frequency apex representing young, undersized specimens is visible for fish from the length class of 8.5-9.0 cm, and in the case of May 2018 and both the ICES SDs - from length class 8.0-cm. In the recent BASS survey, the mean numerical share of undersized sprat (<10.0 cm length) was somewhat similar in the ICES Subdivisions 25 and 26, and amounted 10.7 and 14.5%, on average (Table 4). In the previous BASS (2017) survey bycatch of undersized sprat was 1.4 and 10.5%, respectively in the ICES SDs 25 and 26. The mean share of undersized sprat in the entire study area was 12.6 and 5.7% respectively, in May 2018 and 2017.

For herring the multimodal shape of length distribution curve was characteristic for May 2017 and 2018 as well as for both the ICES SDs (Fig. 8). In May 2017 dominated herring from the length classes of 22.0 and 16.0-16.5 cm adequately, in the ICES Subdivisions 25 and 26. In herring samples from May 2018, young undersized specimens, from the length classes of 13.0 and 12.0 cm prevailed by numbers respectively, in the ICES SDs 25 and 26. The mean numerical share of undersized herring (<16.0 cm length) in samples collected in May 2018 was practically the same in the ICES SDs 25 and 26, i.e. amounted of 42.5 and 42.3% (Table 4). In May 2017, values of mentioned parameter were much lower and amounted 9.9 and 26.6% on average, respectively in the ICES SDs 25 and 26.

The length distribution curve for cod sampled in the ICES SD25 differed very much between May 2017 and May 2018 (Fig. 8). For the previous survey, with approximation it was one frequency apex appeared in the length classes of 35-36 cm, and in May 2018, two maximums of numerical share were visible, i.e. in 23 and 34 cm length classes. In the case of cod caught in the ICES SD26 only data from May 2018 were representative for preparation of the length distribution curve. In the recent BASS survey in mentioned subdivision, specimens from the length class 27 cm dominated by numerical share in samples. The mean bycatch of undersized cod (<35 cm length) in samples collected in May 2018 was 85 and 77% respectively, in the ICES SDs 25 and 26 (Table 4). For comparison, in samples originated from the ICES SD 25 and May 2017 the numerical share of undersized cod was 44%, on average.

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 2018, 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 BASS/2018 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 located within the Polish marine waters is reflected in Figures 11 and 12. The abundance of above-mentioned species per age groups, according to inspected in May 2017 and 2018 the Polish parts of the ICES Subdivisions 25 and 26 is demonstrated in Figure 10.

In May 2018, the highest mean surface biomass density of sprat stock was estimated for the ICES rectangles: 39G9, 40G8 and 39G8, where amounted: 161.3; 100.7 and 98.9 t NM^{-2}, respectively (Fig. 11). The maximum of sprat surface biomass density was obtained in the Gdansk Deep and southern part of the Gotland Deep. In contrast, the minimum values of this parameter were noticed in the south-western parts of investigated 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 2017 (Fig. 11). In May 2017 and May 2018 the mean biomass density of sprat in the ICES SD25 was 27.6 and 35.8 t NM^{-2}, respectively and in the ICES SD26 it was 134.4 and 92.6 t NM^{-2} (Fig. 9).

In May 2018, the highest mean surface biomass density of herring stock was estimated for the ICES rectangles: 39G9 (3.0 t NM^{-2}), 38G6 (3.0 t NM^{-2}), 39G6 (2.1 t NM^{-2}) and 38G7 (2.1 t NM^{-2}) – located adequately, in small eastern part of the Gdansk Deep and in middle part of the Polish marine waters, with the exception of the Slupsk Furrow (Fig. 11). The recent pattern of herring surface biomass density distribution per ICES rectangles can be considered as very different from May 2017. The maximum of herring stock biomass density in May was obtained in the ICES rectangles 39G6 (23.6 t NM^{-2}) and 39G5 (5.4 t NM^{-2}), located eastward from the Bornholm (Fig. 11). In May 2017 and May 2018 the mean biomass density of herring in the ICES SD25 was 6.3 and 1.6 t NM^{-2}, respectively and in the ICES SD26 it was 1.2 and 1.7 t NM^{-2} (Fig. 9). By contrast to sprat, in May 2018 herring mean biomass density was significantly lower, e.g. in the ICES Subdivisions 25 and 26 by 22- and 55-times, respectively.

Results of the acoustic-biotic monitoring in the Polish marine waters indicate on very different geographical distribution of Baltic cod biomass in May 2017 and May 2018. In May 2018, the highest mean biomass surface density was estimated for the ICES rectangles: 38G9 (12.7

t NM^{-2}), 38G8 (3.9 t NM^{-2}) and 39G9 (2.4 t NM^{-2}) – located in the Gulf of Gdansk Deep (Fig. 12). In others more northern and western ICES rectangles the mean biomass surface density of cod was fluctuated from 0.5 to 1.1 t NM^{-2}. However, in five ICES rectangles, namely: 37G5, 37G8, 37G9, 38G6 and 38G7 – located in the southern part of the Polish EEZ (in the vicinity of seacoast), appearance of cod was not detected (Tables 3, 13, Fig 12). The biomass density of Baltic cod in scrutinized a part of the ICES Subdivision 26 was higher than in the ICES Subdivision 25, and amounted 3.7 and 0.6 t NM^{-2}, on average (Fig. 9). In May 2017 high biomass surface density of cod stock was estimated only for a small part of the ICES rectangle 39G5 (Fig. 12). Cod resources were patchy distributed inside the Polish marine waters and in nine others ICES rectangles biomass of cod was equal to zero (Fig. 12, Table 11). In May 2017 the mean biomass density of cod in scrutinized parts of the ICES Subdivisions 25 and 26 was much lower than in May 2018 and at nearly the same level, i.e. ≤0.03 t NM^{-2} (Fig. 9).

In May 2018, the total biomass (B1), the mean surface biomass density (B2) and abundance (A) of dominants significantly differed between fish species and the ICES subdivisions:

	parameter	sprat	herring	cod
ICES SD25	B1 (tons)	183847.9	7963.7	3246.7
	B2 (t NM^{-2})	35.76	1.55	0.63
	A ($\cdot 10^6$ indiv.)	20370.5	272.4	10.3
ICES SD26	B1 (tons)	448599.0	8194.4	17719.4
	B2 (t NM^{-2})	92.58	1.69	3.66
	A ($\cdot 10^6$ indiv.)	53285.9	234.7	46.6

The above listed data indicate that the centre of fish resources temporal distribution in the Polish EEZ, during reported the BASS/2018 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 middle part of the southern Baltic (Figs. 11, 12). Position of sprat as pronounced dominant regarding stock size (abundance, biomass), during the May 2018 survey is not questionable in the case of Polish marine waters.

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 BASS survey carried out in 2018 are illustrated in Figure 13. The air temperature during reported survey varied from 4 to 15°C (avg. was 9.2°C). The wind force changed from 1 to 5°B, and winds from the east direction were prevailed. During fishing operations prevail the light wind (3°B) mostly from north directions (Table 15). The strongest wind directions, occurred during fishing operations, were from east.

The main hydrological parameters at the depths of fish pelagic catches (Table 15), i.e. in the range of 14-78 m (with 18 m vertical net opening on average) changed in the relatively broad ranges. The seawater temperature fluctuated from 2.7 to 7.4°C (the mean was 4.7°C), salinity from 7.4 to 12.7 PSU (the mean was 8.70 PSU) and oxygen content from 0.9 to 8.9 ml/l (the mean was 5.9).

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 near bottom layer was changing horizontally within the range of 3.1-7.6°C and the average was 5.7°C. The lowest seawater temperature was recorded at the catch-station No. 12 (westward from the Gulf of Gdansk) and the highest at the catch-station No. 22, i.e. eastern part of the Bornholm Basin (Fig. 1). Salinity in the bottom waters varied from 7.5 PSU – noticed at the catch-stations No. 5 and 6 (south part of the Gdansk Gulf), to the maximum of 16.9 PSU - appeared at the hydrographical station No. IBY5 (the Bornholm Basin). Oxygen content near bottom of deep waters varied from 0.09 ml l^{-1} – measured at the catch-station No. 2 (the Gdansk Deep) to the maximum of 9.3 ml l^{-1} – calculated at the hydrographical station No. 61 (the mean was 4.3 ml l^{-1}).

The vertical distribution of the seawater temperature, salinity and oxygen content, along the hydrological research profile determined in the southern Baltic in May 2018 is presented on Fig. 15. During the survey period, the waters with oxygen content below 2 ml l^{-1} occurred at depth just below 60m at the Bornholm Basin and the Gdansk Deep. This hypoxic waters were in coincide with waters with salinity above 11 PSU what caused unfavorable conditions for effective reproduction of the Eastern Baltic cod.

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 BASS-2018 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-Center international databases, managed by the ICES Secretariat and designated experts from WGBIFS.

References:

Anon. 1991a. Report of the Planning Group for Hydroacoustic Surveys in the Baltic. ICES CM 1991/J:28.

Anon. 1991b. Report of the Working Group on Assessment of Pelagic Stocks in the Baltic. ICES CM 1991/Assess:18.

Anon., 2012. Manual for International Baltic Acoustic Surveys (IBAS). Version 1.01, 30-03-2012 Helsinki, Finland; ICES Addendum 2: WGBIFS Manual for Baltic Acoustic Surveys, Version 1.01; 24 pp.

Elwertowski, J., Orłowski A., 1984. Composition, distribution and biomass of juvenile sprat in May 1983 in the Southern Baltic. Bulletin of the Sea Fish. Inst., Gdynia, 3-6 (83/86); 5-13.

Elwertowski, J., Orłowski A., Richert S., 1984. Badania oceanograficzno-rybackie południowego Bałtyku prowadzone w maju 1983 r. na r.v. Profesor Siedlecki. Bulletin of the Sea Fish. Inst., Gdynia, 1-2; 3-15.

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.

Grzebielec, R., A. Paciorkowski, M. Wyszyński, W. Grygiel 1995. Polish hydroacoustic assessment survey of herring, sprat and cod stocks in ICES Subdivisions 25 and 26 of the Baltic conducted in October 1994. ICES C.M. 1995/J:18, B.F.C.; 24 pp.

Hagström, O., L-E. Palmén, N. Håkansson, D. Kästner, H. Bremer-Rothbart, W. Grygiel, M. Wyszyński 1989. Acoustic estimates of the herring and the sprat stocks in the Baltic Proper, October 1988. ICES C.M. 1989/J:26, B.F.C.; 9 pp.

Håkansson, N., Kollberg, S., Falk, U., Goetze, E., Rechlin, O. 1979. A hydroacoustic and trawl survey of herring and sprat of the Baltic proper in October 1978. Fischerei-Forschung, 17(2); 7-23.

ICES. 1983. Report of the Planning Group on ICES coordinated herring and sprat acoustic surveys. ICES Document CM 1983/H:12.

ICES. 2017, SISP Manual of International Baltic Acoustic Surveys (IBAS). Series of ICES Survey Protocols SISP 8 – IBAS. 47pp.

ICES. 2018, Report of the Baltic International Fish Survey Working Group (WGBIFS) 24-28 March 2018 Lyngby, Copenhagen, Denmark; ICES CM 2018/EOSG:6.

Kruk, G., B. Schmidt, T. Wodzinowski 2018. Research report from the Polish part of the Baltic Acoustic Spring Survey on board of the r.v. “Baltica” (02-13.05.2017). Working paper, WGBIFS meeting in Lyngby, 24-28.03.2018; 28 pp.

Orłowski, A. 1982. Zasoby ryb polskiej strefy Bałtyku oszacowane metodą hydroakustyczna podczas rejsu r.v. „Profesor siedlecki” w roku 1981. Biuletyn Mor. Inst. Ryb., Gdynia, 1-6 (69-74); 23-28.

Orłowski, A. 1991. Hydroacoustic surveys of fish distribution in relation to environment. Acta Ichthyol. Pisc., Szczecin, XXI; 181-192.

Shvetsov, F., V. Baturin, E. Goetze, R. Oeberst, D. Kästner 1986. Preliminary results of a joint hydroacoustic sprat survey by the USSR and GDR in Baltic in May 1986. ICES C.M. 1986/J:15, B.F.C.

Shvetsov, F., W. Grygiel, M. Fetter, V. Chervontsev, A. Rudneva 1992. Distribution and size of herring and sprat stocks in the Baltic Proper, determined by the acoustic method (October, 1991). ICES C.M. 1992/J:8, B.F.C.; 10 pp.

Simrad. 2012. Simrad EK60, Reference Manual, release 2.4.X. Kongsberg Maritime AS; 256 pp.

Trella K., Schmidt B., Wodzinowski T., Ameryk A., Sprawozdanie z rejsu badawczego typu BASS, nr 7/2018/MIR-PIB na statku r.v. Baltica (GDY100) w dniach 02-13.05.2018 r., MIR-PIB, Gdynia; 24pp., (mimeo).

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 BASS 2017 and 2018 cruises (note: for comparison reasons, presented mean NASC for in the ICES SD 25 (BASS 2017) was calculated without the ICES rectangles 39G5 and 40G7, because in May 2018 mentioned rectangles were acoustically not inspected).

ICES SDs	< NASC > BASS 2017	< NASC > BASS 2018
25	375.7	565.9
26	1850.3	1457.4

Table 2. Average NASC values ($m^2 \cdot NM^{-2}$) for the acoustically covered ICES rectangles, within the Polish EEZ, in 2017 and 2018 BASS cruises (the NASC values from 2017 from Kruk et al., 2018).

ICES SDs	ICES rectangles	Area [NM^2]	< NASC > BASS 2017	< NASC > BASS 2018
25	37G5	642.2	329.8	162.0
25	38G5	1035.7	531.1	292.7
25	38G6	940.2	148.1	339.3
25	38G7	471.7	61.1	305.9
25	39G6	1026.0	407.3	751.7
25	39G7	1026.0	569.0	1009.0
26	37G8	86.0	1229.5	904.4
26	37G9	151.6	368.3	750.6
26	38G8	624.6	1145.4	907.3
26	38G9	918.2	2246.4	580.2
26	39G8	1026.0	895.9	1477.1
26	39G9	1026.0	3633.7	2408.6
26	40G8	1013.0	1360.8	1506.2

Table 3. Fish control-catches data from the Polish BASS survey conducted on board of the r.v. "Baltica" in May 2018.

Haul number	Date of catch	ICES rectangles	ICES SDs	Geographical position of the catch-station				The ship's course during fishing [°]	Depth to the bottom [m]		Headrope depth from the sea surface [m]		Vertical net opening [m]	Local time of shutting net	Trawling duration [min]	CPUE of all species [kg·h⁻¹]	CPUE of particular fish species								
				start		end																			
				latitude N	longitude E	latitude N	longitude E		min	max	min	max					sprat	herring	cod	flounder	three spine stickleback	greater sand-eel	Atlantic mackerel	whiting	fourbeard rockling
1	03.05.2018	39G9	26	55.10'1	019.04'8	55.10'2	019.04'8	275	88	89	64	67	18-20	8.15	30	**1 579.42**	1 520.164	23.610	34.180	1.460	0.005				
2	03.05.2018	38G9	26	54.55'5	019.08'8	54.55'5	019.06'5	260	103	104	40	42	16-17	11.55	30	**625.22**	623.780	1.260		0.180					
3	03.05.2018	38G9	26	54.39'6	019.14'6	54.39'1	019.12'3	255	88	90	65	68	18	15.35	30	**136.39**	73.120	8.160	51.600	3.514					
4	03.05.2018	37G9	26	54.29'2	019.10'7	54.28'0	019.12'7	130	68	70	20	25	18	18.30	30	**54.90**	53.140	1.760		0.000					
5	04.05.2018	37G9	26	54.25'4	019.19'6	54.26'8	019.18'7	340	47	60	25	37	18	9.25	30	**436.84**	432.660	4.180							
6	04.05.2018	37G8	26	54.27'5	018.54'9	54.28'2	018.54'3	335	49	59	29	34	16	12.50	15	**2 175.33**	2 158.920	16.360				0.050			
7	04.05.2018	38G8	26	54.37'2	018.59'3	54.38'1	018.58'9	340	79	79	40	40	18	16.15	15	**937.14**	933.320	2.720		1.096					
8	05.05.2018	40G8	26	55.35'1	018.58'6	55.35'7	018.58'0	330	86	86	60	64	18	10.10	15	**1 740.18**	1 679.600	49.960	5.184	5.432					
9	05.05.2018	40G8	26	55.51'7	018.45'1	55.51'8	018.46'5	80	110	115	62	65	18	14.40	15	**2 447.81**	2 338.000	9.840	86.684	12.652	0.630				
10	06.05.2018	39G8	26	55.11'5	018.40'4	55.12'9	018.40'7	5	88	88	68	68	18	7.30	30	**743.59**	726.980	15.540	1.072	0.000					
11	06.05.2018	38G8	26	54.58'3	018.40'8	54.57'8	018.41'7	130	92	92	70	70	17	10.45	15	**537.26**	451.760	18.720	63.816	2.960					
12	06.05.2018	39G8	26	55.01'7	018.20'0	55.02'3	018.20'0	360	52	62	30	40	18	16.05	15	**3 782.48**	3 742.400	40.080							
13	06.05.2018	39G8	26	55.20'4	018.20'0	55.21'2	018.19'9	360	80	82	30	40	18	19.10	15	**572.56**	570.600	1.960							
14	07.05.2018	40G8	26	55.37'4	018.25'9	55.38'0	018.25'0	340	93	94	60	60	18	7.50	15	**735.78**	717.440	7.720	2.632	7.708	0.280				
15	07.05.2018	38G7	25	54.58'4	017.54'4	54.59'2	017.57'0	65	22	24	6	9	14	18.50	30	**348.69**	324.420	23.080			0.077	1.110			
16	08.05.2018	39G7	25	55.18'7	017.43'0	55.18'8	017.44'4	80	78	80	55	58	18	9.20	15	**511.67**	507.160	2.440	1.656	0.412					
17	08.05.2018	39G7	25	55.14'5	017.18'6	55.14'7	017.16'2	280	91	92	69	70	18	14.25	30	**2 687.72**	2 592.910	17.310	75.018	1.546			0.450	0.484	
18	08.05.2018	38G7	25	54.57'6	017.20'7	54.58'5	017.22'9	60	27	28	10	12	14	18.30	30	**41.35**	37.180	4.152			0.020				
19	09.05..2018	39G6	25	55.17'4	016.40'9	55.17'5	016.43'4	80	73	76	50	52	18	14.00	30	**2 111.19**	2 098.768	11.720	0.702						
20	09.05..2018	38G6	25	54.47'3	016.52'8	54.47'1	016.50'3	260	30	33	13	15	13	19.40	30	**167.28**	127.428	39.852							
21	10.05.2018	38G6	25	54.43'2	016.19'1	54.43'4	016.16'6	280	36	36	15	15	18	8.10	30	**164.48**	162.020	2.460							
22	10.05.2018	39G6	25	55.06'8	016.18'5	55.06'6	016.15'7	265	72	78	50	53	18	12.45	30	**1 496.69**	1 310.450	139.790	38.316	6.628					1.505
23	11.05.2018	38G5	25	54.52'8	015.58'3	54.54'1	015.58'3	10-15	66	68	44	48	18	7.20	30	**732.62**	617.200	52.780	60.122	1.884				0.632	
24	11.05.2018	37G5	25	54.23'8	015.45'3	54.23'9	015.48'0	90	35	36	18	18	13	13.05	30	**97.23**	96.920	0.305							
25	11.05.2018	38G5	25	54.36'1	015.20'8	54.36'2	015.23'2	85	58	59	38	38	18	18.05	30	**791.35**	735.920	37.886	7.396						0.190

Table 4. The mean numerical share of young, undersized fishes per ICES SDs (the Polish BASS/2018 and BASS/2017).

Species	Fish length	BASS 2017			BASS 2018		
		Mean share in % numbers			Mean share in % numbers		
		SD25	SD26	Mean	SD25	SD26	Mean
sprat	< 10 cm	1.4	10.5	5.7	10.7	14.5	12.8
herring	< 16 cm	9.9	26.6	14.8	42.5	42.3	42.4
cod	< 35 cm	43.8	-	43.5	84.9	76.8	81.5

Table 5. Cruise statistics of the Polish BASS survey on board of the r.v. "Baltica", 02-13.05.2018.

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 · 10^6			
						sprat	herring	cod	total	sprat	herring	cod
25	37G5	34	1.68	162.0	642.2	99.8	0.2	0.0	620.8	619.7	1.1	0.0
25	38G5	70	1.59	292.7	1035.7	98.2	1.6	0.2	1902.4	1867.3	31.4	3.8
25	38G6	55	1.66	339.3	940.2	94.0	6.0	0.0	1925.0	1809.0	115.9	0.0
25	38G7	31	1.67	305.9	471.7	95.4	4.6	0.0	864.8	824.9	39.9	0.0
25	39G6	87	1.31	751.7	1026	98.7	1.2	0.1	5876.1	5799.4	73.1	3.7
25	39G7	89	1.09	1009.0	1026	99.9	0.1	0.0	9464.1	9450.2	11.0	2.9
Sum SD25		**366**							**20653.2**	**20370.5**	**272.4**	**10.3**
26	37G8	8	1.14	904.4	86	99.3	0.7	0.0	683.9	679.3	4.5	0.0
26	37G9	28	1.18	750.6	151.6	98.9	1.1	0.0	962.1	952.0	10.1	0.0
26	38G8	58	1.29	907.3	624.6	99.4	0.4	0.2	4378.3	4352.0	18.9	7.4
26	38G9	45	1.47	580.9	918.2	98.1	1.1	0.8	3627.8	3560.0	39.5	28.3
26	39G8	88	1.23	1477.1	1026	99.6	0.4	0.0	12357.7	12303.7	53.9	0.1
26	39G9	27	1.27	2408.6	1026	99.6	0.4	0.0	19500.1	19423.6	70.1	6.4
26	40G8	92	1.27	1506.2	1013	99.7	0.3	0.0	12057.4	12015.4	37.6	4.4
Sum SD26		**346**							**53567.2**	**53285.9**	**234.7**	**46.6**

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 BASS survey on board of the r.v. "Baltica", 02-13.05.2018.

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	8.4	32.4	49.5	346.1	111.3	47.9	19.3	4.9	619.7
25	38G5	79.6	125.5	273.2	1137.4	178.6	42.6	24.2	6.2	1867.3
25	38G6	0.0	74.4	229.1	1153.2	235.1	67.1	38.8	11.3	1809.0
25	38G7	2.0	29.1	94.5	514.1	120.7	39.5	19.4	5.6	824.9
25	39G6	856.9	953.4	992.5	2746.9	187.0	34.6	22.0	6.1	5799.4
25	39G7	3545.9	1663.1	1185.3	2937.5	111.5	2.2	4.1	0.5	9450.2
Sum SD25		**4492.7**	**2878.0**	**2824.1**	**8835.2**	**944.2**	**233.8**	**127.7**	**34.7**	**20370.5**
26	37G8	189.8	85.8	177.7	209.1	15.7	1.1	0.2	0.0	679.3
26	37G9	199.3	118.7	262.6	340.5	27.5	2.6	0.7	0.0	952.0
26	38G8	407.6	570.9	1430.6	1784.7	143.1	13.4	1.7	0.0	4352.0
26	38G9	471.3	382.0	1062.6	1484.1	138.8	17.2	4.0	0.0	3560.0
26	39G8	2000.0	1256.1	3800.5	4782.3	407.4	49.5	8.0	0.0	12303.7
26	39G9	1893.0	2398.3	6366.3	8010.9	661.0	82.9	11.2	0.0	19423.6
26	40G8	447.2	2293.6	3856.5	4947.2	416.2	49.9	4.8	0.0	12015.4
Sum SD26		**5608.2**	**7105.3**	**16956.8**	**21558.8**	**1809.6**	**216.6**	**30.6**	**0.0**	**53285.9**

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 BASS survey on board of the r.v. "Baltica", 02-13.05.2018.

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	50.4	285.8	579.6	4648.9	1694.7	779.4	304.1	75.3	8418.3
25	38G5	303.4	1222.6	2974.1	13658.9	2501.7	679.7	365.4	94.9	21800.8
25	38G6	0.0	793.1	2605.2	14548.8	3378.6	1065.8	593.1	175.1	23159.6
25	38G7	6.8	312.9	1082.5	6607.4	1770.4	628.4	295.8	86.9	10791.1
25	39G6	3133.6	8172.3	9731.8	28398.3	2467.2	551.6	338.3	97.1	52890.2
25	39G7	12042.3	13308.2	11213.3	28845.0	1281.4	32.4	57.3	8.1	66787.9
Sum SD25		**15536.5**	**24094.9**	**28186.4**	**96707.3**	**13094.0**	**3737.4**	**1954.1**	**537.3**	**183847.9**
26	37G8	698.9	616.7	1580.2	1927.9	161.0	13.7	2.0	0.0	5000.3
26	37G9	674.3	907.5	2343.4	3171.8	283.5	32.7	9.3	0.0	7422.5
26	38G8	1375.6	4463.1	12806.5	16641.0	1485.9	173.1	22.5	0.0	36967.8
26	38G9	1478.4	3034.8	9652.2	14307.6	1490.3	219.1	51.3	0.0	30233.8
26	39G8	6345.1	9845.0	34477.9	45700.9	4327.0	632.8	102.7	0.0	101431.3
26	39G9	5930.3	18829.7	57170.8	75458.5	6916.3	1078.8	144.2	0.0	165528.6
26	40G8	1568.4	17398.9	33269.1	44759.8	4292.1	664.1	62.4	0.0	102014.7
Sum SD26		**18071.1**	**55095.8**	**151300.1**	**201967.4**	**18956.0**	**2814.2**	**394.4**	**0.0**	**448599.0**

Table 8. Mean weight of sprat (in grams) per age groups, ICES rectangles and ICES SDs, based on data collected during the Polish BASS survey on board of the r.v. "Baltica", 02-13.05.2018.

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	6.01	8.82	11.70	13.43	15.23	16.28	15.73	15.49	13.58
25	38G5	3.81	9.74	10.88	12.01	14.00	15.95	15.13	15.39	11.68
25	38G6	-	10.66	11.37	12.62	14.37	15.89	15.30	15.45	12.80
25	38G7	3.41	10.74	11.46	12.85	14.67	15.92	15.28	15.38	13.08
25	39G6	3.66	8.57	9.81	10.34	13.20	15.95	15.37	15.80	9.12
25	39G7	3.40	8.00	9.46	9.82	11.49	15.01	13.98	15.01	7.07
MW SD25		**3.46**	**8.37**	**9.98**	**10.95**	**13.87**	**15.99**	**15.30**	**15.49**	**9.03**
26	37G8	3.68	7.19	8.89	9.22	10.26	12.00	12.90	-	7.36
26	37G9	3.38	7.65	8.92	9.32	10.30	12.34	12.90	-	7.80
26	38G8	3.37	7.82	8.95	9.32	10.39	12.91	12.90	-	8.49
26	38G9	3.14	7.94	9.08	9.64	10.74	12.75	12.90	-	8.49
26	39G8	3.17	7.84	9.07	9.56	10.62	12.78	12.90	-	8.24
26	39G9	3.13	7.85	8.98	9.42	10.46	13.02	12.90	-	8.52
26	40G8	3.51	7.59	8.63	9.05	10.31	13.32	12.90	-	8.49
MW SD26		**3.22**	**7.75**	**8.92**	**9.37**	**10.47**	**12.99**	**12.90**	**-**	**8.42**

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 BASS survey on board of the r.v. "Baltica", 02-13.05.2018.

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	0.9	0.0	0.0	0.0	0.0	0.2	0.0	0.0	1.1
25	38G5	2.6	4.2	6.5	4.5	3.9	4.5	1.5	3.7	31.4
25	38G6	78.6	9.1	11.1	5.3	4.1	5.4	1.0	1.4	115.9
25	38G7	23.5	5.0	5.0	2.3	1.5	2.1	0.2	0.2	39.9
25	39G6	40.4	4.3	7.9	5.9	4.1	5.5	1.9	3.0	73.1
25	39G7	1.7	3.2	3.7	0.5	0.7	1.1	0.1	0.1	11.0
Sum SD25		**147.7**	**25.8**	**34.3**	**18.5**	**14.3**	**18.8**	**4.7**	**8.4**	**272.4**
26	37G8	4.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.5
26	37G9	8.5	0.2	0.2	0.2	0.2	0.2	0.1	0.4	10.1
26	38G8	7.3	1.3	1.3	2.8	1.2	0.8	0.8	3.3	18.9
26	38G9	15.6	1.5	4.1	5.2	4.7	1.6	1.5	5.3	39.5
26	39G8	20.8	4.0	8.1	7.9	3.2	2.6	1.2	6.0	53.9
26	39G9	6.2	5.5	11.2	13.6	7.3	3.4	6.6	16.2	70.1
26	40G8	0.0	5.8	10.0	10.4	3.5	2.7	1.4	3.7	37.6
Sum SD26		**62.9**	**18.5**	**35.0**	**40.2**	**20.1**	**11.3**	**11.7**	**34.9**	**234.7**

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 BASS survey on board of the r.v. "Baltica", 02-13.05.2018.

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	15.0	0.0	0.0	0.0	0.0	11.9	0.0	0.0	27.0
25	38G5	38.3	169.4	311.5	235.8	209.3	255.4	98.9	258.2	1576.8
25	38G6	1197.6	342.3	457.0	246.4	196.3	265.3	61.7	90.3	2856.7
25	38G7	327.0	179.6	187.4	100.9	67.6	92.1	14.3	12.8	981.8
25	39G6	436.4	172.4	377.2	318.7	223.2	304.1	116.7	192.4	2141.1
25	39G7	33.0	108.9	130.5	23.8	29.7	44.3	3.8	6.4	380.2
Sum SD25		**2047.3**	**972.5**	**1463.7**	**925.5**	**726.1**	**973.1**	**295.4**	**560.1**	**7963.7**
26	37G8	41.3	0.5	0.7	0.0	1.7	0.0	0.7	0.0	44.9
26	37G9	77.9	4.2	6.8	9.6	8.1	9.3	7.0	27.9	150.7
26	38G8	67.9	32.3	47.3	94.2	49.7	44.3	52.4	206.7	594.9
26	38G9	185.1	54.5	160.5	207.6	189.1	83.7	78.3	336.7	1295.6
26	39G8	239.5	103.5	238.6	294.2	141.6	134.2	71.6	383.7	1606.8
26	39G9	75.8	174.3	425.4	501.0	316.5	182.8	367.4	1066.6	3109.9
26	40G8	0.0	145.8	327.7	360.3	158.6	125.3	69.6	204.2	1391.6
Sum SD26		**687.5**	**515.0**	**1207.0**	**1466.9**	**865.4**	**579.7**	**647.0**	**2225.9**	**8194.4**

Table 11. Mean weight of herring (in grams) per age groups, ICES rectangles and ICES SDs, based on data collected during the Polish BASS survey on board of the r.v. "Baltica", 02-13.05.2018.

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	6.01	8.82	11.70	13.43	15.23	16.28	15.73	15.49	13.58
25	38G5	3.81	9.74	10.88	12.01	14.00	15.95	15.13	15.39	11.68
25	38G6	-	10.66	11.37	12.62	14.37	15.89	15.30	15.45	12.80
25	38G7	3.41	10.74	11.46	12.85	14.67	15.92	15.28	15.38	13.08
25	39G6	3.66	8.57	9.81	10.34	13.20	15.95	15.37	15.80	9.12
25	39G7	3.40	8.00	9.46	9.82	11.49	15.01	13.98	15.01	7.07
MW SD25		**3.46**	**8.37**	**9.98**	**10.95**	**13.87**	**15.99**	**15.30**	**15.49**	**9.03**
26	37G8	3.68	7.19	8.89	9.22	10.26	12.00	12.90	-	7.36
26	37G9	3.38	7.65	8.92	9.32	10.30	12.34	12.90	-	7.80
26	38G8	3.37	7.82	8.95	9.32	10.39	12.91	12.90	-	8.49
26	38G9	3.14	7.94	9.08	9.64	10.74	12.75	12.90	-	8.49
26	39G8	3.17	7.84	9.07	9.56	10.62	12.78	12.90	-	8.24
26	39G9	3.13	7.85	8.98	9.42	10.46	13.02	12.90	-	8.52
26	40G8	3.51	7.59	8.63	9.05	10.31	13.32	12.90	-	8.49
MW SD26		**3.22**	**7.75**	**8.92**	**9.37**	**10.47**	**12.99**	**12.90**	**-**	**8.42**

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 BASS survey on board of the r.v. “Baltica”, 02-13.05.2018.

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	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25	38G5	0.0	1.1	2.1	0.4	0.2	0.0	0.0	0.0	3.8
25	38G6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25	38G7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25	39G6	0.0	1.1	2.4	0.1	0.0	0.0	0.0	0.0	3.7
25	39G7	0.0	0.4	1.6	0.7	0.1	0.0	0.0	0.0	2.9
Sum SD25		**0.0**	**2.5**	**6.1**	**1.3**	**0.3**	**0.0**	**0.0**	**0.0**	**10.3**
26	37G8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
26	37G9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
26	38G8	0.0	2.8	2.0	1.5	1.1	0.0	0.0	0.0	7.4
26	38G9	0.0	9.7	7.6	5.4	3.9	1.2	0.4	0.0	28.3
26	39G8	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.1
26	39G9	0.0	1.6	1.5	2.9	0.2	0.1	0.0	0.0	6.4
26	40G8	0.1	2.6	0.7	0.4	0.4	0.1	0.0	0.0	4.4
Sum SD26		**0.1**	**16.8**	**11.9**	**10.3**	**5.6**	**1.4**	**0.4**	**0.0**	**46.6**

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 BASS survey on board of the r.v. “Baltica”, 02-13.05.2018.

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	168.41	641.16	247.40	102.84	2.44	0.00	0.00	1162.25
25	38G6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
25	38G7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
25	39G6	0.00	126.20	809.30	56.87	25.96	0.00	0.00	0.00	1018.33
25	39G7	0.00	0.00	624.02	343.51	90.88	7.70	0.00	0.00	1066.12
Sum SD25		**0.00**	**294.62**	**2074.48**	**647.77**	**219.68**	**10.14**	**0.00**	**0.00**	**3246.69**
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	2.61	458.01	510.97	717.05	718.13	19.87	0.00	0.00	2426.65
26	38G9	0.00	1714.22	2258.23	3012.51	2966.85	923.48	779.77	0.00	11655.05
26	39G8	0.00	0.00	10.16	40.62	0.00	0.00	0.00	0.00	50.78
26	39G9	0.88	258.10	544.61	1472.71	134.95	68.43	0.00	0.00	2479.68
26	40G8	6.53	336.46	211.40	202.50	283.98	66.41	0.00	0.00	1107.28
Sum SD26		**10.02**	**2766.79**	**3535.36**	**5445.39**	**4103.90**	**1078.19**	**779.77**	**0.00**	**17719.43**

Table 14. Mean weight of cod (in grams) per age groups, ICES rectangles and ICES SDs, based on data collected during the Polish BASS survey on board of the r.v. "Baltica", 02-13.05.2018.

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	-	152.9	310.9	550.3	618.2	683.0	-	-	307.22
25	38G6	-	-	-	-	-	-	-	-	
25	38G7	-	-	-	-	-	-	-	-	
25	39G6	-	117.7	332.5	478.7	852.1	-	-	-	278.55
25	39G7	-	139.7	383.5	461.8	671.5	683.0	-	-	388.09
MW SD25			**136.1**	**338.8**	**493.6**	**661.4**	**683.0**			**319.6**
26	37G8	-	-	-	-	-	-	-	-	
26	37G9	-	-	-	-	-	-	-	-	
26	38G8	82.6	164.6	260.7	466.0	661.6	628.6	-	-	326.63
26	38G9	-	176.2	296.3	560.1	758.8	751.7	1735.0	-	411.63
26	39G8	-	-	499.5	499.5	-	-	-	-	499.50
26	39G9	82.6	157.5	355.1	503.7	623.5	1071.4	-	-	388.26
26	40G8	82.6	127.2	287.1	486.8	662.5	856.6	-	-	252.61
MW SD26		**82.6**	**185.3**	**472.5**	**589.4**	**766.5**	**776.6**			**434.1**

Table 15. Values of the basic meteorological and hydrological parameters recorded in May 2018 at the positions of the r.v. "Baltica" fish control catches (Trella et al., 2018).

Haul no	Date of catch	Haul start time	Meteorological parameters				Hydrological parameters *			Depth of measurement [m]
			Air temperature [°C]	Wind direction	Wind force [B]	sea state	Temperature [°C]	Salinity [PSU]	Oxygen [ml·l^{-1}]	
1	2018-05-03	8.15	5.0	E	5	3	6.4	10.7	1.3	74
2	2018-05-03	11.55	8.0	E	5	4	3.0	7.5	8.5	50
3	2018-05-03	15.35	9.5	NW	3	2	5.4	9.4	2.1	75
4	2018-05-03	18.30	7.5	NW	3	2	4.3	7.4	8.7	31
5	2018-05-04	9.25	7.0	NW	3	2	4.4	7.5	8.6	40
6	2018-05-04	12.50	9.0	NNW	3	2	3.9	7.4	8.4	40
7	2018-05-04	16.15	7.0	N	3	2	4.0	7.5	8.7	40
8	2018-05-05	10.10	8.0	NW	1	1	5.9	10.5	2.2	71
9	2018-05-05	14.40	7.0	NW	2	1	5.3	9.6	0.9	72
10	2018-05-06	7.30	7.0	SW	2	1	6.0	10.7	3.2	77
11	2018-05-06	10.45	11.0	SW	2	1	6.0	10.8	2.8	78
12	2018-05-06	16.05	10.0	W	2	1	3.4	7.5	8.7	40
13	2018-05-06	19.10	7.0	W	2	1	3.4	7.5	8.6	44
14	2018-05-07	7.50	8.0	SW	2	1	3.2	7.6	2.8	69
15	2018-05-07	18.50	11.0	SW	1	1	6.1	7.6	8.6	14
16	2018-05-08	9.20	11.0	E	2	1	3.1	7.9	7.1	65
17	2018-05-08	14.25	10.5	NE	3	1	7.4	12.6	1.9	78
18	2018-05-08	18.30	10.0	NE	3	1	5.2	7.6	8.8	18
19	2018-05-09	14.00	10.0	ENE	3	2	3.3	8.7	6.2	60
20	2018-05-09	19.40	12.0	E	5	3	5.7	7.6	8.1	20
21	2018-05-10	8.10	12.0	E	4	2	5.0	7.6	8.4	24
22	2018-05-10	12.45	13.0	E	3	2	6.3	12.7	1.1	60
23	2018-05-11	7.20	11.0	E	2	1	2.7	8.6	5.5	55
24	2018-05-11	13.05	11.0	WSW	3	1	5.0	7.6	8.9	25
25	2018-05-11	18.05	11.0	W	3	2	3.3	7.7	7.4	47
* data of the mean depth of the fish control-catches (in the middle of trawl vertical opening)										

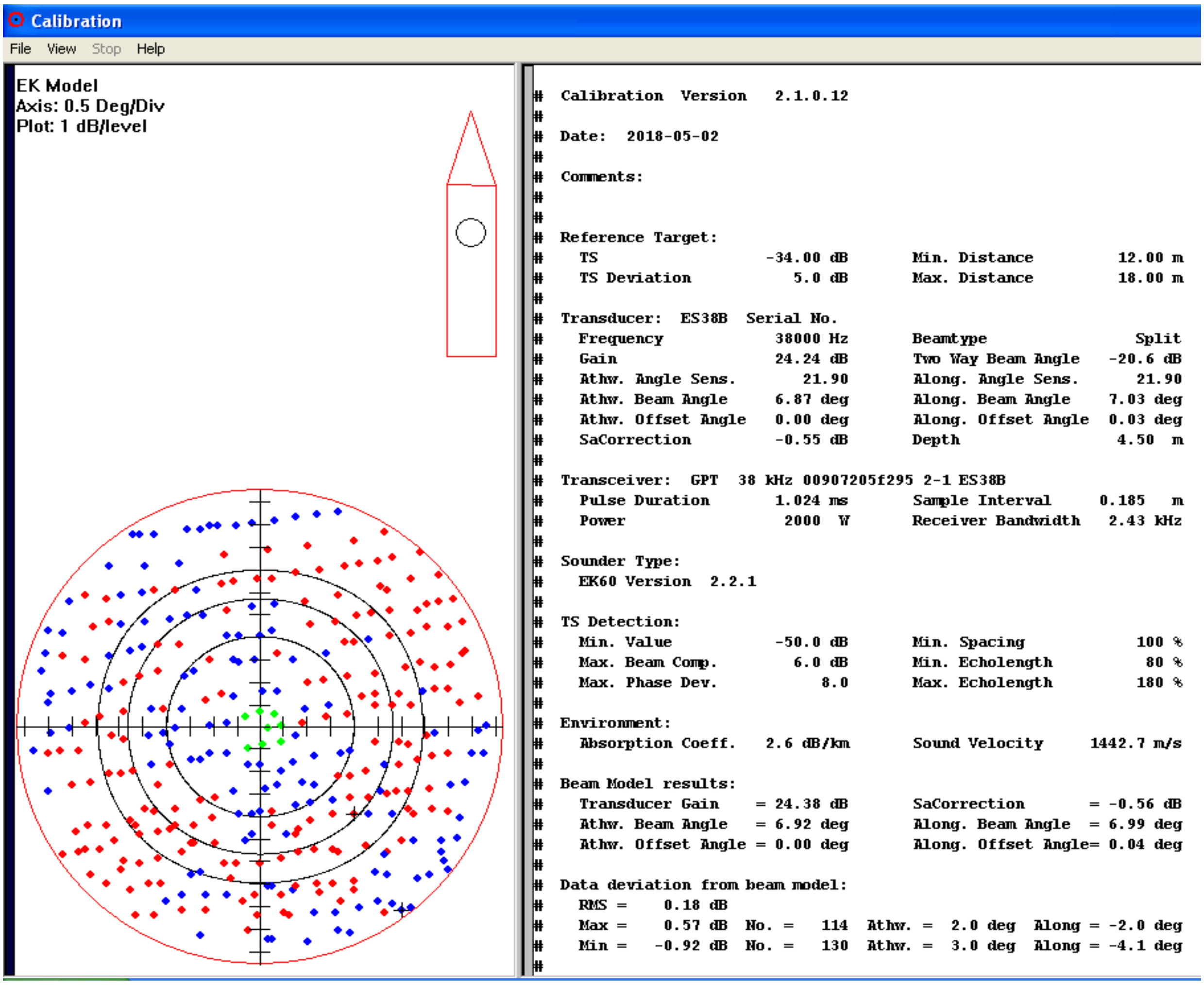

Fig. 1. R.v. “Baltica” cruise BASS 2018: Simrad EK60 calibration report (38 kHz transducer).

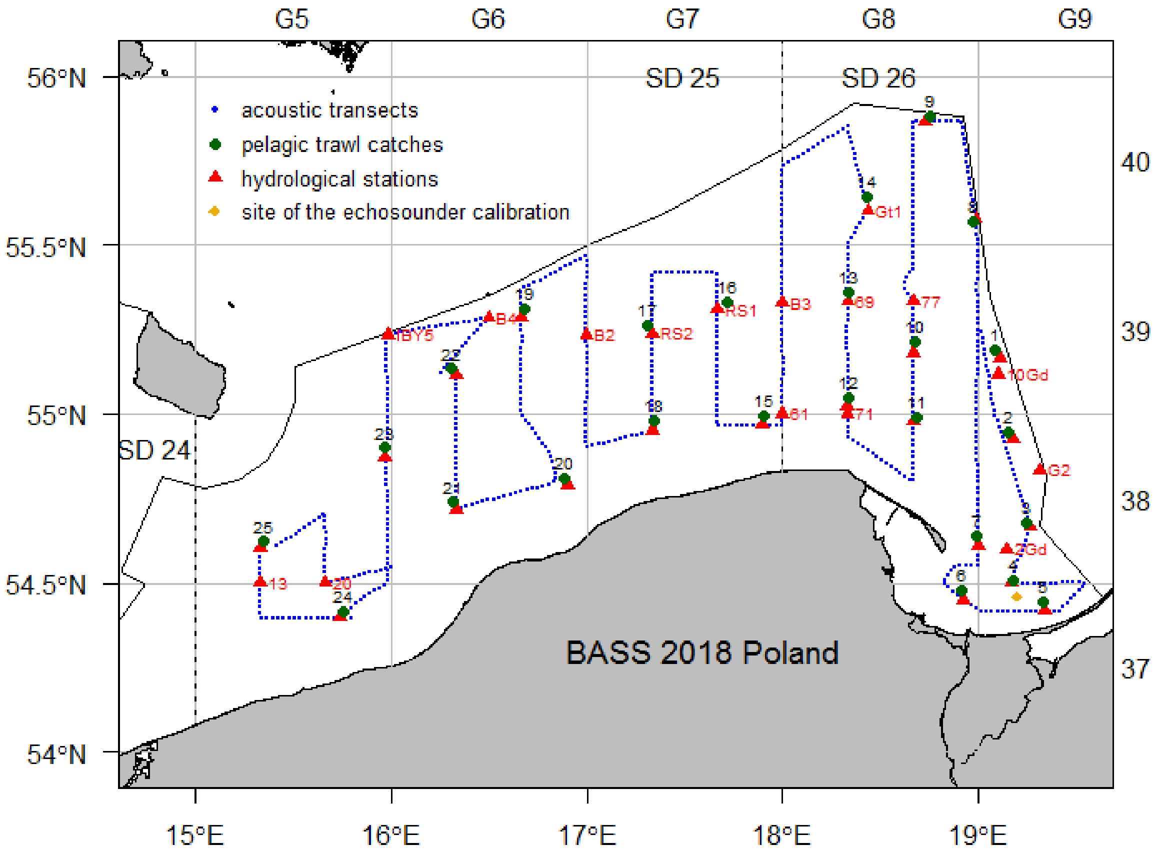

Fig. 2. Location of realized investigations during the Polish BASS survey on board of the r.v. "Baltica", 02–13.05.2018.

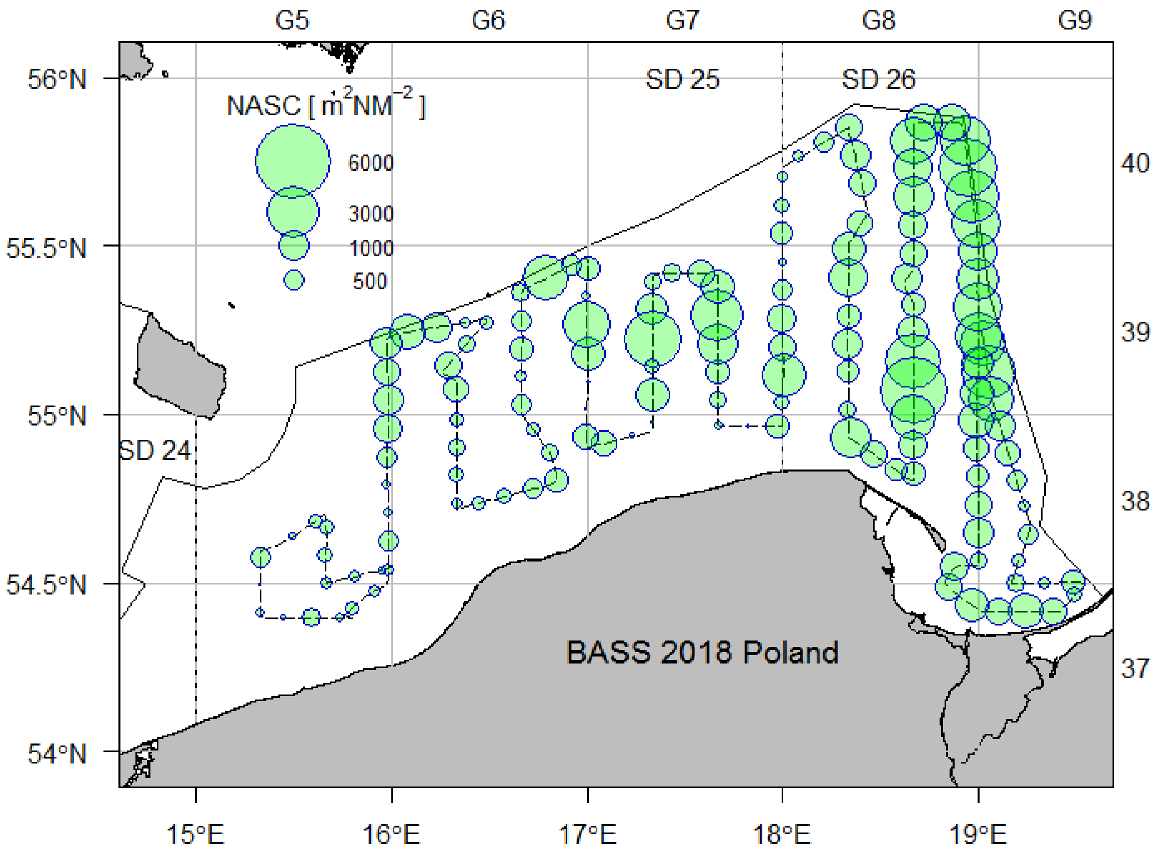

Fig. 3. Cruise track (thin dashed line) and the mean NASC (5 NM intervals, bubbles) recorded during BASS 2018 cruise.

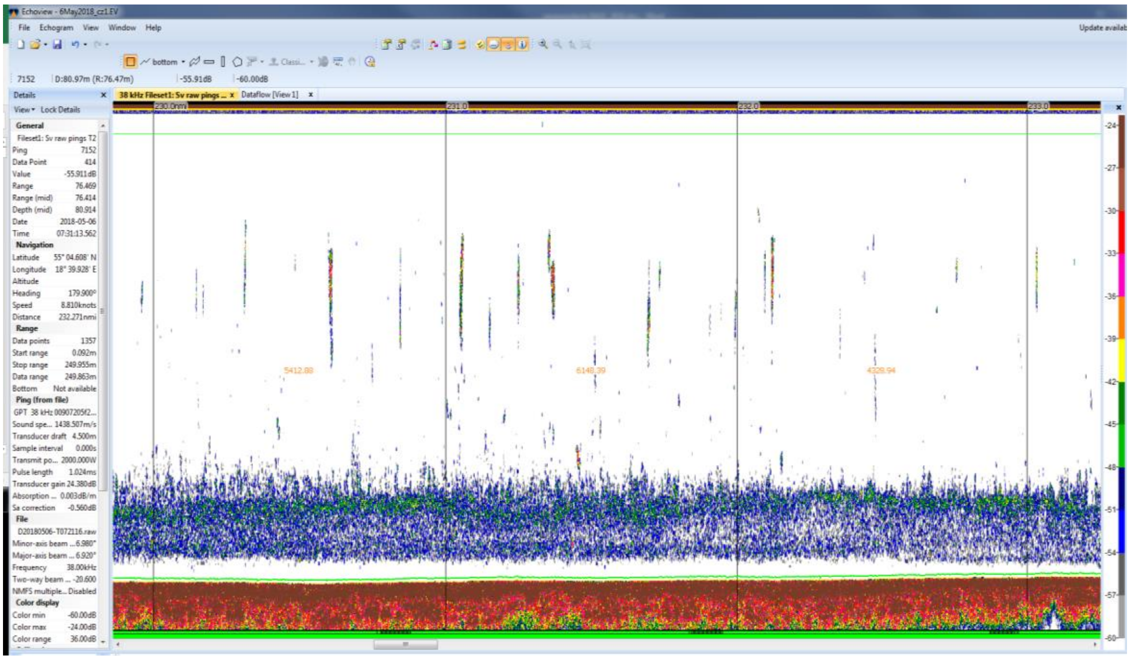

Fig. 4. An example of an echogram analysis for 232[th] mile of the integration, NASC = 6148 (ICES rectangle 39G8, bottom depth 91 m; 06.05.2018).

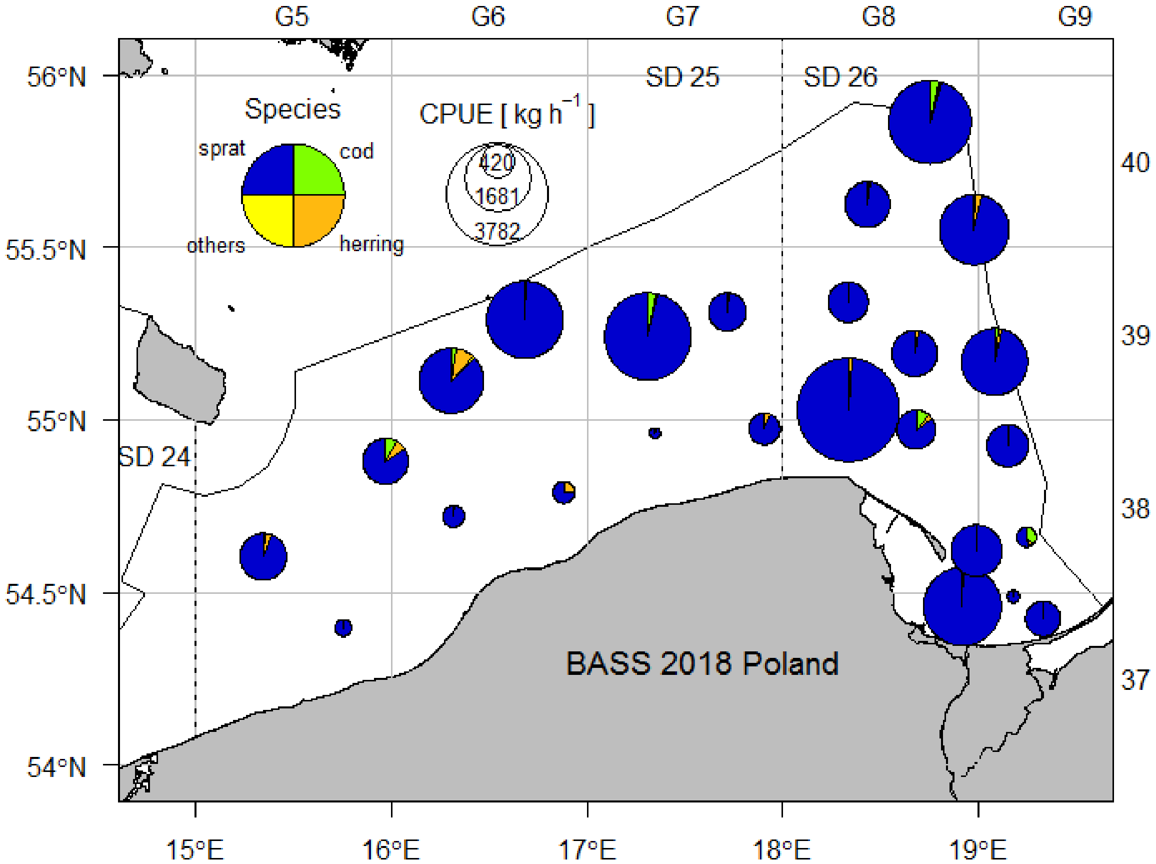

Fig. 5. CPUE [kg h^{-1}] of fish species per single pelagic hauls conducted in the Polish EEZ (BASS/2018 survey).

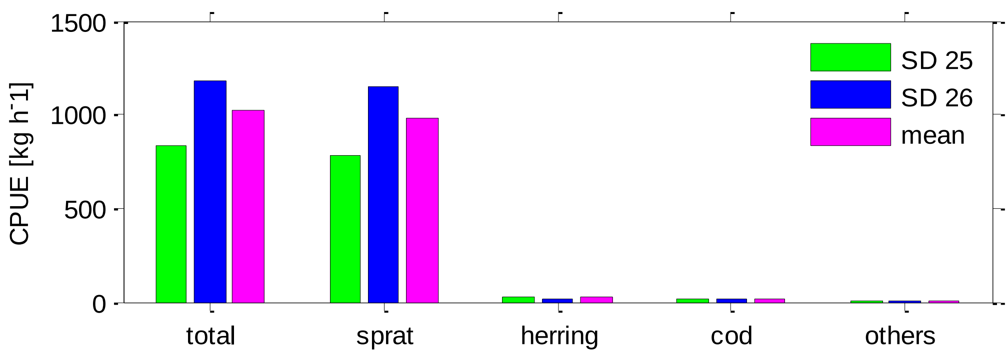

Fig. 6. Mean CPUE [kg h^{-1}] per fish species and the ICES SDs (the Polish BASS/2018 survey).

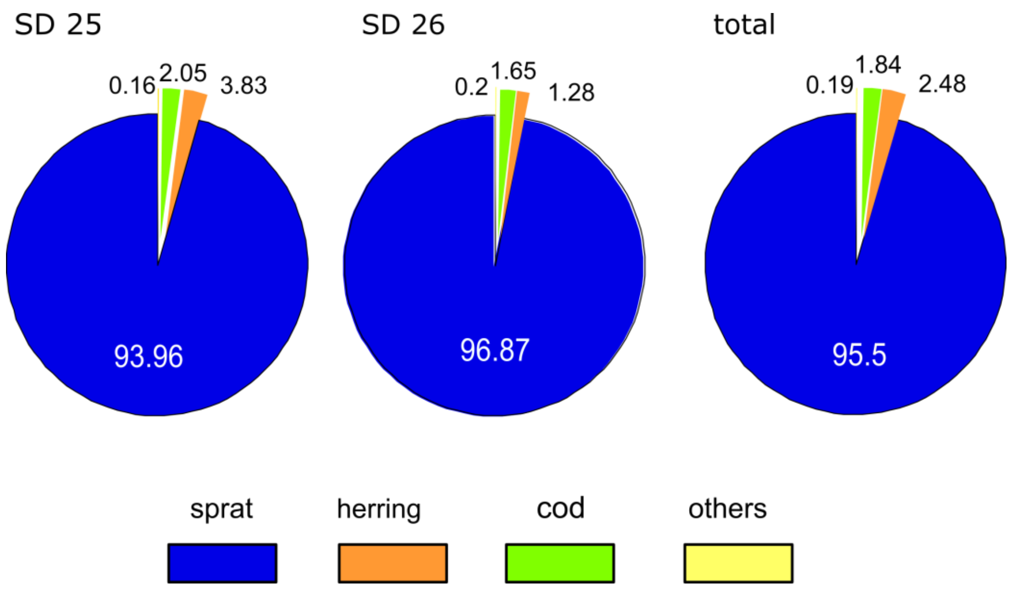

Fig. 7. Share (%) of sprat, herring, cod and other fishes in the mass of total catches per the ICES SDs (the Polish BASS/2018).

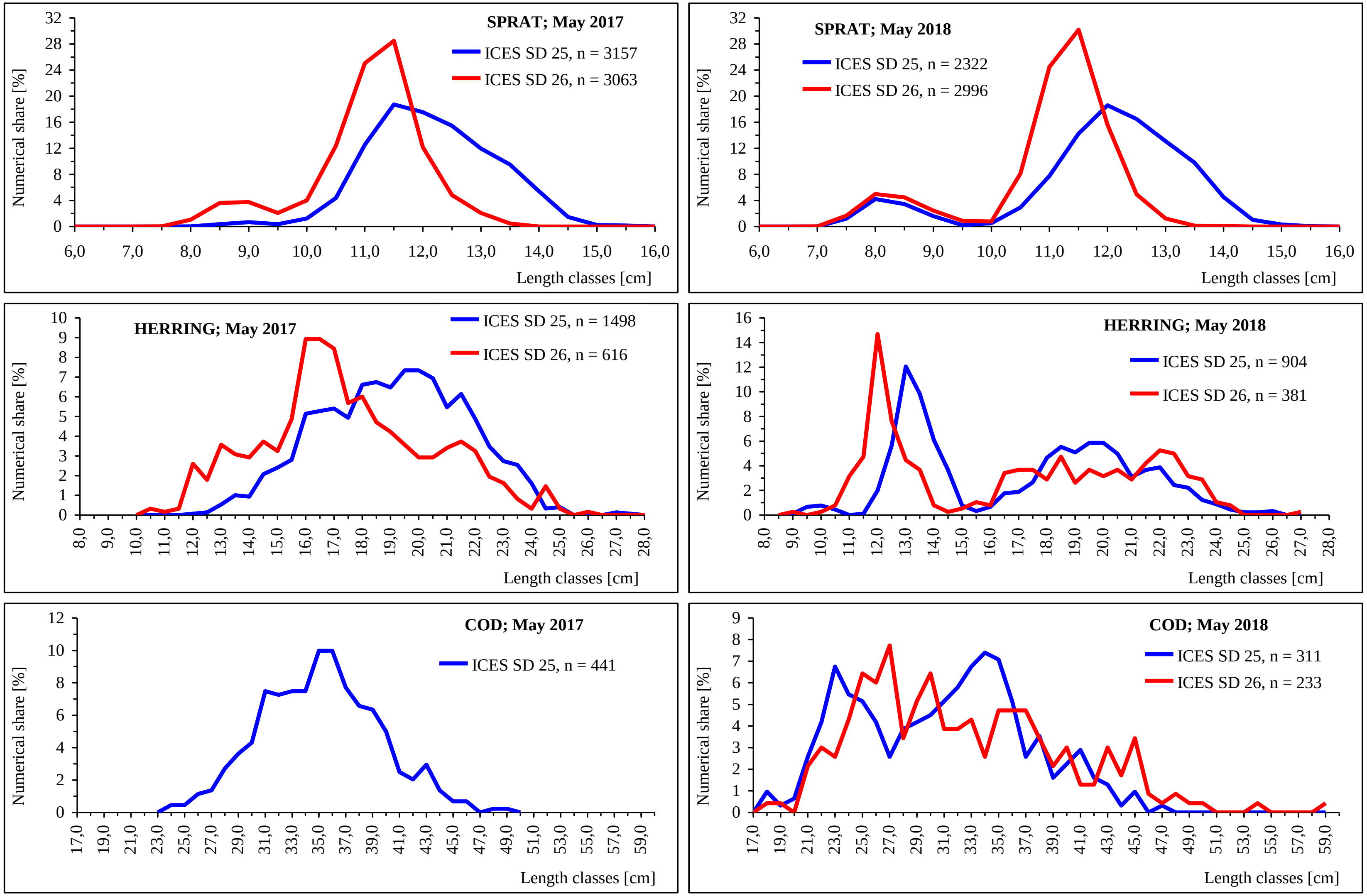

Fig. 8. Length distribution of sprat, herring and cod in samples taken from the control-catches conducted during the Polish BASS/2017 and BASS/2018 surveys.

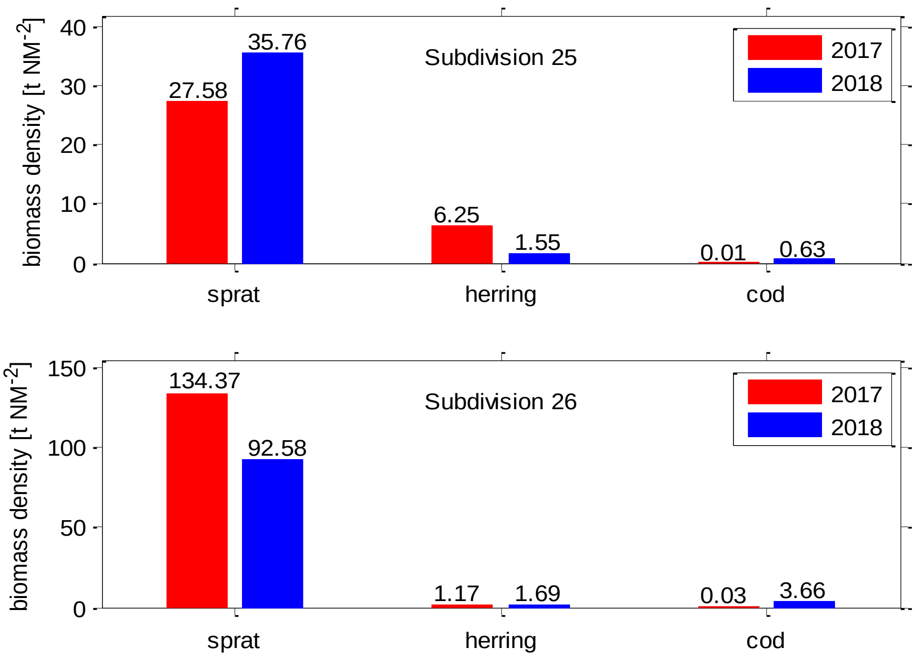

Fig. 9. Mean biomass density in the ICES Subdivisions 25 and 26 in the Polish BASS 2017 and 2018 for the three major fish species (note: for comparison reasons, presented biomass density in SD 25 for 2017 were calculated without the ICES rectangles 39G5 and 40G7, because in 2018 mentioned rectangles were acoustically not inspected).

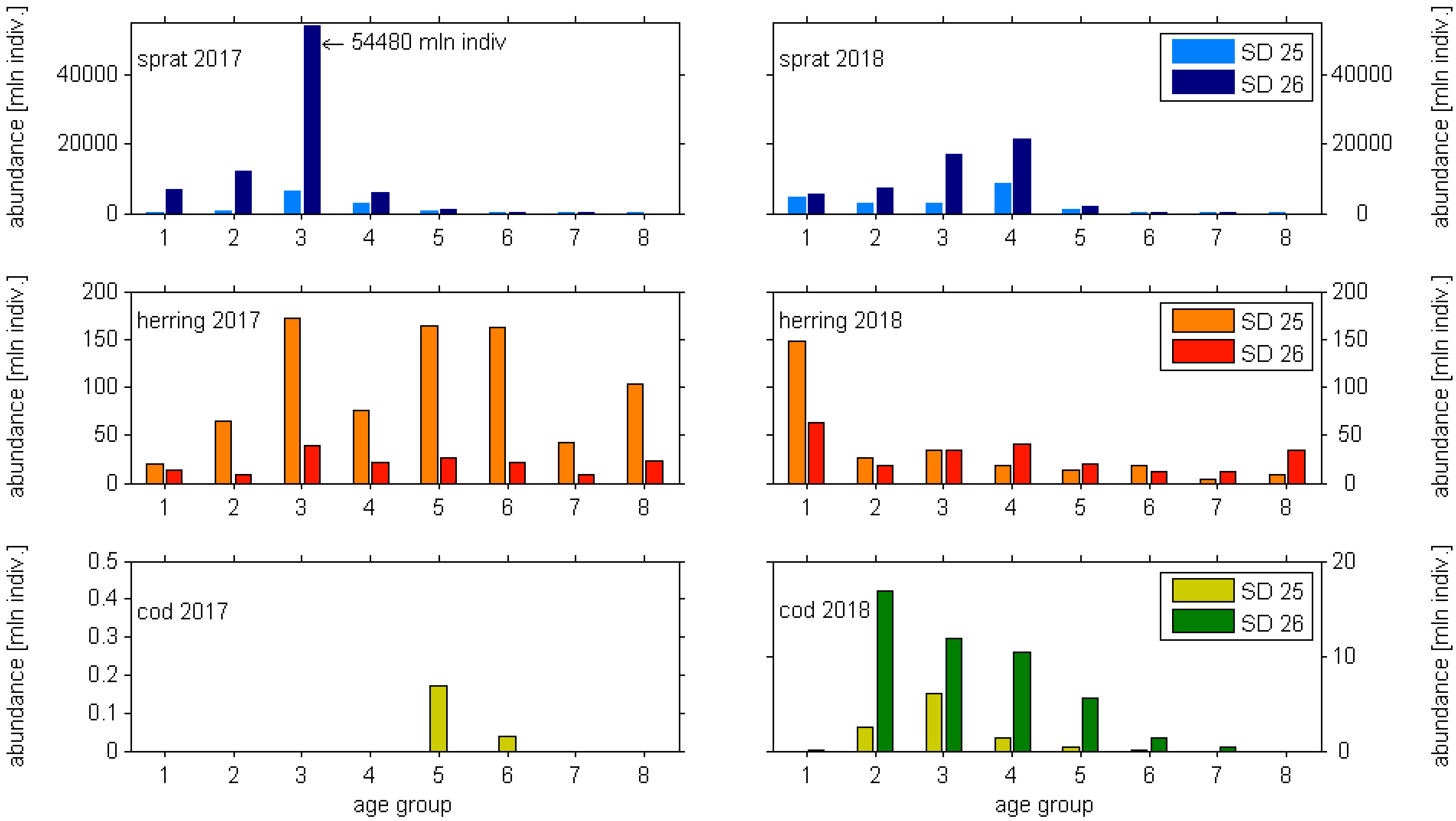

Fig. 10. Abundance of sprat, herring and cod stocks per age groups, according to the ICES Subdivisions 25 and 26, based on data from the Polish BASS surveys in 2017 and 2018 (note: in set of data from 2017, the ICES rectangles 39G5 and 40G7 are not included, because in 2018 mentioned rectangles were acoustically not inspected).

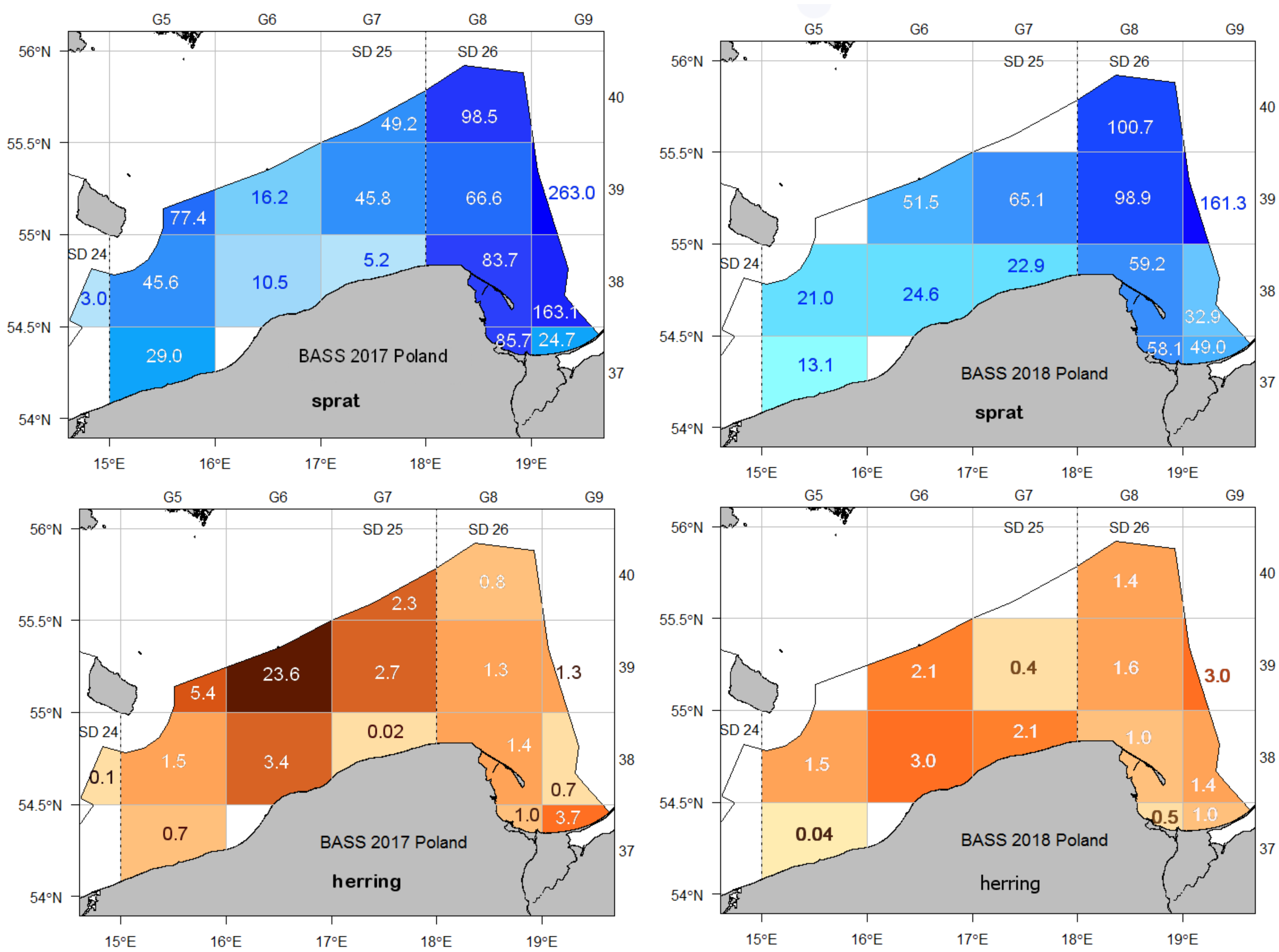

Fig. 11. Biomass surface density of sprat and herring [t·NM^{-2}] in ICES rectangles, estimated using acoustic method, and based on data collected during the Polish BASS 2017 and 2018 surveys.

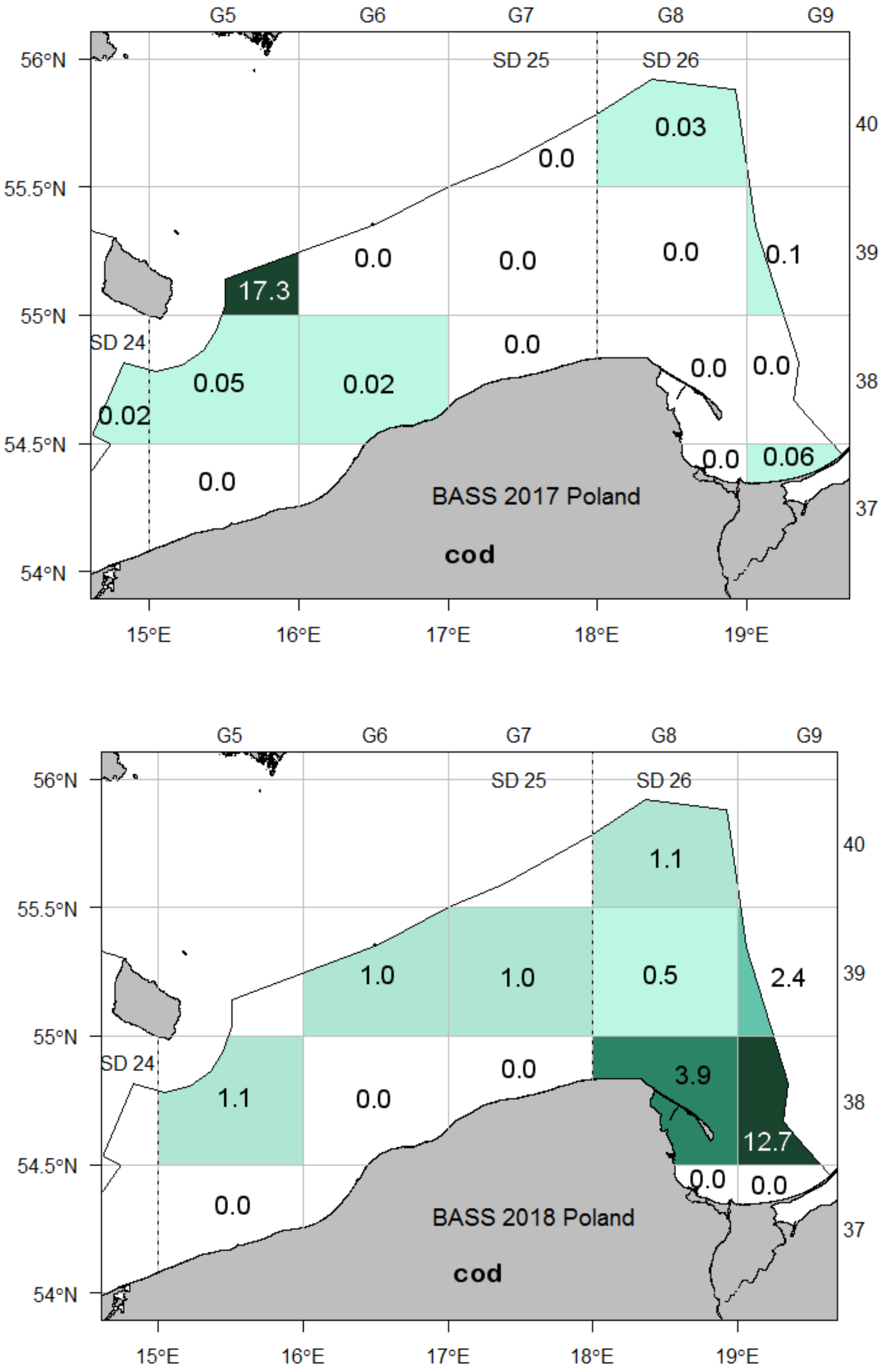

Fig. 12. Biomass surface density of cod [t·NM^{-2}] in ICES rectangles, estimated using acoustic method, and based on data collected during the Polish BASS 2017 and 2018 surveys.

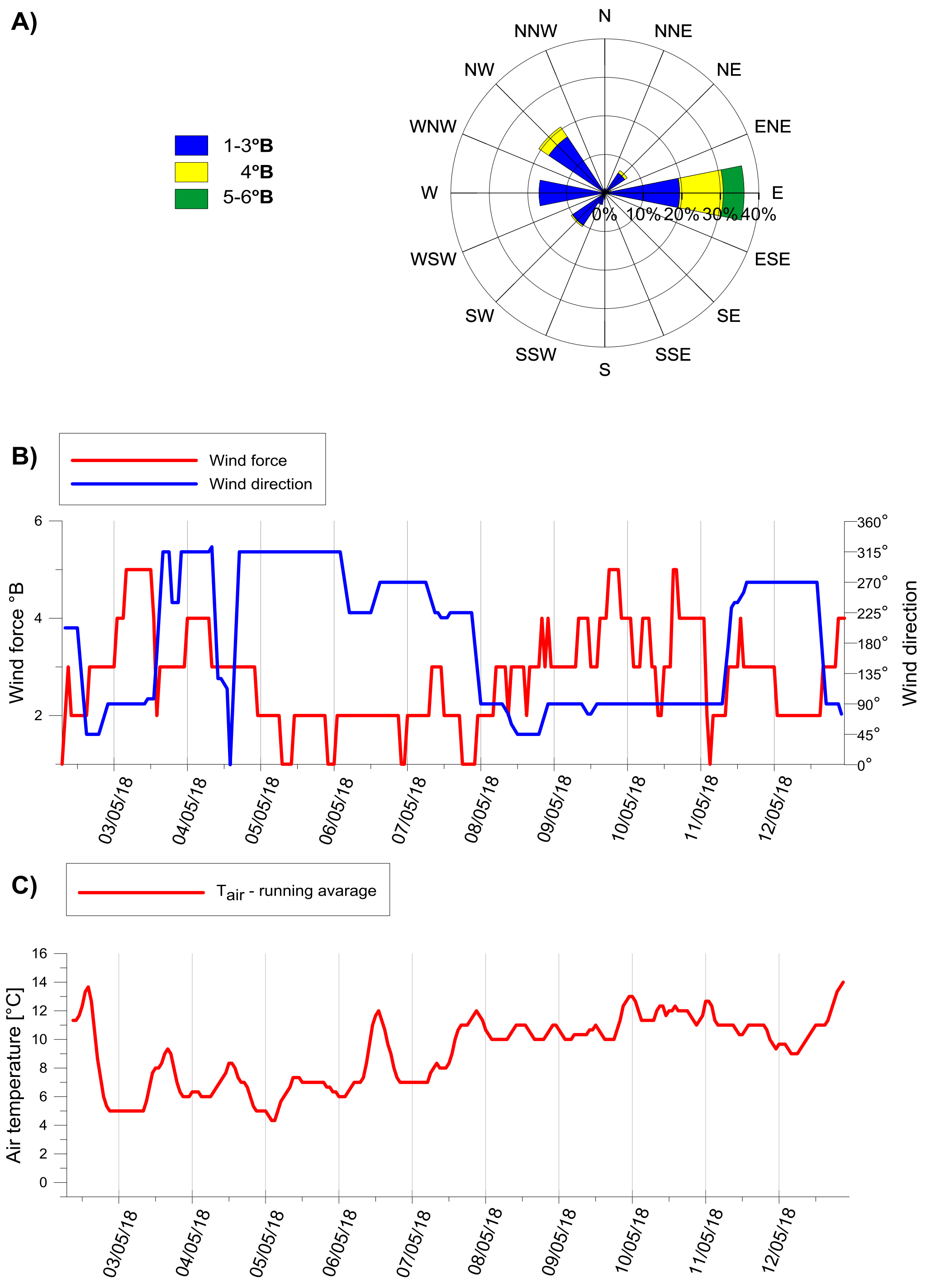

Fig. 13. Changes of meteorological parameters during consecutive days of the Polish BASS survey in May 2018 (fig. Wodzinowski cit. in Trella et al., 2018).

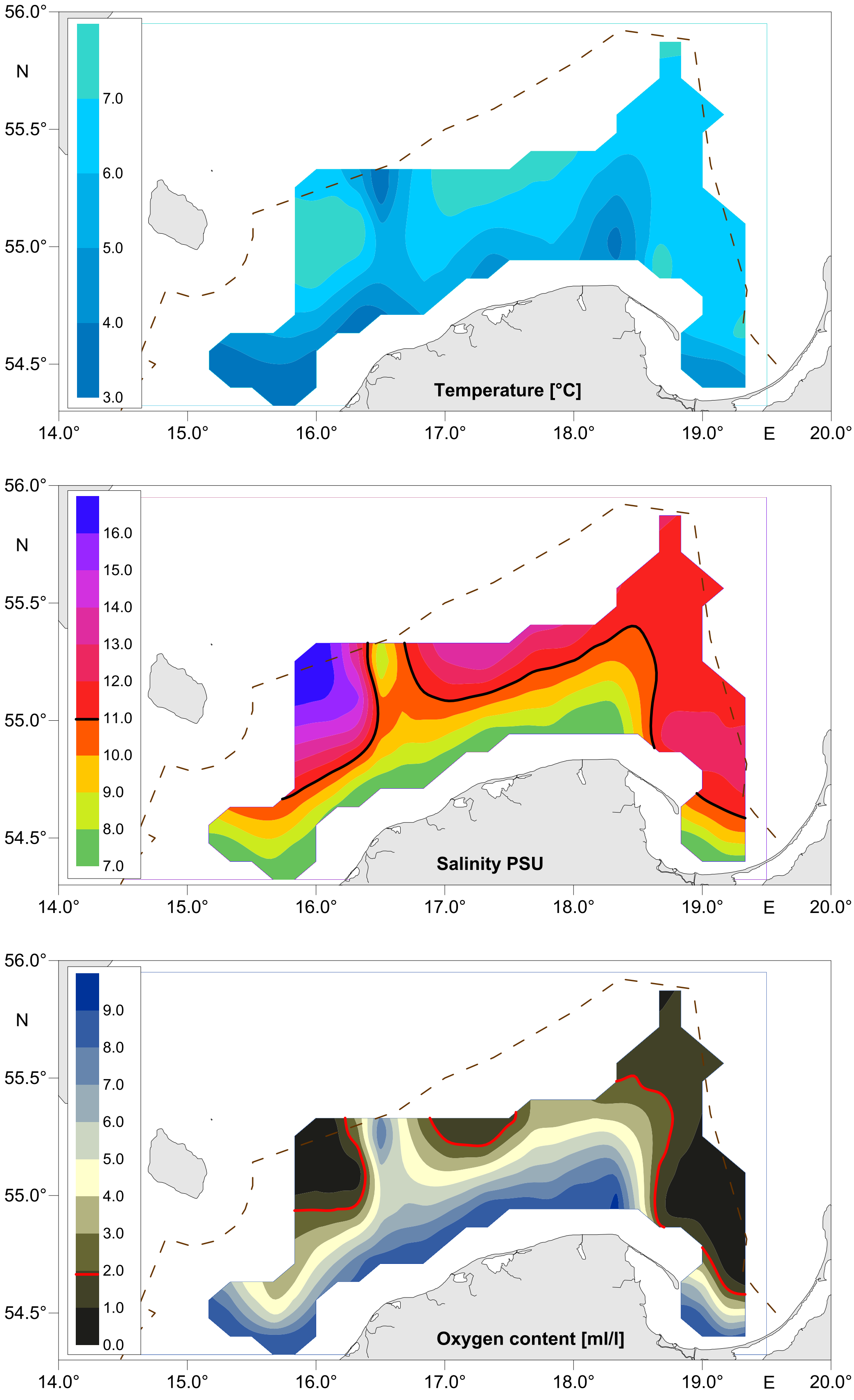

Fig. 14. Horizontal distribution of the seawater temperature, salinity and oxygen content in the near seabed layer of the southern Baltic in May 2018 (fig. Wodzinowski cit. in Trella et al., 2018).

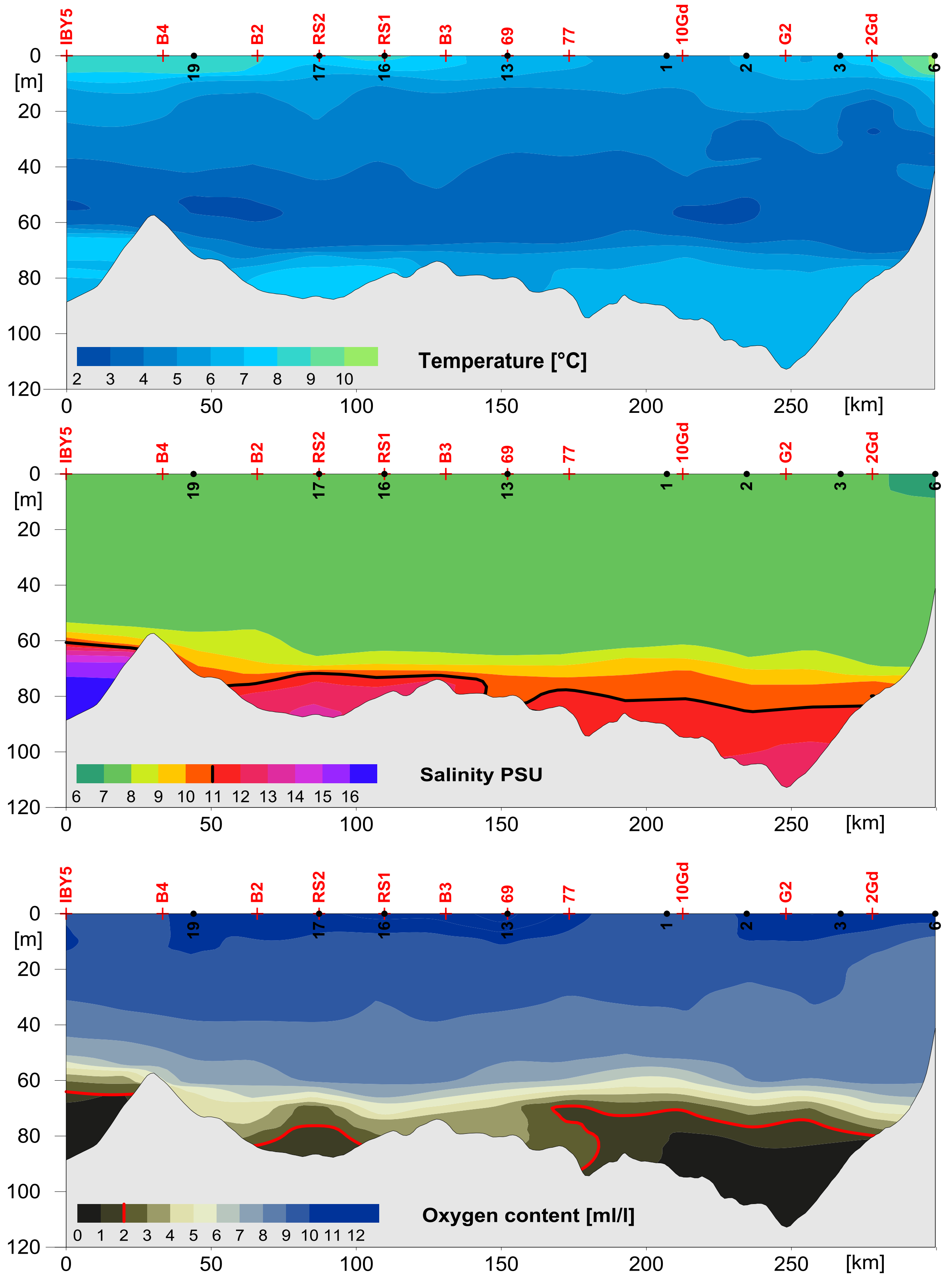

Fig. 15. Vertical distribution of the seawater temperature, salinity and oxygen content, along the hydrological research profile determined in the southern Baltic (May 2018); X- and Y-axes reflects distance (in kilometres) and depth (in meters) from the sea surface to the seabed, respectively (fig. Wodzinowski cit. in Trella et al., 2018).

Fisheries Service under the Ministry of Agriculture of Republic of Lithuania,
Fishery Research and Science State

RESEARCH REPORT FROM THE BALTIC ACOUSTIC SPRING SURVEY (BASS) IN THE ICES SUBDIVISION 26 (LITHUANIAN EXCLUSIVE ECONOMIC ZONE) OF THE BALTIC SEA

(Vessel "DARIUS"; 08.05 - 09.05.2018)

Klaipeda, May, 2018
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 Fisheries Service under the Ministry of Agriculture of Republic of 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

M. Špegys	Fisheries Service under the Ministry of Agriculture of The Republic of Lithuania; Division of Fishery Research and Science, Klaipeda – cruise leader and acoustics;
J. Fedotova	Fisheries Service under the Ministry of Agriculture of The Republic of Lithuania; Division of Fishery Research and Science, Klaipeda - scientific leader and fish sampling
D. Tarvydiene	Fisheries Service under the Ministry of Agriculture of The Republic of Lithuania; Division of Fishery Research and Science, Klaipeda - fish sampling

2.2 Narrative

The cruise of BASS survey took place from 08-th to 09-th of May 2018. 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 (10 of May 2017) 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: 28.04.2014	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	0.08
Along. Offset Angle	-0.15
SA Correction (38 kHz)	-0.18 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

517 herrings and 1870 sprats were measured and 260 herrings and 538 sprats were aged in 6 trawl hauls (Fig. 1)

The results of the catch composition are presented in Table 1. In all catch compositions sprat was dominated (from 60% to 99%).

The length distributions of herring and sprat of the May 2018 were presented in Fig.2 and Fig.3. In the 40H0 ICES rectangle in herring catches were dominated by 10-12 cm length classes and 88.1% of them were 2017 herring generation. In other rectangle (40G9) dominated 4-year fish (Table 10, 12).

Sprat dominated by 8.0 cm length class in 40H0 ICES rectangle (43.6%). And 67% of sprats dominated by 10.0 – 11.0 cm length classes in 40G 9 rectangle witch age were 3-5 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 $108.6 \cdot 10^6$ fishes or about 2066 tonnes.

The estimated sprat stock was $14933.4 \cdot 10^6$ fish or 112633 tonnes.

3.4. Hydrographic data

Hydrographic data by hauls presented in the Table 15. The seawater temperature was 12.5 ºC in the surface layer in the first haul. Water temperature in others hauls was from 7 to 14 ºC. Differences between the first haul and others caused by wind direction. Wind direction was nord-east in the first half day of cruise. Later wind direction changed to east. There was no thermocline in 2018 of May

(Table.15). Salinity was about 6.7 ‰ in all hauls and depts. The oxygen-condition was excellent in all hauls and depts.

4 REFERENCES

Balk, H. & Lindem, T. 2005. Sonar4, Sonar5 and Sonar6 post processing systems, operator manual version 5.9.6. Norway: Balk and Lindem. pp. 1-381

ICES 1983. Report of the Planning Group on ICES co-ordinated herring and sprat acoustic surveys. ICES CM 1983/H:12.

ICES 2016. Manual for the international acoustic survey (BIFS). CM2003/G:05 Ref.: D, H; Appendix 9, Annex 3

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.

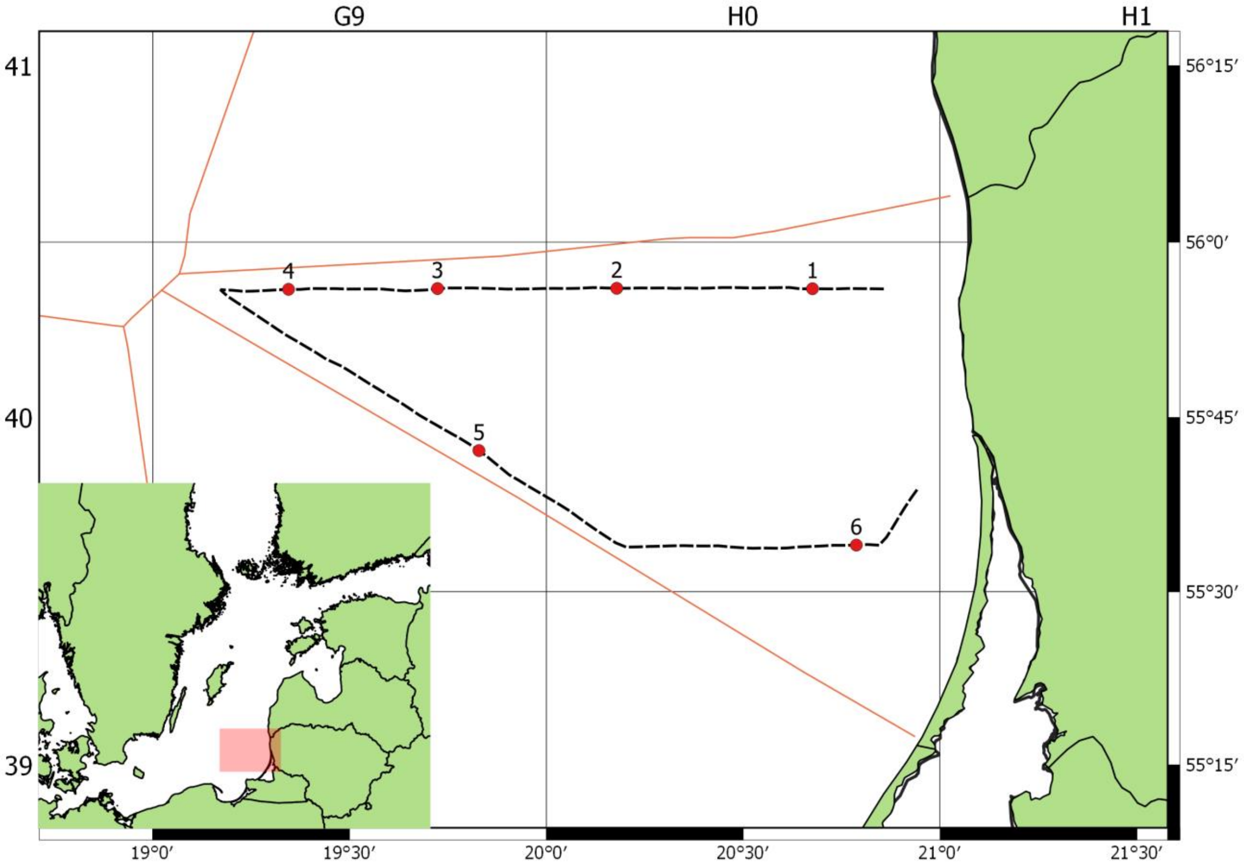

Figure1 The survey grid ant trawl hauls position of R/V “Darius” 08-09 May 2018

Table 1 Catch composition (kg/1hour) per haul (R/V "Darius", 08-09.05.2018)

ICES subdivision 26						
Haul No	1	2	3	4	5	6
Date	2018.05.08	2018.05.08	2017.05.08	2018.05.09	2018.05.09	2018.05.09
Validity	Valid	Valid	Valid	Valid	Valid	Valid
Species/ICES rectangle	40H0	40H0	40G9	40G9	40G9	40H0
Clupea hrengus	1.5	0.68	8.67	1.26	2.0	17.6
Sprattus spratus	23.9	480.0	300.0	200	4.4	52.7
Gasterosteus aculeatus			0.035	0.32	0.01	
Gadus morhua					0.9	
Total	25.4	480.68	308.71	201.58	7.3	70.3

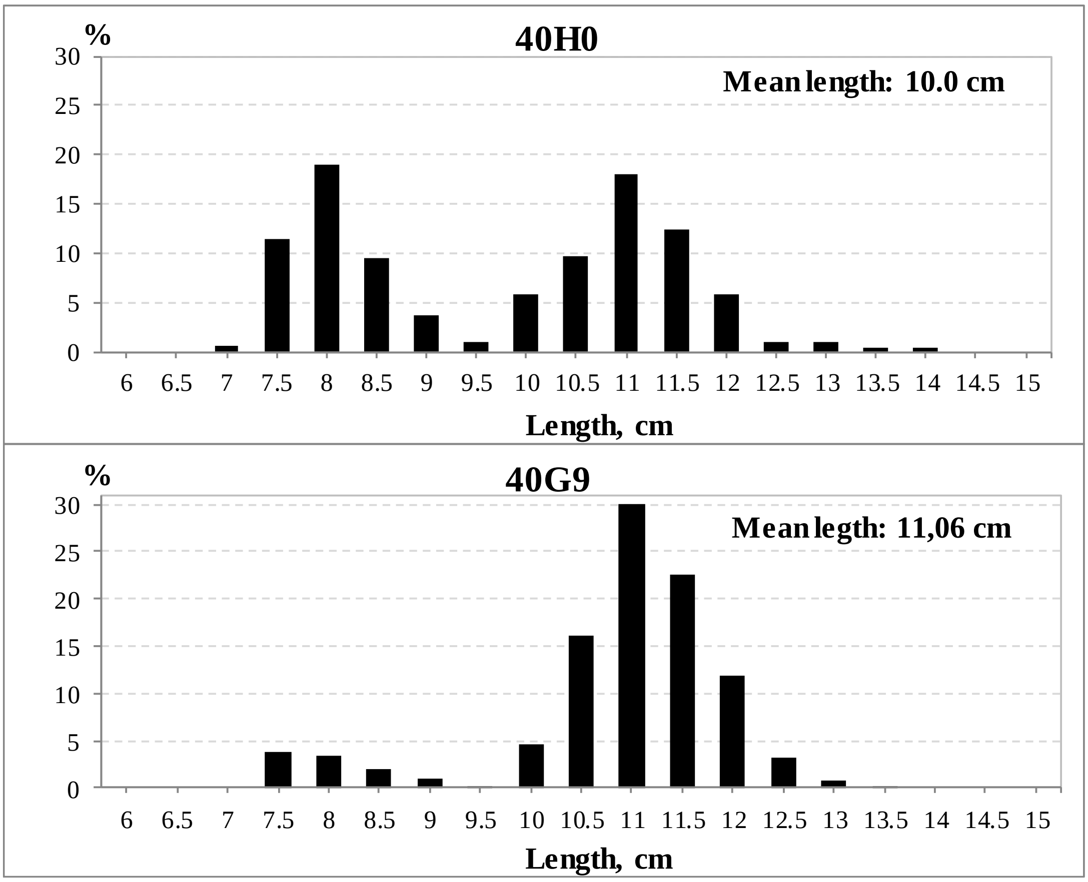

Figure 3 Length distribution of sprat (%) (R/V "Darius", 08-09.05.2018)

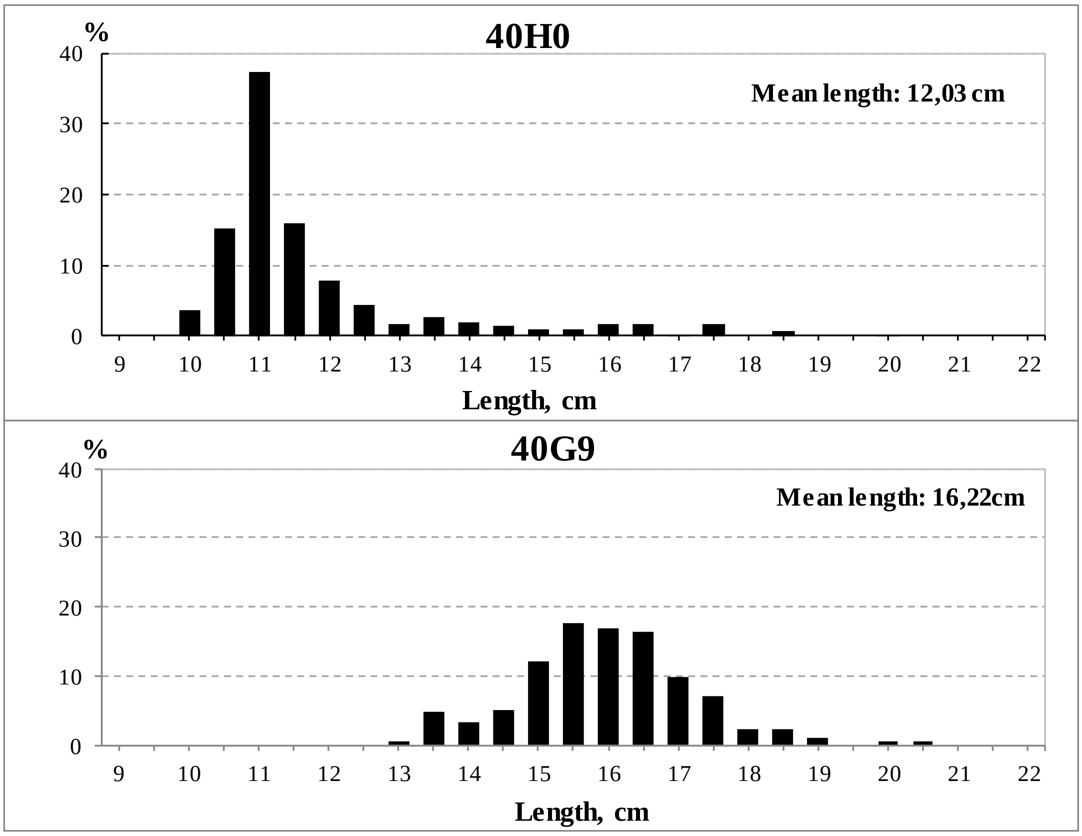

Figure 2. Length composition of herring (%) (R/V "Darius", 08-09.05.2018)

Table 2 R/V "DARIUS" survey statistics (abundance of herring and sprat), 08-09.05.2018

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	8.16	8261.8	59.0	8202.8	54886	678	54208
	40G9	1013.0	6.69	6780.2	49.6	6730.6	59813	1388	58426

Table 3 R/V "DARIUS" survey statistics (aggregated data of herring and sprat), 08-09.05.2018

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	12.03	11.49	0.71	10.05	6.61	99.29	809.6	-51.0
	40G9	3,4,5	16.22	27.99	0.73	11.12	8.68	99.27	803.6	-50.2

Table 4 R/V "DARIUS" survey statistics (herring and sprat), 08-09.05.2018

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	809.6	0.99174	8261.8	0.71	99.29
	40G9	1013	803.6	1.20062	6780.2	0.73	99.27

Table 5 R/V "Darius" estimated age composition (%) of sprat, 08-09.05.2018

SD	Rect.	Age									
		Total	0	1	2	3	4	5	6	7	8
26	40H0	100.0	0.0	43.6	7.6	12.6	20.7	7.5	4.0	3.1	0.8
	40G9	100.0	0.0	9.9	12.1	15.7	32.0	19.3	7.9	2.2	0.9

Table 6 R/V "Darius" estimated number (millions) of sprat, 08-09.05.2018

SD	Rect.	Age									
		Total	0	1	2	3	4	5	6	7	8
26	40H0	8202.8		3580.1	620.7	1033.8	1699.4	616.2	327.3	257.4	67.9
	40G9	6730.6		667.7	815.3	1058.0	2151.7	1299.5	531.3	149.0	58.2

Table 7 R/V "Darius" estimated biomass (in tons) of sprat, 08-09.05.2018

SD	Rect.	Age									
		Total	0	1	2	3	4	5	6	7	8
26	40H0	54208		12332	4775	8573	15268	5984	3452	2890	934
	40G9	58426		2189	6434	9205	20103	12447	5714	1672	662

Table 8 R/V "Darius" estimated mean weights (g) of sprat, -08-09.05.2018

SD	Rect.	Age									
		Mean	0	1	2	3	4	5	6	7	8
26	40H0	6.61		3.4	7.7	8.3	9.0	9.7	10.5	11.2	13.8
	40G9	8.68		3.28	7.89	8.70	9.34	9.58	10.75	11.22	11.38

Table 9 R/V "Darius" estimated mean length (cm) of sprat, 08-09.05.2018

SD	Rect.	Age									
		Mean	0	1	2	3	4	5	6	7	8
26	40H0	10.0		8.1	10.5	10.8	11.1	11.5	11.9	12.2	13.4
	40G9	11.1		8.0	10.5	10.9	11.2	11.4	11.9	12.1	12.2

Table 10 R/V "Darius" estimated age composition (%) of herring, 08-09.05.2018

SD	Rect.	Age									
		Total	0	1	2	3	4	5	6	7	8
26	40H0	100.0	0.0	88.1	2.6	3.6	5.0	0.3	0.3	0.0	0.0
	40G9	100.0	0.0	0.0	6.6	19.0	65.3	8.2	0.5	0.5	0.0

Table 11 R/V "Darius" estimated number (millions) of herring, 08-09.05.2018

SD	Rect.	Age									
		Total	0	1	2	3	4	5	6	7	8
26	40H0	59.0		52.0	1.6	2.1	2.9	0.2	0.2		
	40G9	49.6			3.2	9.4	32.4	4.1	0.2	0.2	

Table 12 R/V "Darius" estimated biomass (in tons) of herring, 08-09.05.2018

SD	Rect.	Age									
		Total	0	1	2	3	4	5	6	7	8
26	40H0	678		498.3	29.6	54.7	81.1	6.4	7.8		
	40G9	1388			63.1	251.8	919.8	138.6	5.3	8.8	

Table 13 R/V "Darius" estimated mean weights (g) of herring, 08-09.05.2018

SD	Rect.	Age									
		Total	0	1	2	3	4	5	6	7	8
26	40H0	11.5		9.6	19.0	25.5	27.8	33.0	40.1		
	40G9	28.0			19.4	26.7	28.4	34.1	23.1	38.2	

Table 14 R/V "Darius" estimated mean length (cm) of herring, 08-09.05.2018

SD	Rect.	Age									
		Total	0	1	2	3	4	5	6	7	8
26	40H0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0
	40G9	16.2	16.2	16.2	16.2	16.2	16.2	16.2	16.2	16.2	16.2

Table 15. The values of hydrological parameters registered at the catching depth in the Baltic Sea ICES SD from the Lithuanian BISS survey conducted by r/v "Darius" in the period of 08-09.05.2018

Haul number	Date of catch	Mean trawling depth, m	Hydrological parameters		
			Temperature, °C	Salinity, ‰	Oxygen, ml/l
1	2018.05.08	32	11.1	6.7	7.4
2	2018.05.08	52	9.5	6.6	7.7
3	2018.05.08	56	7.4	6.7	8.1
4	2018.05.09	72	8.1	6.7	7.9
5	2018.05.09	76	8.4	6.7	7.9
6	2018.05.09	40	14.4	6.7	6.9
Average		60.7			

REPORT

FROM THE JOINT ESTONIAN-POLISH BASS 2018
CONDUCTED BY THE R.V. "BALTICA" IN THE NORTH-EASTERN BALTIC SEA
(26-31 May 2018)

by
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Introduction

The recent joint Estonian-Polish Baltic Acoustic Spring Survey (BASS), marked with the number 8/2018/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 2018 and the European Union (the Commission regulations Nos. 665/2008, 199/2008 and 2010/93/EU financially supported the EST-POL BASS 2018. 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 (ICES 2018[1]).

The main aims of the reported cruise were:

- to provide the echo-integration and to collect the acoustic data along the planed transects in the north-eastern Baltic Sea,
- to conduct the fish pelagic control-catches in the fish concentration locations,
- to collect ichthyological samples specially for herring and sprat,
- to provide hydrological monitoring (water temperature, salinity and oxygen content) at the catch locations.

Personnel

The EST-POL BASS 2018 scientific staff was composed of 7 persons:
Miroslaw Wyszynski (NMFRI, Gdynia – Poland) – survey leader
Bartlomiej Nurek (NMFRI, Gdynia – Poland) – acoustician
Tycjan Wodzinowski (NMFRI, Gdynia – Poland) – hydrologist
Ain Lankov (TUEMI, Tallinn - Estonia) – Estonian scientific staff leader
Andrus Hallang (TUEMI, Tallinn - Estonia) – ichthyologist
Elor Sepp (TUEMI, Tallinn - Estonia) – acoustician
Timo Arula (TUEMI, Tallinn - Estonia) – ichthyologist

[1)] ICES 2018. Report of the Baltic International Fish Survey Working Group (WGBIFS). ICES CM 2018/EOSG: 6.

Narrative

The reported survey took place during the period of 26-31 May 2018. 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 25.05.2018 after the midday and was navigated in the North-eastern direction to the entering point of planed acoustic transect at the geographical position 59°17'N 022°23'E on May 26 (Fig. 1). The at sea researches were ended on 30.05.2018 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 31.05.2018 afternoon.

Survey design and realization

The r.v. "Baltica" realized 392 Nm echo-integration transect and 15 fish control-catches (Fig. 1). All planed ICES rectangles were covered with acoustic transect and control catches. All control catches were performed in the daylight (between 07:40 am. and 17:50 p.m.) using the pelagic trawl type WP 53/64x4 (with 6 mm mesh bar length in the codend). The hauls trawling duration was 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 3 hauls in SD 32.

The length measurements (in 0.5 cm classes) were realized for totally 3470 sprat and 3840 herring individuals. Totally, 409 sprat and 836 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. 2015). 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 IDRONAUT probe were used for hydrological sampling,

Data analysis

The MYRIAX "EchoView v.4.10" 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, 9 fish species were recognized in hauls performed at the North-eastern Baltic Sea (SDs 28.2, 29 and 32 West) in May 2018. Sprat was prevailing species by mass in the total catch with the mean share amounted 62.6 % (especially high in SD 28.2 – 67.8%, but lowest in SD 29 – 54.5%). The rest 7 species (cod, flounder, three spine stickleback, smelt, lumpfish, lesser sandeel and fourbeard rockling) represented only about 0.75% of the total mass 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 May 2018 amounted 619.6 kg/h (comparing to 630.6 and 670.0 kg/h in the same period in 2017 and 2016 respectively). The highest CPUEs for sprat and herring was noted in SD 28.2. The mean CPUEs of sprat were as follow: 710.7 kg/h in ICES SD 28.2, 237.2 kg/h in SD 29 and 359.0 kg/h in SD 32. The mean CPUEs in case of herring were: 323.7, 190.2 and 173.3 kg/h in SDs 28.2, 29 and 32 respectively. Cod and three-spine stickleback prevailed among other species in bycatch with mean CPUEs 2.8 and 1.0 kg/h for all investigated area 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 bimodal character in three investigated SDs. First frequency pick representing sprat generation born in 2017 take place on 7.5-8 cm length classes. The comparably high quantity of this generation was observed in Sub-division 28.2 only. The second pick representing adult sprat placed on 11 cm length class. The length distribution curves by Sub-divisions in case of herring show generally also two frequency picks – first one at 9 cm length class, second one at 14.5-15.5 cm length classes. The first pick shows low quantity of herring generation born in 2017 in both SDs 29 and 32, except slightly better quantity in SD 28.2. The length distribution of three spine stickleback was in range 4-8 cm with modal frequency at 6-6.5 cm length classes, taking into advice all investigated area. The length range of cod was between 17 and 46 cm with modal frequency at 23 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. Fish abundances were almost 50% lower than in 2017, with highest differences in open sea and northern areas.

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 two times lower compared to previous year and concentrations were evenly distributed through survey area. Average weights were similar with the 2017 results. Abundance of herring was about 20% lower compared to previous survey, but average weights were slightly higher.

Meteorological and hydrological characteristics.

The 15 control catches stations 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 meters, and on the catch depth.

Changes of the main meteorological parameters during the joint EST-POL BASS conducted in May 2018 are presented at the Fig. 6. The wind force varied from 1°B to 4°B and average was 2.8°B The most often wind direction was ENE. The air temperature ranged from 13.0 °C to 18.0 °C, and average temperature was 14.7 °C.

The seawater temperature in the sea water surface layers (Fig. 7) varied from 11,30 to 14.08°C (the mean was 12.97°C). The lowest surface temperatures were recorded at the haul 10. The highest ones were noticed at the haul 11. The minimum value of salinity in Practical Salinity Unit (PSU) was 5.46 at the haul 4 in the surface layer. The maximum was 7.07 PSU at the haul 15. The mean value of salinity was 6,38 PSU. The oxygen content in the surface layers of investigated the research area varied in the range of 8.09 ml/l (haul 8) - 9.43 ml/l (haul 7). The mean value of surface water oxygen content was 8.97 ml/l.

The temperature at the control catch depth (Fig. 8) was changing in the range from 2.60 (haul 8) to 5.49 °C (haul 3), the mean was 4.78 °C. Salinity haul waters varied from 7.28 (haul 8) to 9.83 PSU (haul 3), and the mean was 9.04 PSU. Oxygen content varied from 1.05 ml/l (haul 6) to 6.89 ml/l (haul 8), the mean was 2.03 ml/l.

The temperature of near bottom (Fig. 9) layer was changing in the range of 4.24 (haul 8) to 6.32 °C (haul 9), the mean was 5.90 °C. Salinity in the bottom waters varied from 8.46 to 11.58 PSU, and the mean was 10.80 PSU. The low values of salinity was at the haul 8. The highest values of salinity were noticed at the haul 9. Oxygen content varied from 0.00 ml/l to 4.96 ml/l (the mean was 0.71 ml/l). The zero values of this parameter were noticed at the hauls: 1, 2, 3 and 4.

The vertical distributions of the seawater temperature, salinity and oxygen content along the hydrological profile during the joint EST-POL BASS (May 2018) are presented on the Fig. 10.

The vertical hydrological profile at the one of the deepest measuring points (haul 9 start location) during EST-POL BASS in May 2018 is shown on the Fig. 11.

The values of the meteorological and hydrological parameters recorded at the start positions of the r.v. "Baltica" fish control catches during the joint EST-POL BASS conducted in May 2018 are presented in the Tab. 7.

The final report from the EST-POL BASS 2018 will be presented at the meeting of the ICES Baltic International Fish Survey Working Group (WGBIFS) at March 25-29, 2019 in Klaipeda (Lithuania).

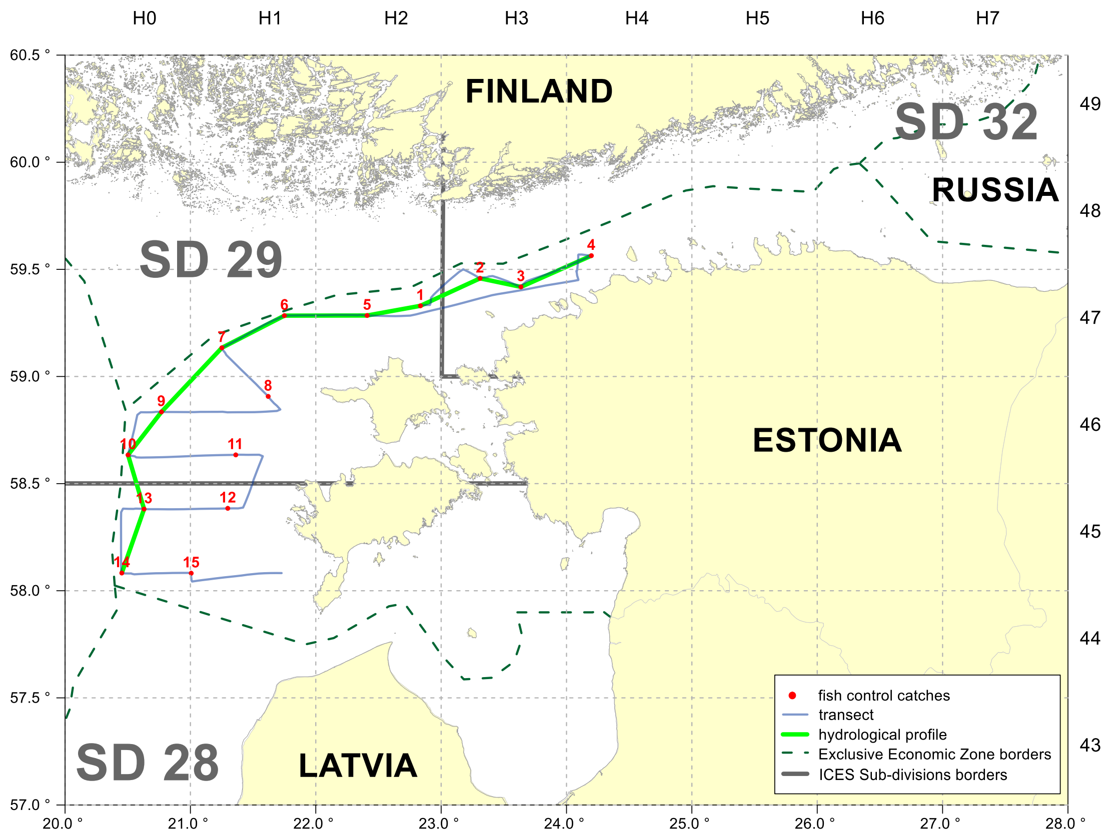

Fig. 1. Acoustic transects and pelagic fish control catches with connected hydrological stations realised during the joint EST-POL BASS (May 2018).

Table 1. Catch results during joint Estonian-Polish BASS conducted by r.v. "Baltica" in the Estonian EEZ in May 2018.

Haul no	Date	ICES rectangle	ICES Sub-division (SD)	Geographical position start latitude 00°00.0'N	Geographical position start longitude 00°00.0'E	Geographical position end latitude 00°00.0'N	Geographical position end longitude 00°00.0'E	Time start	Time end	Haul duration [min]	Total catch [kg]	CPUE [kg/h]	Catch per species [kg] sprat	herring	cod	flounder	lesser sand eel	lumpfish	fourbeard rockling	three-spined stickleback	smelt
1	2018-05-26	47H2	29	59°20.0'	22°51.9'	59°20.0'	22°54.8'	07:40	08:00	20	165,886	497,658	100,290	64,839	0,226					0,150	0,381
2	2018-05-26	47H3	32	59°27.7'	23°20.3'	59°27.8'	23°21.7'	11:15	11:30	15	227,415	909,660	159,580	67,376	0,255					0,204	
3	2018-05-26	47H3	32	59°26.0'	23°39.4'	59°26.3'	23°40.3'	13:35	13:55	20	121,557	364,671	76,452	43,290	0,837					0,036	0,942
4	2018-05-26	48H4	32	59°33.9'	24°10.1'	59°34.1'	24°07.1'	17:00	17:30	30	166,300	332,600	104,669	60,267						0,017	1,347
5	2018-05-27	47H2	29	59°17.1'	22°23.1'	59°17.2'	22°20.4'	08:15	08:35	20	273,988	821,964	153,786	119,350	0,688					0,164	
6	2018-05-27	47H1	29	59°16.6'	21°43.4'	59°16.2'	21°42.0'	11:30	11:45	15	74,737	298,948	48,931	24,777	0,577					0,452	
7	2018-05-27	47H1	29	59°07.3'	21°15.6'	59°06.7'	21°16.5'	14:30	14:45	15	106,040	424,160	40,629	64,144	0,920		0,011			0,336	
8	2018-05-27	46H1	29	58°53.8'	21°37.9'	58°52.8'	21°39.5'	17:20	17:50	30	34,181	68,362	20,579	12,584				0,161		0,857	
9	2018-05-28	46H0	29	58°50.1'	20°44.6'	58°50.1'	20°44.6'	08:00	08:15	15	95,187	380,748	32,580	61,993	0,204	0,163				0,247	
10	2018-05-28	46H0	29	58°37.8'	20°31.4'	58°37.6'	20°33.2'	10:55	11:15	20	46,024	138,072	23,748	20,266	1,231	0,153				0,626	
11	2018-05-28	46H1	29	58°38.0'	21°22.8'	58°38.0'	21°25.7'	15:10	15:40	30	410,126	820,252	267,240	139,781	1,861	0,265				0,612	0,367
12	2018-05-28	45H1	28	58°23.1'	21°16.6'	58°23.0'	21°15.0'	19:20	19:40	30	122,597	245,194	76,458	43,828	1,802	0,255				0,254	
13	2018-05-29	45H0	28	58°22.9'	20°36.2'	58°23.0'	20°34.0'	08:50	09:10	20	25,045	75,134	11,300	10,260	2,864	0,085			0,001	0,535	
14	2018-05-29	45H0	28	58°04.8'	20°28.5'	58°04.8'	20°31.6'	12:35	13:05	30	375,684	751,368	225,200	145,351	4,432	0,552				0,149	
15	2018-05-29	45H1	28	58°04.0'	21°00.3'	58°03.2'	21°00.5'	15:45	16:00	15	773,807	3095,228	551,450	221,462	0,206	0,071				0,618	
									Total catch [kg]	28	1297,133	1048,962	864,408	420,901	9,304	0,963			0,001	1,556	
										29	1206,169	435,113	687,783	507,734	5,707	0,581	0,011	0,161		3,444	0,748
										32	515,272	538,980	340,701	170,933	1,092					0,257	2,289
										Sum	3018,574	619,58	1892,892	1099,568	16,103	1,544	0,011	0,161	0,001	5,257	3,037

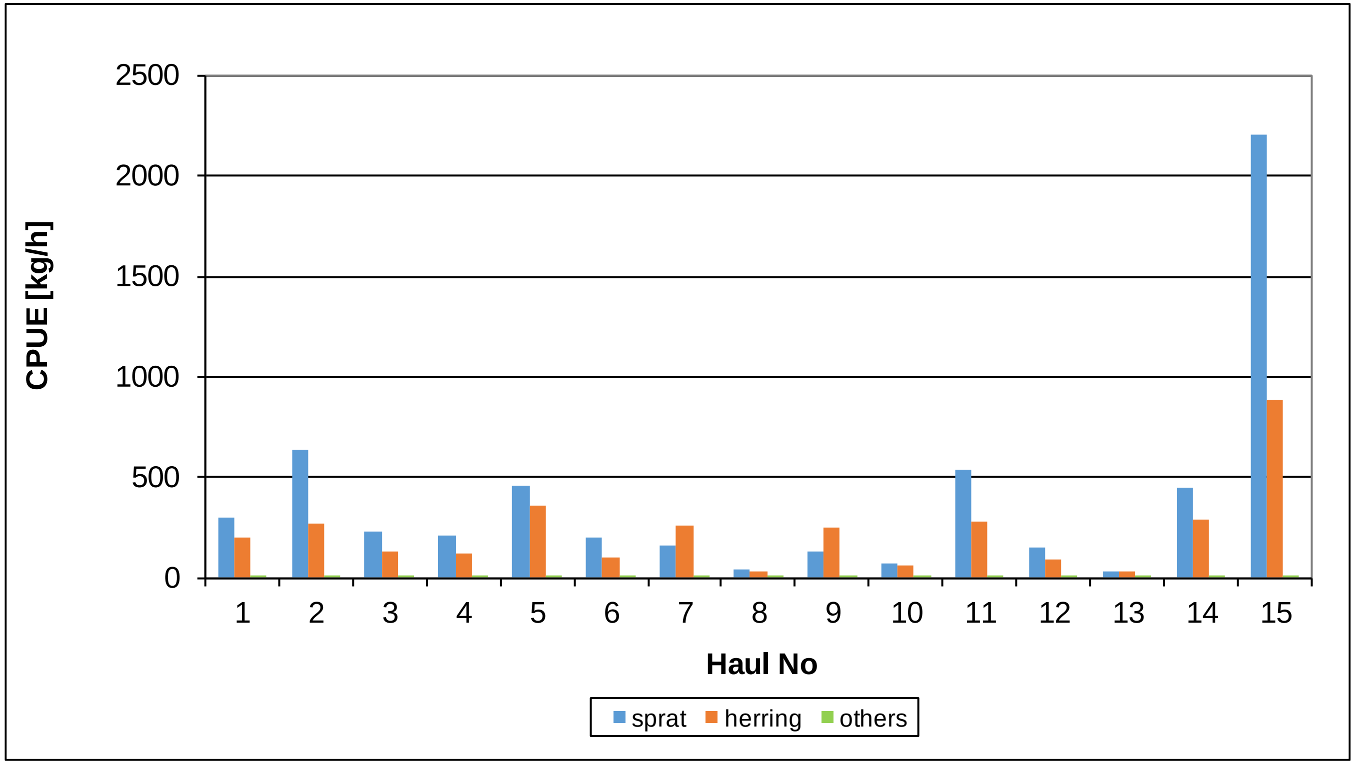

Fig. 2. CPUE values (kg/h) of sprat and herring in particular pelagic fish control catches during the joint EST-POL BASS in the North-eastern Baltic Sea (Sub-divisions 28.2, 29 and 32), May 2018.

Table. 2. Biological sampling in the r.v.”Baltica” joint EST-POL BASS in May 2018.

SD 28.2		SPRAT	HERRING	COD	FLOUNDER	LUMPFISH	THREE SPINED STICKLEBACK	SMELT	FOURBEARD ROCKLING	LESSER SANDEEL	TOTAL
Samples taken	measurements	4	4	4	4		4		1		21
	analyses	4	4								8
Fish measured		905	1047	50	9		95		1		2107
Fish analysed		129	302								431

SD 29		SPRAT	HERRING	COD	FLOUNDER	LUMPFISH	THREE SPINED STICKLEBACK	SMELT	FOURBEARD ROCKLING	LESSER SANDEEL	TOTAL
Samples taken	measurements	8	8	7	4	1	8	2		1	39
	analyses	8	8								16
Fish measured		1873	1992	29	4	1	325	6		1	4231
Fish analysed		153	317								470

SD 32		SPRAT	HERRING	COD	FLOUNDER	LUMPFISH	THREE SPINED STICKLEBACK	SMELT	FOURBEARD ROCKLING	LESSER SANDEEL	TOTAL
Samples taken	measurements	3	3	2			3	2			13
	analyses	3	3								6
Fish measured		692	801	4			17	24			1538
Fish analysed		127	217								344

SUM		SPRAT	HERRING	COD	FLOUNDER	LUMPFISH	THREE SPINED STICKLEBACK	SMELT	FOURBEARD ROCKLING	LESSER SANDEEL	TOTAL
Samples taken	measurements	15	15	13	8	1	15	4	1	1	73
	analyses	15	15								30
Fish measured		3470	3840	83	13	1	437	30	1	1	7876
Fish analysed		409	836								1245

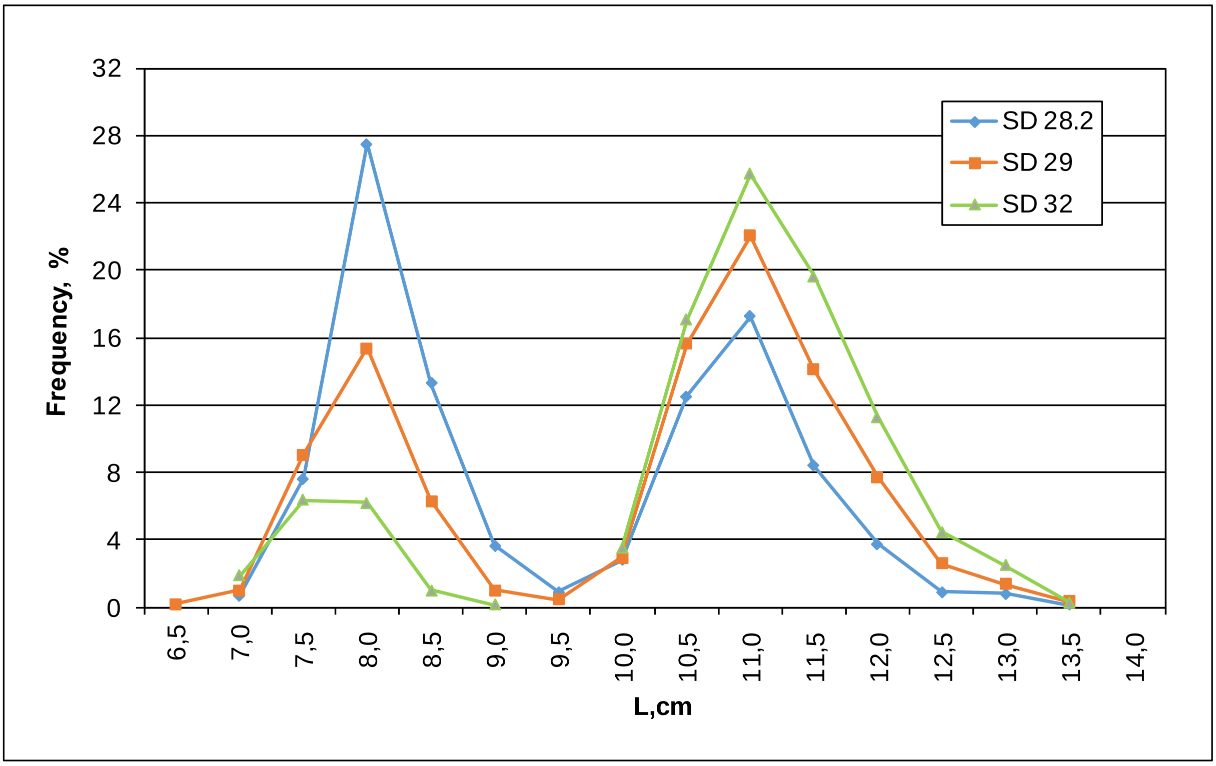

Fig. 3. Sprat length distributions from the control catches conducted by the r.v. “Baltica” during joint EST-POL BASS in the SDs 28.2, 29 and 32 (May 2018).

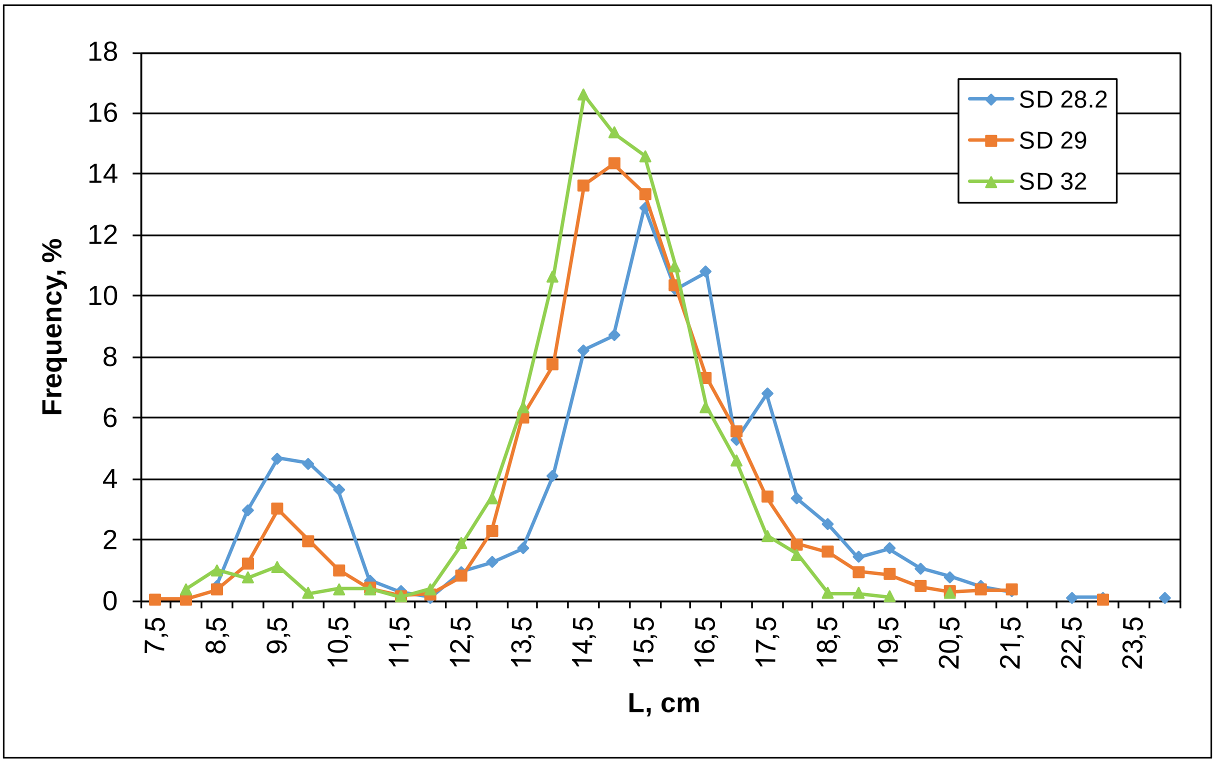

Fig. 4. Herring length distributions from the control catches conducted by the r.v. "Baltica" during joint EST-POL BASS in the SDs 28.2, 29 and 32 (May 2018).

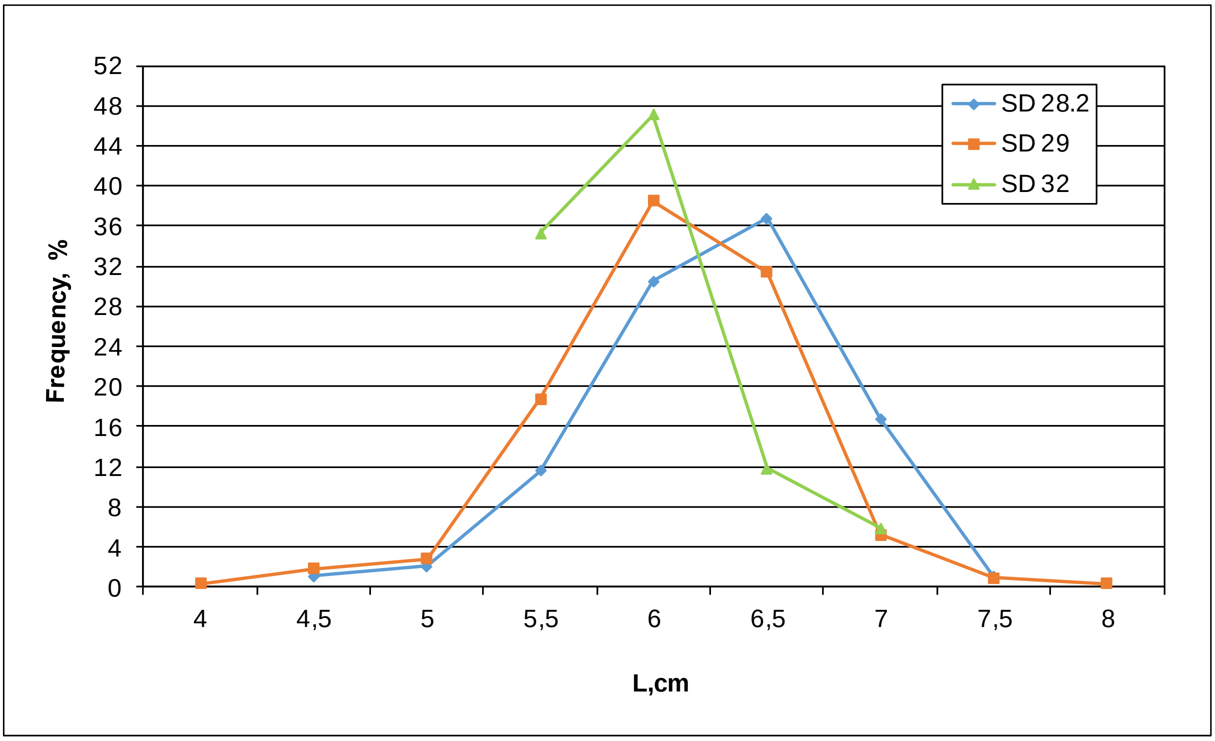

Fig. 5. Three spined stickleback length distributions from the control catches conducted by the r.v. "Baltica" during joint EST-POL BASS in the SDs 28.2, 29 and 32 (May 2018).

Table 3. The BASS survey basic biological and acoustic data concerning the clupeid stocks inhabiting the north- eastern Baltic Sea in May 2018.

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	15.9	80.0	2404.71	2.539	312.9	1.233
28	45H1	827.1	12.0	87.6	2876.44	3.478	352.9	1.015
29	46H0	933.8	28.6	68.1	1855.21	1.987	264.8	1.333
29	46H1	921.5	15.3	79.4	2055.89	2.231	267.5	1.199
29	47H1	920.3	24.3	73.9	3361.61	3.653	468.5	1.283
29	47H2	793.9	19.6	79.9	1785.54	2.249	296.1	1.316
32	47H3	536.2	16.5	83.0	862.41	1.608	209.4	1.302
Average			**18.9**	**78.8**		**2.535**	**310.3**	**1.240**
Total		**5880**			**15201**			

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 2018.

ICES	ICES rectangle	HERRING – age groups								
Sub-div.		1	2	3	4	5	6	7	8+	total
28	45H0	42	18	18	152	18	63	55	17	383
28	45H1	104	13	14	111	13	42	35	12	344
total		146	31	31	263	32	106	90	28	727
29	46H0	89	38	37	190	29	89	28	31	531
29	46H1	21	30	35	150	13	42	11	11	314
29	47H1	11	117	86	390	37	119	28	29	817
29	47H2	9	39	40	173	18	50	12	11	350
total		131	224	197	903	97	300	78	82	2012
32	47H3	9	12	20	56	22	15	5	3	143
total		9	12	20	56	22	15	5	3	143
Grand total		285	268	248	1221	151	421	173	113	2881

Table 4. Continued

ICES Sub-div.	ICES rectangle	SPRAT – age groups								
		1	2	3	4	5	6	7	8+	total
28	45H0	790	226	174	629	41	22	20	23	1924
28	45H1	1579	179	146	518	37	17	18	25	2519
total		2369	404	320	1146	78	38	39	47	4442
29	46H0	489	94	94	498	41	16	15	17	1263
29	46H1	563	82	115	645	76	50	46	54	1632
29	47H1	975	157	174	1016	73	29	28	32	2484
29	47H2	403	70	108	637	65	46	46	52	1426
total		2429	403	491	2796	255	140	135	156	6806
32	47H3	135	63	82	326	35	21	24	30	716
total		135	63	82	326	35	21	24	30	716
Grand total		4933	871	892	4269	368	200	198	232	11964

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 2018.

ICES	ICES rectangle	HERRING – age groups								
Sub-div.		1	2	3	4	5	6	7	8+	total
28	45H0	251	259	352	3195	473	1731	1680	640	8580
28	45H1	581	178	271	2330	344	1177	1092	453	6426
total		832	436	623	5525	817	2908	2772	1094	15006
29	46H0	492	460	514	4184	539	1835	1711	671	10406
29	46H1	129	358	410	3324	224	793	618	293	6149
29	47H1	89	1477	1011	8188	641	2165	1838	457	15866
29	47H2	61	447	474	3739	315	926	676	186	6824
total		771	2742	2409	19435	1719	5718	4843	1608	39245
32	47H3	43	221	181	1473	102	318	204	27	2568
total		43	221	181	1473	102	318	204	27	2568
Grand total		1646	3399	3212	26433	2638	8944	7819	2729	56819

Table 5. Continued

ICES	ICES	SPRAT – age groups								
Sub-div.	rectangle	1	2	3	4	5	6	7	8+	total
28	45H0	2504	1654	1389	4893	411	227	206	240	11523
28	45H1	5049	1364	1221	4192	380	175	187	279	12845
total		7553	3017	2610	9085	790	401	393	518	24368
29	46H0	1469	654	727	3921	370	176	157	183	7657
29	46H1	1682	615	955	5383	735	538	475	563	10945
29	47H1	2747	1111	1352	7897	649	317	288	340	14701
29	47H2	972	500	867	5087	606	485	460	536	9513
total		6870	2881	3900	22287	2360	1515	1379	1623	42816
32	47H3	350	487	626	2643	345	215	203	314	5183
total		350	487	626	2643	345	215	203	314	5183
Grand total		14773	6385	7136	34016	3495	2131	1976	2455	72367

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 2018.

ICES Sub-div.	ICES rectangle	HERRING – age groups								
		1	2	3	4	5	6	7	8+	avg.
28	45H0	6.05	14.24	20.07	21.03	25.59	27.26	30.54	38.55	22.42
28	45H1	5.57	13.60	20.07	21.02	25.82	27.76	31.23	38.78	18.67
29	46H0	5.52	12.06	13.95	22.01	18.56	20.72	61.38	21.58	19.60
29	46H1	6.00	12.00	11.74	22.16	16.88	18.70	58.30	25.64	19.58
29	47H1	8.08	12.59	11.81	21.02	17.17	18.19	65.50	15.79	19.42
29	47H2	6.83	11.41	11.91	21.63	18.01	18.49	58.45	17.72	19.48
32	47H3	5.00	17.70	8.98	26.35	4.55	21.31	40.61	8.64	18.02

Table 6, Continue

ICES Sub-div,	ICES rectangle	SPRAT – age groups								
		1	2	3	4	5	6	7	8+	avg.
28	45H0	3.17	7.32	8.00	7.79	9.99	10.42	10.06	10.59	5.99
28	45H1	3.20	7.63	8.36	8.10	10.21	10.53	10.12	11.31	5.10
29	46H0	3.01	6.95	7.73	7.88	9.06	11.17	10.28	10.64	6.06
29	46H1	2.99	7.46	8.27	8.34	9.64	10.80	10.23	10.45	6.71
29	47H1	2.82	7.09	7.78	7.77	8.90	10.87	10.25	10.54	5.92
29	47H2	2.41	7.13	8.05	7.99	9.33	10.64	10.09	10.29	6.67
32	47H3	2.60	7.69	7.65	8.10	9.96	9.99	8.62	10.63	7.24

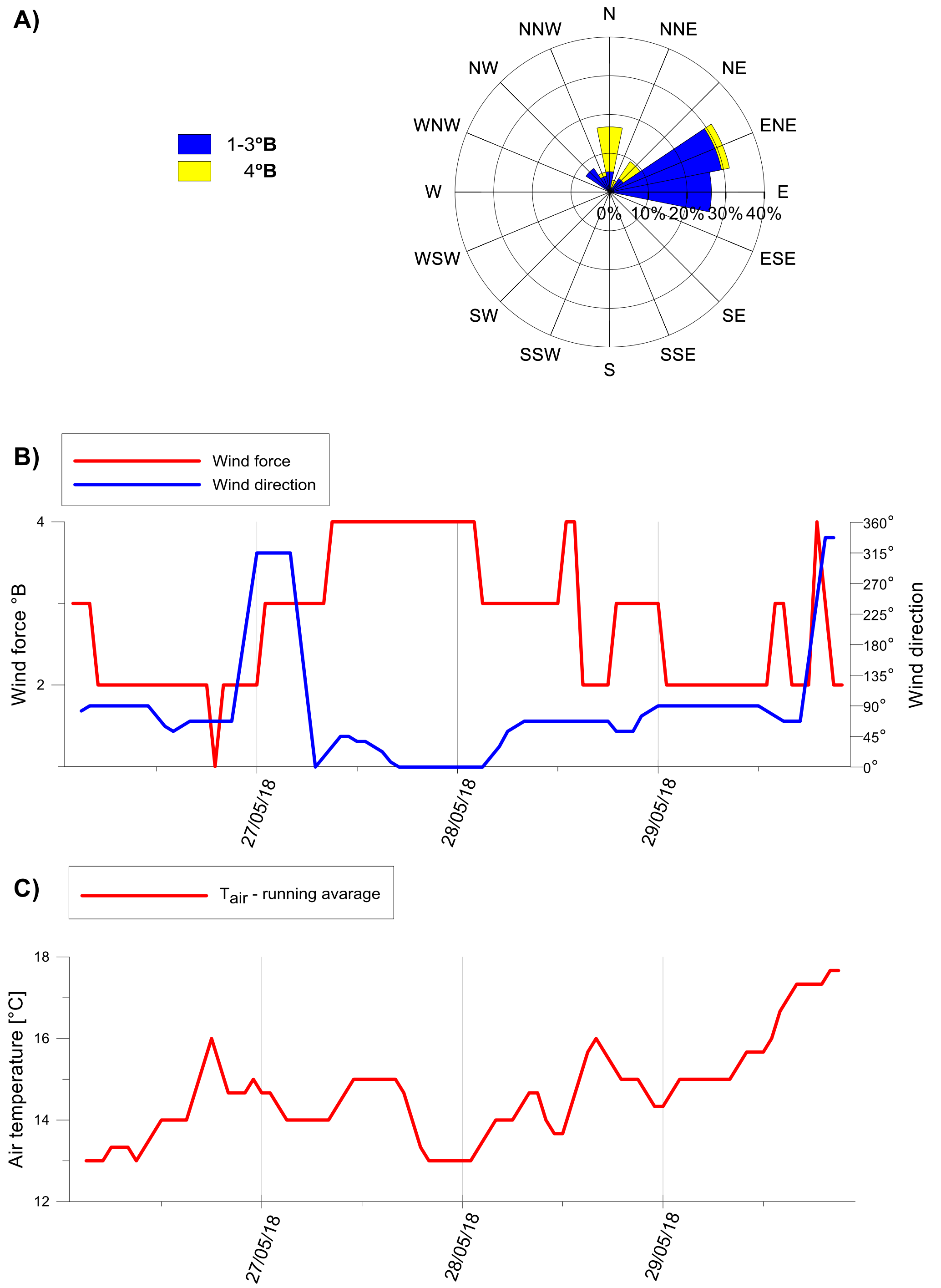

Fig. 6. Changes of the main meteorological parameters during the joint EST-POL BASS conducted in May 2018 (A and B – wind direction and velocity, C – air temperature).

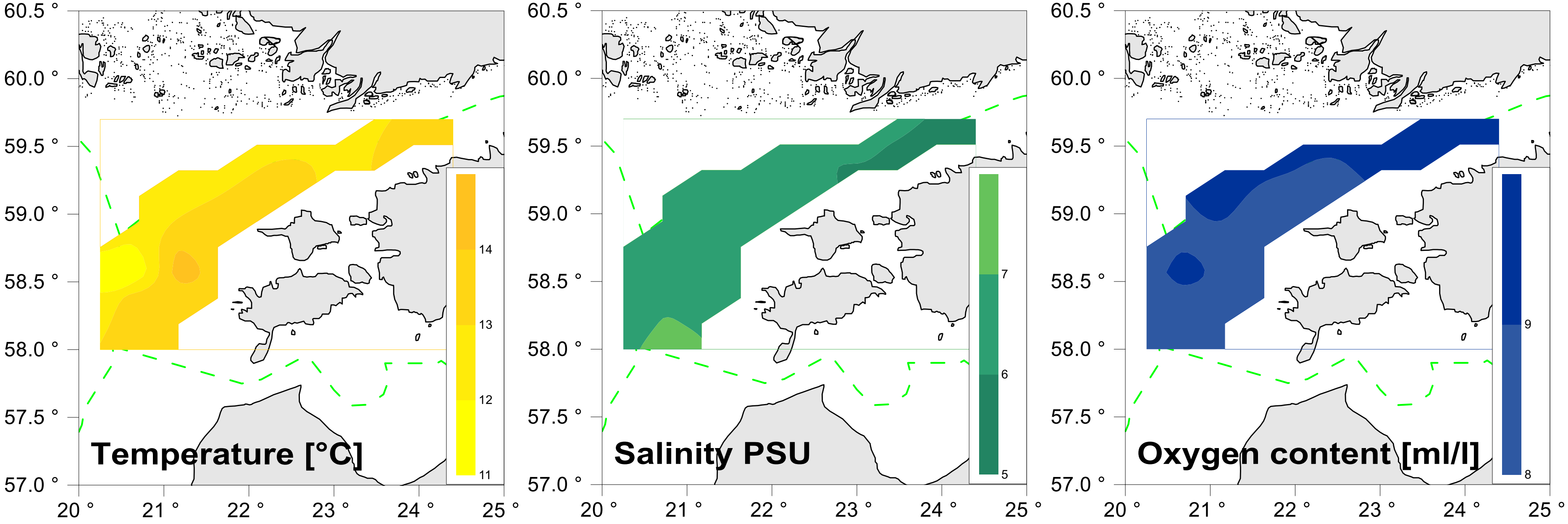

Fig. 7. Horizontal distribution of the seawater temperature, salinity and oxygen content in the surface waters during the joint EST-POL BASS (May 2018)

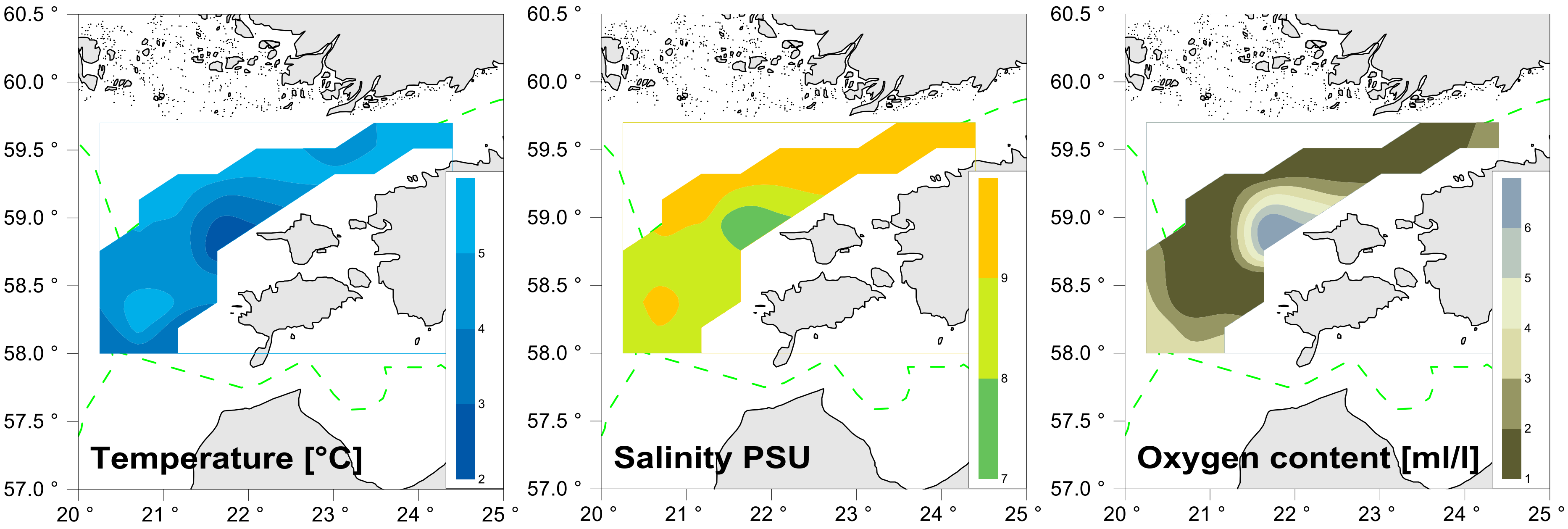

Fig. 8. Horizontal distribution of the seawater temperature, salinity and oxygen content on the control catch depth during the joint EST-POL BASS (May 2018)

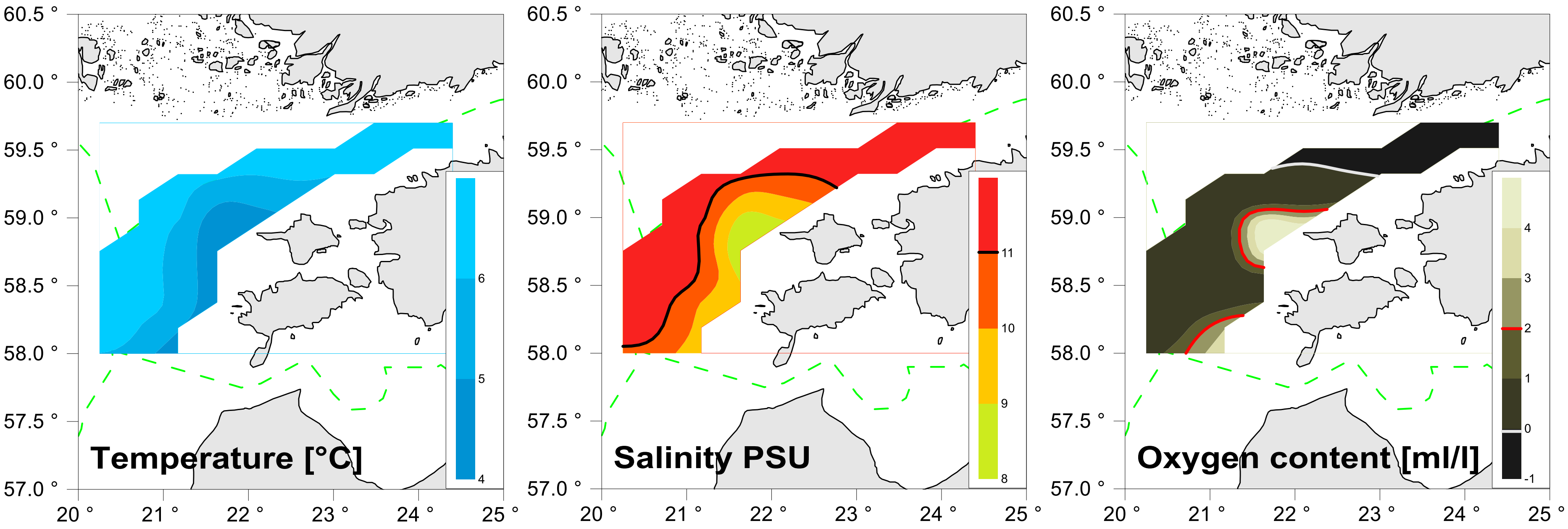

Fig. 9. Horizontal distribution of the seawater temperature, salinity and oxygen content in the near bottom waters during the joint EST-POL BASS (May 2018).

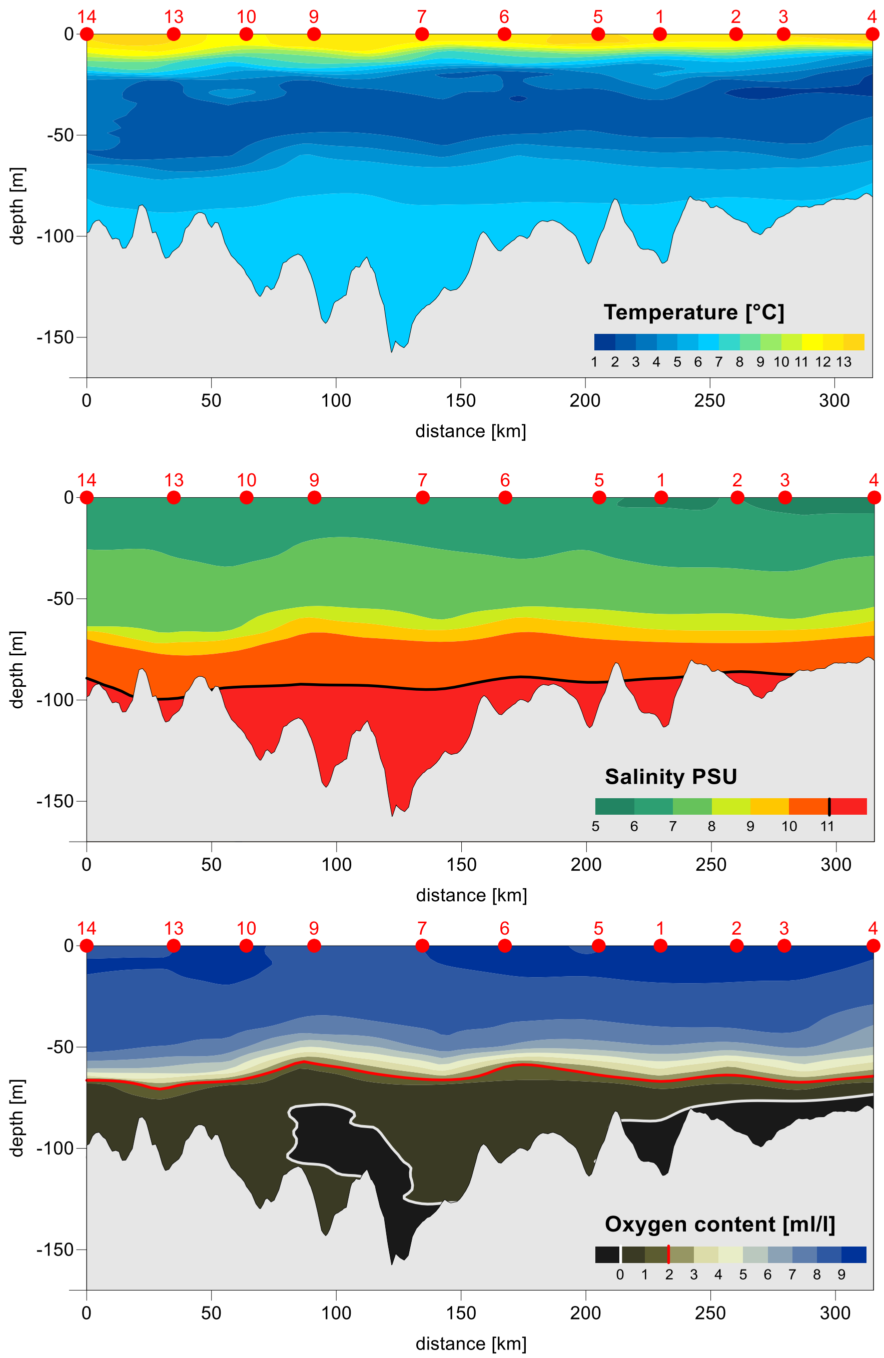

Fig. 10. Vertical distribution of the seawater temperature, salinity and oxygen content along the hydrological profile during the joint EST-POL BASS (May 2018).

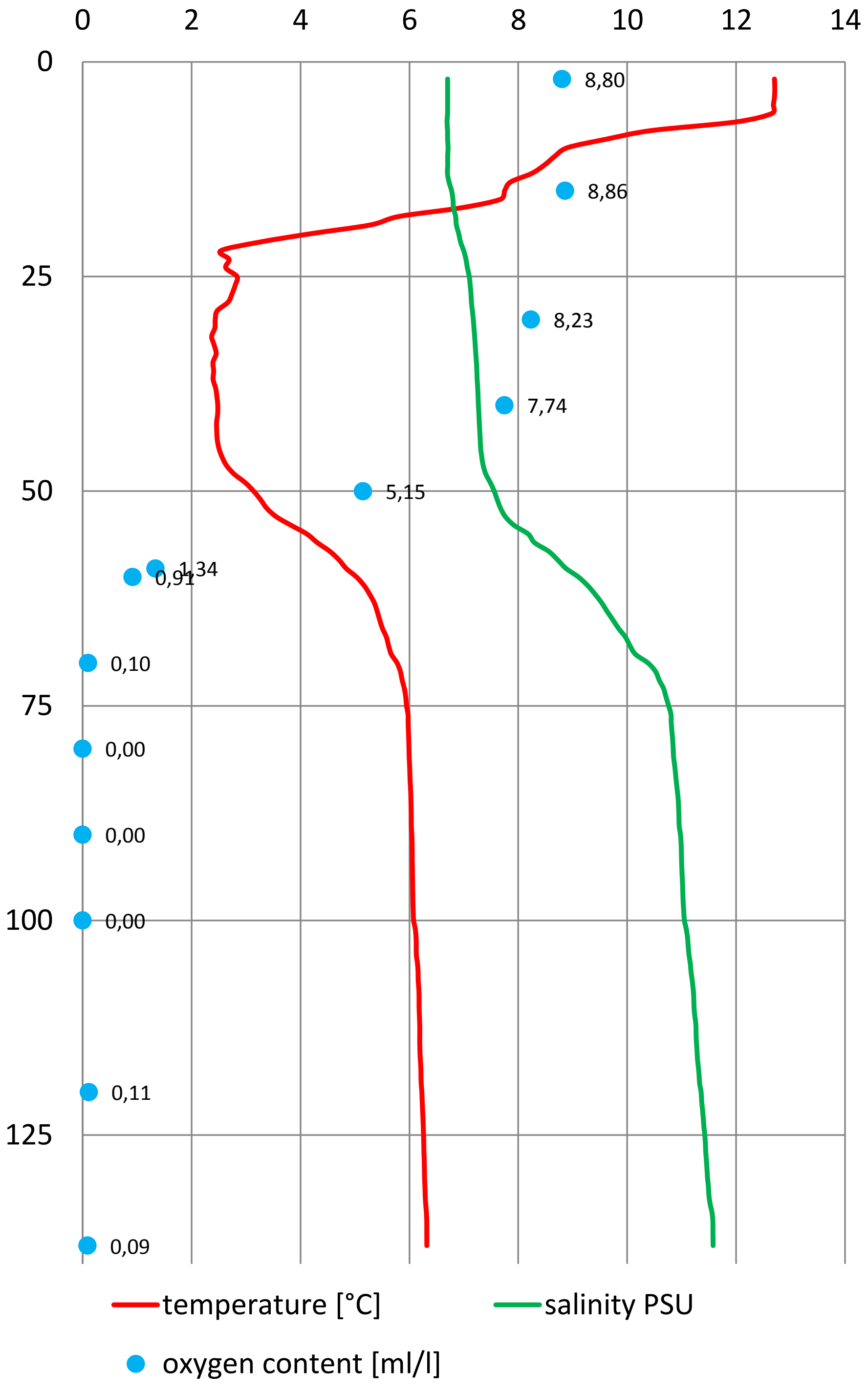

Fig. 11. Vertical hydrological profile at the haul 9 start location during EST-POL BASS (May 2018).

Table 7. Values of the basic meteorological and hydrological parameters recorded in May 2018 at the start positions of the r.v. “Baltica” fish control catches during joint EST-POL BASS.

Number of haul	Date of catch	Meteorological parameters					Hydrological parameters*		
		wind direction	wind force [°B]	sea state	air temper. [°C]	atmospheric pressure [hP]	temperature [°C]	salinity [PSU]	oxygen [ml/l]
1	26-05-2018	E	2	1	13	1029	5,46	9,81	1,24
2	26-05-2018	E	2	1	14	1029	4,95	9,13	1,21
3	26-05-2018	NE	2	1	14	1029	5,49	9,83	1,36
4	26-05-2018	changeable	2	1	16	1028	5,26	9,56	2,03
5	27-05-2018	N	3	2	14	1027	5,30	9,61	1,43
6	27-05-2018	NE	4	2	15	1029	5,40	9,68	1,05
7	27-05-2018	NE	4	2	15	1030	5,33	9,58	1,13
8	27-05-2018	N	4	2	14	1029	2,60	7,28	6,89
9	28-05-2018	ENE	3	2	15	1031	4,84	8,88	1,34
10	28-05-2018	ENE	3	2	14	1031	4,65	8,65	1,28
11	28-05-2018	changeable	2	1	16	1030	4,62	8,69	1,34
12	28-05-2018	NNE	3	1	13	1030	4,94	8,98	1,46
13	29-05-2018	changeable	2	1	15	1026	5,47	9,72	1,14
14	29-05-2018	changeable	2	1	16	1025	3,93	8,17	3,92
15	29-05-2018	ENE	3	1	17	1024	3,44	8,05	3,68
		Mean >	2,9	1,4	15,8	1101,9	5,12	9,69	2,18

* data at the mean depth of the fish control catch

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 2018 ON THE R/V "BALTICA" IN THE ICES SUBDIVISIONS 26N AND 28.2 OF THE BALTIC SEA (18-25 MAY 2018)

Working paper on the WGBIFS meeting in Klaipeda, Lithuania, 25-29.03.2019

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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 [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 7th 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 2018. The reported survey was organized on the basis of the public procurement contract No. BIOR 2018/3/AK/EJZF from 14 February 2018 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, Swedish and Estonian EEZs (ICES Sub-divisions 26N and 28.2). The “Latvian National Fisheries Data Collection Program, 2018” 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 2018].

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 – seven persons:

F. Svecovs, (BIOR, Riga – Latvia) – scientific staff leader, acoustic team;
M. Wyszynski (NMFRI, Gdynia – Poland) – cruise leader, fish sampling team;
T. Wodzinowski (NMFRI, Gdynia – Poland) – hydrologist, hydrology team;
B. Nurek (NMFRI, Gdynia – Poland) – acoustician, acoustic team;
G. Strods (BIOR, Riga – Latvia) – ichthyologist, acoustic and fish sampling team;
V. Cervoncevs (BIOR, Riga – Latvia) – ichthyologist, fish sampling team;
L. Briekmane (BIOR, Riga – Latvia) – ichthyologist, fish sampling team;
A. Makarcuks (BIOR, Riga – Latvia) – hydrobiologist, hydrobiology and fish sampling team.

1.2. SURVEY DESCRIPTION

The reported survey took place during the period of 18-25 May 2018 (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 26N and 28.2), moreover inside the Latvian territorial waters not shallower than 20 m.

The vessel left the Gdynia port (Poland) on 17.05.2018 at 08:00 o'clock p.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 18.05.2018 after midday. The survey ended on 25.05.2018 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 585 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 2018 was 1953.3 nm^2 in the northern part of the ICES Sub-division 26 and 7874.9 nm^2 in Sub-division 28.2, totally 9828.2 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 2014]. The r/v "Baltica" realized 19 fish control-catches (Tab. 1). All catches were performed in the daylight between 07:20 and 19:30 (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 two hauls was shortened to 20 minutes and three hauls to 15 minutes, according to higher power of the echo-integration. The mean speed of vessel while trawling was 3.1 knots. Overall, 3 hauls were conducted in SD 26N and 16 hauls in SD 28.2. Totally 14 hauls were performed in the Latvian EEZ and 5 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 3893 sprat, 2856 herring, 534 cod and 223 flounder individuals. In total, 1712 sprat and 1578 herring individuals were taken for biological analysis. 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.

Ichthyoplankton and zooplankton samples were collected at the positions of the hydrological stations or after trawling. Totally 23 ichthyoplankton and zooplankton stations were realized (Fig. 2) and 46 and 38 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 2018, totally at 23 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, 7 fish species were recognized in hauls performed in the Central-eastern Baltic Sea in May 2018. Sprat was dominating species by mass in the both ICES Sub-divisions 26N and 28.2 (83.4 and 76.9 % respectively). The share of the herring constitutes 15.2 and 21.4 % respectively. The rest 5 species represented 1.7 % (in this 1.3 % belonging to cod) of the total mass in average for all investigated area.

Mean CPUE in BASS 2018 for all species in the investigated area amounted 1253.7 kg/h (comparing to 1436.4 and 1404.7 kg/h in 2017 and 2016 respectively). The mean CPUEs of sprat were: 1353.4 kg/h in ICES SD 26N, and 910.5

kg/h in SD 28.2. The mean CPUEs of herring were as follow: in SD 26N – 246.5 kg/h and 253.5 kg/h in SD 28.2. The CPUE values by particular haul for herring and sprat and are presented at the Fig. 2. The highest CPUE values for sprat were noted from the Central-western part of SD 28.2 to the Northern part of SD 26. The good CPUEs for herring were distributed more 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 2018, 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 2018 are shown in Figures 5, 6 and 7 respectively.

The pelagic fish stock was represented mostly by sprat – 93.8 %, in comparison – 71.5% in 2013, 86.8 % in 2014, 88.2 % in 2015 and 92.9 % in 2016 and 94.1 % in 2017. Herring was represented as 6.2 %, 28.5 % in 2013, 13.2 % in 2014, 11.8 % in 2015, 7.1 % in 2016 and 5.9 % in 2017. The highest sprat stock density 108.8 $n\times10^6/nm^2$ according to acoustic estimates were recorded in ICES rectangle 41G9 of the ICES Sub-division 26. The highest average abundance 7.2 $n\times10^6/nm^2$ 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 2018 had different pattern as in May 2017 and more-less copy distribution in previous years [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 9.7 $n\times10^6/nm^2$ and noted in ICES rectangle 43H1 in central part of the investigated area in Sub-division 28.2 and was on the same level as in 2015 were highest density values was not over 10.2 $n\times10^6/nm^2$ in rectangle 44H0, in 2013 it was 8.8 $n\times10^6/nm^2$ in rectangle 44H0, in 2014 values over 10.0 $n\times10^6/nm^2$ were recorded in two rectangles 43H0 and 45H0, in 2016 the highest density 18.1 $n\times10^6/nm^2$ was recorded in rectangle 42G9 in central part of estimated aquatory and in May 2017 the highest density 26.1 $n\times10^6/nm^2$ was recorded in rectangle 44H0 in northern part of estimated aquatory.

Comparison of the acoustic results from May of 2005-2016 indicated that investigated sprat stock abundance and biomass had decreasing tendency, but herring stock had a slight increase. In 2017 both of sprat and herring stocks had decreased in numbers, but in biomass herring stock had significantly increased. In 2018 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].

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 = 10.8 cm), 1.9÷15.4 g (average W = 7.1 g);
- herring – 8.0÷24.0 cm (average TL = 16.3 cm), 3.4÷66.2 g (average W = 26.4 g);

The sprat length distribution curves have a bimodal character for both above mentioned Sub-divisions. First length frequency pick takes place at 8.5 and 8 cm length classes in SDs 26 and 28.2 respectively, with considerably higher frequency values in SD 28.2 comparing to data from 2017. It represents sprat generation born in 2017. The second higher one at length classes 12 cm (SD 26) and 11 cm (SD 28.2) represents adult sprat.

The herring length distribution curves have a similar multimodal character in both Sub-divisions 26N and 28.2. The highest picks of frequency belong to length classes 17 and 16 cm respectively. The fish representing 8-13 cm length range belonging to the herring generation born in 2017 characterized by very low frequency in both above mentioned SDs.

The cod and flounder abundance in the pelagic control catches was considerably higher, comparing to the data from the recent years. Cod from SD 26 characterized by fish length range 18-43 cm, with modal frequency value at 35 cm length class. But in SD 28.2 its length range was 15-53 cm, and modal frequency values at 22-24 cm length classes. Flounder appearance was more abundant in the catches in SD 28.2. Its length ranged from 18 to 34 cm, with modal frequency values at 23-26 cm length classes. Comparably higher appearance of bottom fish species, like cod and flounder in pelagic zone of SDs 26N and 28.2 during the BASS 2018 survey was impacted by low water oxygenation below 70 m depth coming to the oxygen value of 0 ml/l. The data related to cod aggregated in Table 8, length distributions of cod and flounder shown in Figures 10 and 11.

2.1.3. ICHTHYOPLANKTON ESTIMATES

Totally 46 ichthyoplankton samples collected at 23 station positions during BASS on RV "Baltica", including 23 samples collected in vertical hauls with IKS-80 net and 23 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 2018. 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 below the average values for the previous years. Most of the larvae were sampled in the vertical hauls. They also were more numerous over the bigger depths and in the southern part of the Gotland Basin. There amount gradually decreased towards the northern areas.

Sprat larvae in the water surface layer were not numerous in all the parts of the Gotland Basin with maximal abundance in the central part 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 2015-2017. All the larvae were collected on the water surface. They were more abundant in the central part of the Gotland Basin.

The hydrological conditions in the Gotland Basin in 2018 were very bad for the survival of eggs of cod and four-bearded rockling. As a result only one egg and no larvae of cod were found. No rockling eggs and larvae were registered for the first time in recent years.

Rather many herring larvae were sampled in the shallow waters close to the shoreline to the north from Liepaja.

Biodiversity in the ichthyoplankton was on the low level – one egg of cod and also some larvae of flounder, herring 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 38 samples taken in 23 stations are aggregated in Table 10.

In May 2018 in the Baltic Sea the estimated zooplankton biomass was lower in comparison to 2017. Total zooplankton biomass in 2017 was 243.72 mg/m^3, but in May 2018 194.20 mg/m3. The most part of the biomass (37.42 %) was made from small rotatories and copepods (42.99 %), the residual part was made from cladocers (3.80 %) and other planktonic organisms (15.79 %). 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 2017 and 2018 on average was significantly higher than in 2014 and the long-term average. Overall, the biomass of *Temora longicornis*, taking the top rank among copepods, has the same biomass as in May 2016. *Pseudocalanus* sp. and *Acartia* spp. biomass had decreased in comparison to 2016, but is higher than in 2014. In 2017 increased average biomass of rotatorians *Synchaeta* spp. and *Polychaeta* worms and still remains the same in May 2018. In 2017 and 2018 had increased the role of above mentioned copepods in all aquatory. In deep stations has dramatically decreased estimated quantity and biomass of *Centropages hamatus* – approximately by 3 times than was stated in 2016. 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 at lower level than in 2016 and almost close to the level of long-term average. Overall, the favorable feeding conditions in May 2018 as in 2017 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 2017 are shown at the Figure 12. The wind force varied from 2°B to 7°B and average was 3.6°B. The most often wind direction was from North direction. The air temperature ranged from 9.0 °C to 15.0 °C, and average temperature was 11.2 °C.

2.2.2. HYDROLOGY OF THE GOTLAND DEEP

The seawater temperature in the surface layers (Fig. 13) varied from 7.42 to 13.74°C (the mean was 10.34°C). The lowest surface temperatures were recorded at the station T06. The highest ones were noticed at the haul 15 station. The minimum value of salinity in Practical Salinity Unit (PSU) was 6.70 at the station 00 in the surface layer. The maximum was 7.39 PSU at the haul 3 station. The mean value of salinity was 7.18 PSU. The oxygen content in the surface layers of investigated the research area varied in the range of 8.27 ml/l (haul 6) - 9.73 ml/l (haul 10). The mean value of surface water oxygen content was 9.02 ml/l.

The temperature at the depth layer of hauls was changing (Fig. 14) in the range from 3.01 (haul 7) to 5.57 °C (haul 9), the mean was 4.50 °C. Salinity haul waters varied from 7.39 (haul 12) to 9.94 PSU (haul 9), and the mean was 8.78 PSU. Oxygen content varied from 0.50 ml/l (haul 9) to 8.67 ml/l (haul 7), the mean was 4.01 ml/l.

The temperature of near bottom (Fig.15.) layer was changing in the range of 2.89 (station 00) – 7.09 °C (station 46), the mean was 5.77 °C. Salinity in the bottom waters varied from 7.45 to 13.29 PSU, and the mean was 10.90 PSU. The low values of salinity were at the haul 6 station. The highest values of salinity were noticed at the station 37. Oxygen content varied from 0.00 ml/l to 8.12 ml/l (the mean was 1.74 ml/l). The zero values of this parameter were noticed at the station 37, haul stations 8 and 9.

The vertical distributions of the main hydrological parameters (sea water temperature, salinity and oxygen content) at the vertical hydrological profile at the deepest station (Haul 14 / station 37) in the Southern Gotland Deep measured during the LAT-POL BASS in May 2018 are presented at the Fig. 16, as well as at the hydrological profile of the Gotland Deep is shown at Fig. 17. Values of the basic meteorological and hydrological parameters recorded at the mean depth layer of fish control catches are presented at the table 3.

3. DISCUSSION

The data of the Latvian-Polish BASS in the 2nd quarter of 2018 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 since 2015 is increasing due to very abundant sprat generation of 2014. The mean length and weight of adult sprat had the same tendency to abundance. The geographical distribution of sprat densities in the May 2018 had different pattern as in 2017 and shows smaller aggregations with high densities. The overall estimated good feeding conditions should ensure increasing of individual fish body condition and young fish surviving of pelagic fish species in future.

REFERENCES

Foote, K., Aglen, G. and Nakken, O. 1986. Measurement of fish target strength with split-beam echosounder. J. Acoust. Soc. Am. 80; 612-621.

Grygiel, W. 2006. Polish-Latvian co-operation in biological and acoustic investigations of fish andenvironment of the Baltic Sea (May, October 2005). *Wiadomości Rybackie,* No. 1-2 (149), edited by the Sea Fisheries Institute, Gdynia; 14-17.

Grygiel, W., Svecovs, F., Grelowski, A., Strods, G. and Cervoncevs, V. 2006. Research report from the Latvian-Polish acoustic survey in the central-eastern Baltic (October 2005). Working paper on the WGBIFS meeting, Copenhagen, 03-07.04.2006; 22 pp., [in:] ICES CM 2006/LRC:07, Ref. ACFM, BCC, RMC.

Grygiel, W., Svecovs, F., Grelowski, A., Strods, G. 2007. Research report from the the Latvian – Polish BIAS type survey in the central-eastern Baltic (October 2006). Working paper on the WGBIFS meeting in Rostock, 26-30.03.2007; 21 pp., [in:] ICES CM 2007/LRC:06, Ref. ACFM.

Grygiel, W., Svecovs, F., Grelowski, A. and Strods, G. 2008. Research report from the Latvian-Polish BIAS survey in the central-eastern Baltic (October 2007). Working paper on the WGBIFS meeting in Gdynia, 31.03.-04.04.2008; 25 pp., [in:] ICES CM 2008/LRC:08, Ref. ACOM.

Grygiel, W., Svecovs, F., Grelowski, A. and Strods, G., 2009. Research report from the Latvian-Polish Baltic International Acoustic Survey in the central-eastern Baltic (07-17 October 2008). Working paper on the WGBIFS meeting in Lysekil (Sweden); 30.03.-03.04.2009; 28 pp; [in:] ICES CM 2009/LRC:05, Ref.: TGISUR, ACOM.

Grygiel, W., Svecovs, F., Grelowski, A. and Strods, G. 2010. Research report from the Latvian-Polish Baltic International Acoustic Survey in the central-eastern Baltic (25.09.-04.10.2009). Working paper on the WGBIFS meeting in Klaipeda (Lithuania), 22-26.03.2010; 27 pp., [in:] ICES CM 2010/SSGESST:07, REF. SCICOM, WGISUR, ACOM.

Orłowski, A., W. Grygiel, R. Grzebielec and M. Wyszyński 1997. Polish acoustic survey on pelagic fish distribution in ICES Sub-divisions 24, 25 and 26 in the Baltic Sea, carried out in October 1996. ICES C.M. 1997/EE:07, Environmental Factors; 19 pp.

Hoziosky, S., A., Shvetsov, F., G. and Uzars, D., V. 1987. Mortality components' estimates for sprat in the Eastern Baltic. Fisch.-Forsch., Rostock, 25.

Hoziosky, S., A., Shvetsov, F., G. and Gradalev, E., B. 1988. Contribution to seasonal distribution, migration and mortality component's dynamics in sprat of the Eastern and South-Eastern Baltic. ICES BAL/No:37, 9 pp.

ICES 1983. Report of the Planning Group on ICES coordinated herring and sprat acoustic surveys. ICES C.M. 1983/H:12.

ICES 2003. Report of the Baltic International Fish Survey Working Group. ICES CM. 2003/G:05, Ref. D, H: (Appendix 9, Annex 3).

ICES 2014. SISP Manual of International Baltic Acoustic Surveys (IBAS). Addendum 2: Series of Ices Survey Protocols, Version 1.02.

ICES 2018. First Interim Report of the Baltic International Fish Survey Working Group (WGBIFS). ICESCM 2018/EOSG: 6.

Shvetsov, F., G. 1983. Methods for determination of the stock, fishing and natural mortalities in the Eastern Baltic sprat. Fisch.-Forsch., Rostock, 21.

Shvetsov, F., G., Gradalev, E., B. and Kalejs, M., V. 1988. Dynamics of sprat seasonal and inter-annual distribution in the Eastern Baltic in relation to oceanological factors. Fisch.-Forsch., Rostock, 26.

Shvetsov, F., G. and Gradalev, E., B. 1989. On the feeding migrations of sprat in ICES Subdivisions 26 and 28 of the Baltic Sea. Fisch.-Forsch., Rostock, 27.

Shvetsov, F., Grygiel, W., Fetter, M., Chervontsev, V., and Rudneva, A. 1992. Distribution and size of herring and sprat stocks in the Baltic Proper, determined by the acoustic method (October, 1991). ICES C.M. 1992/J:8.

Svecovs, F., Grygiel, W., Grelowski A., Slembarski, J., Strods, G., Putnis, I., Cervoncevs, V., Kazmers, I. 2012. Cruise report of the joint Latvian-Polish Baltic international acoustic survey – BIAS 2012 on the r/v "Baltica" in the ices subdivisions 26N and 28 of the Baltic sea (10-19.10.2012), BIOR-Riga/SFI-Gdynia document (February 2013), 48 pp. (mimeo).

Shvetsov, F., Feldman, V., Severin, V., Zezera, A., Strods, G. 2002. Application of Hydroacoustic Survey Results in Studies of Eastern Baltic Sprat Distribution and Migration Pattern. Proceedings of the 6th European Conference on Underwater Acoustics. Gdansk p. 457-461.

Svecovs, F., Strods, G., Berzins, V., Makarcuks, A., Cervoncevs, V., Spegys, M. 2010. Cruise report of the joint Latvian-Lithuanian Baltic acoustic spring survey – BASS 2010 on the r/v "Darius" in the ices subdivisions 26N and 28 of the Baltic sea (12-19.05.2010), BIOR-Riga/FRL-Klaipeda document (September 2010), 30 pp. (mimeo).

Svecovs, F., Strods, G., Berzins, V., Makarcuks, A., Putnis, I., Spegys, M. 2011. Cruise report of the joint Latvian-Lithuanian Baltic acoustic spring survey – BASS 2011 on the r/v "Darius" in the ices subdivisions 26N and 28 of the Baltic sea (10-22.05.2011), BIOR-Riga/FRL-Klaipeda document (February 2012), 33 pp. (mimeo).

Svecovs, F., Strods, G., Berzins, V., Makarcuks, A., Putnis, I., Kruze, E. 2012. Cruise report of the joint Latvian-Lithuanian Baltic acoustic spring survey – BASS 2012 on the r/v "Darius" in the ices subdivisions 26N and 28 of the Baltic sea (31.05-08.06.2012), BIOR-Riga/FRL-Klaipeda document (February 2013), 24 pp. (mimeo).

Svecovs, F., Strods, G., Berzins, V., Makarcuks, A., Putnis, I., Cervoncevs, V., Rubene, G. 2013. Cruise report of the Latvian Baltic acoustic spring survey – BASS 2013 on the r/v "Ulrika" in the ices subdivisions 26N and 28 of the Baltic sea (21-29.05.2013), BIOR-Riga document (March 2013), 32 pp. (mimeo).

Svecovs, F., Strods, G., Makarcuks, A., Sepp, E., Arula, T., Berzins, V., Putnis, I., Rubene, G. 2014. Cruise report of the joint Latvian-Estonian Baltic acoustic spring survey – BASS 2014 on the r/v "Ulrika" in the ices subdivisions 26N, 28, 29 and 32W of the Baltic sea (14-26.05.2014), BIOR-Riga/EMI-Tallinn document (March 2015), 37 pp. (mimeo).

Svecovs, F., Strods, G., Makarcuks, A., Sepp, E., Arula, T., Putnis, I. 2015. Cruise report of the joint Latvian-Estonian Baltic acoustic spring survey – BASS 2015 on the r/v "Ulrika" in the ices subdivisions 26N, 28, 29 and 32W of the Baltic sea (12-24.05.2015), BIOR-Riga/EMI-Tallinn document (March 2016), 28 pp. (mimeo).

Svecovs, F., Wyszynski, M., Slembarski, J., Witalis, B., Strods, G., Cervoncevs, V., Putnis, I. 2011. Cruise report of the joint Latvian-Polish Baltic international acoustic survey – BIAS 2011 on the r/v "Baltica" in the ices subdivisions 26N and 28 of the Baltic sea (11-21.10.2011), BIOR-Riga/SFI-Gdynia document (February 2012), 33 pp. (mimeo).

Svecovs, F., Wyszynski, M., Slembarski, J., Wodzinowski, T., Strods, G., Cervoncevs, V., Putnis, I., Kruze E., Bajinskis J. 2013. Cruise report of the joint Latvian-Polish Baltic international acoustic survey – BIAS 2013 on the r/v "Baltica" in the ices subdivisions 26N and 28 of the Baltic sea (09-18.10.2013), BIOR-Riga/SFI-Gdynia document (March 2014), 50 pp. (mimeo).

Svecovs, F., Wyszynski, M., Witalis, Slembarski, J., B., Strods, G., Makarcuks, A., Vingovatova, A., Rubene, G., Cervoncevs, V., Putnis, I. 2016. Cruise report of the joint Latvian-Polish Baltic acoustic spring survey – BASS 2016 on the r/v "Baltica" in the ICES subdivisions 26N and 28.2 of the Baltic sea (12-21.10.2016), BIOR-Riga/SFI-Gdynia document (March 2016), 33 pp. (mimeo).

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 18-25.05.2018

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	2018-05-19	41G9	26	58	36	16	3.3	150	56°04.2'	19°47.4'	56°02.8'	19°48.7'	07:50	30	334.879
2	2018-05-19	41H0	26	59	40	18	3.4	190	56°21.8'	20°10.5'	56°20.3'	20°09.7'	16:10	30	531.270
3	2018-05-19	41G9	26	87	55	18	3.0	220	56°22.0'	19°49.4'	56°21.3'	19°48.5'	19:05	15	783.505
4	2018-05-20	42G9	28.2	127	60	18	3.0	50	56°34.0'	19°14.1'	56°34.6'	19°15.5'	09:50	20	719.680
5	2018-05-20	42H0	28.2	127	60	18	3.0	100	56°38.4'	20°10.9'	56°38.2'	20°13.8'	15:45	30	575.887
6	2018-05-20	42H0	28.2	72	45	18	2.9	90	56°36.8'	20°28.0'	56°36.8'	20°30.6'	18:05	30	155.420
7	2018-05-21	42H0	28.2	62	38	18	3.0	270	56°53.0'	20°24.5'	56°53.0'	20°21.6'	10:25	30	201.910
8	2018-05-21	42H0	28.2	158	60	18	3.1	270	56°53.1'	20°04.7'	56°53.2'	20°03.4'	13:00	15	124.323
9	2018-05-21	42G9	28.2	162	55	18	3.1	280	56°53.1'	19°25.5'	56°53.3'	19°23.0'	16:50	30	785.184
10	2018-05-22	43G9	28.2	177	60	18	3.1	90	57°06.9'	19°40.0'	57°06.8'	19°41.9'	08:25	20	89.315
11	2018-05-22	43H0	28.2	100	60	18	3.0	90	57°07.2'	20°27.5'	57°07.2'	20°29.1'	12:50	15	446.753
12	2018-05-22	43H1	28.2	60	15	18	3.0	305	57°20.2'	21°13.4'	57°21.0'	21°11.4'	18:10	30	24.703
13	2018-05-23	43H0	28.2	127	60	18	3.1	280	57°23.2'	20°33.9'	57°23.4'	20°30.9'	09:15	30	448.073
14	2018-05-23	43H0	28.2	239	60	18	3.1	285	57°18.2'	20°04.7'	57°18.7'	20°01.9'	12:40	30	561.220
15	2018-05-23	43G9	28.2	105	60	17	2.8	20	57°28.8'	19°29.6'	57°29.8'	19°30.3'	17:20	20	1719.607
16	2018-05-24	44G9	28.2	115	60	18	3.1	180	57°37.2'	19°41.5'	57°36.4'	19°41.4'	07:40	15	110.549
17	2018-05-24	44H0	28.2	153	60	18	3.0	185	57°36.3'	20°26.4'	57°34.7'	20°26.0'	12:10	30	846.980
18	2018-05-24	44H0	28.2	103	60	16	2.9	180	57°51.0'	20°44.1'	57°49.8'	20°43.7'	16:25	20	102.344
19	2018-05-24	44H1	28.2	79	55	18	3.1	175	57°52.0'	21°04.3'	57°51.0'	21°04.5'	19:10	20	378.390
												SD26			1649.654
												SD28.2			7290.338
												SD26+28.2			8939.992

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 18-25.05.2018

SD 26		Sprat	Herring	Cod	Flounder	Fourbeard rockling	Three spined stickleback	Smelt	Total
Samples taken	Measurements	3	3	1	2				9
	analyses	3	1						4
Fish measured		615	194	56	7				872
Fish analysed		280	117						397
SD 28.2		**Sprat**	**Herring**	**Cod**	**Flounder**	**Fourbeard rockling**	**Three spined stickleback**	**Smelt**	**Total**
Samples taken	Measurements	16	16	10	11	10	4	1	68
	analyses	16	14						30
Fish measured		3278	2662	478	216	17	4	1	6656
Fish analysed		1432	1461						2893
SUM		**Sprat**	**Herring**	**Cod**	**Flounder**	**Fourbeard rockling**	**Three spined stickleback**	**Smelt**	**Total**
Samples taken	Measurements	19	19	11	13	10	4	1	77
	analyses	19	15						34
Fish measured		3893	2856	534	223	17	4	1	7528
Fish analysed		1712	1578						3290

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 18-25.05.2018

Haul number	Date of catch	Meteorological parameters					Trawling depth		Hydrological parameters		
		wind direction	wind force [°B]	sea state [Degrees]	air temper. [°C]	atmospheric pressure [hP]	Headrope [m]	Footrope [m]	temperature [°C]	salinity [PSU]	oxygen [ml/l]
1	2018-05-19	N	5	3-4	9	1016	36	52	3.62	7.47	7.89
2	2018-05-19	N	4-5	3	10	1022	40	58	3.42	7.48	8.40
3	2018-05-19	N	4	3	10	1023	55	73	4.23	8.68	6.46
4	2018-05-20	N	3	1-2	10	1028	60	78	4.83	9.10	1.91
5	2018-05-20	N	3	1-2	13	1029	60	78	4.08	8.43	5.21
6	2018-05-20	W	3	2	11	1028	45	63	3.42	7.50	8.11
7	2018-05-21	changeable	2	1	12	1029	38	56	3.01	7.43	8.67
8	2018-05-21	changeable	2	1	15	1028	60	78	5.17	9.43	1.84
9	2018-05-21	changeable	2	1	15	1026	55	73	5.57	9.94	0.50
10	2018-05-22	E	3	2	12	1021	60	78	4.69	8.77	3.24
11	2018-05-22	E	2	1-2	13	1020	60	78	5.11	9.35	1.60
12	2018-05-22	NE	2	1	12	1020	15	33	3.51	7.39	8.23
13	2018-05-23	changeable	2	1	12	1020	60	78	4.28	8.91	2.87
14	2018-05-23	changeable	2	1	13	1023	60	78	5.17	9.42	1.48
15	2018-05-23	W	3	1-2	14	1024	60	77	5.35	9.79	1.25
16	2018-05-24	N	3-4	2	12	1028	60	78	4.73	9.22	2.21
17	2018-05-24	NE	4	2	11	1029	60	78	5.51	9.79	1.85
18	2018-05-24	N	4-5	3	13	1029	60	76	5.02	9.39	2.08
19	2018-05-24	N	4-5	3	12	1029	55	73	4.76	9.25	2.49
						Mean	53	70	4.50	8.78	4.02

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 18-25.05.2018

Haul number	Date	ICES rectangle	ICES SD	Total Cactch [kg]	Catch per species [kg]						
					sprat	herring	cod	flounder	threespine stickleback	Fourbeard rockling	smelt
					161789	161722	164712	172894	166365	126450	126736
1	2018-05-19	41G9	26	334.879	332.000	2.740		0.139			
2	2018-05-19	41H0	26	531.270	520.064	11.206					
3	2018-05-19	41G9	26	783.505	589.056	177.944	15.643	0.862			
4	2018-05-20	42G9	28.2	719.680	652.384	60.702	5.146	1.223	0.214	0.011	
5	2018-05-20	42H0	28.2	575.887	466.650	89.095	13.161	6.926	0.055		
6	2018-05-20	42H0	28.2	155.420	142.729	12.411		0.280			
7	2018-05-21	42H0	28.2	201.910	201.668	0.222			0.020		
8	2018-05-21	42H0	28.2	124.323	103.040	4.890	14.236	2.103	0.010	0.044	
9	2018-05-21	42G9	28.2	785.184	634.627	140.253	8.800	1.504			
10	2018-05-22	43G9	28.2	89.315	69.479	12.868	5.133	1.802	0.033		
11	2018-05-22	43H0	28.2	446.753	344.800	87.280	10.141	4.450		0.082	
12	2018-05-22	43H1	28.2	24.703	11.780	12.920			0.003		
13	2018-05-23	43H0	28.2	448.073	220.707	215.043	7.778	4.484		0.061	
14	2018-05-23	43H0	28.2	561.220	473.461	74.019	10.179	3.561			
15	2018-05-23	43G9	28.2	1719.607	1300.986	411.342	6.479	0.628	0.172		
16	2018-05-24	44G9	28.2	110.549	51.501	51.998	6.692	0.337	0.021		
17	2018-05-24	44H0	28.2	846.980	647.940	198.956			0.084		
18	2018-05-24	44H0	28.2	102.344	58.327	43.973			0.010		0.034
19	2018-05-24	44H1	28.2	378.390	242.548	135.842					
SD26				1649.654	1441.120	191.890	15.643	1.001			
SD28.2				7290.338	5622.627	1551.814	87.745	27.298	0.622	0.198	0.034
SD26+28.2				8939.992	7063.747	1743.704	103.388	28.299	0.622	0.198	0.034

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 18-25.05.2018

Table 5A

ICES	ICES	Trawl	Herring			Sprat			$NASC_{PEL}$	$\sigma \times 10^4$	TS calc.
SD	Rect.	No	L, cm	w, g	n, %	L, cm	w, g	n, %	m^2/nm^2	m^2	dB
26	41G9	1,3,4	18.24	36.30	3.60	11.13	7.56	96.36	945.50	-49.95	1.27
	41H0	1,2	13.18	14.18	1.05	11.86	9.13	98.95	357.16	-49.68	1.35
28	42G9	4,5,8,9	17.66	35.90	3.18	11.10	7.47	96.75	471.28	-50.02	1.25
	42H0	5,6,7,8	16.30	27.58	2.46	10.51	6.52	97.44	341.77	-50.51	1.12
	43G9	10,14,15	16.66	27.54	6.72	10.76	7.06	93.25	628.12	-50.10	1.23
	43H0	11,12,13,14	16.67	27.35	8.77	11.23	7.80	91.15	552.65	-49.70	1.35
	43H1	12	11.22	10.18	31.83	9.12	4.34	68.17	162.56	-51.15	0.96
	44G9	15,16	16.61	27.06	8.14	10.64	6.87	91.84	489.77	-50.10	1.23
	44H0	17,18,19	16.53	25.54	9.42	10.33	6.30	90.53	288.45	-50.23	1.19
	44H1	12,19	15.89	24.03	10.90	9.59	5.09	89.08	232.00	-50.66	1.08

Table 5B

ICES	ICES	Area	ρ	Abundance, $n \times 10^6$			n, %		Biomass, $kg \times 10^3$		
SD	Rect.	nm^2	$n \times 10^6/nm^2$	ΣN	$N_{HERRING}$	N_{SPRAT}	herring	sprat	ΣW	$W_{HERRING}$	W_{SPRAT}
26	41G9	1000.0	7.44	7486.37	269.73	7216.64	3.60	96.36	64384.54	9791.40	54593.14
	41H0	953.3	2.64	2516.70	26.41	2490.29	1.05	98.95	23118.32	374.36	22743.97
28	42G9	986.9	3.77	3764.72	119.67	3645.05	3.18	96.75	31534.69	4296.70	27238.00
	42H0	968.5	3.06	3017.01	74.44	2942.57	2.46	97.44	21227.54	2053.39	19174.15
	43G9	973.7	5.11	4998.66	336.05	4662.60	6.72	93.25	42191.82	9256.06	32935.76
	43H0	973.7	4.10	4040.30	354.70	3685.60	8.77	91.15	38444.71	9702.39	28742.32
	43H1	412.7	1.69	695.66	221.45	474.20	31.83	68.17	4312.69	2253.95	2058.74
	44G9	876.6	3.99	3510.60	285.66	3224.94	8.14	91.84	29896.24	7730.35	22165.88
	44H0	960.5	2.42	2344.35	220.86	2123.49	9.42	90.53	19012.31	5641.04	13371.27
	44H1	824.6	2.15	1777.89	193.82	1584.07	10.90	89.08	12727.23	4657.77	8069.46

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 18-25.05.2018

Table 6A CANUM					Age group					Σ
ICES SD	ICES Rect.	1	2	3	4	5	6	7	8+	
26	41G9	107112	105631	86145	296897	12943	8963	3613	12674	633978
	41H0	17349	14948	31174	99255	7573	7417	2263	4652	184631
28	42G9	97923	86870	75207	279633	19706	13614	7004	11950	591908
	42H0	114534	26700	30718	111677	9584	6639	2992	1337	304181
	43G9	176665	113403	65575	270927	9208	11697	6938	13325	667738
	43H0	39362	42592	57714	152914	16786	6423	5286	5141	326218
	43H1	3122	54	108	325	72	18			3699
	44G9	169516	95336	44697	207695	4434	9193	6638	11524	549032
	44H0	117954	49704	23771	107723	5313	3903	1525	6176	316071
	44H1	81507	7541	13697	23212	724	2038	1385	1259	131363

Table 6B n × 10^6					Age group					Σ
ICES SD	ICES Rect.	1	2	3	4	5	6	7	8+	
26	41G9	1219.27	1202.41	980.60	3379.61	147.33	102.03	41.13	144.26	7216.64
	41H0	234.00	201.61	420.47	1338.75	102.14	100.04	30.52	62.75	2490.29
28	42G9	603.02	534.96	463.14	1722.01	121.35	83.84	43.13	73.59	3645.05
	42H0	1107.97	258.29	297.16	1080.33	92.71	64.22	28.94	12.94	2942.57
	43G9	1233.60	791.86	457.89	1891.80	64.29	81.67	48.45	93.04	4662.60
	43H0	444.71	481.20	652.05	1727.62	189.65	72.57	59.72	58.09	3685.60
	43H1	400.18	6.94	13.88	41.64	9.25	2.31	0.00	0.00	474.20
	44G9	995.71	559.99	262.54	1219.97	26.04	54.00	38.99	67.69	3224.94
	44H0	792.46	333.93	159.71	723.73	35.70	26.23	10.25	41.49	2123.49
	44H1	982.88	90.93	165.16	279.91	8.73	24.58	16.70	15.18	1584.07

Table 6C n, %					Age group					Σ
ICES SD	ICES Rect.	1	2	3	4	5	6	7	8+	
26	41G9	16.90	16.66	13.59	46.83	2.04	1.41	0.57	2.00	100.00
	41H0	9.40	8.10	16.88	53.76	4.10	4.02	1.23	2.52	100.00
28	42G9	16.54	14.68	12.71	47.24	3.33	2.30	1.18	2.02	100.00
	42H0	37.65	8.78	10.10	36.71	3.15	2.18	0.98	0.44	100.00
	43G9	26.46	16.98	9.82	40.57	1.38	1.75	1.04	2.00	100.00
	43H0	12.07	13.06	17.69	46.87	5.15	1.97	1.62	1.58	100.00
	43H1	84.39	1.46	2.93	8.78	1.95	0.49			100.00
	44G9	30.88	17.36	8.14	37.83	0.81	1.67	1.21	2.10	100.00
	44H0	37.32	15.73	7.52	34.08	1.68	1.23	0.48	1.95	100.00
	44H1	62.05	5.74	10.43	17.67	0.55	1.55	1.05	0.96	100.00

Table 6D W, kg × 10^3					Age group					Σ
ICES SD	ICES Rect.	1	2	3	4	5	6	7	8+	
26	41G9	3850.09	9041.83	8603.66	28606.99	1477.98	1070.36	410.01	1532.22	54593.14
	41H0	871.02	1727.83	3965.07	12817.81	1071.41	1193.37	337.92	759.55	22743.97
28	42G9	1905.04	4049.13	3877.13	14125.50	1156.63	890.39	446.02	788.14	27238.00
	42H0	3767.73	1911.26	2440.33	9046.86	906.86	661.19	292.28	147.64	19174.15
	43G9	4267.06	5939.10	3784.40	15963.73	650.95	850.12	507.89	972.52	32935.76
	43H0	1413.20	3470.22	5324.84	14702.15	1868.50	714.77	642.63	606.00	28742.32
	43H1	1366.63	62.18	130.44	383.17	91.23	25.07	0.00	0.00	2058.74
	44G9	3451.06	4228.71	2220.79	10327.04	258.18	561.25	404.88	713.96	22165.88
	44H0	2388.03	2506.36	1320.77	5984.39	361.55	268.36	111.81	430.00	13371.27
	44H1	2775.48	748.67	1407.02	2434.83	100.79	246.18	181.80	174.69	8069.46

Table 6E W, %		Age group								
ICES SD	ICES Rect.	1	2	3	4	5	6	7	8+	∑
26	41G9	7.05	16.56	15.76	52.40	2.71	1.96	0.75	2.81	100.00
	41H0	3.83	7.60	17.43	56.36	4.71	5.25	1.49	3.34	100.00
28	42G9	6.99	14.87	14.23	51.86	4.25	3.27	1.64	2.89	100.00
	42H0	19.65	9.97	12.73	47.18	4.73	3.45	1.52	0.77	100.00
	43G9	12.96	18.03	11.49	48.47	1.98	2.58	1.54	2.95	100.00
	43H0	4.92	12.07	18.53	51.15	6.50	2.49	2.24	2.11	100.00
	43H1	66.38	3.02	6.34	18.61	4.43	1.22			100.00
	44G9	15.57	19.08	10.02	46.59	1.16	2.53	1.83	3.22	100.00
	44H0	17.86	18.74	9.88	44.76	2.70	2.01	0.84	3.22	100.00
	44H1	34.39	9.28	17.44	30.17	1.25	3.05	2.25	2.16	100.00

Table 6F w, g		Age group								
ICES SD	ICES Rect.	1	2	3	4	5	6	7	8+	∑
26	41G9	3.16	7.52	8.77	8.46	10.03	10.49	9.97	10.62	7.56
	41H0	3.72	8.57	9.43	9.57	10.49	11.93	11.07	12.10	9.13
28	42G9	3.16	7.57	8.37	8.20	9.53	10.62	10.34	10.71	7.47
	42H0	3.40	7.40	8.21	8.37	9.78	10.30	10.10	11.41	6.52
	43G9	3.46	7.50	8.26	8.44	10.12	10.41	10.48	10.45	7.06
	43H0	3.18	7.21	8.17	8.51	9.85	9.85	10.76	10.43	7.80
	43H1	3.42	8.96	9.40	9.20	9.86	10.84			4.34
	44G9	3.47	7.55	8.46	8.46	9.91	10.39	10.38	10.55	6.87
	44H0	3.01	7.51	8.27	8.27	10.13	10.23	10.91	10.36	6.30
	44H1	2.82	8.23	8.52	8.70	11.55	10.02	10.89	11.51	5.09

Table 6G L, g		Age group								
ICES SD	ICES Rect.	1	2	3	4	5	6	7	8+	∑
26	41G9	8.54	11.19	11.79	11.66	12.46	12.77	12.53	12.97	11.13
	41H0	8.96	11.60	12.03	12.09	12.51	13.32	12.87	13.45	11.86
28	42G9	8.52	11.21	11.63	11.56	12.21	12.76	12.70	12.93	11.10
	42H0	8.63	11.13	11.58	11.64	12.33	12.50	12.65	13.28	10.51
	43G9	8.64	11.07	11.48	11.57	12.30	12.55	12.70	12.70	10.76
	43H0	8.44	11.01	11.49	11.64	12.28	12.37	12.77	12.82	11.23
	43H1	8.58	11.92	12.08	11.97	12.25	12.75			9.12
	44G9	8.64	11.08	11.53	11.57	12.24	12.53	12.66	12.70	10.64
	44H0	8.34	11.10	11.55	11.51	12.39	12.63	13.13	12.64	10.33
	44H1	8.19	11.56	11.71	11.81	13.12	12.56	13.16	13.50	9.59

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 18-25.05.2018

Table 7A CANUM		Age group								Σ
ICES SD	ICES Rect.	1	2	3	4	5	6	7	8+	
26	41G9	61	559	935	9806	528	4317	3337	4153	23696
	41H0	1242	461	31	152	2	21	2	45	1958
28	42G9	99	799	1182	8476	502	3276	2194	2905	19433
	42H0	2221	294	405	1866	179	932	722	1075	7695
	43G9	1934	2755	10684	16364	1706	5937	4227	4520	48127
	43H0	1724	696	7301	7679	1760	5637	3838	2760	31395
	43H1	1304		59	93	34	110	85	42	1728
	44G9	1804	2647	11185	16201	1135	5514	5641	4505	48633
	44H0		1011	9317	7120	1680	6235	4032	3478	32873
	44H1	1697	339	2339	3209	714	3591	2180	2004	16073

Table 7B $n \times 10^6$		Age group								Σ
ICES SD	ICES Rect.	1	2	3	4	5	6	7	8+	
26	41G9	0.69	6.37	10.64	111.62	6.01	49.14	37.99	47.27	269.73
	41H0	16.76	6.21	0.42	2.05	0.03	0.29	0.03	0.60	26.41
28	42G9	0.61	4.92	7.28	52.20	3.09	20.18	13.51	17.89	119.67
	42H0	21.49	2.85	3.92	18.05	1.73	9.02	6.98	10.40	74.44
	43G9	13.51	19.24	74.60	114.27	11.91	41.45	29.51	31.56	336.05
	43H0	19.47	7.86	82.49	86.76	19.88	63.69	43.37	31.18	354.70
	43H1	167.18	0.00	7.60	11.94	4.34	14.11	10.86	5.43	221.45
	44G9	10.60	15.55	65.70	95.16	6.67	32.39	33.13	26.46	285.66
	44H0	0.00	6.79	62.60	47.83	11.29	41.89	27.09	23.37	220.86
	44H1	20.46	4.09	28.20	38.69	8.61	43.31	26.28	24.17	193.82

Table 7C n, %		Age group								Σ
ICES SD	ICES Rect.	1	2	3	4	5	6	7	8+	
26	41G9	0.26	2.36	3.94	41.38	2.23	18.22	14.08	17.53	100.00
	41H0	63.46	23.53	1.61	7.78	0.13	1.10	0.13	2.27	100.00
28	42G9	0.51	4.11	6.08	43.62	2.58	16.86	11.29	14.95	100.00
	42H0	28.87	3.83	5.27	24.25	2.33	12.11	9.38	13.97	100.00
	43G9	4.02	5.73	22.20	34.00	3.55	12.34	8.78	9.39	100.00
	43H0	5.49	2.22	23.26	24.46	5.61	17.96	12.23	8.79	100.00
	43H1	75.49		3.43	5.39	1.96	6.37	4.90	2.45	100.00
	44G9	3.71	5.44	23.00	33.31	2.33	11.34	11.60	9.26	100.00
	44H0		3.08	28.34	21.66	5.11	18.97	12.27	10.58	100.00
	44H1	10.56	2.11	14.55	19.96	4.44	22.34	13.56	12.47	100.00

Table 7D W, $kg \times 10^3$		Age group								Σ
ICES SD	ICES Rect.	1	2	3	4	5	6	7	8+	
26	41G9	8.72	164.76	327.95	3505.50	222.03	1801.34	1598.05	2163.05	9791.40
	41H0	168.23	96.84	10.29	50.72	1.29	9.60	1.01	36.38	374.36
28	42G9	8.32	124.21	196.88	1674.65	98.02	772.65	565.50	856.47	4296.70
	42H0	193.98	45.20	108.42	542.75	51.44	337.98	293.73	479.90	2053.39
	43G9	95.46	299.09	1716.88	2920.16	361.55	1441.84	1055.76	1365.32	9256.06
	43H0	100.57	152.53	1981.25	2352.02	544.68	1915.40	1412.31	1243.64	9702.39
	43H1	863.35	0.00	158.06	270.96	109.21	357.15	291.80	203.43	2253.95
	44G9	72.07	242.68	1415.51	2434.01	211.27	1145.56	1117.09	1092.16	7730.35
	44H0	0.00	126.02	1297.49	1180.36	260.91	1137.24	812.82	826.20	5641.04
	44H1	105.67	67.50	576.61	907.63	201.19	1168.37	784.27	846.53	4657.77

Table 7E W, %		Age group								
ICES SD	ICES Rect.	1	2	3	4	5	6	7	8+	∑
26	41G9	0.09	1.68	3.35	35.80	2.27	18.40	16.32	22.09	100.00
	41H0	44.94	25.87	2.75	13.55	0.34	2.56	0.27	9.72	100.00
28	42G9	0.19	2.89	4.58	38.98	2.28	17.98	13.16	19.93	100.00
	42H0	9.45	2.20	5.28	26.43	2.51	16.46	14.30	23.37	100.00
	43G9	1.03	3.23	18.55	31.55	3.91	15.58	11.41	14.75	100.00
	43H0	1.04	1.57	20.42	24.24	5.61	19.74	14.56	12.82	100.00
	43H1	38.30	0.00	7.01	12.02	4.85	15.85	12.95	9.03	100.00
	44G9	0.93	3.14	18.31	31.49	2.73	14.82	14.45	14.13	100.00
	44H0	0.00	2.23	23.00	20.92	4.63	20.16	14.41	14.65	100.00
	44H1	2.27	1.45	12.38	19.49	4.32	25.08	16.84	18.17	100.00

Table 7F w, g		Age group								
ICES SD	ICES Rect.	1	2	3	4	5	6	7	8+	∑
26	41G9	12.60	25.87	30.83	31.40	36.93	36.66	42.07	45.76	36.30
	41H0	10.04	15.58	24.22	24.70	38.60	33.18	30.40	60.57	14.18
28	42G9	13.61	25.24	27.06	32.08	31.69	38.30	41.86	47.88	35.90
	42H0	9.03	15.87	27.66	30.06	29.70	37.49	42.06	46.16	27.58
	43G9	7.07	15.55	23.01	25.56	30.34	34.78	35.77	43.26	27.54
	43H0	5.16	19.41	24.02	27.11	27.39	30.07	32.57	39.88	27.35
	43H1	5.16		20.80	22.69	25.15	25.31	26.88	37.48	10.18
	44G9	6.80	15.61	21.55	25.58	31.68	35.37	33.72	41.27	27.06
	44H0		18.55	20.73	24.68	23.11	27.15	30.01	35.36	25.54
	44H1	5.16	16.51	20.44	23.46	23.36	26.98	29.84	35.03	24.03

Table 7G L, g		Age group								
ICES SD	ICES Rect.	1	2	3	4	5	6	7	8+	∑
26	41G9	13.00	15.92	17.19	17.01	18.11	18.19	19.10	19.75	18.24
	41H0	11.71	13.83	15.68	15.66	18.00	17.54	18.00	23.33	13.18
28	42G9	13.19	15.85	16.16	16.55	17.03	17.89	18.46	19.75	17.66
	42H0	11.26	13.79	16.47	16.81	16.97	18.29	19.06	20.01	16.30
	43G9	11.00	14.08	15.75	16.04	17.25	18.05	18.49	19.37	16.66
	43H0	9.25	14.86	16.02	16.32	16.66	17.22	17.73	18.99	16.67
	43H1	9.25		16.36	16.45	16.88	17.31	17.70	19.80	11.22
	44G9	10.20	13.89	15.46	16.03	17.75	18.24	18.15	19.25	16.61
	44H0		14.59	15.23	16.04	15.71	16.69	17.31	18.45	16.53
	44H1	9.25	14.17	15.18	15.70	15.47	16.58	17.15	18.48	15.89

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 18-25.05.2018

Table 5A									
ICES	ICES			$NASC_{PEL}$	$\sigma \times 10^4$	TS calc.	ρ	Abundance	Biomass
SD	Rect.	L, cm	w, g	m^2/nm^2	m^2	dB	$n \times 10^6/nm^2$	$n \times 10^6$	$kg \times 10^3$
26	41G9	29.87	263.51	6.74	-37.79	20.91	0.0032	3.22	849.45
	41H0								
28	42G9	28.92	233.54	5.90	-38.01	19.86	0.0030	2.93	684.34
	42H0	29.49	255.42	6.47	-37.82	20.75	0.0031	3.02	770.26
	43G9	27.51	229.02	2.94	-38.37	18.30	0.0016	1.56	357.71
	43H0	28.55	240.50	6.47	-38.10	19.46	0.0033	3.24	778.45
	43H1								
	44G9	27.75	275.03	1.97	-38.18	19.10	0.0010	0.90	248.26
	44H0	28.83	234.46	2.77	-38.04	19.73	0.0014	1.35	316.38
	44H1	31.95	305.45	1.01	-37.26	23.64	0.0004	0.35	107.81

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 18-25.05.2018

Aquatory	Northern part		Central part		Southern part	
Depth strata	>70m	<70m	>70m	<70m	>70m	<70m
Eggs (per $1m^2$)	70.70	–	104.00	92.90	511.00	11.40
Larvae (per $1m^2$)	1.43	–	5.19	-	21.40	-
Eggs (per 10 min. of haul on the water surface)	1.80	–	22.40	1.25	2.00	6.50
Larvae (per 10 min. of haul on the water surface)	0.25	–	1.09	2.25	3.00	0.50

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 18-25.05.2018

Species	Biomass (mg/m^3)	Biomass (%)
Acartia spp.	27.373	14.10
Eurytemora affinis	0.425	0.22
Temora longicornis	31.361	16.15
Centropages hamatus	13.134	6.76
Pseudocalanus sp.	11.135	5.73
Harpacticoida	0.003	0.00
Oithona sp.	0.064	0.03
Bosmina	0.019	0.01
Evadne	6.927	3.57
Podon	0.425	0.22
Synchaeta spp.	72.674	37.42
Polychaeta larvae	2.996	1.54
Bivalvia larvae	0.105	0.05
Fritillaria borealis	27.558	14.19
Copepoda	**83.495**	**42.99**
Cladocera	**7.371**	**3.80**
Rotatoria	**72.674**	**37.42**
Varia	**30.659**	**15.79**
Total	**194.199**	**100.00**

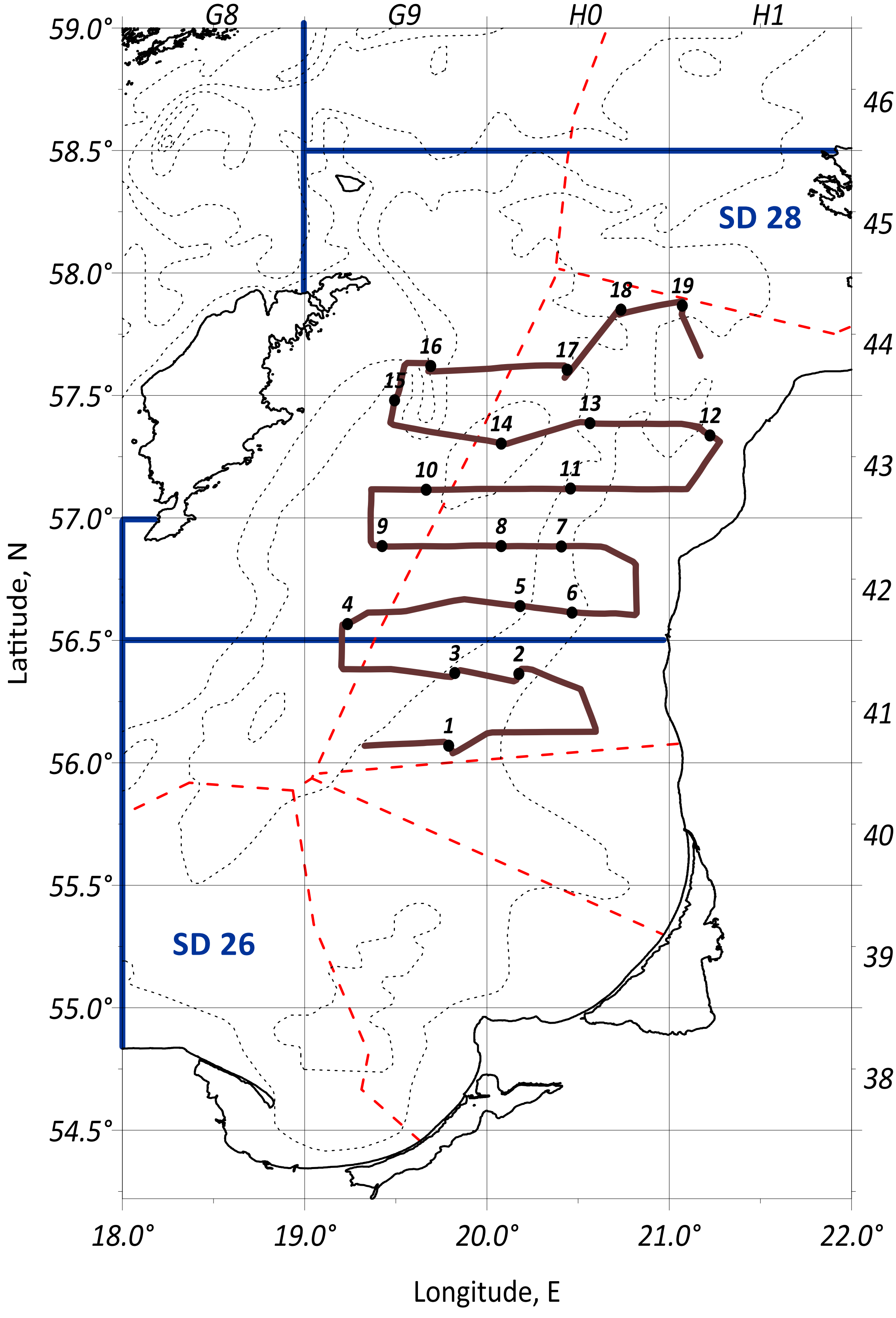

Figure 1: Cruise track design and trawling positions of the Latvian-Polish BASS on the r/v "Baltica" in the period of 18-25.05.2018.

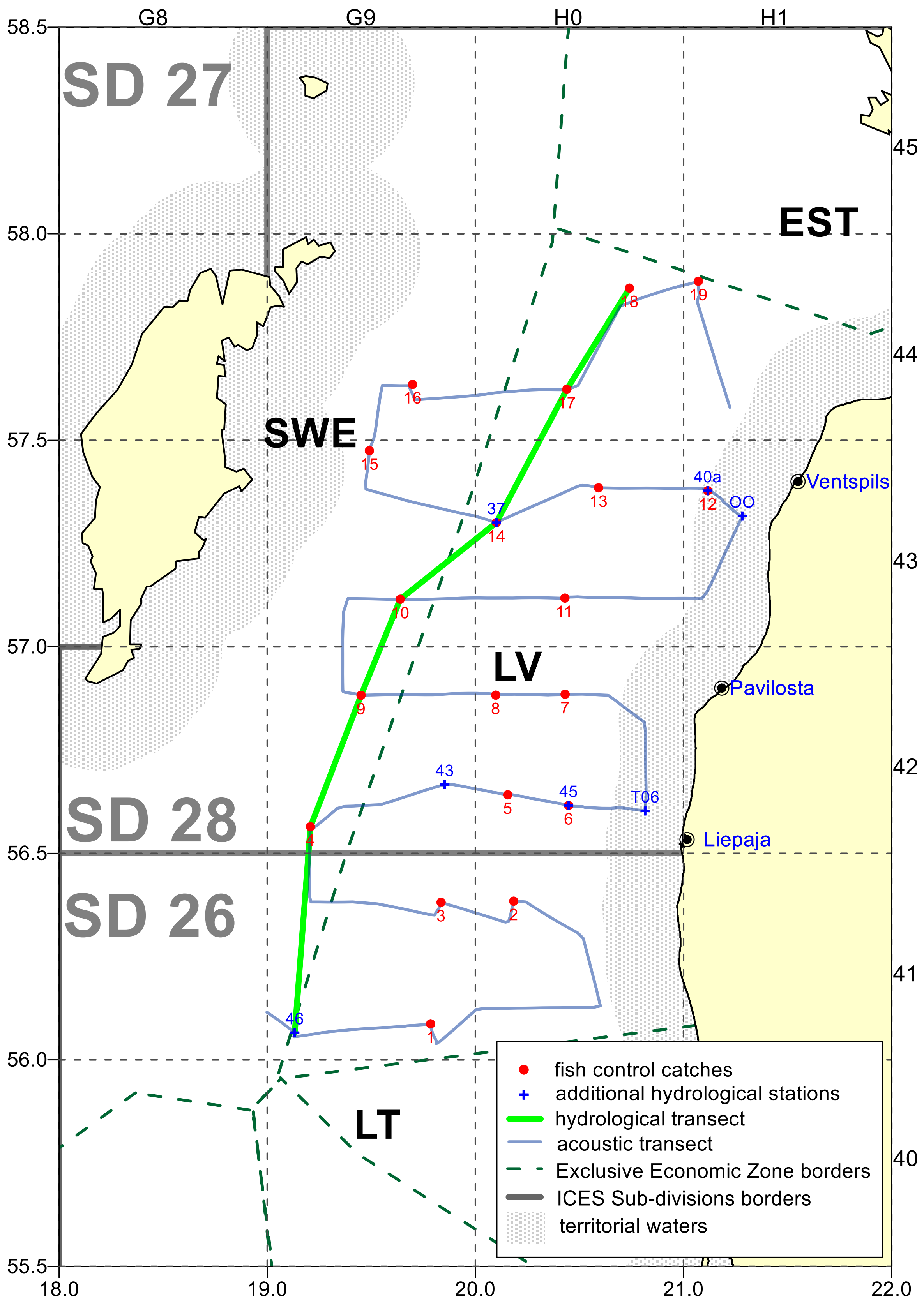

Figure 2: Locations of the hydrological, ichthyoplankton and zooplankton stations performed during the Latvian-Polish BASS on the r/v "Baltica" in the period of 18-25.05.2018.

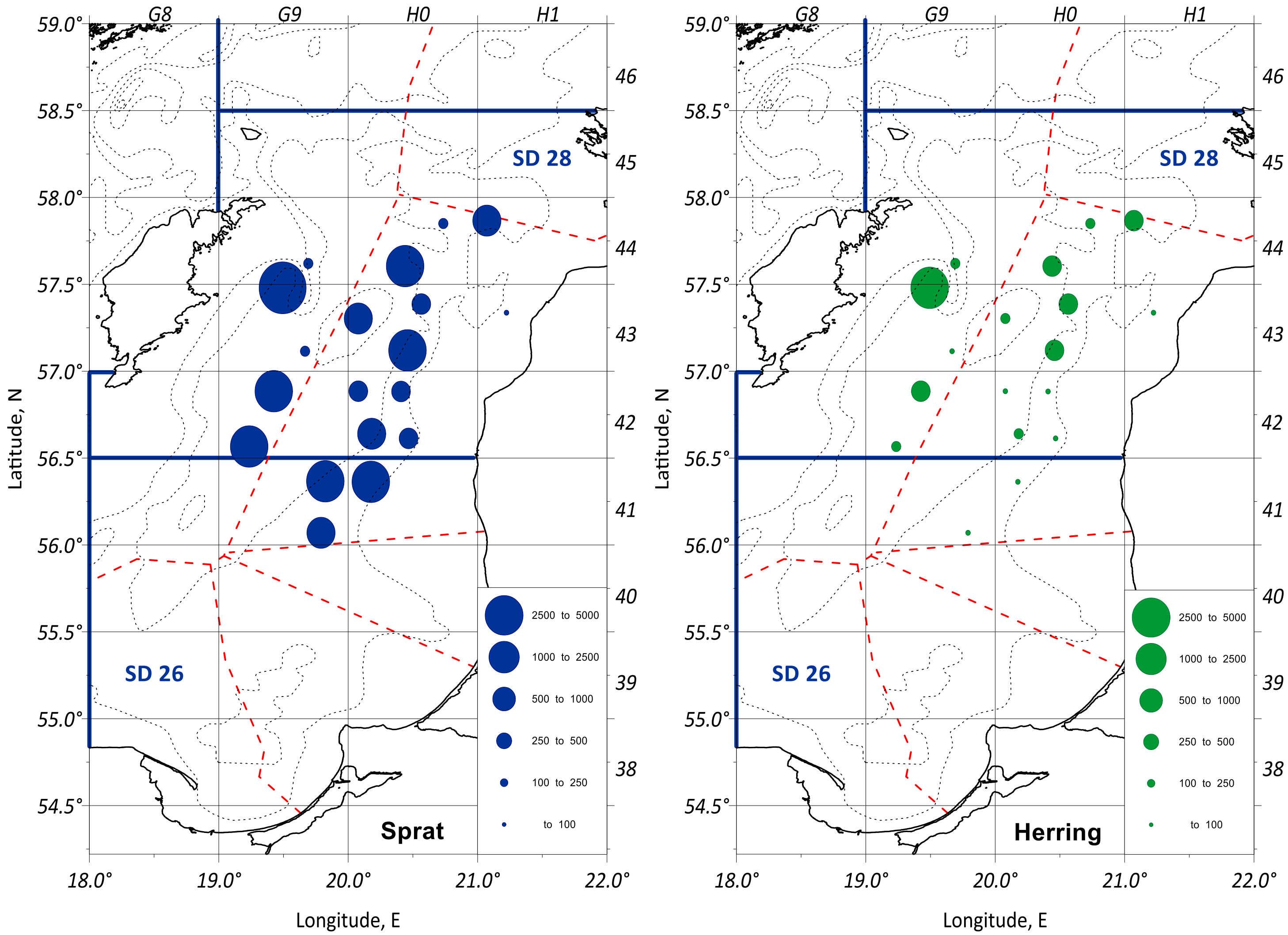

Figure 3: CPUE [kg/h] ranges distribution of dominant fish in the catch hauls in the Baltic Sea ICES SD 26N and 28.2 from the Latvian-Polish BASS conducted by r/v "Baltica" in the period of 18-25.05.2018.

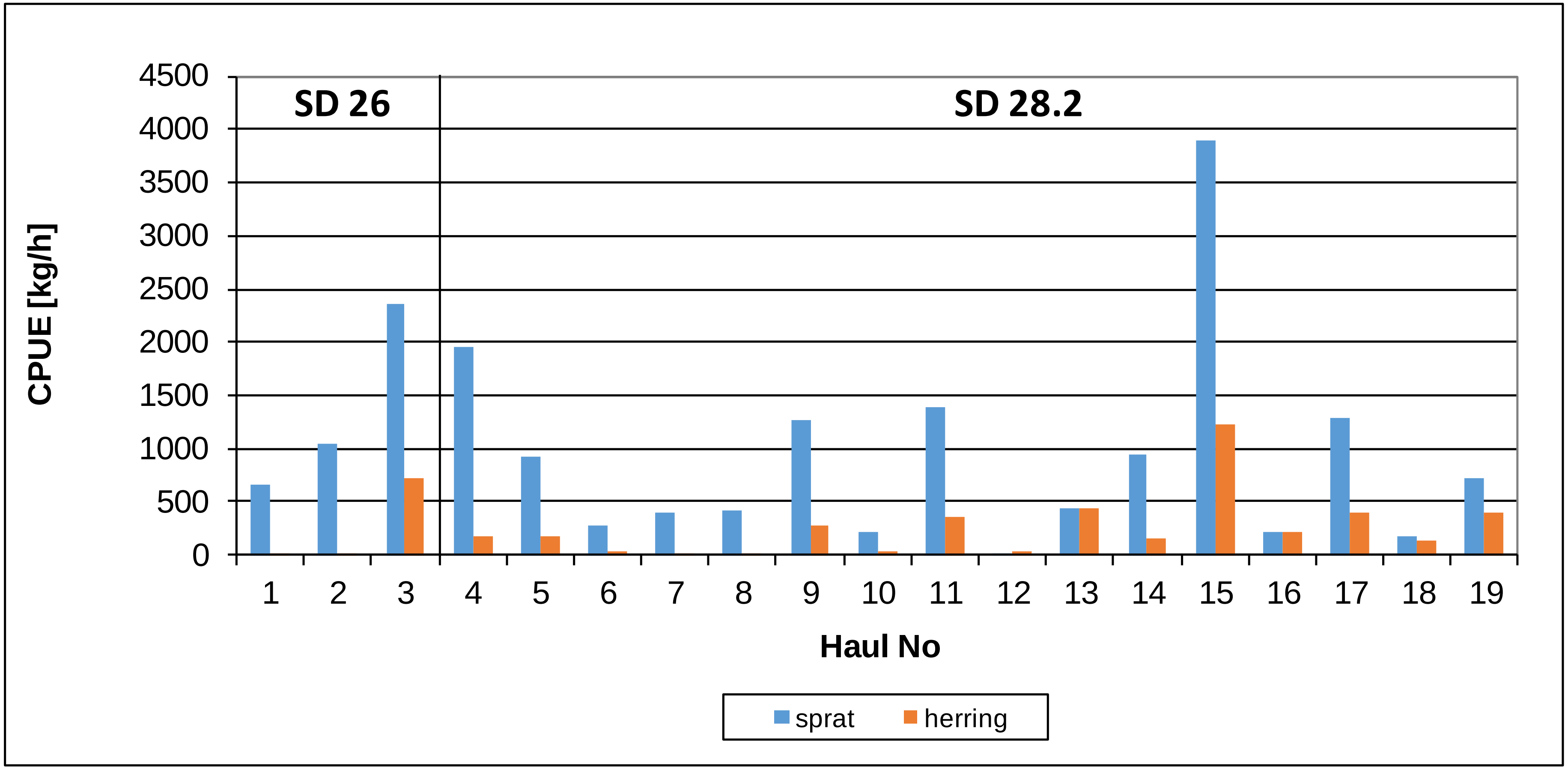

Figure 4: CPUE [kg/h] of dominant pelagic fish in the catch hauls in the Baltic Sea ICES SD 26N and 28.2 from the Latvian-Polish BASS conducted by r/v "Baltica" in the period of 18-25.05.2018.

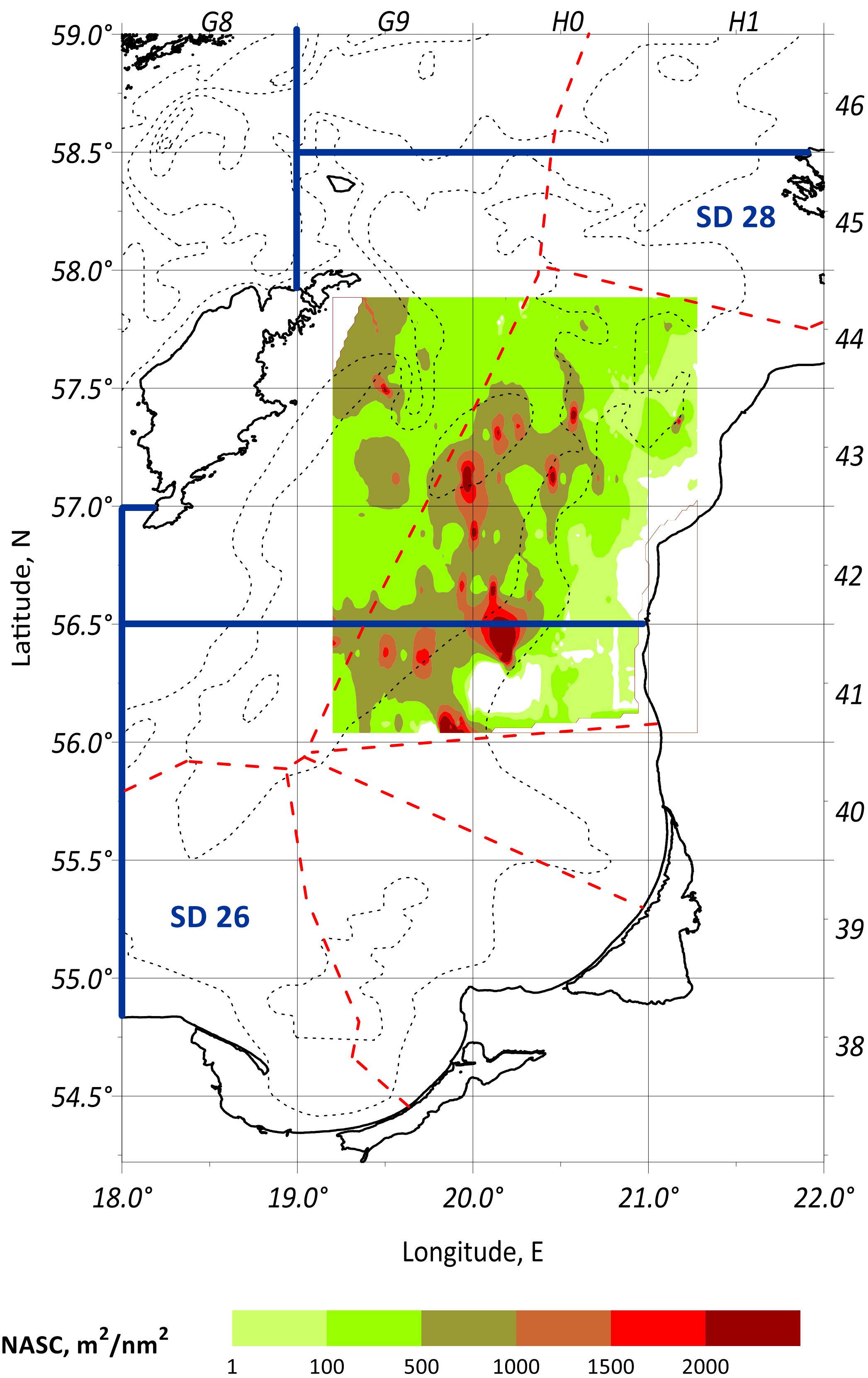

Figure 5: Acoustic parameter NASC distribution in the Baltic Sea ICES SD 26N and 28.2 from the Latvian-Polish BASS conducted by r/v "Baltica" in the period of 18-25.05.2018.

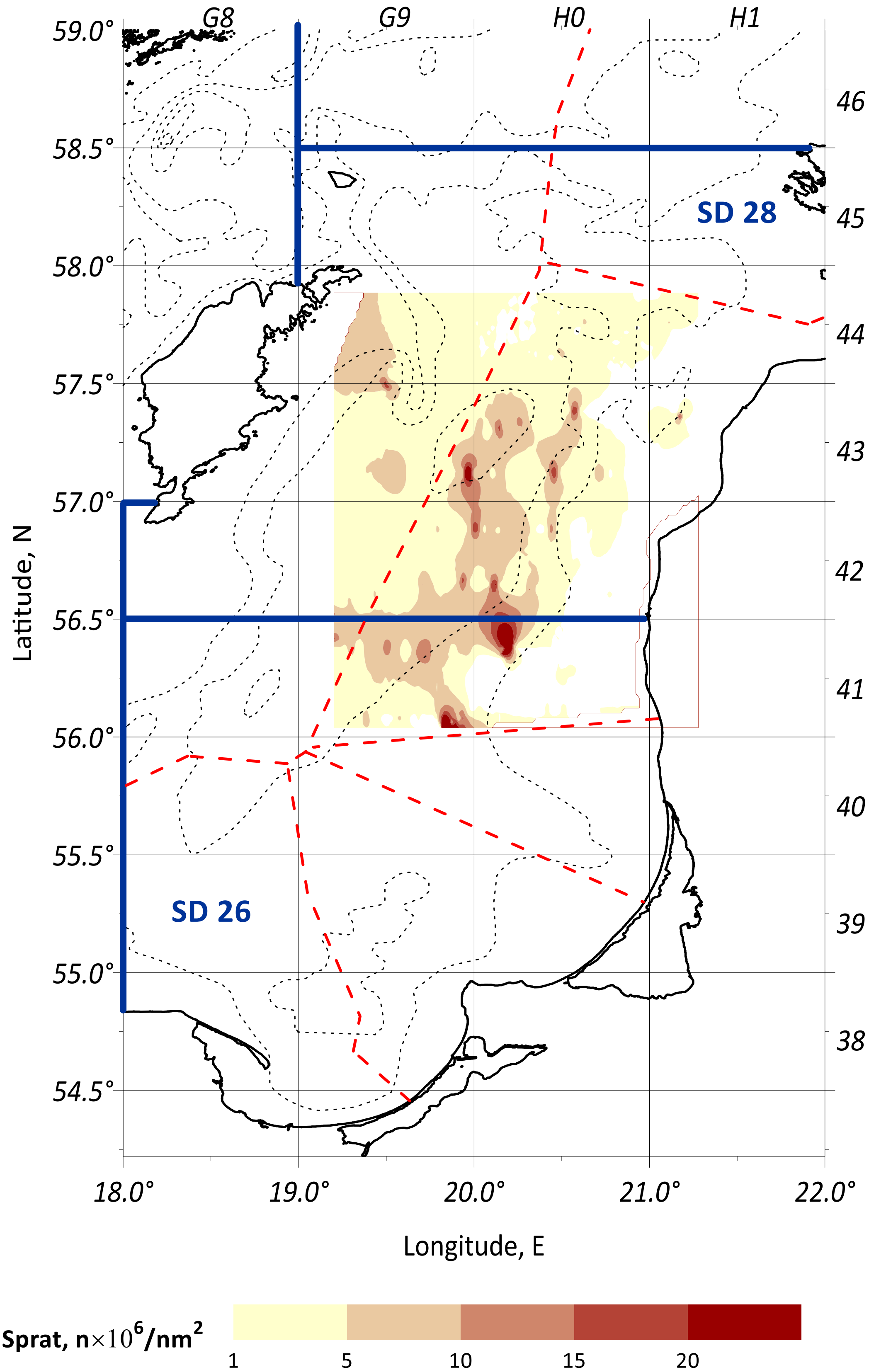

Figure 6: Sprat distribution in the Baltic Sea ICES SD 26N and 28.2 from the Latvian-Polish BASS conducted by r/v "Baltica" in the period of 18-25.05.2018.

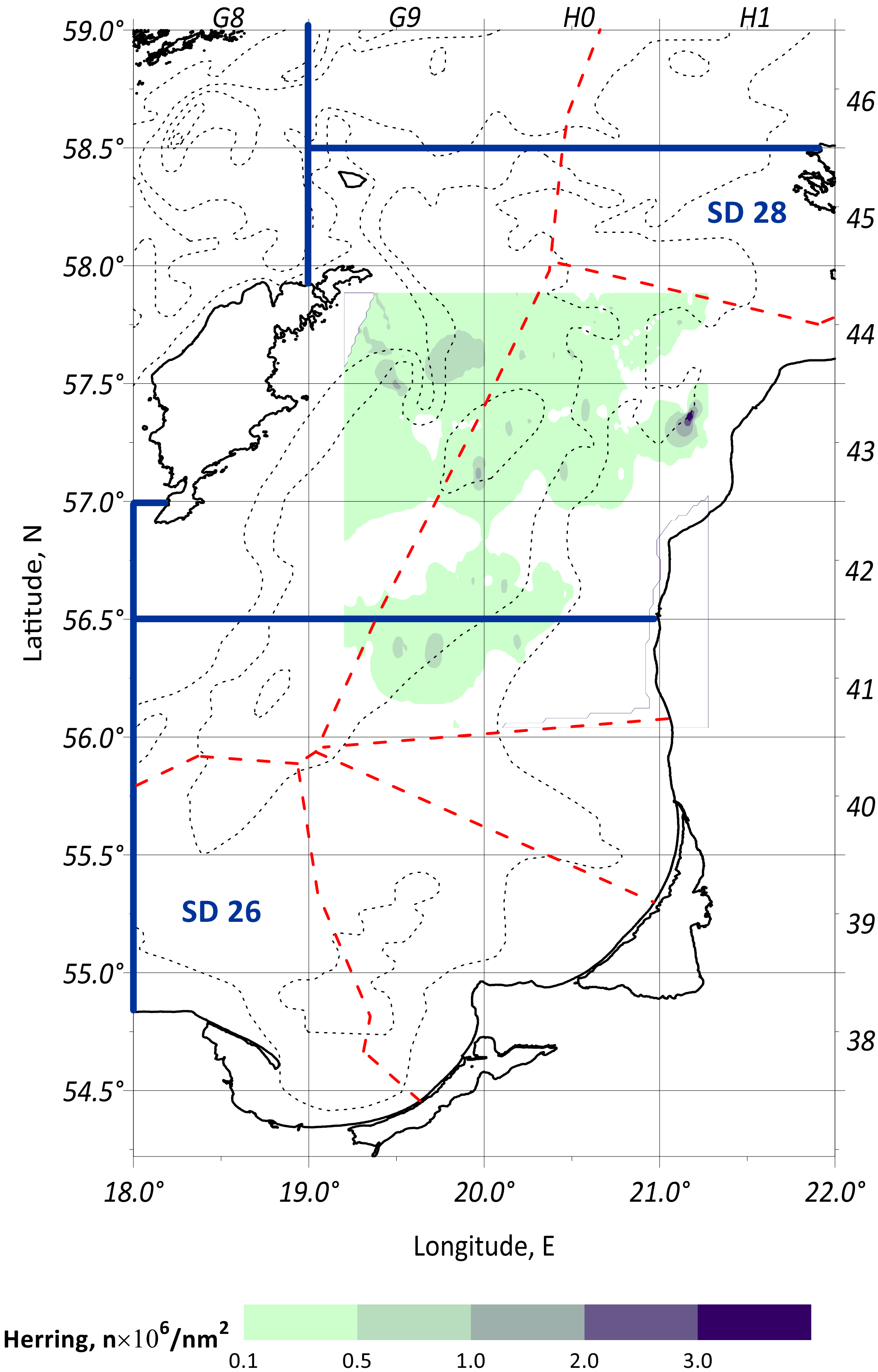

Figure 7: Herring distribution in the Baltic Sea ICES SD 26N and 28.2 from the Latvian-Polish BASS conducted by r/v "Baltica" in the period of 18-25.05.2018.

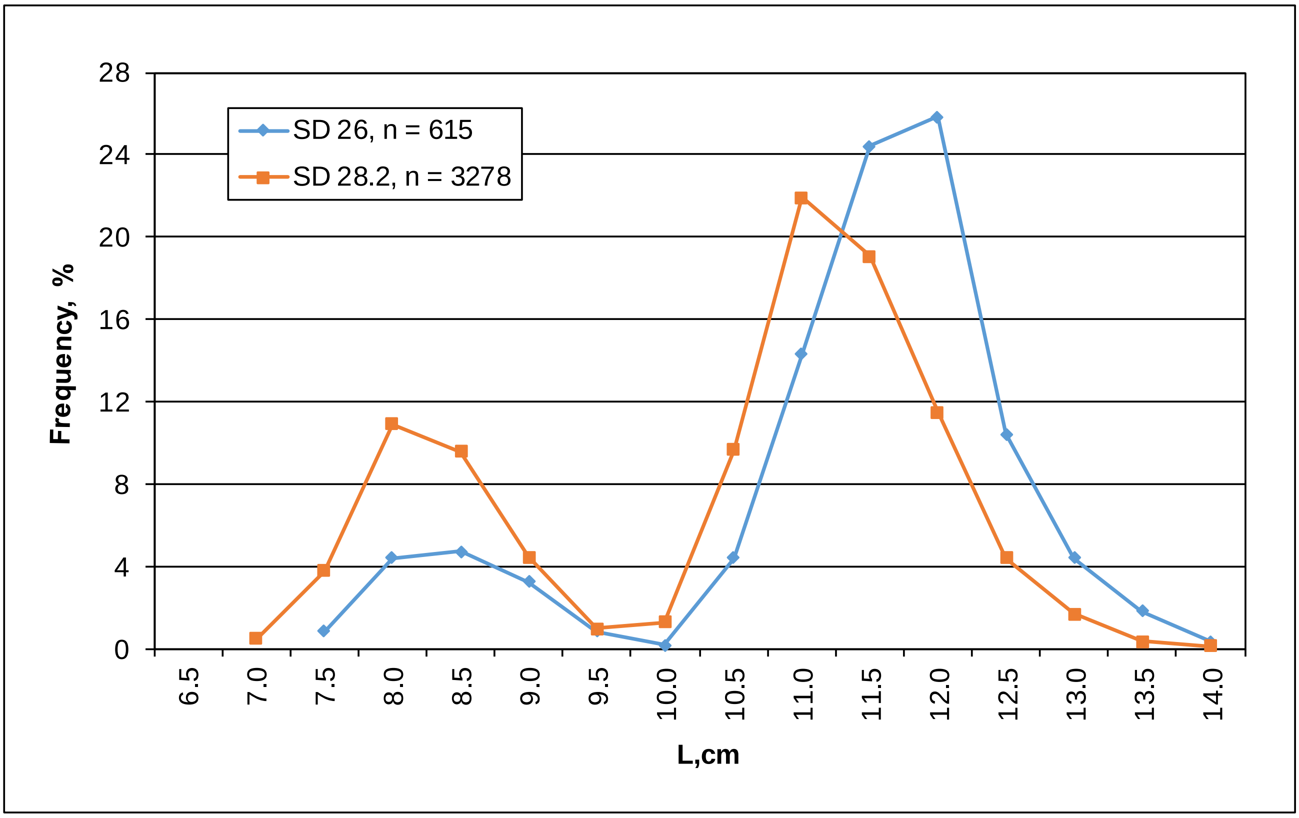

Figure 8: Sprat length distributions in control catches in the Baltic Sea ICES SD 26N and 28.2 from the Latvian-Polish BASS conducted by r/v "Baltica" in the period of 18-25.05.2018.

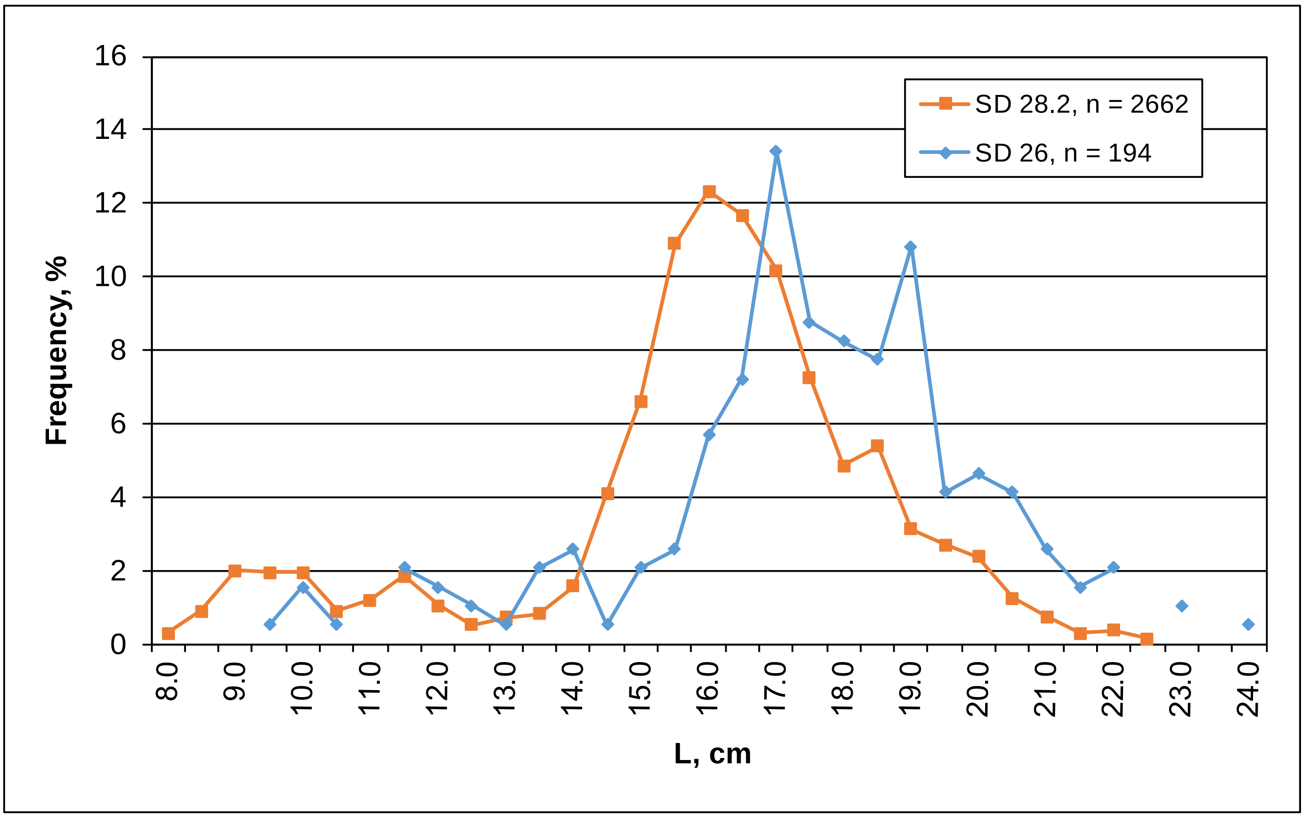

Figure 9: Herring length distributions in control catches in the Baltic Sea ICES SD 26N and 28.2 from the Latvian-Polish BASS conducted by r/v "Baltica" in the period of 18-25.05.2018.

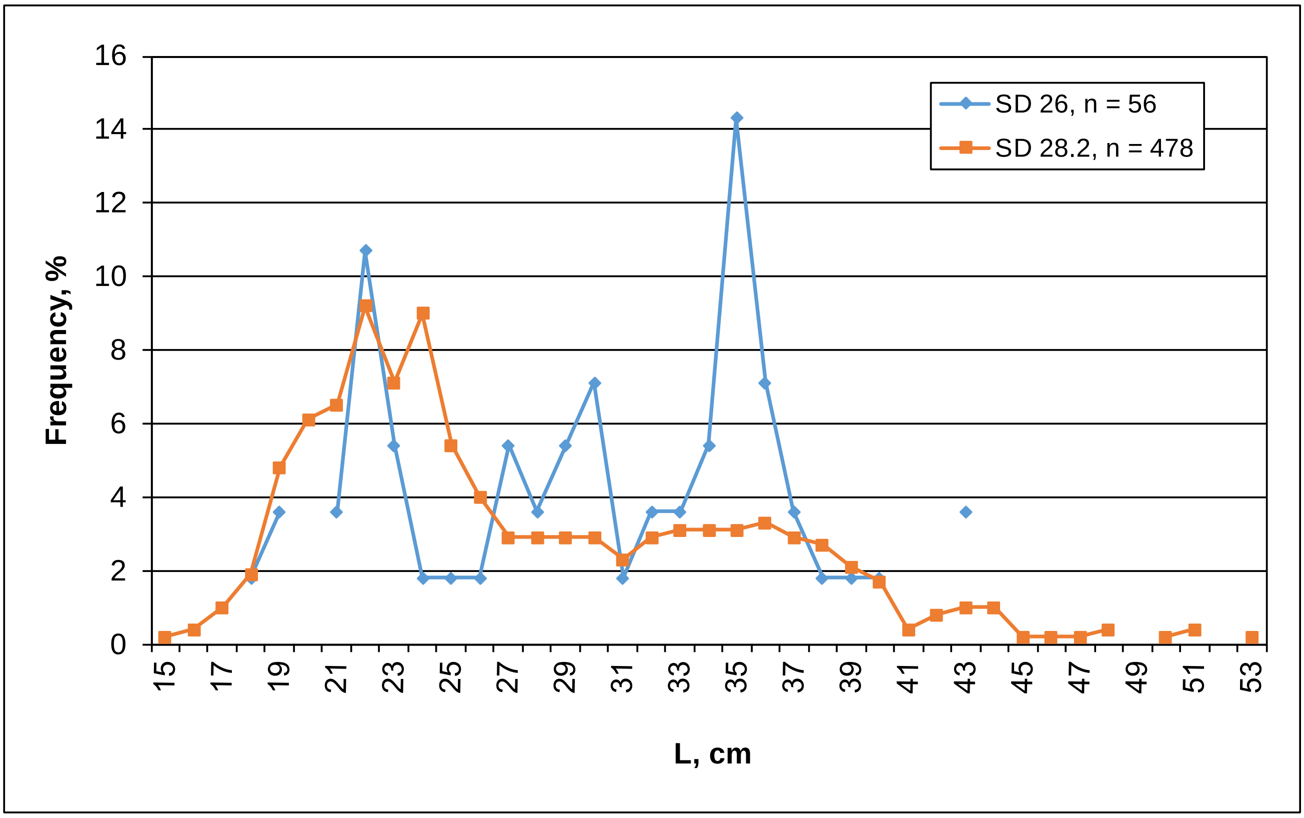

Figure 10: Cod length distributions in control catches in the Baltic Sea ICES SD 26N and 28.2 from the Latvian-Polish BASS conducted by r/v "Baltica" in the period of 18-25.05.2018.

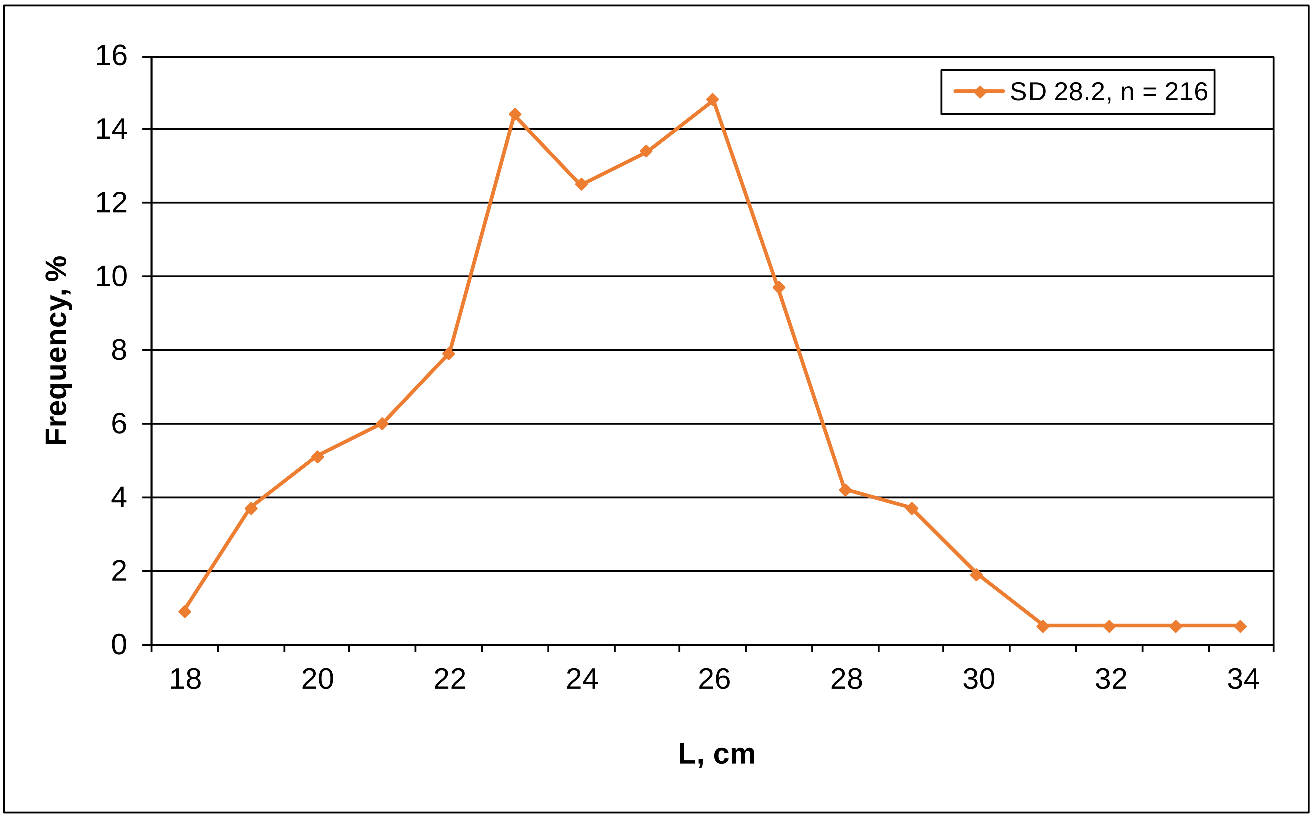

Figure 11: Flounder length distributions in control catches in the Baltic Sea ICES SD 26N and 28.2 from the Latvian-Polish BASS conducted by r/v "Baltica" in the period of 18-25.05.2018.

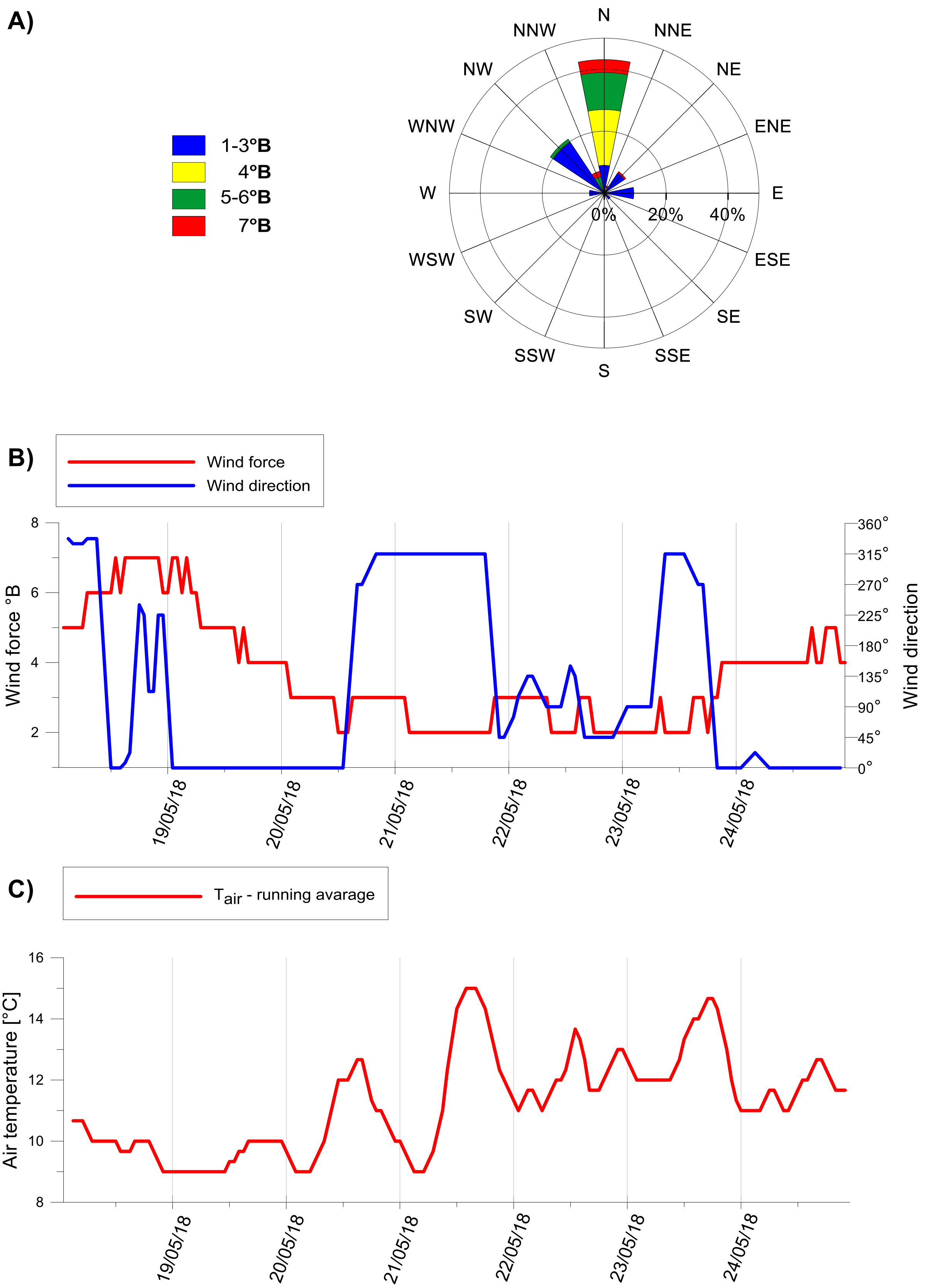

Figure 12: Changes of the main meteorological parameters (wind force, direction and the daily air temperature) during the Latvian-Polish BASS in the Baltic Sea ICES SD 26N and 28.2 conducted by r/v "Baltica" in the period of 18-25.05.2018.

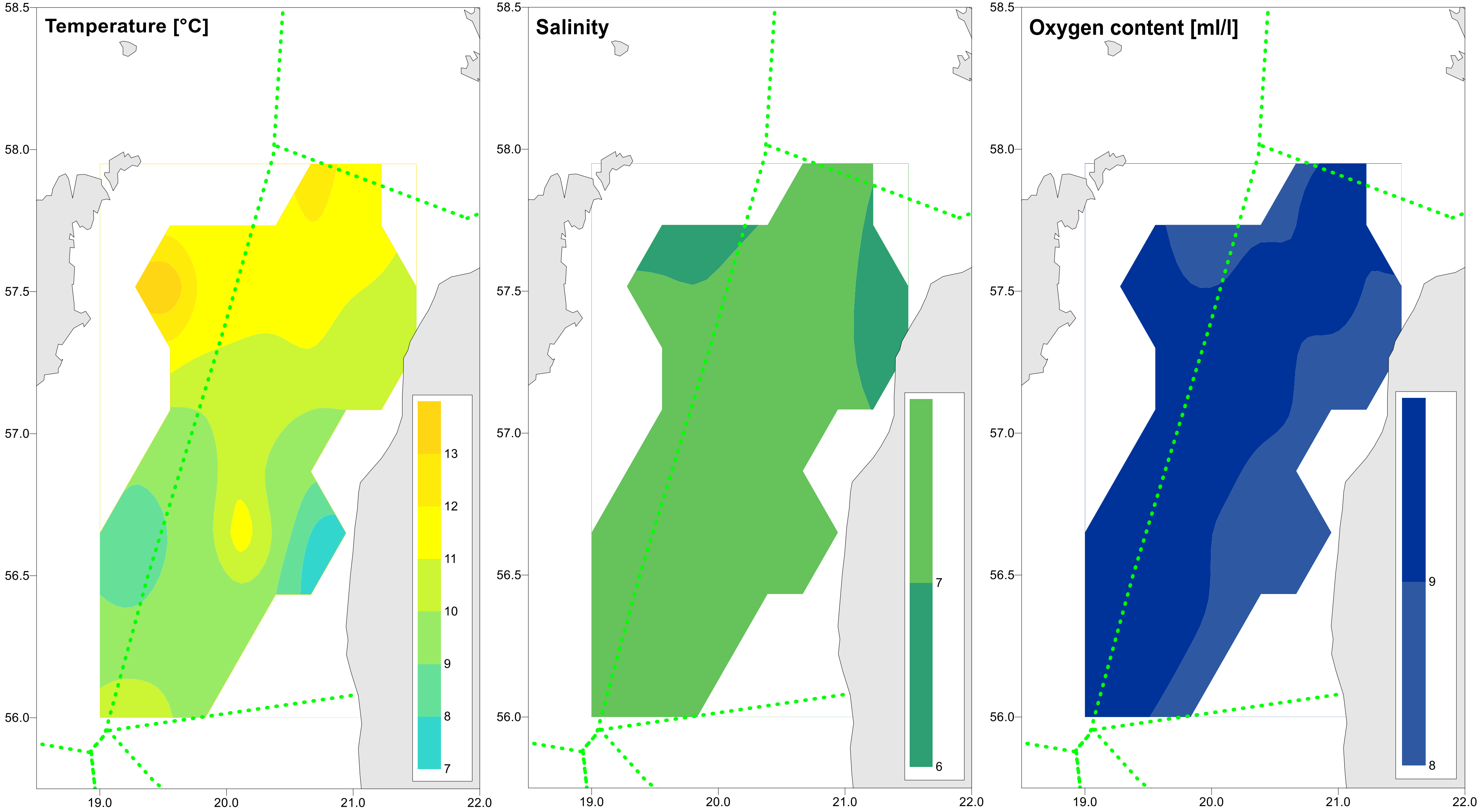

Figure 13: Horizontal distribution of the main hydrological parameters (temperature, salinity, oxygen content) measured in the surface water layer of the Gotland Deep in the Baltic Sea ICES SD 26N and 28.2 from the Latvian-Polish BASS conducted by r/v "Baltica" in the period of 18-25.05.2018.

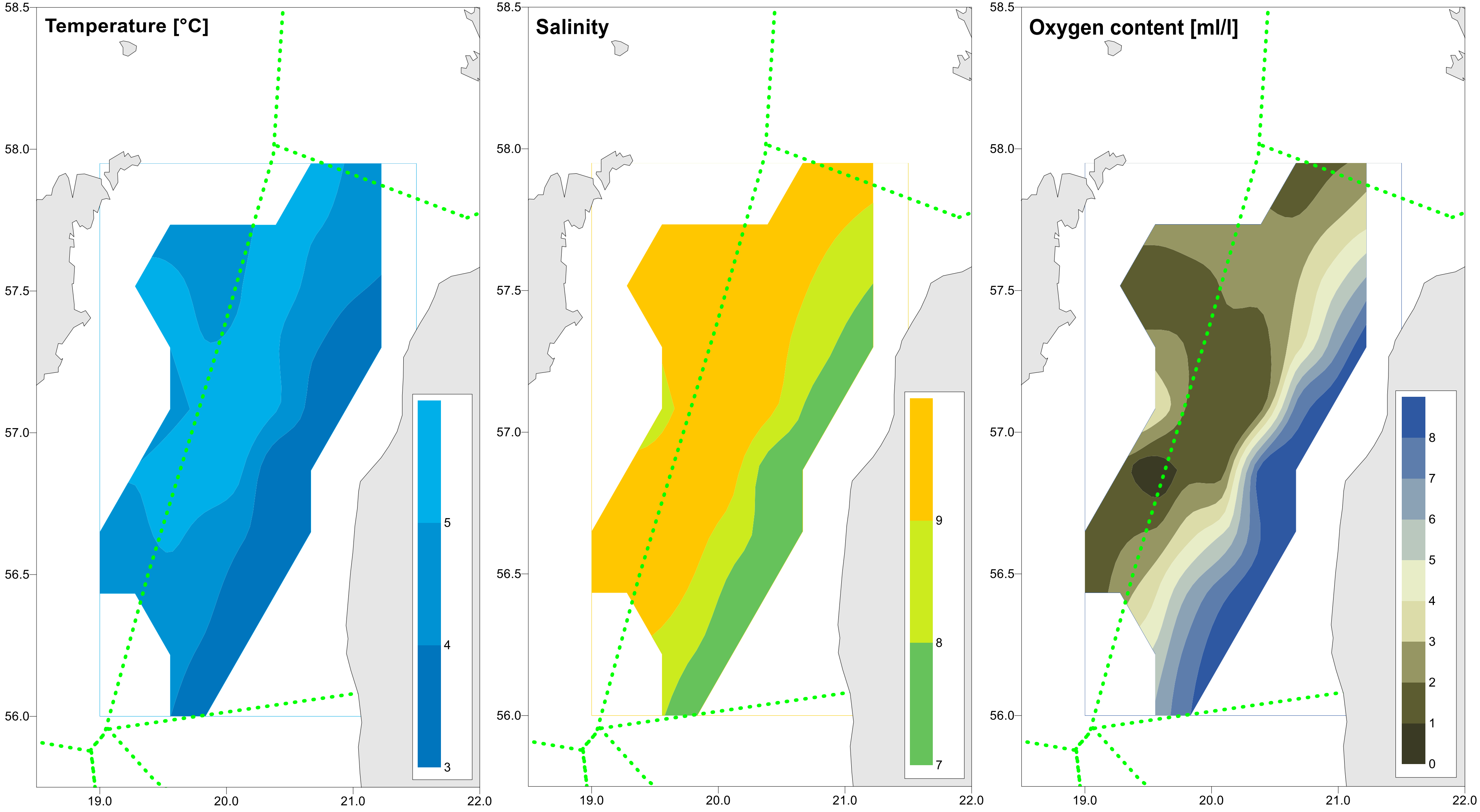

Figure 14: Horizontal distribution of the main hydrological parameters (temperature, salinity, oxygen content) measured in the haul depth layer of the Gotland Deep in the Baltic Sea ICES SD 26N and 28.2 from the Latvian-Polish BASS conducted by r/v "Baltica" in the period of 18-25.05.2018.

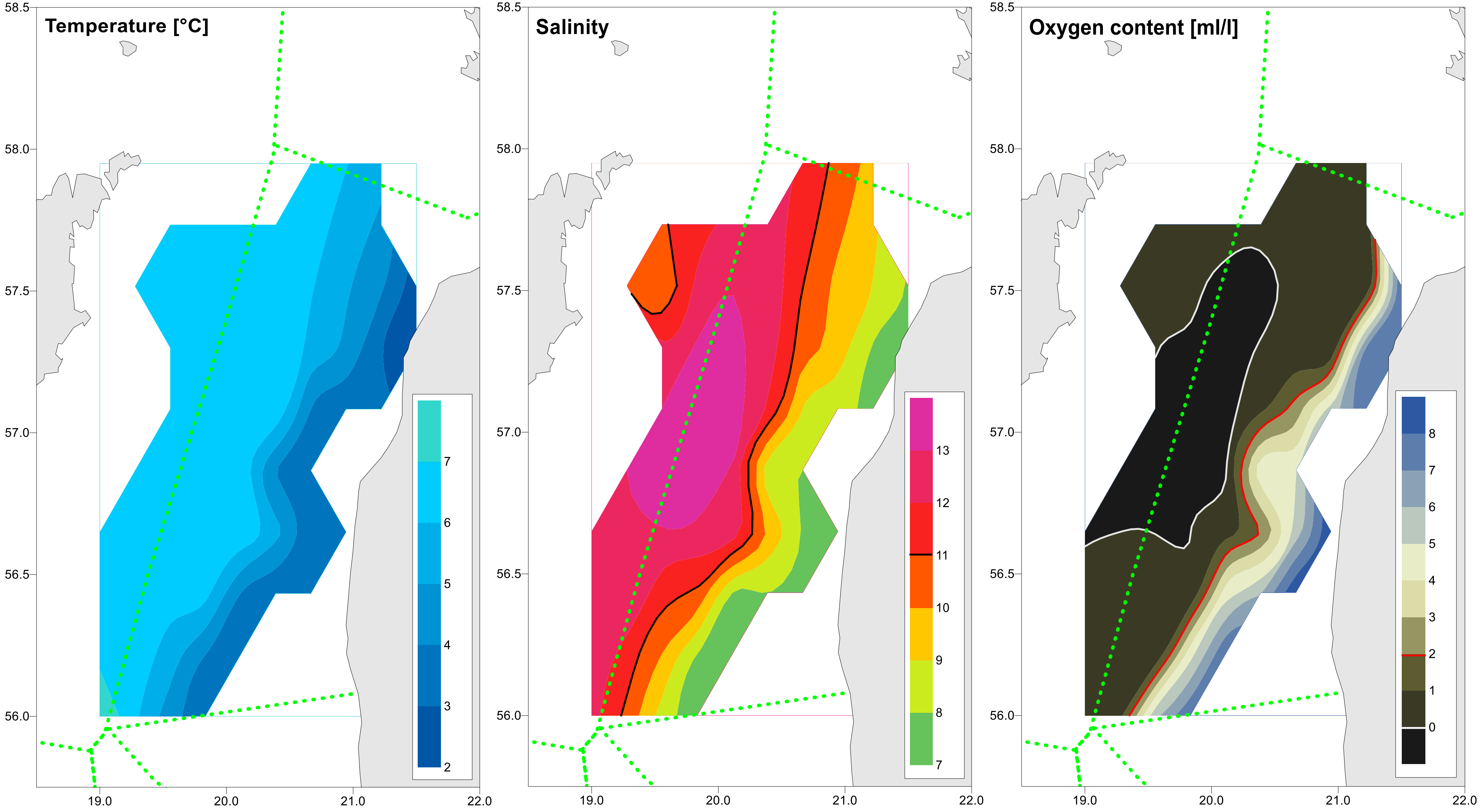

Figure 15: Horizontal distribution of the main hydrological parameters (temperature, salinity, oxygen content) measured in the bottom water layer of the Gotland Deep in the Baltic Sea ICES SD 26N and 28.2 from the Latvian-Polish BASS conducted by r/v "Baltica" in the period of 18-25.05.2018.

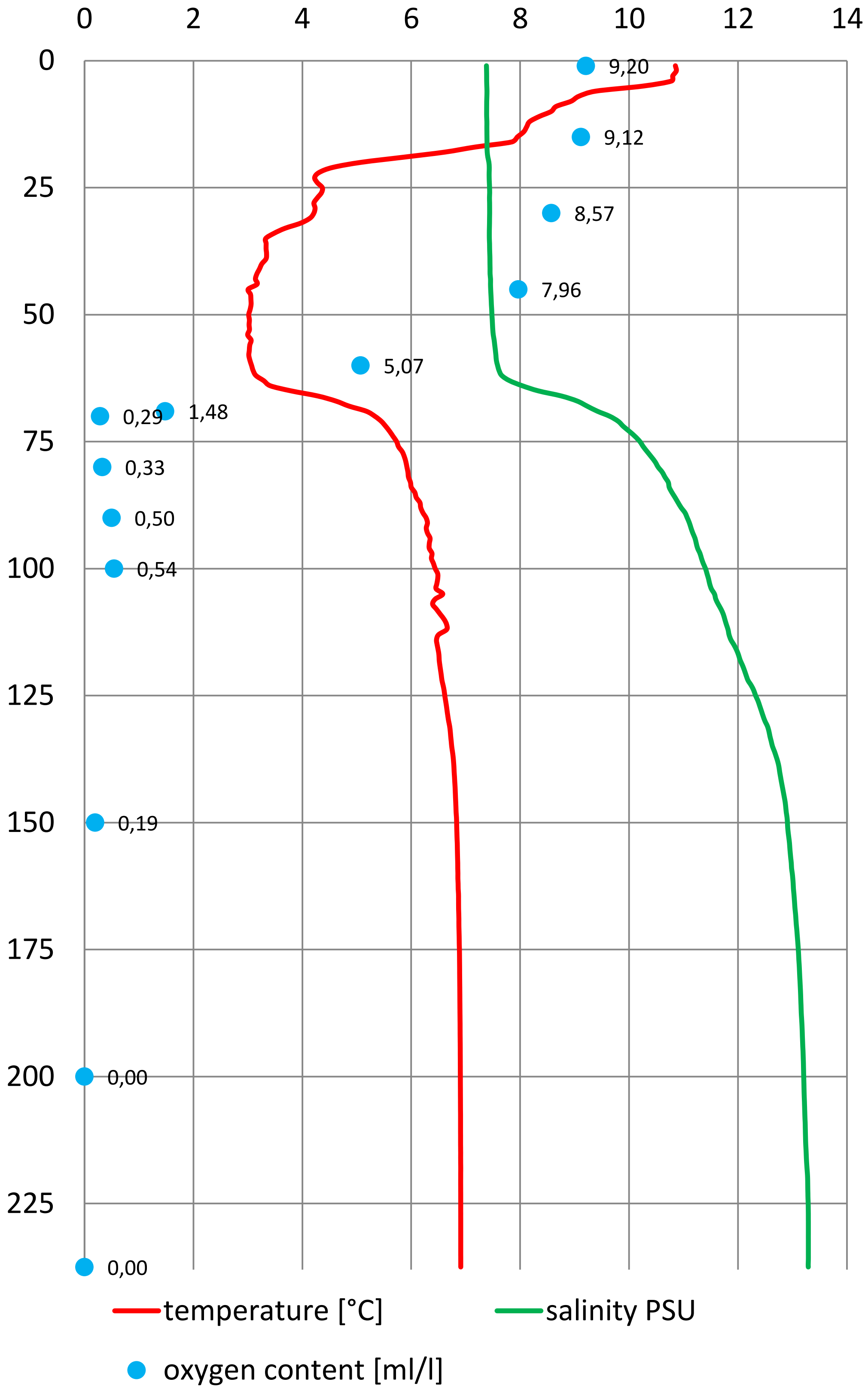

Figure 16: Vertical distribution of the seawater temperature, salinity and oxygen content at the deepest part (Station 37) of the Gotland Basin in the Baltic Sea ICES SD 26N and 28.2 from the Latvian-Polish BASS conducted by r/v "Baltica" in the period of 18-25.05.2018.

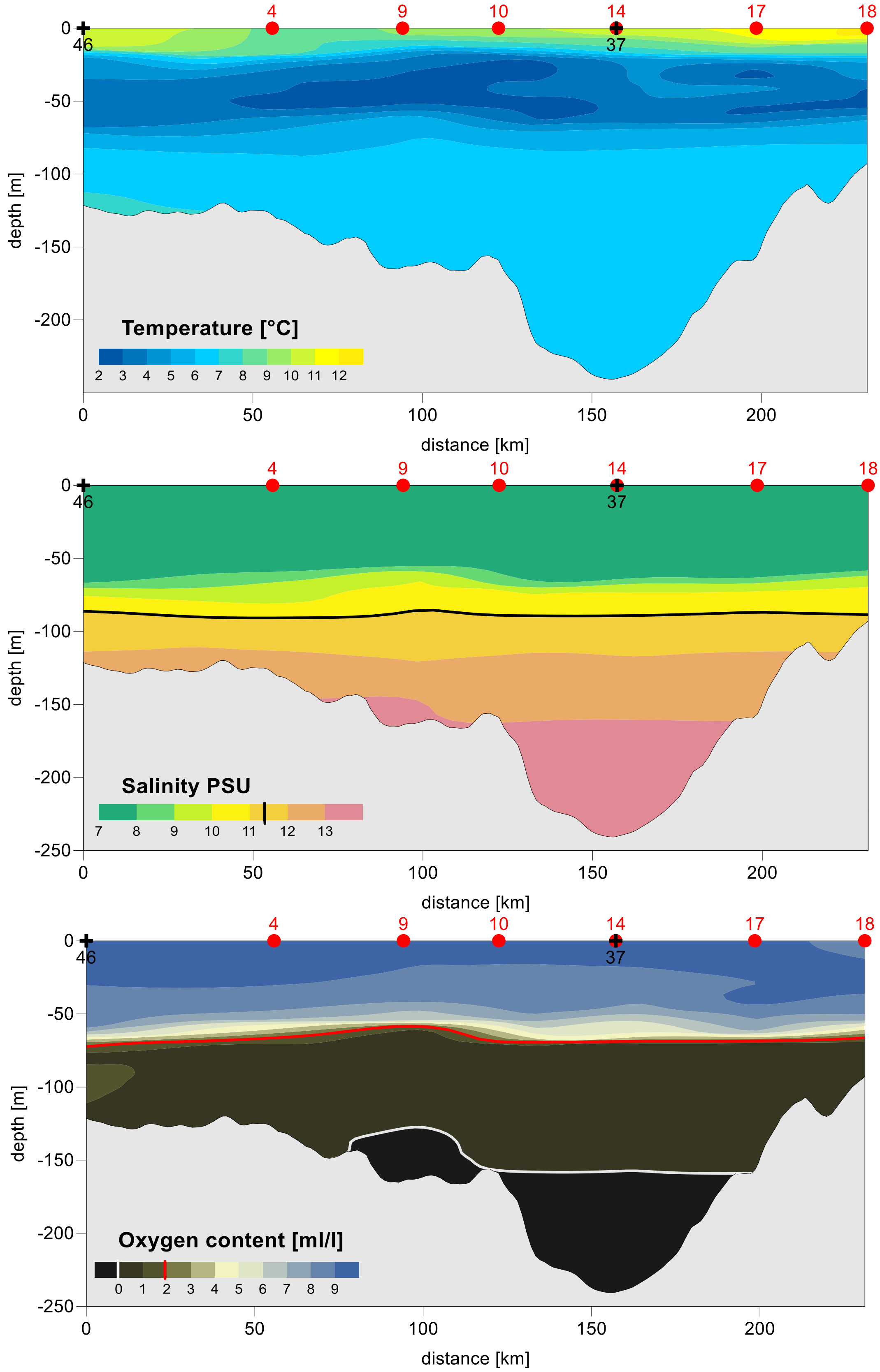

Figure 17: Vertical distribution of the seawater temperature, salinity and oxygen content along the hydrological profile in the Baltic Sea ICES SD 26N and 28.2 from the Latvian-Polish BASS survey conducted by r/v "Baltica" in the period of 18-25.05.2018.

Federal Research Institute for Rural Areas, Forestry and Fisheries

Thünen Institute of Sea Fisheries (TI-SF)[1]
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Survey Report FRV Solea

German Acoustic Autumn Survey (GERAS)

01 – 19 October 2018

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 31st 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). Altogether, 1211 nmi (plus 107 nmi night and daytime transects for comparison) of hydroacoustic transects were covered. The survey effort was comparable to previous years.

1.2 Objectives

The survey has the main objective to annually assess the clupeoid 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:

- 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

1.3 Survey summary

In the majority of sampled rectangles, mean NASC values per nautical mile were distinctly higher than the values measured in 2017 and in SD 22 and SD 21 (in 2 and 3 cases, respectively) higher than the long-time mean values. Despite this increase from 2017, the majority of rectangles sampled in 2018 still showed mean NASC values below the long time mean. While NASC values measured were higher in ICES Subdivisions 21, 22 and 23 (in comparison with 2017), levels in SD 24 were in all but two rectangles distinctly lower than the already low NASC values measured in the previous year. While in SD 23, as in 2017, unusually low NASC values (albeit higher than in the previous year) were measured, indicating absence of the dense aggregations of herring usually observed in that area at this time of the year. On a repetition of the transect in SD 23 during daytime for comparison, NASC values measured were distinctly higher than those recorded during nighttime, indicating higher presence of clupeids in the area.

For species allocation and identification, altogether 62 fishery hauls were conducted (including 58 valid hauls during the survey and 3 valid hauls on comparison transects). Vertical hydrography profiles were measured on 106 stations.

2 SURVEY DESCRIPTION & METHODS APPLIED

2.1 Cruise narrative

The 754th cruise of FRV Solea represents the 31st subsequent GERAS survey. Embarkation of scientific crew as well as equipment of FRV Solea with all hydroacoustic equipment and biological sampling gear took place on the morning of October 1st in Kiel harbor. On the same afternoon, Solea left port for the calibration of scientific echosounders. The calibration site off Strande that had been chosen for calibration in the previous year was again approached based on the prevailing weather conditions that were considered acceptable (4-5 Bft, westerly winds). After calibration the vessel returned to Kiel harbor in the late evening to allow switching of survey operations to night time. Leaving of port and start of survey was scheduled for October 2nd in the afternoon. The hydroacoustic survey operations commenced October 2nd at 06:00 PM in SD 22 in Kiel Bight.

Generally, survey operations were conducted during nighttime to account for the more pelagic distribution of clupeids during that time. Adverse 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. In the first night of survey operations, weather conditions deteriorated (10 Bft westerly winds) but allowed continuation of the survey in the narrow Belt Sea. After finishing SD 22, survey operations commenced in SD 24 and SD 23 which both were covered as planned due to favorable weather conditions, as was SD 21 afterwards. Regular survey operations were accomplished on October 16th. After a switch of survey operations back to daytime, a comparative sampling (hydroacoustics and fishery) of SD 23 (Sound) was conducted to validate weak registrations recorded during the regular, initial passage. The scientific program was finished on October 18th, 04:45 PM. The ship arrived at Marienehe port on October 19th, 07:00 AM.

Altogether, the following survey schedule was accomplished:

Belt Sea	(SD 22)	02. - 06.10.
Arkona Sea	(SD 24)	07. - 11.10.
Sound	(SD 23)	12.10.
Kattegat	(SD 21)	13. - 16.10.
Sound (day)	(SD 23)	18.10.

Total survey time	15 nights (+ 1 day comparison in SD 23)
Fishery hauls	62 (58 valid, 2 invalid, 3 daytime comparison)
CTD-casts	106
Hydroacoustic transects	1211 nmi (+ 107 nmi transects for comparison)

Overall regular hydroacoustic transect length was 1211 nmi (2016: 1167 nmi).

2.2 Survey design

ICES statistical rectangles were used as strata for all Subdivisions (ICES, 2014). 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 regular cruise track length was 1211 nmi covering a survey area of 12 400 nmi^2 (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. The main pelagic species of interest were herring and sprat. 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 were conducted with Echoview 9 software (Echoview Software Pty Ltd, 2018). 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 netsounder indicated large catches. To validate and allocate echorecordings, altogether 62 fishery hauls were conducted (Figure 1), out of which 57 valid (night time) hauls were utilized for further processing. 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, 106 CTD-profiles were measured (Figure 6).

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
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 (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. The total number was separated into the categories mentioned above and further into herring and sprat according to the mean catch composition.

In accordance with the guidelines in the "SISP Manual of International Baltic Acoustic Surveys (IBAS)" (ICES, 2017) further calculations were performed as follows:

<u>Fish species considered:</u>

Herring	(*Clupea harengus*)
Transparent goby	(*Aphia minuta*)
European Anchovy	(*Engraulis encrasicolus*)
Cod	(*Gadus morhua*)
Three-spined stickleback	(*Gasterosteus aculeatus*)
Whiting	(*Merlangius merlangus*)
Saithe	(*Pollachius pollachius*)
Mackerel	(*Scomber scombrus*)

Fish species considered (contd.):

Sprat	(*Sprattus sprattus*)
Horse mackerel	(*Trachurus trachurus*)
Norway pout	(*Trisopterus esmarckii*)
Poor cod	(*Trisopterus minutus*)

Exclusion of trawl hauls with very low catches:

Haul No.	Rectangle	Subdivision (SD)
6	40G0	22
12	38G0	23
29	38G2	24
45, 49	41G2	21
53	43G1	21
57	42G2	21

Exclusion of trawl hauls due to net damage:

Haul No.	Rectangle	Subdivision (SD)
31	39G2	24
52	41G1	21

Exclusion of day time trawl hauls:

Haul No.	Rectangle	Subdivision (SD)
60-61	40G2	23
62	41G2	23

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)
2, 3	40G0	22
4	41G0	22
5	40G1	22
9	39G1	22
29	38G2	24
47	41G0	21

Usage of neighboring trawl information for rectangles which contain only acoustic investigations:

Rectangle/SD to be filled	with Haul No.	of Rectangle/SD
43G2/21	58 and 54-56	42G2 and 43G1/21
39F9/22	7 and 8	40F9 and 39G0/22
40F9/22	2, 3	40G0/22
39G2/23	32 and 33	39G2 and 39G3/24
37G4/24	23, 26, 27	38G4/24

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 based on baseline samples of WBSSH and CBH in 2011-2017 and in 2018 support the applicability of the SF (Oeberst et al., 2013, WD Oeberst et al., 2014; WD Oeberst et al., 2015; WD Oeberst et al., 2016; WD Oeberst et al., 2017; WD Gröhsler and Schaber, 2018, WD Gröhsler and Schaber, 2019). In SD 24, the SF was finally also applied to ICES rectangle 39G2 (SD 23 area) since biological samples of 39G2 (SD 24 area) were used to raise the corresponding recorded S_A values.

In 2018, the age-length distribution of herring in SD 22 and SD 23 indicated a low contribution of fish of CBH origin. Thus, the SF was not applied in subdivisions 22 and 23 in 2018.

Accordingly, the applicability of the SF continued in 2018 despite the occurrence of some CBH in the GERAS baseline samples of WBSSH in SD 21 and 23.

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 now excludes CBH in 2005-2017 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 2018. The majority of these NASC measurements can be allocated to clupeids. In many rectangles surveyed, mean NASC values were significantly higher than those recorded in 2017, in some rectangles also above the long-time survey average. However, despite this increase from the previous year, mean NASC per rectangle was in the majority of rectangles still well below the long-term average. On ICES subdivision scale, mean NASC values were higher than in the previous year in subdivisions 21, 22 and 23, but significantly lower in SD 24.

In SD 21, overall NASC values measured were distinctly higher than those measured in the previous year. Only in one rectangle (42G1), mean NASC per 1 nmi EDSU was lower. SD 21 had the largest fraction of rectangles with NASC values exceeding not only the 2017 measurements (in 6 out of 7 rectangles) but also the long-term survey mean (in 3 out of 7 rectangles). Aggregations were mostly patchy along the cruisetrack, with the exception of the northern part of the Kattegat area surveyed, where increased NASC levels were measured more continuously.

In SD 22, mean NASC values recorded were also higher than the previous year in 6 out of 11 rectangles surveyed (similar values recorded in 2 out of 11 rectangles). In some rectangles, the increase in NASC measured was almost tenfold, but originated from only short transect sections in the 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 showed decreased NASC values. No clear aggregation or area of increased NASC measurements was evident.

As in the previous year, the large aggregations of big herring that usually can be observed in SD 23 in the Sound were not present in autumn 2018. Although NASC values were distinctly higher than the levels measured in 2017, they still were well below the long-term survey mean. A replicate measurement of parts of the transect in SD 23 during night time and a full daytime replicate a few days later corroborated these findings, although daytime measurements showed somewhat increased NASC values in the area.

In SD 24, mean NASC values were significantly lower than the values measured in 2017 in 6 out of 9 rectangles surveyed. The only exception -with a fourfold increase from the previous year- was rectangle 37G2 (west of Fischland-Darß-Zingst Peninsula), an area with usually very low NASC measurements. As in the years before, higher aggregations were detected north-east and east of Rügen Island, but also –to a lesser degree- in the central and northern parts of the Arkona Basin.

3.2 Biological data (T. Gröhsler)

Fishery hauls according to ICES Subdivision:

SD	Hauls (n)
21	15 (incl. 1 invalid haul)
22	18
23	8 (incl. 3 daytime hauls)
24	21 (incl. 1 invalid haul)

Altogether, 1 623 individual herring, 917 sprat, 295 European anchovies and 166 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, 41 different species were recorded. Herring were caught in 58, sprat in 56 hauls (of 58 day- and nighttime hauls). SD 23, which is typically characterized by the highest mean catch rates per station (kg 0.5 h^{-1}), showed the lowest values ever recorded (during nighttime hauls). In contrast to 2017, when sardines (*Sardina pilchardus*) only appeared in catches from SD 21, this species in 2018 was also caught in SD 22 and SD 23. As in previous years, anchovy (*Engraulis encrasicolus*) were present in the whole survey area, albeit in a higher frequency of occurrence compared to 2017 (7 of 57 hauls in 2017; 26 of 58 day- and nighttime hauls in 2018).

Altogether, the following fish species were sampled and processed:

Species	Length measurements (n)	Prevalence (n of hauls)
Aphia minuta	761	37
Belone belone	22	13
Clupea harengus	12 915	58
Ctenolabrus rupestris	49	8
Cyclopterus lumpus	8	5
Engraulis encrasicolus	523	26
Eutrigla gurnadus	14	7
Gadus morhua	248	24
Gasterosteus aculeatus	1 214	39
Gobius niger	14	7
Limanda limanda	222	19
Merlangius merlangus	887	44
Merluccius merluccius	12	3
Mullus surmuletus	3	3
Neogobius melanostomus	8	3
Platichthys flesus	51	13
Pleuronectes platessa	28	10
Pomatoschistus minutus	208	32
Sardina pilchardus	245	17
Scomber scombrus	195	16
Sprattus sprattus	10 515	56

Species	Length measurements (n)	Prevalence (n of hauls)
Trachinus draco	177	17
Trachurus trachurus	617	46
Trisopterus esmarkii	30	4
Others	183	-

Figures 3 and 4 show relative length-frequency distributions of herring and sprat in ICES subdivisions 21, 22, 23 and 24 for the years 2017 and 2018. Compared to results from the previous survey in 2017, the following conclusions for **herring** can be drawn (Figure 3):

- Catches in SD 21 showed a multimodal distribution with modes at 11.75 cm, 15.25-15.75 cm and 21.2.5-21.75 cm. This is in contrast to 2017, when a bimodal distribution showed modes at 14.75 and 17.75 cm,
- The catches in SD 22 were dominated by the incoming year class (ca. ≤15 cm) with a mode at 13.25 cm. This is in contrast to a multimodal distribution with two modes at 11.25 cm and 15.26 cm and one mode of 18.75 cm in 2017.
- As in the two years before, larger herring (>20 cm) were more or less absent from night time catches conducted in SD 23. The catches in 2018 as in 2017 were dominated by the contribution of the incoming year class (ca. ≤15 cm), showing a mode at 13.25 cm in 2017 and at 12.25 in 2018 cm.
- In SD 24, the herring length-frequency distribution was characterized by a similar contribution of the incoming year class (ca. ≤15 cm) and older herring (>15 cm) in both years. However, the bimodal distribution in 2018 showed a higher contribution of younger herring (ca. ≤15 cm) (≤15 cm: mode 2017/11.75 cm and mode 2018/13.75 cm; >15 cm: mode 2017/18.25 cm and mode 2018/17.75 cm).

Relative length-frequency distributions of **sprat** in the years 2017 and 2018 (Figure 4) can be characterized as follows:

- In SD 21 catches of the incoming year class (ca. ≤10 cm) were virtually absent in both years. The catches were dominated by the contribution of larger sprat.
- In SDs 22 and 24, the sprat length-frequency distribution was characterized by a similar contribution of the incoming year class (ca. ≤10 cm) and older sprat in both years. However, the bimodal distribution in 2018 showed slightly more of the incoming year class (<10 cm), at the same time less of older sprat.
- In SD 23, the catches were dominated by the incoming year class (ca. ≤10 cm) in 2018, whereas the catches in 2017 showed a bimodal distribution with equivalent contributions of the incoming year class (ca. ≤10 cm) and older sprat.
- Altogether, the present contribution of the incoming year class (ca. ≤10 cm) seemed to be rather low.

3.3 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 summarized in Table 9 and Table 12.

3.3.1 Herring incl. Central Baltic Herring (CBH)

The herring stock in Subdivisions 21-24 was estimated to be 4.3 x 10^9 fish (Table 7) or 90.0 x 10^3 tonnes (Table 9). For the included area of Subdivisions 22-24 the number of herring was calculated to be 2.9 x 10^9 fish or 59.8 x 10^3 tonnes.

3.3.2 Herring excl. Central Baltic Herring (CBH)

Estimated numbers of herring excluding CBH in SDs 21-24 by age group and SD/rectangle for 2017 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.

Removal of the CBH fraction in SD 24 (and in rectangle 39G2 of SD 23) from the herring HAWG-GERAS index (standard index area: excl. results of rectangles 43G1 and 43G2 of SD 21 as well as 37G3 and 37G4 of SD 24) resulted in biomass reductions of 19.8 % with corresponding reductions in numbers of 10.9 % (-15.8 % and -12.7 %, respectively in 2017; Figure 5).

3.3.3 Sprat

The estimated sprat stock in Subdivisions 21-24 was 4.7 x 10^9 fish (Table 10) or 57.2 x 10^3 tonnes (Table 12). For the included area of Subdivisions 22-24 the number of sprat was calculated to be 3.8 x 10^9 fish or 43.1 x 10^3 tonnes. The overall abundance estimate in 2018 was dominated by on year old sprat (year class 2017, Figure 4 and Table 10).

3.4 Hydrography

Vertical profiles of temperature and salinity 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, 106 CTD casts were conducted during this survey.

Surface temperatures ranged from ca. 14°C in the Kiel Bight (SD 22) and ca. 13 °C in the Kattegat area to (SD 21) around 10-11°C in the northern Arkona Basin (SD 24)(Figure 6). Bottom temperatures were similar in most parts of Subdivisions 21, 22 and 23, but due to strong thermohaline layering in most parts of the Arkona Basin and the area of the Bornholm Basin covered were significantly different in SD 24. While bottom temperatures in the central Arkona Sea exceeded surface temperatures (maximum temperatures around 13 °C), bottom temperatures in the Bornholm Basin area were comparatively low at around 8 °C.

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). Compared to 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 anoxic conditions were measured in the inner Mecklenburg Bight/Bay of Lübeck as well as in the southwestern part of the Little Belt (SD 22). Anoxic conditions above the seafloor were observed in the southern part of the Little Belt and the inner Mecklenburg Bight. Reduced oxygen levels were also measured in the deeper parts of the Bornholm Basin area covered.

4 DISCUSSION

Compared to 2017, the present estimates of herring (total survey area incl. CBH) show a further significant decrease in stock biomass, whereas abundance values increased:

Herring (incl. CBH)	Difference compared to 2017	
Area	Numbers (%)	Biomass (%)
Subdivisions 22-24	+18	-41
Subdivisions 21-24	+56	-19

Herring (excl. CBH)	Difference compared to 2017	
Area	Numbers (%)	Biomass (%)
Subdivisions 22-24	+19	-49
Subdivisions 21-24	+63	-22

Compared to 2017, the present significant increase in numbers together with the continuing decrease in biomass was mainly driven by a higher contribution of 0-group herring (2018/2017: +177 %) that are characterized by lower mean weights, and also by a lower number of older and thus heavier herring of ages 2-7 (-39 %). The present herring biomass estimates (total survey area incl. CBH & excl. CBH) represent the second lowest recorded values in the whole time series since 1993.

The usually recorded dominant high number of large herring fish in SD 23 (the Sound), which is seen as an important transition and aggregation area for the WBSSH stock during its spawning migration (Nielsen, 1996), was in 2018 as in 2016-2017 for the third time since many years almost absent. This complete absence could, as in the previous year, be explained by delayed immigration of WBSSH from the feeding areas in the Skagerrak in 2018. The exceptionally low numbers in 2016 and even further decreased numbers in 2017 and 2018 of large and older herring could also be explained by the very low recruitment, which was recorded by the N20 during the last years. The sustained downward trend in recruitment could explain the further disappearance of older herring in time. The strong correlation of N20 with the 1-age group (Polte et al., 2018) of GERAS index 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. While differences in catchability might contribute to varying fractions of (old) herring in daytime vs. nighttime catches, as indicated by a higher fraction of big WBBSH in the daytime hauls, the small-scale NASC distribution recorded during the regular night-transect in SD 23 and another comparison sampling during daytime a few days later did not differ notably between the two transect runs (Figure 7). Possible shifts in distribution of the large herring aggregations towards shallower areas that cannot be surveyed with the current survey design and setup may also have occurred. During daytime passes of the survey area (transition) as well as during the comparison survey in SD 23 during daytime, aggregations of angling boats in shallow areas (but partly also areas covered in the survey) were observed with occupants catching big herring with rod and line. Additionally, during a diversion of the vessel into Copenhagen port for disembarking of a crew member after the survey had been accomplished, enormous and continuous aggregations of clupeids were detected on the echosounder in shallow water (depth < 15 m). A comparison with echorecordings from this section, if available from previous years, is intended to address these possible shifts and to investigate whether a corresponding fraction of herring had been distributed in these areas in years with high registrations along the regular transects as well.

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 2018, no such migration can 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	Hydroacoustics, Cruise leader	TI-SF
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M. Koth	Fishery biology	TI-OF
S.-E. Levinsky	Fishery biology	DTU Aqua (DK)
S. Winning	Fishery biology	TI-OF/TI-SF

6 REFERENCES

Arivis (2014) GERIBAS II software, version 2.1.0.

Echoview Software Pty Ltd (2018) Echoview software, version 9. Echoview Software Pty Ltd, Hobart, Australia.

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.

Gröhsler, T., Oeberst, R., Schaber, M., Larson, N. and Kornilovs, G. (2013) Discrimination of western Baltic spring-spawning and central Baltic herring (*Clupea harengus* L.) based on growth vs. natural tag information. ICES Journal of Marine Science, 70 (6): 1108-1117. doi:19.1093/icesjms/fst064.

Gröhsler, T., Schaber, M., Larson, N. and Oeberst, R. (2016) Separating two herring stocks from growth data: long-term changes in survey indices for Western Baltic Spring Spawning Herring (*Clupea harengus*) after application of a stock separation function. Journal of Applied Ichthyology 32: 40-45; doi: 10.1111/jai.12924

Gröhsler, T. and Schaber, M. (2019 in prep.). Applicability of the Separation Function (SF) in 2018. WD for WGBIFS 2019.

Gröhsler, T. and Schaber, M. (2018). Applicability of the Separation Function (SF) in 2017. WD for WGBIFS 2018.

ICES (2017) SISP Manual of International Baltic Acoustic Surveys (IBAS). Series of ICES Survey Protocols SISP 8 – IBAS. 47pp.

ICES (2015) Report of the Workshop on scrutinisation procedures for pelagic ecosystem surveys (WKSCRUT). ICES CM 2015 / SSGIEOM: 18

ICES (2013) Report of the Benchmark Workshop on Pelagic Stocks (WKPELA 2013). ICES Document CM 2013/ACOM: 46

ICES (1983) Report of the Planning Group on ICES coordinated herring and sprat acoustic surveys. ICES Document CM 1983/H:12.

Miethe, T., Gröhsler, T., Böttcher, U. and von Dorrien, C. (2014) The effects of periodic marine inflow into the Baltic Sea on the migration patterns of Western Baltic spring-spawning herring. ICES Journal of Marine Science, 71(3): 519-527.

Nielsen, J. R. (1996) Acoustic monitoring of herring related to the establishment of a fixed link across the Sound between Copenhagen and Malmö. DFU-rapport Nr. 11-96, ISSN 1395-8216, 93pp.

Oeberst, R., Gröhsler, T., Schaber, M. and Larsen, N. (2013) Applicability of the Separation Function (SF) in 2011 and 2012. WD 01 for HAWG. ICES Document CM 2013/ACOM06: Sec 14: 819-825 & WD for WGBIFS. ICES Document CM 2013/SSGESST:08: Annex 9: 399-405.

Oeberst, R., Gröhsler, T. and Schaber, M. (2014) Applicability of the Separation Function (SF) in 2013. WD for WGIPS 2014.

Oeberst, R., Gröhsler, T. and Schaber, M. (2015) Applicability of the Separation Function (SF) in 2014. WD for WGIPS 2015.

Oeberst, R., Gröhsler, T. and Schaber, M. (2016) Applicability of the Separation Function (SF) in 2015. WD for WGBIFS 2016.

Oeberst, R., Gröhsler, T. and Schaber, M. (2017) Applicability of the Separation Function (SF) in 2016. WD for WGIPS 2017.

Gröhsler, T. and Schaber, M. (2018) Applicability of the Separation Function (SF) in 2017. WD for WGBIFS 2018.

Polte, P. and Groehsler, T. (2018) 2017 Western Baltic spring spawning herring recruitment monitored by the Rügen Herring Larvae Survey. WD for HAWG. ICES Document CM 2018/ACOM07: Annex 6: 868-871

7 FIGURES

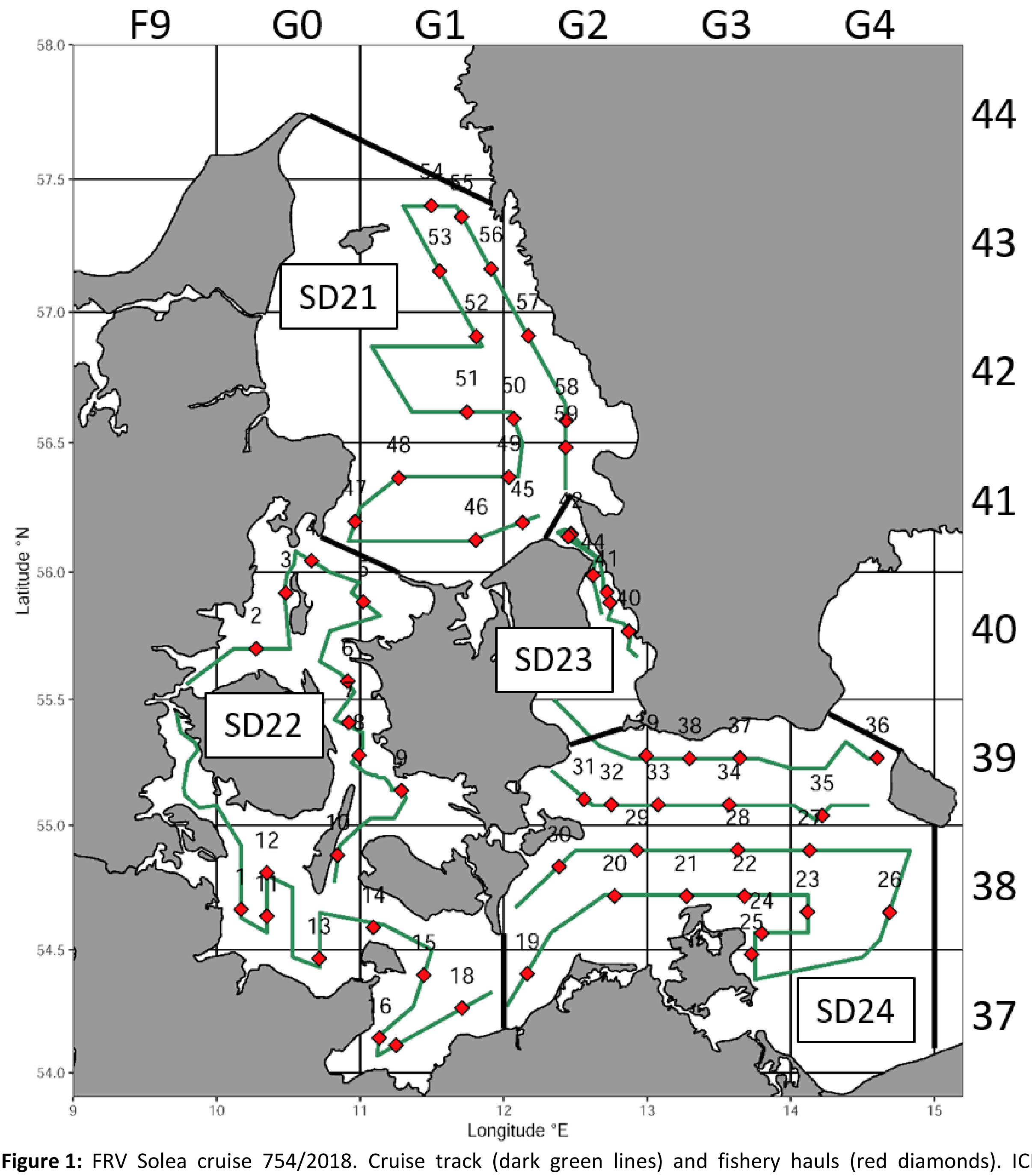

Figure 1: FRV Solea cruise 754/2018. Cruise track (dark green lines) and fishery hauls (red diamonds). ICES statistical rectangles are indicated in the top and right axis. Thick black lines separate ICES subdivisions (SD).

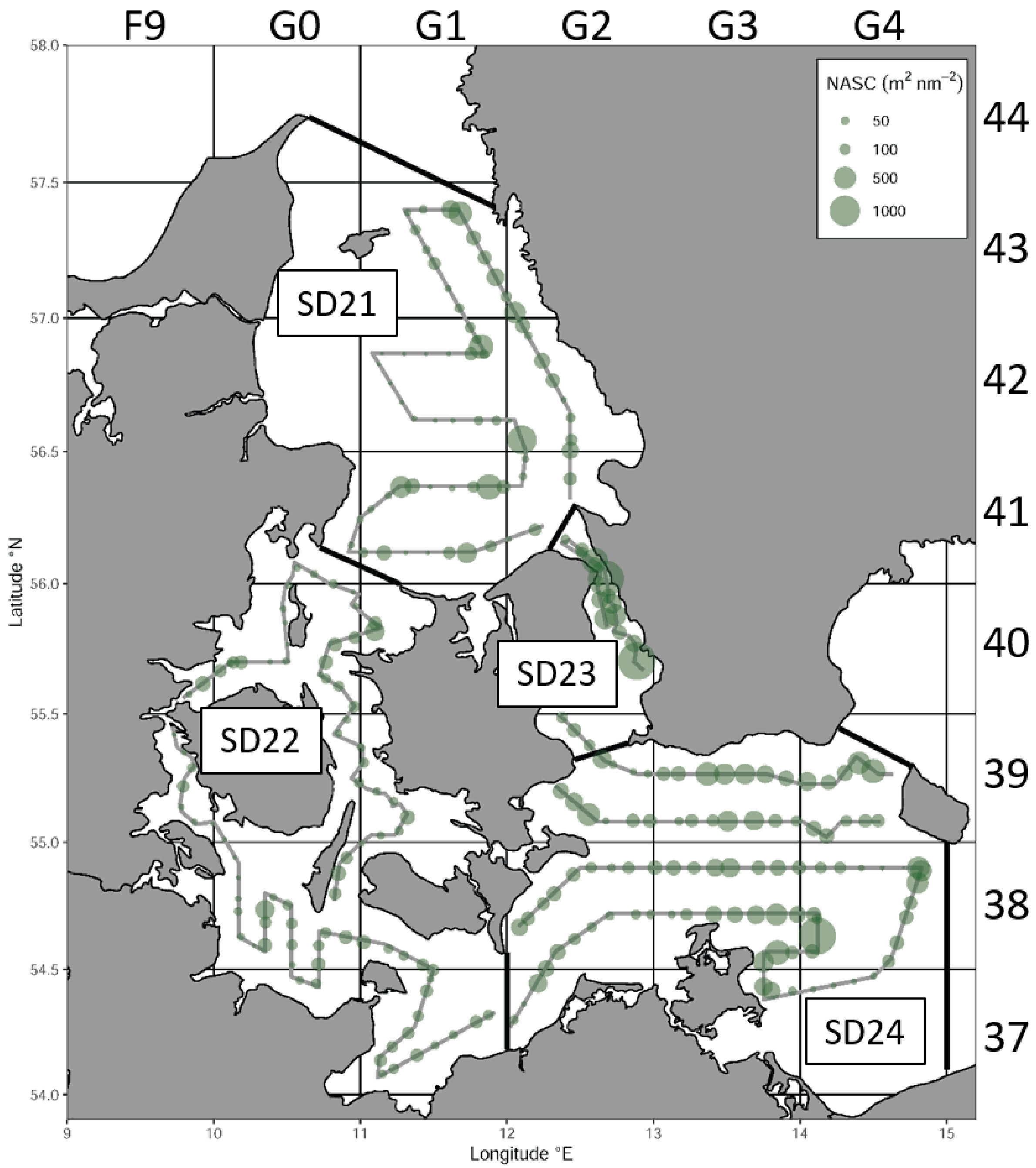

Figure 2: FRV Solea cruise 754/2018. Cruise track (thin grey lines) and mean NASC (5 nmi intervals, dots). ICES statistical rectangles are indicated in the top and right axis. Thick black lines separate ICES subdivisions (SD).

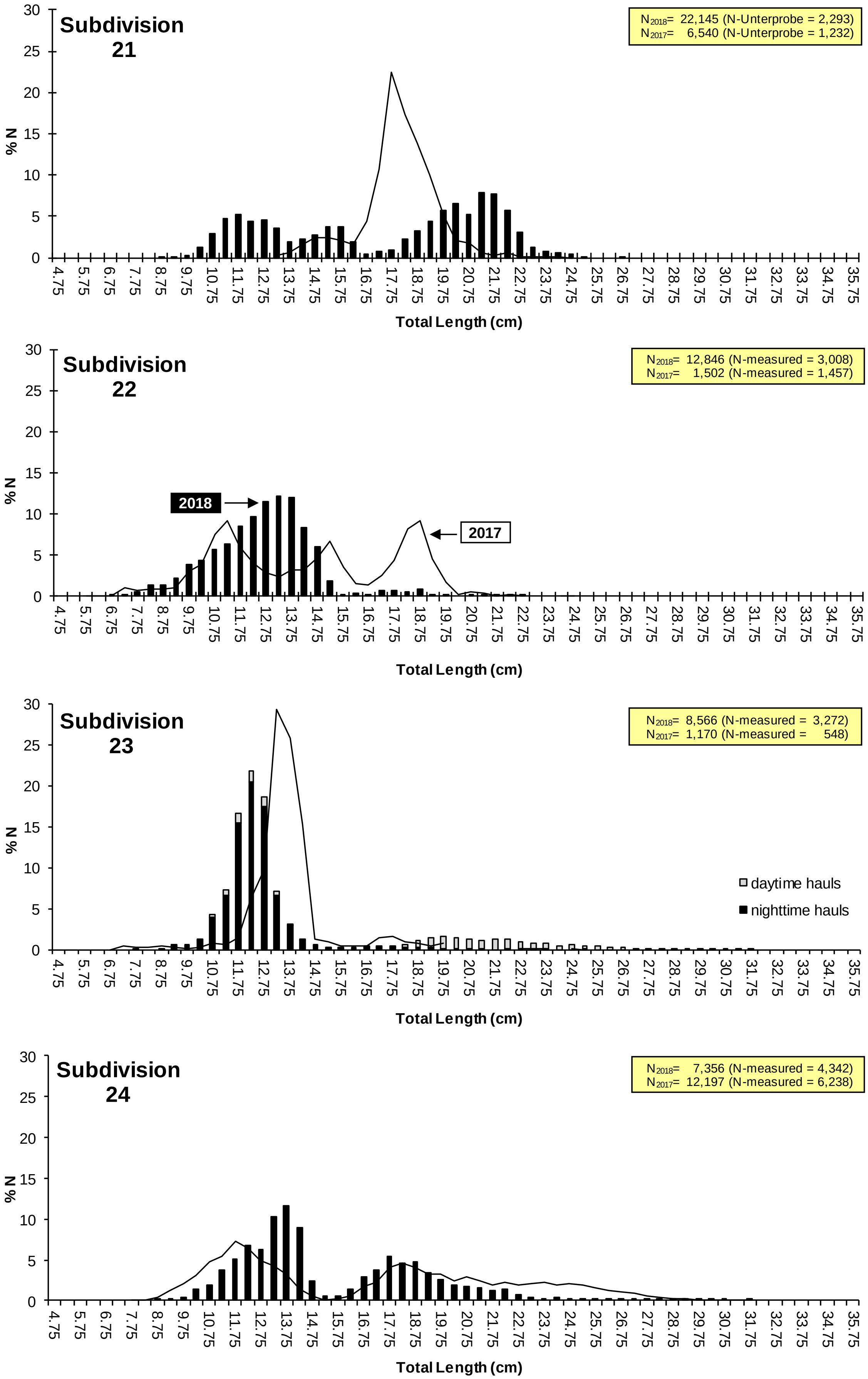

Figure 3: FRV Solea cruise 754/2018. Herring (*Clupea harengus*) length-frequency distribution (bars) compared to previous year (cruise 740/2017, lines). Daytime comparison hauls conducted in SD 23 are included.

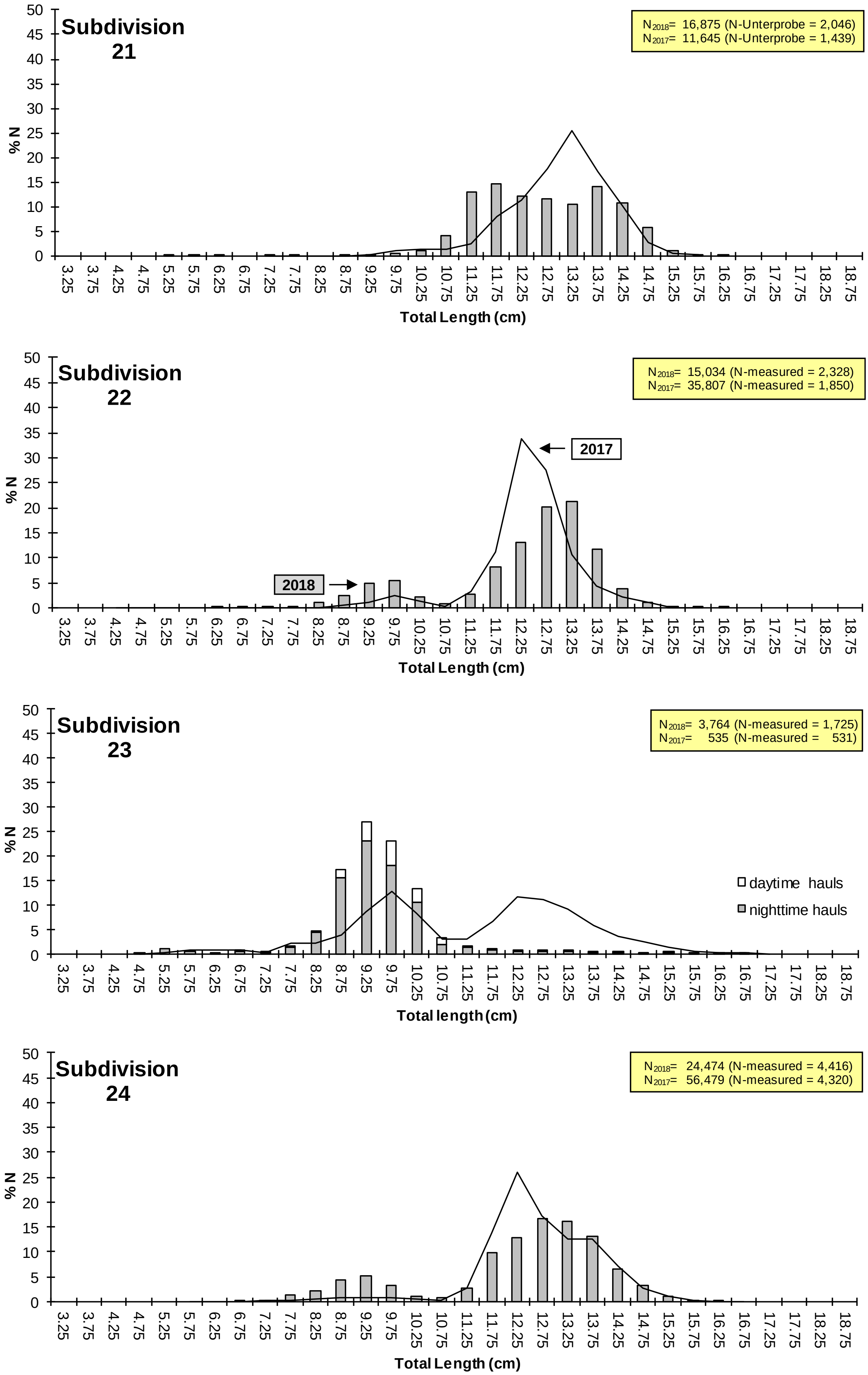

Figure 4: FRV Solea cruise 754/2018. Sprat (*Sprattus sprattus*) length-frequency distribution (bars) compared to previous year (cruise 740/2017, lines). Daytime comparison hauls conducted in SD 23 are included.

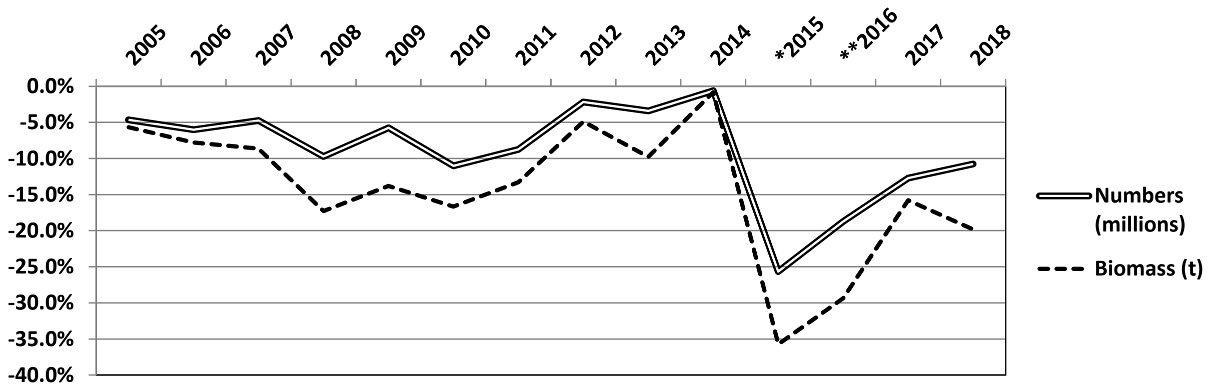

Figure 5: Relative changes in abundance and biomass of Western Baltic Spring Spawning herring in ICES Subdivisions 21-24 (2005-2018) after application of the stock separation function (SF, Gröhsler et al., 2013) to the abundance and biomass index generated from German acoustic survey data (GERAS). **2015 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*

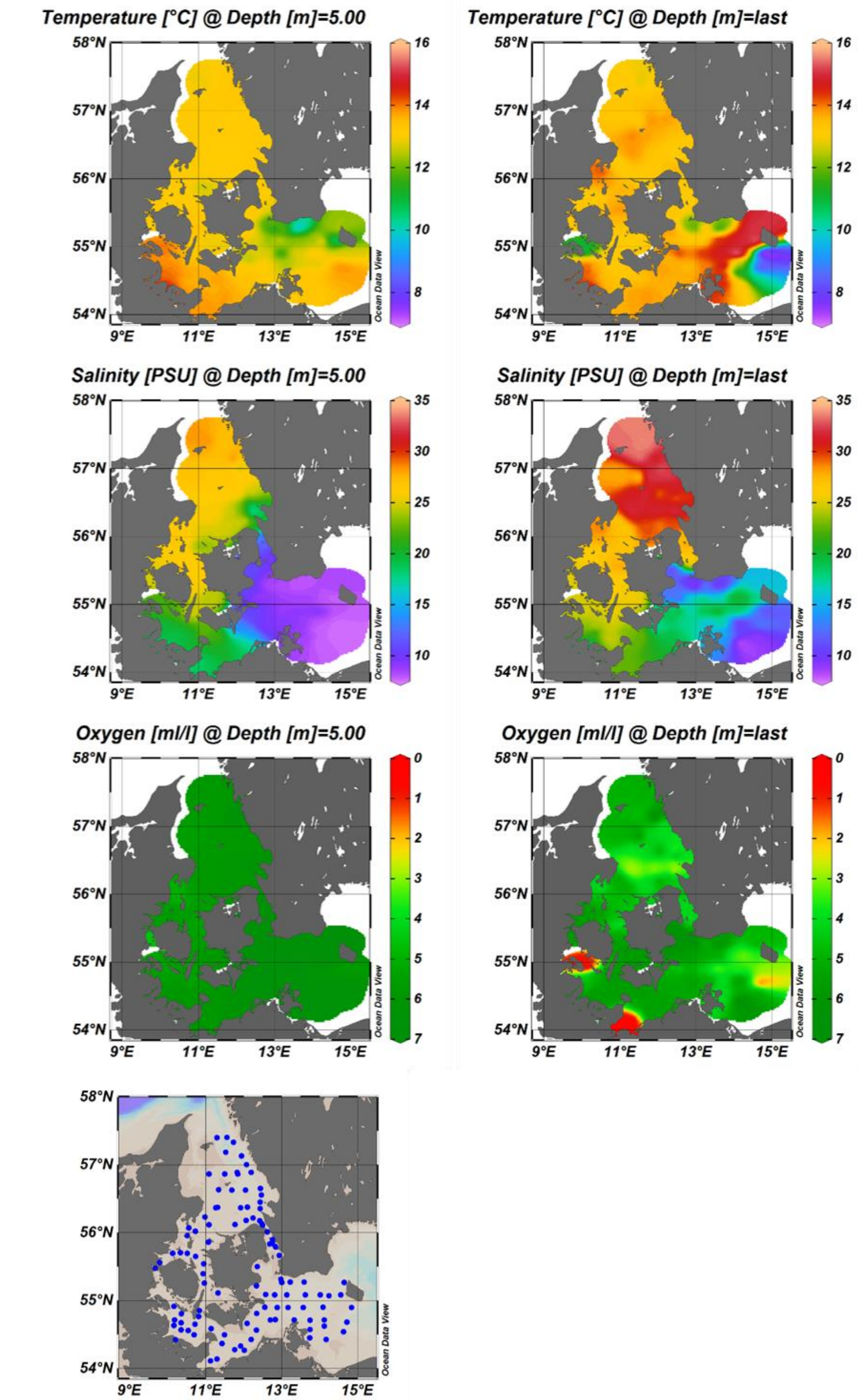

Figure 6: FRV Solea cruise 754/2018: Hydrography. CTD stations are depicted as blue dots in the area map (lower panel). Temperature (°C, top panels), salinity (PSU, middle panels and oxygen concentration (ml/l, lower panels) near the surface (left) and near the seafloor (right).

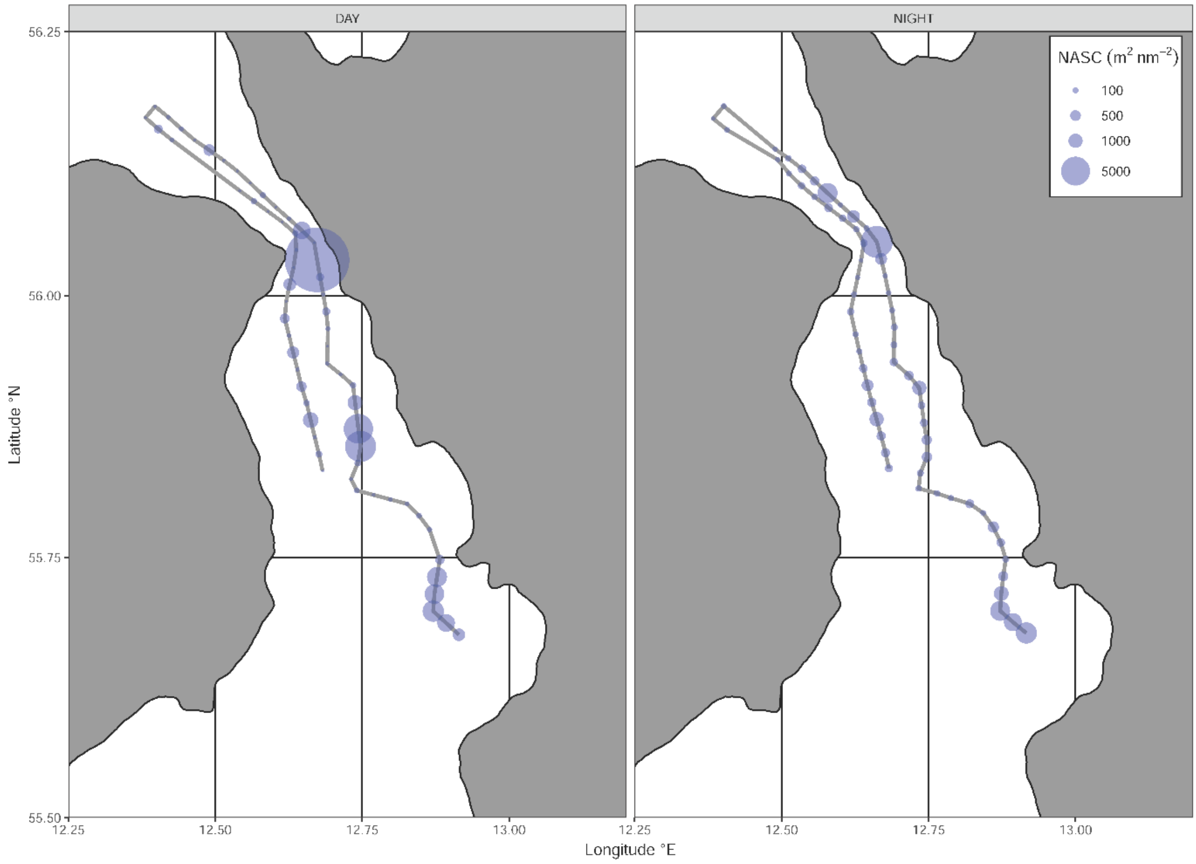

Figure 7: FRV Solea cruise 754/2018. Comparison of NASC-values/clupeid distribution during night (left) and daytime (right) sampling in the Sound (ICES Subdivision 23). Cruise track (thin grey lines) and mean NASC (1 nmi intervals, dots).

8 TABLES

Table 1: FRV Solea cruise 754/2018: Simrad EK80 calibration report (38 kHz Transducer).

Date:	01.10.2018		
Calibration Site:	Strande Bay/Kiel Bight (54°25.35 N, 10°12.29 E)		
Transceiver Type:	WBT		
Software Version:	EK80 1.12.2		
Reference Target:	Tungsten (WC-Co) 38.1 mm		
Transducer:	ES38-7 Serial No. 147		
Frequency:	38000 Hz	Beamtype:	Split/Narrow
Gain:	26.62 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.:	0.005297	Sound Velocity:	1487.32 m/s
Temperature:	14.7 °C	Salinity:	19 PSU
Calibration results:			
Transducer Gain:	26.81 dB	SaCorrection:	-0.08 dB
Beamwidth Athw.:	6.32 deg	Beamwidth Along.:	6.19 deg
Offset Athw.:	-0.25 deg	Offset Along.:	0.08 deg
RMS-Error:	0.10		

Table 2: FRV Solea cruise 754/2018: Catch composition (kg 0.5 h^{-1}) by haul in SD 21.

Haul No.	45	46	47	48	49	50	51	53	54	55	56	57	58
Species/ICES Rectangle	41G2	41G1	41G0	41G1	41G2	42G2	42G1	43G1	43G1	43G1	43G1	42G2	42G2
APHIA MINUTA			0.02		0.01		+	+	+	0.01	0.01	+	0.01
BELONE BELONE						0.09	0.04		0.09	0.04			
CARCINUS									0.01	+		+	
CLUPEA HARENGUS	0.86	773.09	0.10	40.81	0.51	12.76	1.48	0.54	30.40	9.53	31.81	0.62	5.32
ENGRAULIS ENCRASICOLUS				0.14	0.54	0.02	2.08	0.02	0.77	1.38		0.04	0.01
EUTRIGLA GURNARDUS				0.12			+			+			
GASTEROSTEUS ACULEATUS		0.01			+	+	+		0.01				
LIMANDA LIMANDA				0.24									
LOLIGO	0.03			0.01	0.04	0.01				0.02		0.03	0.02
LOLIGO FORBESI				0.01		+	0.05	0.01	+	0.22	0.01	0.01	
MERLANGIUS MERLANGUS		0.15		0.15		0.12	0.30		0.18	0.46		0.01	0.52
MERLUCCIUS MERLUCCIUS								0.01		0.01			
MULLUS SURMULETUS										0.01			
POLLACHIUS VIRENS				1.04									
POMATOSCHISTUS MINUTUS			+					+	+	+		+	+
SARDINA PILCHARDUS		0.07		0.07		0.02			0.03	1.26	0.20		0.30
SCOMBER SCOMBRUS		3.51	0.23	1.18	0.59		1.98	11.99	0.28	0.22	0.17	3.19	2.83
SEPIOLA								+		0.05	0.01	+	
SPRATTUS SPRATTUS		114.26	0.05	92.57	0.08	0.10	2.32	0.01	0.21	4.33	14.41	0.56	32.28
SQUALUS ACANTHIAS										12.28	1.70		
TRACHINUS DRACO	0.03	1.52		4.82		0.39	2.53	0.11	0.18	0.08	0.04	0.28	0.37
TRACHURUS TRACHURUS		0.02	+	0.10	0.39	+	+	0.03	0.04	0.28	0.08	0.12	0.06
TRISOPTERUS ESMARKI									0.01	0.10			
TRISOPTERUS MINUTUS										0.08			
Total	**0.92**	**892.63**	**0.40**	**141.26**	**2.16**	**13.51**	**10.78**	**12.72**	**32.21**	**30.36**	**48.44**	**4.86**	**41.72**
Medusae	0.47	0.00	7.07	1.06	0.31	0.41	0.23	0.15	3.28	1.05	1.33	0.18	2.27

Haul 52
not valid

Haul No.	59	Total
Species/ICES Rectangle	41G2	
APHIA MINUTA	0.01	**0.07**
BELONE BELONE		**0.26**
CARCINUS		**0.01**
CLUPEA HARENGUS	6.59	**914.42**
ENGRAULIS ENCRASICOLUS		**5.00**
EUTRIGLA GURNARDUS		**0.12**
GASTEROSTEUS ACULEATUS	+	**0.02**
LIMANDA LIMANDA	0.05	**0.29**
LOLIGO	+	**0.16**
LOLIGO FORBESI		**0.31**
MERLANGIUS MERLANGUS	0.12	**2.01**
MERLUCCIUS MERLUCCIUS	0.00	**0.02**
MULLUS SURMULETUS		**0.01**
POLLACHIUS VIRENS		**1.04**
POMATOSCHISTUS MINUTUS		**+**
SARDINA PILCHARDUS	0.02	**1.97**
SCOMBER SCOMBRUS		**26.17**
SEPIOLA		**0.06**
SPRATTUS SPRATTUS	4.13	**265.31**
SQUALUS ACANTHIAS		**13.98**
TRACHINUS DRACO	0.29	**10.64**
TRACHURUS TRACHURUS	0.44	**1.56**
TRISOPTERUS ESMARKI		**0.11**
TRISOPTERUS MINUTUS		**0.08**
Total	**11.65**	**1243.62**
Medusae	3.81	21.61

+ = < 0.01 kg

Table 3: FRV Solea cruise 754/2018: 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**	**40G0**	**40G0**	**41G0**	**40G1**	**40G0**	**39G0**	**39G0**	**39G1**	**38G0**	**38G0**	**38G0**	**37G0**
APHIA MINUTA		+	+	0.01	+	0.01	0.04		0.01	+		+	+
BELONE BELONE	0.03				0.05	0.09	0.05	0.13	0.05	0.18			
CLUPEA HARENGUS	0.86	0.44	0.79	0.91	0.81		2.08	103.78		6.58	4.62	0.42	10.25
CRANGON CRANGON			+				+		0.01	+			
CTENOLABRUS RUPESTRIS			0.02		0.01		0.05		0.23				0.02
CYCLOPTERUS LUMPUS	0.07									0.71			
ENGRAULIS ENCRASICOLUS	+		0.15	0.60	0.12		0.06	0.19	0.02				0.03
EUTRIGLA GURNARDUS								0.03					
GADUS MORHUA									0.04	0.30			
GASTEROSTEUS ACULEATUS	0.15	0.08		+			+		5.50	0.01	1.00	0.17	+
GOBIUS NIGER			0.01	+	+		+		0.02				
LIMANDA LIMANDA			0.37	0.01	0.01		0.02	0.13	0.03	0.22			0.13
LOLIGO							+						
LOLIGO FORBESI	+		+	0.01			+						
MERLANGIUS MERLANGUS	0.02		0.01	0.12	0.08		0.02	0.36		0.02		0.02	0.01
MULLUS SURMULETUS			0.01	0.01									
NEOGOBIUS MELANOSTOMUS					0.01				0.01				
PLATICHTHYS FLESUS													
PLEURONECTES PLATESSA								0.44					
POLLACHIUS VIRENS										3.94			
POMATOSCHISTUS MINUTUS			+		0.01		+		0.01			+	
PUNGITIUS PUNGITIUS									+				
SARDINA PILCHARDUS								0.16					0.01
SCOMBER SCOMBRUS								1.90					0.04
SOLEA VULGARIS										0.71	0.26		
SPRATTUS SPRATTUS	0.29	0.75	0.06	0.03	0.04		0.25	134.79		8.30	13.81		22.97
SYMPHODUS MELOPS								0.01					
SYNGNATHUS TYPHLE									+				
TRACHINUS DRACO				0.12	0.19								
TRACHURUS TRACHURUS		0.01	0.01	0.08	0.02	0.01	0.06	0.28	0.06	0.01	+		0.09
TRISOPTERUS ESMARKI	+												
TRISOPTERUS MINUTUS										+			
Total	**1.42**	**1.28**	**1.43**	**1.90**	**1.35**	**0.11**	**2.63**	**242.20**	**5.99**	**20.98**	**19.69**	**0.61**	**33.55**
Medusae	14.44	43.12	4.86	3.67	1.93	2.81	2.31	3.01	2.62	3.20	7.63	12.26	16.77

Haul No.	**14**	**15**	**16**	**17**	**18**	**Total**
Species/ICES Rectangle	**38G1**	**37G1**	**37G1**	**37G1**	**37G1**	
APHIA MINUTA	+		+		+	**0.07**
BELONE BELONE			0.09			**0.67**
CLUPEA HARENGUS	14.03	4.25	2.39	8.23	7.04	**167.48**
CRANGON CRANGON		+				**0.01**
CTENOLABRUS RUPESTRIS	+				0.01	**0.34**
CYCLOPTERUS LUMPUS						**0.78**
ENGRAULIS ENCRASICOLUS					0.03	**1.20**
EUTRIGLA GURNARDUS				0.01		**0.04**
GADUS MORHUA		0.38	2.13			**2.85**
GASTEROSTEUS ACULEATUS	0.05		0.04	0.58	0.17	**7.75**
GOBIUS NIGER						**0.03**
LIMANDA LIMANDA	0.67	19.80		0.08	0.92	**22.39**
LOLIGO						**+**
LOLIGO FORBESI						**0.01**
MERLANGIUS MERLANGUS	0.04	2.54		0.08	0.40	**3.72**
MULLUS SURMULETUS						**0.02**
NEOGOBIUS MELANOSTOMUS						**0.02**
PLATICHTHYS FLESUS		0.48	0.47		0.33	**1.28**
PLEURONECTES PLATESSA	0.45	1.15		0.18		**2.22**
POLLACHIUS VIRENS						**3.94**
POMATOSCHISTUS MINUTUS	+			+		**0.02**
PUNGITIUS PUNGITIUS						**+**
SARDINA PILCHARDUS		0.02				**0.19**
SCOMBER SCOMBRUS	0.04	0.10				**2.08**
SOLEA VULGARIS						**0.97**
SPRATTUS SPRATTUS	4.41	13.03	0.34	0.10	2.58	**201.75**
SYMPHODUS MELOPS						**0.01**
SYNGNATHUS TYPHLE						**+**
TRACHINUS DRACO						**0.31**
TRACHURUS TRACHURUS	0.01		0.02	0.06	1.36	**2.08**
TRISOPTERUS ESMARKI						**+**
TRISOPTERUS MINUTUS						**+**
Total	**19.70**	**41.75**	**5.48**	**9.32**	**12.84**	**422.23**
Medusae	7.02	5.09	2.80	8.85	10.89	153.29

+ = < 0.01 kg

Table 4: FRV Solea cruise 754/2018: Catch composition (kg 0.5 h^{-1}) by haul in SD 23.

Haul No.	40	41	42	43	44	*60	*61	*62	Total
Species/ICES Rectangle	40G2	40G2	41G2	41G2	40G2	40G2	40G2	41G2	
APHIA MINUTA	0.14	0.08	0.03	0.03	0.01	+		+	0.29
CLUPEA HARENGUS	4.31	9.52	14.98	38.02	12.60	0.51	95.03	2.48	177.45
CRANGON CRANGON	+		+						+
CTENOLABRUS RUPESTRIS		+							+
ENGRAULIS ENCRASICOLUS	0.01		0.01			+	0.03		0.05
EUTRIGLA GURNARDUS			+	0.24					0.24
GADUS MORHUA	4.77	29.29			9.29		3.70		47.05
GASTEROSTEUS ACULEATUS	+	0.06	0.03	+	0.01		0.02		0.12
LEANDER	+		+						+
LIMANDA LIMANDA			0.72	1.77					2.49
LOLIGO			+				+	0.38	0.38
MERLANGIUS MERLANGUS	0.11	0.04	0.09	1.31	11.57	0.06			13.18
PLATICHTHYS FLESUS	0.43								0.43
PLEURONECTES PLATESSA					0.40				0.40
POMATOSCHISTUS MINUTUS	+	+		+	+				+
PSETTA MAXIMA				0.54					0.54
SARDINA PILCHARDUS	0.01	0.01			0.14	+	0.03	+	0.19
SEPIOLA				0.02					0.02
SPRATTUS SPRATTUS	9.82	0.32	1.62	3.08	3.93	2.26	1.60	0.35	22.98
TRACHINUS DRACO			0.05	0.37	0.07				0.49
TRACHURUS TRACHURUS	+	0.03	0.02	0.64	0.02		0.23	0.01	0.95
TRISOPTERUS ESMARKI		+							+
Total	**19.60**	**39.35**	**17.55**	**46.02**	**38.04**	**2.83**	**100.64**	**3.22**	**267.25**
Medusae	0.23	0.83	0.75	0.13	0.51	4.31	0.15	0.58	**7.49**

+ = < 0.01 kg

Table 5: FRV Solea cruise 754/2018: Catch composition (kg 0.5 h-1) by haul in SD 24.

Haul No.	19	20	21	22	23	24	25	26	27	28	29	30	32
Species/ICES Rectangle	37G2	38G2	38G3	38G3	38G4	38G3	37G3	38G4	38G4	38G3	38G2	38G2	39G2
APHIA MINUTA	+					+						+	+
BELONE BELONE					0.19								
CLUPEA HARENGUS	2.51	0.80	1.45	1.07	1.33	4.78	8.12	33.12	4.51	8.95	0.95	1.24	2.02
CRANGON CRANGON		+	+	+				+		+			+
CYCLOPTERUS LUMPUS											0.13	0.47	
ENGRAULIS ENCRASICOLUS			+										0.03
GADUS MORHUA	0.20	0.11	2.02	1.91	5.43	28.19	8.98	7.20	0.42	0.74			0.01
GASTEROSTEUS ACULEATUS		0.47	0.19	0.02				+	0.12	0.03	2.22	1.13	1.00
GOBIUS NIGER											+		+
LIMANDA LIMANDA	1.42	0.08		0.31									
MERLANGIUS MERLANGUS	0.09	1.11	0.70	10.44		110.99	15.61		0.46	3.46		0.02	+
MYOXOCEPHALUS SCORPIUS										+			
NEOGOBIUS MELANOSTOMUS													+
PLATICHTHYS FLESUS		0.16	0.64	1.27		4.45	2.34	0.21		0.46			
PLEURONECTES PLATESSA		1.61	1.25			0.28		0.22		0.55			
POMATOSCHISTUS MINUTUS		+	0.02	+		+	0.01	+		0.01	+	+	0.02
PUNGITIUS PUNGITIUS			+										
SCOMBER SCOMBRUS						0.55							
SCOPHTHALMUS RHOMBUS	0.55												
SPRATTUS SPRATTUS	5.57	0.39	11.78	77.20	56.20	4.62	4.37	13.78	4.53	20.99	0.01	0.71	0.16
STIZOSTEDION LUCIOPERCA						0.71	1.27						
TRACHURUS TRACHURUS	0.09	0.21	0.11	0.11		0.15	0.02	0.04		0.01			+
Total	**10.43**	**4.94**	**18.16**	**92.33**	**63.15**	**154.72**	**40.72**	**54.57**	**10.04**	**35.20**	**3.31**	**3.57**	**3.24**
Medusae	1.64	16.14	4.95	1.97	64.22	2.13	2.18	2.64	18.35	4.51	10.93	16.19	3.62

Haul 31 not valid

Haul No.	33	34	35	36	37	38	39	Total
Species/ICES Rectangle	39G3	39G3	39G4	39G4	39G3	39G3	39G2	
APHIA MINUTA	+	+					+	+
BELONE BELONE								0.19
CLUPEA HARENGUS	5.27	13.03	7.49	17.44	15.63	12.40	50.41	192.52
CRANGON CRANGON	+		+					+
CYCLOPTERUS LUMPUS		0.79						1.39
ENGRAULIS ENCRASICOLUS	0.04				0.02			0.09
GADUS MORHUA	3.81	1.36	1.00		10.07	5.30		76.75
GASTEROSTEUS ACULEATUS	0.13	0.12	0.02	0.09		0.01		5.55
GOBIUS NIGER								+
LIMANDA LIMANDA								1.81
MERLANGIUS MERLANGUS	0.01	1.66	1.08	0.24	0.12	0.29		146.28
MYOXOCEPHALUS SCORPIUS								+
NEOGOBIUS MELANOSTOMUS								+
PLATICHTHYS FLESUS		0.26					+	9.79
PLEURONECTES PLATESSA								3.91
POMATOSCHISTUS MINUTUS	0.01		+		+	+	0.01	0.08
PUNGITIUS PUNGITIUS								+
SCOMBER SCOMBRUS								0.55
SCOPHTHALMUS RHOMBUS								0.55
SPRATTUS SPRATTUS	0.32	25.63	2.47	21.42	3.41	11.66	28.12	293.34
STIZOSTEDION LUCIOPERCA								1.98
TRACHURUS TRACHURUS	0.01	+						0.75
Total	**9.60**	**42.85**	**12.06**	**39.19**	**29.25**	**29.66**	**78.54**	**735.53**
Medusae	1.30	0.54	2.79	0.63	4.55	3.94	1.60	**164.80**

+ = < 0.01 kg

Table 6: FRV Solea, cruise 754/2018. 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	40.2	0.261	166.50	4.08	3.06	6.80	5.10
21	41G1	946.8	121.9	2.394	482.10	44.19	55.38	213.04	266.97
21	41G2	432.3	77.3	1.316	253.93	48.59	39.64	123.39	100.65
21	42G1	884.2	49.5	1.550	282.37	24.10	40.54	68.05	114.47
21	42G2	606.8	219.9	2.227	599.17	54.31	42.97	325.42	257.49
21	43G1	699.0	129.3	1.393	648.82	72.44	18.77	470.00	121.80
21	43G2	107.0	357.2	1.399	273.20	57.40	35.06	156.80	95.79
21	Total	3,784.2			2706.09			1363.50	962.27
22	37G0	209.9	99.1	1.543	134.81	32.78	65.17	44.20	87.85
22	37G1	723.3	94.7	1.383	495.27	51.43	28.09	254.69	139.15
22	38G0	735.3	92.6	1.120	607.94	37.57	40.90	228.43	248.67
22	38G1	173.2	121.8	1.082	194.97	61.77	35.60	120.42	69.41
22	39F9	159.3	40.7	1.227	52.84	37.76	30.09	19.95	15.90
22	39G0	201.7	36.0	1.227	59.18	37.76	30.09	22.34	17.81
22	39G1	250.0	65.2	0.262	622.14	0.00	0.00	0.00	0.00
22	40F9	51.3	150.7	1.231	62.80	45.80	28.71	28.77	18.03
22	40G0	538.1	71.8	1.231	313.86	45.80	28.71	143.76	90.11
22	40G1	174.5	279.2	1.497	325.45	43.06	2.78	140.12	9.04
22	41G0	173.1	46.9	1.368	59.34	26.81	1.45	15.91	0.86
22	Total	3,389.7			2928.60			1018.59	696.83
23	39G2	130.9	132.8	1.050	165.56	46.43	3.32	76.88	5.49
23	40G2	164.0	485.3	1.633	487.38	44.60	28.63	217.36	139.55
23	41G2	72.3	501.0	1.289	281.01	75.75	16.12	212.88	45.29
23	Total	367.2			933.95			507.12	190.33
24	37G2	192.4	132.9	1.623	157.55	26.97	70.02	42.49	110.31
24	37G3	167.7	192.4	3.105	103.91	16.49	74.83	17.13	77.75
24	37G4	875.1	21.7	1.898	100.05	20.48	74.26	20.49	74.30
24	38G2	832.9	131.8	0.670	1638.45	11.85	10.57	194.18	173.23
24	38G3	865.7	254.5	3.112	707.97	8.26	76.26	58.49	539.87
24	38G4	1034.8	229.5	1.898	1251.25	20.48	74.26	256.22	929.15
24	39G2	406.1	181.7	1.094	674.48	37.67	22.26	254.11	150.15
24	39G3	765.0	262.0	2.355	851.08	46.04	46.68	391.83	397.30
24	39G4	524.8	278.8	2.341	625.01	27.39	68.69	171.18	429.30
24	Total	5,664.5			6,109.75			1406.12	2881.36
22-24	Total	9,421.4			9,972.30			2931.83	3768.52
21-24	Total	13,205.6			12,678.39			4295.33	4730.79

Table 7: FRV Solea, cruise 754/2018. 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	5.10	1.70								6.80
21	41G1	91.20	90.35	24.18	4.74	1.62	0.95				213.04
21	41G2	122.39	0.83	0.06	0.11						123.39
21	42G1	64.74	3.05	0.25							68.04
21	42G2	162.53	144.11	15.72	1.78	0.67	0.62				325.43
21	43G1	468.92	1.08								470.00
21	43G2	156.48	0.32								156.80
21	Total	1,071.36	241.44	40.21	6.63	2.29	1.57	0.00	0.00	0.00	1,363.50
22	37G0	41.12	2.66	0.13	0.07	0.15	0.07				44.20
22	37G1	229.70	21.86	0.56	1.07	1.39	0.10				254.68
22	38G0	223.66	4.09	0.36	0.09	0.22					228.42
22	38G1	120.11	0.06	0.19	0.06						120.42
22	39F9	19.07	0.70	0.13	0.03	0.03					19.96
22	39G0	21.35	0.78	0.14	0.03	0.03					22.33
22	39G1										0.00
22	40F9	28.77									28.77
22	40G0	143.76									143.76
22	40G1	113.75	14.93	10.25	0.90	0.28					140.11
22	41G0	12.25	2.69	0.72	0.03	0.23					15.92
22	Total	953.54	47.77	12.48	2.28	2.33	0.17	0.00	0.00	0.00	1,018.57
23	39G2	74.71	0.71	0.19	0.32	0.64	0.15	0.11		0.04	76.87
23	40G2	204.19	8.11	1.29	0.66	2.24	0.75	0.13			217.37
23	41G2	209.84	1.55	0.71	0.19	0.37	0.18	0.03			212.87
23	Total	488.74	10.37	2.19	1.17	3.25	1.08	0.27	0.00	0.04	507.11
24	37G2	36.63	2.00	0.64	0.97	1.79	0.30	0.12	0.02	0.02	42.49
24	37G3	3.30	0.94	2.28	3.06	3.20	2.16	0.95	0.36	0.89	17.14
24	37G4	7.41	2.49	1.18	2.37	3.96	1.87	0.57	0.28	0.36	20.49
24	38G2	177.60	5.74	0.51	2.05	6.23	1.23	0.60	0.11	0.11	194.18
24	38G3	27.44	4.67	3.41	5.77	9.12	4.50	1.63	0.64	1.32	58.50
24	38G4	92.61	31.09	14.71	29.63	49.56	23.43	7.16	3.51	4.53	256.23
24	39G2	234.24	6.64	1.13	2.66	6.76	1.58	0.76	0.17	0.17	254.11
24	39G3	169.98	55.86	14.87	36.25	73.55	26.79	8.03	3.21	3.29	391.83
24	39G4	9.09	25.49	11.82	28.75	46.53	30.02	10.15	4.29	5.05	171.19
24	Total	758.30	134.92	50.55	111.51	200.70	91.88	29.97	12.59	15.74	1,406.16
22-24	Total	2,200.58	193.06	65.22	114.96	206.28	93.13	30.24	12.59	15.78	2,931.84
21-24	Total	3,271.94	434.50	105.43	121.59	208.57	94.70	30.24	12.59	15.78	4,295.34

Table 8: FRV Solea, cruise 754/2018. 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	19.64	42.50								25.36
21	41G1	22.89	51.20	73.06	81.30	85.88	99.58				42.71
21	41G2	13.23	48.82	54.24	32.00						13.51
21	42G1	12.45	43.94	69.92							14.07
21	42G2	13.98	50.86	68.58	94.20	81.07	117.66				33.72
21	43G1	11.49	40.90								11.56
21	43G2	12.12	38.54								12.17
21	Total	13.23	50.77	71.26	83.95	84.47	106.72				22.16
22	37G0	10.90	34.81	68.00	31.00	33.56	52.00				12.68
22	37G1	10.06	34.69	63.16	46.61	34.77	52.00				12.60
22	38G0	9.07	36.19	78.50	31.06	34.43					9.70
22	38G1	9.33	63.80	63.80	63.80						9.47
22	39F9	14.16	35.77	66.43	48.78	34.32					15.34
22	39G0	14.16	35.77	66.43	48.78	34.32					15.32
22	39G1										0.00
22	40F9	11.77									11.77
22	40G0	11.77									11.77
22	40G1	18.89	42.80	65.12	63.80	35.94					25.14
22	41G0	18.07	38.02	71.90	32.41	37.50					24.18
22	Total	11.41	37.62	65.85	52.63	35.06	52.00	0.00	0.00	0.00	13.46
23	39G2	12.01	31.71	41.62	39.74	31.93	48.43	44.98		59.32	12.69
23	40G2	10.58	39.94	44.60	36.57	37.64	32.67	43.40			12.33
23	41G2	10.94	50.05	69.35	65.30	46.99	29.17	43.40			11.55
23	Total	10.95	40.89	52.37	42.10	37.58	34.28	44.04		59.32	12.06
24	37G2	12.92	29.79	27.81	36.72	32.09	35.43	41.92	67.38	67.38	15.58
24	37G3	9.04	38.06	59.92	59.90	55.09	56.46	62.23	65.36	62.02	47.94
24	37G4	10.12	34.25	53.15	50.08	42.32	51.20	54.82	54.15	60.90	32.86
24	38G2	10.08	33.15	36.89	36.25	34.34	38.23	36.73	47.05	51.17	12.19
24	38G3	10.49	34.57	56.06	56.09	47.02	57.99	57.79	65.73	62.27	32.01
24	38G4	10.12	34.25	53.15	50.08	42.32	51.20	54.82	54.15	60.90	32.87
24	39G2	12.69	32.48	35.51	37.85	33.77	41.66	39.73	45.23	56.11	14.44
24	39G3	13.53	33.45	43.73	41.97	37.16	43.47	51.71	47.85	58.31	28.07
24	39G4	14.19	33.96	53.72	68.89	54.06	86.92	90.18	91.30	89.49	61.30
24	Total	11.86	33.70	50.13	52.21	42.94	60.68	65.56	65.95	69.60	28.43
22-24	Total	11.46	35.06	53.22	52.12	42.77	60.36	65.37	65.95	69.57	20.40
21-24	Total	12.04	43.79	60.10	53.85	43.23	61.13	65.37	65.95	69.57	20.96

Table 9: FRV Solea, cruise 754/2018. 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	100.2	72.3								172.4
21	41G1	2,087.6	4,625.9	1,766.6	385.4	139.1	94.6				9,099.2
21	41G2	1,619.2	40.5	3.3	3.5						1,666.5
21	42G1	806.0	134.0	17.5							957.5
21	42G2	2,272.2	7,329.4	1,078.1	167.7	54.3	73.0				10,974.6
21	43G1	5,387.9	44.2								5,432.1
21	43G2	1,896.5	12.3								1,908.9
21	Total	14,169.6	12,258.6	2,865.4	556.6	193.5	167.6	0.0	0.0	0.0	30,211.2
22	37G0	448.2	92.6	8.8	2.2	5.0	3.6				560.5
22	37G1	2,310.8	758.3	35.4	49.9	48.3	5.2				3,207.9
22	38G0	2,028.6	148.0	28.3	2.8	7.6					2,215.3
22	38G1	1,120.6	3.8	12.1	3.8						1,140.4
22	39F9	270.0	25.0	8.6	1.5	1.0					306.2
22	39G0	302.3	27.9	9.3	1.5	1.0					342.0
22	39G1										0.0
22	40F9	338.6									338.6
22	40G0	1,692.1									1,692.1
22	40G1	2,148.7	639.0	667.5	57.4	10.1					3,522.7
22	41G0	221.4	102.3	51.8	1.0	8.6					385.0
22	Total	10,881.4	1,797.0	821.8	119.98	81.7	8.8	0.00	0.00	0.0	13,710.6
23	39G2	897.3	22.5	7.9	12.7	20.4	7.3	5.0		2.4	975.4
23	40G2	2,160.3	323.9	57.5	24.1	84.3	24.5	5.6			2,680.4
23	41G2	2,295.7	77.6	49.2	12.4	17.4	5.3	1.3			2,458.8
23	Total	5,353.3	424.0	114.7	49.3	122.1	37.0	11.9	0.0	2.4	6,114.6
24	37G2	473.3	59.6	17.8	35.6	57.4	10.6	5.0	1.4	1.4	662.1
24	37G3	29.8	35.8	136.6	183.3	176.3	122.0	59.1	23.5	55.2	821.6
24	37G4	75.0	85.3	62.7	118.7	167.6	95.7	31.3	15.2	21.9	673.3
24	38G2	1,790.2	190.3	18.8	74.3	213.9	47.0	22.0	5.2	5.6	2,367.4
24	38G3	287.9	161.4	191.2	323.6	428.8	261.0	94.2	42.1	82.2	1,872.3
24	38G4	937.2	1,064.8	781.8	1,483.9	2,097.4	1,199.6	392.5	190.1	275.9	8,423.2
24	39G2	2,972.5	215.7	40.1	100.7	228.3	65.8	30.2	7.7	9.5	3,670.5
24	39G3	2,299.8	1,868.5	650.3	1,521.4	2,733.1	1,164.6	415.2	153.6	191.8	10,998.4
24	39G4	129.0	865.6	635.0	1,980.6	2,515.4	2,609.3	915.3	391.7	451.9	10,493.9
24	Total	8,994.7	4,547.0	2,534.3	5,822.1	8,618.3	5,575.6	1,964.9	830.3	1,095.5	39,982.8
22-24	Total	25,229.3	6,768.0	3,470.8	5,991.4	8,822.1	5,621.5	1,976.8	830.3	1,097.9	59,808.0
21-24	Total	39,398.8	19,026.6	6,336.2	6,547.9	9,015.6	5,789.0	1,976.8	830.3	1,097.9	90,019.1

Table 10: FRV Solea, cruise 754/2018. Numbers (millions) of sprat by age and area.

Sub-division	Rectangle/ Age group	0	1	2	3	4	5	6	7	8+	Total
21	41G0		2.13	1.27	1.36	0.23	0.11				5.10
21	41G1		107.64	44.24	63.62	40.74	9.80		0.93		266.97
21	41G2	2.76	95.15	2.15	0.48	0.07	0.05				100.66
21	42G1		104.95	6.08	2.18	0.80	0.30		0.16		114.47
21	42G2	1.29	152.89	23.71	45.14	27.57	6.89				257.49
21	43G1	0.33	114.65	5.68	0.70	0.36	0.09				121.81
21	43G2	0.44	90.48	4.09	0.51	0.23	0.06				95.81
21	Total	4.82	667.89	87.22	113.99	70.00	17.30	0.00	1.09	0.00	962.31
22	37G0	10.27	16.12	38.92	9.98	11.65	0.73		0.16		87.83
22	37G1	54.51	35.43	23.55	6.59	10.20	6.22		2.65		139.15
22	38G0	113.11	30.40	65.46	17.48	20.42	1.42		0.38		248.67
22	38G1	69.22	0.19								69.41
22	39F9	0.96	4.49	6.65	1.65	1.99	0.15				15.89
22	39G0	1.08	5.03	7.45	1.85	2.23	0.17				17.81
22	39G1										0.00
22	40F9	10.98	0.50	3.57	1.36	1.41	0.20				18.02
22	40G0	54.89	2.52	17.83	6.82	7.04	1.02				90.12
22	40G1			5.11	1.97	1.97					9.05
22	41G0		0.33	0.34	0.09	0.09					0.85
22	Total	315.02	95.01	168.88	47.79	57.00	9.91	0.00	3.19	0.00	696.80
23	39G2	0.62	2.10	1.67	0.58	0.45	0.07	0.01			5.50
23	40G2	121.04	12.10	2.49	0.53	3.08	0.16	0.16			139.56
23	41G2	43.45	1.66	0.14	0.01	0.03					45.29
23	Total	165.11	15.86	4.30	1.12	3.56	0.23	0.17	0.00	0.00	190.35
24	37G2	6.77	48.04	32.96	11.35	9.36	1.23	0.51	0.04	0.04	110.30
24	37G3	55.46	18.62	2.35	0.66	0.56	0.07	0.03			77.75
24	37G4	13.82	18.71	20.54	10.18	8.71	1.48	0.74	0.06	0.06	74.30
24	38G2	83.98	47.88	25.98	8.21	6.65	0.13	0.39			173.22
24	38G3	134.72	208.91	117.87	39.73	32.26	4.41	1.69	0.14	0.14	539.87
24	38G4	172.82	233.97	256.83	127.34	108.95	18.48	9.21	0.78	0.78	929.16
24	39G2	16.43	48.30	46.34	19.52	15.70	2.77	0.91	0.09	0.09	150.15
24	39G3	46.02	136.02	124.09	45.14	37.11	6.27	2.21	0.23	0.23	397.32
24	39G4	70.30	117.64	120.44	58.06	49.78	7.97	4.64	0.23	0.23	429.29
24	Total	600.32	878.09	747.40	320.19	269.08	42.81	20.33	1.57	1.57	2,881.36
22-24	Total	1,080.45	988.96	920.58	369.10	329.64	52.95	20.50	4.76	1.57	3,768.51
21-24	Total	1,085.27	1,656.85	1,007.80	483.09	399.64	70.25	20.50	5.85	1.57	4,730.82

Table 11: FRV Solea, cruise 754/2018. 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		16.32	17.41	18.44	18.11	19.08				17.30
21	41G1		14.69	18.28	19.39	20.76	20.68		23.63		17.58
21	41G2	3.43	10.52	15.50	18.81	18.60	19.08				10.48
21	42G1		12.55	15.85	19.16	21.03	20.76		23.63		12.95
21	42G2	2.86	12.73	18.12	19.55	20.17	19.71				15.36
21	43G1	3.00	12.62	15.15	19.13	19.92	19.66				12.78
21	43G2	2.92	12.46	15.17	18.91	19.73	19.61				12.59
21	Total	3.20	12.66	17.64	19.43	20.51	20.27		23.63		14.59
22	37G0	6.00	13.58	15.41	16.24	16.07	18.15		20.50		14.19
22	37G1	5.54	12.15	14.67	17.28	17.63	22.90		20.50		11.27
22	38G0	5.03	13.46	15.41	16.38	16.25	18.23		20.50		10.61
22	38G1	5.19	10.11								5.20
22	39F9	5.49	13.26	15.24	16.41	16.21	17.74				14.36
22	39G0	5.49	13.26	15.24	16.41	16.21	17.74				14.36
22	39G1										0.00
22	40F9	7.10	11.60	16.17	16.76	16.71	17.74				10.62
22	40G0	7.10	11.60	16.17	16.76	16.71	17.74				10.62
22	40G1			16.40	16.40	16.40					16.40
22	41G0		13.01	15.43	16.40	16.40					14.70
22	Total	5.62	12.90	15.42	16.54	16.53	21.08		20.50		10.92
23	39G2	6.14	11.76	13.99	14.75	15.01	16.78	18.23			12.46
23	40G2	5.75	11.41	17.24	17.84	19.76	25.00	25.00			6.84
23	41G2	4.87	10.87	15.72	15.00	15.68					5.13
23	Total	5.52	11.40	15.93	16.21	19.13	22.50	24.60			6.60
24	37G2	5.29	11.77	14.16	15.35	15.54	16.78	17.61	19.77	19.77	12.86
24	37G3	4.03	9.18	13.10	15.35	15.65	16.84	17.28			5.73
24	37G4	5.33	11.58	14.59	16.21	16.31	17.64	17.92	19.77	19.77	12.64
24	38G2	4.38	10.32	13.90	15.08	15.37	15.51	16.83			8.42
24	38G3	4.23	11.33	14.01	15.31	15.51	16.96	17.73	19.77	19.77	10.76
24	38G4	5.33	11.58	14.59	16.21	16.31	17.64	17.92	19.77	19.77	12.64
24	39G2	4.80	12.23	14.17	15.55	15.76	17.42	18.13	19.77	19.77	12.96
24	39G3	5.29	11.83	14.35	15.45	15.58	17.21	18.25	19.77	19.77	12.75
24	39G4	4.89	11.69	14.51	16.05	16.21	17.32	18.56	19.77	19.77	12.67
24	Total	4.76	11.50	14.37	15.86	16.01	17.40	18.07	19.77	19.77	11.89
22-24	Total	5.13	11.63	14.57	15.95	16.13	18.11	18.12	20.26	19.78	11.44
21-24	Total	5.12	12.05	14.84	16.77	16.90	18.64	18.12	20.89	19.78	12.08

Table 12: FRV Solea, cruise 754/2018. 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		34.8	22.1	25.1	4.2	2.1				88.2
21	41G1		1,581.2	808.7	1,233.6	845.8	202.7		22.0		4,693.9
21	41G2	9.5	1,001.0	33.3	9.0	1.3	1.0				1,055.1
21	42G1		1,317.1	96.4	41.8	16.8	6.2		3.8		1,482.1
21	42G2	3.7	1,946.3	429.6	882.5	556.1	135.8				3,954.0
21	43G1	1.0	1,446.9	86.1	13.4	7.2	1.8				1,556.3
21	43G2	1.3	1,127.4	62.1	9.6	4.5	1.2				1,206.1
21	Total	15.4	8,454.6	1,538.2	2,215.0	1,435.9	350.7	0.0	25.8	0.0	14,035.6
22	37G0	61.6	218.9	599.8	162.1	187.2	13.3		3.3		1,246.1
22	37G1	302.0	430.5	345.5	113.9	179.8	142.4		54.3		1,568.4
22	38G0	568.9	409.2	1,008.7	286.3	331.8	25.9		7.8		2,638.7
22	38G1	359.3	1.9								361.2
22	39F9	5.3	59.5	101.4	27.1	32.3	2.7				228.2
22	39G0	5.9	66.7	113.5	30.4	36.2	3.0				255.7
22	39G1										0.0
22	40F9	78.0	5.8	57.7	22.8	23.6	3.6				191.4
22	40G0	389.7	29.2	288.3	114.3	117.6	18.1				957.3
22	40G1			83.8	32.3	32.3					148.4
22	41G0		4.3	5.3	1.5	1.5					12.5
22	Total	1,770.7	1,226.0	2,604.0	790.6	942.3	208.9	0.0	65.4	0.0	7,607.9
23	39G2	3.8	24.7	23.4	8.6	6.8	1.2	0.2			68.5
23	40G2	696.0	138.1	42.9	9.5	60.9	4.0	4.0			955.3
23	41G2	211.6	18.0	2.2	0.2	0.5					232.5
23	Total	911.4	180.8	68.5	18.2	68.1	5.2	4.2	0.0	0.0	1,256.3
24	37G2	35.8	565.4	466.7	174.2	145.5	20.6	9.0	0.8	0.8	1,418.8
24	37G3	223.5	170.9	30.8	10.1	8.8	1.2	0.5			445.8
24	37G4	73.7	216.7	299.7	165.0	142.1	26.1	13.3	1.2	1.2	938.8
24	38G2	367.8	494.1	361.1	123.8	102.2	2.0	6.6			1,457.7
24	38G3	569.9	2,367.0	1,651.4	608.3	500.4	74.8	30.0	2.8	2.8	5,807.1
24	38G4	921.1	2,709.4	3,747.2	2,064.2	1,777.0	326.0	165.0	15.4	15.4	11,740.7
24	39G2	78.9	590.7	656.6	303.5	247.4	48.3	16.5	1.8	1.8	1,945.5
24	39G3	243.5	1,609.1	1,780.7	697.4	578.2	107.9	40.3	4.6	4.6	5,066.2
24	39G4	343.8	1,375.2	1,747.6	931.9	806.9	138.0	86.1	4.6	4.6	5,438.6
24	Total	2,857.9	10,098.5	10,741.7	5,078.4	4,308.3	744.9	367.3	31.1	31.1	34,259.2
22-24	Total	5,540.0	11,505.3	13,414.2	5,887.2	5,318.7	959.0	371.5	96.5	31.1	43,123.3
21-24	Total	5,555.4	19,960.0	14,952.4	8,102.2	6,754.5	1,309.7	371.5	122.2	31.1	57,158.9

Table 13: FRV Solea, cruise 754/2018. Numbers (m) of herring excl. CBH in SDs 24 (23) by age/W-rings & area.

Sub-division	Rectangle/ W-rings	0	1	2	3	4	5	6	7	8+	Total	
21	41G0	5.10	1.70								6.80	
21	41G1	91.20	90.35	24.18	4.74	1.62	0.95				213.04	
21	41G2	122.39	0.83	0.06	0.11						123.39	
21	42G1	64.74	3.05	0.25							68.04	
21	42G2	162.53	144.11	15.72	1.78	0.67	0.62				325.43	
21	43G1	468.92	1.08								470.00	
21	43G2	156.48	0.32								156.80	
21	Total	1,071.36	241.44	40.21	6.63	2.29	1.57	0.00	0.00	0.00	1,363.50	
22	37G0	41.12	2.66	0.13	0.07	0.15	0.07				44.20	
22	37G1	229.70	21.86	0.56	1.07	1.39	0.10				254.68	
22	38G0	223.66	4.09	0.36	0.09	0.22					228.42	
22	38G1	120.11	0.06	0.19	0.06						120.42	
22	39F9	19.07	0.70	0.13	0.03	0.03					19.96	
22	39G0	21.35	0.78	0.14	0.03	0.03					22.33	
22	39G1										0.00	
22	40F9	28.77									28.77	
22	40G0	143.76									143.76	
22	40G1	113.75	14.93	10.25	0.90	0.28					140.11	
22	41G0	12.25	2.69	0.72	0.03	0.23					15.92	
22	Total	953.54	47.77	12.48	2.28	2.33	0.17	0.00	0.00	0.00	1,018.57	
23	39G2	74.71	0.69	0.09	0.07						75.56	
23	40G2	204.19	8.11	1.29	0.66	2.24	0.75	0.13			217.37	
23	41G2	209.84	1.55	0.71	0.19	0.37	0.18	0.03			212.87	
23	Total	488.74	10.35	2.09	0.92	2.61	0.93	0.16	0.00	0.00	505.80	
24	37G2	36.63	1.75	0.05	0.07						38.50	
24	37G3	3.30	0.94	2.21	2.02	0.46	0.12	0.06	0.01	0.01	9.13	
24	37G4	7.41	2.49	0.97	0.73	0.24	0.12	0.04	0.00	0.00	12.00	
24	38G2	177.60	5.74	0.17							183.51	
24	38G3	27.44	4.56	3.05	2.87	0.73	0.38	0.14	0.07	0.03	39.27	excl. CBH
24	38G4	92.61	31.09	12.12	9.14	2.96	1.47	0.44	0.05	0.05	149.93	
24	39G2	234.24	6.46	0.37	0.15						241.22	
24	39G3	169.98	55.28	8.86	4.65	0.55	0.33	0.35	0.04	0.04	240.08	
24	39G4	9.09	25.49	9.88	14.45	8.77	12.72	3.85	0.90	0.98	86.13	
24	Total	758.30	133.80	37.68	34.08	13.71	15.14	4.88	1.07	1.11	999.77	
22-24	Total	2,200.58	191.92	52.25	37.28	18.65	16.24	5.04	1.07	1.11	2,524.14	
21-24	Total	3,271.94	433.36	92.46	43.91	20.94	17.81	5.04	1.07	1.11	3,887.64	

Table 14: FRV Solea, cruise 754/2018. Mean weight (g) of herring excl. CBH in SDs 24 (23) by age/W-rings & area.

Sub-division	Rectangle/ W-rings	0	1	2	3	4	5	6	7	8+	Total	
21	41G0	19.64	42.50								25.36	
21	41G1	22.89	51.20	73.06	81.30	85.88	99.58				42.71	
21	41G2	13.23	48.82	54.24	32.00						13.51	
21	42G1	12.45	43.94	69.92							14.07	
21	42G2	13.98	50.86	68.58	94.20	81.07	117.66				33.72	
21	43G1	11.49	40.90								11.56	
21	43G2	12.12	38.54								12.17	
21	Total	13.23	50.77	71.26	83.95	84.47	106.72				22.16	
22	37G0	10.90	34.81	68.00	31.00	33.56	52.00				12.68	
22	37G1	10.06	34.69	63.16	46.61	34.77	52.00				12.60	
22	38G0	9.07	36.19	78.50	31.06	34.43					9.70	
22	38G1	9.33	63.80	63.80	63.80						9.47	
22	39F9	14.16	35.77	66.43	48.78	34.32					15.34	
22	39G0	14.16	35.77	66.43	48.78	34.32					15.32	
22	39G1										0.00	
22	40F9	11.77									11.77	
22	40G0	11.77									11.77	
22	40G1	18.89	42.80	65.12	63.80	35.94					25.14	
22	41G0	18.07	38.02	71.90	32.41	37.50					24.18	
22	Total	11.41	37.62	65.85	52.63	35.06	52.00				13.46	
23	39G2	12.01	31.98	59.32	59.32						12.29	
23	40G2	10.58	39.94	44.60	36.57	37.64	32.67	43.40			12.33	
23	41G2	10.94	50.05	69.35	65.30	46.99	29.17	43.40			11.55	
23	Total	10.95	40.92	53.64	44.23	38.97	31.99	43.40			12.00	
24	37G2	12.92	31.04	67.38	67.38						13.91	
24	37G3	9.04	38.06	60.86	67.60	78.39	89.40	95.35	100.69	100.69	42.85	
24	37G4	10.12	34.25	58.64	73.04	84.22	122.79	114.97	100.69	100.69	25.83	
24	38G2	10.08	33.15	51.17							10.84	
24	38G3	10.49	34.90	59.63	71.32	95.56	140.93	106.93	148.80	100.69	25.09	excl. CBH
24	38G4	10.12	34.25	58.64	73.04	84.22	122.79	114.97	100.69	100.69	25.82	
24	39G2	12.69	32.82	54.77	59.32						13.32	
24	39G3	13.53	33.58	55.41	67.54	81.46	97.27	189.17	100.69	100.69	21.29	
24	39G4	14.19	33.96	58.92	97.27	119.05	138.88	150.81	180.98	194.47	78.10	
24	Total	11.86	33.81	58.10	82.02	106.80	135.94	148.10	171.37	183.49	23.14	
22-24	Total	11.46	35.14	59.78	79.29	88.34	129.11	144.77	171.37	183.49	17.00	
21-24	Total	12.04	43.85	64.77	80.00	87.92	127.14	144.77	171.37	183.49	18.81	

Table 15: FRV Solea, cruise 754/2018. Total biomass (t) of herring excl. CBH in SDs 24 (23) by age/W-rings & area.

Sub-division	Rectangle/ W-rings	0	1	2	3	4	5	6	7	8+	Total	
21	41G0	100.2	72.3								172.4	
21	41G1	2,087.6	4,625.9	1,766.6	385.4	139.1	94.6				9,099.2	
21	41G2	1,619.2	40.5	3.3	3.5						1,666.5	
21	42G1	806.0	134.0	17.5							957.5	
21	42G2	2,272.2	7,329.4	1,078.1	167.7	54.3	73.0				10,974.6	
21	43G1	5,387.9	44.2								5,432.1	
21	43G2	1,896.5	12.3								1,908.9	
21	Total	14,169.6	12,258.6	2,865.4	556.6	193.5	167.6	0.0	0.0	0.0	30,211.2	
22	37G0	448.2	92.6	8.8	2.2	5.0	3.6				560.5	
22	37G1	2,310.8	758.3	35.4	49.9	48.3	5.2				3,207.9	
22	38G0	2,028.6	148.0	28.3	2.8	7.6					2,215.3	
22	38G1	1,120.6	3.8	12.1	3.8						1,140.4	
22	39F9	270.0	25.0	8.6	1.5	1.0					306.2	
22	39G0	302.3	27.9	9.3	1.5	1.0					342.0	
22	39G1										0.0	
22	40F9	338.6									338.6	
22	40G0	1,692.1									1,692.1	
22	40G1	2,148.7	639.0	667.5	57.4	10.1					3,522.7	
22	41G0	221.4	102.3	51.8	1.0	8.6					385.0	
22	Total	10,881.4	1,797.0	821.8	119.98	81.7	8.8	0.00	0.00	0.0	13,710.6	
23	39G2	897.3	22.1	5.3	4.2						928.8	
23	40G2	2,160.3	323.9	57.5	24.1	84.3	24.5	5.6			2,680.4	
23	41G2	2,295.7	77.6	49.2	12.4	17.4	5.3	1.3			2,458.8	
23	Total	5,353.3	423.6	112.1	40.7	101.7	29.8	6.9	0.0	0.0	6,068.0	
24	37G2	473.3	54.3	3.4	4.7	0.0	0.0	0.0	0.0	0.0	535.7	
24	37G3	29.8	35.8	134.5	136.6	36.1	10.7	5.7	1.0	1.0	391.2	
24	37G4	75.0	85.3	56.9	53.3	20.2	14.7	4.6	0.0	0.0	310.0	
24	38G2	1,790.2	190.3	8.7	0.0	0.0	0.0	0.0	0.0	0.0	1,989.2	
24	38G3	287.9	159.1	181.9	204.7	69.8	53.6	15.0	10.4	3.0	985.3	excl. CBH
24	38G4	937.2	1,064.8	710.7	667.6	249.3	180.5	50.6	5.0	5.0	3,870.8	
24	39G2	2,972.5	212.0	20.3	8.9	0.0	0.0	0.0	0.0	0.0	3,213.7	
24	39G3	2,299.8	1,856.3	490.9	314.1	44.8	32.1	66.2	4.0	4.0	5,112.3	
24	39G4	129.0	865.6	582.1	1,405.6	1,044.1	1,766.6	580.6	162.9	190.6	6,727.0	
24	Total	8,994.7	4,523.6	2,189.4	2,795.4	1,464.2	2,058.2	722.7	183.4	203.7	23,135.1	
22-24	Total	25,229.3	6,744.1	3,123.3	2,956.1	1,647.6	2,096.8	729.7	183.4	203.7	42,913.7	
21-24	Total	39,398.8	19,002.8	5,988.7	3,512.6	1,841.0	2,264.3	729.7	183.4	203.7	73,124.9	

Survey Summary Table WGBIFS 2019

Name of the survey (abbreviation):	GERAS / BIAS (GER) (FRV Solea SB754)
Target Species:	Herring (*Clupea harengus,* Western Baltic Spring Spawning Herring WBSSH; Central Baltic Herring CBH), Sprat (*Sprattus sprattus*), Anchovy (*Engraulis encrasicolus*), European Pilchard (*Sardina pilchardus*)
Survey dates:	01-19 Oct 2018

Summary:

The objectives of the survey were carried out successfully and as planned in all of the covered ICES Subdivisions. Adverse weather conditions occurred during the first night of the survey in the southwestern part of SD 22 (Kiel Bight) but did not require interruption of survey operations and are not considered to affect acoustic estimates (see below). Altogether, 62 trawl hauls were carried out during the survey providing biological data for age stratified abundance estimation of target species herring and sprat (58 valid hauls utilized for estimates).

Measured NASC values per 1 nmi EDSU allocated to clupeids were higher in most parts of the survey area in comparison to the previous year (exception SD 24), but below the long-term survey mean. A further decrease in abundance of Western Spring Spawning Herring (-22% and -49% in SD 21-24 and 22-24 respectively) was recorded to the second lowest levels of the time series since 1993. Abundance increased (+56% and +19% respectively) due to a high contribution of 0-group herring. In sprat, abundance and biomass in the survey area declined by 37 % and 43% respectively. As in the previous years, dense aggregations of large, mature herring seemed to be absent from their overwintering area in SD23.

contributi	***Description***
Survey design	Stratified systematic (parallel where applicable) design. Start point not randomized.
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 in some areas but did not affect significant parts of the depth layers utilized for integration or occurred in an area with known low fish densities (southwestern part of SD 22).
Extinction (shadowing)	No particular issues as targets are scattered in loose aggregations in most of the surveyed areas during the survey operation.
Blind zone	Night-time distribution of clupeids in surface layers (i.e. within blind zone and near-field) is assumed to occur but is not quantified. (Integration start depth 10 m).
Dead zone	No particular issue as clupeids are mostly distributed pelagic and away from seafloor during night-time survey operations.

Allocation of backscatter to species	Directed trawling. Mixed species category applied throughout survey. Species allocations based on combined trawl haul composition (per ICES statistical rectangle).
Target strength	As listed in SISP Survey manual (ICES, 2017).
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. 2018 survey: Survey area covered as planned. Stock containment considered achieved.
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). 2018 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.
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. 2018 survey: Biological information for some rectangles 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)	
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	

Working paper on the WGBIFS meeting in Klaipeda (Lithuania) 25-29.03.2019

Research report from the Polish part of the Baltic International Acoustic Survey on board of the r.v. "Baltica" (28.09 - 13.10.2018)

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INTRODUCTION

The autumn acoustic-biotic surveys has been carried out in the Baltic Proper since 1978, however on the very beginning as the Swedish-German (GDR) cruise, not fully coordinated by the ICES (Håkansson et al. 1979, Hagström et al. 1989). The initial Polish acoustic survey in the southern Baltic was conducted in July 1981, on board of the r.v. "Profesor Siedlecki" (Orłowski 1982, 1991). In October 1982, the National Marine Fisheries Research Institute (NMFRI) began simultaneous the acoustic, biological and fisheries investigations focused on herring and sprat stocks size estimation and their spatial distribution, mostly in the southern Baltic (Grzebielec et al. 1995). The above-mentioned survey can be accepted as the beginning of somewhat regular autumn acoustic surveys in the Polish EEZ.

In the 1980s, the NMFRI contribution to those surveys was limited to chartering of commercial stern cutter the m/t "HEL-100", which was designated for fish control-hauls realization. Moreover, the NMFRI delegates participated in several autumn acoustic surveys on board of the Swedish r.v. "Argos" (Hagström et al. 1989). Sporadically, also the Polish r.v. "Profesor Siedlecki" participated in the Baltic acoustic surveys, e.g. in May 1985, October 1989 and 1990. In the 1980s and at the beginning of 1990s, the ICES Planning Group for Hydroacoustic Surveys in the Baltic with close cooperation of the ICES Working Group on Assessment of Pelagic Stocks in the Baltic were responsible for logistically coordination of international acoustic surveys (Anon. 1991a). The mentioned ICES working and planning groups were also answerable on implementation of collected international data to the final assessment of Baltic sprat and herring stocks biomass and abundance (Anon. 1991b).

Since 1994, the permanent participation of the Polish r.v. "Baltica", managed by the NMFRI in Gdynia, has took place in the framework of the ICES Baltic International Acoustic Surveys (BIAS) long-term programme. The ICES Baltic International Fish Survey Working Group (WGBIFS) coordinates methods of investigations, timing of surveys, spatial allocation of surveying vessels and general pattern of pelagic control-hauls distribution in the Baltic regarding the BIAS acoustic surveys. The above-mentioned working group is also responsible for the compilation of international results needed for seasonal assessment of clupeids stocks size in the Baltic. The set of international input data and recommendations are next transferred to the ICES Baltic Fisheries Assessment Working Group [WGBFAS] for final evaluation of fish stocks size and a prediction of annual TAC of given species.

The reported Polish BIAS/2018 survey was conducted on board of the r.v. "Baltica" inside the Polish EEZ, in the period of 28.09.-13.10.2018. The survey was focused on monitoring of clupeids and cod spatial-seasonal distribution in pelagic zone of the southern Baltic (parts of the ICES Subdivisions 24, 25 and 26). The EK60 SIMRAD acoustic system with the new determined calibration parameters were applied to completing the BIAS survey tasks. The Polish Fisheries Data Collection Programme for 2018 and the European Union (the Commission Regulations Nos. 1639/2001, 1581/2005, 665/2008, 1078/2008, 2008/949/EC, 2010/93/EU) financially and logistically supported the Polish BIAS survey marked with internal No. 18/2018/MIR-PIB.

The WGBFAS will use recently collected BIAS data for tuning clupeids stock biomass assessment and spatial distribution based on data from commercial catches in 2018. Acoustic estimates are, until present time, the commercial fishery independent unique source of input data available to the WGBFAS.

The main goal of 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 Polish part of the southern Baltic at autumn 2018. Moreover, the paper contains 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/2018 survey on board of the r.v. "Baltica" were realized by the NMFRI (Gdynia) nine members of the scientific team, with Szymon Smolinski as a cruise leader. The group of researchers was composed of:
Beata Schmidt – hydroacoustician,
Zuzanna Celmer – hydroacoustician,
Julia Gutkowska – intern, sprat analyses,
Grzegorz Modrzejewski – technician, sprat analyses,
Wojciech Deluga – technician, herring analyses,
Ireneusz Wybierala - technician, herring analyses,
Krzysztof Radtke - ichthyologist, cod and other fish species analyses,
Anetta Ameryk – hydrologist.

The course of the cruise

The r.v. “Baltica” left the Gdynia port on 28th of September 2018 at 07:00 a.m. and was navigated in the east direction, where, to the south of the Hel Peninsula, the acoustic integration and biological sampling started towards the north. During the first two days, the research tasks were carried out along the transects located at the Gdansk Bay and the Gdansk Deep. On the third day of the cruise (30 of September 2018), at the mouth of the Vistula River a successful calibration of the acoustic system SIMRAD EK60, installed on the vessel, was carried out. In the following days, the survey operations were conducted in the ICES subdivision 26 in easterly direction. Deterioration of weather conditions (storm) made it impossible to carry out research tasks on the 3rd of October. The survey operations were resumed the following day. The acoustic integration was completed on the 12th of October 2018. The r/v “Baltica” returned to the Gdynia port on 13th of October 2018 around 7:15 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 2018 cruise (Fig. 2). 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 2018 survey. Calibration of the vessel’s acoustic system was performed on 30th of September 2018 at following location: λ = 019°22.95' E and φ = 54°26.24'N over seabed depth of 50 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. Calibration results obtained in September 2018 were considered as good for 38 kHz (RMS=0.12) and 120 kHz (RMS=0.18). 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 Figure 1.

The acoustic sampling was performed along the pre-selected acoustic transects on the distance of 829 NM. The echo-integration data were collected in a daytime at the ship speed of 7 kn. To maintain comparability with historical data, pre-selected echo-integration transects were planned in a similar pattern as were in recent years, i.e. since autumn 2013 BIAS survey, when transects were reshaped comparing with period of 2009-2012.

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 were carried out taking into account the new calibration constants determined during the calibration (for the first two days of acoustic recording, the calibrations constants were corrected in Echoview software). As 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 linear domain) from 10 m below the sea surface to about 0.5 m over the seafloor and then averaged it within 1 NM interval. Than the mean NASC (Nautical Area Scattering Coefficient) per ICES rectangles were calculated. Also, weighted mean NASC per ICES SDs were calculated with use of size of investigated areas as weight.

Overall 38 catch-stations (1 in the ICES SD 24, 20 in the ICES SD 25 and 17 in the ICES SD 26) were conducted by the r.v. "Baltica" in the period of 28.09 - 12.10.2018 (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 technical point of view. The trawling depth was chosen in accordance with echo distribution, visible on the screen of echosound. Because of a relatively high vertical opening (up to 20 m) of applied a pelagic trawl and the technical-acoustics disturbances from a set vessel-trawl, the areas shallower than 30-m 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 large concentration of fishes in the operation area of a fishing gear. In the cases of two-layer fish concentrations appearing, the net was used for 15 minutes in each layer. The mean speed of surveying vessel during trawling ranged from 3.1 to 3.5 knots. Fish catches were localized on the depth ranged from 19 to 61 m from the sea surface (position of the headrope of trawl). At trawling positions, depth to the bottom varied from 28 to 108 m.

Fish caught in each control-haul was 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, 37, 35 and 3 representative samples were taken for the length and mass determination of sprat, herring and cod, respectively. The length and mass were measured for 6820 sprat, 7725 herring and 407 cod individuals. Respectively, 533, 715 and 125 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, 50 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 raw data, aggregated to the 1-m depth stratums, were the source of information 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 the each catch-station with the automatic station MILOS 500.

Data 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 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). However, during BIAS cruise in 2018, in rectangles 38G4, 38G7 and 37G8 only one haul per rectangle was performed, and no one haul was completed in rectangle 39G9. In such cases, the haul made in an adjacent rectangular with similar hydrology condition and resulted with similar species share and length distribution were included into analysis in given rectangle. In this way, haul No. 20 and haul No. 1 were included into analysis in ICES rectangles 38G4 and 37G8 respectively. In rectangle 39G9 species composition and length distribution was based on results from hauls No. 8 and No. 12. However analysis in ICES rectangle 38G7 were based on only one haul carried out within (the nearest haul in 38G5 rectangle were performed in different hydrological condition, and was assumed as unrepresentative for shallow 37G5 ICES rectangle). In case when the mean numerical share of sprat herring and cod in ICES rectangle exceeded 99%, other species were excluded from further calculations. 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

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 control-catches of given the ICES rectangle.

RESULTS

Acoustic results

The spatial distribution of mean NASC values (5 NM intervals), predominantly derived from clupeids, measured on hydroacoustic transects during BIAS 2018 survey is presented on Figure 3. Considerable differences in the mean NASC values on ICES subdivisions and ICES rectangles as well as annual scales existed (Tables 1, 2). In 2018, the mean NASC values in the ICES SD 24 and 25 was 52 and 64%, respectively smaller than in the ICES SD 26 (558.3 m^2NM^{-2}). Overall NASC values recorded in the Polish EEZ during BIAS 2018 survey were higher as recorded during BIAS 2017 and clearly higher than at autumn 2016. Comparing to the previous years, the mean NASC values recorded in 2018 survey remained at a similar level as recorded in 2016 and 2017 in SD25, and as much as two-fold increase in SD26 was observed. In SD 24 it remained at similar level as in the previous year and increased three times comparing to 2016. Similar to autumn 2017, during BIAS 2018 survey, the highest NASC values were recorded in the south-eastern Polish part of the Gulf of Gdansk - in ICES rectangles 37G8, 37G9 and 38G9 mean NASC values exceeded 1000 m^2Nm^2 and were almost twice as high as in 2017 (Table 2). The highest NASC value per 1 NM equal to 13440 m^2NM^{-2} was recorded for 103^{rd} mile of the integration, located in the ICES rectangle 37G9, where the bottom depth was 70 m (Fig. 4).

Fish catches, biological parameters and stocks size

In September-October 2018, overall, 17 fish species were recorded in 38 scrutinized pelagic control-hauls taking place in the Polish parts of the ICES Subdivisions 24, 25 and 26 (Table 3, Fig. 2). Totally, 8516.8 kg of fish in 38 hauls were caught, and the mean share of sprat, herring, cod and all other species was adequately, 58.3; 39.7; 1.6 and 0.5%. Zero fish catches in single hauls were not achieved. Any sea-mammals and any sea-birds wasn't detected in the control-catches. Sprat dominated by mass in control-hauls and herring was placed on the second position with the mean CPUE in the entire study area amounted 473.8 and 201.2 kg h^{-1}, respectively. Sprat and herring occurred in each pelagic control-haul. Cod can be considered as a significant bycatch in accomplished the pelagic trawl catches (Table 3, Figs. 5-7). The mean CPUE and the mean share of cod in all inspected parts of the Polish marine waters was 7.8 kg h^{-1} and 1.6%, respectively. Values of share of cod in mass of the pelagic control-catches decreased from west to east of scrutinized areas and in the ICES Subdivisions 24, 25 and 26 amounted adequately: 7.4; 2.0 and 0.6% on average. The appearance of cod was noticed in 63% of hauls number. From the remaining fish species only salmon and flounder with total catch of 27.8 and 4.6 kg in the entire study area was remarkable as component of bycatch.

In the ICES Subdivision 26, sprat clearly prevailed by the mean CPUE (890.7 kg h^{-1}) and the mean share (85%) in 17 hauls realised inside the Polish part of the mentioned subdivision. The fish catches composition in the middle and western parts of the Polish EEZ (the ICES Subdivisions 24 and 25) was dominated by herring, but sprat played the second role regarding CPUE and mean share in total weight of caught fishes (Figs. 5-7). The mean share of herring and sprat e.g. in the ICES SD 25 (overall 20 hauls was realised there) was 62 and 35%, respectively, and the mean CPUE of above-mentioned fish species was 247.5 and 138.9 kg h^{-1}. The highest CPUE of sprat (varied from 737.4 to 5281.4 kg h^{-1}) was obtained in a limited number of research catches conducted in the vicinity of the Peninsula of Hel and in the south-eastern part of the Gulf of Gdańsk (ICES SD 26; Figs. 2, 5). Somewhat high CPUE (911.3 kg h^{-1}) of sprat was achieved also in a haul made on a border between the Slupsk Furrow and the Gdansk Deep. The highest CPUE of herring (changed from 419.5 to 727.6 kg h^{-1}) was obtained in several control-catches accomplished along almost completely the northern part of the Polish EEZ. The highest CPUE of cod, amounted 73.7 and 79.1 kg h^{-1} was achieved in two hauls accomplished in the Gdansk Deep and western part of the Slupsk Furrow.

The results of sprat, herring and cod some biological features investigations in September-October 2018 are presented in Figure 8 and Tables 4, 8, 11, 14. The total length of species dominated in control-hauls conducted in the all investigated areas ranged as follows:

- sprat – 7.0 ÷ 15.5 cm (avg. l.t. = 11.5 cm, avg. W = 10.0 g),
- herring – 8.0 ÷ 27.5 cm (avg. l.t. = 18.3 cm, avg. W = 37.7 g),
- cod – 19.0 ÷ 54.0 cm (avg. l.t. = 34.8 cm, avg. W = 328.7 g).

The bimodal shape of length distribution curves for sprat in September-October 2018 was differ from one-peak curves characteristic for September-October 2017 samples (Fig. 8). However, in both years the main frequency apex, according to given ICES subdivision was distinguish in the same length class (Fig. 8). In samples from the ICES Subdivision 26 dominated specimens from class 11.5 cm, in the ICES Subdivision 25 - from class 12.5 cm and in the ICES Subdivision 24 - from class 13.5 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; 9.0 and 9.5 cm, in the case of the ICES Subdivisions 26, 25 and 24, respectively. In the recent BIAS survey, the mean numerical share of undersized sprat (in Poland determined as <10.0 cm total length) in given ICES subdivision was significantly higher than during the same type of survey in 2017 (Table 4). For example, in the ICES Subdivision 25 values of mentioned parameter were 0.2 and 18.6% adequately, in autumn 2017 and 2018. The mean bycatch of undersized sprat in the entire study area was 1.2 and 21.3%, respectively in 2017 and 2018.

For herring collected in September-October 2018, the unimodal shape of length distribution curve was characteristic for samples originated from the ICES Subdivisions 25 and 26, but for the ICES Subdivision 24 it was multimodal shape (Fig. 8). In samples from the ICES Subdivisions 25 and 26 dominated specimens from the same length class 17.0 cm however, in the ICES Subdivision 24 - from classes 18.5 and 20.5 cm, representing adults, commercially sized herring. In the distinction from above mentioned, the bimodal shape of length distribution curves was characteristic for herring samples from September-October 2017 (Fig. 8). For herring collected in the ICES Subdivisions 24 and 25, the maximum of numerical share was visible in the length class 17.5 cm, but in a case of samples from the ICES Subdivision 26 – in the length class 12.0 cm, representing young, undersized specimens. For herring samples from September-October 2017, the second, smaller than above frequency apex was noticed in the length classes 12.5 cm, 12.0 cm and 17.5 cm adequately, in the ICES Subdivisions 24, 25 and 26. In the recent BIAS survey, the mean numerical share of undersized herring (in Poland determined as <16.0 cm total length) in given ICES subdivision was significantly lower than during the same type of survey in 2017 (Table 4). For example, in the ICES Subdivision 26 values of mentioned parameter were 80.9 and 14.9% adequately, in autumn 2017 and 2018. The mean bycatch of undersized herring in the entire study area was 23.7 and 11.0%, respectively in 2017 and 2018.

The length distribution curves for cod sampled in the ICES Subdivisions 24, 25 and 26 in September-October 2017 and 2018 were multimodal, without one specific length class dominated by frequency (Fig. 8). However, should be underlined that numbers of cod sampled in the ICES Subdivision 24 was much smaller than in two other ICES subdivisions. In recently collected samples, cod with the length class 33 cm prevailed by numbers in the ICES Subdivision 25, and with the length classes 30-35 cm - in the ICES Subdivision 26. The BIAS/2018 data for cod from the ICES Subdivision 24 can be considered as not representative. The mean numerical share of undersized cod (determined as <35.0 cm total length) not differed much between ICES subdivisions as well as between the BIAS/2017 and BIAS/2018 surveys. The mean bycatch of undersized cod in the entire study area was 46.6 and 54.5%, respectively in 2017 and 2018 (Table 4).

Data reflects changes of the mean weight of sprat, herring and cod per age groups according to ICES rectangles inspected during the BIAS/2018 survey are presented in Tables 8, 11 and 14.

The basic data evaluated in September-October 2018, 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 BIAS/2018 cruise statistics and average NASC values for acoustically covered ICES rectangles, within the Polish EEZ (Table 5). The mean biomass surface density of sprat, herring and cod, per ICES subdivisions and ICES rectangles, located within the Polish marine waters is reflected in Figures 9, 11, 12. The abundance of above-mentioned species per age groups, according to inspected in autumn 2017 and 2018 the Polish parts of the ICES Subdivisions 24, 25 and 26 is demonstrated in Figure 10.

In September/October 2018, 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 Gdansk Bay), where amounted: 149.4 and 67.9 t NM^{-2}, respectively (Fig. 11). The minimum value of this parameter was noticed in the western parts of investigated Polish marine waters, in ICES rectangle 38G5 and amounted 1.6 t NM^{-2}. Comparing to 2017, the much higher mean biomass surface density per rectangle in SD26 was observed. In 2018 the mean biomass density of sprat in the ICES SD 24 was much lower than in 2017 (6.3 and 20.8 t NM^{-2} in 2018 and 2017 respectively), whereas it remained on the same level in the ICES SD 25 (5.3 and 5.2 t NM^{-2} in 2018 and 2017 respectively) and it was much higher in the ICES SD 26 in 2018 (21.2 t NM^{-2}) than in 2017 (2.9 t NM^{-2}) (Fig. 9).

In September/October 2018, the highest mean biomass surface density of herring stock was estimated for the ICES rectangle 38G9 (80.8 t NM^{-2}) – located in the eastern part of Gdansk Deep (Fig. 11). The recent pattern of herring surface biomass density distribution per ICES rectangles can be considered as almost a mirror picture from autumn 2017 (Fig. 11). In 2018 the mean biomass density of herring in the ICES SD 24 was much higher than in 2017 (1.7 and 23.4 t NM^{-2} in 2018 and 2017 respectively), whereas in others ICES SDs it remained on the similar level: around 15 t NM^{-2} for both years in ICES SD25 and 26.4 and 29 t NM^{-2} for 2017 and 2018 respectively in ICES SD26 (Fig. 9).

During the BIAS 2018 cruise the highest mean biomass surface density of cod was estimated for the ICES rectangles: 38G8 (7.9 t NM^{-2}) – located in the Gulf of Gdansk Deep (Fig. 12). In other rectangles the mean biomass surface density of cod was fluctuated from 0.03 to 3.0 t NM^{-2}. However, in four ICES rectangles, namely: 37G5, 37G8, 37G9 and 38G7 – located in the southern part of the Polish EEZ (in the vicinity of seacoast), appearance of cod was not detected (Tables 3, 13, Fig 12). In 2018 the biomass density of Baltic cod was on similar level in all three ICES SDs and amounted 1.1, 0.9 and 1.2 t NM^{-2} in SD24, SD25 and SD26 respectively (Fig. 9). Comparing to 2017 data, in 2018 mean biomass surface density of cod was lower in ICES SD26 (1.9 t NM^{-2} in 2017 and 1.2 t NM^{-2} in 2018) and on the same level in SD25 (0.9 t·NM^{-2}).

In September/October 2018, the total biomass (B1), the mean surface biomass density (B2) and abundance (A) of dominants significantly differed between fish species and the ICES subdivisions:

ICES SD	parameter	sprat	herring	cod
24	B1 (tons)	6485.7	24201.0	1106.2
	B2 (t NM^{-2})	6.3	23.4	1.1
	A (·10^6 indiv.)	523.5	494.2	3.0
25	B1 (tons)	38095.5	105480.0	6285.8
	B2 (t NM^{-2})	5.3	14.8	0.9
	A (·10^6 indiv.)	3550.8	2694.7	20.5
26	B1 (tons)	102490.3	140512.4	5940.5
	B2 (t NM^{-2})	21.2	29.0	1.2
	A (·10^6 indiv.)	12045.9	4115.0	18.6

The above listed data indicate that the centre of fish resources temporal distribution in the Polish EEZ, during reported the BASS/2018 survey was located in ICES SD26 in the southern and central parts of Gdansk Basin (Figs. 11, 12).

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 2018 are illustrated in Figure 13. The air temperature during reported survey varied from 8.5 to 16.8°C (avg. was 12.6°C). The wind force changed from 1 to 6°B, and winds from the south-west direction were prevailed. During fishing operations prevail the moderate wind (5°B) mostly from south-west directions (Table 15). The strongest wind directions, occurred during fishing operations, were from north.

The main hydrological parameters at the depths of fish pelagic catches (Table 15), i.e. in the range of 19-90 m (with 18 m vertical net opening on average) changed in the relatively broad ranges. The seawater temperature fluctuated from 3.6 to 16.4°C (the mean was 8.4°C), salinity from 7.3 to 16.3 PSU (the mean was 9.1 PSU) and oxygen content from 0.09 at haul No. 23 (the Bornholm Basin, depth 90m) to 7.6 ml l^{-1} (the mean was 4.9).

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 near bottom layer was changing horizontally within the range of 4.1-16.1°C and the mean was 7.9°C. The lowest seawater temperature was recorded at the hydrological station

No. 71 (westward from the Gdansk Deep) and the highest at the calibration station, i.e. southern part of the Gdansk Bay (Fig. 2). Salinity in the bottom waters varied from 7.3 PSU – noticed at the catch-stations No. 6 and 7 (southern part of in the Gdansk Gulf), to the maximum of 16.6 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 catch-station No. 3 and hydrological station G2 (in the Gdansk Deep at depth 103 and 106 m respectively) to the maximum of 7.2 ml l^{-1} – calculated at the catch-station No. 30 in ICES rectangle 38G7 (the mean was 3.1 ml l^{-1}).

The vertical distribution of the seawater temperature, salinity and oxygen content, along the hydrological research profile determined in the southern Baltic during BIAS 2018 survey is presented on Fig. 15. In both deep basins, the Bornholm Basin and the Gdansk Deep, unfavourable conditions for effective reproduction of the Eastern Baltic cod existed. Especially in the Gdank Deep water with oxygen condition for effective spawning didn't occure – the water saline enough for effective spawning (above 11PSU) is located in hypoxic water layer (with oxygen content below 2 ml l^{-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-2018 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 24, 25 and 26. The base acoustic, fisheries, biological and hydrological data collected during reported survey will be stored in the ICES Data-Center international databases, managed by the ICES Secretariat and designated experts from WGBIFS.

References:

Anon. 1991a. Report of the Planning Group for Hydroacoustic Surveys in the Baltic. ICES CM 1991/J:28.

Anon. 1991b. Report of the Working Group on Assessment of Pelagic Stocks in the Baltic. ICES CM 1991/Assess:18.

Anon., 2012. Manual for International Baltic Acoustic Surveys (IBAS). Version 1.01, 30-03-2012 Helsinki, Finland; ICES Addendum 2: WGBIFS Manual for Baltic Acoustic Surveys, Version 1.01; 24 pp.

Elwertowski, J., Orłowski A., 1984. Composition, distribution and biomass of juvenile sprat in May 1983 in the Southern Baltic. Bulletin of the Sea Fish. Inst., Gdynia, 3-6 (83/86); 5-13.

Elwertowski, J., Orłowski A., Richert S., 1984. Badania oceanograficzno-rybackie południowego Bałtyku prowadzone w maju 1983 r. na r.v. Profesor Siedlecki. Bulletin of the Sea Fish. Inst., Gdynia, 1-2; 3-15.

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.

Grzebielec, R., Paciorkowski A., Wyszyński M., Grygiel W., 1995. Polish hydroacoustic assessment survey of herring, sprat and cod stocks in ICES Subdivisions 25 and 26 of the Baltic conducted in October 1994. ICES C.M. 1995/J:18, B.F.C.; 24 pp.

Hagström, O., L-E. Palmén, N. Håkansson, D. Kästner, H. Bremer-Rothbart, W. Grygiel, M. Wyszyński 1989. Acoustic estimates of the herring and the sprat stocks in the Baltic Proper, October 1988. ICES C.M. 1989/J:26, B.F.C.; 9 pp.

Håkansson, N., Kollberg, S., Falk, U., Goetze, E., Rechlin, O. 1979. A hydroacoustic and trawl survey of herring and sprat of the Baltic proper in October 1978. Fischerei-Forschung, 17(2); 7-23.

ICES. 1983. Report of the Planning Group on ICES coordinated herring and sprat acoustic surveys. ICES Document CM 1983/H:12.

ICES. 2017, SISP Manual of International Baltic Acoustic Surveys (IBAS). Series of ICES Survey Protocols SISP 8 – IBAS. 47pp.

ICES. 2018, Report of the Baltic International Fish Survey Working Group (WGBIFS) 24-28 March 2018 Lyngby, Copenhagen, Denmark; ICES CM 2018/EOSG:6.

Kruk, G., Smolinski Sz., Schmidt B., Wodzinowski T., 2018. Research report from the Polish part of the Baltic International Acoustic Survey on board of the r.v. “Baltica” (13-30.09.2017). Working paper, WGBIFS meeting in Copenhagen (Denmark), 24-28.03.2018; 28 pp.

Orłowski, A. 1982. Zasoby ryb polskiej strefy Bałtyku oszacowane metodą hydroakustyczna podczas rejsu r.v. „Profesor siedlecki” w roku 1981. Biuletyn Mor. Inst. Ryb., Gdynia, 1-6 (69-74); 23-28.

Orłowski, A. 1991. Hydroacoustic surveys of fish distribution in relation to environment. Acta Ichthyol. Pisc., Szczecin, XXI; 181-192.

Shvetsov, F., Baturin V., Goetze E., Oeberst R., Kästner D., 1986. Preliminary results of a joint hydroacoustic sprat survey by the USSR and GDR in Baltic in May 1986. ICES C.M. 1986/J:15, B.F.C.

Shvetsov, F., Grygiel W., Fetter M., Chervontsev V., Rudneva A., 1992. Distribution and size of herring and sprat stocks in the Baltic Proper, determined by the acoustic method (October, 1991). ICES C.M. 1992/J:8, B.F.C.; 10 pp.

Simrad. 2012. Simrad EK60, Reference Manual, release 2.4.X. Kongsberg Maritime AS; 256 pp.

Smoliński Sz., Schmidt B., Wodzinowski T., Sprawozdanie z bałtyckiego międzynarodowego rejsu akustycznego (BIAS) przeprowadzonego w polskiej EEZ na statku r.v. Baltica w dniach 28.09-13.10.2018 roku., MIR-PIB, Gdynia; 22pp., (mimeo).

Table 1. Weighted mean NASC values (m^2 NM^{-2}) for the Polish parts of the ICES SDs 24, 25 and 26, calculated with use of areas of ICES rectangles as weight, for BIAS 2016, 2017 and 2018 cruises.

ICES SDs	< NASC > BIAS 2016	< NASC > BIAS 2017	< NASC > BIAS 2018
24	89.2	253.5	268.1
25	172.3	195.7	201.4
26	248.4	261.6	558.3

Table 2. Average NASC values (m^2 NM^{-2}) for the acoustically covered ICES rectangles, within the Polish EEZ, in 2016, 2017 and 2018 BIAS cruises.

ICES SDs	ICES rectangles	Area [NM^2]	< NASC > BIAS 2016	< NASC > BIAS 2017	< NASC > BIAS 2018
24	38G4	1034.8	89.2	253.5	268.1
25	37G5	642.2	100.7	178.6	208.3
25	38G5	1035.7	209.5	191.1	175.4
25	38G6	940.2	151.8	55.5	133.6
25	38G7	471.7	41.2	9.8	85.6
25	39G5	979	220.2	334.5	176.7
25	39G6	1026	241.1	176.7	222.1
25	39G7	1026	189.6	125.9	298.5
25	40G7	1013	125.9	383.8	244.7
26	37G8	86	767.5	549.2	1021.7
26	37G9	151.6	2739.7	1333.1	2121.4
26	38G8	624.6	336	248.9	927
26	38G9	918.2	170.9	381.9	1024.8
26	39G8	1026	118.7	249.1	367.4
26	39G9	1026	57.6	99.1	159.9
26	40G8	1013	172.4	152.9	231.8

Table 3. Fish control-catches data from the Polish BIAS survey conducted on board of the r.v. “Baltica” in September/October 2018.

Haul no	Date	ICES rectangles	ICES SDs	Geographical position start latitude N	start longitude E	end latitude N	end longitude E	Mean bottom depth [m]	Headrope depth from the sea surface [m]	Vertical net oppening [m]	Trawling speed [w]	The ship's course during fishing [°]	Local time of shutting net	Trawling duration [min.]	CPUE [kg·h⁻¹]	CPUE sprat	herring	cod	flounder	salmon	lumpfish	river lamprey	great sand eel	three spined stickleback	four-bearded rockling	smelt	whiting	shorthorn sculpin	straightnose pipefish	nine spined stickleback	plaice	turbot
1	28-09-2018	38G8	26	54°32.3'	18°53.1'	54°31.9'	18°54.7'	66	29	16	3.4	110	09:45	20	5107.51	5093.64	13.83															0.040
2	28-09-2018	38G8	26	54°48.0'	18°55.0'	54°47.2'	18°58.2'	98	40	17	3.1	115	14:20	30	996.34	837.16	158.88				0.265	0.040										
3	29-09-2018	38G9	26	54°49.9'	19°11.4'	54°49.9'	19°18.9'	106	32	15	3.2	105	09:40	30	202.10	2.94	199.16															
4	29-09-2018	38G9	26	54°35.6'	19°09.5'	54°35.1'	19°11.8'	81	47	18	3.1	105	14:00	30	833.82	737.42	94.49	1.380	0.540													
5	29-09-2018	37G9	26	54°29.6'	19°20.5'	54°29.5'	19°20.9'	69	35	18	3.1	10	16:45	5	5290.73	5281.42	8.83					0.480										
6	30-09-2018	37G9	26	54°25.4'	19°18.4'	54°25.8'	19°18.9'	51	29	18	3.2	30	10:40	10	1452.31	1440.31	11.67									0.325						
7	30-09-2018	37G8	26	54°28.3'	18°55.0'	54°29.7'	18°55.9'	63	35	18	3.1	20	13:40	30	109.34	103.10	5.27		0.770			0.200							0.001			
8	01-10-2018	39G8	26	55°24.6'	18°59.9'	55°25.4'	18°58.1'	89	36	19	3.0	310	07:35	30	116.64	67.12	48.84	0.434										0.244				
9	01-10-2018	40G8	26	55°43.8'	18°55.8'	55°43.6'	18°54.9'	86	55	18	2.9	245	11:35	15	738.29	6.80	727.56	3.932														
10	01-10-2018	40G8	26	55°51.2'	18°40.0'	55°49.8'	18°40.0'	108	40	16	3.1	180	14:50	30	97.85	47.70	28.46	0.262		21.420				0.004								
11	01-10-2018	40G8	26	55°35.6'	18°40.3'	55°34.3'	18°40.4'	85	35	20	3.0	180	18:25	30	111.51	1.34	108.16	2.010														
12	02-10-2018	39G8	26	55°08.9'	18°41.3'	55°08.8'	18°42.8'	92	39	20	3.0	100	08:00	20	248.31	75.42	168.96	3.375			0.558											
13	02-10-2018	38G8	26	54°54.2'	18°41.5'	54°54.5'	18°43.0'	86	55	20	3.0	75	11:25	20	651.03	51.87	522.03	73.716	3.120						0.291							
14	04-10-2018	39G8	26	55°14.6'	18°21.1'	55°14.4'	18°22.6'	81	45	16	3.0	100	10:15	20	406.20	317.13	83.01	6.060														
15	04-10-2018	40G8	26	55°35.7'	18°27.1'	55°35.4'	18°29.3'	94	51	18	3.0	100	14:55	30	326.29	48.62	264.16	13.510														
16	05-10-2018	39G5	25	55°12.4'	15°57.2'	55°13.2'	15°59.3'	89	57	18	3.0	60	09:55	30	257.20	106.64	143.88	6.680														
17	05-10-2018	38G6	25	54°53.4'	16°01.4'	54°54.0'	16°03.5'	63	44	16	3.0	50	13:55	30	311.26	164.64	126.84	3.360		14.240	1.706										0.470	
18	05-10-2018	37G5	25	54°29.8'	15°58.9'	54°29.6'	15°56.3'	43	22	18	3.2	255	18:20	30	83.49	12.64	70.48		0.370													
19	06-10-2018	38G4	24	54°41.7'	14°49.7'	54°42.8'	14°51.3'	55	36	16	3.2	30	08:00	30	312.91	83.78	200.30	23.110	0.306								5.410					
20	06-10-2018	38G5	25	54°39.4'	15°00.7'	54°40.7'	15°01.8'	57	36	18	3.0	25	09:40	30	829.55	121.36	699.30	8.450	0.440													
21	06-10-2018	37G5	25	54°29.9'	15°20.6'	54°29.6'	15°22.1'	47	28	16	3.0	110	17:00	20	101.10	31.56	69.18											0.360				
22	06-10-2018	38G5	25	54°35.7'	15°20.0'	54°37.2'	15°20.2'	56	38	17	3.1	5	18:30	30	127.17	0.16	97.76	28.760	0.496													
23	07-10-2018	39G5	25	55°08.2'	15°39.8'	55°06.9'	15°39.7'	90	50	17	3.0	185	13:10	30	310.27	164.04	138.34	7.820							0.070							
24	07-10-2018	38G5	25	54°57.1'	15°39.4'	54°55.8'	15°38.9'	80	60	17	3.0	180	16:15	30	98.30	14.18	83.88	0.240														
25	08-10-2018	39G6	25	55°06.2'	16°19.0'	55°05.2'	16°17.2'	73	53	16	3.0	220	08:00	30	644.54	46.50	578.64	15.716	3.160						0.180						0.340	
26	08-10-2018	38G6	25	54°41.9'	16°18.6'	54°43.3'	16°19.9'	40	20	16	3.0	25	13:00	30	35.43	27.12	8.28						0.026									
27	09-10-2018	39G6	25	55°09.2'	16°38.4'	55°09.9'	16°40.4'	67	42	16	3.0	55	07:20	30	176.52	74.80	101.36		0.356													
28	09-10-2018	39G6	25	55°21.5'	16°40.6'	55°22.6'	16°42.3'	63	38	16	3.2	45	10:10	30	692.54	483.06	207.62				1.844			0.019						0.002		
29	09-10-2018	39G7	25	55°14.5'	17°01.4'	55°15.1'	17°02.7'	85	50	16	3.0	55	15:40	20	741.11	91.29	648.42				1.395											
30	10-10-2018	38G7	25	54°59.0'	17°21.0'	54°59.0'	17°22.0'	28	13	13	3.2	90	09:00	15	1053.24	1032.60	20.64															
31	10-10-2018	39G7	25	55°10.0'	17°20.1'	55°09.9'	17°23.3'	60	37	17	3.0	90	11:30	30	171.91	105.14	45.82	0.440		19.860	0.652											
32	10-10-2018	39G7	25	55°18.2'	17°21.3'	55°18.5'	17°23.7'	82	61	18	3.0	75	14:30	30	358.83	18.84	260.90	79.090														
33	10-10-2018	40G7	25	55°32.2'	17°33.0'	55°32.4'	17°35.7'	43	23	16	3.1	80	18:30	30	502.20	5.56	492.52	3.410	0.710													
34	11-10-2018	39G7	25	55°26.5'	17°41.1'	55°25.9'	17°43.3'	78	44	18	3.2	125	07:40	30	563.58	142.34	419.48	0.954			0.804											
35	11-10-2018	39G7	25	55°19.1'	17°38.9'	55°19.9'	17°36.6'	79	52	18	3.0	305	10:10	30	541.30	80.04	455.00	5.850							0.150		0.260					
36	11-10-2018	39G8	26	55°10.2'	18°00.6'	55°09.9'	18°02.3'	45	20	18	3.0	115	16:55	20	913.05	911.31	1.74															
37	12-10-2018	39G8	26	55°19.7'	18°00.7'	55°18.9'	18°02.8'	74	43	20	3.1	130	08:00	30	177.97	118.38	51.96	7.630														
38	12-10-2018	40G7	25	55°44.2'	17°59.0'	55°44.1'	17°56.3'	63	40	18	3.0	260	12:30	30	337.51	55.78	280.74	0.990														

Table 4. The mean numerical share of young, undersized fishes per ICES SDs (the Polish BIAS/2018 and BIAS/2017).

Species	Fish threshold length	BIAS 2017 Mean share in % numbers SD24	SD25	SD26	Mean	BIAS 2018 Mean share in % numbers SD24	SD25	SD26	Mean
sprat	< 10 cm	0	0.2	2.9	1.2	16.2	18.6	25.1	21.3
herring	< 16 cm	25.3	22.5	80.9	23.7	3.8	8.5	14.9	11.0
cod	< 35 cm	60.6	41.2	-	46.6	25.0	58.0	53.1	54.5

Table 5. Cruise statistics of the Polish BIAS survey on board of the r.v. "Baltica", 28.09-13.10.2018.

ICES SDs	ICES rectangles	EDSU [NM]	<σ> $[m^2 \cdot 10^{-4}]$	< NASC> $[m^2 \cdot NM^{-2}]$	Area $[NM^2]$	species composition [%]			Abundance $\cdot 10^6$			
						sprat	herring	cod	total	sprat	herring	cod
24	38G4	31	2.72	268.1	1034.8	51.3	48.4	0.3	1020.7	523.5	494.2	3.0
Sum SD24		**31**							**1020.7**	**523.5**	**494.2**	**3.0**
25	37G5	44	2.01	208.3	642.2	59.5	40.5	0.0	667.1	396.9	270.2	0.0
25	38G5	76	3.53	175.4	1035.7	24.3	73.8	1.9	515.2	125.2	380.1	10.0
25	38G6	68	1.32	133.6	940.2	89.4	10.6	0.0	952.1	851.3	100.6	0.3
25	38G7	22	1.31	85.6	471.7	99.3	0.7	0.0	309.2	306.9	2.3	0.0
25	39G5	31	2.12	176.7	979	71.3	28.5	0.2	817.3	583.1	232.9	1.4
25	39G6	79	2.22	222.1	1026	54.9	45.0	0.1	1024.5	562.1	461.5	0.9
25	39G7	97	2.62	298.5	1026	47.5	51.9	0.7	1170.8	555.8	607.3	7.6
25	40G7	17	3.06	244.7	1013	20.9	79.0	0.0	809.8	169.6	639.9	0.3
Sum SD25		**434**			**7133.8**				**6266.0**	**3550.8**	**2694.7**	**20.5**
26	37G8	9	1.00	1021.7	86	98.3	1.7	0.0	876.4	861.7	14.7	0.0
26	37G9	29	1.06	2121.4	151.6	99.8	0.2	0.0	3039.9	3032.9	7.0	0.0
26	38G8	46	1.66	927.0	624.6	77.5	22.1	0.4	3496.6	2710.4	771.1	15.1
26	38G9	56	2.21	1024.8	918.2	50.8	49.2	0.0	4248.9	2158.2	2090.7	0.1
26	39G8	98	1.38	367.4	1026	86.1	13.9	0.1	2729.9	2350.1	378.3	1.4
26	39G9	26	1.87	159.9	1026	71.6	28.4	0.0	878.2	628.8	249.0	0.4
26	40G8	100	2.58	231.8	1013	33.4	66.4	0.2	909.5	303.9	604.2	1.5
Sum SD26		**364**			**4845.4**				**16179.5**	**12045.9**	**4115.0**	**18.6**

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", 28.09-13.10.2018.

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.]
24	38G4	81.59	26.42	104.05	139.15	124.61	44.51	1.60	0.00	1.60	523.53
Sum SD24		81.59	26.42	104.05	139.15	124.61	44.51	1.60	0.00	1.60	523.53
25	37G5	253.90	25.32	29.50	44.21	34.22	6.98	2.70	0.00	0.07	396.91
25	38G5	5.39	4.87	22.54	42.42	35.96	11.01	2.86	0.07	0.07	125.19
25	38G6	491.71	31.73	83.70	125.24	96.75	14.81	6.79	0.40	0.16	851.30
25	38G7	86.89	39.37	51.50	65.64	53.72	7.05	2.69	0.00	0.00	306.86
25	39G5	0.00	20.69	116.08	213.83	178.30	38.53	14.72	0.00	0.91	583.06
25	39G6	10.40	18.30	116.88	201.60	166.49	33.63	13.54	0.77	0.46	562.08
25	39G7	57.11	89.95	124.81	152.65	110.59	13.11	7.44	0.10	0.07	555.81
25	40G7	3.55	32.92	40.41	47.58	37.03	5.64	2.47	0.00	0.03	169.62
Sum SD25		908.96	263.15	585.43	893.17	713.06	130.75	53.21	1.34	1.77	3550.84
26	37G8	242.23	389.36	119.33	84.98	25.61	0.20	0.00	0.00	0.00	861.71
26	37G9	583.06	1337.51	534.61	412.61	158.76	4.95	0.00	1.42	0.00	3032.91
26	38G8	352.99	853.09	588.18	623.65	271.99	15.43	2.35	2.67	0.00	2710.35
26	38G9	270.10	317.05	356.45	700.72	443.55	53.70	3.00	13.60	0.00	2158.15
26	39G8	752.56	272.61	421.27	581.55	292.89	23.53	0.42	5.30	0.00	2350.13
26	39G9	33.77	72.38	159.57	231.18	118.69	10.73	0.28	2.17	0.00	628.77
26	40G8	45.34	19.13	51.63	107.73	68.24	9.15	0.66	2.00	0.00	303.87
Sum SD26		2280.05	3261.13	2231.04	2742.41	1379.73	117.68	6.72	27.15	0.00	12045.90

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", 28.09-13.10.2018.

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]
24	38G4	452.57	265.82	1320.27	1908.45	1789.63	691.56	28.71	0.00	28.71	6485.72
Sum SD24		452.57	265.82	1320.27	1908.45	1789.63	691.56	28.71	0.00	28.71	6485.72
25	37G5	1293.38	229.27	354.47	583.28	461.01	106.48	38.08	0.00	1.26	3067.23
25	38G5	29.85	48.46	283.02	581.08	502.02	168.83	41.55	1.44	1.26	1657.53
25	38G6	2356.30	307.57	1015.57	1616.71	1288.54	222.68	91.45	7.86	2.78	6909.45
25	38G7	436.93	369.02	610.78	838.84	704.22	99.76	35.60	0.00	0.00	3095.15
25	39G5	0.00	209.71	1457.95	2870.02	2441.12	581.13	211.04	0.00	15.79	7786.77
25	39G6	44.73	192.48	1452.72	2674.88	2274.29	509.03	190.53	15.11	8.01	7361.77
25	39G7	262.31	842.41	1464.80	1919.62	1429.43	192.66	95.51	1.92	1.17	6209.83
25	40G7	17.26	313.23	470.95	606.05	485.02	82.18	32.63	0.00	0.47	2007.79
Sum SD25		4440.76	2512.16	7110.27	11690.48	9585.65	1962.74	736.38	26.33	30.75	38095.51
26	37G8	808.65	2859.65	1081.04	827.08	261.10	2.46	0.00	0.00	0.00	5839.97
26	37G9	2146.89	9773.83	4861.33	4107.11	1673.81	66.00	0.00	19.32	0.00	22648.29
26	38G8	1322.32	6439.33	5650.42	6587.03	3044.24	210.21	36.11	36.24	0.00	23325.89
26	38G9	930.36	2441.81	3598.68	8202.74	5494.20	749.41	45.98	184.79	0.00	21647.96
26	39G8	2729.36	2196.07	4170.96	6433.43	3421.03	320.57	6.48	71.97	0.00	19349.87
26	39G9	138.12	617.42	1594.93	2582.88	1397.57	147.45	4.34	29.51	0.00	6512.21
26	40G8	180.53	166.21	536.63	1266.25	843.51	134.94	10.96	27.12	0.00	3166.15
Sum SD26		8256.22	24494.33	21493.98	30006.52	16135.45	1631.02	103.86	368.94	0.00	102490.34

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", 28.09-13.10.2018.

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]
24	38G4	5.55	10.06	12.69	13.72	14.36	15.54	17.96	-	17.96	12.39
MW SD24		5.55	10.06	12.69	13.72	14.36	15.54	17.96		17.96	12.39
25	37G5	5.09	9.05	12.02	13.19	13.47	15.25	14.11	-	17.33	7.73
25	38G5	5.54	9.96	12.56	13.70	13.96	15.33	14.51	19.60	17.33	13.24
25	38G6	4.79	9.69	12.13	12.91	13.32	15.03	13.46	19.60	17.33	8.12
25	38G7	5.03	9.37	11.86	12.78	13.11	14.16	13.22	-	-	10.09
25	39G5	-	10.13	12.56	13.42	13.69	15.08	14.34	-	17.33	13.36
25	39G6	4.30	10.52	12.43	13.27	13.66	15.14	14.07	19.60	17.33	13.10
25	39G7	4.59	9.37	11.74	12.58	12.93	14.70	12.84	19.60	17.33	11.17
25	40G7	4.86	9.51	11.65	12.74	13.10	14.58	13.23	-	17.33	11.84
MW SD25		4.89	9.55	12.15	13.09	13.44	15.01	13.84	19.60	17.33	10.73
26	37G8	3.34	7.34	9.06	9.73	10.19	12.37	-	-	-	6.78
26	37G9	3.68	7.31	9.09	9.95	10.54	13.34	-	13.59	-	7.47
26	38G8	3.75	7.55	9.61	10.56	11.19	13.62	15.35	13.59	-	8.61
26	38G9	3.44	7.70	10.10	11.71	12.39	13.96	15.35	13.59	-	10.03
26	39G8	3.63	8.06	9.90	11.06	11.68	13.62	15.35	13.59	-	8.23
26	39G9	4.09	8.53	9.99	11.17	11.77	13.75	15.35	13.59	-	10.36
26	40G8	3.98	8.69	10.39	11.75	12.36	14.75	16.52	13.59	-	10.42
MW SD26		3.62	7.51	9.63	10.94	11.69	13.86	15.47	13.59		8.51

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", 28.09-13.10.2018.

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.]
24	38G4	16.10	16.92	0.00	51.06	215.67	105.02	49.95	27.46	12.04	494.23
Sum SD24		16.10	16.92	0.00	51.06	215.67	105.02	49.95	27.46	12.04	494.23
25	37G5	8.79	38.15	12.62	36.06	95.35	30.26	26.95	12.13	9.85	270.17
25	38G5	5.13	40.44	15.76	54.72	124.94	45.14	45.46	27.17	21.32	380.09
25	38G6	23.23	11.47	4.69	9.44	26.66	8.17	8.00	4.90	4.01	100.57
25	38G7	0.69	0.39	0.17	0.15	0.56	0.15	0.13	0.02	0.03	2.30
25	39G5	6.77	47.02	15.96	29.41	79.89	21.74	17.92	7.59	6.58	232.88
25	39G6	12.71	125.12	46.33	48.54	159.06	31.76	23.37	7.83	6.81	461.52
25	39G7	4.21	98.11	33.19	83.52	220.74	64.16	56.96	24.69	21.74	607.31
25	40G7	0.00	91.94	27.34	97.47	227.40	76.34	67.21	25.93	26.26	639.89
Sum SD25		61.52	452.64	156.05	359.30	934.60	277.71	246.01	110.26	96.61	2694.72
26	37G8	4.18	5.71	0.91	0.97	1.48	0.74	0.41	0.12	0.20	14.71
26	37G9	4.31	1.44	0.24	0.38	0.37	0.20	0.06	0.00	0.00	7.01
26	38G8	168.22	118.98	54.26	49.63	149.30	75.42	54.27	35.92	65.10	771.10
26	38G9	77.06	373.53	195.44	197.36	532.01	274.67	177.88	84.55	178.20	2090.69
26	39G8	64.54	48.00	30.43	31.98	90.38	49.09	28.72	12.32	22.87	378.33
26	39G9	1.91	35.25	25.20	26.57	71.90	39.33	22.41	9.17	17.24	248.99
26	40G8	0.22	73.23	66.87	71.46	188.59	99.04	51.57	19.38	33.80	604.16
Sum SD26		320.44	656.15	373.34	378.35	1034.03	538.50	335.32	161.45	317.41	4115.00

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", 28.09-13.10.2018.

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]
24	38G4	201.66	422.53	0.00	2867.15	10070.05	5751.00	2275.66	1675.86	937.13	24201.02
Sum SD24		201.66	422.53	0.00	2867.15	10070.05	5751.00	2275.66	1675.86	937.13	24201.02
25	37G5	96.01	1152.67	417.37	1533.76	3680.32	1329.04	1293.37	695.93	558.67	10757.13
25	38G5	66.24	1224.17	548.06	2550.71	5374.51	2244.00	2382.68	1622.75	1294.94	17308.06
25	38G6	216.67	328.92	144.44	424.38	1107.20	376.81	412.89	292.42	240.81	3544.55
25	38G7	7.84	10.62	4.44	5.71	19.17	5.91	5.52	1.12	1.28	61.61
25	39G5	89.59	1329.67	462.77	1166.15	2883.05	969.65	856.05	430.26	388.29	8575.48
25	39G6	178.30	3352.13	1240.01	1696.18	5236.46	1306.30	1024.32	420.58	377.93	14832.21
25	39G7	57.91	2885.36	1039.84	3487.66	8292.83	2804.31	2725.47	1433.30	1254.08	23980.77
25	40G7	0.00	2836.63	934.29	4288.39	8760.62	3376.46	3246.46	1465.66	1511.65	26420.16
Sum SD25		712.56	13120.17	4791.23	15152.95	35354.15	12412.48	11946.75	6362.02	5627.66	105479.97
26	37G8	29.31	110.15	23.42	25.68	48.60	25.29	16.89	6.57	11.81	297.71
26	37G9	33.87	29.97	6.05	9.40	10.25	5.93	2.08	0.00	0.00	97.56
26	38G8	1313.79	2562.48	1613.56	1594.21	5610.73	2973.54	2618.32	2154.17	3989.81	24430.61
26	38G9	728.17	8334.37	5916.52	6148.76	19035.47	10528.45	8217.63	4895.52	10395.38	74200.27
26	39G8	535.90	1079.71	959.12	1010.09	3123.49	1746.39	1258.33	682.97	1237.49	11633.48
26	39G9	19.82	861.10	786.39	828.59	2438.06	1395.90	970.52	494.05	905.95	8700.38
26	40G8	2.88	1914.40	2057.98	2191.17	6364.33	3404.83	2206.54	1098.74	1911.47	21152.34
Sum SD26		2663.72	14892.18	11363.04	11807.90	36630.93	20080.33	15290.32	9332.03	18451.92	140512.36

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", 28.09-13.10.2018.

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]
24	38G4	12.52	24.97	-	56.15	46.69	54.76	45.56	61.03	77.83	48.97
MW SD24		12.52	24.97		56.15	46.69	54.76	45.56	61.03	77.83	48.97
25	37G5	10.93	30.21	33.08	42.53	38.60	43.92	47.98	57.36	56.69	39.82
25	38G5	12.91	30.27	34.77	46.61	43.02	49.71	52.41	59.73	60.73	45.54
25	38G6	9.33	28.68	30.78	44.97	41.53	46.10	51.62	59.73	60.01	35.25
25	38G7	11.31	26.95	26.14	38.94	33.99	40.53	42.24	45.41	43.01	26.81
25	39G5	13.24	28.28	28.99	39.65	36.09	44.61	47.77	56.68	59.04	36.82
25	39G6	14.03	26.79	26.77	34.94	32.92	41.13	43.83	53.71	55.48	32.14
25	39G7	13.77	29.41	31.33	41.76	37.57	43.71	47.85	58.05	57.69	39.49
25	40G7	-	30.85	34.18	44.00	38.53	44.23	48.30	56.52	57.56	41.29
MW SD25			28.99	30.70	42.17	37.83	44.70	48.56	57.70	58.25	38.88
26	37G8	7.02	19.29	25.65	26.43	32.78	34.19	41.65	56.17	59.62	20.23
26	37G9	7.86	20.89	25.29	24.51	27.35	29.79	33.05	-	-	13.93
26	38G8	7.81	21.54	29.74	32.12	37.58	39.43	48.25	59.97	61.29	31.68
26	38G9	9.45	22.31	30.27	31.16	35.78	38.33	46.20	57.90	58.33	35.49
26	39G8	8.30	22.49	31.52	31.59	34.56	35.57	43.81	55.46	54.10	30.75
26	39G9	10.36	24.43	31.21	31.18	33.91	35.49	43.30	53.85	52.56	34.94
26	40G8	13.26	26.14	30.77	30.66	33.75	34.38	42.79	56.71	56.55	35.01
MW SD26		8.31	22.70	30.44	31.21	35.43	37.29	45.60	57.80	58.13	34.15

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", 28.09-13.10.2018.

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.]
24	38G4	0.00	0.00	1.66	0.98	0.26	0.06	0.00	0.00	0.00	2.96
Sum SD24		0.00	0.00	1.66	0.98	0.26	0.06	0.00	0.00	0.00	2.96
25	37G5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
25	38G5	0.00	0.00	8.73	1.15	0.08	0.00	0.00	0.00	0.00	9.95
25	38G6	0.00	0.00	0.19	0.09	0.00	0.00	0.00	0.00	0.00	0.28
25	38G7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
25	39G5	0.00	0.05	0.97	0.37	0.01	0.00	0.00	0.00	0.00	1.40
25	39G6	0.00	0.00	0.69	0.14	0.05	0.00	0.04	0.00	0.00	0.91
25	39G7	0.00	0.00	4.19	3.36	0.08	0.00	0.00	0.00	0.00	7.63
25	40G7	0.00	0.00	0.14	0.15	0.00	0.00	0.00	0.00	0.00	0.29
Sum SD25		0.00	0.05	14.90	5.26	0.21	0.00	0.04	0.00	0.00	20.47
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	0.20	8.29	5.65	0.97	0.00	0.00	0.00	0.00	15.12
26	38G9	0.00	0.00	0.04	0.04	0.01	0.00	0.00	0.00	0.00	0.09
26	39G8	0.00	0.00	0.87	0.51	0.06	0.00	0.00	0.00	0.00	1.44
26	39G9	0.00	0.00	0.27	0.13	0.02	0.00	0.00	0.00	0.00	0.43
26	40G8	0.00	0.00	0.83	0.51	0.12	0.00	0.00	0.00	0.00	1.47
Sum SD26		0.00	0.20	10.31	6.85	1.19	0.00	0.00	0.00	0.00	18.55

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", 28.09-13.10.2018.

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]
24	38G4	0.00	0.00	467.11	424.23	147.94	66.93	0.00	0.00	0.00	1106.20
Sum SD24		0.00	0.00	467.11	424.23	147.94	66.93	0.00	0.00	0.00	1106.20
25	37G5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
25	38G5	0.00	0.00	1785.27	411.30	50.91	0.00	0.00	0.00	0.00	2247.48
25	38G6	0.00	0.00	58.83	34.02	0.00	0.00	0.00	0.00	0.00	92.85
25	38G7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
25	39G5	0.00	2.97	266.96	144.43	5.26	0.00	0.00	0.00	0.00	419.62
25	39G6	0.00	0.00	177.81	48.88	38.64	0.00	40.94	0.00	0.00	306.26
25	39G7	0.00	0.00	1181.85	1845.76	45.95	0.00	0.00	0.00	0.00	3073.56
25	40G7	0.00	0.00	51.72	94.31	0.00	0.00	0.00	0.00	0.00	146.03
Sum SD25		0.00	2.97	3522.44	2578.70	140.76	0.00	40.94	0.00	0.00	6285.80
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	13.28	1860.66	2504.89	521.43	0.00	0.00	0.00	0.00	4900.27
26	38G9	0.00	0.00	12.19	14.99	4.16	0.00	0.00	0.00	0.00	31.34
26	39G8	0.00	0.00	196.91	236.42	24.51	0.00	0.00	0.00	0.00	457.84
26	39G9	0.00	0.00	61.59	61.96	5.93	0.00	0.00	0.00	0.00	129.47
26	40G8	0.00	0.00	185.58	180.84	55.10	0.00	0.00	0.00	0.00	421.52
Sum SD26		0.00	13.28	2316.93	2999.11	611.13	0.00	0.00	0.00	0.00	5940.45

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", 28.09-13.10.2018.

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]
24	38G4	-	-	281.16	432.54	575.60	1085.00	-	-	-	373.61
MW SD24											
25	37G5	-	-	-	-	-	-	-	-	-	
25	38G5	-	-	204.58	358.21	641.35	-	-	-	-	225.78
25	38G6	-	-	311.96	362.68	-	-	-	-	-	
25	38G7	-	-	-	-	-	-	-	-	-	
25	39G5	-	55.00	275.79	390.83	423.95	-	-	-	-	
25	39G6	-	-	258.69	352.60	841.99	-	1080.00	-	-	336.64
25	39G7	-	-	281.87	548.67	596.25	-	-	-	-	402.61
25	40G7	-	-	368.88	646.80	-	-	-	-	-	
MW SD25				236.35	490.24	655.48		1080.00			306.92
26	37G8	-	-	-	-	-	-	-	-	-	
26	37G9	-	-	-	-	-	-	-	-	-	
26	38G8	-	65.00	224.36	443.14	537.23	-	-	-	-	324.08
26	38G9	-	-	319.15	353.93	333.93	-	-	-	-	336.96
26	39G8	-	-	225.82	465.28	381.21	-	-	-	-	316.97
26	39G9	-	-	225.22	465.25	291.43	-	-	-	-	303.24
26	40G8	-	-	222.81	351.44	460.73	-	-	-	-	287.32
MW SD26			65.00	224.73	437.77	514.74					320.20

Table 15. Values of the basic meteorological and hydrological parameters recorded in September/October 2018 at the positions of the r.v. "Baltica" fish control catches (Smoliński et al., 2018).

Haul no	Date of catch	Haul start time	Meteorological parameters				Hydrological parameters*			Depth of measurement [m]
			Air temperature [°C]	Wind direction	Wind force [B]	Sea state	Temperature [°C]	Salinity [PSU]	Oxygen [ml l^{-1}]	
1	28-09-2018	09:45	13.5	WNW	6	3	16.18	7.35	6.1	37
2	28-09-2018	14:20	12.3	NW	6	4	15.76	7.31	6.21	48
3	29-09-2018	09:40	11.7	NW	4	2	4.4	7.45	7.43	41
4	29-09-2018	14:00	12.2	WNW	4	2	9.92	7.39	5.57	56
5	29-09-2018	16:45	13.7	WSW	3	2	16.36	7.3	5.95	44
6	30-09-2018	10:40	10.8	S	5	2	15.88	7.31	6.18	38
7	30-09-2018	13:40	14.4	S	5	3	15.89	7.34	6.1	44
8	01-10-2018	07:35	13.6	W	3	2	4.5	7.45	6.79	46
9	01-10-2018	11:35	13.6	WSW	3	2	4.17	8.6	4.02	64
10	01-10-2018	14:50	12.9	NW	3	2	3.74	7.46	7.55	48
11	01-10-2018	18:25	12.7	NW	3	2	4.54	7.46	7.1	45
12	02-10-2018	08:00	11.7	W	5	3	4.27	7.44	7.41	49
13	02-10-2018	11:25	11	WSW	6	3	5.91	10.6	0.63	65
14	04-10-2018	10:15	11.7	W	5	3	3.61	7.57	7.15	53
15	04-10-2018	14:55	10.4	W	5	3	5.14	8.89	4.98	60
16	05-10-2018	09:55	13.7	SW	5	3	9.1	11.37	3.58	64
17	05-10-2018	13:55	14.4	SW	6	4	8.9	12.3	3.56	52
18	05-10-2018	18:20	16.3	SW	5	3	14.9	7.53	6.29	31
19	06-10-2018	08:00	13.2	S	5	3	6.95	11.75	2.1	43
20	06-10-2018	09:40	13.6	SW	4	2	7.32	12.13	1.98	45
21	06-10-2018	17:00	15.3	SW	4	2	6.17	10.34	5.67	37
22	06-10-2018	18:30	15	SW	4	2	7.64	12.14	2.25	46
23	07-10-2018	13:10	9.4	N	7	5	7.41	16.28	0.09	90
24	07-10-2018	16:15	10.5	N	6	3	10.41	12.81	3.35	60
25	08-10-2018	08:00	11.7	SW	4	3	9.89	14.7	0.95	61
26	08-10-2018	13:00	11.2	SW	5	3	14.71	7.52	6.25	28
27	09-10-2018	07:20	13.1	SW	5	3	4.88	8.05	6.29	50
28	09-10-2018	10:10	12	SW	5	3	5.96	9.28	3.95	46
29	09-10-2018	15:40	13.5	SW	5	3	4.92	9.14	4.69	58
30	10-10-2018	09:00	13.4	SW	4	2	12.46	7.42	6.79	19
31	10-10-2018	11:30	13	SW	3	2	9.34	7.51	6.87	45
32	10-10-2018	14:30	13.8	SW	3	2	6.1	10.22	0.39	70
33	10-10-2018	18:30	12.4	SW	3	2	10.35	7.58	6.88	31
34	11-10-2018	07:40	14.1	SE	4	2	4.72	7.59	6.92	53
35	11-10-2018	10:10	14.5	SE	5	2	5.25	9.83	1.66	61
36	11-10-2018	16:55	15.7	E	5	3	14.15	7.39	6.31	28
37	12-10-2018	08:00	14.3	SE	5	3	3.76	7.55	6.67	53
38	12-10-2018	12:30	14.3	SE	5	3	4	8.21	5.41	49

* date of the mean depth of the control-caches (in the middle of trawl vertical opening)

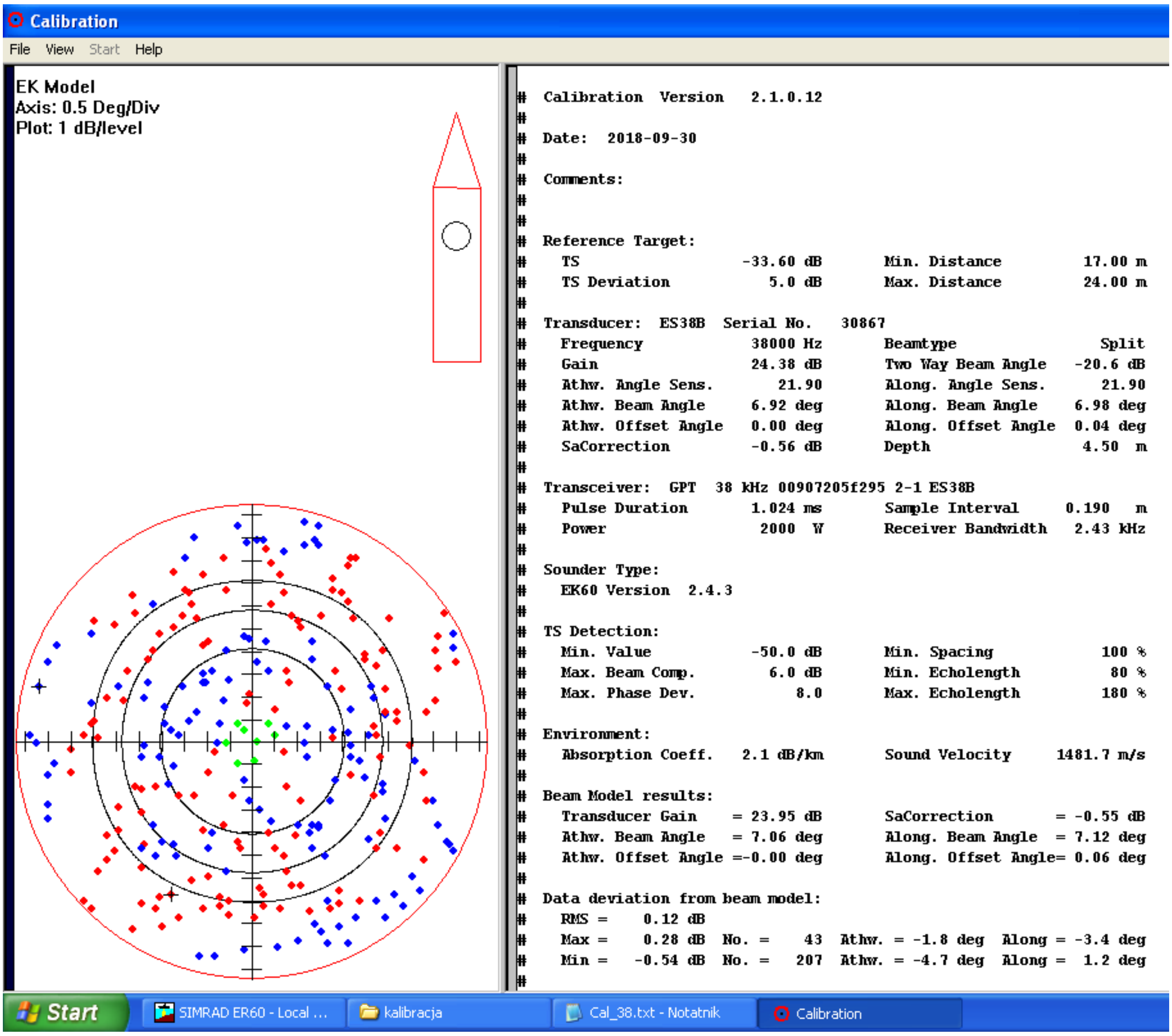

Fig. 1. R.v. “Baltica” cruise BIAS 2018: Simrad EK60 calibration report (38 kHz transducer).

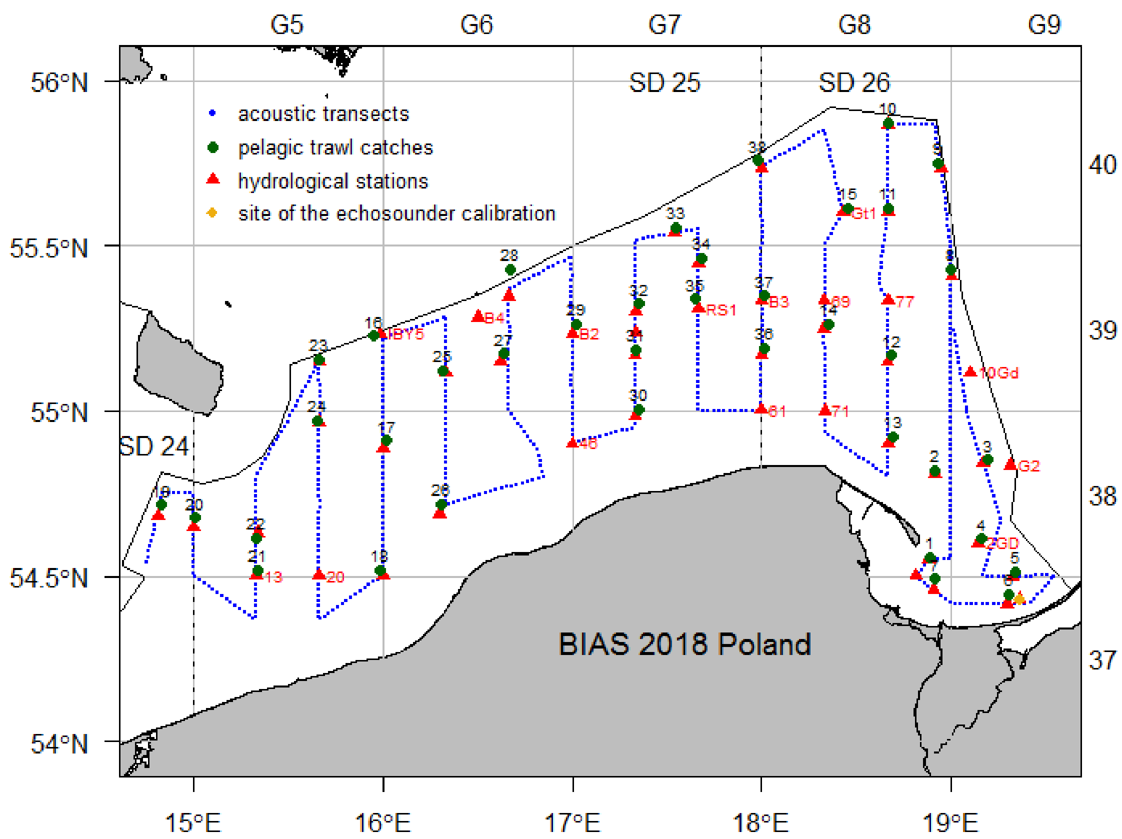

Fig. 2. Location of realized investigations during the Polish BIAS survey on board of the r.v. "Baltica", 28.09–13.10.2018.

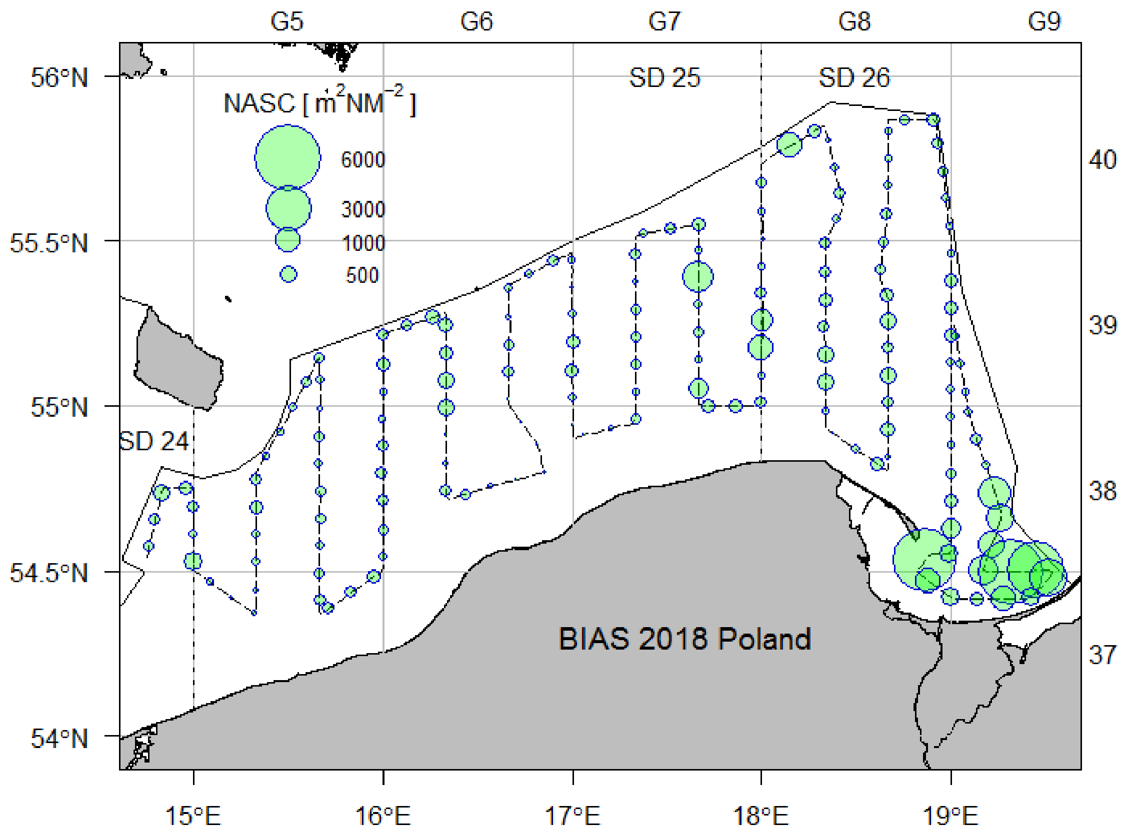

Fig. 3. Cruise track (thin dashed line) and the mean NASC (5 NM intervals, bubbles) recorded during BIAS 2018 cruise.

13440.68
5666.97

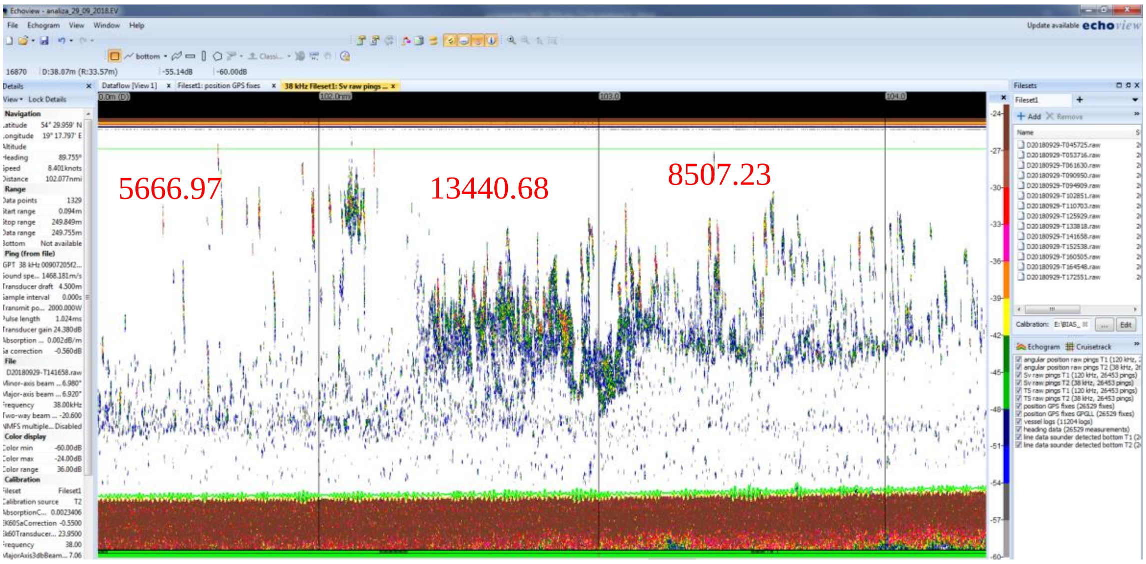

Fig. 4. An example of an echogram analysis for 103rd mile of the integration, NASC = 13440 m^2 NM^{-2} (ICES rectangle 37G9, bottom depth 70 m; 29.09.2018).

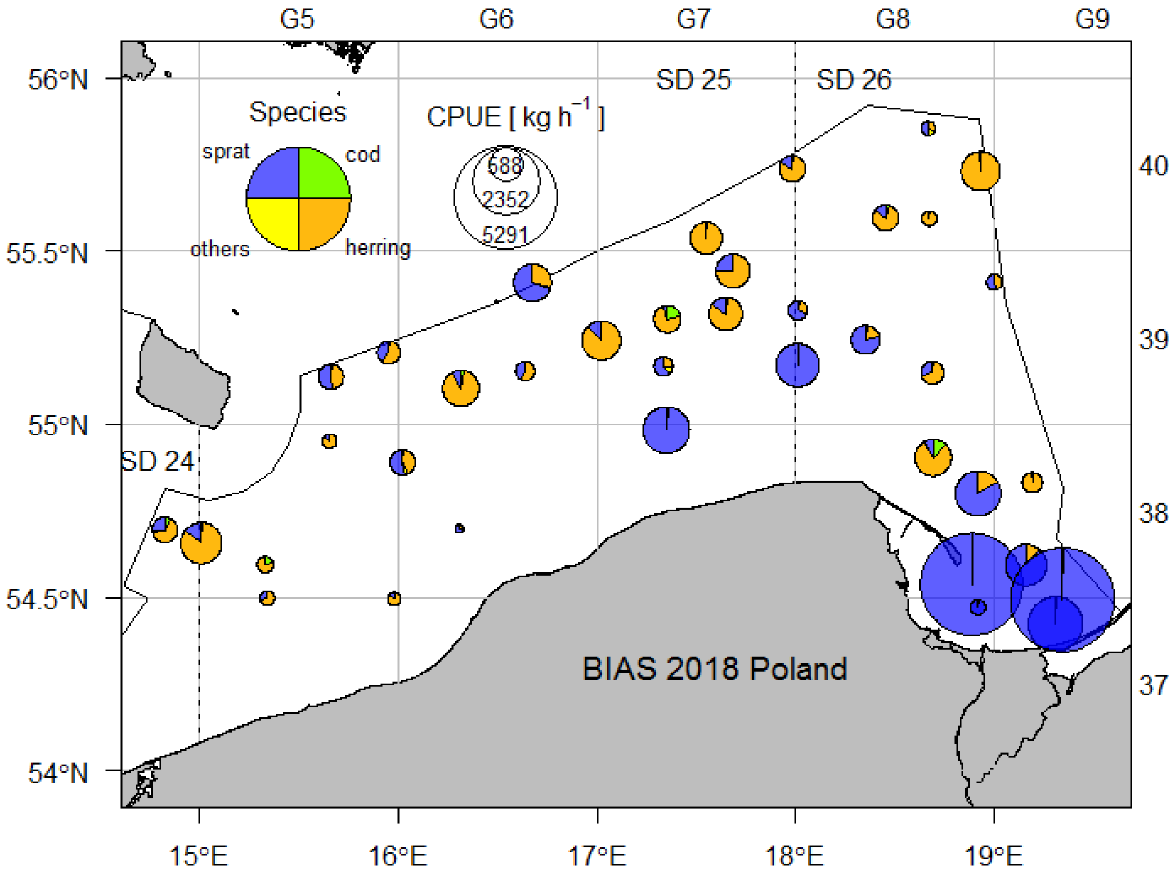

Fig. 5. CPUE [kg h^{-1}] of fish species per single pelagic hauls conducted in the Polish EEZ (BIAS/2018 survey).

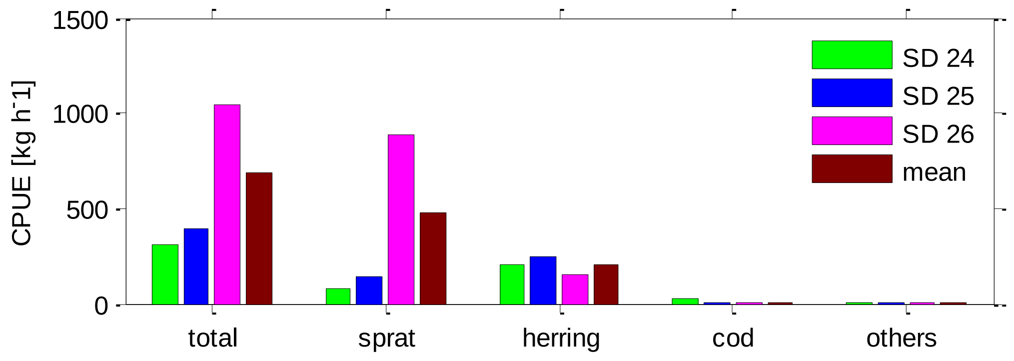

Fig. 6. Mean CPUE [kg h^{-1}] per fish species and the ICES SDs (the Polish BIAS/2018 survey).

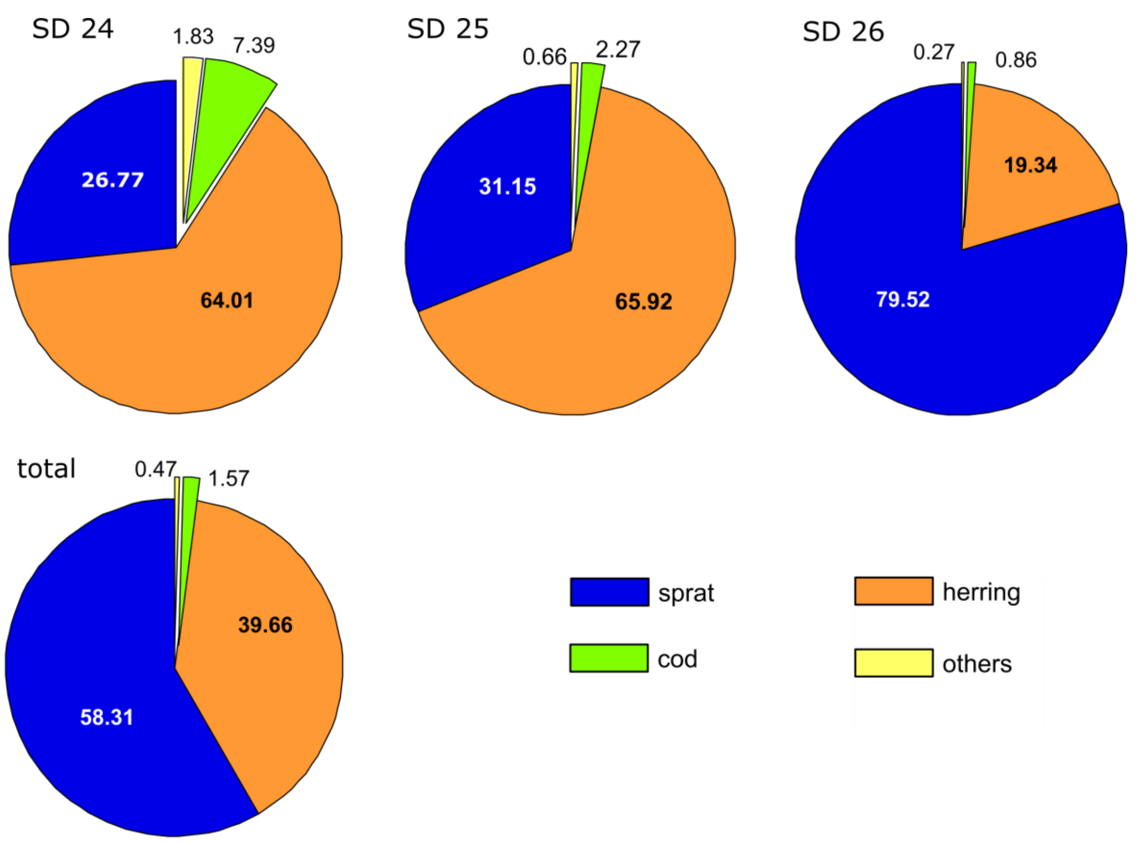

Fig. 7. Share (%) of sprat, herring, cod and other fishes in the mass of total catches per the ICES SDs (the Polish BIAS/2018).

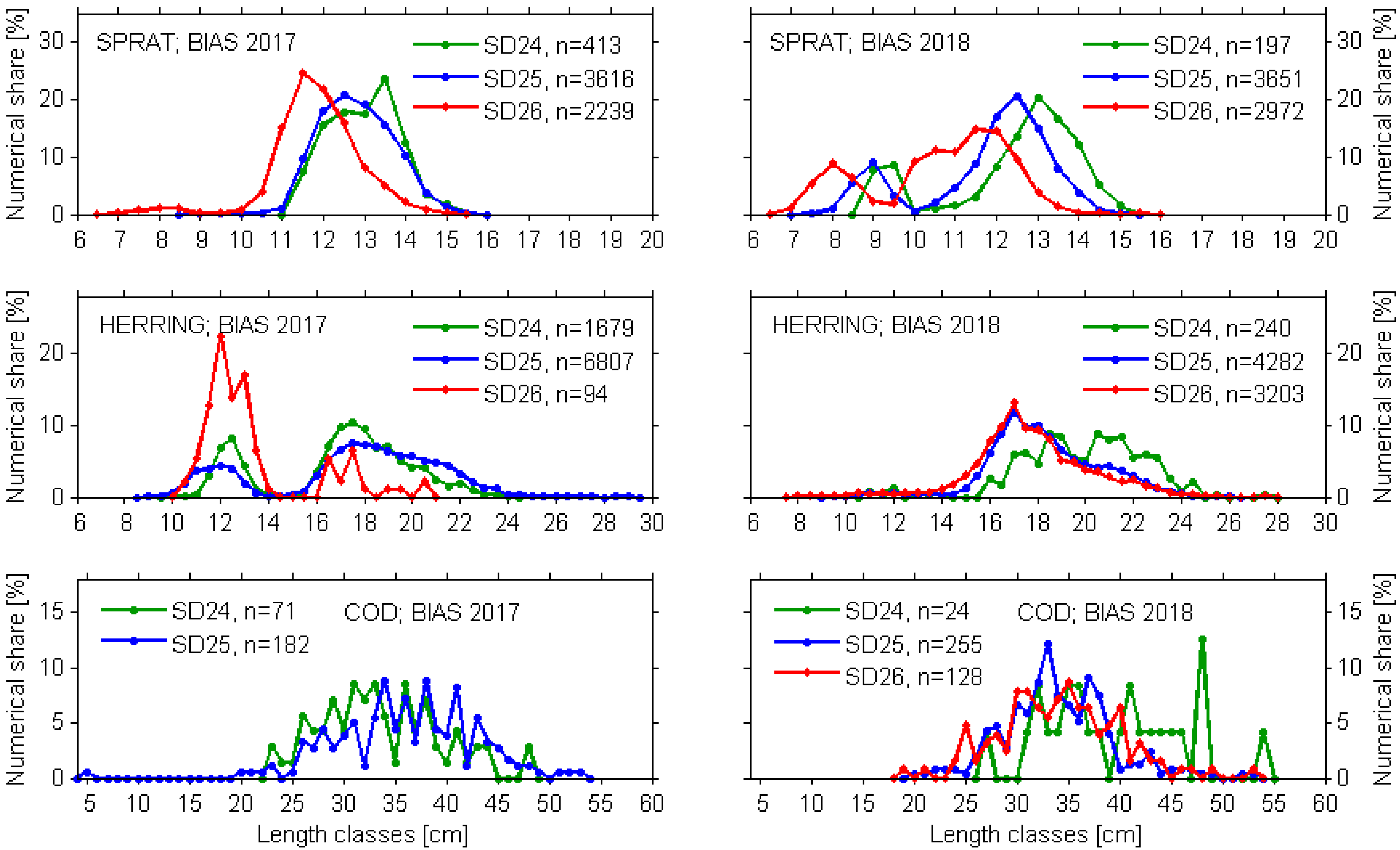

Fig. 8. Length distribution of sprat, herring and cod in samples taken from the control-catches conducted during the Polish BIAS/2017 and BIAS2018 surveys.

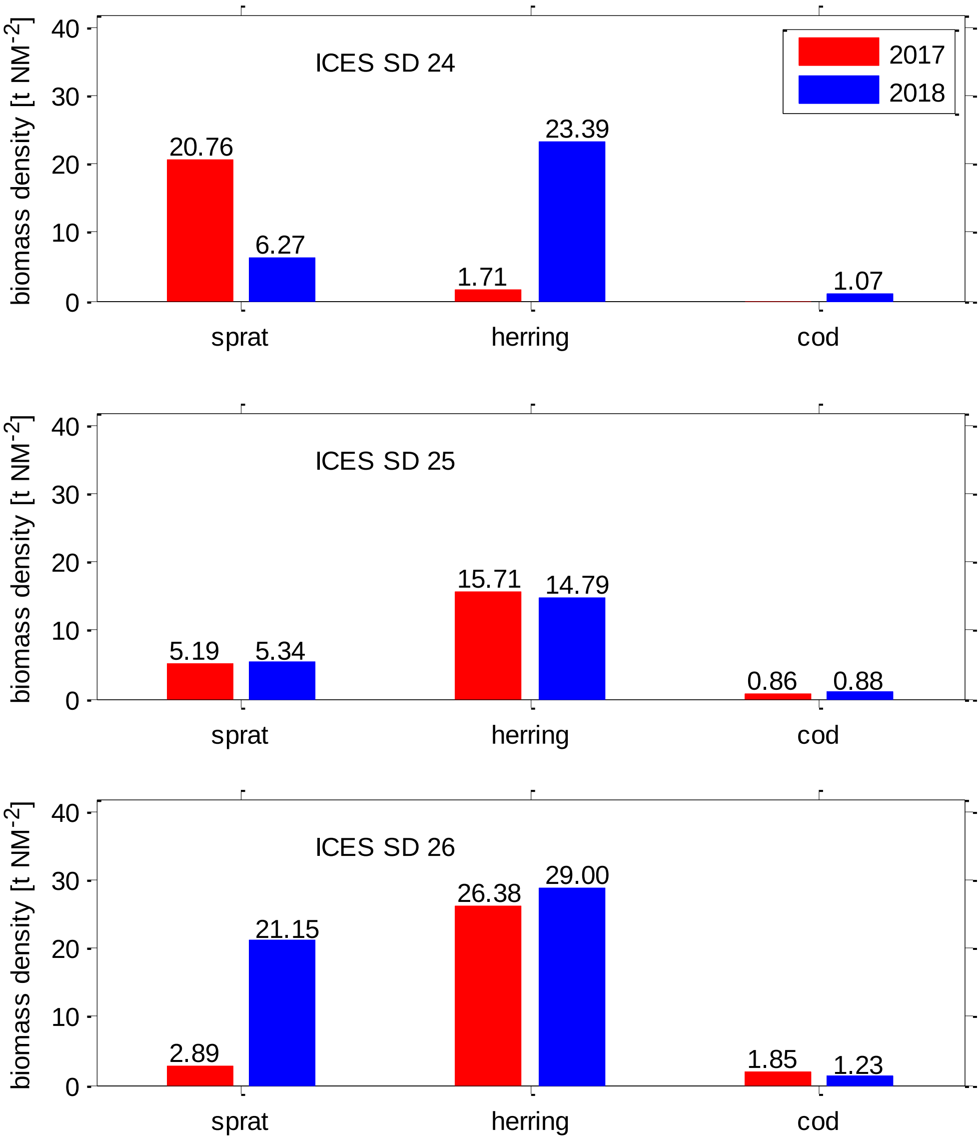

Fig. 9. Mean biomass surface density [t NM^{-2}] of sprat, herring and cod in the ICES Subdivisions 24, 25 and 26 in the Polish BIAS 2017 and 2018 surveys.

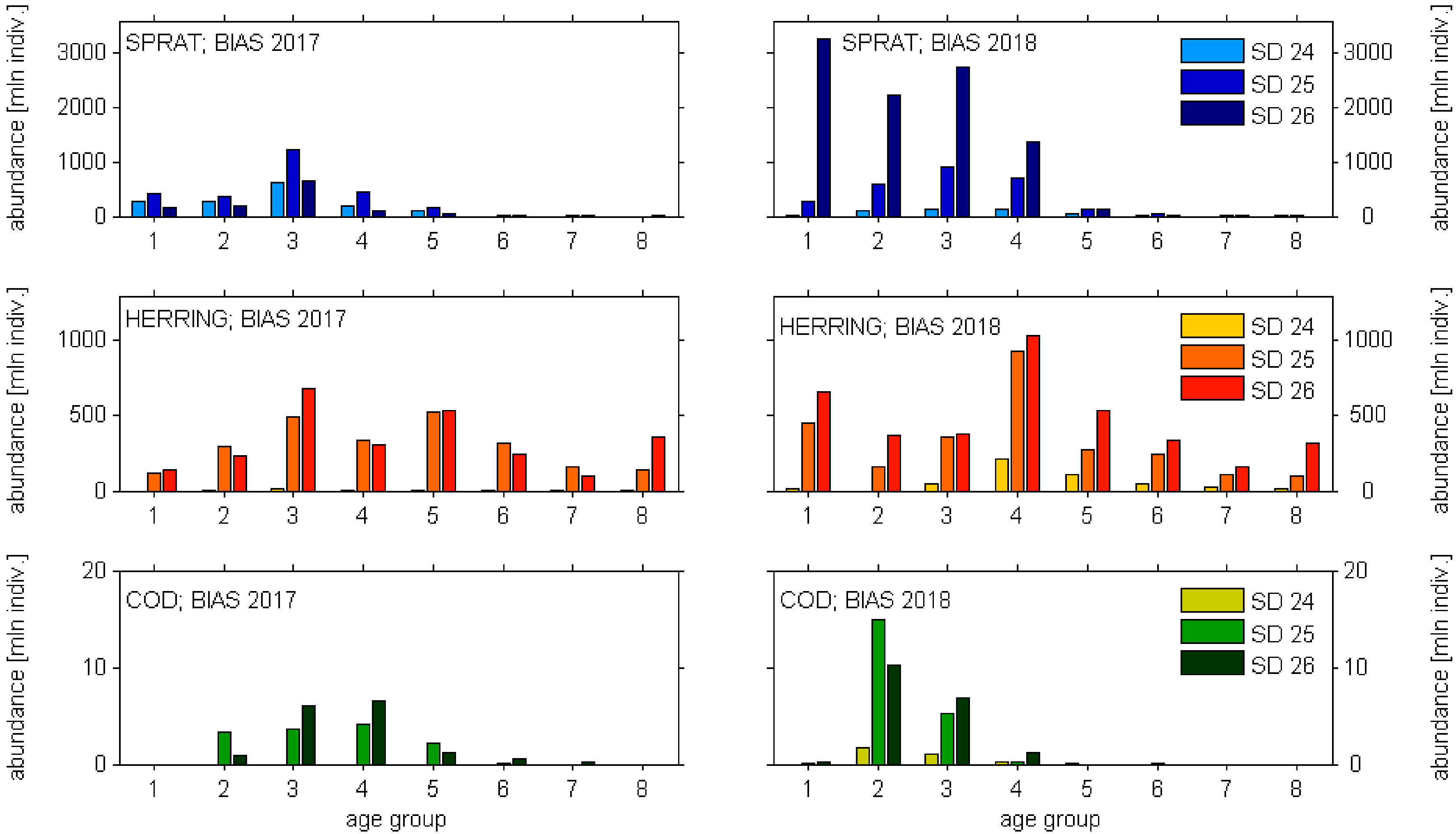

Fig. 10. Abundance (in mln indiv.) of sprat, herring and cod stocks per age groups, according to the ICES Subdivisions 24, 25 and 26, based on data from the Polish BIAS surveys in 2017 and 2018.

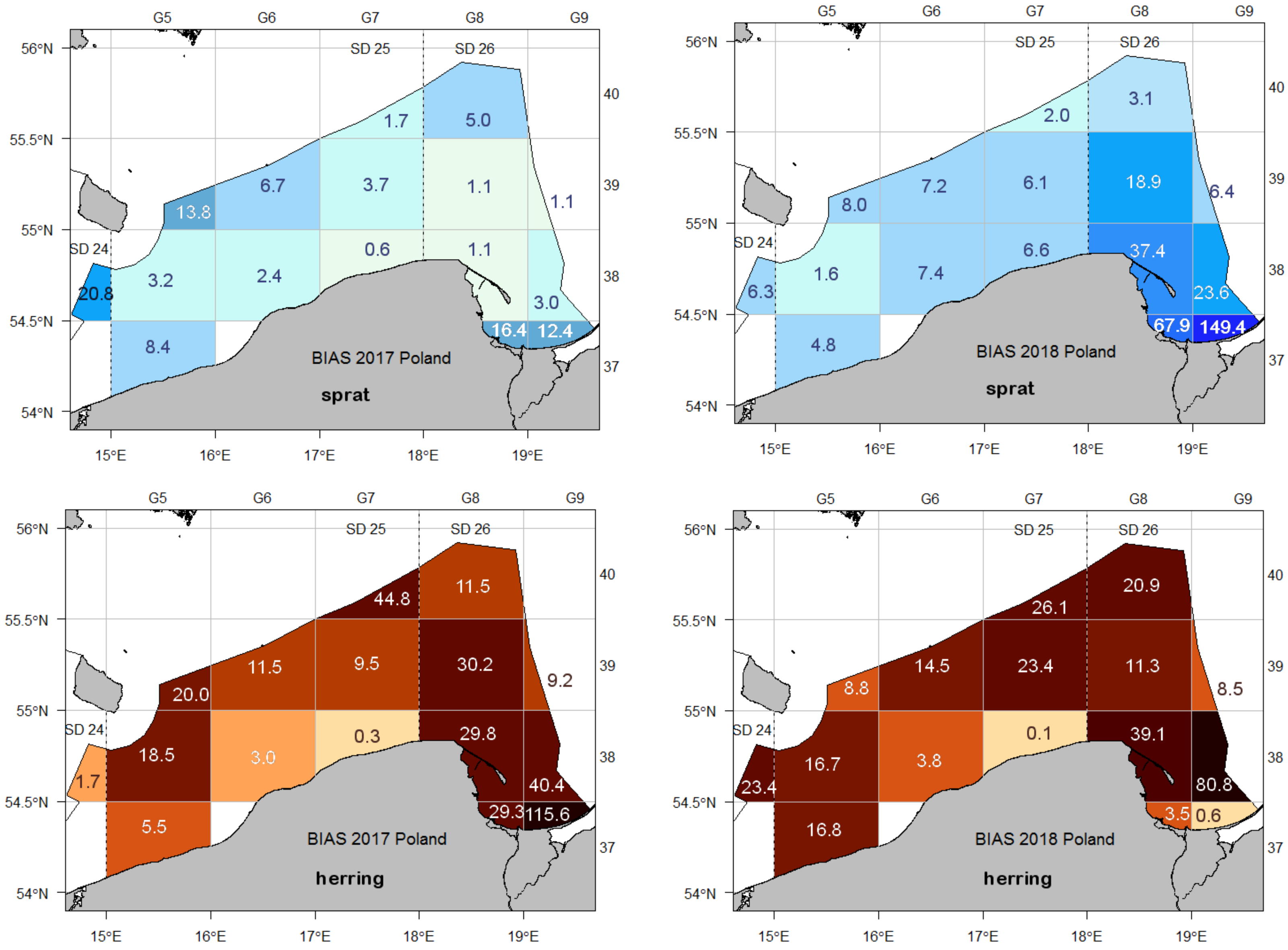

Fig. 11. Biomass surface density of sprat and herring [t NM^{-2}] per ICES rectangles, estimated using acoustic method, and based on data collected during the Polish BIAS 2017 and 2018 surveys.

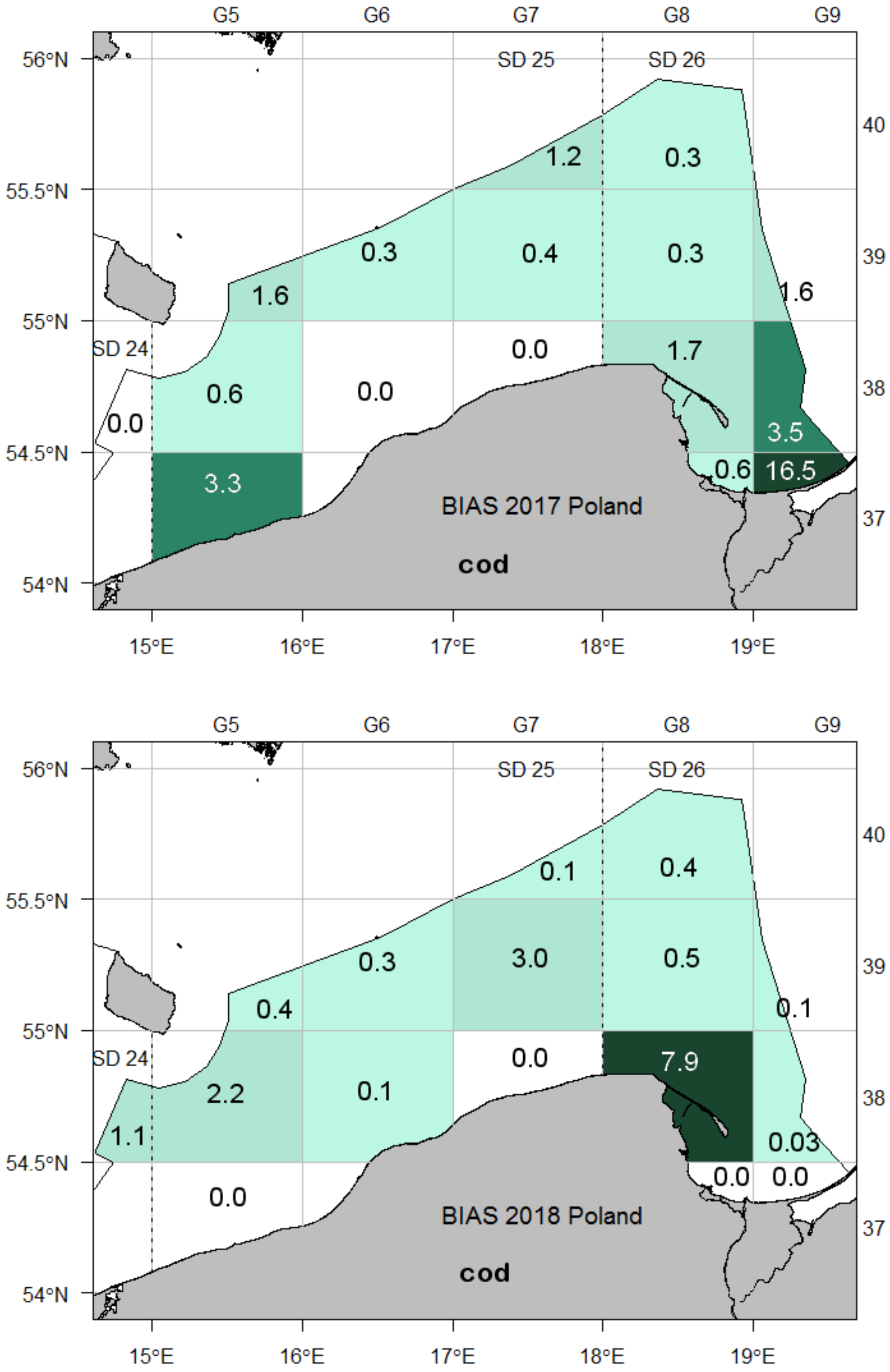

Fig. 12. Biomass surface density of cod [t NM^{-2}] per ICES rectangles, estimated using acoustic method, and based on data collected during the Polish BIAS 2017 and 2018 surveys.

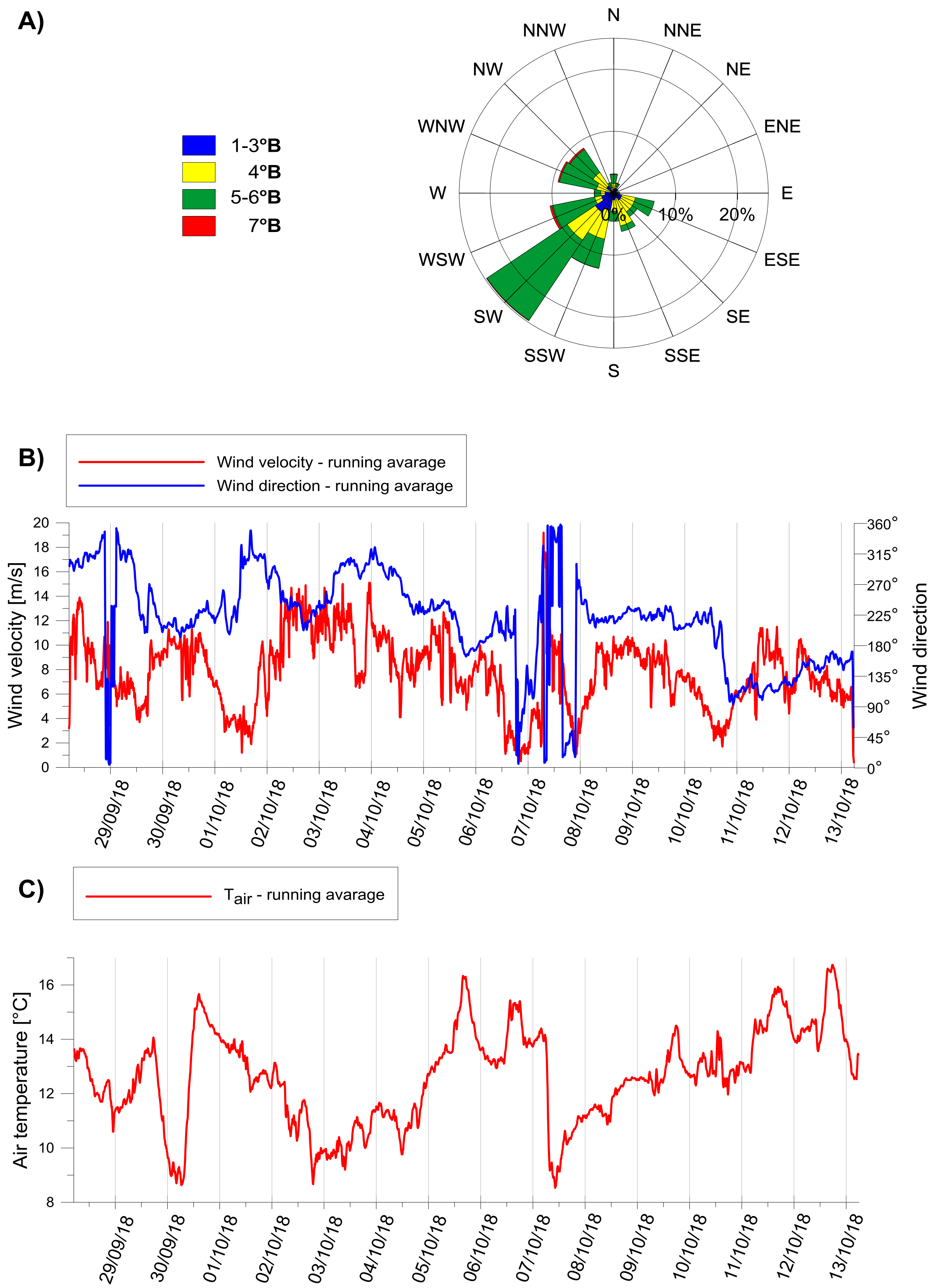

Fig. 13. Changes of meteorological parameters during consecutive days of the Polish BIAS survey in September/October 2018 (fig. Wodzinowski after Smoliński et al., 2018).

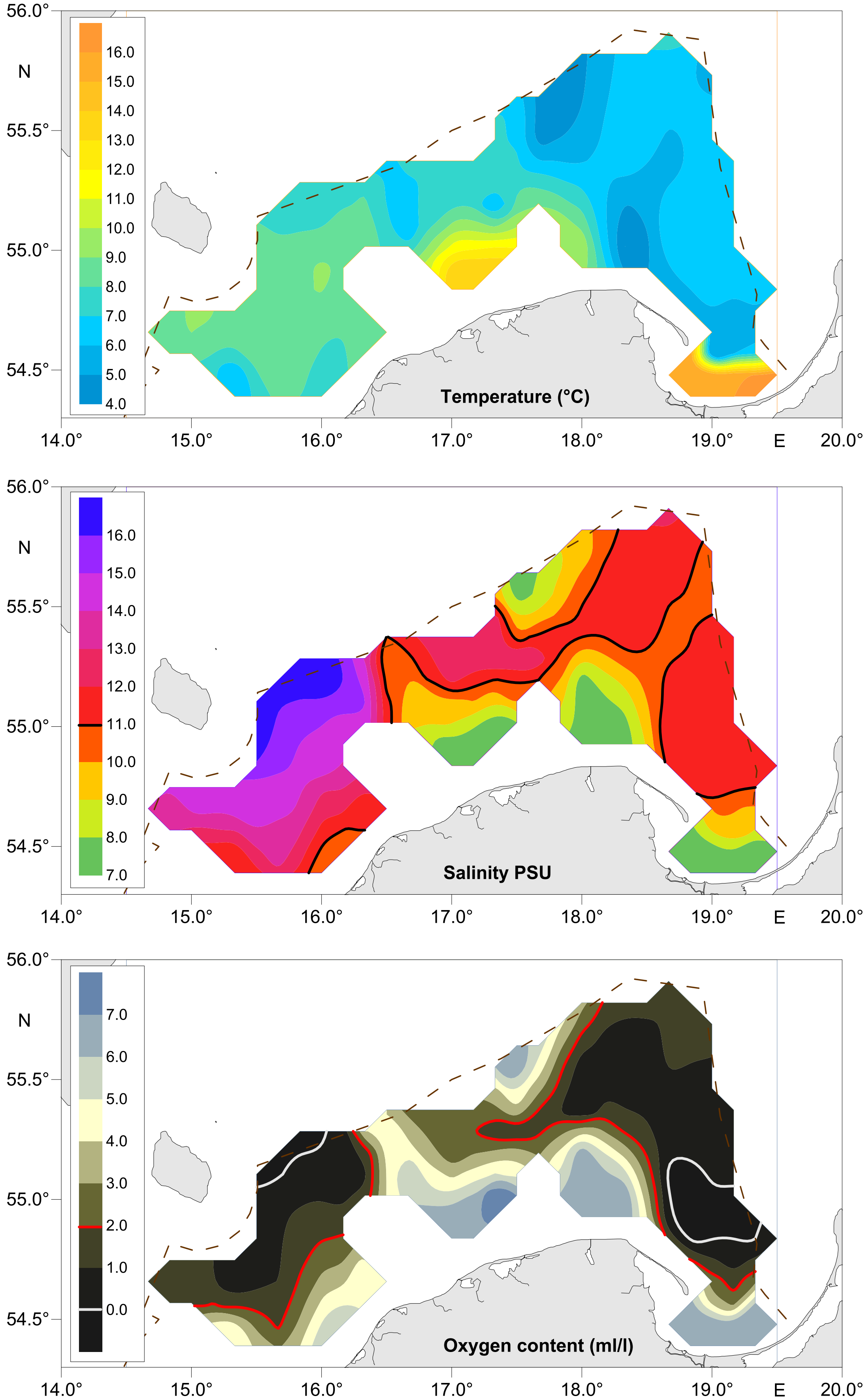

Fig. 14. Horizontal distribution of the seawater temperature, salinity and oxygen content in the near seabed layer of the southern Baltic in September/October 2018 (fig. Wodzinowski after Smoliński et al., 2018).

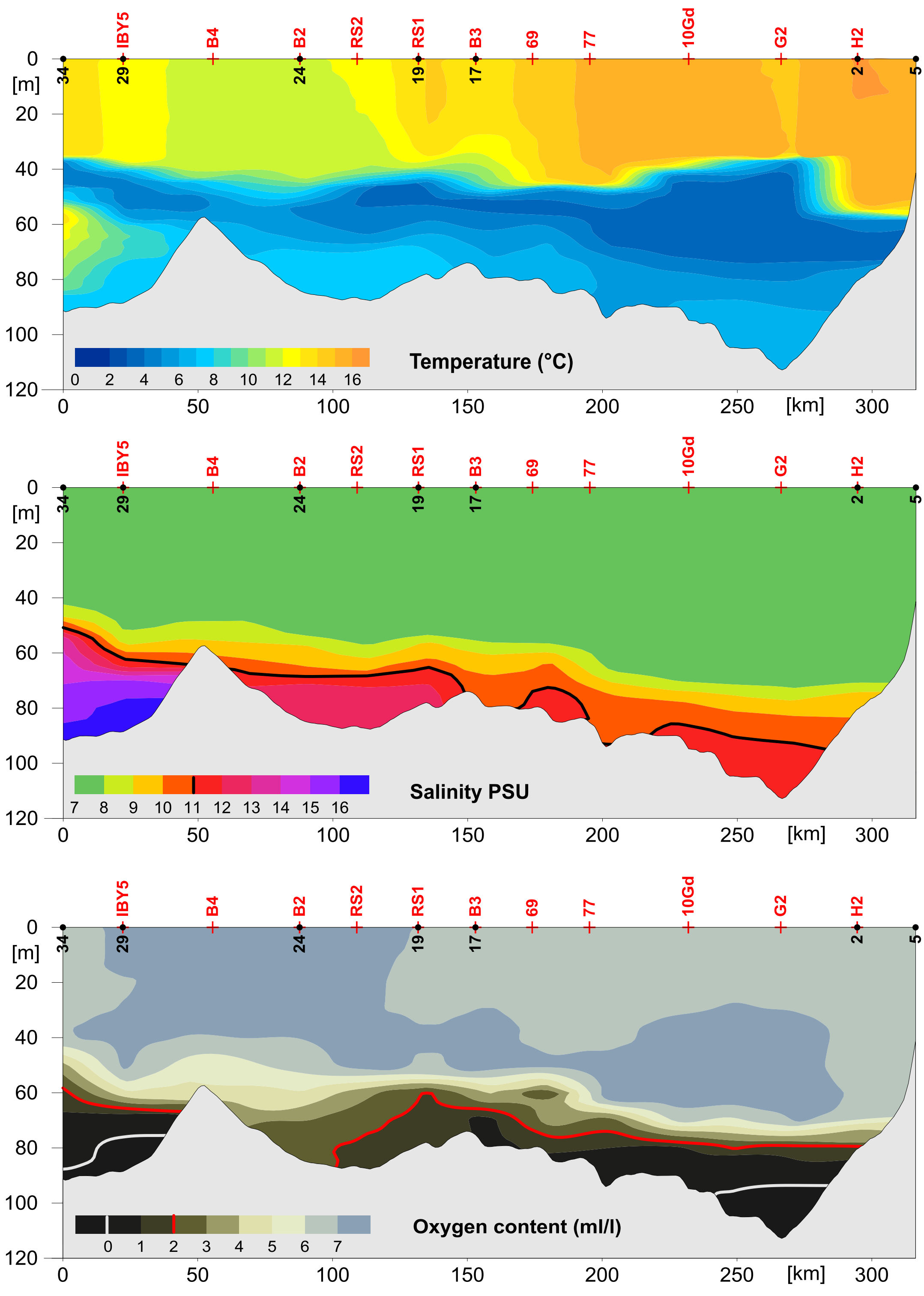

Fig. 15. Vertical distribution of the seawater temperature, salinity and oxygen content, along the hydrological research profile determined in the southern Baltic (September/October 2018); X- and Y-axes reflects distance (in kilometres) and depth (in meters) from the sea surface to the seabed, respectively (fig. Wodzinowski after Smoliński et al., 2018).

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 "169" and Vessel N55 ; 18.10. - 19.10.2018)

Working paper on the WGBIFS meeting in Klaipeda, Lithuania, 25.03-29.03.2019

Klaipeda, October, 2018
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 “169”. 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 "169" for fish sampling and vessel NZ55 for acoustic records 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 BIAS survey took place from 18-th to 19-th of October 2018. 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 111 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 -0.79 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	12.5
Along. Beam Angle	12.96
Athw. Offset Angle	0.62
Along. Offset Angle	0.29
SA Correction (38 kHz)	-0.79 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 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 $TS = 20 \log L \text{ (cm)} - 71.2$ (ICES 1983/H:12)

Gadoids $TS = 20 \log L \text{ (cm)} - 67.5$ (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

1670 herrings, 1195 sprats and 1 lumpfish, 1 three-spined stickleback, 137 cods, 1 flounder and 1 river lamprey were measured in 6 hauls. Totally 367 individuals of sprat, 755 of herring and 137 cods 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. Herring represented both rectangles practically. Sprat dominated only in first trawl catch - 99.3% (coastal rectangle 40H0). Most of herring were fish 3-6 years and 16.5-19.5 length classes in the both rectangles.

In the rectangle 40H0 more than 81% of sprat was represented by fish 1-2 years and 10.5-11.0 cm. In the western part of LEEZ (40G9 rectangle ICES) 82.6% of sprat was adult fish 11.4-12.3 cm length and 2-4 ages. Young fish of last year generation was about 9% in the 40H0 rectangle and only 3.4% in the 40G9 rectangle.

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 $4420.4*10^6$ fish or about 167577.1 tones. Only in 40H0 rectangle 0.1% of herring stock was 0+ age and 12.5 cm length class. In the far rectangle they were not at all (Fig. 2 and Table 8).

The sprat stock was estimated $15379.8*10^6$ fish or about 137770.6 tones. (Fig. 3 and Table 5).

Comparison of the acoustic results from last years (2010-2018) indicated that investigated herring stock abundance have increasing tendency in the LEEZ. In 2018 was recorded the highest average parameters of the herring stock densities in the rectangle 40H0 (Fig.4).

Compared with last year, the abundance of sprat stock decreased by more than 3 times, and biomass - more than 2.5 times.

As in 2017, the high-density sprat concentrations indicated in the northern part of the ICES rectangle 40H0.

3.4. 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, 6 hydrological stations were making. The hydrological and hydro biological research profiles location is presented in Table.15.

Water temperature in hauls was from 9.4 to 14,3 ºC. Differences between the first haul and others caused by wind direction. Wind direction was south in the first half day of cruise. Later wind direction changed to east, south-east. There was no thermocline in 2018 of October. Salinity was about 7.2 ‰ in all hauls and depts. The oxygen-condition was excellent in all hauls and depts.

4. REFERENCES

Balk, H. & Lindem, T. 2005. Sonar4, Sonar5 and Sonar6 post processing systems, operator manual version 5.9.6. Norway: Balk and Lindem. pp. 1-381

ICES 1983. Report of the Planning Group on ICES co-ordinated herring and sprat acoustic surveys. ICES CM 1983/H:12.

ICES 2016. Manual for the international acoustic survey (BIFS). CM2003/G:05 Ref.: D, H; Appendix 9, Annex 3

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.

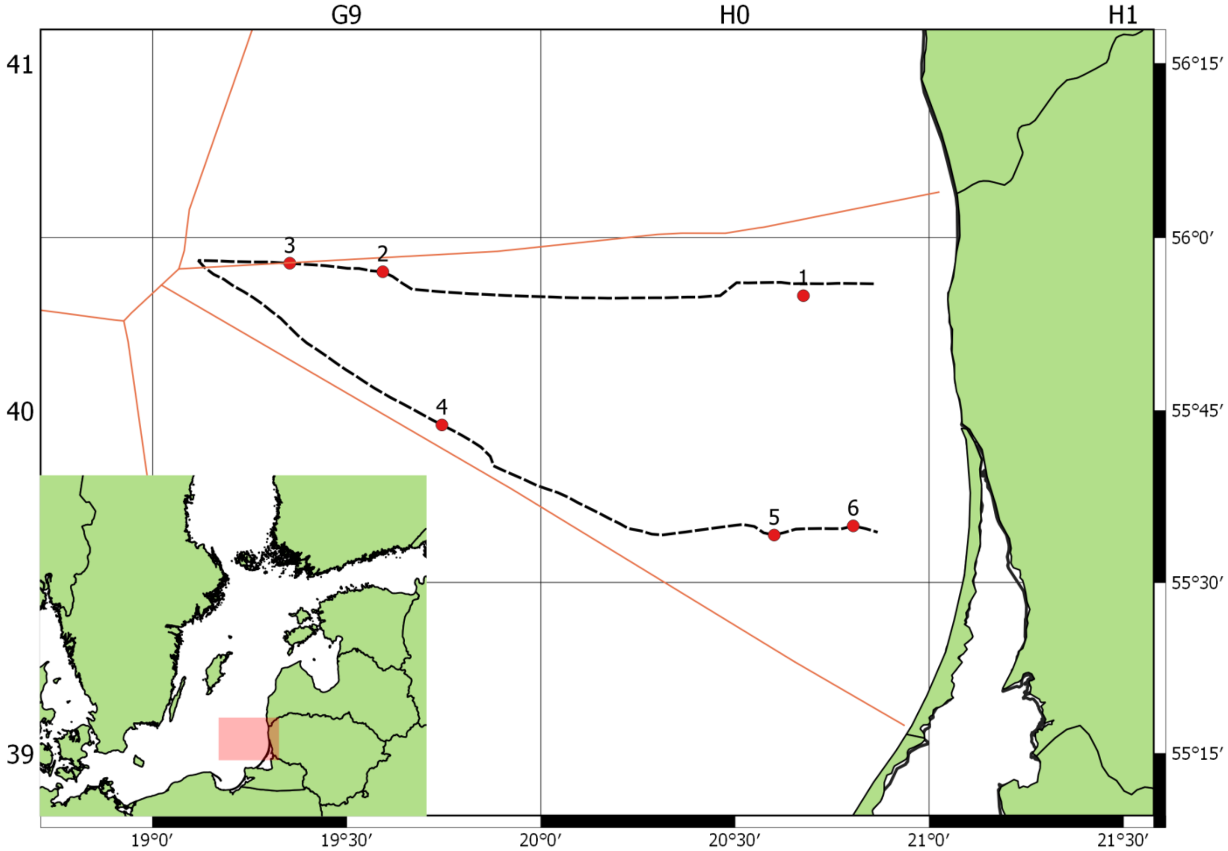

Figure 1. The survey grid and trawl hauls position of F/V "DARIUS" (18-19 October 2018)

Table 1 Catch composition (kg/1hour) per haul (F/V "169", 18.10- 19.10.2018)

ICES subdivision 26						
Haul No	1	2	3	4	5	6
Date	18.10.2018	18.10.2017	18.10.2018	19.10.2018	19.10.2018	19.10.2018
Validity	Valid	Valid	Valid	Valid		Valid
Species/ICES rectangle	40H0	40G9	40G9	40G9	40H0	40H0
Clupea harengus		59.06	90.0	366.71	547.08	120.0
Sprattus sprattus	40.0	30.94		27.58	31.50	280.0
Cyclopterus lumpus		0.57				
Gasterosteus aculeatus		0.004		0.01		
Baltic cod				5.16	261.42	
Platichthys flesus	0.284			0.26		
Lampetra fluviatilis				0.29		
Total	40.284	90.57	90.0	400.0	840.0	400.0

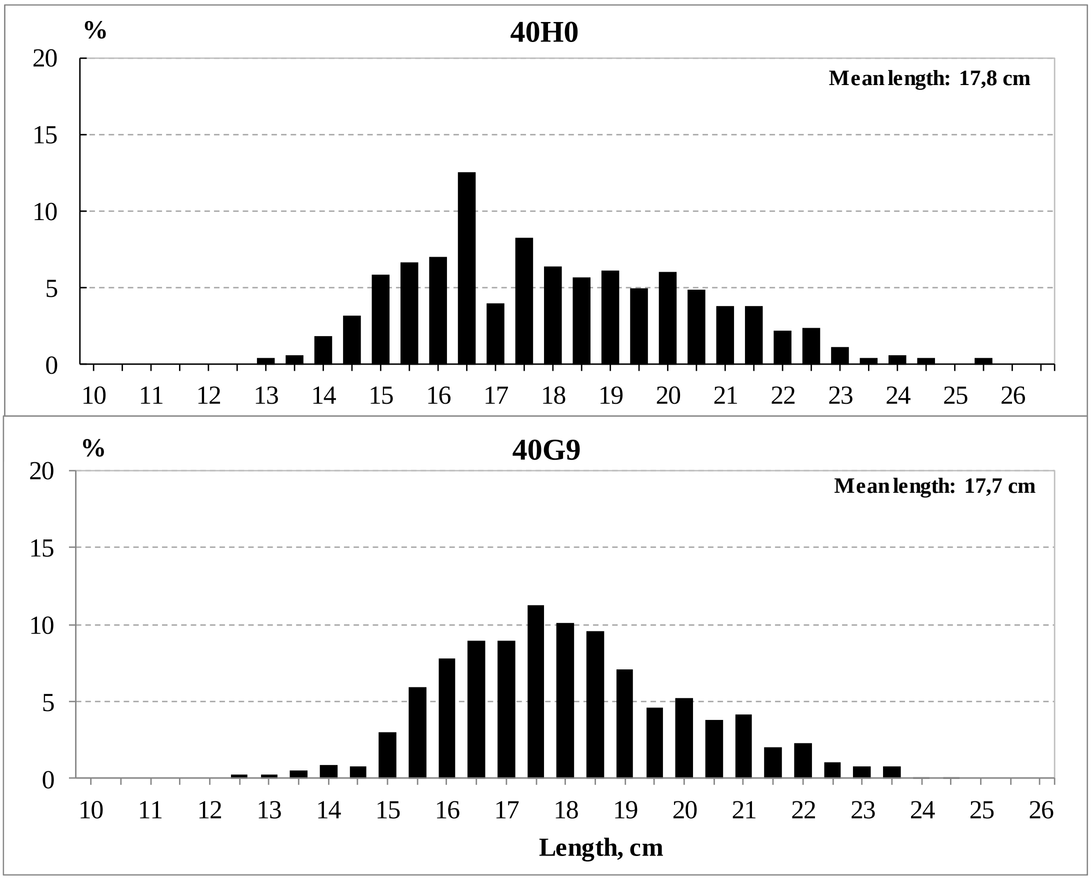

Figure 2 Length distribution of herring (%) (BIAS, 18.10- 19.10.2018

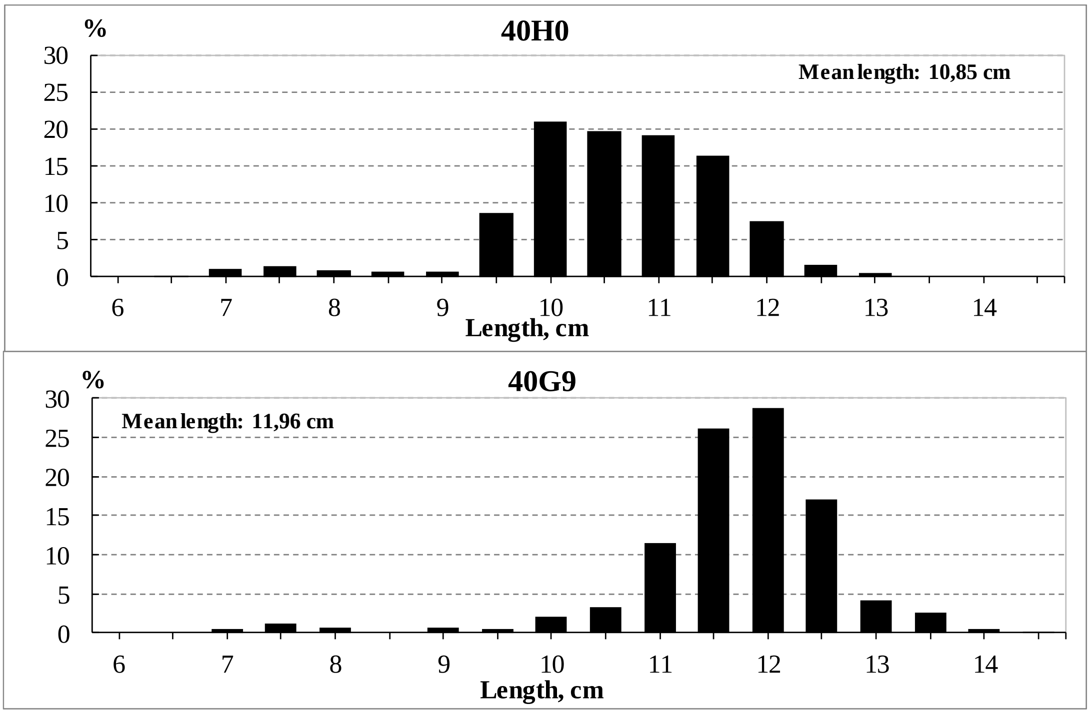

Figure 3 Length distribution of sprat (%) (BIAS, 18.10- 19.10.2018)

Table 2 BIAS survey statistics (abundance of herring and sprat), 18.10- 19.10.2018

ICES SD	ICES Rect.	Area nm^2	ρ mln/nm²	Abundance, mln			Biomass, tonn		
				N sum	N her	N spr	W sum	W her	W spr
26	40H0	1012,1	19,35	19587,3	4265,0	15322,3	300023	161896,9	138126,1
	40G9	1013,0	0,21	212,8	155,4	57,4	6325	5680,1	644,5

Table 3 BIAS survey statistics (aggregated data of herring and sprat), 18.10- 19.10.2018

ICES SD	ICES Rect.	No trawl	Herring			Sprat			SA m²/nm²	TS calc. dB
			L, cm	w, g	Numb.,%	L, cm	w, g	Numb.,%		
26	40H0	1,5,6	17,80	37,96	21,77	10,85	9,01	78,23	12,2	-73,0
	40G9	2,3,4	17,77	36,56	73,01	11,96	11,22	26,99	54,5	-46,8

Table 4 BIAS survey statistics (herring and sprat), 18.10- 19.10.2018

ICES SD	ICES Rect.	Area nm²	SA m²/nm²	σ *10^4 nm²	Abundance mln.	Species composition (%)	
						herring	sprat
26	40H0	1012	12,2	0,00628	19587,3	21,77	78,23
	40G9	1013	54,5	2,59587	212,8	73,01	26,99

Table 5 BIAS survey estimated age composition (%) of sprat, 18.10- 19.10.2018

SD	Rect.	Age									
		Total	0	1	2	3	4	5	6	7	8
26	40H0	100,0	8,6	45,3	36,3	7,3	2,5	0,03			
	40G9	100,0	3,4	6,8	35,1	28,4	19,1	3,1	2,9	0,7	0,5

Table 6 BIAS survey estimated number (millions) of sprat, 18.10- 19.10.2018

SD	Rect.	Age									
		Total	0	1	2	3	4	5	6	7	8
26	40H0	15322,3	1313,5	6946,9	5560,4	1120,6	376,1	4,8			
	40G9	57,4	2,0	3,9	20,2	16,3	10,9	1,8	1,6	0,4	0,3

Table 7 BIAS survey estimated biomass (in tons) of sprat, 18.10- 19.10.2018

SD	Rect.	Age									
		Total	0	1	2	3	4	5	6	7	8
26	40H0	138126	6769	57093	56694	12954	4551	65			
	40G9	644	7	35	214	195	136	23	23	6	4

Table 8 BIAS estimated mean weights (g) of sprat, 18.10- 19.10.2018

SD	Rect.	Age									
		Mean	0	1	2	3	4	5	6	7	8
26	40H0	9,01	5,2	8,2	10,2	11,6	12,1	13,6			
	40G9	11,22	3,7	9,0	10,6	12,0	12,5	13,0	13,9	13,9	14,5

Table 9 BIAS estimated mean length (cm) of sprat, 18.10- 19.10.2018

SD	Rect.	Age									
		Total	0	1	2	3	4	5	6	7	8
26	40H0	10,85	8,5	10,2	11,3	12,0	12,2	13,0			
	40G9	11,96	8,0	10,5	11,4	12,1	12,3	12,7	13,2	13,5	13,8

Table 10 BIAS estimated age composition (%) of herring, 18.10- 19.10.2018

SD	Rect.	Age									
		Total	0	1	2	3	4	5	6	7	8
26	40H0	100,0	0,1	13,0	7,8	17,6	23,3	15,0	13,7	4,7	4,7
	40G9	100,0		6,3	6,2	14,7	35,2	19,2	13,2	2,9	2,3

Table 11 BIAS survey estimated number (millions) of herring, 18.10- 19.10.2018

SD	Rect.	Age									
		Total	0	1	2	3	4	5	6	7	8
26	40H0	4265,0	5,0	554,7	333,7	751,9	995,2	639,4	584,2	200,6	200,4
	40G9	155,4	0,0	9,8	9,7	22,9	54,6	29,8	20,5	4,5	3,6

Table 12 BIAS survey estimated biomass (in tons) of herring, 18.10- 19.10.2018

SD	Rect.	Age									
		Total	0	1	2	3	4	5	6	7	8
26	40H0	161897	71	12399	8582	24358	36410	28430	28700	10844	12102
	40G9	5680	0	196	258	714	1865	1203	987	258	199

Table 13 BIAS survey estimated mean weights (g) of herring, 18.10- 19.10.2018

SD	Rect.	Age									
		Total	0	1	2	3	4	5	6	7	8
26	40H0	37,96	14,3	22,4	25,7	32,4	36,6	44,5	49,1	54,1	60,4
	40G9	36,56		20,1	26,7	31,1	34,2	40,3	48,2	57,5	55,0

Table 14 BIAS survey estimated mean length (cm) of herring, 18.10- 19.10.2018

SD	Rect.	Age									
		Total	0	1	2	3	4	5	6	7	8
26	40H0	17,80	12,5	14,4	15,6	16,8	17,4	18,8	19,4	20,3	21,2
	40G9	17,77		14,4	15,8	16,6	17,2	18,2	19,5	21,0	20,5

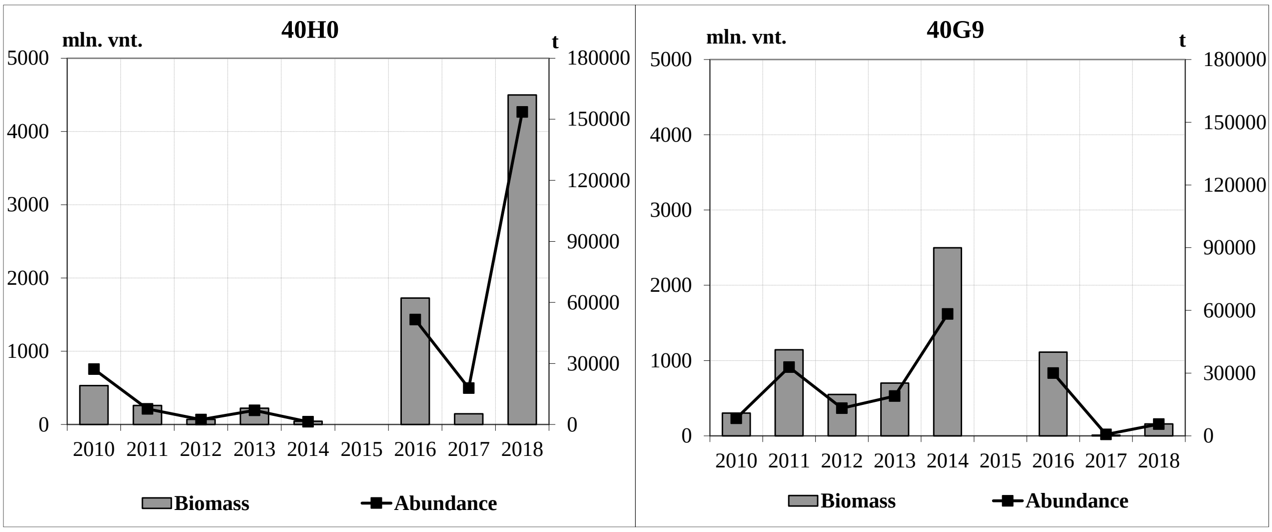

Figure 4 Biomass and abundance of herring by acoustic survey results from October of 2010 – 2018 in ICES rectangles 40H0 and 40G9

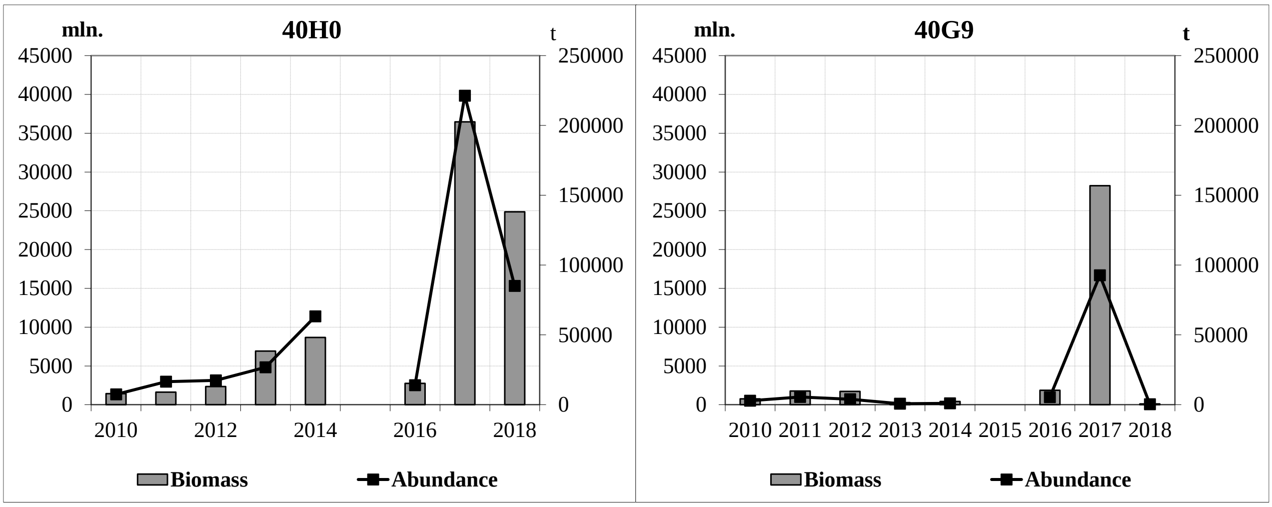

Figure 5. Biomass and abundance of sprat by acoustic survey results from October of 2010 – 2018 in ICES rectangles 40H0 and 40G9

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 18.10-19.10.2018.

Haul number	**Date of catch**	**Trawling depth, m**	**Hydrological parameters**		
			Temperature, °C	**Salinity, ‰**	**Oxygen, ml/l**
1	**2018.10.18**	34	14.3	7.2	6.8
2	**2018.10.18**	51	11.8	7.2	7.2
3	**2018.10.18**	56	9.9	7.2	7.6
4	**2018.10.19**	75	9.4	7.2	7.7
5	**2018.10.19**	63	10.3	7.2	7.5
6	**2018.10.19**	45	11.0	7.3	7.4
Average					

REPORT

**FROM THE JOINT ESTONIAN-POLISH BIAS 2018
CONDUCTED BY THE R.V. "BALTICA" IN THE NORTH-EASTERN BALTIC SEA
(21-31 October 2018)**

by
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** University of Tartu, Estonian Marine Institute, Tallinn (Estonia)

Introduction

The recent joint Estonian-Polish Baltic International Acoustic Survey (BIAS), marked with the number 5/2018/NMFRI/TUEMI was based on the procurement contract No 6-20/HR/68-13 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).

The Estonian Data Collection Program for 2018 and the European Union (the Commission regulations Nos. 665/2008, 199/2008 and 2010/93/EU) financially supported the EST-POL BIAS 2018. 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 (ICES 2018[1]).

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 at the fish concentration locations,
- to collect ichthyological samples specially for herring and sprat,
- to provide hydrological monitoring (water temperature, salinity and oxygen content) at the catch locations.

Personnel

The EST-POL BIAS 2017 scientific staff was composed of 8 persons:
Miroslaw Wyszynski (NMFRI, Gdynia – Poland) – survey leader
Bartlomiej Nurek (NMFRI, Gdynia – Poland) – acoustician
Tycjan Wodzinowski (NMFRI, Gdynia – Poland) – hydrologist
Tiit Raid (TUEMI, Tallinn – Estonia) – Estonian scientific staff leader
Ain Lankov (TUEMI, Tallinn - Estonia) – ichthyologist
Andrus Hallang (TUEMI, Tallinn - Estonia) – ichthyologist
Viktor Kajalainen (TUEMI, Tallinn - Estonia) – ichthyologist
Elor Sepp (TEMI, Tallinn - Estonia) – acoustician

[1]ICES 2018. Report of the Baltic International Fish Survey Working Group (WGBIFS). ICES CM 2018/EOSG: 06, Ref. ACOM and SCICPOM; 380 pp.

Narrative

The reported survey took place during the period of 21-31 October 2018 (according to the survey research plan). The at sea researches (echo-integration, fish control catches and hydrological stations) were conducted aboard r.v. "Baltica" within Estonian EEZ (the ICES Sub-divisions 28.2, 29 and 32), moreover inside the territorial waters of this country not shallower than 20 m depth.

The survey started from the Gdynia port (Poland) on 20.10.2018 early morning and was navigated in the North-eastern direction to the Ventspils port (Latvia) for the Estonian scientific team embarkation on board the vessel and next to the entering point of planed acoustic transect crossing Estnioan EEZ boundary at the geographical position 57°52'2N 021°14'7E on October 21 (Fig. 1). The at sea researches were ended on 28.10.2018 at 22:30 o'clock. Due to heavy stormy weather (sea state 4-5) the vessel reached the port Ventspils for disembarkation Estonian scientific team on October 31. Then the r.v. "Baltica" started its journey to the home-port in Gdynia (Poland), reaching it on 01.11.2018 afternoon.

Survey design and realization

The r.v. "Baltica" realized 841.7 Nm echo-integration transect and 19 fish control-catches (Fig. 1, Tab. 1). All planed ICES rectangles were covered with acoustic transect and control catches except rectangle 46H0 in SD 29. Bulk of control catches were performed in the daylight except three of them performed at nightfall between 06:00 and 07:30 p.m.). The pelagic trawl type WP 53/64x4 (with 6 mm mesh bar length in the codend) was used for catches. Trawling duration was from 5 to 20 minutes, due to high fish density observed on the net-sounder monitor. The mean speed of vessel while providing echo-integration was 8.0 knots, in case of trawling it was 3.0 knots. Overall, 4 hauls were conducted in SD 28.2, 5 hauls in SD 29 and 10 hauls in SD 32.

The length measurements (in 0.5 cm classes) were realized for 3805 sprat and 3354 herring individuals. Totally, 337 sprat and 515 herring individuals were taken for biological analysis (Tab. 2).

Acoustic data were collected with the EK-60 echo-sounder equipped with "Echo-view V4.10" software for the data analysis. The acoustic equipment was calibrated before the survey (in September 2018) according to the methodology described in the "SISP Manual of International Baltic Acoustic Surveys (IBAS)", Version 2.0 (ICES, 2017). The basic acoustic and biological data collected during recently carried out survey 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.

Data analysis

The MYRIAX "EchoView v.4.10" 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, 12 fish species were recognized in hauls performed at the North-eastern Baltic Sea in October 2018. Sprat was prevailing species by mass in the total catch with the mean share amounted 71.9 % (especially high in SD 28.2 – 86.4%, but lowest in SD 32 – 53.1%). The second one was herring with mean share by mass 27,6% (maximum in SD 32 – 45.9%). The rest 10 species (cod, flounder, three and nine spine sticklebacks, shorthorn sculpin, smelt, lumpfish, vendace, straightnose pipefish and lamprey) represented only about 0.5% of the total mass 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 2018 amounted 1188.6 kg/h (comparing to 1085.4 kg/h in the same period in 2017, 729.5 kg/h in 2016 and 845.5 kg/h in 2015). The most valuable CPUEs for sprat were noted in SDs 28.2 and 29, but for herring – in SDs 29 and 32. The mean CPUEs of sprat were as follow: 1488.1 kg/h in ICES SD 28.2, 1260.0 kg/h in SD 29 and 398.5 kg/h in SD 32. The mean CPUEs in case of herring were: 228.4, 374.4 and 344.5 kg/h in SDs 28.2, 29 and 32 respectively.

The length distributions of sprat and herring according to the ICES Sub-divisions 28.2, 29 and 32 are shown on Fig. 3 and 4 respectively. The sprat length distribution curves represent similar character in three investigated SDs. First frequency pick representing sprat generation born in 2018 take place on 7-8.5 cm length classes and shows low quantity in all investigated Sub-divisions 28.2, 29 and 32. The second one representing adult sprat placed on 10.5-11.5 cm length classes. The length distribution curves by Sub-divisions in case of herring show generally the same picture – modal frequency picks fell to 14.5-15.5 cm length classes. Moreover the curves shows very low abundance of herring generation born in 2018 in all SDs. Three and nine spine sticklebacks as well as smelt were the most frequently species in bycatch, particularly in SD 32. Their length distributions are presented at Fig. 5-7.

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 spatial distribution of sprat biomass was similar to previous survey, abundance being highest in Gulf of Finland and west of islands Hiiumaa and Saaremaa. The abundance and biomass of herring was highest in the western part of Gulf of Finland and lowest in the Baltic Proper. The average weight of herring was similar to the previous survey, abundance of herring was slightly higher and abundance of sprat about two times lower compared to the previous survey.

Meteorological and hydrological characteristics.

The 19 hydrological stations at the start control catches positions were inspected with the SeaBird 911 CTD-probe combined with the rosette sampler. Oxygen content was determined by SBE43 sensor. The calibration was performed with the Winkler method. The row data aggregated to the 1-m depth stratum.

The wind velocity varied from 0.5 to 20.1 m/s and average was 9.1 m/s. The most often wind direction was not tantamount to describe. The air temperature ranged from 2.2 °C to 13.4 °C, and average temperature was 7.2 °C (Fig. 8).

The seawater temperature in the surface layers varied from 9,92 to 12.00 °C (the mean was 11.46 °C).The lowest surface temperatures were recorded at the haul 19. The highest ones were noticed at the hauls 3 and 4. The minimum value of salinity in Practical Salinity Unit (PSU) was 4.93 at the haul 3 in the surface layer. The maximum was 6.92 PSU at the haul 19. The mean value of salinity was 6.25 PSU. The oxygen content in the surface layers of investigated the research area varied in the range of 6.79 ml/l (haul 4) up to 7.22 ml/l (haul 19). The mean value of surface water oxygen content was 7.03 ml/l.

The temperature of near bottom layer was changing in the range of 4.56 (haul 15) to 12.05 °C (haul 3), the mean was 6.19 °C. Salinity in the bottom waters varied from 4.94 to 11.60 PSU, and the mean was 9.20 PSU. The low values of salinity was at the haul 3. The highest values of salinity were noticed at the haul 18. Oxygen content varied from 0.00 ml/l to 7.06 ml/l at the haul 3. The mean was 1.62 ml/l. The zero values of this parameter were noticed at the hauls: 1, 8, 9, 10, 11, 13, 14, 17, 18, 19 (Fig. 9 and 10). The vertical distribution of the seawater temperature, salinity and oxygen content along the hydrological profile connected with haul No 18 located at deepest station in SD 28.2 is shown at Fig. 11. Generally the hydrological investigations showed the vast none oxygenated area below 70 m depth from southern part of Estonian EEZ to the mouth of Finland Bay.

The temperature at the hauls layer was changing in the range from 4.03 (haul 19) to 12.01 °C (hauls 3 and 4), the mean was 7.57 °C. Salinity haul waters varied from 4.92 (haul 3) up to 10.13 PSU (haul 17), and the mean was 7.20 PSU. Oxygen content varied from 1.87 ml/l (haul 14) to 7.20 ml/l (haul 19), the mean was 4.93 ml/l (Tab. 7).

The final report from the EST-POL BIAS 2018 will be presented at the meeting of the ICES Baltic International Fish Survey Working Group (WGBIFS) at March 25-29, 2019 in Klaipeda (Lithuania).

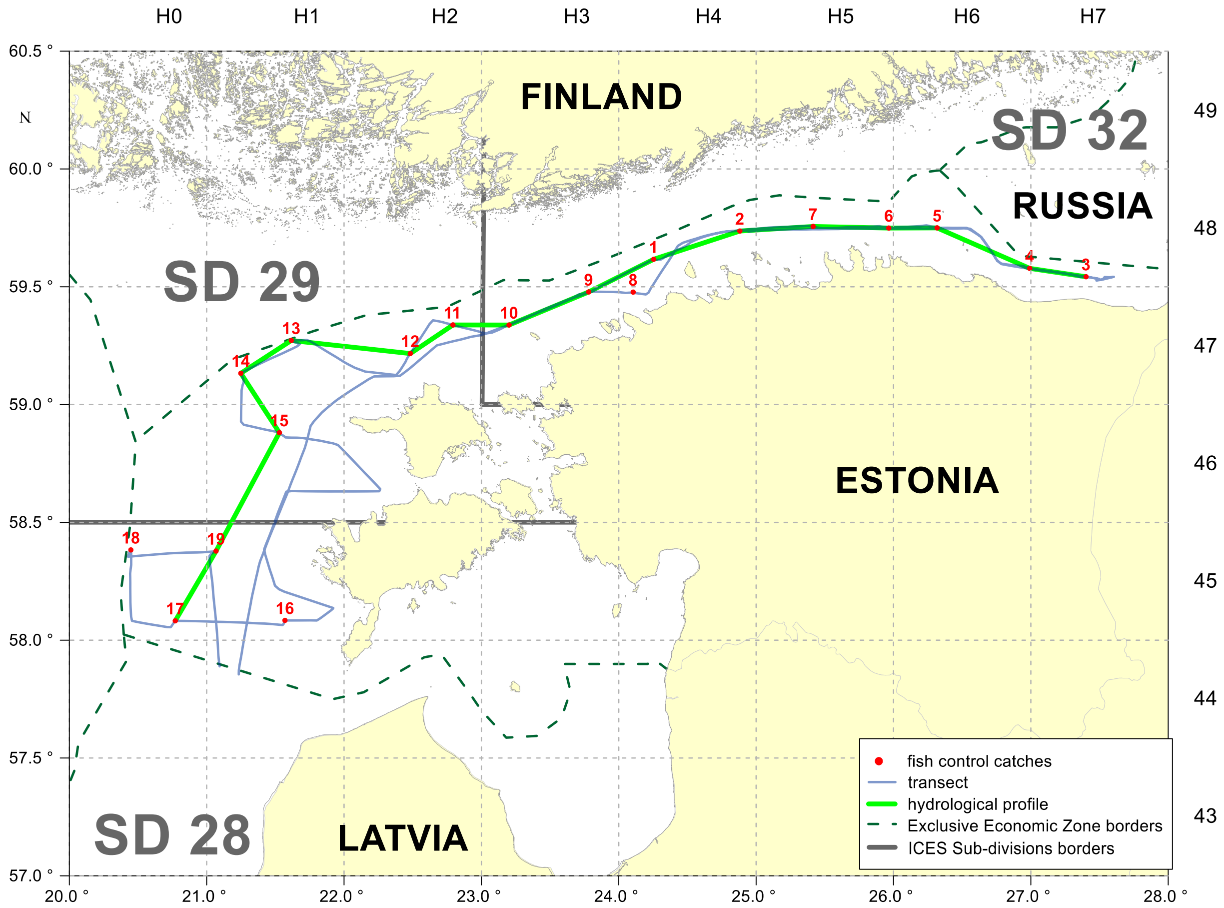


Fig. 1. Acoustic transects and pelagic fish control catches (trawling start positions) with connected hydrological stations realized during the joint EST-POL BIAS (October, 2018).

Table 1. Catch [kg] and CPUE [kg/h] results during the joint Estonian-Polish BIAS conducted by r.v. “Baltica” in Estonian EEZ in October 2018.

Haul no	Date	ICES rectangle	ICES Sub-division (SD)	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	Time end	Haul duration [min]	Total catch [kg]	Catch per species [kg] sprat	herring	cod	flounder	straightnose pipefish	lamprey	shorthorn sculpin	nine-spined stickleback	three-spined stickleback	smelt	lumpfish	vendace
1	2018-10-22	48H4	32	59°36.8'	24°16.7'	59°36.0'	24°17.8'	12:45	12:55	10	157,540	19,425	136,760						0,012	0,063	1,280		
2	2018-10-22	48H4	32	59°44.2'	24°54.2'	59°44.2'	24°55.6'	16:05	16:20	15	300,640	272,951	26,576						0,031	0,872	0,210		
3	2018-10-23	48H7	32	59°32.5'	27°23.3'	59°32.4'	27°21.6'	07:40	08:00	20	47,618	16,377	30,887				0,078		0,009	0,143			0,124
4	2018-10-23	48H6	32	59°34.9'	26°58.7'	59°35.1'	26°57.2'	10:00	10:15	15	99,880	77,786	21,664						0,090	0,270	0,070		
5	2018-10-23	48H6	32	59°45.2'	26°17.8'	59°45.3'	26°15.9'	13:55	14:15	20	315,147	128,616	178,020				0,067			0,283	8,161		
6	2018-10-23	48H5	32	59°45.1'	25°56.4'	59°45.3'	25°54.6'	16:00	16:15	15	80,700	4,834	73,824							0,097	1,945		
7	2018-10-23	48H5	32	59°44.9'	25°27.7'	59°45.1'	25°25.8'	18:10	18:30	20	29,970	5,586	22,885						0,018	0,378	1,103		
8	2018-10-25	47H4	32	59°28.5'	24°05.0'	59°28.4'	24°03.9'	07:55	08:05	10	229,820	207,435	21,902						0,023	0,253	0,207		
9	2018-10-25	47H3	32	59°28.5'	23°45.8'	59°28.1'	23°44.1'	09:45	10:05	20	418,560	112,802	302,158							0,168	3,432		
10	2018-10-25	47H3	32	59°20.0'	23°10.8'	59°19.4'	23°09.0'	13:00	13:20	20	272,850	137,162	134,152							0,226	1,310		
11	2018-10-25	47H2	29	59°20.5'	22°45.7'	59°20.8'	22°44.0'	15:20	15:40	20	491,982	103,494	386,761	0,232					0,020	0,393	1,082		
12	2018-10-25	47H2	29	59°12.2'	22°28.0'	59°11.6'	22°27.2'	18:00	18:15	15	123,931	9,791	112,330					0,301	0,014	0,049	1,446		
13	2018-10-26	47H1	29	59°15.8'	21°38.6'	59°15.6'	21°39.6'	09:10	09:20	10	318,006	315,996	1,430		0,166					0,033	0,381		
14	2018-10-26	47H1	29	59°07.2'	21°15.5'	59°06.0'	21°16.1'	12:10	12:30	20	180,220	94,922	84,631							0,307	0,360		
15	2018-10-26	46H1	29	58°52.3'	21°32.8'	58°51.9'	21°33.7'	15:40	15:55	15	943,018	942,440				0,0002						0,578	
16	2018-10-28	45H1	28.2	58°04.3'	21°33.7'	58°04.1'	21°33.5'	07:20	07:25	5	388,287	387,920	0,063					0,025				0,279	
17	2018-10-28	45H0	28.2	58°04.2'	20°45.3'	58°03.5'	20°44.5'	11:00	11:20	20	116,055	5,542	105,724	4,555						0,234			
18	2018-10-28	45H0	28.2	58°22.2'	20°26.2'	58°21.6'	20°25.9'	15:45	15:55	10	227,534	161,846	65,480							0,114		0,094	
19	2018-10-28	45H1	28.2	58°22.2'	21°02.7'	58°22.0'	21°02.3'	19:25	19:30	5	43,040	25,807	16,889						0,034	0,284	0,026		
									Total catch [kg]	28.2	774,916	581,115	188,156	4,555				0,025	0,034	0,632	0,026	0,373	
										29	2057,157	1466,643	585,152	0,232	0,166			0,301	0,034	0,782	3,269	0,578	
										32	1952,725	982,974	948,828				0,145		0,183	2,753	17,718		0,124
										Sum	4784,798	3030,732	1722,136	4,787	0,166	0,0002	0,145	0,326	0,251	4,167	21,013	0,951	0,124

Haul no	Date	ICES rectangle	ICES Sub-division (SD)	Haul duration [min]	Total CPUE [kg/h]	CPUE per species [kg/h] sprat	herring	cod	flounder	straightnose pipefish	lamprey	shorthorn sculpin	nine-spined stickleback	three-spined stickleback	smelt	lumpfish	vendace
1	2018-10-22	48H4	32	10	945,240	116,550	820,560						0,072	0,378	7,680		
2	2018-10-22	48H4	32	15	1202,560	1091,804	106,304						0,124	3,488	0,840		
3	2018-10-23	48H7	32	20	142,854	49,131	92,661				0,234		0,027	0,429			0,372
4	2018-10-23	48H6	32	15	399,520	311,144	86,656						0,360	1,080	0,280		
5	2018-10-23	48H6	32	20	945,441	385,848	534,060				0,201			0,849	24,483		
6	2018-10-23	48H5	32	15	322,800	19,336	295,296							0,388	7,780		
7	2018-10-23	48H5	32	20	89,910	16,758	68,655						0,054	1,134	3,309		
8	2018-10-25	47H4	32	10	1378,920	1244,610	131,412						0,138	1,518	1,242		
9	2018-10-25	47H3	32	20	1255,680	338,406	906,474							0,504	10,296		
10	2018-10-25	47H3	32	20	818,550	411,486	402,456							0,678	3,930		
11	2018-10-25	47H2	29	20	1475,946	310,482	1160,283	0,696					0,060	1,179	3,246		
12	2018-10-25	47H2	29	15	495,724	39,164	449,320					1,204	0,056	0,196	5,784		
13	2018-10-26	47H1	29	10	1908,036	1895,976	8,580		0,996					0,198	2,286		
14	2018-10-26	47H1	29	20	540,660	284,766	253,893							0,921	1,080		
15	2018-10-26	46H1	29	15	3772,073	3769,760	0,000			0,001						2,312	
16	2018-10-28	45H1	28	5	4659,446	4655,040	0,754					0,305				3,348	
17	2018-10-28	45H0	28	20	348,165	16,626	317,172	13,665						0,702			
18	2018-10-28	45H0	28	10	1365,204	971,076	392,880							0,684		0,564	
19	2018-10-28	45H1	28	5	516,480	309,684	202,668						0,408	3,408	0,312		
		Mean CPUE by SDs [kg/h]		28.2	1722,324	1488,107	228,368	3,416				0,076	0,102	1,199	0,078	0,978	
				29	1638,488	1260,030	374,415	0,139	0,199	0,0002		0,241	0,023	0,499	2,479	0,462	
				32	750,148	398,507	344,453				0,044		0,078	1,045	5,984		0,037
				Total	1188,590	854,613	327,899	0,756	0,052	0,00004	0,023	0,079	0,068	0,933	3,818	0,328	0,020

Table. 2. Biological sampling in the r.v.”Baltica” joint EST-POL BIAS in October 2018.

SD 28.2		sprat	herring	cod	flounder	straightnose pipefish	lamprey	shorthorn sculpin	nine-spined stickleback	three-spined stickleback	smelt	lumpfish	vendace	SUM
Samples taken	measurements	4	4	1				1	1	3	1	2	1	18
	analyses	4	3											7
Fish measured		762	752	22				1	14	111	1	2	3	1668
Fish analysed		114	152											266

SD 29		sprat	herring	cod	flounder	straightnose pipefish	lamprey	shorthorn sculpin	nine-spined stickleback	three-spined stickleback	smelt	lumpfish	vendace	SUM
Samples taken	measurements	5	4	1	1	1		3	2	4	4	1		26
	analyses	5	4											9
Fish measured		977	741	1	1	1		3	4	49	30	3		1810
Fish analysed		128	156											284

SD 32		sprat	herring	cod	flounder	straightnose pipefish	lamprey	shorthorn sculpin	nine-spined stickleback	three-spined stickleback	smelt	lumpfish	vendace	SUM
Samples taken	measurements	10	10				2		6	10	9			47
	analyses	10	10											20
Fish measured		2066	1861				2		57	299	252			4537
Fish analysed		131	207											338

TOTAL		sprat	herring	cod	flounder	straightnose pipefish	lamprey	shorthorn sculpin	nine-spined stickleback	three-spined stickleback	smelt	lumpfish	vendace	SUM
Samples taken	measurements	19	18	2	1	1	2	4	9	17	14	3	1	91
	analyses	19	17											36
Fish measured		3805	3354	23	1	1	2	4	75	459	283	5	3	8015
Fish analysed		373	515											888

Table 3. The BIAS survey basic biological and acoustic data concerning the clupeid stocks inhabiting the north- eastern Baltic Sea in October 2018.

ICES Sub-div.	ICES rectangle	Area [NM²]	Share [%-indiv.]		Total abundance [x10⁶]	Abundance density [10⁶/NM²]	NASC [m²/NM²]	σ [cm²]
			herring	sprat				
28	45H0	947.2	49.5	49.0	6077.71	6.417	1230.9	1.92
28	45H1	827.1	11.4	85.6	10072.83	12.178	1559.4	1.28
29	46H1	921.5	10.5	86.6	4176.16	4.532	594.2	1.31
29	46H2	258.0	10.5	86.6	749.20	2.904	380.8	1.31
29	47H1	920.3	11.4	87.9	3337.90	3.627	460.8	1.27
29	47H2	793.9	71.3	26.7	4290.86	5.404	1020.8	1.89
32	47H3	536.2	40.1	58.7	2724.64	5.081	792.0	1.56
32	48H4	835.1	39.3	57.9	17615.05	21.093	3106.9	1.47
32	48H5	767.2	63.0	18.7	4156.42	5.418	888.2	1.64
32	48H6	776.1	23.6	71.6	5122.51	6.600	853.9	1.29
32	48H7	851,4	54.5	42.9	2681.14	3.149	430.2	1.37
Average			**35.0**	**61.1**		**6.946**	**1028.9**	**1.48**
Total		**8434**			**61004.43**			

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 2018.

ICES Sub-div.	ICES rectangle	HERRING – age groups									
		0	1	2	3	4	5	6	7	8+	total
28	45H0	10.59	109.69	471.83	316.35	1550.20	65.69	317.55	97.83	65.96	3005.70
28	45H1	46.76	150.01	213.52	99.35	431.49	14.81	74.33	18.31	103.53	1152.10
total		57.35	259.69	685.34	415.71	1981.69	80.50	391.88	116.14	169.49	4157.80
29	46H1	19.38	50.70	59.41	58.94	167.62	20.10	26.51	21.58	15.13	439.38
29	46H2	3.48	9.10	10.66	10.57	30.07	3.61	4.76	3.87	2.71	78.83
29	47H1	4.28	35.71	52.16	59.60	159.33	19.71	22.83	16.97	9.06	379.66
29	47H2	38.51	437.98	548.38	472.13	1139.88	147.97	151.21	96.52	28.13	3060.72
total		65.65	533.49	670.62	601.25	1496.90	191.39	205.29	138.94	55.04	3958.58
32	47H3	4.28	70.42	210.87	289.27	277.18	140.85	84.06	15.16		1092.10
32	48H4	145.04	791.16	2025.81	1687.34	1359.87	558.62	309.46	48.26		6925.56
32	48H5	26.95	258.92	668.66	712.25	604.29	208.48	114.37	26.21		2620.13
32	48H6	31.78	248.95	268.71	292.84	228.74	89.34	42.95	5.14		1208.45
32	48H7	77.81	966.38	182.50	101.66	78.50	29.22	19.75	4.20		1460.02
total		285.86	2335.83	3356.56	3083.36	2548.57	1026.51	570.59	98.97		13306.25
Grand total		408.86	3129.02	4712.52	4100.31	6027.17	1298.40	1167.76	354.05	224.53	21422.63

Table 4. Continued

ICES	ICES rectangle	SPRAT – age groups									
Sub-div.		0	1	2	3	4	5	6	7	8+	Total
28	45H0	83.73	212.44	726.46	168.92	623.28	828.64	197.09	52.29	84.54	2977.40
28	45H1	1035.61	1386.42	2231.52	513.56	1550.56	1415.80	278.40	82.06	132.24	8626.16
total		1119.34	1598.86	2957.99	682.47	2173.84	2244.43	475.49	134.35	216.78	11603.55
29	46H1	9.87	711.21	481.23	274.96	1098.38	779.15	197.32	33.12	29.39	3614.63
29	46H2	1.77	127.59	86.33	49.33	197.05	139.78	35.40	5.94	5.27	648.47
29	47H1	305.36	772.39	423.30	165.56	650.22	487.04	102.35	14.00	12.17	2932.40
29	47H2	75.75	212.69	130.99	81.77	291.25	238.38	72.40	21.05	21.31	1145.59
total		392.76	1823.89	1121.86	571.61	2236.90	1644.34	407.46	74.11	68.14	8341.08
32	47H3	45.60	587.64	261.54	67.95	471.59	122.71	7.65	10.06	23.64	1598.38
32	48H4	219.46	4246.86	1434.48	446.16	2849.52	787.28	28.19	59.43	127.08	10198.46
32	48H5	20.14	252.20	96.86	39.26	245.92	80.40	7.46	8.42	25.45	776.11
32	48H6	55.07	1880.60	495.60	117.20	817.62	223.47	10.92	22.43	43.27	3666.17
32	48H7	13.27	379.54	118.52	51.39	361.77	141.33	14.94	19.75	47.48	1147.99
total		353.54	7346.82	2407.00	721.97	4746.42	1355.20	69.15	120.09	266.92	17387.11
Grand total		1865.64	10769.57	6486.85	1976.05	9157.16	5243.97	952.10	328.55	551.84	37331.74

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 2018.

ICES	ICES rectangle	HERRING – age groups									
Sub-div.		0	1	2	3	4	5	6	7	8+	total
28	45H0	48.72	1708.61	9420.03	7360.92	38774.53	2004.15	8359.90	3395.16	2432.69	73504.71
28	45H1	179.23	2000.89	3930.29	2199.06	10192.56	432.10	1957.41	604.16	379.90	21875.59
total		228	3709	13350	9560	48967	2436	10317	3999	2813	95380
29	46H1	74.31	652.04	1034.93	1243.27	3832.73	470.06	693.80	587.37	478.61	9067.13
29	46H2	13.33	116.98	185.67	223.04	687.59	84.33	124.47	105.37	85.86	1626.65
29	47H1	16.98	470.33	991.45	1292.03	3673.16	457.18	568.71	433.23	270.00	8173.05
29	47H2	131.06	5660.44	9697.29	9692.74	24159.04	3293.00	3625.44	2358.83	773.92	59391.76
total		236	6900	11909	12451	32353	4305	5012	3485	1608	78259
32	47H3	19.13	841.75	3488.54	5620.63	5646.68	3132.19	2035.86	444.74	0.00	21229.53
32	48H4	524.96	8697.86	33350.14	32117.82	27270.13	12421.67	7702.45	1342.98	0.00	123428.02
32	48H5	90.29	2789.78	10972.88	13528.87	12116.24	4502.21	2768.76	683.06	0.00	47452.09
32	48H6	122.46	2676.86	4490.45	5725.65	4883.36	2059.01	1028.46	128.39	0.00	21114.65
32	48H7	341.66	10103.39	2904.07	1918.36	1546.84	645.46	473.51	104.26	0.00	18037.56
total		1098	25110	55206	58911	51463	22761	14009	2703	0	231262
Grand total		1562	35719	80466	80922	132783	29501	29339	10188	4421	404901

Table 5. Continued

ICES Sub-div.	ICES rectangle	SPRAT – age groups 0	1	2	3	4	5	6	7	8+	total
28	45H0	293.73	1694.27	6653.45	1550.15	6104.39	8746.57	2183.30	596.40	1029.87	28852.12
28	45H1	2695.84	10154.92	19036.55	4389.54	13768.39	13916.41	2911.68	935.44	1532.75	69341.52
total		2990	11849	25690	5940	19873	22663	5095	1532	2563	98194
29	46H1	30.99	5351.73	3824.67	2494.87	9674.14	7433.00	1999.82	368.98	327.03	31505.23
29	46H2	5.56	960.10	686.15	447.58	1735.55	1333.48	358.77	66.20	58.67	5652.05
29	47H1	1174.08	5571.94	3291.22	1536.93	5711.93	4717.72	1021.62	163.43	141.37	23330.25
29	47H2	271.60	1528.13	1013.25	756.83	2578.47	2297.37	747.74	242.35	250.38	9686.11
total		1482	13412	8815	5236	19700	15782	4128	841	777	70174
32	47H3	165.52	4186.83	2078.59	592.50	4096.94	1144.54	84.28	103.43	253.37	12705.99
32	48H4	942.68	28536.61	10807.01	3823.46	24290.15	7101.35	319.84	592.54	1384.42	77798.06
32	48H5	85.11	1716.27	758.81	347.98	2177.63	757.85	84.82	87.06	286.39	6301.92
32	48H6	279.70	13110.33	3811.16	1017.50	7076.20	2069.08	125.07	228.79	467.60	28185.43
32	48H7	68.42	2629.71	925.26	464.90	3308.10	1365.57	157.59	199.80	492.63	9611.99
total		1541	50180	18381	6246	40949	12438	772	1212	2884	134603
Grand total		6013	75441	52886	17422	80522	50883	9995	3584	6224	302971

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 2018.

ICES Sub-div.	ICES rectangle	HERRING – age groups									
		0	1	2	3	4	5	6	7	8+	avg.
28	45H0	4.60	15.58	19.97	23.27	25.01	30.51	26.33	34.70	36.88	24.46
28	45H1	3.83	13.34	18.41	22.13	23.62	29.18	26.33	32.99	3.67	18.99
29	46H1	3.83	12.86	17.42	21.09	22.87	23.38	26.17	27.22	31.63	20.64
29	46H2	3.83	12.86	17.42	21.09	22.87	23.38	26.17	27.22	31.63	20.64
29	47H1	3.97	13.17	19.01	21.68	23.05	23.19	24.92	25.53	29.79	21.53
29	47H2	3.40	12.92	17.68	20.53	21.19	22.25	23.98	24.44	27.51	19.40
32	47H3	4.47	11.95	16.54	19.43	20.37	22.24	24.22	29.33		19.44
32	48H4	3.62	10.99	16.46	19.03	20.05	22.24	24.89	27.83		17.82
32	48H5	3.35	10.77	16.41	18.99	20.05	21.60	24.21	26.06		18.11
32	48H6	3.85	10.75	16.71	19.55	21.35	23.05	23.95	25.00		17.47
32	48H7	4.39	10.45	15.91	18.87	19.70	22.09	23.97	24.85		12.35

Table 6. Continue

ICES Sub-div.	ICES rectangle	SPRAT – age groups									
		0	1	2	3	4	5	6	7	8+	avg.
28	45H0	3.51	7.98	9.16	9.18	9.79	10.56	11.08	11.41	12.18	9.69
28	45H1	2.60	7.32	8.53	8.55	8.88	9.83	10.46	11.40	11.59	8.04
29	46H1	3.14	7.52	7.95	9.07	8.81	9.54	10.14	11.14	11.13	8.72
29	46H2	3.14	7.52	7.95	9.07	8.81	9.54	10.14	11.14	11.13	8.72
29	47H1	3.84	7.21	7.78	9.28	8.78	9.69	9.98	11.67	11.61	7.96
29	47H2	3.59	7.18	7.74	9.26	8.85	9.64	10.33	11.51	11.75	8.46
32	47H3	3.63	7.12	7.95	8.72	8.69	9.33	11.01	10.28	10.72	7.95
32	48H4	4.30	6.72	7.53	8.57	8.52	9.02	11.35	9.97	10.89	7.63
32	48H5	4.23	6.81	7.83	8.86	8.86	9.43	11.38	10.33	11.25	8.12
32	48H6	5.08	6.97	7.69	8.68	8.65	9.26	11.46	10.20	10.81	7.69

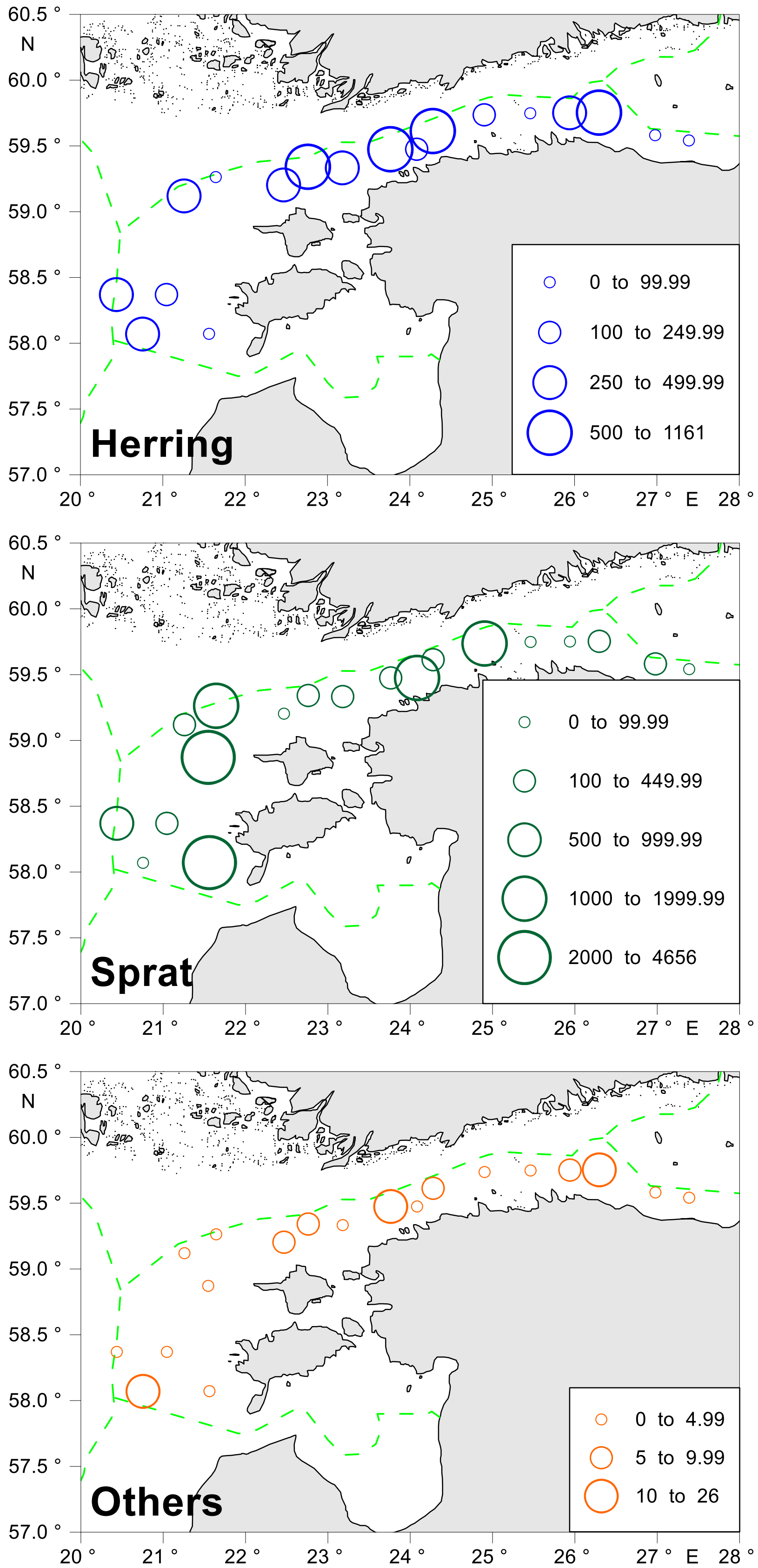


Fig. 2. Distribution of CPUE values (kg/h) for herring, sprat and other species in the pelagic fish control catches during the joint EST-POL BIAS in the North-eastern Baltic Sea, October 2018.

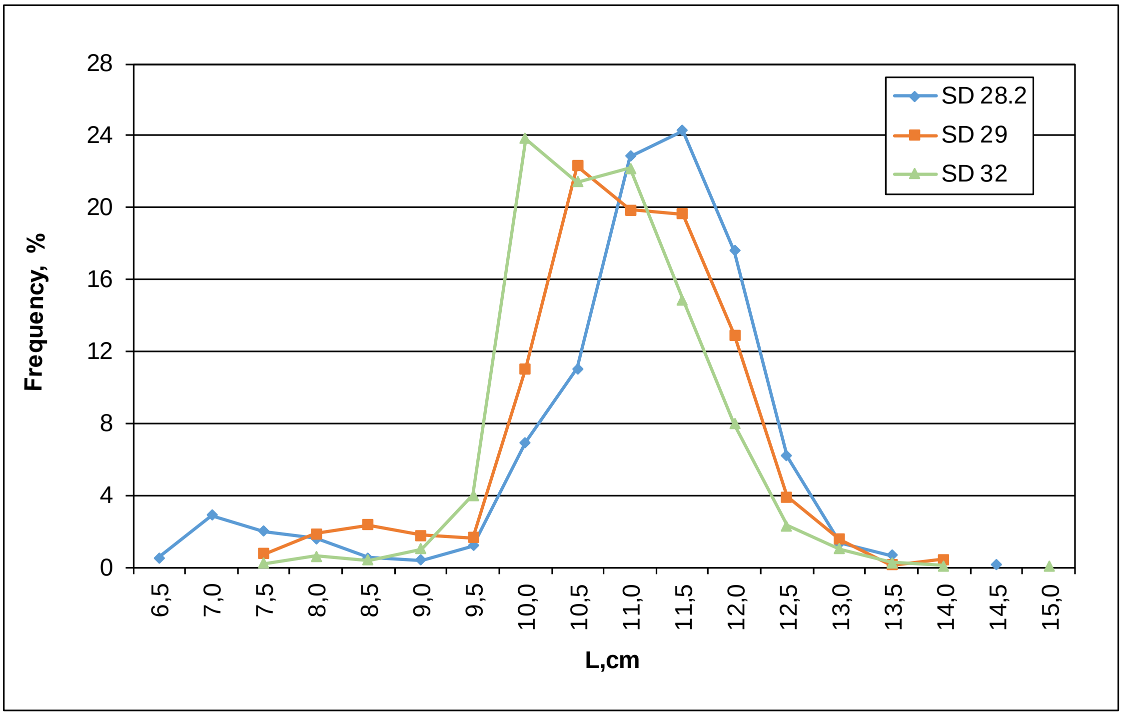


Fig. 3. Sprat length distributions from the control catches conducted by the r.v. “Baltica” during the joint EST-POL BIAS in the SDs 28.2, 29 and 32 (October, 2018).

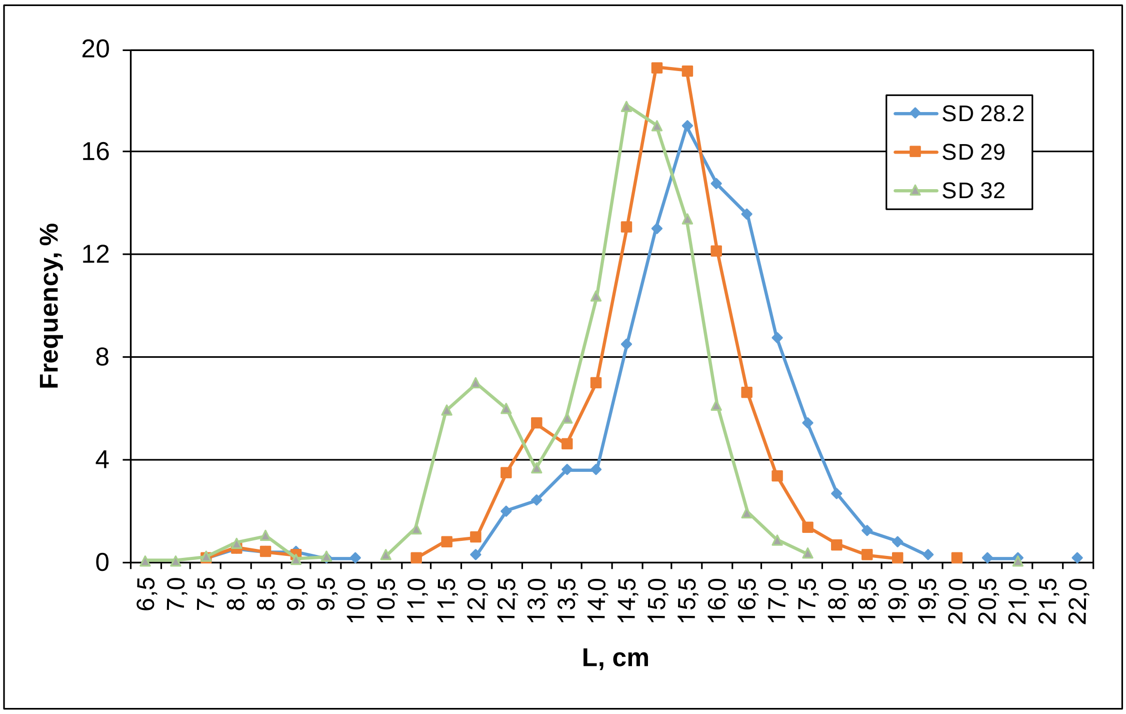


Fig. 4. Herring length distributions from the control catches conducted by the r.v. “Baltica” during the joint EST-POL BIAS in the SDs 28.2, 29 and 32 (October, 2018).

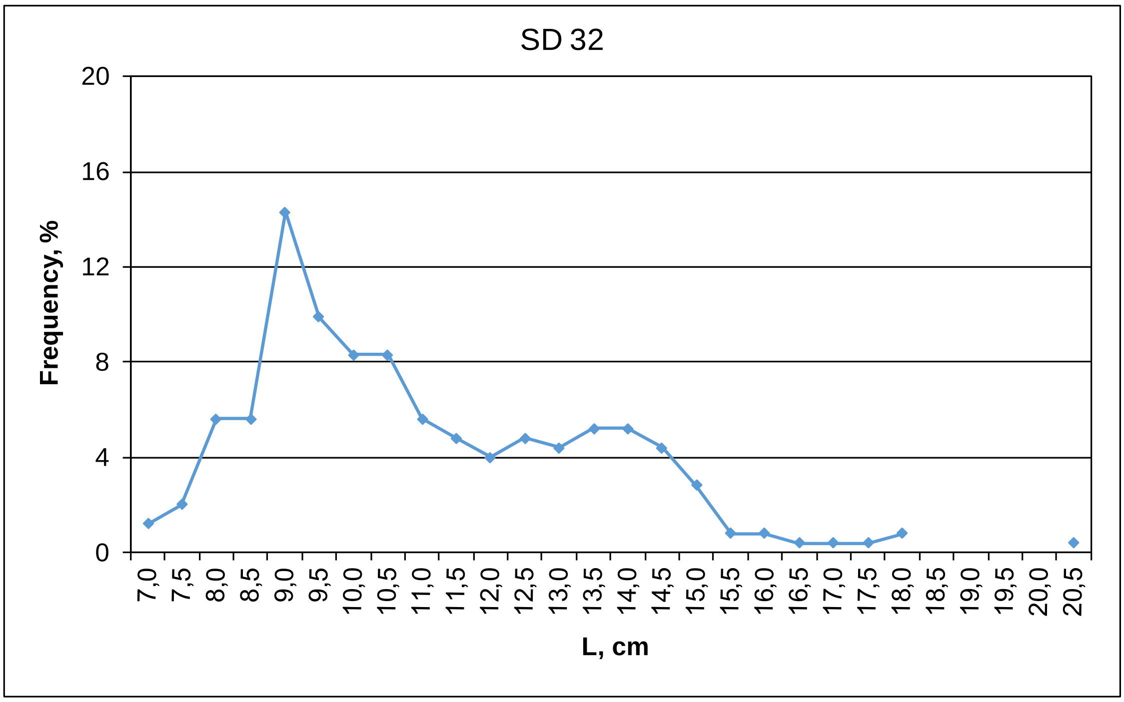


Fig. 5. Smelt length distribution from the control catches conducted by the r.v. "Baltica" during the joint EST-POL BIAS in the SD 32 (October, 2018).

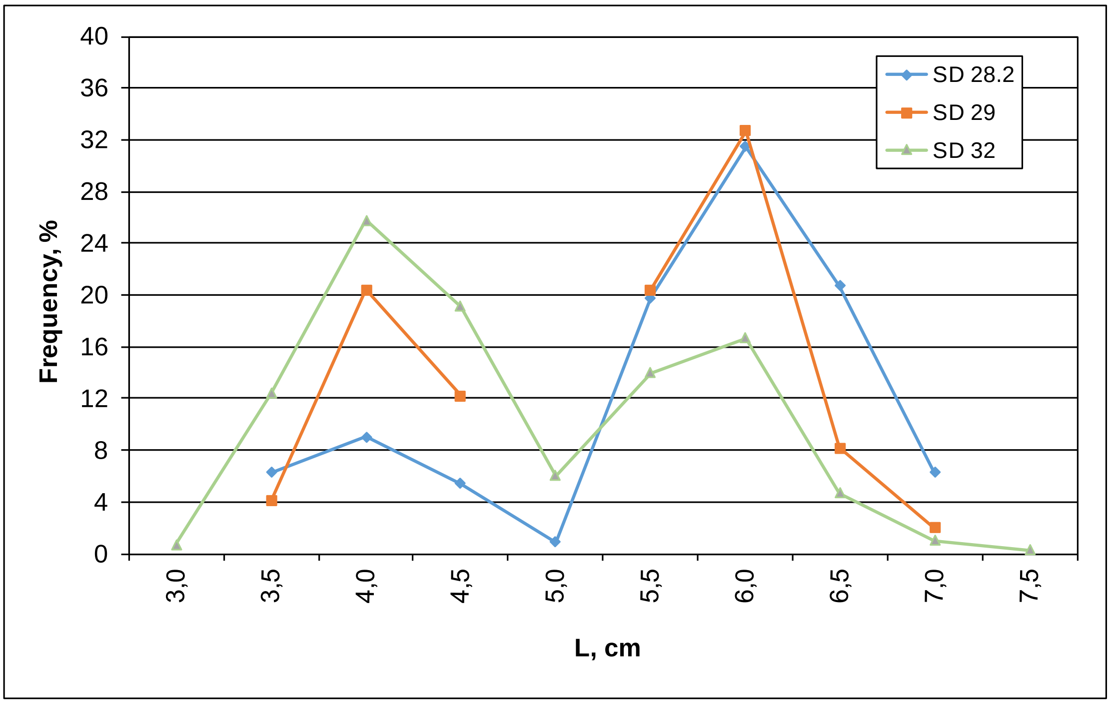


Fig. 6. Three-spined stickleback length distributions from the control catches conducted by the r.v. "Baltica" during the joint EST-POL BIAS in the SDs 28.2, 29 and 32 (October, 2018).

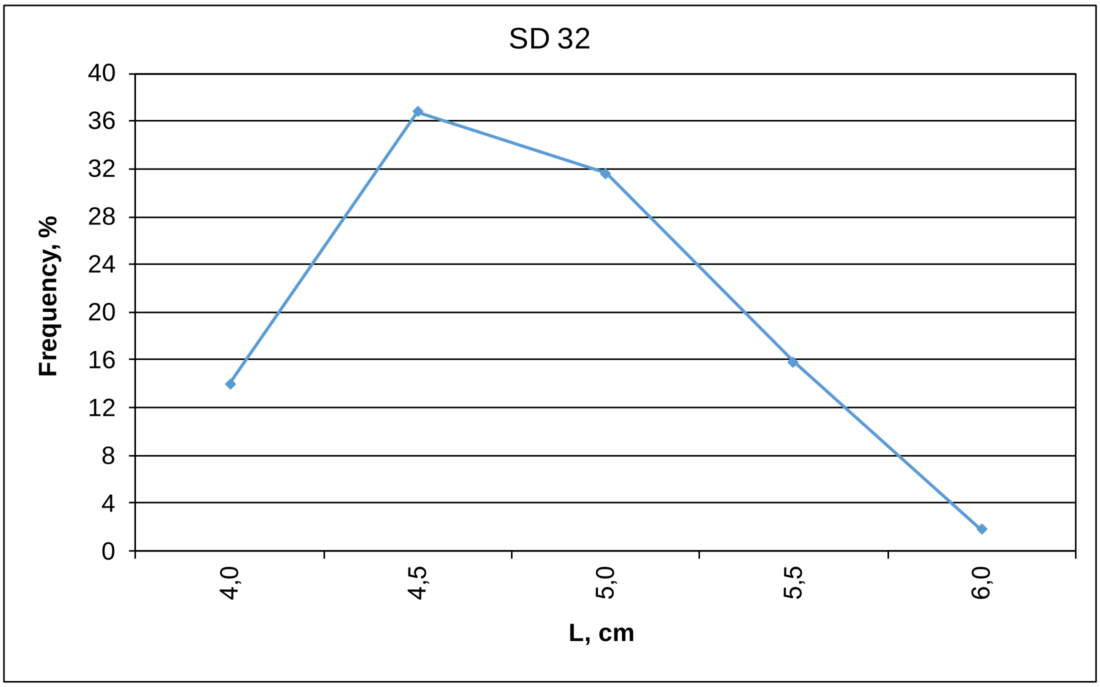


Fig. 7. Nine-spined stickleback length distribution from the control catches conducted by the r.v. “Baltica” during the joint EST-POL BIAS in the SD 32 (October, 2018).

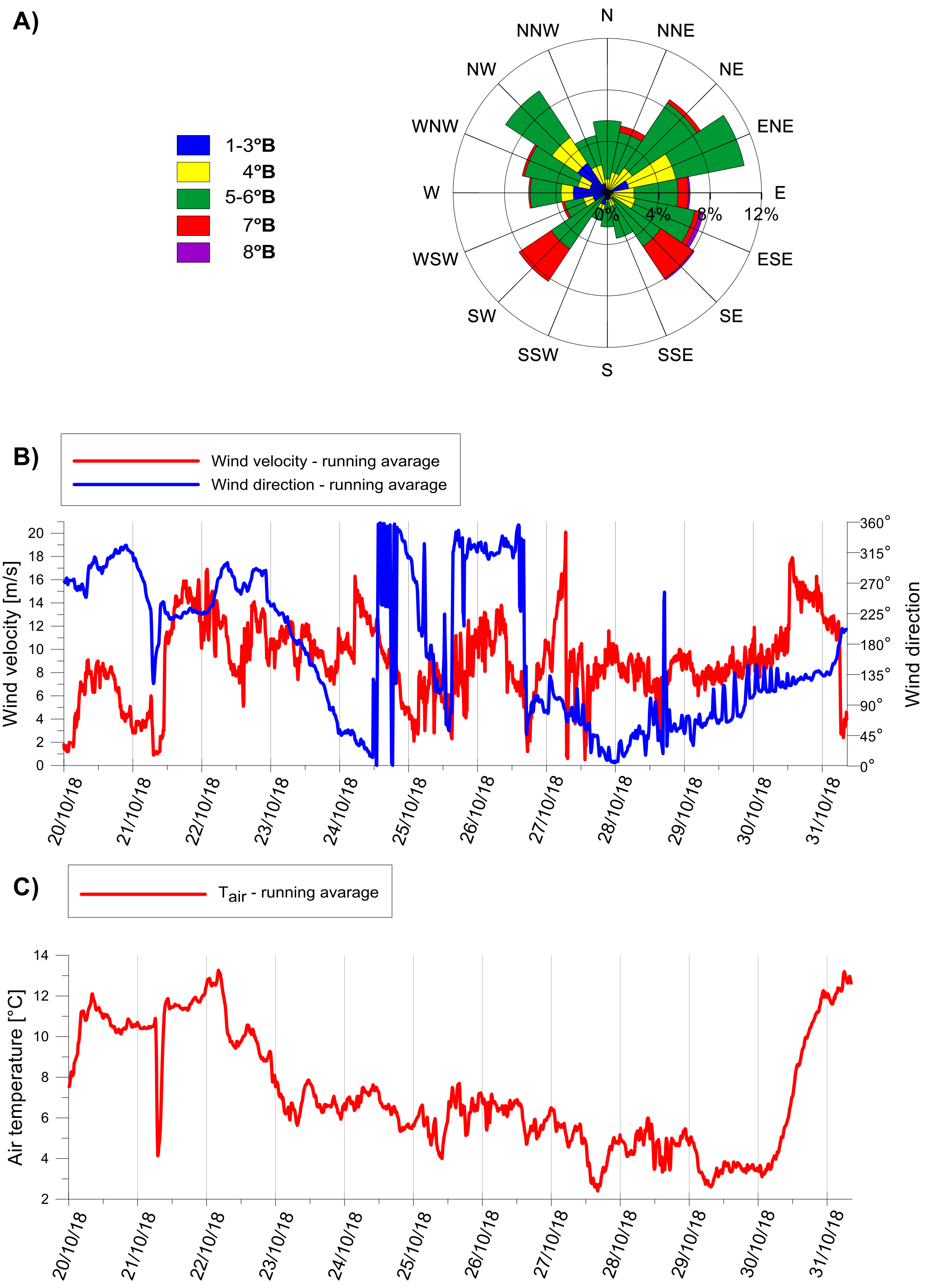


Fig.8. Changes of the main meteorological parameters during joint EST-POL BIAS conducted in October 2018 (A and B – wind direction and velocity, C – air temperature).

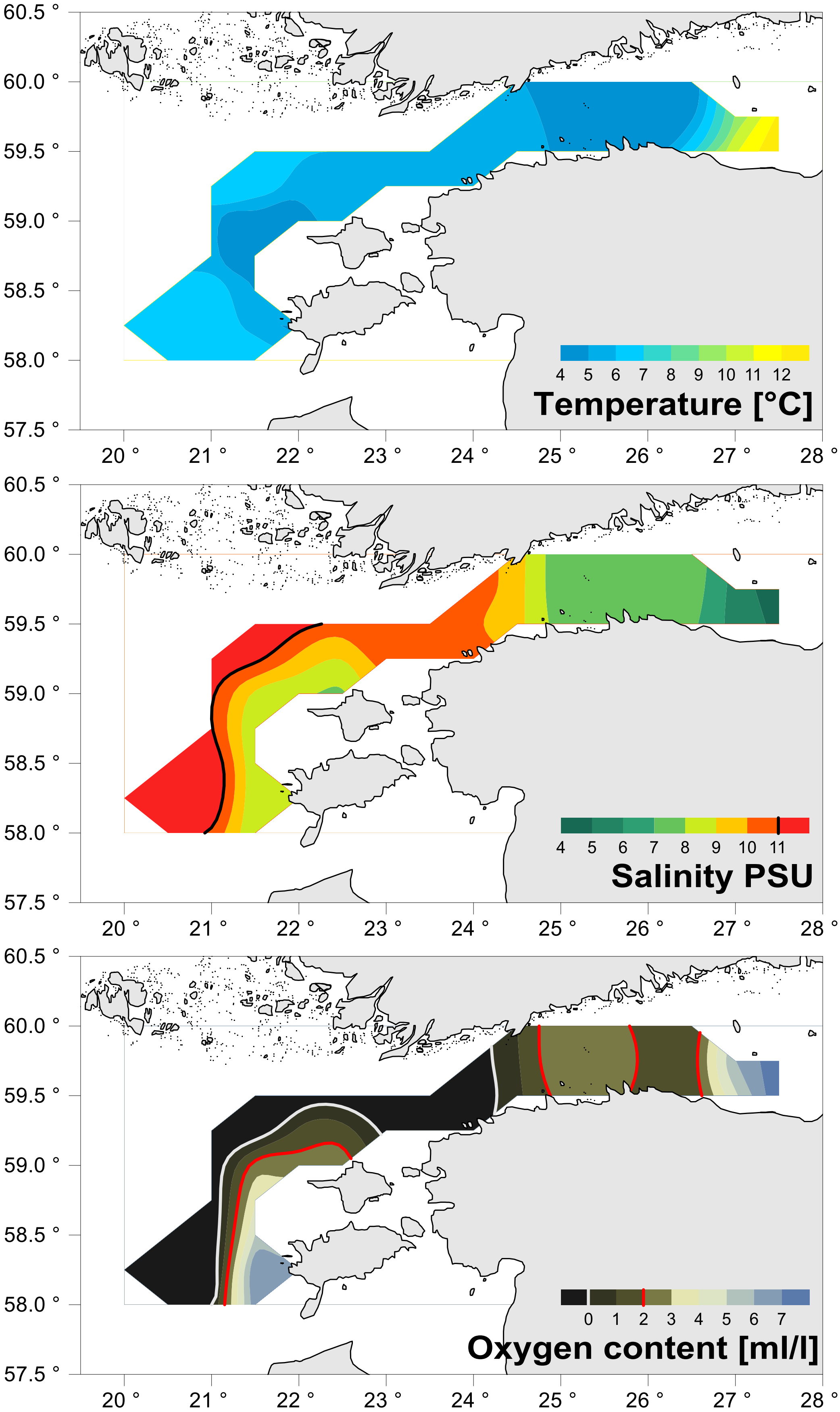


Figure 9. Distribution of the seawater temperature, salinity and oxygen content in the near bottom waters (EST-POL BIAS, October 2018).

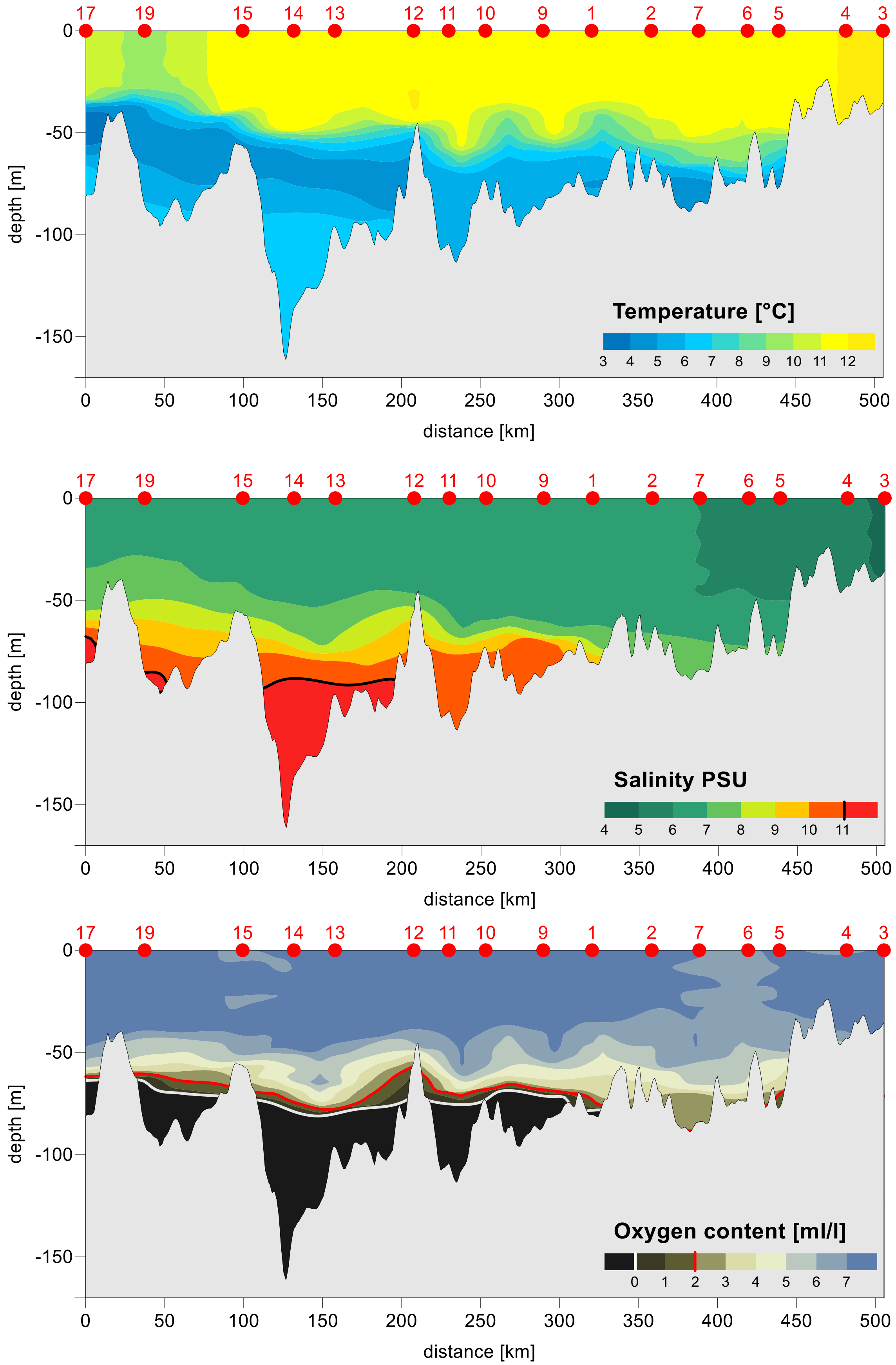


Fig. 10. Vertical distribution of the seawater temperaturę, salinity and oxygen content along the hydrological horizontal profile (EST-POL BIAS, October 2018).

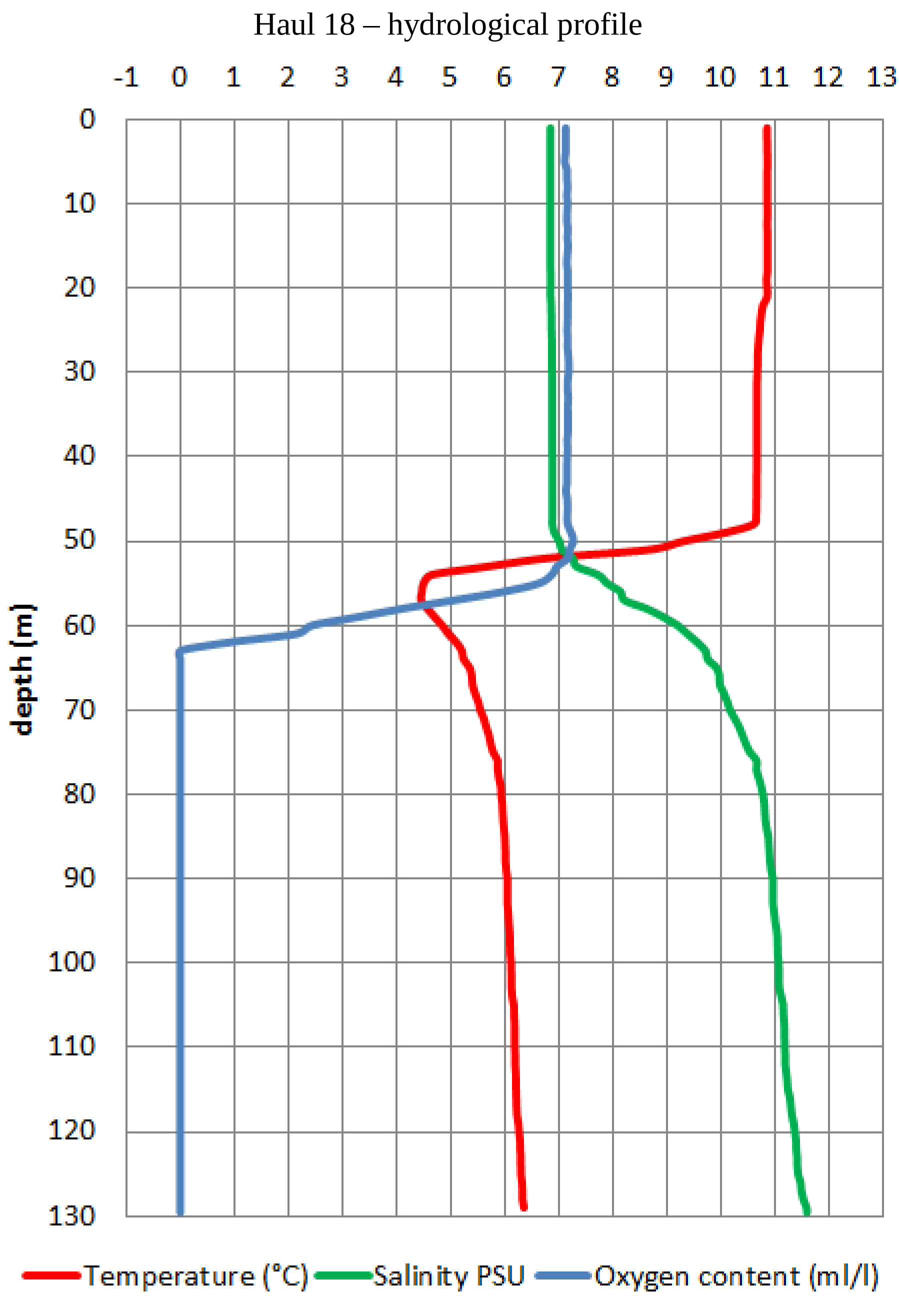
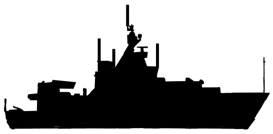


Figure 11. Vertical distribution of the seawater temperature, salinity and oxygen content along the hydrological profile connected with haul No 18 located at deepest station in SD 28.2 (October 2018).

Table 7. Values of the basic meteorological and hydrological parameters recorded in October 2018 at the positions of the r.v. “Baltica” fish control catches during EST-POL BIAS.

Haul number	Date of catch	Mean headrope depth [m]	Meteorological parameters					Hydrological parameters*		
			wind direction	wind force [°B]	sea state	air temper. [°C]	atmospheric pressure [hP]	temperature [°C]	salinity [PSU]	oxygen [ml/l]
1	2018-10-22	55	WNW	5	3	5	1009	5.53	7.16	3.77
2	2018-10-22	40	W	5	3	10	1007	9.93	6.17	5.87
3	2018-10-23	15	SW	5	3	6	1000	12.01	4.92	7.11
4	2018-10-23	22	SW	5	3	6	996	12.01	5.13	7.04
5	2018-10-23	45	S	5	3	8	989	8.43	6.32	4.89
6	2018-10-23	40	S	5	3	7	987	10.43	6.07	5.91
7	2018-10-23	46/10	S	5	3	7	984	9.61	6.19	5.58
8	2018-10-25	50	SSE	4	2	5	994	8.28	6.60	5.28
9	2018-10-25	58/45	SSE	5	2-3	5	994	5.35	8.22	2.91
10	2018-10-25	40/52	ESE	5	2	5	994	5.68	7.90	3.81
11	2018-10-25	57	NE	3	2	7	994	6.72	7.61	4.82
12	2018-10-25	40	NW	5	2-3	8	994	6.42	7.46	4.40
13	2018-10-26	45	NW	6	3-4	7	998	6.55	7.07	5.93
14	2018-10-26	40/60	NW	5	3-4	6	1000	4.76	9.05	1.87
15	2018-10-26	35	NW	5	3	7	1001	6.20	7.25	5.85
16	2018-10-28	20	NNE	6	3-4	4	1014	11.51	6.91	6.99
17	2018-10-28	60	NE	6	3-4	5	1020	5.58	10.13	1.94
18	2018-10-28	50	NE	6	3-4	5	1022	4.85	9.21	2.44
19	2018-10-28	30	NE	6	3-4	5	1025	4.03	7.46	7.20

* data at the mean depth of the fish control catch



Baltic International Acoustic Survey

Report for R/V Aranda

Cruise 3/2018

ICES_BIAS2018

29th September – 11th October 2018

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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 2018, 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 31 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 29.09.2018 at 23:00 (UTC 20:00) 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 11.10.2018 and the vessel was navigated back to the port of Helsinki.

The Finnish BIAS 2018 survey had interruptions when the fishing could not be performed due to stormy weather and breakdown of the fishing gear. Therefore, only two fishing stations could be realized in ICES SD 29 and none in SD 32.

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 dual system SeaBird CTD instrument was used with state-of-the-art sensors for salinity, temperature, oxygen, connectivity and distance to seabed.

Calibration

The SIMRAD EK60 echo sounder with all transducers was calibrated on 29.9.2018, according to the IBAS manual (ICES 2017). 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 neighboring 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
Panu Hänninen	SYKE	CTD
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	Fish sampling, Trawling
Pasi Ala-opas	Luke	Trawling
Markku Gavrilov	Luke	Trawling
Pentti Kananen	Luke	Trawling
Otto Kiukkonen	Private specialist	Trawling, equipment maintenance
Kimmo Kirstua	Private specialist	Trawling, equipment maintenance
Peter Koskinen	Private specialist	Trawling, equipment maintenance
Konsta Isometsä	Luke	Acoustics
Erkki Jaala	Luke	Acoustics
Perttu Rantanen	Luke	Database maintenance
Petri Sarvamaa	Luke	Database maintenance

Luke: Luonnonvarakeskus / Natural Resources Institute Finland
SLU: Sveriges lantbruksuniversitet / Swedish University of Agricultural Sciences
SYKE: Suomen ympäristökeskus / Finnish Environment Institute

RESULTS

FISH CATCHES, BIOLOGICAL AND HYDRO-METEOROLOGICAL DATA

The number of planned trawling stations was 49. From these, 31 trawling stations were accomplished, and from those 30 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 27 and 3 in northern Baltic proper (SD 29) .The northern Gulf of Finland (SD 32) remained without trawl samples due to storm in the beginning of the journey and gear damage on the way back. Several trawling stations in SD 29 were also skipped due to same reasons.

The 5395 kg combined catches (Table 1) consisted of 16 fish species (5309 kg) and mostly unidentified organic matter categorized as "waste" (86 kg), but also including large number of mysids and small amounts of the isopod *Saduria entomon*. The most common and abundant species were herring (*Clupea harengus*) (4008 kg), three-spined stickleback (*Gasterosteus aculeatus*) (1142 kg) and sprat (*Sprattus sprattus*) (144 kg). All observed species are presented in Table 2. From the sub-samples of the 30 fish catches a total of 13493 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, 3346 and 849 samples respectively (Table 4). The mean weights for each length-class were also derived from these individual fish samples.
In addition from SD 30, 8 samples of 15 herring individuals to Finnish National Institute for health and Welfare (THL) for investigation of environmental toxins, 3 samples of 150 herring individuals for analysis of environmental toxins to Naturhistoriska Riksmuséet (NRM) of Sweden, 14 DNA-samples of 50 herring to check the spawning period of Bothnian Sea herring in comparison to other Baltic herring stocks for SLU and University of Uppsala and 1 sample of 20 kg herring for Swedish National Food Agency (NFA) to analyse the dioxin contents were collected and frozen.

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 and results are shown in Figures 5 and 6. Total of 32 CTD casts were done during the entire cruise. Here only a part of the CTD casts is presented.

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 1654 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 surveys 2017 and 2018. Length distributions for herring and sprat by ICES subdivision in 2018 are shown in Figure 3 and herring length distributions in SD 30 in years 2014-2018 in Figure 4. 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.

REFERENCES

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

Grygiel, W., O. Kaljuste, A. Grelowski and J. Pönni 2007. Research report from the Estonian-Finnish-Polish BIAS type survey in the north-eastern Baltic (October 2006). Working paper on the WGBIFS meeting in Rostock, 26-30.03.2007; 23 pp., [in:] ICES CM 2007/LRC:06, Ref. ACFM.

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

ICES 1983. Report of the Planning Group on ICES coordinated herring and sprat acoustic surveys. ICES C.M. 1983/H:12.

ICES 2017. Manual for the International Baltic Acoustic Surveys (IBAS), Version 2.0. Series of ICES Survey Protocols, SISP 8 – IBAS.

TABLES, MAP, AND FIGURES

Table 1. Trawl catches (kg) by species/category during the Finnish BIAS-survey in 2018.

Haul num.	Haul name	ICES SD	Ammodytes tobianus	Clupea harengus	Coregonus lavaretus	Cyclopterus lumpus	Gasterosteus aculeatus	Hyperoplus lanceolatus	Lampetra fluviatilis	Liparis liparis	Nerophis ophidion	Osmerus eperlanus	Pomatoschistus microps	Pungitius pungitius	Saduria entomon	Salmo salar	Sprattus sprattus	Taurulus bubalis	"Waste"	Fish catch (kg)	Catch total (kg)
1	49G9-1	29		137.96			10.21					0.04		0.01	0.01		9.95		6.82	158.17	165.00
2	50G8-1	30		28.97			28.72				0.003			0.01	0.00		2.61		7.38	60.32	67.70
3	50G7-1	30		100.34			21.41	0.03			0.001						4.22			126.00	126.00
4	51G7-1	30		109.24			29.41	0.01							0.00		0.34		3.00	139.00	142.00
5	51G8-1	30		85.64			111.54				0.004						1.65		1.17	198.84	200.00
6	51G9-1	30		4.62			150.81									0.27	3.15			158.86	158.86
7	52G7-1	30		178.44			32.24												0.32	210.68	211.00
8	52G8-1	30	0.018	266.66			14.79										0.70		1.84	282.17	284.00
9	52G9-1	30		268.20			13.54				0.001						10.22		3.04	291.97	295.00
10	53G9-1	30	0.003	48.02			5.57		0.01					0.01	0.00		5.21		1.18	58.82	60.00
11	53G8-1	30		172.81			49.67		0.04	0.02									7.47	222.54	230.00
12	53G8-2	30		83.71			11.80			0.18					0.00				0.32	95.68	96.00
13	53G9-2	30		162.79			9.01			0.02	0.001				0.00		2.29		0.89	174.10	175.00
14	54G8-1	30		182.89			1.37				0.001								9.74	184.26	194.00
15	55G9-1	30		262.84			6.90			0.01							0.26		0.98	270.02	271.00
17	55H0-2	30		97.21	0.08		1.62	0.02			0.002	8.67			0.12		11.60	0.003	0.69	119.19	120.00
18	54G9-1	30		256.40			0.71			0.04					0.06				5.80	257.14	263.00
19	54H0-1	30		115.86			6.29					4.35			0.00		8.63		0.86	135.14	136.00
20	53H0-1	30		68.26			3.25			0.04					0.00		5.67		3.78	77.22	81.00
21	53H0-2	30		250.94			4.85			0.01	0.001				0.01		8.09		1.10	263.89	265.00
22	52G9-2	30		234.47			46.78			0.10					0.00		3.74		7.91	285.08	293.00
23	52H0-1	30		30.89			20.82			0.02									0.34	51.73	52.07
24	52H0-2	30	0.029	167.67			9.42			0.01					0.00		0.79		0.09	177.91	178.00
25	51G9-2	30	0.022	217.16			6.02			0.12	0.001				0.00		0.23		8.44	223.56	232.00
26	51H0-1	30		192.84			38.06								0.00		0.37		8.73	231.27	240.00
27	51H0-2	30		101.10			133.25					0.07			0.00		20.27		2.31	254.68	257.00
28	50H0-1	30	0.001	79.61			259.77					0.02			0.00		12.10		1.49	351.51	353.00
29	50G9-1	30	0.049	35.08			69.97		0.05						0.00		0.26		0.59	105.41	106.00
30	48G9-1	29	0.013	67.52		0.17	44.61				0.001	0.03	0.002		0.02	0.18	31.45			143.98	144.00
Total (kg)			**0.135**	**4008.12**	**0.08**	**0.17**	**1142.41**	**0.06**	**0.10**	**0.57**	**0.016**	**13.18**	**0.002**	**0.02**	**0.24**	**0.46**	**143.79**	**0.003**	**86.27**	**5309.12**	**5395.62**

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 2018 BIAS-survey.

Species	**ICES SD**		**Total**
	29	**30**	
Liparis liparis		24	**24**
Hyperoplus lanceolatus		5	**5**
Sprattus sprattus	366	1640	**2006**
Gasterosteus aculeatus	187	1745	**1932**
Osmerus eperlanus	3	138	**141**
Pungitius pungitius	2	4	**6**
Pomatoschistus microps	2		**2**
Salmo salar	1	1	**2**
Lampetra fluviatilis		3	**3**
Ammodytes tobianus	1	10	**11**
Cyclopterus lumpus	2		**2**
Coregonus lavaretus		2	**2**
Clupea harengus membras	673	8668	**9341**
Nerophis ophidion	3	13	**16**
Total	**1240**	**12253**	**13493**

Table 4. Individual samples of herring and sprat (for age determination) per SD.

L-class	Sprat			Herring		
	29	30	Sprat Total	29	30	Herring Total
40					1	1
50					1	1
55					1	1
60					2	2
65					6	6
70	4	1	5	6	10	16
75	7	2	9	6	20	26
80	6		6	6	35	41
85	4	1	5	6	39	45
90	1	1	2	5	44	49
95	3	2	5	3	38	41
100	14	12	26	2	29	31
105	20	36	56	2	30	32
110	20	72	92	2	43	45
115	20	84	104	2	67	69
120	20	109	129	7	80	87
125	20	118	138	20	113	133
130	15	112	127	20	137	157
135	2	90	92	20	142	162
140		51	51	20	159	179
145		18	18	20	167	187
150		5	5	20	183	203
155				20	187	207
160				20	185	205
165				20	190	210
170				19	190	209
175				13	180	193
180				4	173	177
185				4	143	147
190				2	111	113
195				3	100	103
200					83	83
205				1	52	53
210					39	39
215					27	27
220					10	10
225					8	8
230					2	2
235					1	1
240					1	1
245					2	2
250					1	1
255					1	1
265					1	1
Total	**156**	**714**	**870**	**273**	**3034**	**3307**

Table 5. Numbers and locations of fishing stations (WGS-84) during Finnish BIAS-survey in 2018.

Haul nro	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	49G9-1	30.09.2018	29	600173N	193090E	595775N	193038E	118	3	5.9	165	34.06	50	150	104	18
2	50G8-1	01.10.2018	30	603967N	185562E	603705N	185498E	51	3	2.55	67.7	22.07	15	85	80.4	18
3	50G7-1	01.10.2018	30	604887N	174843E	604685N	175845E	57	2.5	2.38	126	17.36	23	50	56	18
4	51G7-1	02.10.2018	30	610603N	175190E	610608N	175629E	44	3	2.2	142	33.66	10	65	65	18
5	51G8-1	02.10.2018	30	610620N	184740E	610697N	185070E	35	2.8	1.63	200	49.9	7	68	64.5	20
6	51G9-1	02.10.2018	30	610720N	190826E	611126N	190876E	84	3	4.2	159	159	15	65	65	18
7	52G7-1	02.10.2018	30	613826N	174954E	613823N	175551E	60	2.8	2.8	211	46.5	8	65	66	20
8	52G8-1	03.10.2018	30	613737N	182069E	613460N	182083E	60	3	3	284	52.9	7	50	64.3	20
9	52G9-1	03.10.2018	30	614117N	190609E	614392N	190669E	60	3	3	295	54	11	68	64.1	23
10	53G9-1	03.10.2018	30	620105N	191641E	615640N	190890E	123	2.5	5.13	60	43	18	70	69.4	20
11	53G8-1	03.10.2018	30	620366N	180808E	620500N	181141E	45	2.9	2.18	230	47.64	11	80	63.7	20
12	53G8-2	04.10.2018	30	620978N	183356E	621266N	183461E	60	3	3	96	24.5	10	93	69	20
13	53G9-2	04.10.2018	30	622017N	191305E	622361N	191584E	80	3.2	4.27	175	50.7	15	107	64	20
14	54G8-1	04.10.2018	30	623525N	184953E	623525N	185694E	67	2.6	2.9	194	36.08	75	180	100	15
15	55G9-1	04.10.2018	30	630326N	190327E	630524N	191505E	60	3.3	3.3	271	50.94	10	160	64	20
16	55H0-1(INV)	05.10.2018	30	631423N	201729E	631215N	201462E	52	3	2.6	0		18	75	98	?
17	55H0-2	05.10.2018	30	631160N	201169E	631311N	200624E	64	2.8	2.99	120	50.16	10	77	68	20
18	54G9-1	05.10.2018	30	623836N	193285E	623942N	192774E	66	2.8	3.08	263	39.1	75	130	104	15
19	54H0-1	05.10.2018	30	623608N	201619E	623474N	201373E	44	2.5	1.83	136	39.66	18	80	64	18
20	53H0-1	06.10.2018	30	622667N	201188E	622554N	200687E	60	2.7	2.7	81	29.16	20	100	70	20
21	53H0-2	06.10.2018	30	620699N	201855E	620469N	200988E	105	3	5.25	265	51	10	125	61.2	22
22	52G9-2	06.10.2018	30	615854N	194924E	615651N	194132E	47	2.7	2.11	293	46.48	8	85	65.8	20
23	52H0-1	07.10.2018	30	614862N	200311E	614467N	200483E	74	3.2	3.95	54	54	15	118	77	20
24	52H0-2	07.10.2018	30	615090N	202546E	615489N	202098E	90	3	4.5	178	51.5	15	105	68	20
25	51G9-2	07.10.2018	30	612204N	195393E	612429N	194929E	76	2.5	3.17	232	41.48	80	110	96.3	20
26	51H0-1	07.10.2018	30	612014N	201217E	611978N	201726E	60	2.5	2.5	240	45.98	10	125	66.5	22
27	51H0-2	08.10.2018	30	611518N	204410E	611297N	204357E	55	2.5	2.29	257	54.12	10	80	63	20
28	50H0-1	08.10.2018	30	605726N	201232E	605578N	200920E	52	2.6	2.25	353	60.74	10	90	63	20
29	50G9-1	08.10.2018	30	604648N	193650E	604483N	193647E	44	2.8	2.05	106	45.16	9	79	66.3	20
30	48G9-1	09.10.2018	29	595855N	191427E	595721N	191133E	44	2.8	2.05	144	50.03	10	121	65	20
31	48H2-1(INV)	10.10.2018	29	593388N	225820E	593360N	225613E	20	2.8	0.93	37		30	70		?

Table 6. Survey statistics by area r/v Aranda in 2018.

ICES SD	ICES Rect.	NM	N (million/nm²)	Area (nm²)	Sa (m²/nm²)	σ (cm²)	N total (million)	Herring (%)	Sprat (%)	Cod (%)	3-spinn. (%)
48G9	29	66	11.0702	772.8	488.936	0.4416706	8555	8.74	6.50	0.00	84.74
49G9	29	75	3.11671	564.2	411.528	1.320391	1758	53.04	7.76	0.00	39.17
50G7	30	28	6.47108	403.1	497.363	0.7685943	2608	38.37	0.33	0.00	61.29
50G8	30	63	10.1289	833.4	503.912	0.4974978	8441	31.87	1.26	0.00	66.84
50G9	30	70	10.2243	879.5	412.434	0.4033852	8992	3.41	0.04	0.00	96.54
50H0	30	53	15.4379	795.1	659.793	0.4273842	12275	3.30	0.66	0.00	96.04
51G7	30	28	7.50025	614.5	659.606	0.8794451	4609	21.04	0.25	0.00	78.71
51G8	30	57	13.6208	863.7	708.411	0.5200938	11764	12.74	0.17	0.00	87.09
51G9	30	78	2.38904	865.8	295.364	1.2363284	2068	11.09	0.33	0.00	88.57
51H0	30	57	3.88623	865.7	304.675	0.7839878	3364	14.38	2.23	0.00	83.39
52G7	30	23	3.42927	482.6	398.875	1.1631477	1655	30.77	0.00	0.00	69.23
52G8	30	62	3.32223	852	580.548	1.7474654	2831	58.19	0.43	0.00	41.38
52G9	30	73	2.92436	852	353.065	1.2073215	2492	31.13	1.63	0.00	67.24
52H0	30	75	3.82982	852	350.095	0.9141296	3263	36.70	0.28	0.00	63.00
53G8	30	61	3.53901	838.1	354.268	1.0010347	2966	21.13	0.00	0.00	78.84
53G9	30	64	2.86282	838.1	375.526	1.3117371	2399	62.71	2.98	0.00	34.28
53H0	30	87	1.79535	838.1	310.989	1.7321865	1505	71.42	5.42	0.00	23.14
54G8	30	29	1.07239	642.2	273.097	2.5466156	689	91.71	0.00	0.00	8.28
54G9	30	72	1.11124	824.2	281.441	2.5326702	916	97.27	0.00	0.00	2.72
54H0	30	35	3.68667	727.9	409.955	1.1119923	2684	59.71	4.43	0.00	33.86
55G9	30	31	1.44731	625.6	279.85	1.9335861	905	74.57	0.16	0.00	25.26
55H0	30	27	2.25631	688.6	326.239	1.4458975	1554	57.07	13.11	0.00	16.31

Table 7. Numbers (millions) of herring by age and area (r/v Aranda 2018).

SD	Rect	0	1	2	3	4	5	6	7	8+	Total
29	48G9	172.18	225.06	130.36	57.20	86.86	17.81	22.86	11.27	24.14	747.73
29	49G9	98.58	186.92	234.44	113.00	158.33	38.69	40.57	20.39	41.79	932.71
30	50G7	477.64	251.02	124.56	46.76	47.41	13.00	10.12	5.49	25.00	1000.99
30	50G8	2634.81	27.78	14.81	6.02	4.12	0.79	0.98	0.28	0.33	2689.93
30	50G9	4.31	58.87	97.29	42.53	47.89	14.57	12.24	6.74	22.36	306.80
30	50H0	98.51	113.36	92.54	33.33	33.99	8.98	7.58	4.19	12.75	405.25
30	51G7	31.78	78.01	253.95	144.67	172.75	53.84	48.97	35.20	150.61	969.78
30	51G8	73.64	54.15	388.55	272.51	360.74	112.73	90.62	42.04	103.23	1498.20
30	51G9	4.40	26.70	60.48	34.94	49.86	15.44	12.59	6.27	18.79	229.46
30	51H0	96.09	91.41	100.19	45.29	61.57	19.99	16.43	10.64	42.13	483.75
30	52G7	3.99	6.92	101.83	91.99	145.98	47.95	37.39	19.01	54.24	509.30
30	52G8	36.55	57.53	443.11	313.40	399.50	118.56	89.39	41.95	147.23	1647.22
30	52G9	56.92	72.18	164.34	111.63	163.16	53.37	43.12	24.93	86.01	775.68
30	52H0	195.61	476.58	257.01	92.89	95.13	25.85	21.08	9.73	23.80	1197.68
30	53G8	1.58	13.98	126.16	95.67	149.68	49.83	40.95	28.19	120.83	626.86
30	53G9	458.28	298.96	265.64	137.15	175.02	53.28	42.72	20.19	53.47	1504.72
30	53H0	121.53	273.49	219.40	112.36	145.28	46.86	40.75	23.25	91.70	1074.62
30	54G8	0.52	26.51	163.79	115.57	159.87	50.52	38.96	18.79	57.04	631.57
30	54G9	3.30	93.47	272.67	153.83	190.04	56.23	43.67	20.69	56.94	890.84
30	54H0	727.06	488.75	144.17	48.75	70.95	24.28	19.60	14.38	64.46	1602.41
30	55G9	61.73	60.24	190.87	104.22	117.66	34.57	29.91	16.41	59.59	675.20
30	55H0	294.36	200.62	161.84	71.98	72.54	19.56	18.47	10.73	36.64	886.73

Table 8. Mean weight (g) of herring by age and area (r/v Aranda 2018).

SD	Rect.	0	1	2	3	4	5	6	7	8+
29	48G9	3.84	13.92	18.71	22.12	22.05	23.31	27.05	26.89	29.89
29	49G9	3.58	14.26	19.25	21.88	21.93	23.84	25.78	24.20	32.94
30	50G7	5.77	13.41	21.09	25.14	27.49	29.51	30.46	36.74	50.82
30	50G8	4.61	12.40	20.24	24.79	25.63	26.28	26.39	26.58	26.61
30	50G9	7.31	16.33	22.32	25.52	28.34	30.46	31.60	36.32	43.05
30	50H0	5.60	15.39	21.37	24.87	27.75	29.49	30.68	35.53	43.39
30	51G7	7.71	14.89	23.62	26.06	28.75	31.52	32.91	39.62	46.51
30	51G8	4.86	17.65	24.34	26.76	29.05	30.29	30.78	33.45	36.92
30	51G9	6.04	16.28	23.37	26.47	29.52	30.99	31.70	34.46	39.91
30	51H0	5.03	15.64	22.12	25.94	29.32	31.50	33.14	38.48	45.05
30	52G7	4.94	18.29	25.38	27.56	29.87	30.84	31.40	34.79	40.22
30	52G8	6.77	16.27	24.52	26.65	28.66	29.99	30.21	34.56	46.29
30	52G9	5.65	15.70	23.98	26.88	29.58	31.20	32.46	37.06	42.43
30	52H0	6.70	14.55	21.35	25.12	27.62	29.20	29.91	32.72	38.21
30	53G8	8.19	17.12	24.68	27.12	29.88	31.66	33.28	39.26	47.51
30	53G9	5.03	14.93	22.62	26.17	28.93	30.55	31.09	34.06	37.43
30	53H0	6.42	14.51	22.57	26.15	29.08	31.25	32.60	37.63	45.27
30	54G8	14.17	17.02	24.40	26.82	29.16	30.51	31.11	34.56	41.49
30	54G9	12.54	16.38	23.46	26.14	28.62	30.09	30.57	34.03	43.16
30	54H0	5.22	14.16	20.11	26.03	29.52	31.22	33.64	38.89	50.91
30	55G9	5.29	16.13	23.38	25.86	28.32	30.45	31.60	37.08	44.18
30	55H0	5.18	14.25	22.17	25.35	27.80	30.00	31.13	37.02	42.87

Table 9. Total biomass (ton) of herring by age and area (r/v Aranda 2018).

SD	Rect.	0	1	2	3	4	5	6	7	8+	Total
29	48G9	660.4	3133.3	2439.2	1265.5	1915.3	415.0	618.5	303.0	721.8	11471.9
29	49G9	352.8	2664.6	4511.9	2472.0	3472.9	922.3	1045.9	493.5	1376.4	17312.4
30	50G7	2755.1	3366.2	2626.7	1175.6	1303.1	383.6	308.2	201.7	1270.7	13390.9
30	50G8	12142.1	344.6	299.9	149.2	105.6	20.9	25.9	7.4	8.7	13104.2
30	50G9	31.5	961.6	2171.7	1085.4	1357.3	443.8	386.9	244.7	962.5	7645.4
30	50H0	551.6	1744.4	1977.2	829.1	943.2	264.9	232.5	149.0	553.2	7245.2
30	51G7	244.9	1161.8	5999.0	3770.0	4966.5	1697.0	1611.7	1394.6	7004.5	27850.1
30	51G8	357.6	955.7	9457.3	7292.1	10478.5	3414.6	2789.4	1406.2	3811.2	39962.6
30	51G9	26.5	434.8	1413.5	924.8	1471.5	478.3	399.2	215.9	749.7	6114.3
30	51H0	482.9	1429.7	2216.2	1175.1	1805.5	629.6	544.3	409.5	1898.2	10591.0
30	52G7	19.7	126.6	2584.0	2535.7	4359.9	1478.9	1174.1	661.2	2181.4	15121.5
30	52G8	247.5	935.8	10864.1	8351.4	11449.4	3555.9	2700.9	1449.8	6814.7	46369.5
30	52G9	321.4	1133.5	3941.6	3000.2	4826.9	1665.3	1399.8	924.1	3649.0	20861.9
30	52H0	1311.2	6932.7	5487.5	2333.7	2627.4	754.9	630.3	318.4	909.5	21305.5
30	53G8	12.9	239.3	3114.0	2594.7	4472.3	1577.4	1362.9	1106.7	5740.5	20220.6
30	53G9	2306.6	4462.4	6009.6	3588.7	5063.3	1628.1	1327.9	687.8	2001.2	27075.6
30	53H0	779.7	3967.6	4952.8	2937.6	4224.7	1464.6	1328.5	874.8	4151.7	24682.0
30	54G8	7.4	451.2	3996.1	3100.0	4662.0	1541.7	1212.2	649.2	2366.5	17986.2
30	54G9	41.4	1530.6	6396.3	4021.3	5439.2	1692.1	1335.0	704.3	2457.3	23617.4
30	54H0	3791.9	6919.4	2899.6	1269.1	2094.7	758.1	659.3	559.1	3281.9	22233.1
30	55G9	326.4	971.5	4463.0	2694.8	3331.8	1052.8	944.9	608.5	2632.3	17026.1
30	55H0	1525.8	2859.6	3587.9	1824.7	2016.5	586.7	575.0	397.4	1570.9	14944.5

Table 10. Numbers (millions) of sprat by age and area (r/v Aranda 2018).

SD	Rect	0	1	2	3	4	5	6	7	8+	Total
29	48G9	54.53	166.73	41.27	25.86	142.43	108.35	7.51	8.35	1.21	556.26
29	49G9	18.58	35.28	9.15	5.54	33.73	27.48	2.46	3.15	1.07	136.43
30	50G7	0.00	1.55	0.91	0.45	1.25	3.52	0.19	0.20	0.58	8.65
30	50G8	6.74	27.00	9.62	4.32	12.83	37.75	1.88	2.21	4.08	106.44
30	50G9	0.00	0.01	0.19	0.16	0.64	1.97	0.12	0.24	0.46	3.78
30	50H0	0.00	6.54	6.05	3.83	12.64	37.81	2.56	3.85	7.41	80.69
30	51G7	0.00	1.81	1.02	0.64	1.88	5.45	0.08	0.15	0.36	11.40
30	51G8	0.65	0.97	1.55	0.89	2.93	9.18	0.73	1.10	2.23	20.22
30	51G9	0.00	0.63	0.60	0.36	1.09	3.19	0.19	0.26	0.50	6.81
30	51H0	0.00	3.61	4.93	3.46	12.30	36.63	2.28	3.76	7.98	74.95
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	0.94	0.53	0.42	1.41	4.92	0.57	0.95	2.37	12.11
30	52G9	0.00	1.02	1.47	1.38	5.73	19.35	1.95	3.40	6.24	40.54
30	52H0	0.00	0.36	0.75	0.54	1.58	4.84	0.23	0.34	0.57	9.21
30	53G8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30	53G9	0.00	3.71	4.57	3.20	10.75	33.42	2.70	4.34	8.82	71.51
30	53H0	0.00	4.62	5.65	3.89	12.70	38.94	2.76	4.34	8.65	81.56
30	54G8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30	54G9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30	54H0	0.00	7.13	6.09	4.76	17.78	56.24	4.24	7.27	15.25	118.75
30	55G9	0.00	0.00	0.05	0.05	0.28	0.83	0.05	0.09	0.13	1.47
30	55H0	0.00	43.51	21.61	10.88	28.48	82.64	3.82	3.86	8.91	203.71

Table 11. Mean weight (g) of sprat by age and area (r/v Aranda 2018).

C	Rect.	0	1	2	3	4	5	6	7	8+
29	48G9	3.47	8.54	9.83	9.88	10.30	10.62	12.13	11.45	12.60
29	49G9	3.02	8.41	9.98	9.99	10.59	10.86	12.14	11.97	13.32
30	50G7		9.26	11.52	12.34	12.41	12.64	13.27	14.69	15.98
30	50G8	3.10	9.61	10.84	12.15	12.40	12.50	13.18	14.35	14.13
30	50G9		12.15	12.71	12.88	13.36	13.50	14.87	14.98	15.19
30	50H0		10.32	11.89	12.66	12.89	13.17	14.07	14.79	14.92
30	51G7		10.28	11.79	12.28	12.51	12.46	11.53	13.05	12.97
30	51G8	5.00	8.88	10.89	12.85	13.29	13.44	14.19	14.64	15.22
30	51G9		9.92	11.88	12.52	12.78	12.98	13.80	14.65	14.79
30	51H0		10.06	12.10	12.81	13.06	13.29	14.20	14.70	15.18
30	52G7									
30	52G8		10.37	11.73	13.38	13.56	13.92	14.62	15.14	15.82
30	52G9		10.02	12.56	13.34	13.70	13.93	14.86	15.04	15.29
30	52H0		10.28	12.31	12.61	13.01	13.04	13.89	14.19	14.12
30	53G8									
30	53G9		10.26	11.99	12.92	13.10	13.46	14.39	14.96	15.24
30	53H0		9.71	12.06	12.80	13.05	13.32	14.28	14.83	15.14
30	54G8									
30	54G9									
30	54H0		9.96	12.12	13.05	13.32	13.53	14.48	14.77	15.30
30	55G9			13.37	13.33	13.55	13.56	14.15	13.90	13.77
30	55H0		9.75	11.50	12.17	12.31	12.42	13.06	14.56	15.06

Table 12. Total biomass (ton) of sprat by age and area (r/v Aranda 2018).

SD	Rect.	0	1	2	3	4	5	6	7	8+	Total
29	48G9	189.24	1423.09	405.72	255.38	1466.35	1151.12	91.11	95.61	15.27	5092.89
29	49G9	56.14	296.77	91.32	55.34	357.16	298.51	29.82	37.71	14.22	1236.98
30	50G7	0.00	14.35	10.47	5.56	15.56	44.43	2.48	2.96	9.25	105.07
30	50G8	20.88	259.54	104.30	52.55	159.18	471.81	24.76	31.76	57.69	1182.47
30	50G9	0.00	0.06	2.36	2.06	8.59	26.56	1.81	3.56	7.05	52.05
30	50H0	0.00	67.46	71.92	48.56	163.00	498.08	36.07	56.97	110.51	1052.57
30	51G7	0.00	18.60	12.01	7.88	23.55	67.92	0.98	1.96	4.72	137.64
30	51G8	3.26	8.61	16.90	11.39	38.97	123.34	10.33	16.03	33.90	262.74
30	51G9	0.00	6.28	7.10	4.50	13.86	41.44	2.61	3.80	7.36	86.94
30	51H0	0.00	36.28	59.70	44.37	160.62	486.79	32.33	55.28	121.13	996.51
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	9.74	6.18	5.56	19.14	68.51	8.31	14.40	37.49	169.34
30	52G9	0.00	10.26	18.44	18.38	78.53	269.58	29.01	51.22	95.40	570.82
30	52H0	0.00	3.70	9.23	6.86	20.57	63.14	3.15	4.84	8.02	119.49
30	53G8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30	53G9	0.00	38.12	54.87	41.34	140.82	449.97	38.88	64.89	134.42	963.31
30	53H0	0.00	44.81	68.17	49.81	165.79	518.93	39.39	64.42	130.97	1082.29
30	54G8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30	54G9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30	54H0	0.00	70.98	73.78	62.15	236.76	760.62	61.40	107.37	233.35	1606.41
30	55G9	0.00	0.00	0.61	0.69	3.80	11.24	0.66	1.19	1.81	19.99
30	55H0	0.00	424.32	248.49	132.44	350.63	1026.23	49.89	56.21	134.23	2422.45

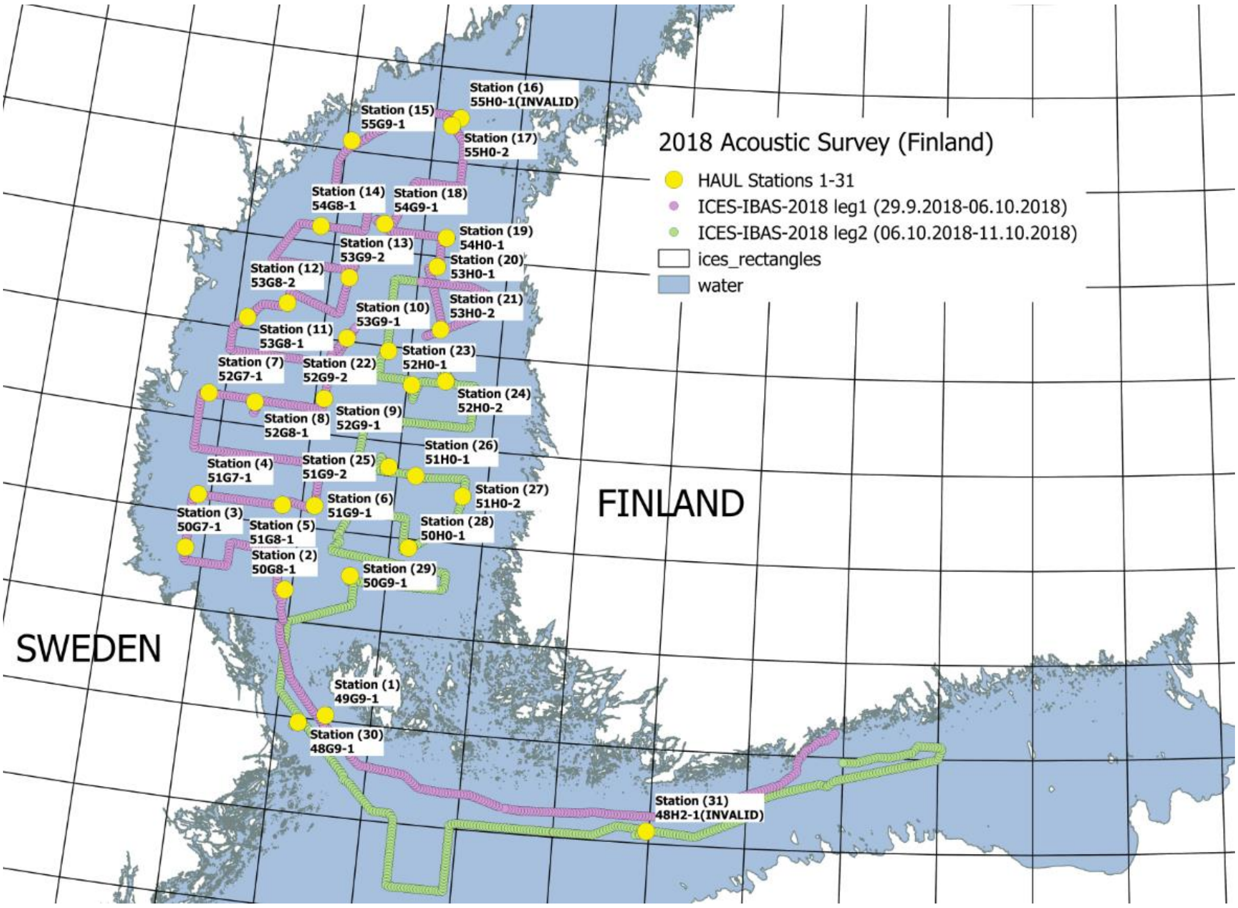


Figure 1. Cruise track and trawl stations of r/v Dana during the Finnish BIAS-survey in 2018.

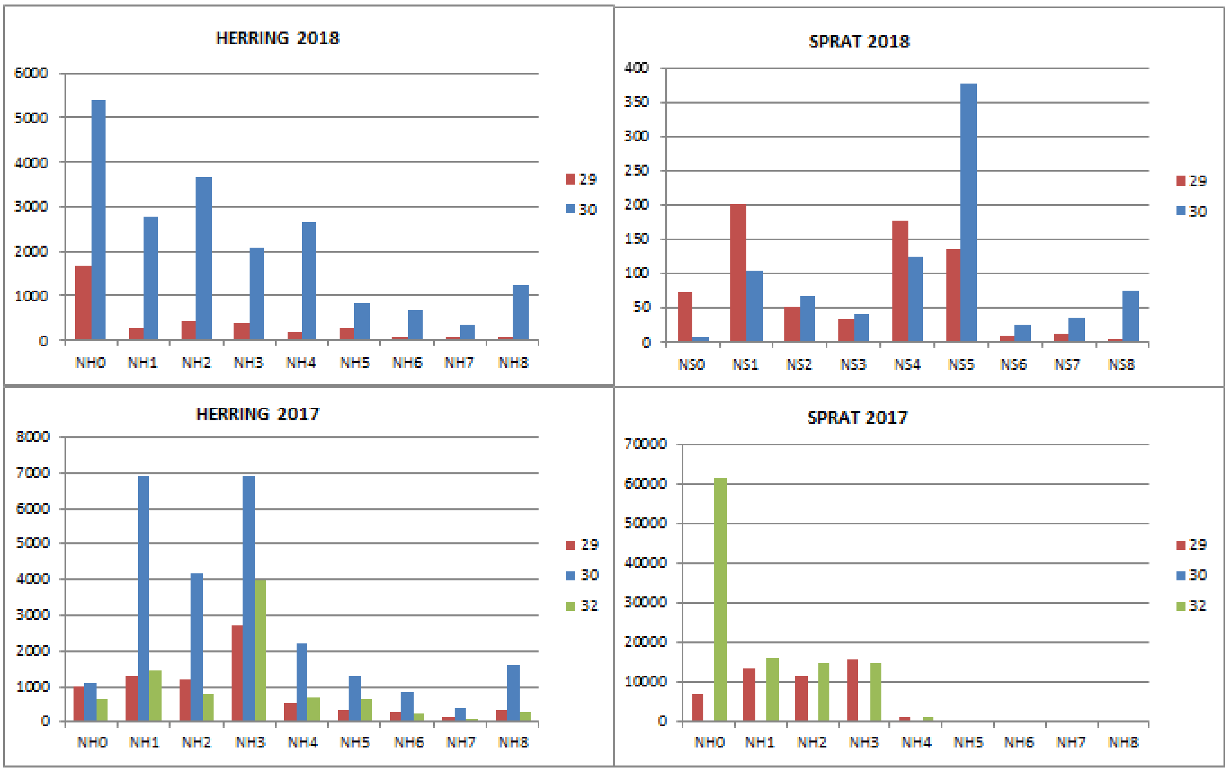


Figure 2. Abundance of herring and sprat per age groups according to the ICES Sub-divisions in Finnish BIAS surveys 2017 and 2018.

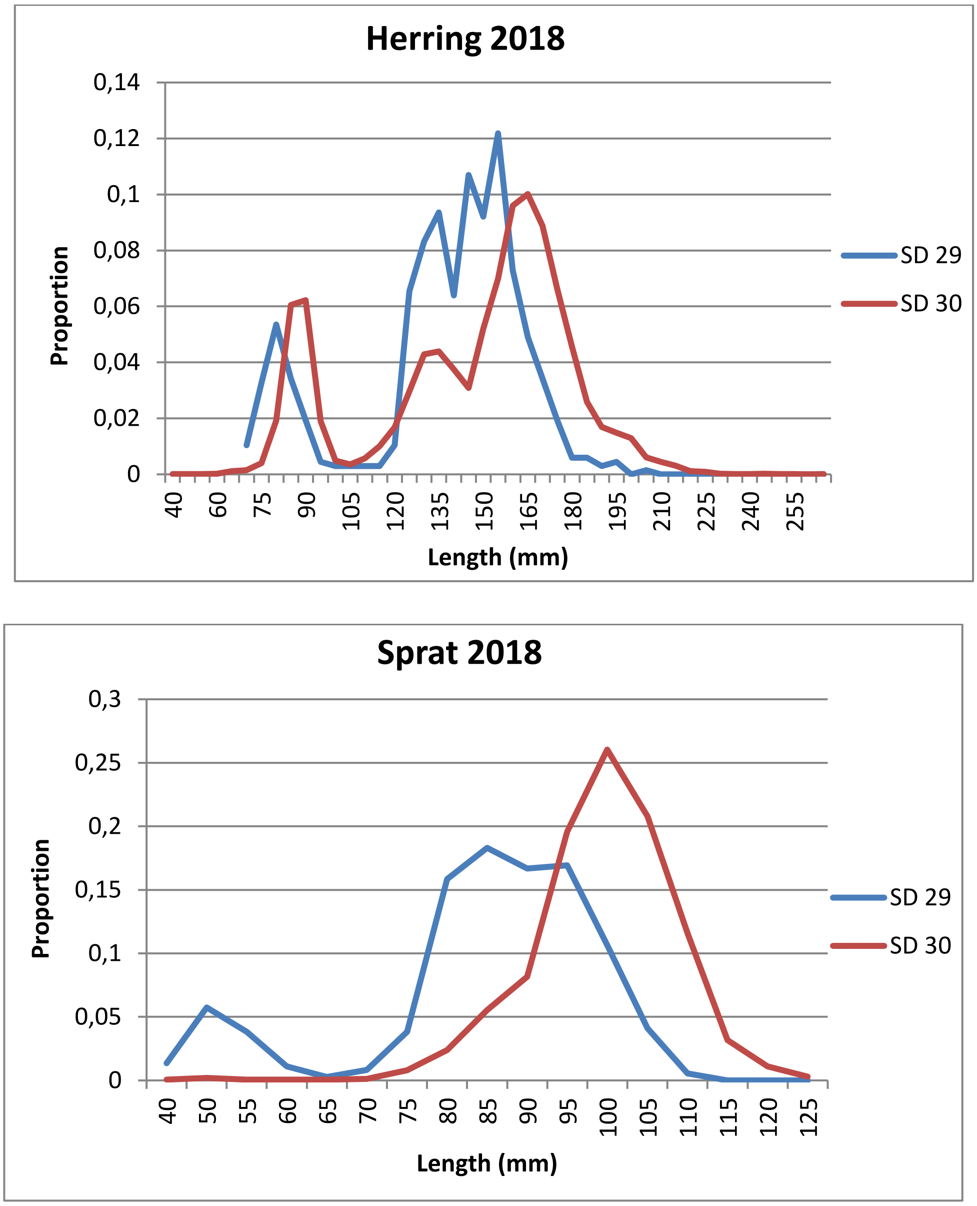


Figure 3. Proportional length distributions of measured herring and sprat in Sub-Divisions 29 and 30.

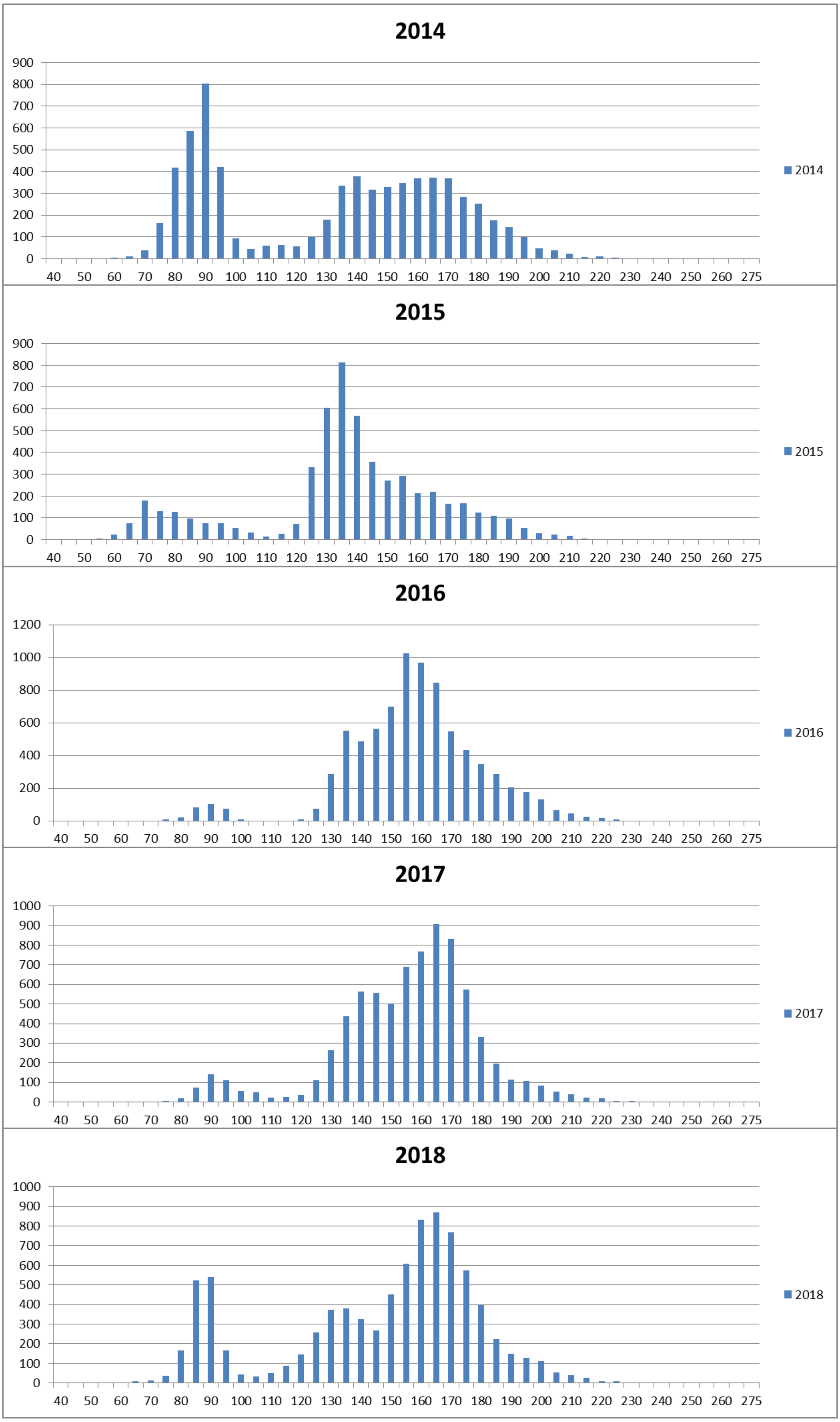
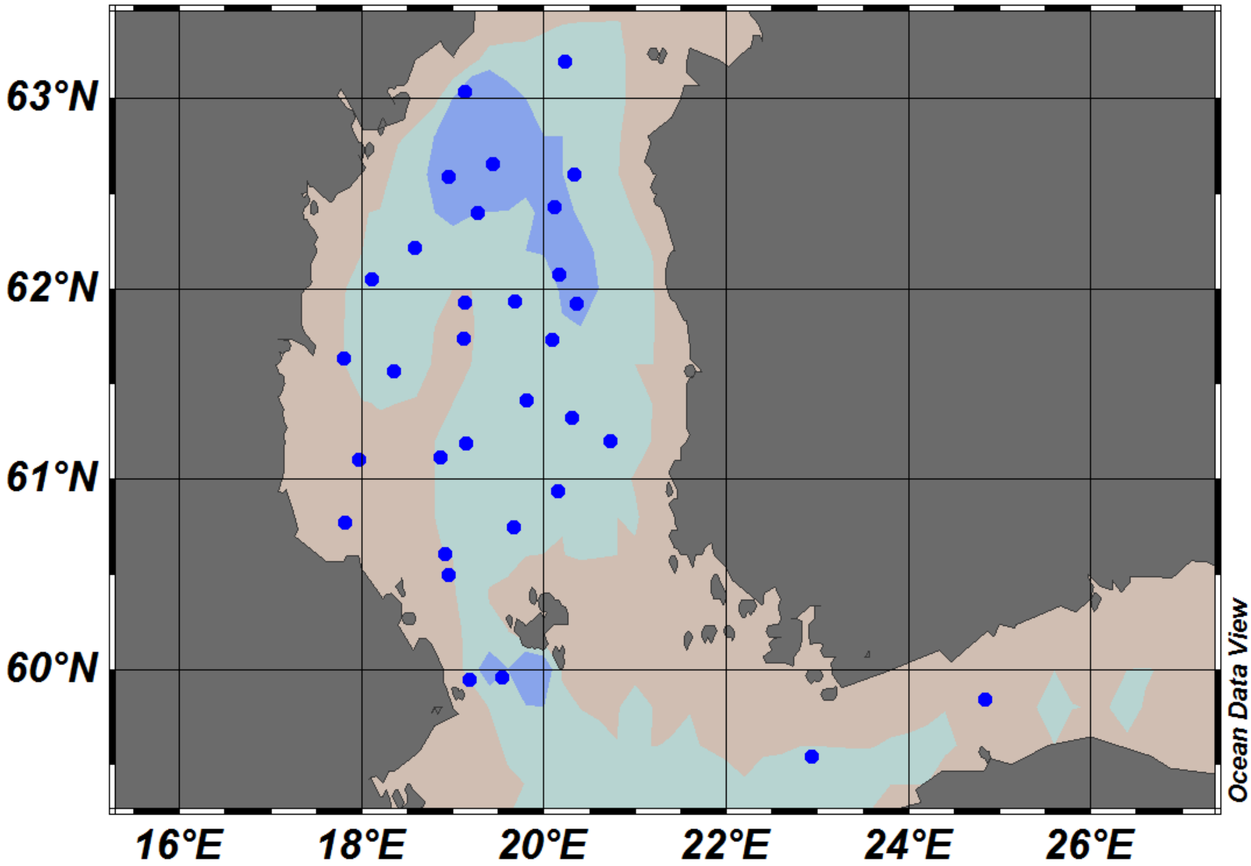


Figure 4. Length distributions of herring from acoustic surveys in Sub-Division 30 in years 2014-2018



Figire 5. Map of the CTD stations (blue dots) during the Finnish BIAS-survey in 2018.

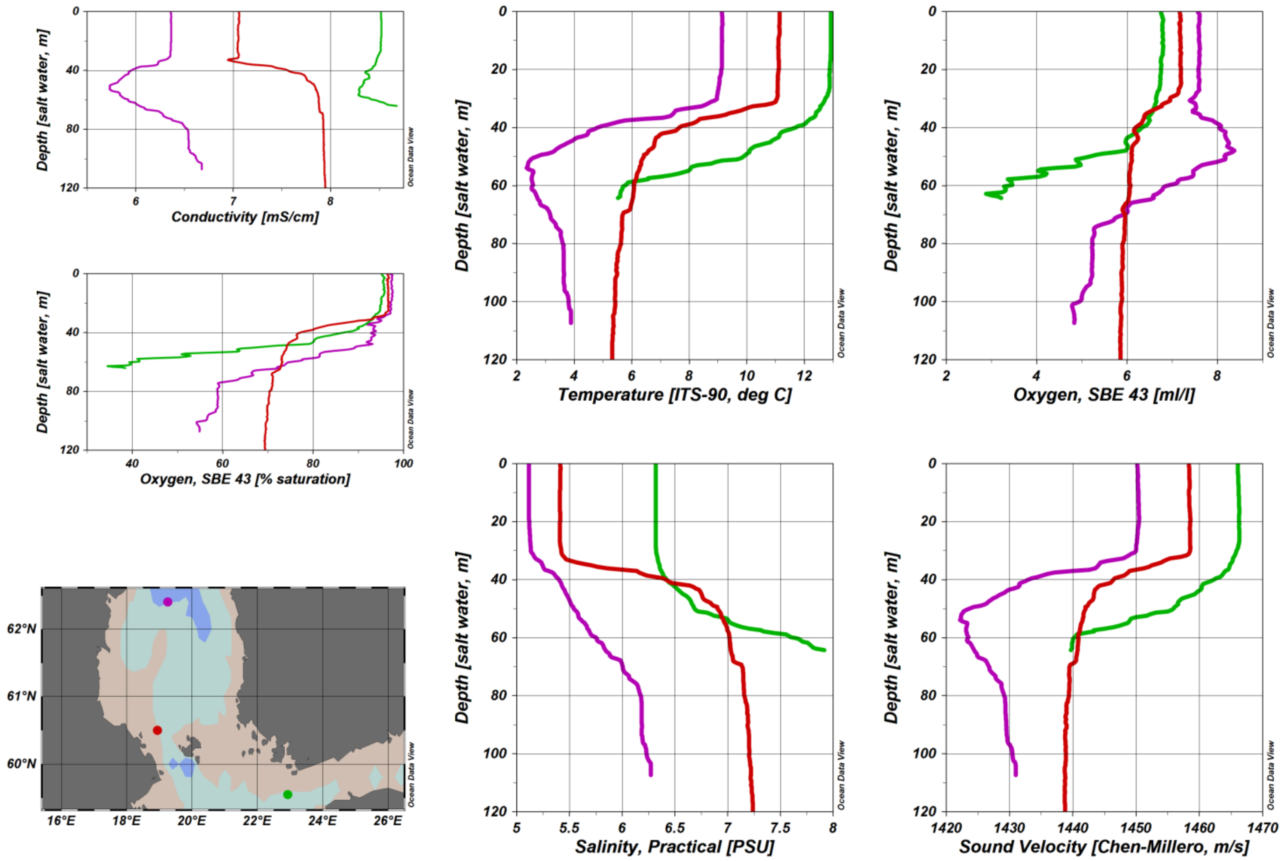


Figure 6. Vertical distribution of the sound velocity, conductivity, water temperature, salinity, and oxygen concentration in three stations (in purple and red in SD30, and green in SD29).

Baltic International Acoustic Survey Report for R/V Dana

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

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

Contents

1 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

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

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 1247 nautical miles. The cruise track and positions of trawl hauls are shown in figure 2.

2.3 Calibration

The SIMRAD EK60 echo sounder with the transducer ES38B was calibrated at Bornö in Gullmarssfjorden 2018-10-02 and 2018-10-03 according to the BIAS manual.[3] Values from the calibration were within required accuracy. The change of calibration site was decided after correspondance with Simrad. Due to the distance between the calibration site and the survey area the gain was recalculated using the equation: $\mathrm{G} = \mathrm{G}_0 + 10 * log10(c_0^2/c^2)$ (Bodholt 2002)

2.4 Acoustic data collection

The acoustic sampling was performed around the clock. SIMRAD EK60[4] echo sounder with the 38 kHz transducer (ES38b) mounted on a towed body is used for the acoustic transect data collection, additionally a hull mounted 38 kHz transducer (ES38B) was used during the fishing stations (the towed body is taken aboard when fishing). The settings of the hydroacoustic equipment were as described in the BIAS manual[5]. 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 with a "Seabird 9+" CTD when calibrating the acoustic instruments and whenever a haul was conducted, additional hydrographic data was collected on a selection of these stations.

2.7 Personnel

The participating scientific crew can be seen in table 2

Svensson, Matilda	IMR, Lysekil, Sweden	Fish sampling
Jernberg, Carina	IMR, Lysekil, Sweden	Fish sampling
Johannesson, Per	IMR, Lysekil, Sweden	Technician calibration
Larson, Niklas	IMR, Lysekil, Sweden	Scientific & Expedition leader, Acoustics
Lövgren, Olof	IMR, Lysekil, Sweden	Acoustics
Johansson, Marianne	IMR, Lysekil, Sweden	Fish sampling
Palmen-Bratt, Anne-Marie	IMR, Lysekil, Sweden	Fish sampling
Sjöberg, Rajlie	IMR, Lysekil, Sweden	Fish sampling
Svenson, Anders	IMR, Lysekil, Sweden	Expedition leader, Acoustics
Tell, Anna-Kerstin	SMHI, Gothenburg	Oceanography

Table 2: Participating scientific crew

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. 2010 herrings and 1473 sprats were aged. Catch compositions by trawl haul is presented in Table 8. Length distributions for herring and sprat by ICES subdivision are shown in figures 3 to 12.

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 2015 for SD25 to 29 and thus can be used in the assessment work done by WGBFAS.

5 References

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

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

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

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

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

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

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

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

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

6 Tables, map and figures

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

Table 3: Survey statistics

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

Table 4: Estimated number (millions) of sprat

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

Table 5: Estimated mean weights (g) of sprat

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

Table 6: Estimated number (millions) of herring

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

Table 7: Estimated mean weights (g) of herring

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

Table 8: Catch composition per haul.

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

Table 8 (continued): Catch composition per haul

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

Table 8 (continued): Catch composition per haul

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

Table 8 (continued): Catch composition per haul

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

Table 8 (continued): Catch composition per haul

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

Table 8 (continued): Catch composition per haul

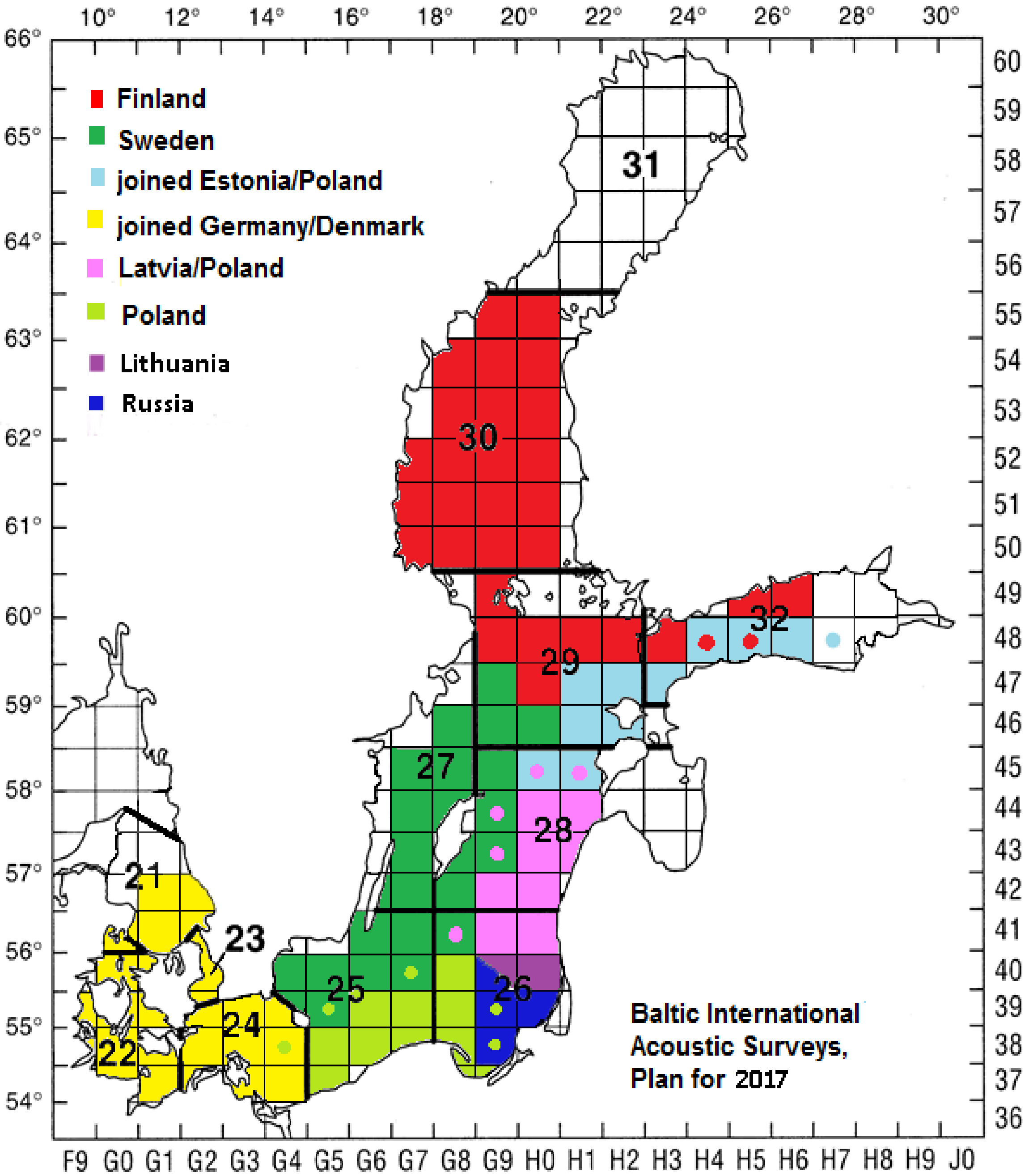


Figure 1: Map over which ICES square are allocated to each country (On axes: longitude, latitude and ICES name of square eg:41G8)

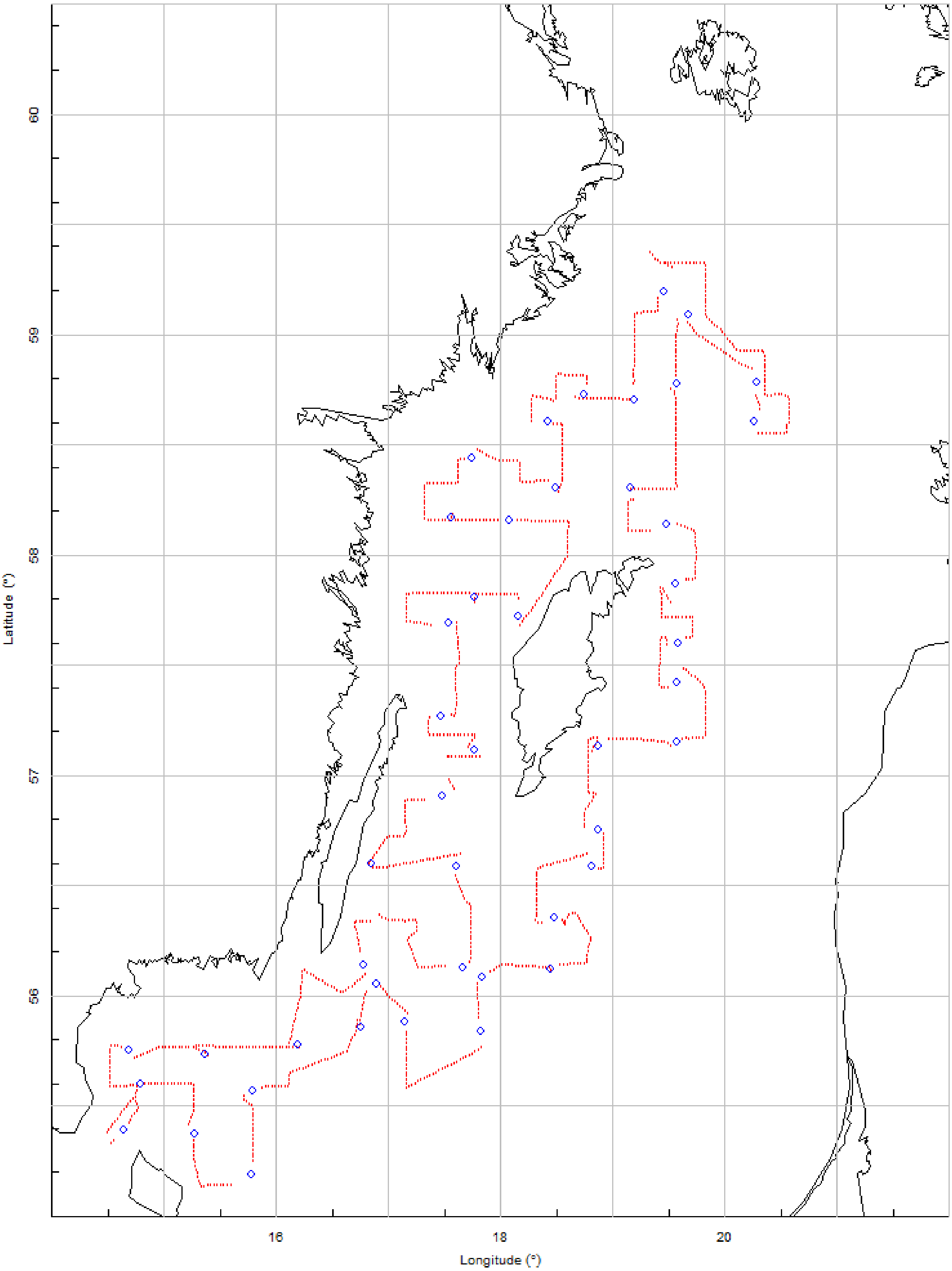


Figure 2: cruise track(red), positions of trawl hauls (blue) and survey grid (ICES squares)(grey)

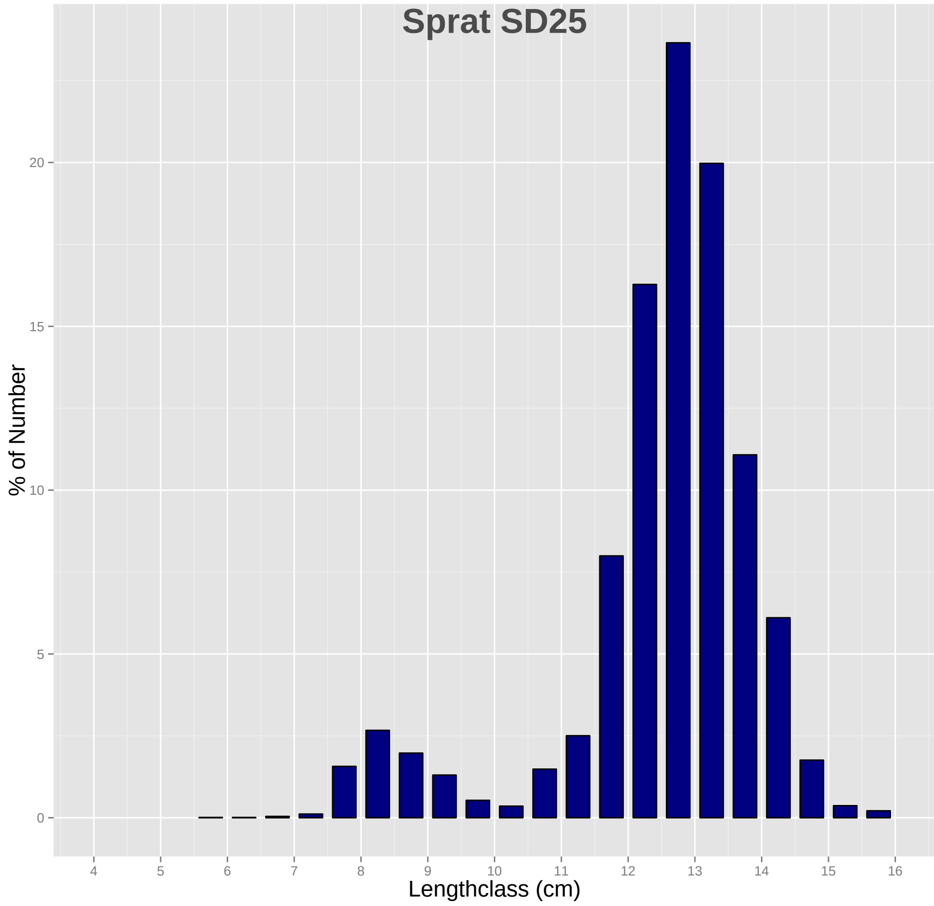


Figure 3: Length distribution of sprat from subdivision 25

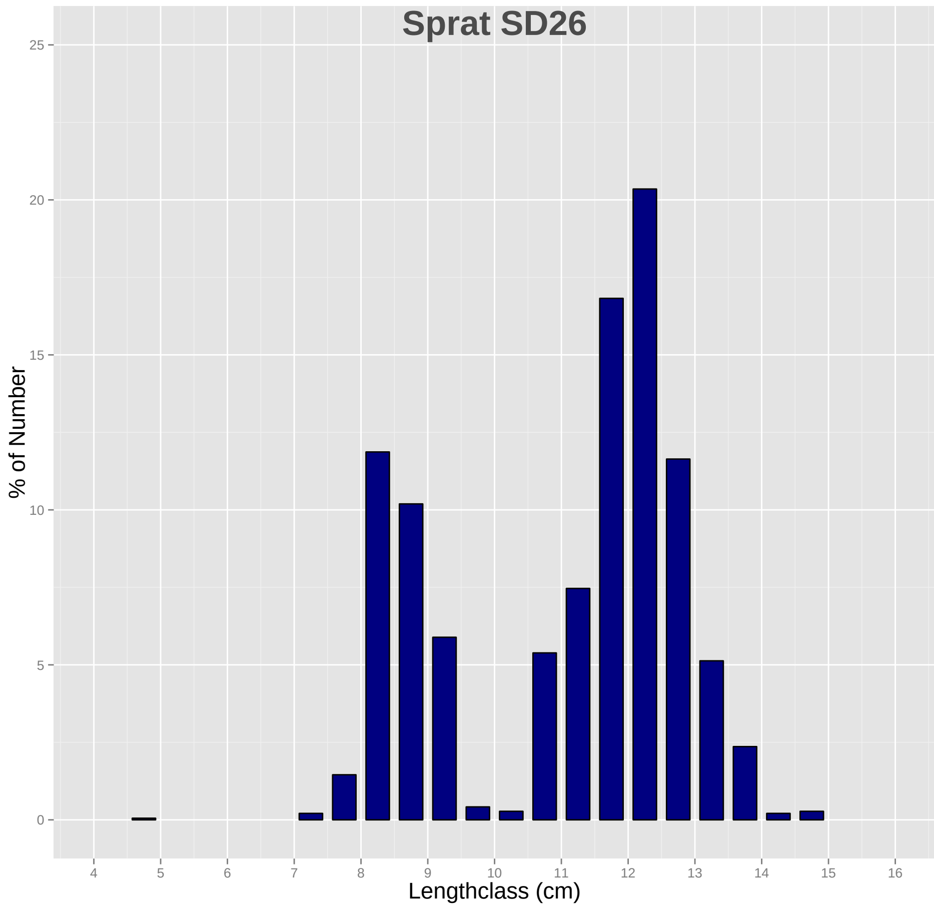


Figure 4: Length distribution of sprat from subdivision 26

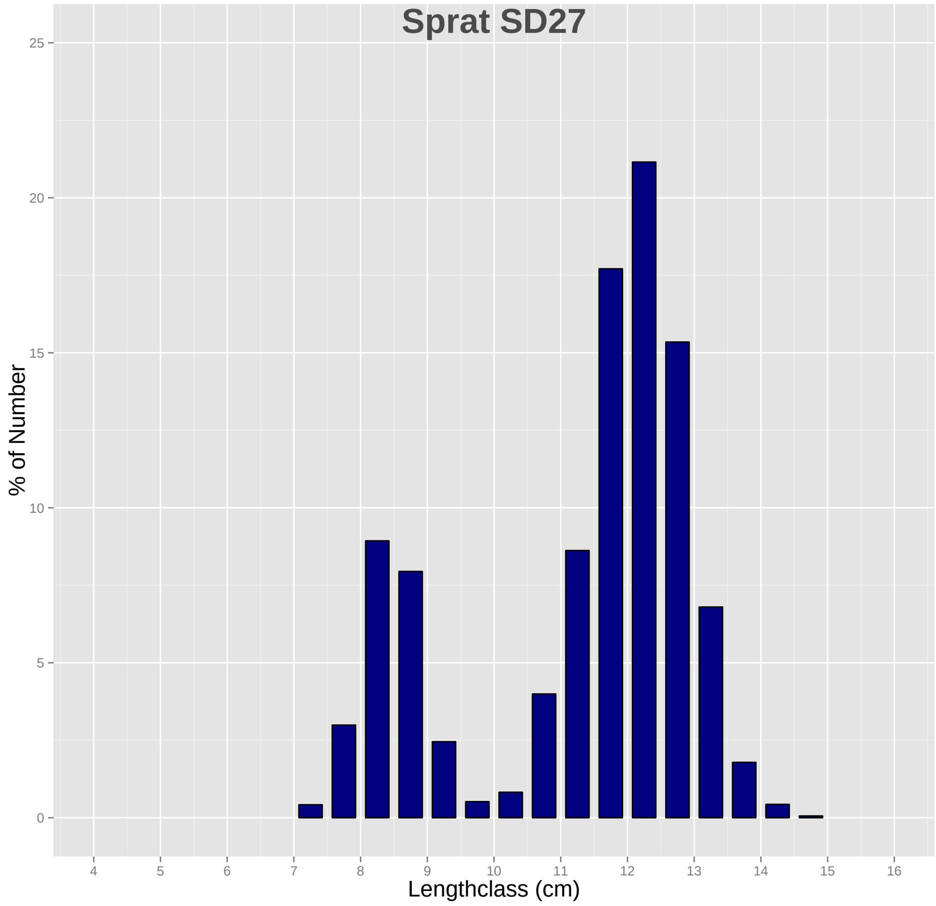


Figure 5: Length distribution of sprat from subdivision 27

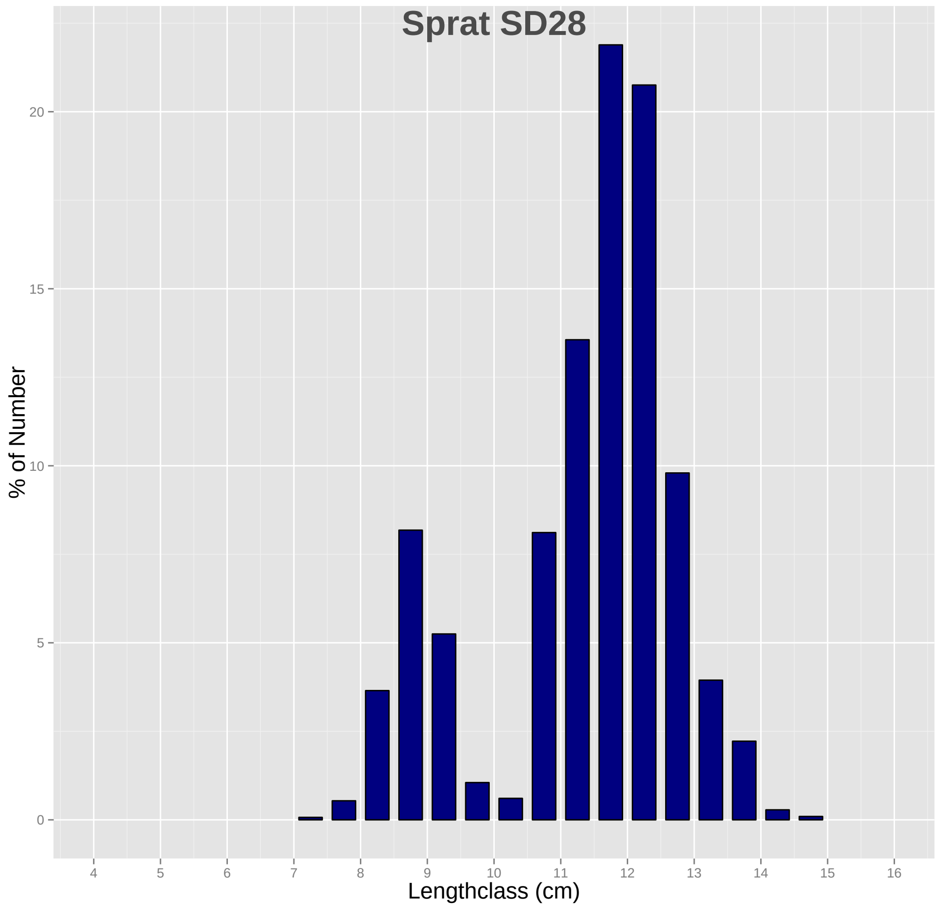


Figure 6: Length distribution of sprat from subdivision 28

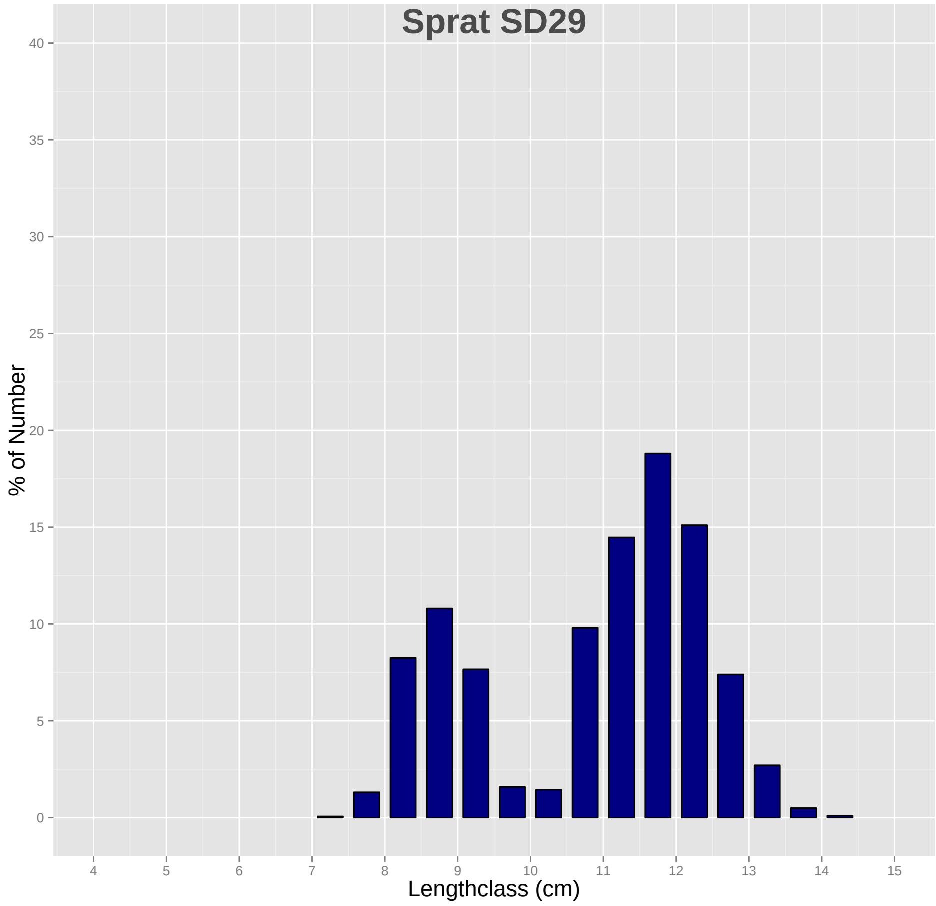


Figure 7: Length distribution of sprat from subdivision 29

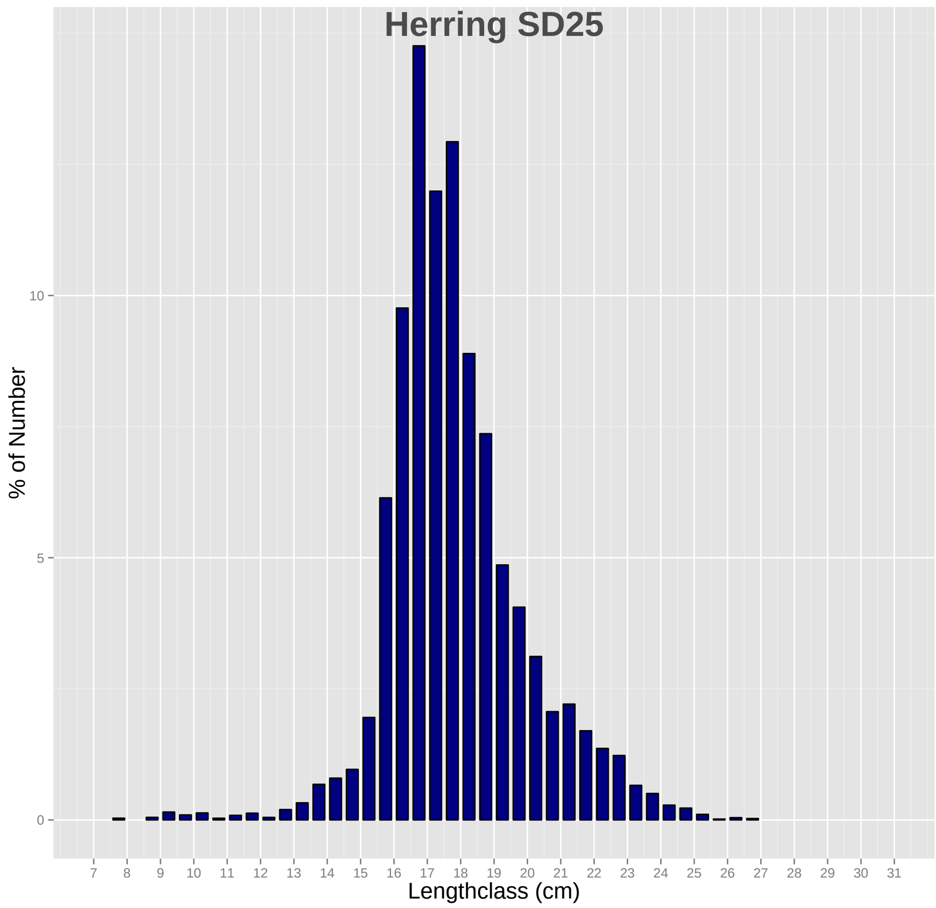


Figure 8: Length distribution of herring from subdivision 25

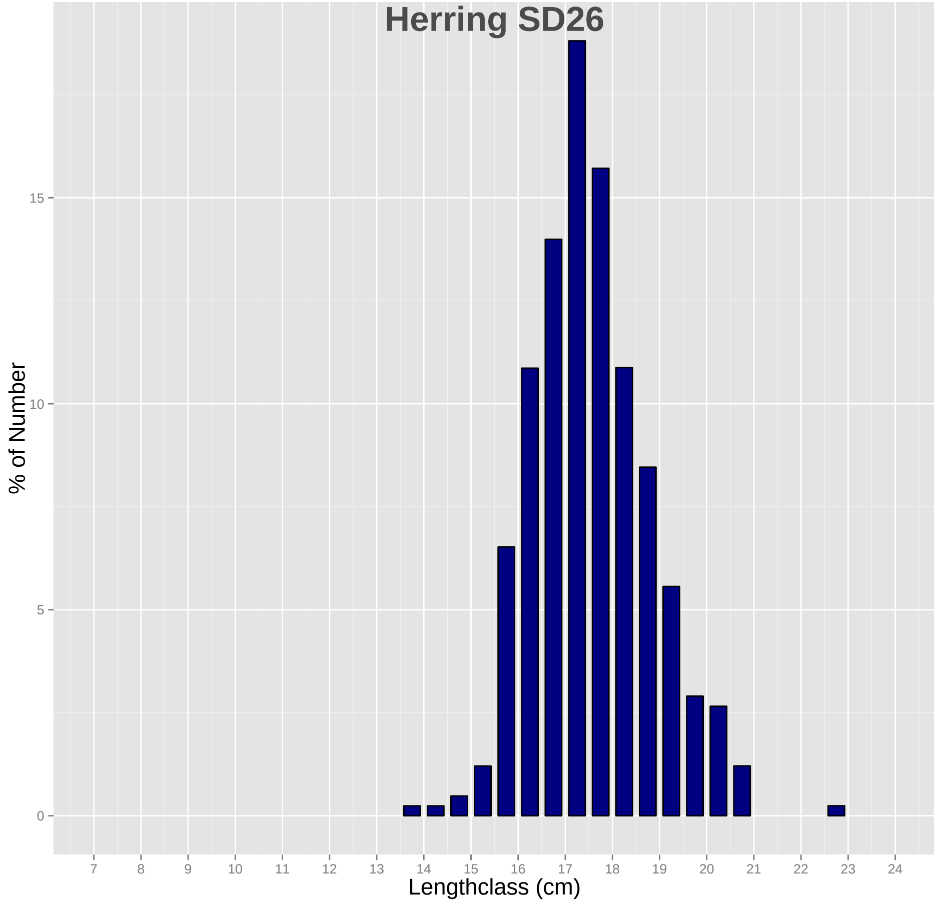


Figure 9: Length distribution of herring from subdivision 26

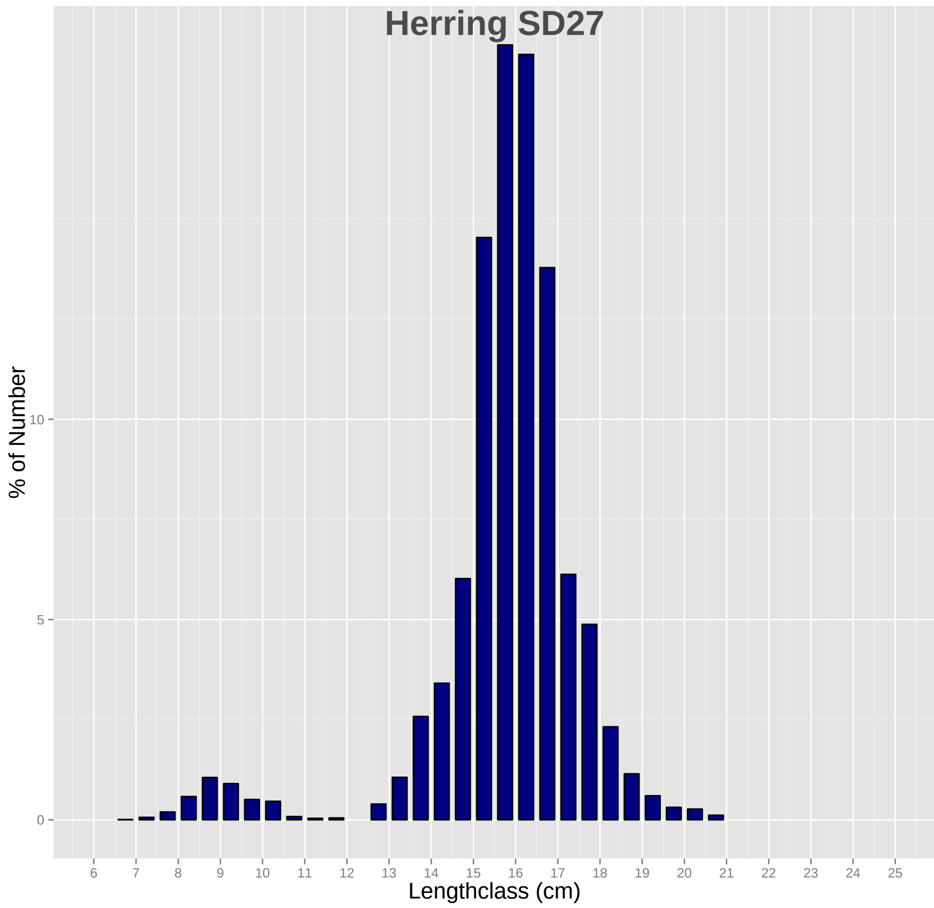


Figure 10: Length distribution of herring from subdivision 27

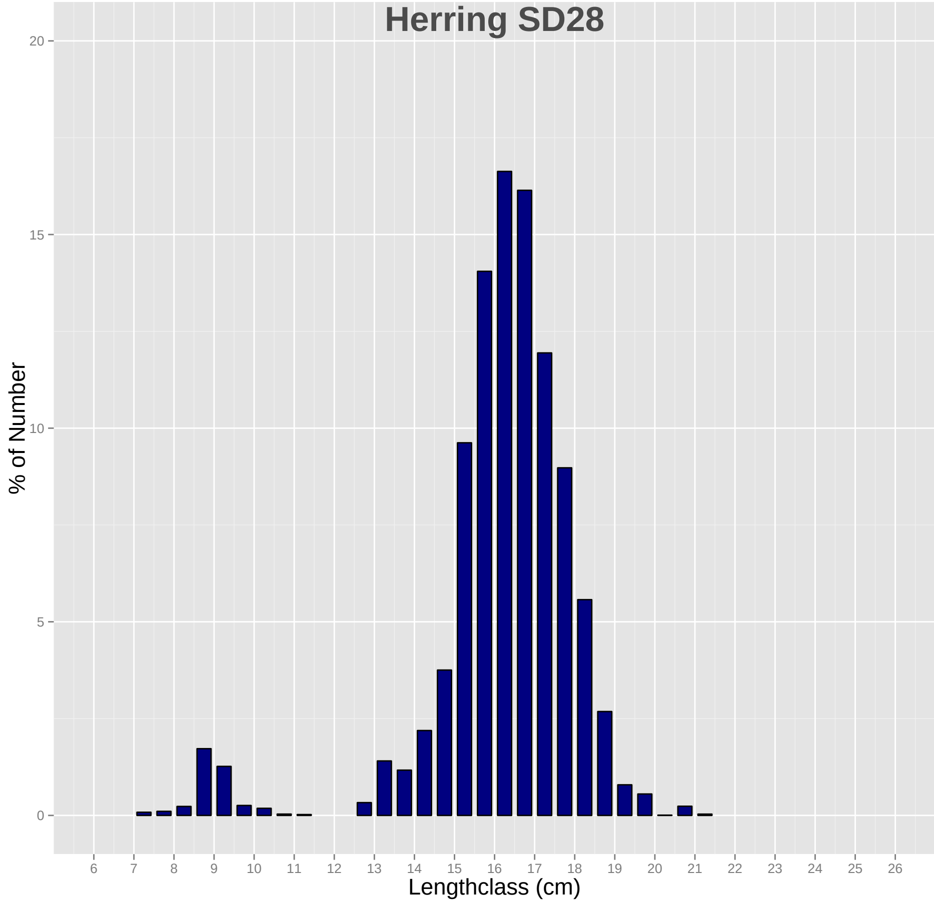


Figure 11: Length distribution of herring from subdivision 28

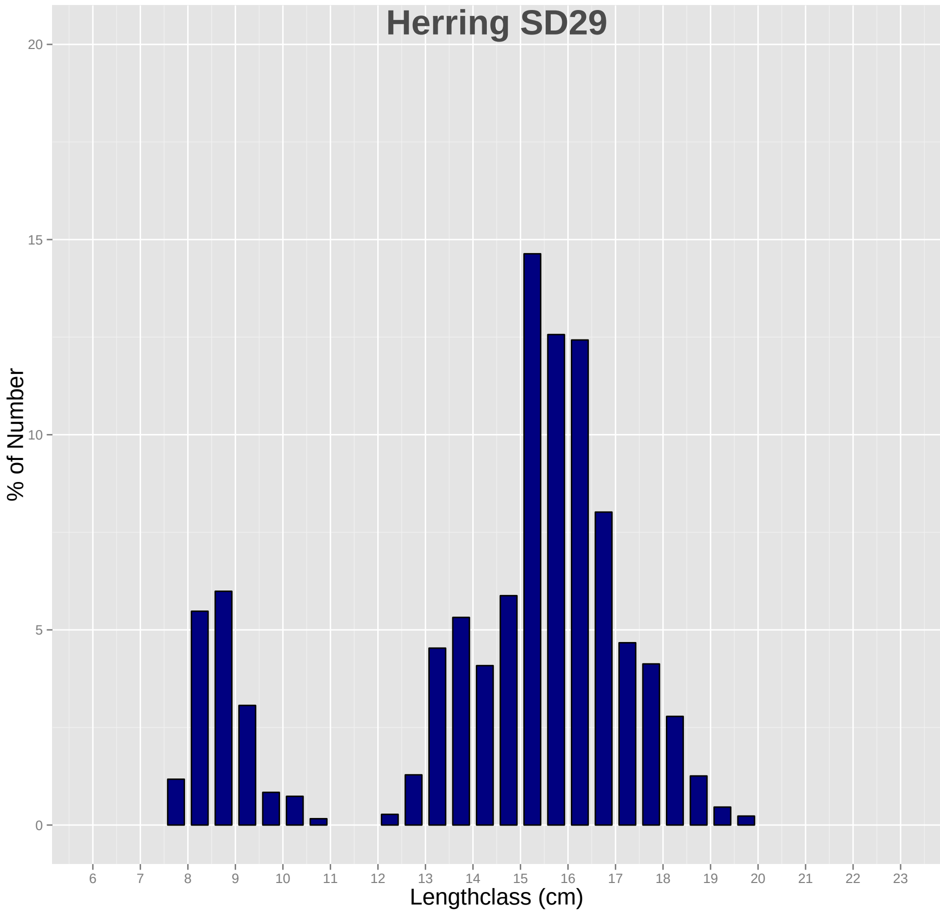


Figure 12: Length distribution of herring from subdivision 29

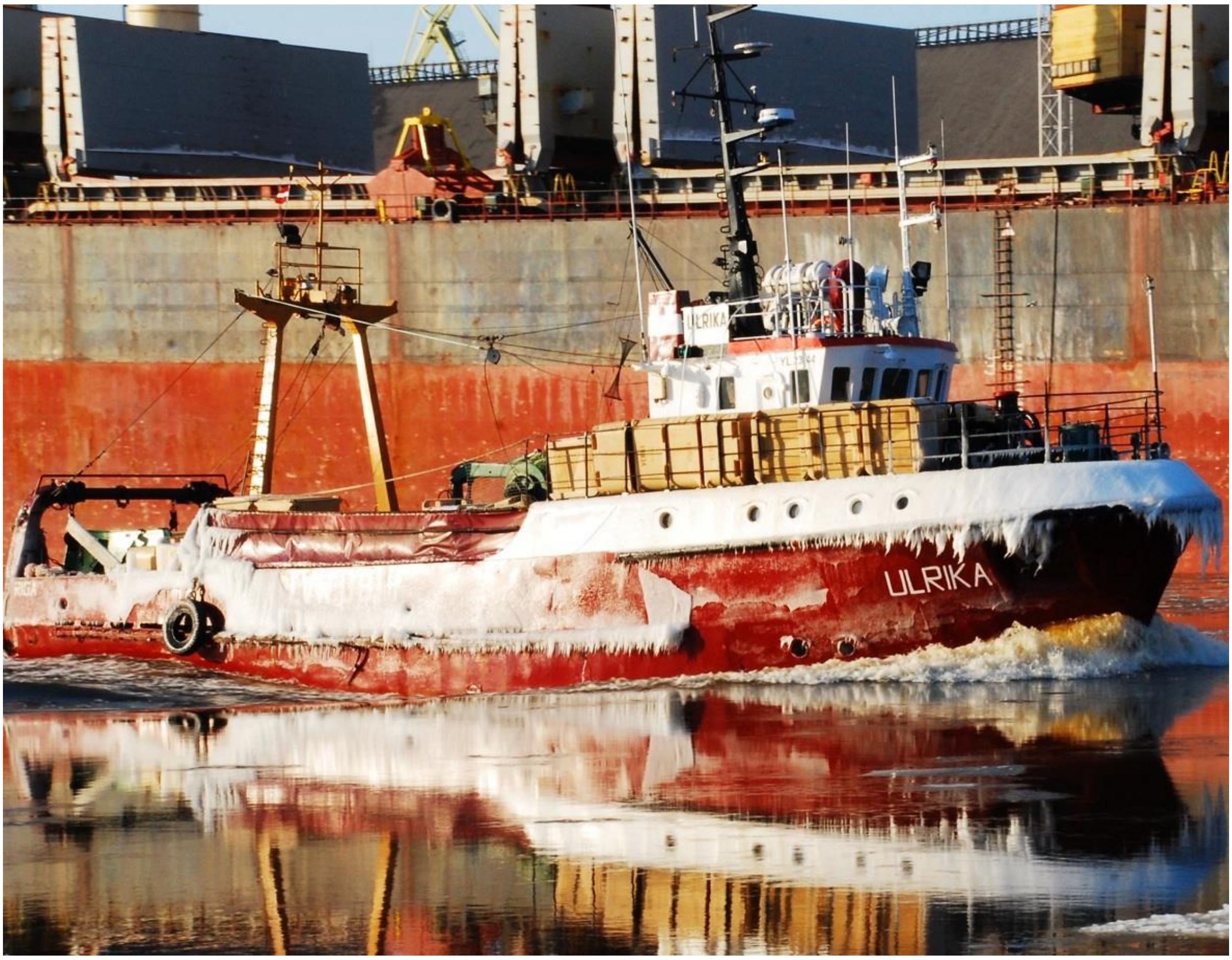
INSTITUTE OF FOOD SAFETY, ANIMAL HEALTH AND ENVIRONMENT – BIOR, RIGA (LATVIA)

THE CRUISE REPORT

FROM THE LATVIAN BALTIC INTERNATIONAL ACOUSTIC SURVEY – BIAS 2018 ON THE F/V “ULRIKA” IN THE ICES SUBDIVISIONS 26N AND 28 OF THE BALTIC SEA

(17-26 October 2018)

GUNTARS STRODS•JANIS GRUDULS•FAUSTS SVECOVS•VIESTURS BERZINS•
•ALLA VINGOVATOVA•IVARS PUTNIS•VADIMS CERVONCEVS•



Riga, March 2019

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 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.

The Latvian Baltic International Acoustic Survey (BIAS) in the ICES Sub-divisions 26N and 28 in October 2018 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. The reported cruise was organized on the basis of the agreement between the Institute of Food Safety, Animal Health and Environment (BIOR) from Riga and the fishing company "Vergi" Ltd from Jurmala. The vessel was operated within the Latvian and Swedish EEZs (ICES Sub-divisions 26N and 28). The "Latvian National Fisheries Data Collection Programme, 2018" in accordance with the EU Commission Regulations No.1639/2001 and No.1581/2004 was partly subsidized this cruise. It was coordinated by the ICES Baltic International Fish Survey Working Group (WGBIFS).

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. Hydrological parameters measurements are the information source about abiotic 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 calculation.

The ICES Baltic Fisheries Assessment Working Group (WGBFAS) can apply the present BASS data for clupeids (especially for sprat) stock biomass assessment and spatial distribution updating. The basic acoustic and biological data collected during recently carried out survey are stored in the BAD1 and acoustic.db international databases, managed by the ICES Secretariat.

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 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 analyse 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.

MATERIALS AND METHODS

Personnel

The scientific staff was composed of three persons:

G. Strods – scientific staff and cruise leader, acoustics, fish sampling

Janis Gruduls – fish sampling, hydrobiology and hydrology

V. Cervoncevs – herring sampling.

Survey description

The reported BIAS survey of the f/v "Ulrika" took place during the period of 17-26 October 2018. The vessel left the port of Ventspils on 21.05.2013 at 00:05 o'clock GMT+02:00. The sea researches were conducted in the period of 17-21.10.2018 and 24-26.10 within Latvian and Swedish EEZs (ICES Sub-divisions 26N and 28). The research activity had been stopped at 20:00 o'clock GMT+02:00 on 26th of October and the vessel returned back to the port of Ventspils for the scientific team disembarkation there. The almost full eight working days were utilized for fulfilling the survey purposes and two days for scientific team transfer and equipment installation and stripping.

Survey performance

The survey echo-integration tracks were planned in a similar pattern as in the previous years, due to historical comparability of the data. Overall 513 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 2018 was 7080.2 nm^2, in the northern part of the ICES Sub-division 26 – 1953.3 nm^2 and in Sub-division 28 – 5126.9 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 vertical distribution of clupeids actual density pattern along the transect. The intention was to carry out at least two control hauls per the ICES statistical rectangle. The water depth range-layer with sufficient for fish oxygen content (minimum 1.5-2.0 ml/l) were taken into account in the process of the hauls distribution.

Totally 16 control haul in the pelagic offshore zone were conducted with the pelagic trawl with max. 76 m horizontal opening, max. 24 m vertical opening and 10 mm mesh bar length in the codend. The trawling depth and the net opening were controlled by the sonar type IGEK. The trawl headrope positions in particular hauls were localized on the depth range from 7 to 80 m from the sea surface (Tab. 1). Mean headrope depth location in all investigated areas was 39 m. The trawl mouth vertical opening ranged from 20 to 24 m (mean – 20 m) and horizontal opening ranged from 72 to 76 m (mean – 76 m). The mean bottom depth at trawling positions varied from 32 to 246 m (mean for all investigated area – 106 m). Totally, 5 hauls were localized in the ICES Sub-division 26 and 11 hauls in the ICES Sub-division 28. On the whole, 13 catch samples were taken in the Latvian EEZ and 3 samples were taken from the hauls made along Latvian and Sweden EEZs border. The catches were made at the daylight between 07:39 a.m. and 16:30 p.m. GMT+02:00. The mean speed of the vessel during trawling was 3.2 knots. The trawling time of the single valid haul lasted for 30 minutes, with an exception of 2 hauls with 20 minutes duration and 2 hauls with 15 duration. All hauls can be accepted as representative (valid from technical point of view).

The samples of sprat, herring and cod were taken from each catch station to determine the species proportion, length-mass relationship, sex, maturity and age-length relationship. Measured and analyzed fish amount shown in Table 2. Detailed ichthyological analyses were made according to standard procedures, directly on board of surveying vessel.

Species composition and fish length distributions were based on trawl catch results. Mean target strength of clupeid fishes was calculated according to the following formula [ICES 1983, 2012]:

for clupeids: $TS = 20\log L - 71.2$;
for gadoids: $TS = 20\log L - 67.5$;
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.

The basic hydrological parameters (seawater temperature, salinity and oxygen contents) were measured from the surface to the bottom after every haul if weather conditions was favorable. Totally, 19 hydrological stations were inspected during survey on f/v “Ulrika”. The location of hydrological and hydrobiological research profiles is presented in Fig. 2. The Seabird SBE 19plus was used for above-mentioned measurements. The row data were aggregated to the 10 m depth stratums.

Zooplankton samples were collected at the positions of the hydrological stations or after trawling. Totally 13 zooplankton stations were realized and 22 zooplankton samples were taken. Zooplankton has been 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. Samples from 100 m deep were conserved in 2.5% unbuffered formaldehyde solution with sea water, but samples from 50 m depth were fixed by spirit solution with sea water and both processed during the year.

RESULTS

Biological data

Catch statistics

Catch per SD and species of the survey are given in Tab. 3-6.

The total length of dominant pelagic fish species ranged as follows:

- sprat – 7.5÷14.5 cm (average TL = 11.8 cm), 2.6÷16.6 g (average W = 9.9 g);
- herring – 8.5÷21.5 cm (average TL = 16.8 cm), 4.0÷60.0 (average W = 29.2 g);

Acoustical and biological estimates

The basic acoustic and biological data (surveyed area statistics, mean NASC, the mean scattering cross-section, calculated target strength, the total number of fish, percentages of herring and sprat) per ICES rectangles, collected in October 2018, as well as the estimated abundance and biomass of sprat and herring per above mentioned rectangles are given in Tab. 4. The age structured data of sprat and herring are aggregated in Tab. 5-6. The geographical distribution of NASC, sprat and herring stock densities in the central-eastern Baltic in October 2018 are shown in Fig. 4-6.

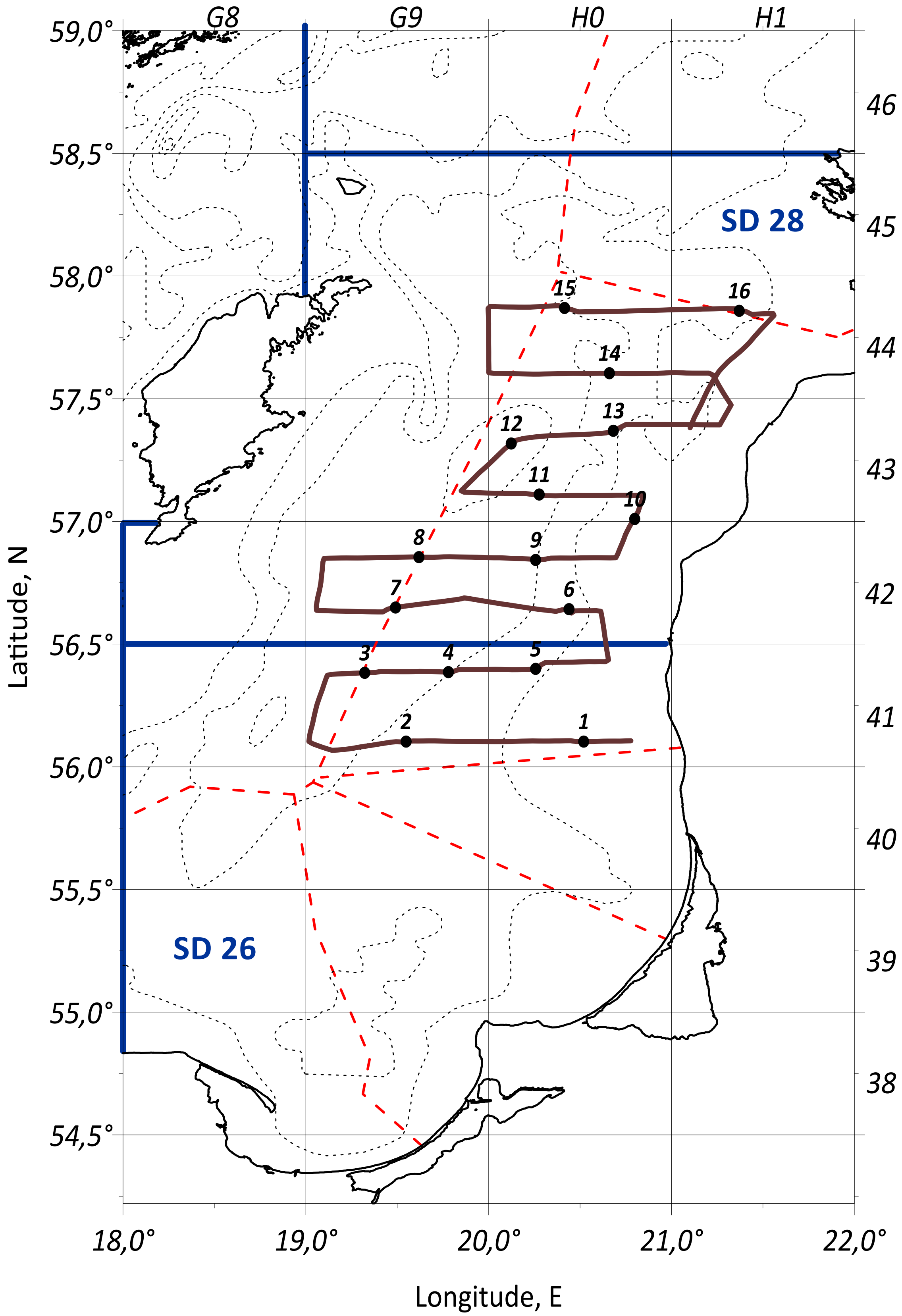


Figure 1. Cruise track design and hauls of the Latvian Baltic International Acoustic Survey on the f/v "Ulrika", 17-26.10.2018.

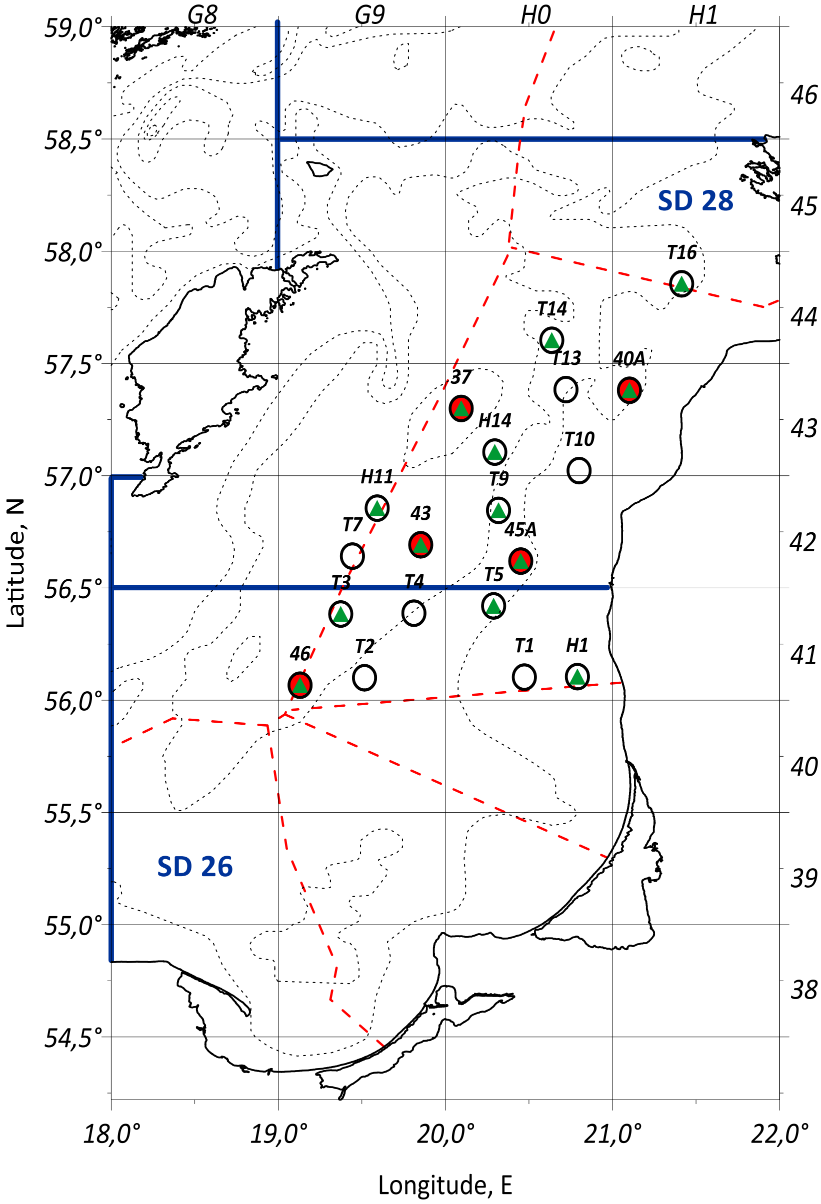


Figure 2. Locations of the hydrological and hydrobiological stations performed during the Latvian Baltic International Acoustic Survey on the f/v "Ulrika", 17-26.10.2018.
(red dots - HELCOM stations; **black rings** - hydrological stations; Green triangles - zooplankton stations).

Table 1. Fish control-catch results in the Baltic Sea ICES SD 26N and 28 from the Latvian Baltic International Acoustic Survey on the f/v "Ulrika", 17-26.10.2018.

Haul number	Date	ICES rectangle	ICES SD	Mean bottom depth [m]	Headrope depth [m]	Horizontal opening [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	17.10.2018	41H0	26	32	7	72	24	3.2	270	56°06'10''	20°31'11''	56°06'10''	20°28'21''	09:30	30	3.368
2	17.10.2018	41G9	26	65	45	76	20	3.0	260	56°06'10''	19°32'54''	56°06'00''	19°30'57''	14:45	20	753.720
3	18.10.2018	41G9	26	134	60	76	20	3.3	85	56°22'59''	19°19'20''	56°23'02''	19°22'25''	08:38	30	416.620
4	18.10.2018	41G9	26	100	60	76	20	3.2	90	56°23'09''	19°46'47''	56°23'15''	19°48'41''	12:05	20	420.267
5	18.10.2018	41H0	26	62	35	76	20	2.8	40	56°23'57''	20°15'24''	56°25'12''	20°17'19''	15:19	30	170.108
6	19.10.2018	42H0	28	78	30/50	76	20	3.1	270	56°38'33''	20°26'22''	56°38'20''	20°23'38''	07:53	30	206.640
7	19.10.2018	42G9	28	134	40	76	20	3.2	260	56°38'57''	19°29'26''	56°38'31''	19°26'37''	13:52	30	577.780
8	20.10.2018	42G9	28	121	30	76	20	3.4	90	56°51'16''	19°37'07''	56°51'14''	19°39'57''	08:02	30	72.160
9	20.10.2018	42H0	28	126	40	76	20	3.1	90	56°50'35''	20°15'25''	56°50'44''	20°19'05''	11:36	30	18.543
10	20.10.2018	43H0	28	74	50	76	20	3.3	0	57°00'36''	20°47'56''	57°01'22''	20°48'01''	16:04	15	281.540
11	21.10.2018	43H0	28	152	20	76	20	3.4	270	57°06'35''	20°16'35''	57°06'18''	20°13'34''	07:39	30	330.000
12	21.10.2018	43H0	28	246	50	76	20	3.2	40	57°19'03''	20°07'24''	57°19'59''	20°09'22''	13:17	30	2.385
13	21.10.2018	43H0	28	67	45	76	20	3.0	60	57°22'10''	20°40'54''	57°23'01''	20°43'18''	16:30	30	421.545
14	25.10.2018	44H0	28	128	30	76	20	3.2	270	57°36'14''	20°39'37''	57°36'12''	20°38'12''	15:04	15	620.226
15	26.10.2018	44H0	28	105	40	76	20	3.1	120	57°52'12''	20°24'54''	57°51'43''	20°27'38''	09:14	30	560.850
16	26.10.2018	44H1	28	70	33	74	22	3.1	100	57°51'30''	21°22'13''	57°51'18''	21°24'51''	14:17	30	1600.570
SD26	2013.05.21-22	41G9-41H0	26													1764.083
SD28	2013.05.23-29	42H0-44H1	28													4692.239
SD26+28	2013.05.21-29	41G9-44H1	26-28													6456.322

Table 2. Number of measured and aged fish individuals in the Baltic Sea ICES SD 26N and 28.2 from the Latvian Baltic International Acoustic Survey on the f/v "Ulrika", 17-26.10.2018.

SD 26		Sprat	Herring	Others	Total
Samples taken	measurements	5	5	9	19
	analyses	5	5		10
Fish measured		921	880	64	1865
Fish analysed		265	450		715
SD 28.2		Sprat	Herring	Cod	Total
Samples taken	measurements	10	10	24	44
	analyses	8	7		15
Fish measured		1727	1660	429	3816
Fish analysed		939	646		1585
SUM		Sprat	Herring	Cod	Total
Samples taken	measurements	15	15	33	63
	analyses	13	12		25
Fish measured		2648	2540	493	5681
Fish analysed		1204	1096		2300

Table 3. Fish control-catch results by species in the Baltic Sea ICES SD 26N and 28 from the Latvian Baltic International Acoustic Survey on the f/v "Ulrika", 17-26.10.2018.

Fish Species	SD 26	SD 28.2	Total SD
Sprat	1021.055	3325.720	4346.775
Herring	728.950	1273.716	2002.667
Cod	11.877	40.645	52.522
Flounder	0.110	0.441	0.551
Turbot		0.086	0.086
Stickleback	1.800	49.392	51.192
Smelt	0.022		0.022
Fourbeard rockling	0.040	0.200	0.240
Shorthorn sculpin	0.120	0.590	0.710
Lumpfish	0.108	1.366	1.474
Snakeblenny		0.083	0.083
Total Fish	1764.083	4692.239	6456.322

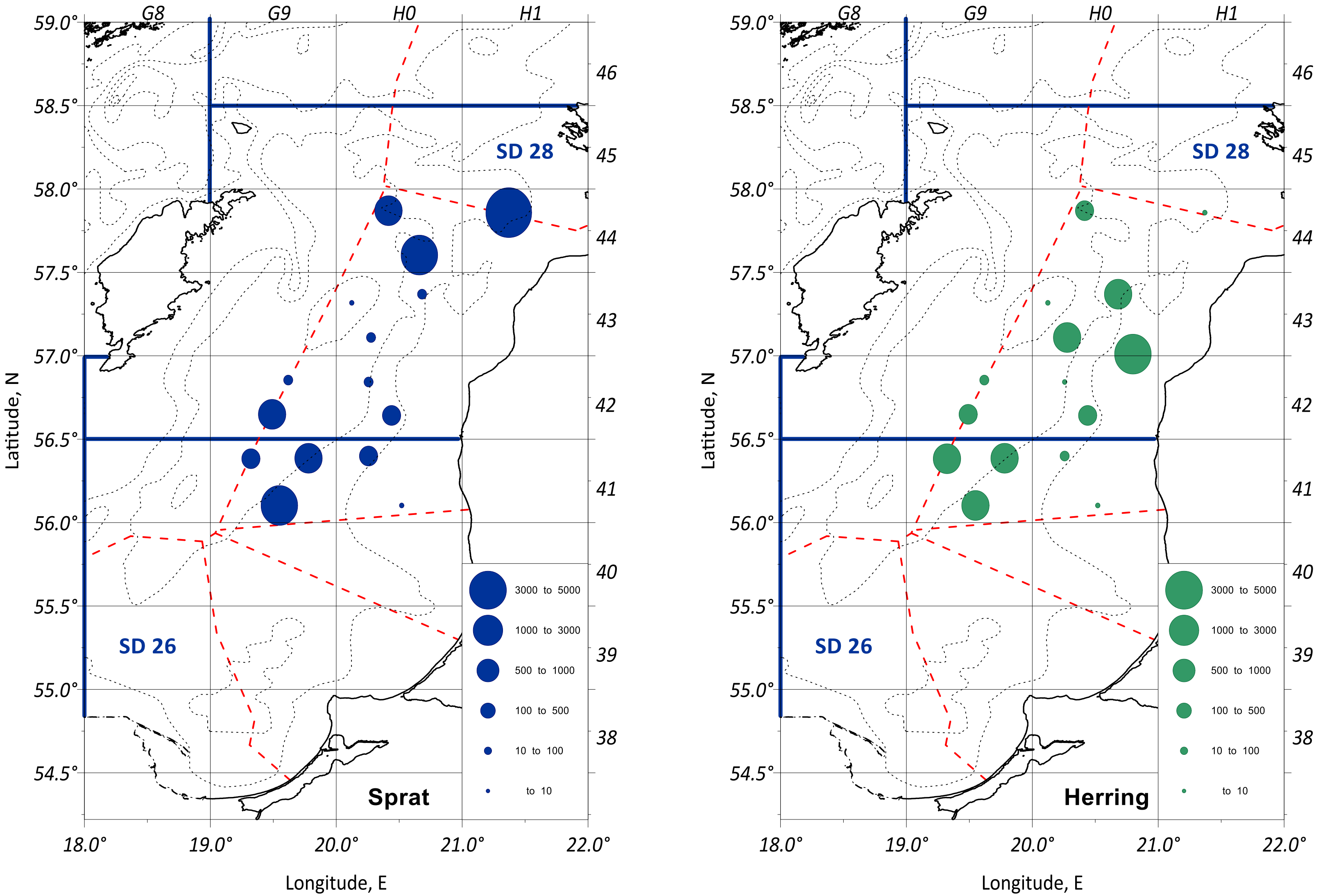


Figure 3. CPUE [kg/h] ranges distribution of sprat and herring in the catch hauls in the Baltic Sea ICES SD 26N and 28 from the Latvian Baltic International Acoustic Survey on the f/v "Ulrika", 17-26.10.2018.

Table 4. Survey statistics of pelagic fish species from the Latvian BIAS
in the Baltic Sea ICES SD 26N and 28.2 conducted by f/v "Ulrika" in the period of 17-26.10.2018.

Table 4A

ICES SD	ICES Rect.	Trawl No	Herring L, cm	Herring w, g	Herring n, %	Sprat L, cm	Sprat w, g	Sprat n, %	$NASC_{PEL}$ m^2/nm^2	$\sigma \times 10^4$ m^2	TS calc. dB
	44H1	14, 16	16.3	31.2	<0.1	10.9	8.9	>99.9	233	1.1743	-50.3
28	44H0	14, 15	15.7	23.7	1.3	10.8	8.8	98.7	291	1.1689	-50.3
	43H1	10, 16	17.6	33.0	8.8	11.1	9.1	91.2	163	1.3784	-49.6
	43H0	10, 11, 12,	17.1	30.4	86.8	11.3	9.3	13.2	557	2.6047	-46.8
	42H0	6, 9, 10	17.5	32.7	67.0	11.4	9.5	33.0	346	2.4287	-47.1
	42G9	7, 8	16.2	27.5	10.5	11.9	10.0	89.5	469	1.5175	-49.2
26	41H0	1, 5	16.9	30.4	7.1	11.3	9.7	92.9	357	1.4110	-49.5
	41G9	2, 3, 4	17.1	29.9	70.2	11.8	10.6	29.8	951	2.4667	-47.1

Table 4B

ICES SD	ICES Rect.	Area nm^2	ρ $n \times 10^6/nm^2$	Abundance, $n \times 10^6$ ΣN	$N_{HERRING}$	N_{SPRAT}	n, % herring	sprat	Biomass, $kg \times 10^3$ ΣW	$W_{HERRING}$	W_{SPRAT}
	44H1	824.6	1.98	1636.3	0.1	1636.2	<0.1	>99.9	14204	2	14499
28	44H0	960.5	2.49	2392.9	30.0	2362.9	1.3	98.7	20990	712	20891
	43H1	412.7	1.18	486.6	42.9	443.7	8.8	91.2	5461	1417	4045
	43H0	973.7	2.14	2082.6	1807.6	274.9	86.8	13.2	57596	54890	2567
	42H0	968.5	1.42	1379.3	924.6	454.8	67.0	33.0	34964	30262	4301
	42G9	986.9	3.09	3053.1	319.2	2733.9	10.5	89.5	37566	8773	27467
26	41H0	953.3	2.53	2413.1	172.0	2241.1	7.1	92.9	27373	5226	21691
	41G9	1000.0	3.86	3856.6	2707.0	1149.6	70.2	29.8	92587	80929	12134

Table 5. Sprat stock characteristics from the Latvian BIAS
in the Baltic Sea ICES SD 26N and 28.2 conducted by f/v "Ulrika" in the period of 17-26.10.2018.

Table 5A n × 10^6		Age group									Σ
ICES SD	ICES Rect.	0	1	2	3	4	5	6	7	8+	
	44H1	240	490	198	145	510	8	8	18	18	1636
28	44H0	543	576	201	234	576	116	47	24	47	2363
	43H1		158	58	48	169			5	5	444
	43H0	8	93	24	22	79	11	22	11	5	275
	42H0	44	86	59	37	162	20	27	7	12	455
	42G9	87	482	289	231	973	128	243	115	185	2734
26	41H0	178	575	288	340	658	70	60	36	36	2241
	41G9	73	239	131	103	414	115	39	13	22	1150

Table 5B n, %		Age group									Σ
ICES SD	ICES Rect.	0	1	2	3	4	5	6	7	8+	
	44H1	14.6	30.0	12.1	8.9	31.2	0.5	0.5	1.1	1.1	100.0
28	44H0	23.0	24.4	8.5	9.9	24.4	4.9	2.0	1.0	2.0	100.0
	43H1		35.7	13.1	10.7	38.1			1.2	1.2	100.0
	43H0	3.0	33.7	8.9	7.9	28.7	4.0	7.9	4.0	2.0	100.0
	42H0	9.7	19.0	13.0	8.1	35.7	4.3	5.9	1.6	2.7	100.0
	42G9	3.2	17.6	10.6	8.5	35.6	4.7	8.9	4.2	6.8	100.0
26	41H0	7.9	25.7	12.9	15.2	29.4	3.1	2.7	1.6	1.6	100.0
	41G9	6.3	20.8	11.4	9.0	36.1	10.0	3.4	1.2	1.9	100.0

Table 5C W, kg × 10^3		Age group									Σ
ICES SD	ICES Rect.	0	1	2	3	4	5	6	7	8+	
	44H1	1126.2	4064.2	1913.1	1506.5	5267.1	90.1	98.3	218.7	215.1	14499.4
28	44H0	2539.3	4971.7	2026.3	2441.5	6215.6	1307.2	553.8	289.2	546.0	20890.5
	43H1		1215.7	531.5	498.9	1668.7			62.3	67.6	4044.7
	43H0	39.7	712.8	230.3	225.9	805.9	113.0	242.5	130.1	67.0	2567.2
	42H0	186.5	682.0	560.5	389.2	1703.0	222.5	308.8	89.6	158.4	4300.5
	42G9	428.9	4122.8	2698.2	2622.8	10491.2	1431.8	3051.0	1435.3	2424.6	28706.6
26	41H0	733.5	4711.6	2843.8	3854.1	7079.7	761.8	743.4	480.4	482.5	21690.9
	41G9	319.8	2140.7	1386.2	1196.7	4820.2	1335.8	489.7	155.1	289.4	12133.7

Table 5D w, g		Age group									Σ
ICES SD	ICES Rect.	0	1	2	3	4	5	6	7	8+	
	44H1	4.7	8.3	9.7	10.4	10.3	10.9	11.9	12.2	12.0	8.9
28	44H0	4.7	8.6	10.1	10.4	10.8	11.3	11.9	12.3	11.7	8.8
	43H1		7.7	9.1	10.5	9.9			11.8	12.8	9.1
	43H0	4.9	7.7	9.4	10.4	10.2	10.4	11.1	12.0	12.3	9.3
	42H0	4.2	7.9	9.5	10.5	10.5	11.3	11.5	12.2	12.9	9.5
	42G9	4.9	8.5	9.3	11.3	10.8	11.2	12.5	12.5	13.1	10.5
26	41H0	4.1	8.2	9.9	11.3	10.8	10.9	12.3	13.5	13.3	9.7
	41G9	4.4	8.9	10.6	11.6	11.6	11.6	12.5	11.7	13.3	10.6

Table 5E L, g		Age group									Σ
ICES SD	ICES Rect.	0	1	2	3	4	5	6	7	8+	
	44H1	8.8	10.4	11.3	11.7	11.7	12.0	12.5	13.0	13.3	10.9
28	44H0	8.7	10.6	11.4	11.6	11.8	12.1	12.6	13.0	12.8	10.8
	43H1		10.2	11.1	11.9	11.5			12.5	13.5	11.1
	43H0	8.8	10.3	11.3	11.8	11.8	11.9	12.3	12.8	13.0	11.3
	42H0	8.5	10.6	11.4	12.1	12.0	12.5	12.7	13.0	12.8	11.4
	42G9	9.1	10.8	11.3	12.3	12.0	12.3	13.0	13.0	13.3	11.9
26	41H0	8.4	10.6	11.5	12.2	11.9	12.1	12.8	13.3	12.5	11.3
	41G9	8.7	10.9	11.8	12.3	12.3	12.4	12.7	13.1	13.8	11.8

Table 6. Herring stock characteristics from the Latvian BIAS
in the Baltic Sea ICES SD 26N and 28.2 conducted by f/v "Ulrika" in the period of 17-26.10.2018.

Table 6A n × 10^6		Age group									Σ
ICES SD	ICES Rect.	0	1	2	3	4	5	6	7	8+	
	44H1										
28	44H0		4	5	4	11	1	4	1	1	30
	43H1			2	6	14	3	9	5	5	43
	43H0		53	118	230	592	158	296	191	171	1808
	42H0		6	50	123	297	85	202	85	76	925
	42G9		25	36	49	144	17	32	8	9	319
26	41H0	2	45	12	22	27	24	15	12	11	172
	41G9		253	270	331	1066	289	422	52	25	2707

Table 6B n, %		Age group									Σ
ICES SD	ICES Rect.	0	1	2	3	4	5	6	7	8+	
	44H1										
28	44H0		12.0	18.1	12.0	36.1	4.8	12.0	2.4	2.4	100.0
	43H1			4.0	13.9	31.7	6.9	20.8	10.9	11.9	100.0
	43H0		2.9	6.5	12.7	32.7	8.7	16.4	10.5	9.5	100.0
	42H0		0.7	5.5	13.3	32.1	9.2	21.8	9.2	8.2	100.0
	42G9		7.7	11.2	15.4	45.0	5.3	10.1	2.4	3.0	100.0
26	41H0	1.2	26.3	7.1	13.0	15.8	14.1	8.9	7.1	6.5	100.0
	41G9		9.3	10.0	12.2	39.4	10.7	15.6	1.9	0.9	100.0

Table 6C W, kg × 10^3		Age group									Σ
ICES SD	ICES Rect.	0	1	2	3	4	5	6	7	8+	
	44H1										
28	44H0		73.2	105.5	98.8	277.2	27.6	130.8	31.5	31.5	747
	43H1			52.4	176.4	424.2	103.8	313.2	196	233	1466.3
	43H0		1118.3	2737.6	6394	17286.4	5166.6	9886.4	7181.6	7746.3	57313.6
	42H0		125.4	1230	3259.5	8969.4	3000.5	7090.2	3272.5	3245.2	30247.5
	42G9		512.5	849.6	1313.2	4089.6	508.3	1068.8	299.2	317.7	8932
26	41H0	32	940.5	282	587.4	839.7	777.6	577.5	460.8	532.4	5314.8
	41G9		5540.7	6318	9400.4	32619.6	10693	15867.2	2074.8	1205	80127.2

Table 6D w, g		Age group									Σ
ICES SD	ICES Rect.	0	1	2	3	4	5	6	7	8+	
	44H1										
28	44H0		18.3	21.1	24.7	25.2	27.6	32.7	31.5	31.5	24.9
	43H1			26.2	29.4	30.3	34.6	34.8	39.2	46.6	34.1
	43H0		21.1	23.2	27.8	29.2	32.7	33.4	37.6	45.3	31.7
	42H0		20.9	24.6	26.5	30.2	35.3	35.1	38.5	42.7	32.7
	42G9		20.5	23.6	26.8	28.4	29.9	33.4	37.4	35.3	28.0
26	41H0	16.0	20.9	23.5	26.7	31.1	32.4	38.5	38.4	48.4	30.9
	41G9		21.9	23.4	28.4	30.6	37.0	37.6	39.9	48.2	29.6

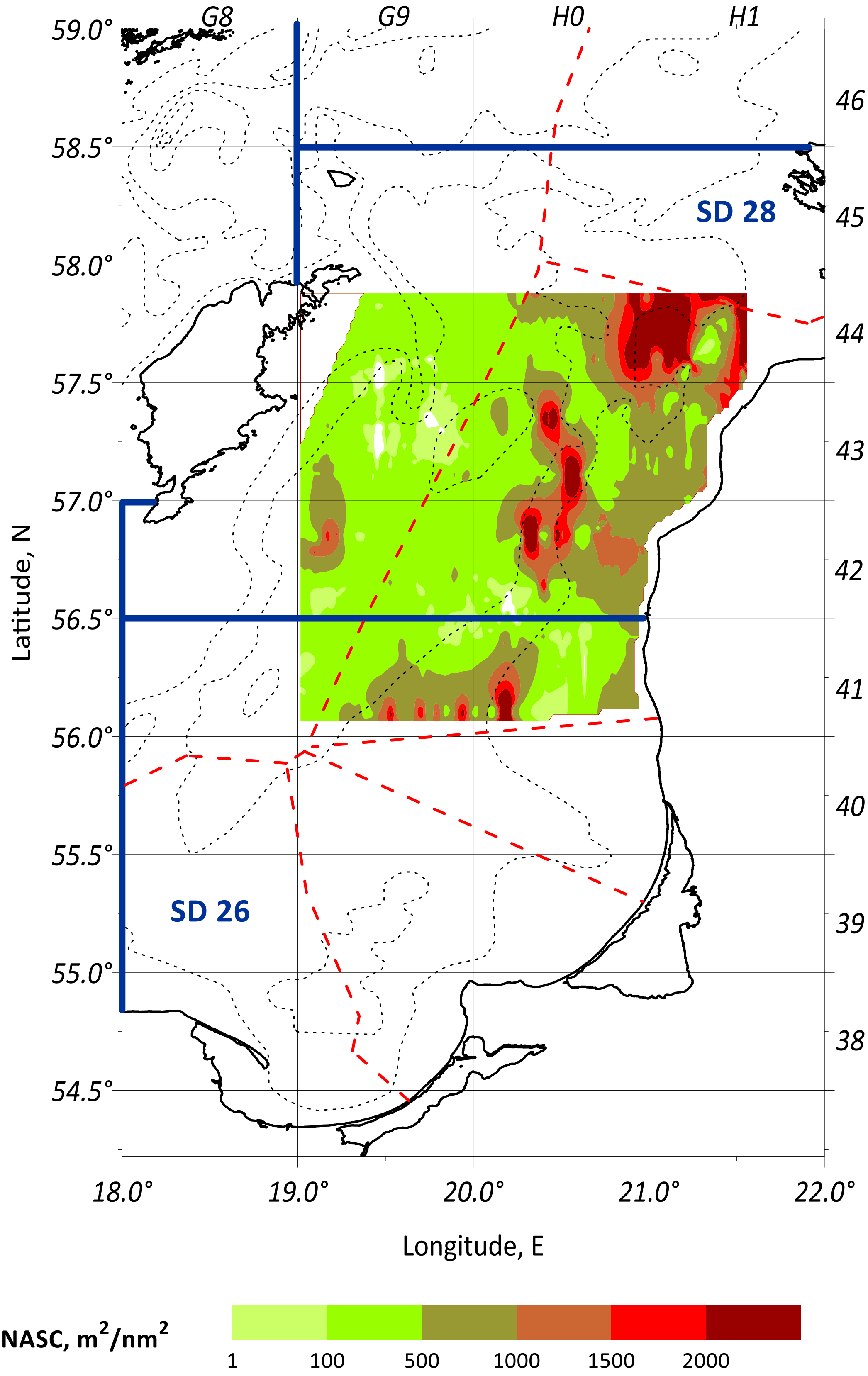


Figure 4. Acoustic parameter NASC distribution from the Latvian BIAS in the Baltic Sea ICES SD 26N and 28.2 conducted by f/v "Ulrika" in the period of 17-26.10.2018.

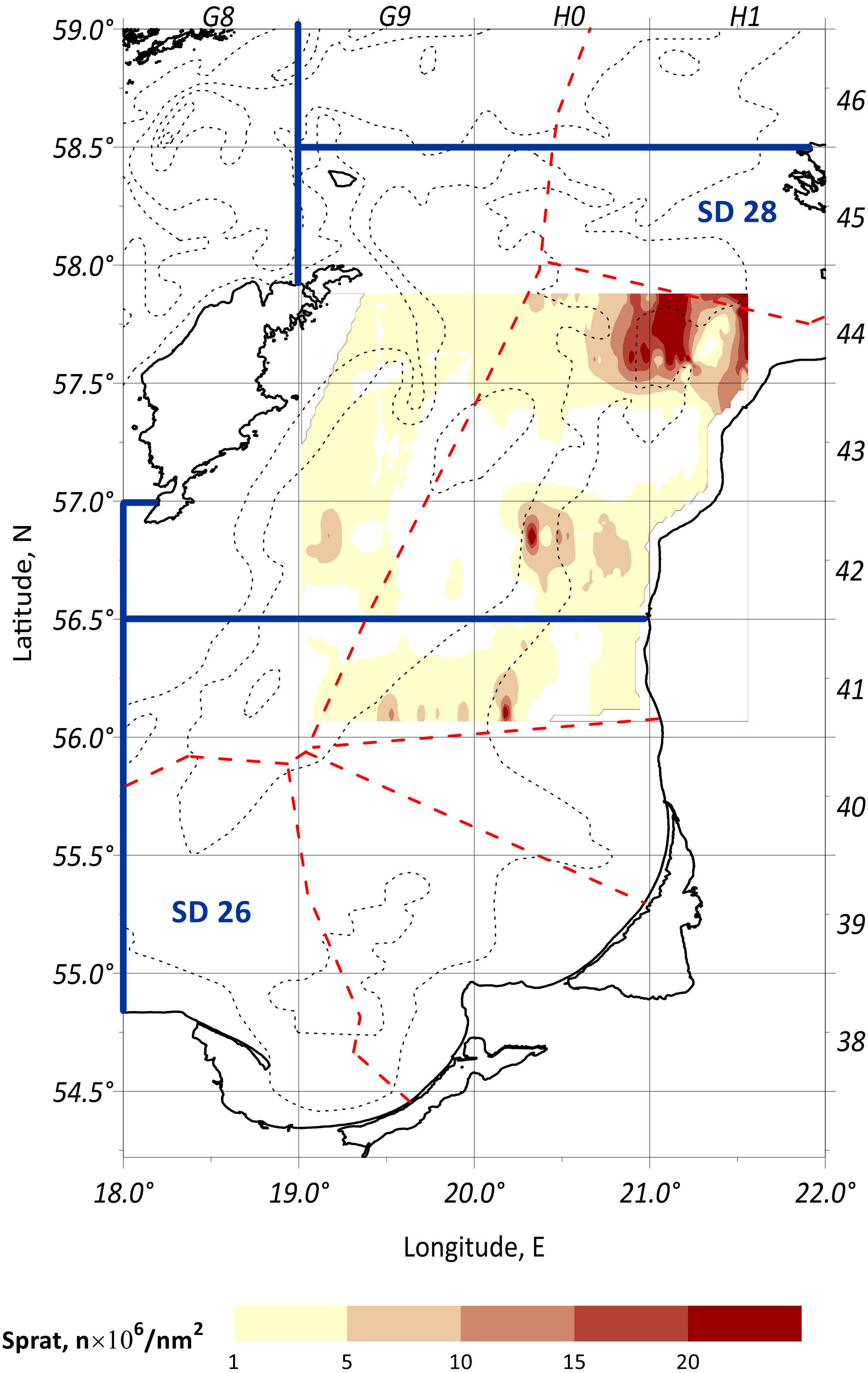


Figure 5. Sprat distribution (n×10^6) from the Latvian BIAS in the Baltic Sea ICES SD 26N and 28.2 conducted by f/v "Ulrika" in the period of 17-26.10.2018.

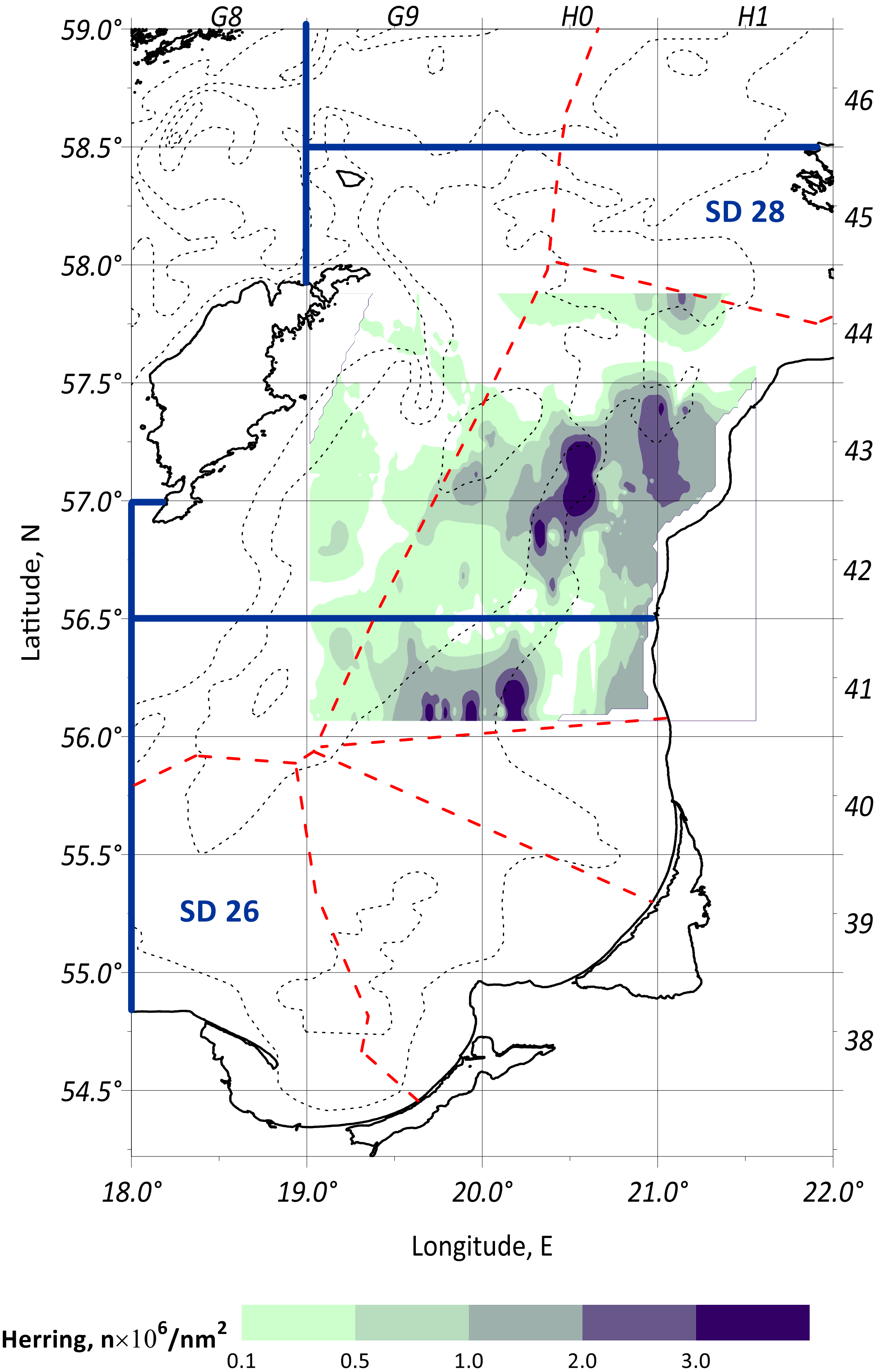


Figure 6. Herring distribution (n×10[6]) from the Latvian BIAS in the Baltic Sea ICES SD 26N and 28.2 conducted by f/v "Ulrika" in the period of 17-26.10.2018.

Annex 8: List of presentations made at the WGBIFS 2019 meeting

1. BASS presentation of Estonia, made by Elor Sepp (Estonia);
2. BASS presentation of Latvia, made by Guntars Strods (Latvia);
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 Finland, made by Juha Lilja (Finland);
7. BIAS presentation of Estonia, made by Elor Sepp (Estonia);
8. BIAS presentation of Latvia, made by Guntars Strods (Latvia);
9. BIAS presentation of Lithuania, made by Marijus Spegys (Lithuania);
10. BIAS presentation of Poland, made by Beata Schmidt (Poland);
11. BIAS presentation of Germany, made by Paco Rodriguez-Tress (Germany);
12. BIAS presentation of Sweden, made by Niklas Larson (Sweden);
13. BITS presentation of Estonia, made by Elor Sepp (Estonia);
14. BITS presentation of Latvia, made by Ivo Sics (Latvia);
15. BITS presentation of Lithuania, made by Marijus Spegys (Lithuania);
16. BITS presentation of Poland, made by Krzysztof Radtke (Poland);
17. BITS presentation of Germany, made by Andrés Velasco (Germany);
18. BITS presentation of Denmark, made by Henrik Degel (Denmark);
19. Presentation of summary actions on WGCHAIRS, made by Olavi Kaljuste (Sweden);
20. Presentation about the WKSABI outcomes relevant for WGBIFS, made by Vaishav Soni (ICES secretariat);
21. Presentation about the data availability and quality of BITS data in DATRAS for the swept area effort index calculations, made by Henrik Degel (Denmark).

All these presentations are available in the folder "Presentations" in the WGBIFS 2019 SharePoint site.