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Baltic International Fish Survey Working Group (WGBIFS)

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

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Contents

1 Introduction

The acoustic surveys have been conducted in the Baltic Sea internationally since 1978. The starting point was the cooperation between Sweden and the German Democratic Republic in October 1978, which produced the first acoustic estimates of total biomass of herring - *Clupea harengus* and sprat - *Sprattus sprattus* in the Baltic Proper (Håkansson *et al.*, 1979). Since then there has been at least one annual hydroacoustic survey for herring and sprat stocks mainly for assessment purposes and results have been reported to ICES to be used for stock assessment (Hagström *et al.*, 1991; ICES, 1994a, 1995a, 1995b; 2006; Gasyukov *et al.*, 2009; Grygiel and Orłowski, 2009).

At the ICES Annual Science Conference in September 1997, the Baltic Fish Committee decided, that a manual for the International Baltic Acoustic Surveys (IBAS) should be elaborated. The structure of the manual follows that of the Baltic International Trawl Surveys (BITS). In order to obtain standardization for all ICES acoustic surveys some demands from the Manual for Herring Acoustic Surveys in ICES Divisions 3, 4 and 6 (ICES, 1994b) are adopted.

The objective of the Baltic International Acoustic Survey (BIAS) and Baltic Acoustic Spring Survey (BASS) programs are to standardize survey design, acoustic measurements, fishing method and data analysis throughout all national surveys where data are used as abundance indices for Baltic herring, sprat and to some extent cod stocks assessment purposes.

2 Survey design

2.1 Area of observation

The acoustic surveys should cover the total area of the ICES Division 3 (Figure 2.1.). The border by the ICES Subdivisions is given in Figure 2.1. and Table 2.1. The area is limited inshore by the 10 m depth line. Historically, the national EEZ was typically the boundary for the area covered in the national acoustic surveys. Such survey design lead to the problems with overlapping areas and to an inefficient use of survey time. Therefore, during the Baltic International Fish Survey Working Group (WGBIFS) meeting in 2005 it was agreed that, each ICES statistical rectangle of the area under investigation was allocated to one country, thus each country has a mandatory responsible area. A general assignment scheme of the ICES statistical rectangles to the countries in the Baltic Sea is presented in Figure 2.2.. It should be emphasized that, Denmark and Germany are performing the acoustic surveys also in the ICES Subdivision 21, the borders of which are not currently defined. The above allocation scheme should be used for the planning of Baltic International Acoustic Surveys. As there are only few countries participating in Baltic Acoustic Spring Surveys, partition of the rectangles within the planned survey area among the participating countries is agreed during the preceding the WGBIFS meeting.

2.2 Stratification

The stratification is based on the ICES statistical rectangles with a range of 0.5 degrees in latitude and 1 degree in longitude. The areas (A) of all strata limited inshore by the 10 m depth line are given in Table 2.2.

2.3 Transects

Parallel fixed transects are spaced on ICES rectangles basis at a maximum distance of 15 nautical miles (NM; Figures 2.3.A., 2.3.B.).

The transect density should be about 60 NM per area of 1000 NM^2.

Near islands and in straits the strategy of parallel transects can leads to an unsuitable coverage of the survey area. In this case, a zigzag course should be used to achieve a regular covering. The length of the survey track per 1000 NM^2 track should be the same as when using parallel transects.

2.4 Observation time

The Baltic Acoustic Spring Survey (BASS) and Baltic International Acoustic Survey (BIAS) are carried out annually in May and September/October, respectively. It is assumed that during autumn survey there is little or no emigration or immigration of pelagic stocks in the main part of the Baltic Sea so that the estimates are representing a good ‘snapshot’ of the herring, sprat and cod resources. The spring survey is focuses on estimating the stock size indices of sprat.

In the shallow water areas of the western Baltic a great part of the fish concentrations are close to the bottom during daytime and therefore not detectable with echosounder (Orłowski, 2000; 2001). This leads to a potential underestimation of fish (Orłowski, 2005). Therefore, shallow water areas in the western Baltic should be surveyed only during night-times, which is defined as a period one hour after sunset and one hour before sunrise.

3 Acoustic measurements

3.1 Equipment

The standard acoustic equipment used in the BIAS and BASS surveys is the Simrad EK/EY-60 echo-sounder (Simrad, 2012) and the standard frequency is 38 kHz.

It is recommended to follow instructions and recommendations concerning the underwater noise of research vessels (Mitson, 1995; Mitson and Knudsen, 2003; Ona *et al.*, 2007; De Robertis *et al.*, 2008; De Robertis and Wilson, 2011; De Robertis and Handegard, 2013).

Some basic, historical information about theory of underwater acoustics and echo-sounder transducers can be found in Bodholt (1991, 1996).

3.2 Instrument settings

Some instrument settings may influence the acoustic measurements to a high degree. Therefore, the following calibration settings are essential in order to achieve the correct function of the acoustic device:

Parameter	EK-60
Maximum transmit power (W)	Transmit Power
Integrated 2-way beam angle (dB)	Two-way Beam Angle
Volume backscatter gain (dB)	Gain
sA gain correction	SaCorrection
Alongship angle sensitivity	Angle Sensitivity, Alongship
Athwartship angle sensitivity	Angle Sensitivity, Athwartship
Alongship beam width at 3-dB points (deg.)	3dB Beam Width, Alongship
Athwartship beam width at 3-dB points (deg.)	3dB Beam Width, Athwartship
Offset of the acoustic axis in the along ship direction (deg.)	Angle Offset, Alongship
Offset of the acoustic axis in the athwart ship direction (deg.)	Angle Offset, Athwartship
Pulse Length	1 m sec.
Sound attenuation (dB km-1)	Absorption (in brackish water 3 dB km-1)

The following settings are recommended to use during the data collection:

Pulse rate	1 ping per second
The high ping rate, i.e. of 3–4 pings per second (optional)	
Absorption coef.	3 dB/km
Pulse Length	1 ms.
Bottom margin	0.5 m

It is recommended to record this setting regularly to have a log about the main function of the acoustic measuring system. The threshold (Min Sv = -60 dB) is NOT set during data acquisition. This threshold should only apply to data post-processing.

3.3 Sampling unit

The length of the survey transect should be divided into 1 NM elementary sampling distance units (ESDU), where acoustic measurements are averaged to give one value of nautical area scattering coefficient (NASC) (Simmonds and MacLennan, 2005).

3.4 Calibration

A calibration of the transducer must be conducted at least once during the survey with the same ping rate and parameter settings as described in Section 3.2. If possible, the transducer should be calibrated both at the beginning and at the end of the survey. Annually, prior to each calibration, respective experts (divers) must inspect the hull-mounted transducers and photographical documentation of the state of transducers must be presented. The surface of transducers should be cleaned from bio-fouling (barnacle, algae, etc.) and covered with protective paint.

Foote *et al.* (1987) and Simrad (2012) describe calibration procedures. It is recommended to use the 60 mm copper (Cu) sphere for the 38 kHz echosounder. The theoretical target strength (TS) of the sphere should be determined according to Foote *et al.* (1987) or to use a standard sphere target strength calculator, such as (http://swfscdata.nmfs.noaa.gov/AST/SphereTS/).

If calibration is performed in the site with different hydrological conditions as prevailing in the survey area, the transducer gain needs to be recalculated and edited in EK-60 Simrad transducer settings as described in Bodholt (2002):

G = G_0 + 10*log10(c_0^2 / c^2) (Bodholt 2002).

The data deviation from beam model RMS parameter value should be less than 0.3 dB however, the values between 0.3–0.4 dB could also be considered as a valid calibration.

An example of coverage of the beam area during calibration process is presented in Figure 3.1.

3.5 Intercalibration

When more than one ship is engaged in the same area in the same time the performance of the equipment should be compared by means of an inter-calibration. Preferably, the vessels should start and finish the inter-calibration with trawl hauls. A survey track should be chosen in the areas with high-density scattering layers. The settings of the acoustic equipment should be kept constant during the whole survey.

During the inter-calibration, one leading vessel should proceed 0.5 nautical miles ahead of another. The lateral distance between the survey tracks should be 0.3 NM. The inter-calibration should be done with two 20 NM transects covering approximately the same area. The first 20 NM transect with one vessel leading, then turn around, and have the other vessel lead (Ona *et al.*, 2007; De Robertis *et al.* 2008; De Robertis and Wilson, 2011; De Robertis and Handegard, 2013).

3.6 S_A at trawl stations

The new approach for combining the results of the fish trawling stations during the acoustic surveys was presented during the WGBIFS meeting in 2012. This new method uses relationships between the S_A values of the target species and the S_A value of the total water column during the trawling stations. Thus, it is recommended that S_A values from the total water column during trawling stations be collected as a standard procedure. Accordingly, fish trawling stations are defined as a period between settings and shut retrieving the gear. Hence, S_A(k) is noted as total S_A values during the trawling station *k* and S_A(i,k) is noted as S_A value of the target species *i* during the trawling station *k*.

4 Fishing

4.1 Gear

Trawl hauls should be performed with small-meshed pelagic gears. The stretched mesh size in the codend of the pelagic trawl used in the ICES Subdivisions 22–24 and 25–32 should be 20 mm and 12 mm, respectively.

The collection of the trawl gears used in surveys is given in Table 4.1. An example of the technical scheme of pelagic trawl type WP 53/64x4, used by the Polish RV "Baltica" in the BIAS surveys, is presented in Figure 4.1. The proposal of standardization the pelagic trawls for fishing during BIAS and BASS surveys (ToR j) was discussed during the WGBIFS annual meetings in 2015 and 2016. However, due to a lack of real independent scientific advice, which one gear can be applied as a standard, the problem was not solved yet and will be prolonged on the next meetings.

Ona (1999) has described information about the entering of fish into the trawls, and Walsh and Godø (2003) have considered the quantitative analysis of fish reaction to towed fishing gears.

4.2 Method

The collection of biological samples is performed to determine the species composition at fishing-station. The length, age and weight of target fish species should be determined.

It is recommended to sample a minimum of two hauls per the ICES statistical rectangle. The country responsible for acoustic-trawl monitoring in given ICES rectangle (Figure 2.2.) is oblige to coordinate accomplishment of a minimum two catch-stations during the BIAS and BASS surveys by own or chartered research vessel. During the same type of survey is allowed realization by a foreign vessel of additional catch-station in given ICES rectangle (in most cases in the border rectangles).

Standard fishing speed is 3.0–3.5 knots.

The duration of standard trawl hauls is 30 minutes.

Relative numerical share of all fish species should be recorded to aid acoustic species identification. In situations with fish vertically distributed over the whole water column, specifically in shallow waters, the whole depth range should be sampled by the trawl haul. In the case of two or more layers in one area (Figure 4.2), it is recommended to sample all layers by same haul. That should be done by trawling in the one layer first and then shifting the gear into another layer. Trawling time in each layer should be equal excluding the time for the shift of gear from one layer to another. If shoals and scattering layers are present (Figure 4.3.), both should be sampled by same trawl haul as described above.

4.3 Samples

4.3.1 Species composition

The species composition of the total catch should be established and the corresponding total weight of every species in each fishing-station should be registered (Table 4.3.1).

In case of homogenous large catches of clupeids, a subsample of at least 50–60 kg should be taken and sorted out for the identification of the species composition. In the practice, 3 boxes with such fish should be collected from beginning, middle-part and end-part of catch in trawl. The weight of the subsample and the total weight per species in the subsample should be recorded.

In case of heterogeneous large catches consisting of a mixture of clupeids and few larger species, the total catch should be partitioned into the part of larger species and that of the mixture of clupeids. From the mixture of clupeids, a subsample of at least 50 kg should be taken. The total weight per species for the part of the larger species and the total weight of the subsample of mixed clupeids should be registered.

In the case, when sampled catch is difficult to identify to species level, and then may be grouped to genus or family taxonomic units.

4.3.2 Length distribution

Length distributions are recorded for all fish species caught. Length is defined as the total length, measured from tip of snout to tip of caudal fin. Both herring and sprat should be measured from each catch-station and sorted out into 0.5-cm classes (midpoints x 0.25 and x 0.75 cm), and into 1-cm classes for all other species (midpoints x 0.5 cm). Additional information on the fish length-measuring scheme is described in Figure 4.4.

In case of large catches of clupeids with a condensed length distribution, a subsample should be taken containing at least 200 specimens per species to get a reasonable length distribution. For other species, at least 50 specimens should be measured, if possible.

4.3.3 Weight distribution

Herring and sprat should be sorted out into 0.5-cm length classes and all fish that are length measured are weighed, accordingly to each single length class as stratum. Two alternative procedures can be applied in the case of sprat and herring weight determination:

1. if the weather condition at sea is good and the marine scales are very stable, then each individual fish taken for ichthyological analysis is weighed and in the final phase of sampling or after that, the mean weight of each length-class is calculated,
2. sprat and herring taken for the length measurements is weighed by 0.5-cm length-classes and the mean weight is calculated as a quotient of sum of weight and sum of number of individuals in given length-class.

If the weather conditions at sea are rough and the marine scales are not stable, the samples are collected for length and weight determination in the next days of survey or in the coastal laboratory.

The procedure 1) is recommended to apply during the survey at least for herring. In the case of cod (which is considered as a bycatch during the BIAS and BASS) all individuals should be collected for the length measurements and weight determination.

Depending on the availability of work force, two alternative methods described below can be applied.

Maximum effort method (preferred). The mean weight of every length class for herring and sprat is to be measured for each catch-station**.**

Minimum effort method. The mean weight per length class for herring and sprat is to be measured for each ICES subdivisions**.** It is recommended to cover the whole subdivision homogeneously.

4.3.4 Age distribution

If otoliths samples are to be taken of herring, sprat and cod (the target species), the number of otoliths per length-class is not fixed. The following minimum sampling levels should be maintained for the ICES subdivision and per 0.5-cm length class:

- 5 otoliths per length class, if fish length is <10 cm
- 10 otoliths per length class, if fish length is ≥10 cm.

For the smallest size groups, that presumably contain only one age group, the number of otoliths per length-class may be reduced.

Taking into account, the available work force two methods are possible:

Maximum effort method (preferred). The otoliths samples are collected for herring, sprat and cod per each trawl haul and all length-classes.

Minimum effort method. The otoliths samples are collected for herring, sprat and cod per each the ICES subdivision and all length-classes. It is recommended to cover the whole subdivision homogeneously.

4.4 Environmental data

Temperature, salinity and oxygen content should be measured with a CTD probe before or after each catch-station, and recorded at least in 1-m intervals.

5 Data analysis

5.1 Species composition

Trawl catches within each ICES rectangle are combined to give an average species composition of the catch. Each trawl catch is given equal weight, unless it is decided that a trawl catch is not representative for the fish concentrations sampled. In this case, the particular trawl-catch data are not used. The above-mentioned case is occurred when:

- the single catch-station is realized by a foreign vessel on the boundary of ICES rectangles as additional one to two obligatory hauls realized by country responsible for acoustic-trawl monitoring in given rectangle;
- even if the catch-station was realized by designated country however, in the real wrongful weather conditions the catch can be considered as not representative for fish distribution;
- catch was realized wrongly from technical or methodological points of view, e.g. a trawl was performed in an area of high S_A and few fish were present in catch;
- the trawl codend was destroyed during fishing operation (invalid station);
- trawling, by mistake, was made in one water layer only however fish shoals were diverse between two vertical zones (upper and lower).

The species frequency f_i of species *i* can be estimated by the formula below:

$$f_i = \frac{1}{M} \sum_{k=1}^{M} \frac{n_{ik}}{N_k} \qquad (5.1)$$

where: n_{ik} - the fish number of species *i* in haul *k*, N_k - the total fish number in this haul and *M* is the number of hauls in the ICES rectangle.

It is allowed to exclude a species from further total species frequency calculation if the overall mean contribution to all sampled hauls is lower than one per cent.

Data on the share of cod and clupeids in samples as well as their abundance per the ICES rectangle should be reported to at least two decimals rounding format and sent to the acoustic surveys data coordinators (for names see the Section 2.1), for a final calculation of fish stocks resources.

5.2 Length distribution

It is assumed that catches are poorly related to abundance (by ICES rectangle) hence each trawl catch is given an equal weight. The fish length frequency f_{ij} in the length class *j* is calculated as the mean of all M_i trawl catches containing species *i;* see the formula below:

Annex 1:

$$f_{ij} = \frac{1}{M_i} \sum_{k=1}^{M_i} \frac{n_{ijk}}{N_{ik}} \qquad (5.2)$$

where: n_{ijk} - the number of fish within the length class *j*, and N_{ik} - the total number of species *i* in the haul *k*.

5.3 Age distribution

Minimum effort method: all sampled otoliths within each the ICES subdivision is assumed representative for the species age distribution within this area. The age–length-key in this ICES subdivision can be expressed as frequencies f_{aj} or as relative quantities (fractions) q_{aj} associated with age *a* in length class *j*. The combination of the age length key q_{aj} for the whole subdivision with the length distribution f_j from a specific ICES-rectangle result in the age distribution f_a for this ICES-rectangle, i.e.:

Annex 2: $$f_a = \sum_j q_{aj} \cdot f_j \qquad (5.3.1)$$

Maximum effort method: the age distribution for each ICES rectangle is estimated as simple mean of all samples, i.e.:

Annex 3: $$f_a = \frac{1}{M} \sum_k f_{ak} \qquad (5.3.2)$$

The example of fish (Baltic sprat) ALK calculation (age structure) in ICES rectangle or subdivision is presented in Table 5.3.

5.4 Weight distribution

Minimum effort method: for the calculation of the weight distribution per age group W_a we use also the normalized age–length-key q_{aj} (see Section 5.3) and the mean weight per length-class W_j:

$$W_a = \sum_j q_{aj} \cdot f_j \cdot W_j \qquad (5.4.1)$$

Maximum effort method: the weight distribution for each rectangle is estimated as simple mean of all samples:

$$w_a = \frac{1}{M} \sum_k w_{ak} \qquad (5.4.2)$$

5.5 Lack of sample hauls

In the case of lack of sample hauls (no data on fish species composition and length structure) within an individual ICES rectangle (because of small bottom depth, bad weather conditions, or other limitations) a mean of all available neighbouring ICES rectangles should be taken.

5.6 Allocation of records

During the survey, herring and sprat normally is difficult to distinguish from other species by visual inspection of the echogram. Such problem is typical, when fish are dispersed in a water column moreover; very frequently sprat, young herring and smelt are well mixed, inhabiting the same niche of inshore waters. Both herring and sprat tend to be distributed in scattering layers or in pelagic layers of small schools, and it is not possible to ascribe values to typical herring schools.

Species allocation is then based entirely upon trawl catch composition. The estimates of total fish density are then allocated to species and age groups according to the trawl catch composition in the corresponding ICES rectangle.

5.7 Target strength of an individual fish

The mean cross section σ of an individual fish of species i should be derived from a function, which describes the length-dependence of the target-strength:

$$TS = a_i + b_i \cdot \log L \qquad (5.7.1)$$

a_i and b_i are constants for the species i' and L is the length of the individual fish in cm.

The equivalent formula for the cross section is:

$$\sigma_{ij} = 4\pi \cdot 10^{a_i/10} \cdot L_j^{b_i/10} \tag{5.7.2}$$

Normally we assume a quadratic relationship that means b_i is 20 (Simmonds and MacLennan, 2005). We get the formula:

$$\sigma_{ij} = d_i \cdot L_j^{\ 2} \tag{5.7.3}$$

The parameters *a*, *b* and *d* are listed in Table 5.7 for different species.

Until new TS parameters are agreed upon, the following is suggested:

- gadoids should be treated as cod;
- salmonids and three-spined stickleback should be treated as herring;
- other fish species should be treated as cod.

Recently calculated values of TS parameters for *Scomber scombrus* (Table 5.7) are recommended to use for preparation of the standard dataset from the BIAS and BASS surveys. However, the Atlantic mackerel appearance in the Baltic Sea is noticed only sporadically, mostly in the south-western part of the sea, and due to specific hydrological conditions.

Note: information about the split-beam technique applied for in-situ TS measurements is described in Bodholt and Solli (1992).

5.8 Estimation of the mean cross section in the ICES rectangle

The basis for the estimation of total fish density *F* from the measured nautical area scattering coefficient s_A (or NASC) is the conversion factor *c* (MacLennan *et al.* 2002).

$$F = s_A \cdot c = \frac{s_A}{<\sigma>} \tag{5.8.1}$$

The mean cross section <σ> in the ICES rectangle is dependent from the species composition and the length distributions of all species. From formula 5.7.3 we get the corresponding cross section $<\sigma_i>$

$$<\sigma_i> = \sum_j f_{ij} \cdot d_i \cdot L_j^2 \tag{5.8.2}$$

where: L_j is the midpoint of the *j*-th length class and f_{ij} the respective frequency.

It follows that the mean cross section in the ICES rectangle can be estimated as the weighted mean of all species related cross sections $<\sigma_i>$:

Annex 4: $$<\sigma> = \sum f_i \sigma_i = \sum_i f_i \sum_j f_{ij} d_i L_j^2 \tag{5.8.3}$$

5.9 Abundance estimation

The total number of fish in the ICES rectangle is estimated as:

$$N = F \cdot A = \frac{s_A}{<\sigma>} \cdot A \tag{5.9.1}$$

This total abundance is split into species classes N_i by

$$N_i = N \cdot f_i \tag{5.9.2}$$

especially in abundance of herring N_h, sprat N_s and cod N_c.

The abundance of the species *i* is divided into age classes, $N_{a,j}$ according to the age distribution $f_{i,a}$ in each the ICES rectangle:

$$N_{ia} = N_i \cdot f_{ia} \tag{5.9.3}$$

Biomass estimation

The biomass Q_{ia} for the species *i* and the age group *a* is calculated from the abundance N_{ia} and the mean weight per age group:

$$Q_{ai} = N_{ai} \cdot W_a \tag{5.10.1}$$

Note: more information about definitions and symbols used in this manual is presented e.g. in MacLennan *et al.* (2002), and information on sources of error in acoustic estimation of fish abundance – in Aglen (1994).

The example of calculations method and formulas used for fish stocks (herring and sprat) abundance and biomass assessment are presented in Annex 2.

6 Data exchange and database

6.1 Exchange of survey results

Main results of the recently conducted acoustic survey (BASS and BIAS) should be summarized and uploaded one month before the WGBIFS meeting of the next year to the data folder of the current WGBIFS SharePoint. Data should be uploaded in the exchange format using the Excel spreadsheet. Names of files should contain the abbreviation of the survey (e.g. BIAS), three letters code of the countries responsible (e.g. Pol – for Poland, Swe – for Sweden, etc.), when files are named as e.g. BIAS_Pol_data2008.xls. An example of the file is available on the SharePoint folder "DATA" (acoustic survey data exchange file.xls). The following documents should be uploaded to the SharePoint:

- a map showing the echo integration tracks and the location of fish catch-stations;
- an Excel file with spread sheets accordingly like in the Table 6.1.

The new standard exchange format, which is described in the Table 6.1, is recommended for the next survey documents preparation. The exchange Excel-sheets consists of the following 10 tables:

- SU: Description of the different surveys;
- ST: Basic values for the computation of the abundance;
- N_HerW: Number of herring (million) WBSSH per age group;
- N_HerC: Number of herring (million) CBH per age group;
- N_Spr: Number of sprat (millions) per age group;
- N_Cod: Number of cod (millions) per age group;
- W_HerW: Mean weight of herring (gramme) WBSSH per age group;
- W_HerC: Mean weight of herring (gramme) CBH per age group;
- W_Spr: Mean weight of sprat (gramme) per age group;
- W_cod: Mean weights of cod per age group.

The herring stock under investigation was divided in to Western Baltic Spring Spawning Herring (WBSSH) and Central Baltic Herring (CBH) stocks and there are exchange sheets for both stocks. The percentage of cod in the exchange sheet "ST" should be at least submitted. The exchange sheets "N_Cod" and "W_cod" are optional but recommended if the age distribution of cod is available.

6.2 Databases

The data of the Baltic Acoustic Spring Survey (BASS) are stored in the BASS_DB.mdb. The data of the Baltic International Acoustic Survey (BIAS) are stored in the BIAS_DB.mdb. These Microsoft Access-files also include queries with the used algorithms for creation of the report tables and the calculation of the different tuning fleets. The current versions of the database files are located in the folder "Data" of the WGBIFS Share Point. The inner structure of the tables is summarized in the Table 6.2.

It should be underlined, that beginning from 2016, acoustic-trawl surveys results from the next both types of cruises needs to be also uploaded to the newly created ICES acoustic database (linked with the StoX programme), and managed by the ICES Data Centre. The transition period will be lasted five years, needs for collecting representative time-series data from both types of database, which will be used for comparative analysis.

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8 Figures

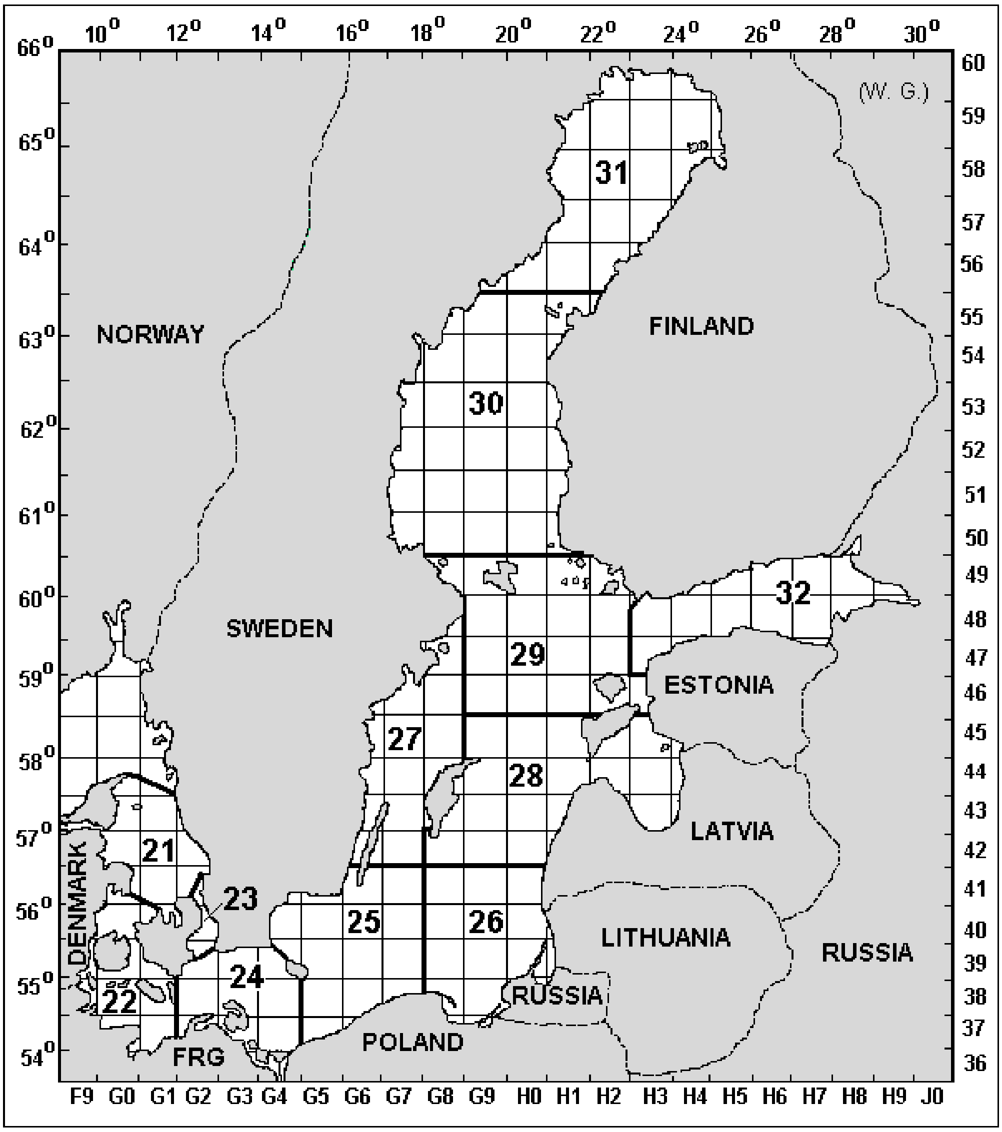


Figure 2.1. ICES subdivisions border and the ICES rectangles codes in the Baltic Sea. On the x-axis (e.g. G4, G5) are rectangle coordinates in longitude dimension at 1° intervals and on the right y-axis (e.g. 38, 39) are rectangle coordinates in latitude dimension at 0.5° intervals. Thus, rectangles are named e.g. 38G4, 39G5; remark - borders of the ICES Subdivision 21 are not fixed so far.

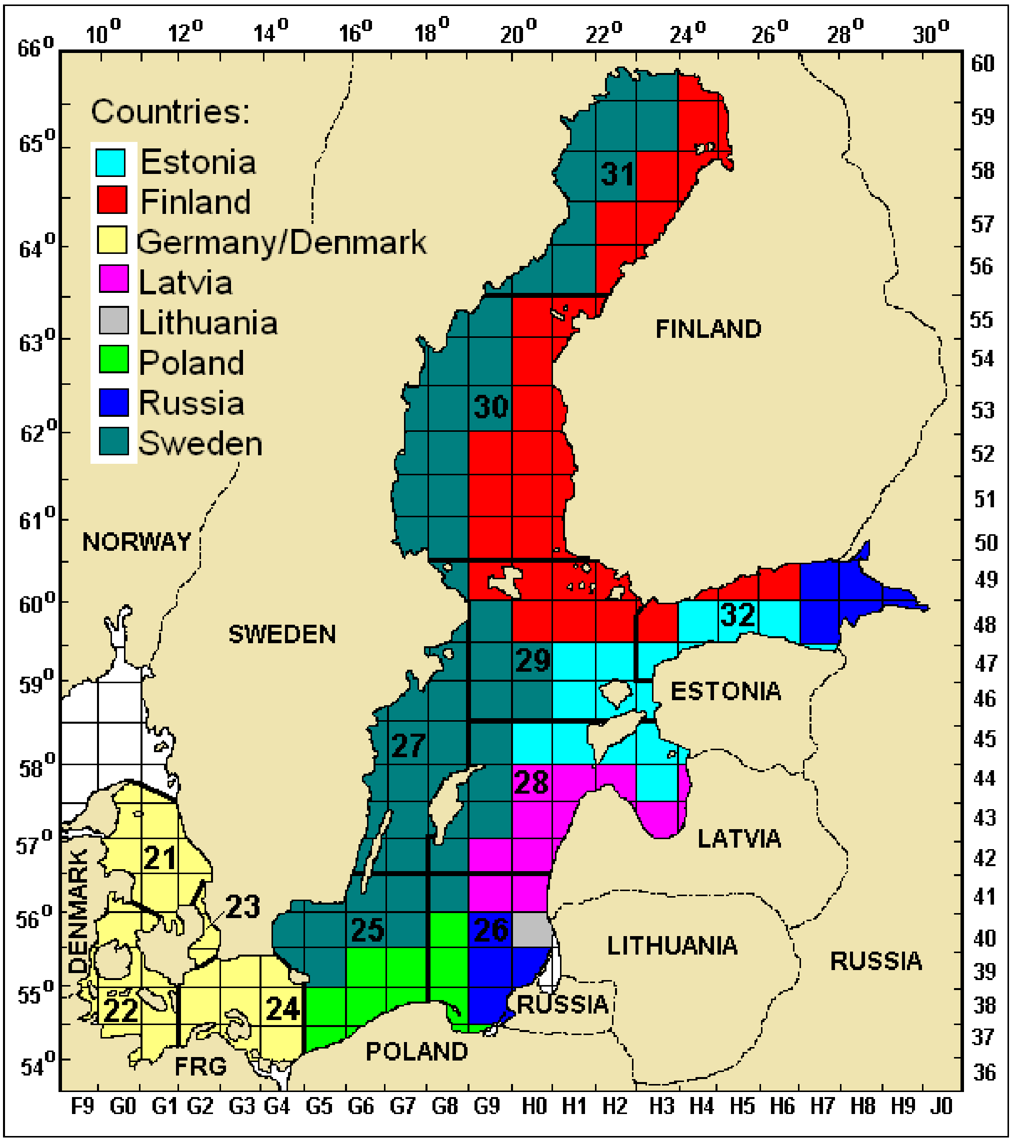


Figure 2.2. General assignment scheme of the ICES statistical rectangles (within standard acoustic surveys) to the countries in the Baltic Sea.

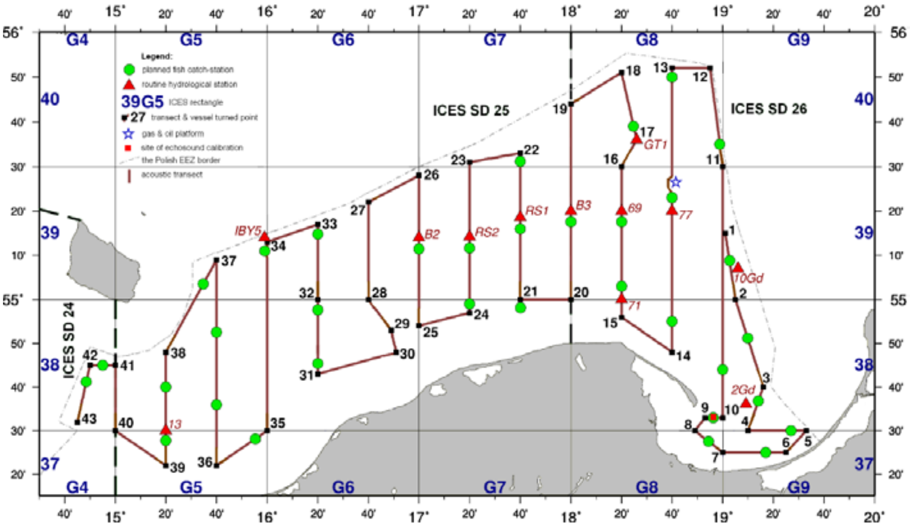


Figure 2.3.A. The example of scheme of acoustic transects distribution planned during the BIAS survey (the Polish RV "Baltica", Sep.-Oct. 2013); note: location of shallow waters, national EEZ borders, large technical constructions at sea and the navy military trainings areas modified the shape of acoustic transects.

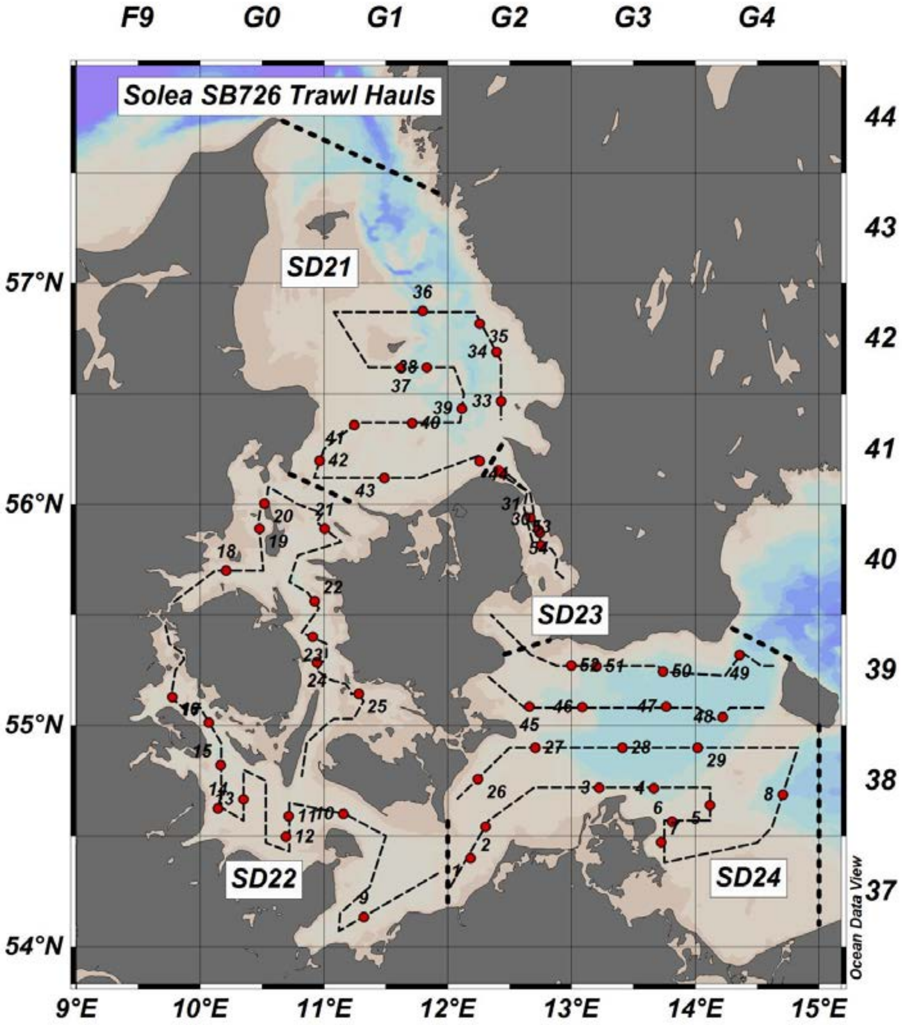
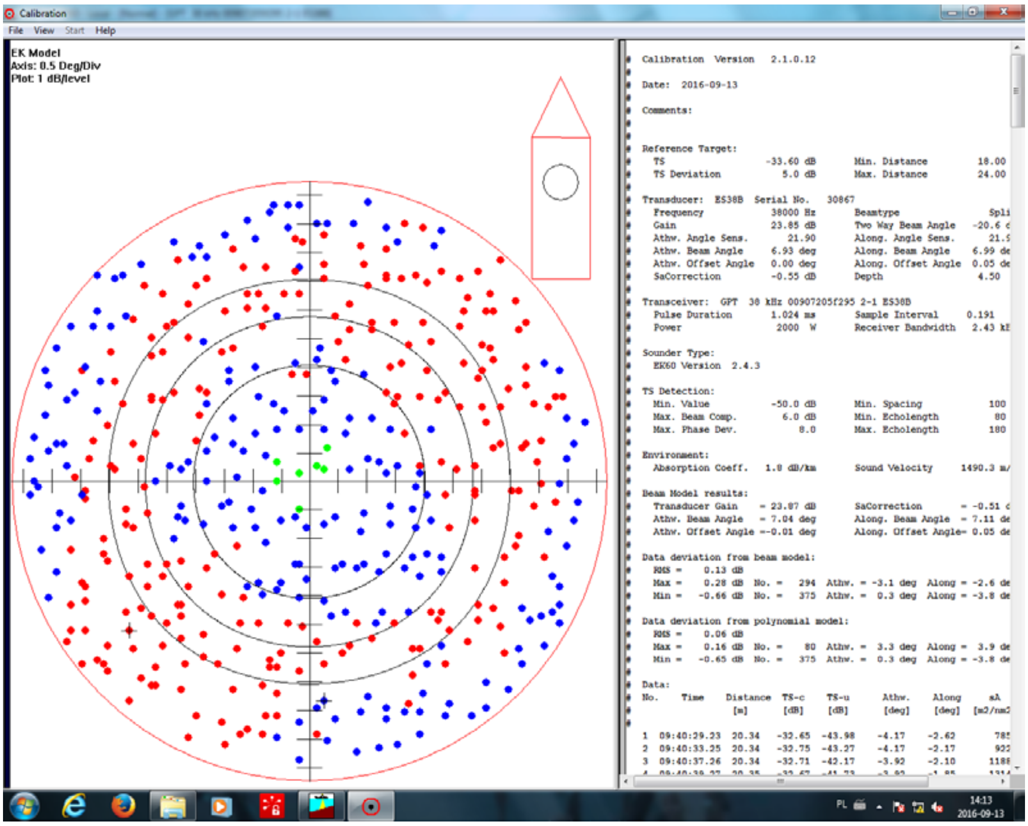
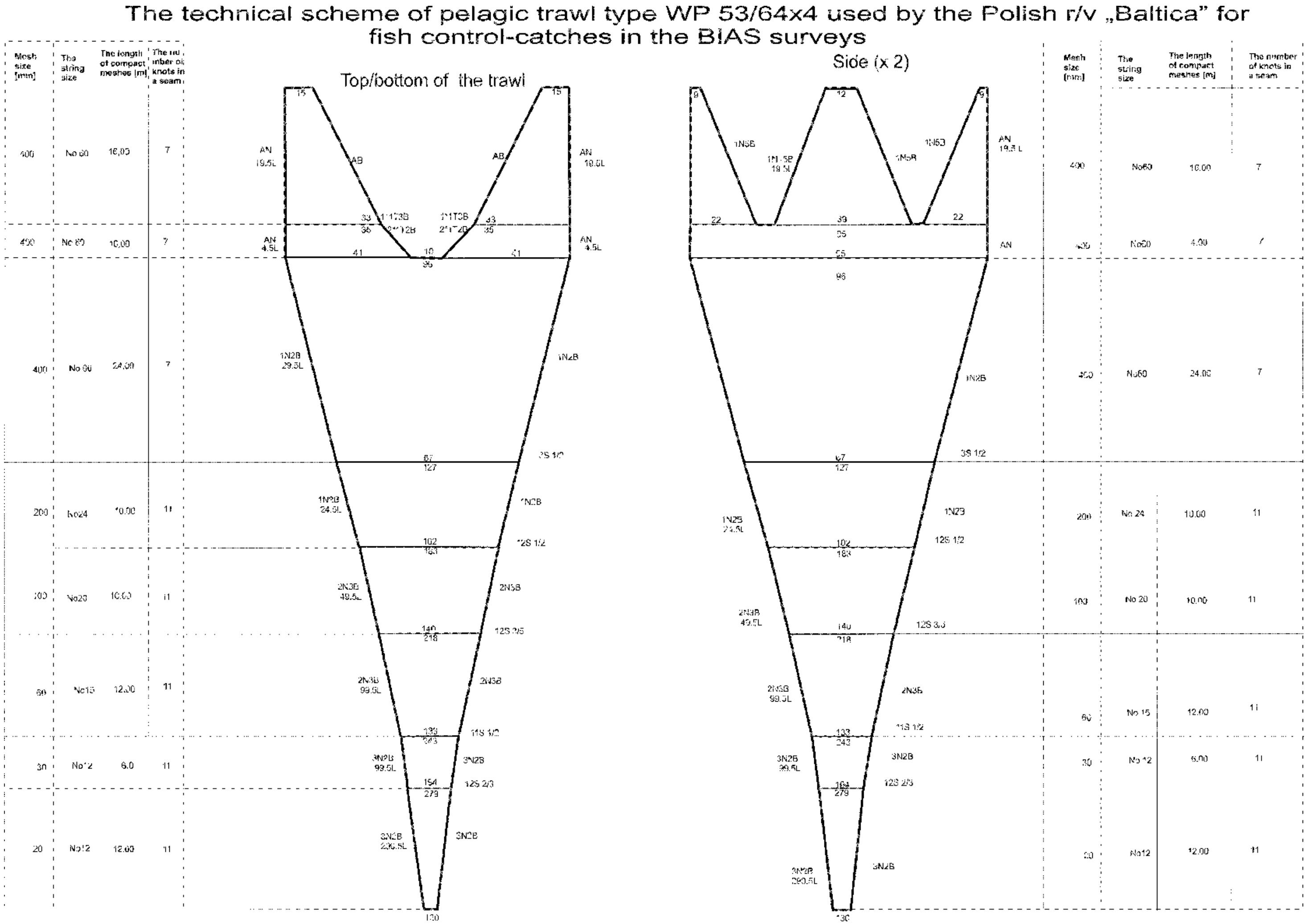


Figure 2.3.B. The map of acoustic transects distribution (thin dashed lines) during the German RV "Solea" BIAS/2016 survey, with indicated catch-stations (red bullets); after Schaber and Gröhsler, 2017, [in:] ICES WGBIFS 2017 Report – Annex 7.



```
Calibration  Version   2.1.0.12

Date:  2016-09-13

Comments:


Reference Target:
  TS                      -33.60 dB       Min. Distance         18.00
  TS Deviation               5.0 dB       Max. Distance         24.00

Transducer:  ES38B  Serial No.   30867
  Frequency               38000 Hz        Beamtype                Spli
  Gain                    23.85 dB        Two Way Beam Angle   -20.6 d
  Athw. Angle Sens.         21.90         Along. Angle Sens.      21.
  Athw. Beam Angle        6.93 deg        Along. Beam Angle    6.99 de
  Athw. Offset Angle      0.00 deg        Along. Offset Angle  0.05 de
  SaCorrection           -0.55 dB         Depth                 4.50

Transceiver:  GPT  38 kHz 00907205f295 2-1 ES38B
  Pulse Duration          1.024 ms        Sample Interval     0.191
  Power                    2000  W        Receiver Bandwidth   2.43 k

Sounder Type:
  EK60 Version  2.4.3

TS Detection:
  Min. Value              -50.0 dB        Min. Spacing            100
  Max. Beam Comp.           6.0 dB        Min. Echolength          80
  Max. Phase Dev.             8.0         Max. Echolength         180

Environment:
  Absorption Coeff.   1.0 dB/km           Sound Velocity     1490.3 m/

Beam Model results:
  Transducer Gain    = 23.87 dB           SaCorrection        = -0.51 
  Athw. Beam Angle   = 7.04 deg           Along. Beam Angle  = 7.11 de
  Athw. Offset Angle =-0.01 deg           Along. Offset Angle= 0.05 de

Data deviation from beam model:
  RMS =    0.13 dB
  Max =    0.28 dB  No. =   294  Athw. = -3.1 deg  Along = -2.6 de
  Min =   -0.66 dB  No. =   375  Athw. =  0.3 deg  Along = -3.8 de

Data deviation from polynomial model:
  RMS =    0.06 dB
  Max =    0.16 dB  No. =    80  Athw. =  3.3 deg  Along =  3.9 de
  Min =   -0.65 dB  No. =   375  Athw. =  0.3 deg  Along = -3.8 de

Data:
No.     Time      Distance  TS-c     TS-u      Athw.    Along     sA
                    [m]     [dB]     [dB]      [deg]    [deg]   [m2/nm
 
1  09:40:29.23  20.34    -32.65  -43.98    -4.17    -2.62       785
2  09:40:33.25  20.34    -32.75  -43.27    -4.17    -2.17       922
3  09:40:37.26  20.34    -32.71  -42.17    -3.92    -2.10      1188
```

Figure 3.1. An example (a screenshot) of coverage of the beam area during calibration process of the Simrad EK-60 with 38 kHz transducer, performed on 13.09.2016 by the RV “Baltica”.



Mesh size [mm]	The string size	The length of compact meshes [m]	The number of knots in a seam
400	No 60	16,00	7
400	No 60	10,00	7
400	No 60	24,00	7
200	No24	10,00	11
100	No20	10,00	11
60	No15	12,00	11
30	No12	6.0	11
20	No12	12,00	11

Mesh size [mm]	The string size	The length of compact meshes [m]	The number of knots in a seam
400	No60	10.00	7
400	No60	4.00	7
400	No60	24.00	7
200	No 24	10.00	11
100	No 20	10.00	11
60	No 15	12.00	11
30	No 12	6.00	11
20	No12	12.00	11

Figure 4.1. An example of the technical scheme of pelagic trawl type WP 53/64x4 used by the Polish r/v “Baltica” in the BIAS surveys.

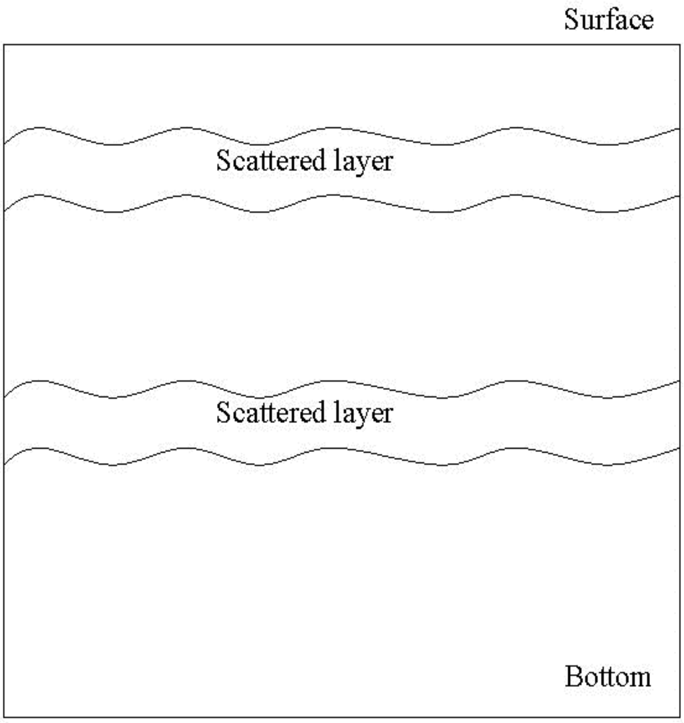


Figure 4.2. Multiple scattering fish layers.

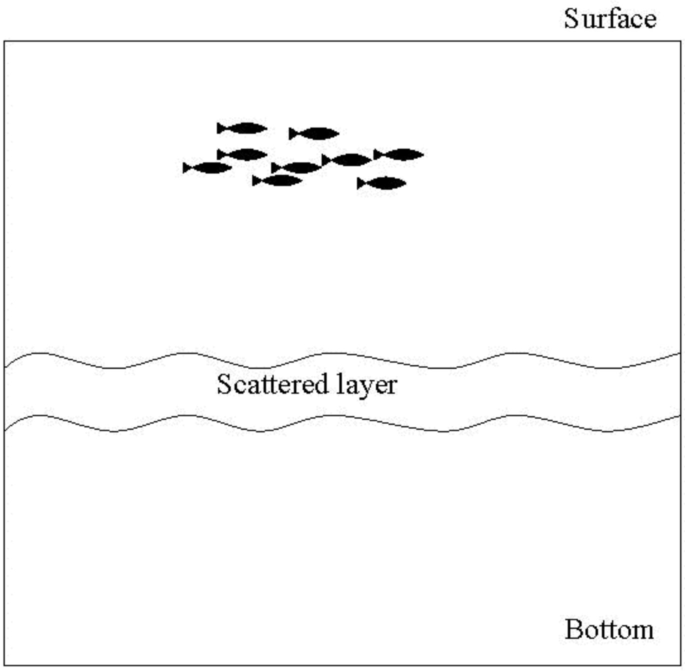


Figure 4.3. Shoals and scattering fish layers.

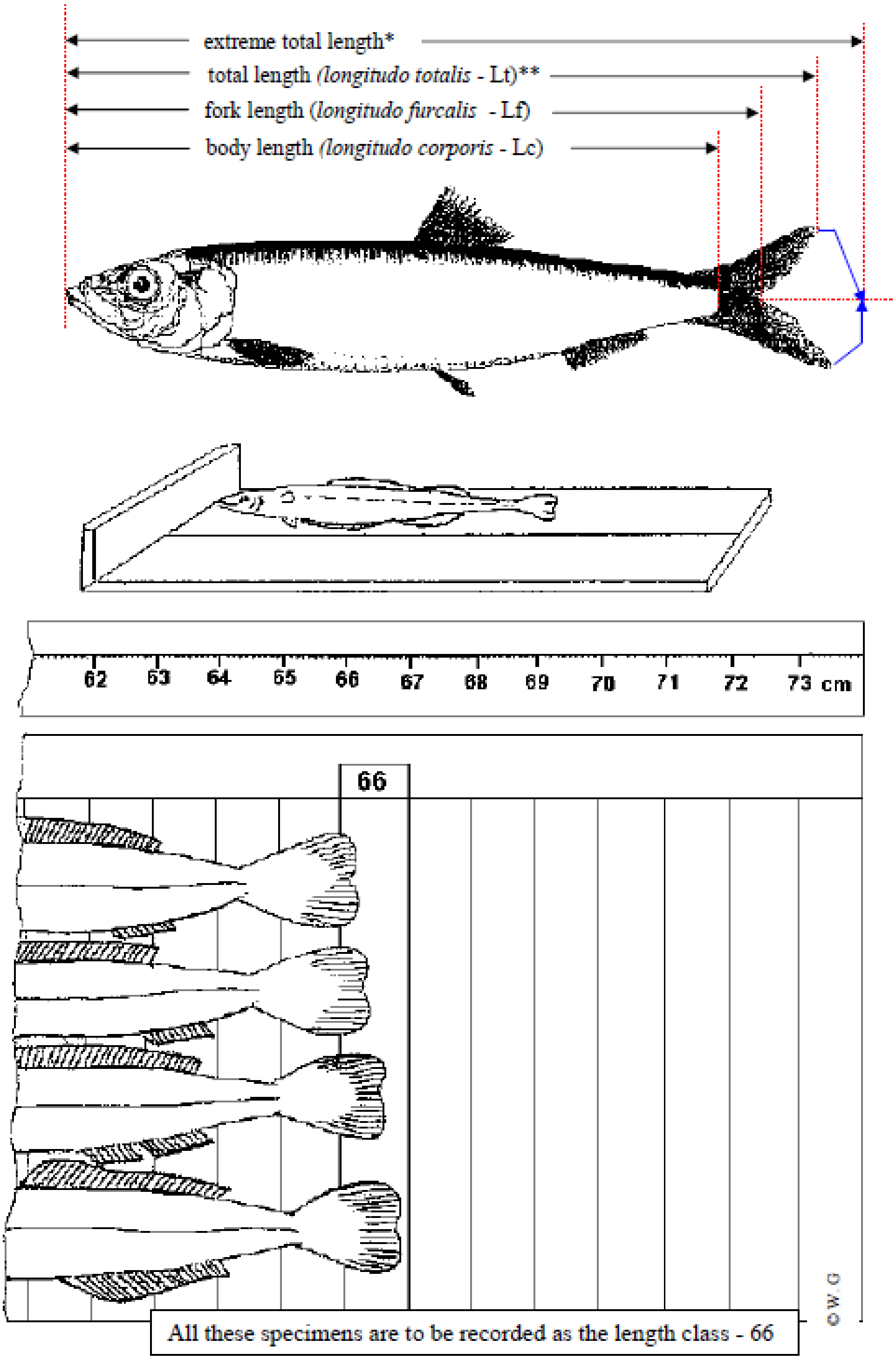


Figure 4.4. The fish length measuring scheme; symbols used: * - during measuring upper and lower lobes of caudal fin are getting together (Anon. 1974), ** - during measuring caudal fin is in the natural position.

9 Tables

Table 2.1. The boundaries of the ICES subdivisions of the Baltic Sea and the Belts (IBSFC Fishery Rules); note: the country, which is responsible for the BIAS survey realization in given subarea, is mentioned in parentheses; see also Figure 2.2..

Remark: Denmark and Germany are performing the acoustic surveys also in the ICES Subdivision 21, which borders are not clarified so far.

Subdivision 22	**(GERMANY AND DENMARK - JOINTLY)**
Northern boundary:	a line from Hasenore head to Gniben Point
Eastern boundary:	a line at longitude 12° East due South from Zealand to Falster, then along the East coast of the Island of Falster to Gedser Odde (54°34′N, 11°58′E), then due South to the coast of the Federal Republic of Germany.
Subdivision 23	**(GERMANY AND DENMARK - JOINTLY)**
Northern boundary:	a line from Gilbjerg Head to the Kullen.
Southern boundary:	a line from Falsterbo Light on the Swedish coast to Stevns Light on the Danish coast.
Subdivision 24	**(GERMANY AND DENMARK - JOINTLY)**
The western boundaries coincide with the eastern boundary of the ICES Subdivision 22 and the southern boundary of the ICES Subdivision 23. The eastern boundary runs along the line from Sandhammeren Light to Hammerode Light and south of the Bornholm further along 15°E.	
Subdivision 25	**(POLAND AND SWEDEN - PARTLY)**
Northern boundary:	the latitude 56°30′N.
Eastern boundary:	the longitude 18°E.
Western boundary:	coincides with the eastern boundary of the ICES Subdivision 24
Subdivision 26	**(POLAND, RUSSIA, LITHUANIA,LATVIA AND SWEDEN - PARTLY)**
Northern boundary:	the latitude 56°30′N.
Eastern boundary:	the longitude 18°E.
Subdivision 27	**(SWEDEN)**
Eastern boundary:	the longitude 19°E from 59°41′N to the Isle of Gotland and from the Isle of Gotland along 57°N to 18°E and further to the south along the longitude 18°E.
Western boundary:	the latitude 56°30′N.
Subdivision 28	**(LATVIA, ESTONIA AND SWEDEN - PARTLY)**
Northern boundary:	the latitude 58°30′N.
	the latitude 56°30′N.
Western boundary:	north of Gotland, the latitude 19°E and south of Gotland along 57°N to the longitude 18°E, and further south along the longitude 18°E.

Subdivision 29	**(FINLAND, SWEDEN AND ESTONIA - PARTLY)**
Northern boundary:	the latitude 60°30′N.
Eastern boundary:	the longitude 23°E to 59°N and further along 59°N to the southeastern boundary: the latitude 58°30′N.
Western boundary:	from 59°41′N, along the longitude 19°E to the south.
Subdivision 30	**(FINLAND AND SWEDEN - PARTLY)**
Northern boundary:	the latitude 63°30′N.
Southern boundary:	the latitude 60°30′N.
Subdivision 31	**(FINLAND AND SWEDEN - PARTLY)**
Southern boundary:	the latitude 63°30′N.
Subdivision 32	**(ESTONIA, FINLAND AND RUSSIA - PARTLY)**
Western boundary:	coincides with the eastern boundary of the ICES Subdivision 29

Table 2.2. Area [NM²] of the ICES rectangles and subdivisions with water depth of more or equal than 10 m.

SD																												
21	41G0	41G1	41G2	42G1	42G2	43G1	43G2	44G0	44G1																			
	108.1	946.8	432.3	884.2	606.8	699.0	107.0	239.9	580.5																			
22	37G0	37G1	38F9	38G0	38G1	39F9	39G0	39G1	40F9	40G0	40G1	41G0	41G1															
	209.9	723.3	51.9	735.3	173.2	159.3	201.7	250.0	51.3	538.1	174.5	173.1	18.0															
23	39G2	40G2	41G2																									
	130.9	164.0	72.3																									
24	37G2	37G3	37G4	38G2	38G3	38G4	39G2	39G3	39G4																			
	192.4	167.7	875.1	832.9	865.7	1034.8	406.1	765.0	524.8																			
25	37G5	37G6	38G5	38G6	38G7	39G4	39G5	39G6	39G7	40G4	40G5	40G6	40G7	41G4	41G5	41G6	41G7											
	642.2	130.7	1035.7	940.2	471.7	287.3	979.0	1026.0	1026.0	677.2	1012.9	1013.0	1013.0	59.4	190.2	764.4	1000.0											
26	37G8	37G9	38G8	38G9	38H0	39G8	39G9	39H0	39H1	40G8	40G9	40H0	40H1	41G8	41G9	41H0	41H1											
	86	151.6	624.6	918.2	37.8	1026	1026	881.6	12.8	1013	1013	1012	56.3	1000	1000	953.3	16.6											
27	42G6	42G7	43G6	43G7	43G8	44G6	44G7	44G8	45G6	45G7	45G8	46G6	46G7	46G8	47G8	48G8												
	266.0	986.9	269.8	913.8	106.1	200.9	960.5	456.6	72.9	908.7	947.2	38.9	452.6	884.8	264.3	53.8												
28	42G8	42G9	42H0	42H1	43G8	43G9	43H0	43H1	43H3	43H4	44G8	44G9	44H0	44H1	44H2	44H3	44H4	45G9	45H0	45H1	45H2	45H3	45H4					
	945.4	986.9	968.5	75	296.2	973.7	973.7	412.7	744.3	261.9	68.1	876.6	960.5	824.6	627.3	936.1	290.6	924.5	947.2	827.1	209.9	638.2	96.5					
29	46G9	46H0	46H1	46H2	46H3	47G9	47H0	47H1	47H2	48G9	48H0	48H1	48H2	49G8	49G9	49H0	49H1	49H2										
	933.8	933.8	921.5	258.0	13.2	876.2	920.3	920.3	793.9	772.8	730.3	544.0	597.0	196.0	564.2	85.3	65.2	28.4										
30	50G7	50G8	50G9	50H0	50H1	51G7	51G8	51G9	51H0	51H1	52G7	52G8	52G9	52H0	52H1	53G7	53G8	53G9	53H0	53H1	54G7	54G8	54G9	54H0	55G8	55G9	55H0	55H1
	403.1	833.4	879.5	795.1	41.6	614.5	863.7	865.8	865.7	237.3	482.6	852.0	852.0	852.0	263.9	354.5	838.1	838.1	838.1	126.6	13.2	642.2	824.2	727.9	103.6	625.6	688.6	86.7
31	56G9	56H0	56H1	56H2	56H3	57H1	57H2	57H3	57H4	58H1	58H2	58H3	58H4	59H1	59H2	59H3	59H4	60H2	60H3	60H3								
	8.1	269.2	789.7	414.3	13.2	558.1	782.0	518.9	9.0	486.0	767.8	766.1	256.6	105.8	603.1	752.5	409.0	49.2	181.2	58.0								
32	47H3	47H4	47H7	48H3	48H4	48H5	48H6	48H7	48H8	49H4	49H5	49H6	49H7	49H8	49H9	50H8												
	536.2	90.9	90.0	615.7	835.1	767.2	776.1	851.4	308.5	64.8	306.9	586.5	754.6	665.1	205.2	43.0												

Table 4.1. Specification of trawl gears that were used in BIAS surveys. Trawl type P is pelagic and B is bottom. Length of head line (Headl) , groundrope (Groundr), and sweeps. The densifications of mesh sizes from trawl opening to codend, trawl height and spread during the haul.

Country	Vessel	Power	Code	Gear name	Type	Panels	Headl	Groundr	Sweeps	Length	Circum	Mesh sizes from trawl opening to cod-end												Height	Spread
		kW			B/P	2/4	m	m	m	m	m	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	m	m
GER	WAH3	2900	GOV	GOV	B	2	36.0	52.8	110.0	51.7	76.0	200	160	120	80	50								4	23
GER	WAH3	2900	PS205	PSN205	P	4	50.4	55.4	99.5	84.3	205.0	400	200	160	80	50								12	28
GER	WAH3	2900	1600#	1600# Engelnetz	P	4	70.0	78.0	69.5	118.5	315.0	200	100	50										19	36
GER	SOL	588	BLACK	Blacksprutte 854#	P	4	39.2	39.2	105.0	60.4	156.0	8/200	4/200	200	160	120								11	22
GER	SOL	588	PS388	Krake	P	4	42.0	42.0	63.5	59.8	142.4	400	200	80										9	21
GER	SOL	588	H20	HG20/25	B	2	25.7	39.8	63.5	41.9	51.0	120	80	40										3	15
GER	SOL	588	AAL	Aalhopser	B	2	31.0	29.7	63.5	57.5	119.0	160	120	80	40									6	19
GER	SOL	588	KAB	Kabeljaubomber	P	2	53.2	53.2	63.5	73.5	129.6	200	160	120										11	30
POL	BAL	1030	P20	P20/25	B	2	28.0	42.4	100.0	53.4		120	40											4	11
POL	BAL	1030	TV3	TV-3 930#	B	4	71.7	78.8			74.4	200	40											6.5	
POL	BAL	1030	WP53	WP53/64x4	P	4	53.0	53.0	88.0	86.0	217.6	800	100											22	32
RUS	MON		RTM	RTM33S	P																				
RUS	ATL	1764	RTA	70/300 project0495	P	4	70.0	70.0	75.0	101.3	300.0	7000	5000	4000	2000	800	400	200	100	80	60	45	37	28	41
FIN	JUL	750	1600'	Finflyder combi	P	4	86.0	86.0	60.0	160.3	467.2	3200	1600	800	290	120	80	40						23	38
SWE	ARG	1324	FOTOE	Fotö 3.2	P	4	60.2	60.2	108.0	98.0	260.0	6400	3200	1600	800	400	200	100	40					16	90
SWE	ARG	1324	MACRO	Macro 5A:1	P	4	86.0	86.0	108.0	98.0	205.0	6400	3200	1600	800	400	200	100	40					19	105
FIN	ARA	3000	FOTOE	Fotö 3.2	P	4	60.2	60.2	108.0	98.0	260.0	6400	3200	1600	800	400	200	100	40					16	90

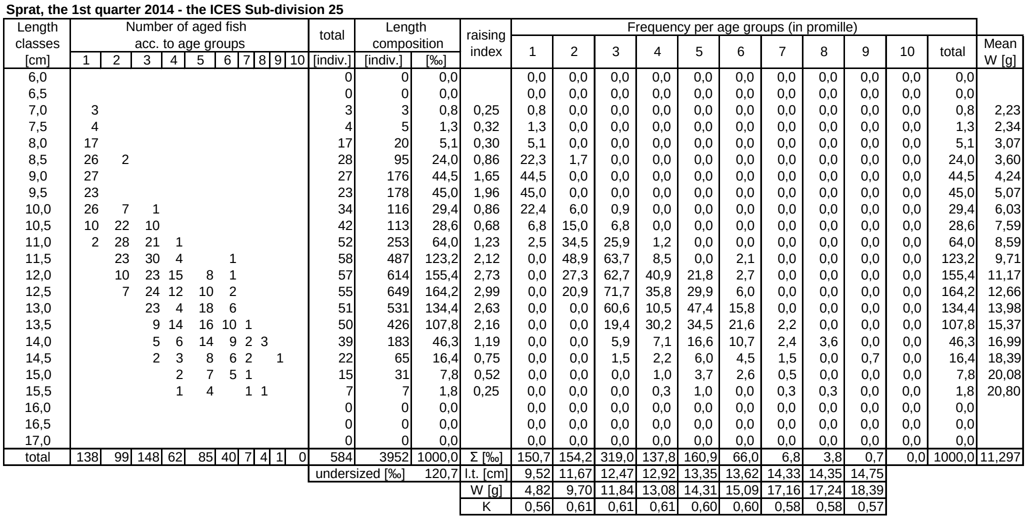
Note: The trawls type P20/25 and TV-3 930# were used by the Polish RV "Baltica" during acoustic surveys very occasionally (in limited time and areas), for experimental catches only.

Table 4.3. Species list.

NODC	Scientific name	English name
3734030201	*AURELIA AURITA*	COMMON JELLYFISH
5704020401	*SEPIETTA OWENIANA*	
5706010401	*ALLOTEUTHIS SUBULATA*	
6188030110	*CANCER PAGURUS*	EDIBLE CRAB
8603010000	*PETROMYZINIDAE*	LAMPREYS
8603010217	*LAMPETRA FLUVIATILIS*	RIVER LAMPREY
8603010301	*PETROMYZON MARINUS*	SEA LAMPREY
8606010201	*MYXINE GLUTINOSA*	HAGFISH
8710010201	*SQUALUS ACANTHIAS*	SPURDOG / SPINY DOGFISH
8713040134	*RAJA RADIATA*	STARRY RAY
8741010102	*ANGUILLA ANGUILLA*	EEL
8747010000	*CLUPEIDAE*	HERRINGS
8747010109	*ALOSA FALLAX*	TWAITE SHAD
8747010201	*CLUPEA HARENGUS*	HERRING
8747011701	*SPRATTUS SPRATTUS*	SPRAT
8747012201	*SARDINA PILCHARDUS*	PILCHARD, SARDINE
8747020104	*ENGRAULIS ENCRASICOLUS*	ANCHOVY
8755010115	*COREGONUS OXYRINCHUS / C. LAVARETUS*	WHITEFISH / HOUTING / POWAN
8755010305	*SALMO SALAR*	SALMON
8755010306	*SALMO TRUTTA*	TROUT
8755030301	*OSMERUS EPELANUS*	SMELT
8756010237	*ARGENTINA SPYRAENA*	LESSER SILVERSMELT
8759010501	*MAUROLICUS MUELLERI*	PEARLSIDE
8776014401	*RUTILUS RUTILUS*	ROACH
8791030402	*GADUS MORRHUA*	COD
8791030901	*POLLACHIUS VIRENS*	SAITHE
8791031301	*MELANOGRAMMUS AEGLEFINUS*	HADDOCK
8791031501	*RHINONEMUS CIMBRIUS*	FOUR BEARDED ROCKLING
8791031701	*TRISOPTERUS MINUTUS*	POOR COD
8791031703	*TRISOPTERUS ESMARKI*	NORWAY POUT
8791031801	*MERLANGIUS MERLANGIUS*	WHITING
8791032201	*MICROMESTISTIUS POTASSOU*	BLUE WHITING
8791040105	*MERLUCCIUS MERLUCCIUS*	HAKE
8793010000	*ZOARCIDAE*	EEL-POUTS
8793010724	*LYCODES VAHLII*	VAHL'S EELPOUT
8793012001	*ZOARCES VIVIPARUS*	EELPOUT
8803020502	*BELONE BELONE*	GARFISH
8818010101	*GASTEROSTEUS ACULEATUS*	THREE-SPINED STICKLEBACK
8818010201	*SPINACHIA SPINACHIA*	SEA STICKLEBACK
8820020000	*SYNGNATHIDAE*	PIPE FISH
8820020119	*SYNGNATUS ROSTELLATUS*	NILSSON'S PIPEFISH
8820020120	*SYNGNATUS ACUS*	GREAT PIPEFISH
8820020123	*SYNGNATUS TYPHLE*	DEEP-SNOUTED PIPEFISH
8820022101	*ENTELURUS AEQUOREUS*	SNAKE PIPEFISH

NODC	Scientific name	English name
8826020601	*EUTRIGLA GURNARDUS*	GREY GURNARD
8831020825	*COTTUS GOBIO*	BULLHEAD
8831022205	*MYOXOCEPHALUS QUADRICORNIS*	FOUR SPINED SCULPIN
8831022207	*MYOXOCEPHALUS SCORPIUS*	BULL ROUT
8831024601	*TAURULUS BUBALIS*	SEA SCORPION
8831080803	*AGONUS CATAPHRACTUS*	POGGE
8831090828	*LIPARIS LIPARIS*	SEA SNAIL
8831091501	*CYCLOPTERUS LUMPUS*	LUMPFISH
8835020101	*DICETRARCHUS LABRAX*	BASS
8835200202	*PERCA FLUVIATILIS*	PERCH
8835200403	*STIZOSTEDION LUCIOPERCA*	ZANDER (PIKEPERCH)
8835280103	*TRACHURUS TRACHURUS*	HORSE MACKEREL
8835450202	*MULLUS SURMULETUS*	RED MULLET
8839013501	*CTENOLABRUS RUPESTRIS*	GOLD SINNY
8840060102	*TRACHINUS DRACO*	GREATER WEEVER
8842120905	*LUMPENUS LAMPRETAEFORMIS*	SNAKE BLENNY
8842130209	*PHOLIS GUNELLUS*	BUTTERFISH
8845010000	*AMMODYTIDAE*	SANDEELS
8845010105	*AMMODYTES TOBIANUS (LANCEA)*	SANDEEL
8845010301	*HYPEROPLUS LANCEOLATUS*	GREATER SANDEEL
8846010106	*CALLIONYMUS LYRA*	SPOTTED DRAGONET
8846010107	*CALLIONYMUS MACULATUS*	DRAGONET
8847010000	*GOBIIDAE*	GOBIES
8847015101	*POMATOSCHISTUS MINUTUS*	SAND GOBY
8847015103	*POMATOSCHISTUS MICROPS*	COMMON GOBY
8847016701	*LESUEURIGOBIUS FRIESSII*	FRIESES' GOBY
8850030302	*SCOMBER SCOMBRUS*	MACKEREL
8857030402	*SCOPHTHALMUS MAXIMUS*	TURBOT
8857030403	*SCOPHTHALMUS RHOMBUS*	BRILL
8857031702	*ARNOGLOSSUS LATERNA*	SCALDFISH
8857040603	*HIPPOGLOSSOIDES PLATESSOIDES*	LONG ROUGH DAB
8857040904	*LIMANDA LIMANDA*	DAB
8857041202	*MICROSTOMUS KITT*	LEMON SOLE
8857041402	*PLATICHTHYS FLESUS*	FLOUNDER
8857041502	*PLEURONECTES PLATESSA*	PLAICE
8858010601	*SOLEA SOLEA*	SOLE
8858010801	*BUGLOSSIDIUM LUTEUM*	SOLENETTE

Table 5.3. The example of ALK calculation for Baltic sprat.



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Length classes [cm]	Number of aged fish acc. to age groups										total	Length composition		raising index	Frequency per age groups (in promille)											Mean W [g]
	1	2	3	4	5	6	7	8	9	10	[indiv.]	[indiv.]	[‰]		1	2	3	4	5	6	7	8	9	10	total	
6,0											0	0	0,0		0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	
6,5											0	0	0,0		0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	
7,0	3										3	3	0,8	0,25	0,8	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,8	2,23
7,5	4										4	5	1,3	0,32	1,3	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	1,3	2,34
8,0	17										17	20	5,1	0,30	5,1	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	5,1	3,07
8,5	26	2									28	95	24,0	0,86	22,3	1,7	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	24,0	3,60
9,0	27										27	176	44,5	1,65	44,5	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	44,5	4,24
9,5	23										23	178	45,0	1,96	45,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	45,0	5,07
10,0	26	7	1								34	116	29,4	0,86	22,4	6,0	0,9	0,0	0,0	0,0	0,0	0,0	0,0	0,0	29,4	6,03
10,5	10	22	10								42	113	28,6	0,68	6,8	15,0	6,8	0,0	0,0	0,0	0,0	0,0	0,0	0,0	28,6	7,59
11,0	2	28	21	1							52	253	64,0	1,23	2,5	34,5	25,9	1,2	0,0	0,0	0,0	0,0	0,0	0,0	64,0	8,59
11,5		23	30	4		1					58	487	123,2	2,12	0,0	48,9	63,7	8,5	0,0	2,1	0,0	0,0	0,0	0,0	123,2	9,71
12,0		10	23	15	8	1					57	614	155,4	2,73	0,0	27,3	62,7	40,9	21,8	2,7	0,0	0,0	0,0	0,0	155,4	11,17
12,5		7	24	12	10	2					55	649	164,2	2,99	0,0	20,9	71,7	35,8	29,9	6,0	0,0	0,0	0,0	0,0	164,2	12,66
13,0			23	4	18	6					51	531	134,4	2,63	0,0	0,0	60,6	10,5	47,4	15,8	0,0	0,0	0,0	0,0	134,4	13,98
13,5			9	14	16	10	1				50	426	107,8	2,16	0,0	0,0	19,4	30,2	34,5	21,6	2,2	0,0	0,0	0,0	107,8	15,37
14,0			5	6	14	9	2	3			39	183	46,3	1,19	0,0	0,0	5,9	7,1	16,6	10,7	2,4	3,6	0,0	0,0	46,3	16,99
14,5			2	3	8	6	2		1		22	65	16,4	0,75	0,0	0,0	1,5	2,2	6,0	4,5	1,5	0,0	0,7	0,0	16,4	18,39
15,0				2	7	5	1				15	31	7,8	0,52	0,0	0,0	0,0	1,0	3,7	2,6	0,5	0,0	0,0	0,0	7,8	20,08
15,5				1	4		1	1			7	7	1,8	0,25	0,0	0,0	0,0	0,3	1,0	0,0	0,3	0,3	0,0	0,0	1,8	20,80
16,0											0	0	0,0		0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	
16,5											0	0	0,0		0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	
17,0											0	0	0,0		0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	
total	138	99	148	62	85	40	7	4	1	0	584	3952	1000,0	Σ [‰]	150,7	154,2	319,0	137,8	160,9	66,0	6,8	3,8	0,7	0,0	1000,0	11,297
											undersized [‰]		120,7	l.t. [cm]	9,52	11,67	12,47	12,92	13,35	13,62	14,33	14,35	14,75			
														W [g]	4,82	9,70	11,84	13,08	14,31	15,09	17,16	17,24	18,39			
														K	0,56	0,61	0,61	0,61	0,60	0,60	0,58	0,58	0,57			

Table 5.7. Target strength parameters for some species in the Baltic Sea.

Species	*A*	*B*	*D*
Clupea harengus	-71.2	20	9.533E-07
Sprattus sprattus	-71.2	20	9.533E-07
Gadus morhua	-67.5	20	2.235E-06
Scomber scombrus	-84.9	20	4.066E-08

Table 6.1. Format and content of the Excel-exchange file.

Structure of table SU

Field	Type	Length	Rounded to decimals	Description
CCODE	C	20		Survey code (e.g. BIAS_FinEst2013)
SHIP	C	20		Name of the vessel
YEAR	C	5		Survey year
COUNTRY	C	3		Country delivering and holding the original data (e.g. Fin)

Structure of table ST

Field	Type	Length	Rounded to decimals	Description
CCODE	C	20		Survey code
SD	C	4		ICES Subdivision
RECT	C	5		ICES rectangle
AREA	N	7	1	Area [NM²] see according the values in the manual
SA	N	7	1	Mean Sa [m²/NM²]
SIGMA	N	7	3	Mean s [cm²] see formula (5.8.3)
NTOT	N	8	2	Total number of fish (millions) see formula (5.9.1)
HHerW	N	7	2	Percentage of herring, Western Baltic Spring Spawner (WBSSH)

Field	Type	Length	Rounded to decimals	Description
HHerC	N	7	2	Percentage of herring, Central Baltic Stock (CBH)
HSpr	N	7	2	Percentage of sprat
Hcod	N	7	3	Percentage of cod

Structure of table N_HerW

Field	Type	Length	Rounded to decimals	Description
CCODE	C	20		Survey code
SD	C	4		ICES subdivision
RECT	C	5		ICES rectangle
NH0	N	8	2	Number of herring WBSSH age group 0 (millions)
NHerW1	N	8	2	Number of herring WBSSH age group 1 (millions)
NHerW2	N	8	2	Number of herring WBSSH age group 2 (millions)
NHerW3	N	8	2	Number of herring WBSSH age group 3 (millions)
NHerW4	N	8	2	Number of herring WBSSH age group 4 (millions)
NHerW5	N	8	2	Number of herring WBSSH age group 5 (millions)
NHerW6	N	8	2	Number of herring WBSSH age group 6 (millions)
NHerW7	N	8	2	Number of herring WBSSH age group 7 (millions)
NHerW8	N	8	2	Number of herring WBSSH age group 8+ (millions)

Structure of table N_HerC

Field	Type	Length	Rounded to decimals	Description
CCODE	C	20		Survey code
SD	C	4		ICES Subdivision
RECT	C	5		ICES rectangle
NHerC0	N	8	2	Number of herring CBH age group 0 (millions)
NHerC1	N	8	2	Number of herring CBH age group 1 (millions)
NHerC2	N	8	2	Number of herring CBH age group 2 (millions)
NHerC3	N	8	2	Number of herring CBH age group 3 (millions)
NHerC4	N	8	2	Number of herring CBH age group 4 (millions)
NHerC5	N	8	2	Number of herring CBH age group 5 (millions)

Field	Type	Length	Rounded to decimals	Description
NHerC6	N	8	2	Number of herring CBH age group 6 (millions)
NHerC7	N	8	2	Number of herring CBH age group 7 (millions)
NHerC8	N	8	2	Number of herring CBH age group 8+ (millions)

Structure of table N_Spr

Field	Type	Length	Rounded to decimals	Description
CCODE	C	20		Survey code
SD	C	4		ICES subdivision
RECT	C	5		ICES rectangle
NSpr0	N	8	2	Number of sprat age group 0 (millions)
NSpr1	N	8	2	Number of sprat age group 1 (millions)
NSpr2	N	8	2	Number of sprat age group 2 (millions)
NSpr3	N	8	2	Number of sprat age group 3 (millions)
NSpr4	N	8	2	Number of sprat age group 4 (millions)
NSpr5	N	8	2	Number of sprat age group 5 (millions)
NSpr6	N	8	2	Number of sprat age group 6 (millions)
NSpr7	N	8	2	Number of sprat age group 7 (millions)
NSpr8	N	8	2	Number of sprat age group 8+ (millions)

Structure of table N_Cod

Field	Type	Length	Rounded to decimals	Description
CCODE	C	20		Survey code
SD	C	4		ICES subdivision
RECT	C	5		ICES rectangle
NCod0	N	8	2	Number of cod age group 0 (millions)
NCod1	N	8	2	Number of cod age group 1 (millions)
NCod2	N	8	2	Number of cod age group 2 (millions)
NCod3	N	8	2	Number of cod age group 3 (millions)
NCod4	N	8	2	Number of cod age group 4 (millions)

Field	Type	Length	Rounded to decimals	Description
NCod5	N	8	2	Number of cod age group 5 (millions)
NCod6	N	8	2	Number of cod age group 6 (millions)
NCod7	N	8	2	Number of cod age group 7 (millions)
NCod8	N	8	2	Number of cod age group 8+ (millions)

Structure of table W_HerW

Field	Type	Length	Rounded to decimals	Description
CCODE	C	20		Survey code
SD	C	4		ICES subdivision
RECT	C	5		ICES rectangle
WHerW0	N	7	2	Mean weight of herring WBSSH age group 0 (gramme)
WHerW1	N	7	2	Mean weight of herring age group 1 (gramme)
WHerW2	N	7	2	Mean weight of herring WBSSH age group 2 (gramme)
WHerW3	N	7	2	Mean weight of herring WBSSH age group 3 (gramme)
WHerW4	N	7	2	Mean weight of herring WBSSH age group 4 (gramme)
WHerW5	N	7	2	Mean weight of herring WBSSH age group 5 (gramme)
WHerW6	N	7	2	Mean weight of herring WBSSH age group 6 (gramme)
WHerW7	N	7	2	Mean weight of herring WBSSH age group 7 (gramme)
WHerW8	N	7	2	Mean weight of herring WBSSH age group 8+ (gramme)

Structure of table W_HerC

Field	Type	Length	Rounded to decimals	Description
CCODE	C	20		Survey code
SD	C	4		ICES Subdivision
RECT	C	5		ICES rectangle
WHerC0	N	7	2	Mean weight of herring CBH age group 0 (gramme)
WHerC1	N	7	2	Mean weight of herring CBH age group 1 (gramme)
WHerC2	N	7	2	Mean weight of herring CBH age group 2 (gramme)
WHerC3	N	7	2	Mean weight of herring CBH age group 3 (gramme)

Field	Type	Length	Rounded to decimals	Description
WHerC4	N	7	2	Mean weight of herring CBH age group 4 (gramme)
WHerC5	N	7	2	Mean weight of herring CBH age group 5 (gramme)
WHerC6	N	7	2	Mean weight of herring CBH age group 6 (gramme)
WHerC7	N	7	2	Mean weight of herring CBH age group 7 (gramme)
WHerC8	N	7	2	Mean weight of herring CBH age group 8+ (gramme)

Structure of table W_Spr

Field	Type	Length	Rounded to decimals	Description
CCODE	C	20		Survey code
SD	C	4		ICES Subdivision
RECT	C	5		ICES rectangle
WSpr0	N	7	2	Mean weight of sprat age group 0 (gramme)
WSpr1	N	7	2	Mean weight of sprat age group 1 (gramme)
WSpr2	N	7	2	Mean weight of sprat age group 2 (gramme)
WSpr3	N	7	2	Mean weight of sprat age group 3 (gramme)
WSpr4	N	7	2	Mean weight of sprat age group 4 (gramme)
WSpr5	N	7	2	Mean weight of sprat age group 5 (gramme)
WSpr6	N	7	2	Mean weight of sprat age group 6 (gramme)
WSpr7	N	7	2	Mean weight of sprat age group 7 (gramme)
WSpr8	N	7	2	Mean weight of sprat age group 8+ (gramme)

Structure of table W_cod

Field	Type	Length	Rounded to decimals	Description
CCODE	C	20		Survey code
SD	C	4		ICES Subdivision
RECT	C	5		ICES rectangle
WCod0	N	7	2	Mean weight of cod age group 0 (gramme)
WCod1	N	7	2	Mean weight of cod age group 1 (gramme)
WCod2	N	7	2	Mean weight of cod age group 2 (gramme)
WCod3	N	7	2	Mean weight of cod age group 3 (gramme)
WCod4	N	7	2	Mean weight of cod age group 4 (gramme)
WCod5	N	7	2	Mean weight of cod age group 5 (gramme)
WCod6	N	7	2	Mean weight of cod age group 6 (gramme)
WCod7	N	7	2	Mean weight of cod age group 7 (gramme)
WCod8	N	7	2	Mean weight of cod age group 8+ (gramme)

Table 6.2. Structure in BIAS and BASS database format.

Structure of table SURV

Field	Type	Length	Rounded to decimals	Description
CCODE	String	10		Survey code
SHIP	String	20		Name of ship
YEAR	Int	4		Year of survey
COUNTRY	String	20		responsible country

Structure of table STAT

Field	Type	Length	Rounded to decimals	Description
CCODE	String	10		Survey code
SD	String	4		ICES subdivision
RECT	String	5		ICES rectangle
FLAG	Dec	6	4	Treatment for multiple coverage (1)
SA	Dec	10	1	NASC per ESDU
SIGMA	Dec	10	1	Acoustic cross section of mean target
NTOT	Dec	10	2	Total number of targets
HH	Dec	6	2	Proportion of herring
HS	Dec	6	2	Proportion of sprat
HC	Dec	6	2	Proportion of cod

Remarks	String	50

Structure of table NHER (abundance of herring)

Field	Type	Length	Rounded to decimals	Description
CCODE	String	10		Survey code
SD	String	4		ICES subdivision
RECT	String	5		ICES rectangle
N	Dec	10	2	Number (millions)
AGE	Int	1		Age group (1–8)

Structure of table NSPR (abundance of sprat)

Field	Type	Length	Rounded to decimals	Description
CCODE	String	10		Survey code
SD	String	4		ICES subdivision
RECT	String	5		ICES rectangle
N	Dec	10	2	Number (millions)
AGE	Int	1		Age group (1–8)

Structure of table NCOD (abundance of cod)

Field	Type	Length	Rounded to decimals	Description
CCODE	String	10		Survey code
SD	String	4		ICES subdivision
RECT	String	5		ICES rectangle
N	Dec	10	2	Number (millions)
AGE	Int	1		Age group (1–8)

Structure of table WHER (Mean weight of herring)

Field	Type	Length	Rounded to decimals	Description
CCODE	String	10		Survey code
SD	String	4		ICES subdivision
RECT	String	5		ICES rectangle
N	Dec	10	2	Mean weight (gramme)
AGE	Int	1		Age group (1–8)

Structure of table WSPR (Mean weight of sprat)

Field	Type	Length	Rounded to decimals	Description
CCODE	String	10		Survey code
SD	String	4		ICES subdivision
RECT	String	5		ICES rectangle
N	Dec	10	2	Mean weight (gramme)
AGE	Int	1		Age group (1–8)

Structure of table WCOD (Mean weight of cod)

Field	Type	Length	Rounded to decimals	Description
CCODE	String	10		Survey code
SD	String	4		ICES subdivision
RECT	String	5		ICES rectangle
N	Dec	10	2	Mean weight (gramme)
AGE	Int	1		Age group (1–8)

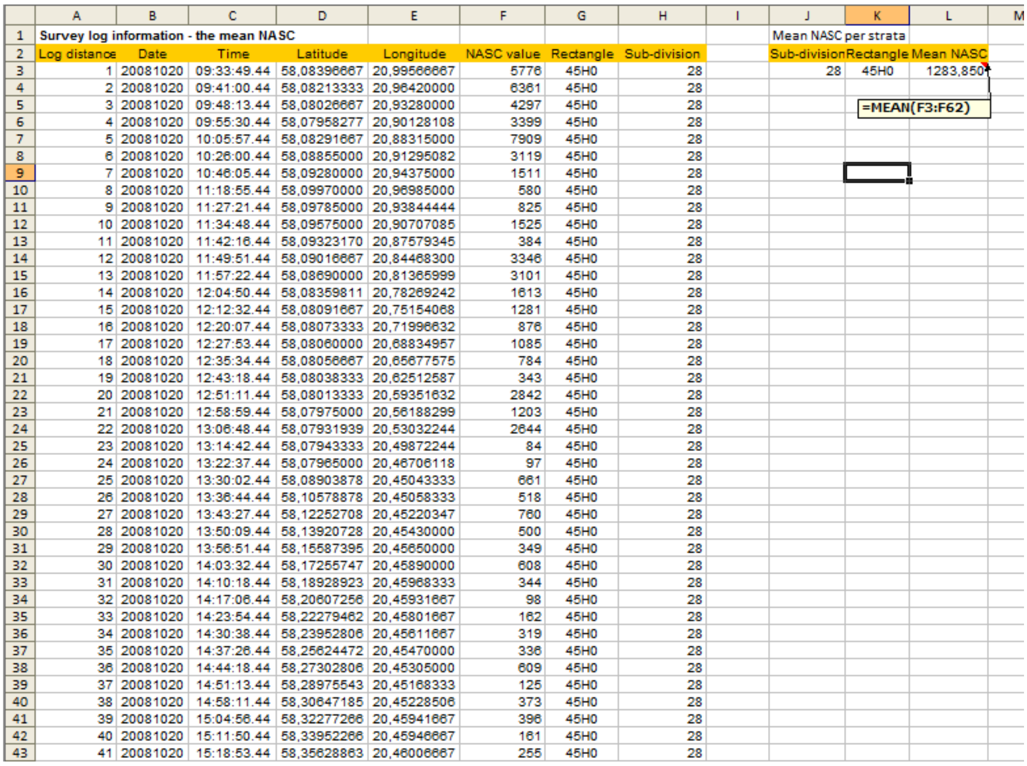
Annex 1: List of symbols

a	age group
i	species
j	length class
k	haul
a_i, b_i, d_i	parameter of the TS-length relation for species *i*
f_i	frequency of species *i*
f_a	frequency of age group *a*
f_j	frequency of length *j*
f_{ij}	frequency of length class *j* for species *i*
f_{ia}	frequency of age group *a* for species *i*
n_{ik}	fish number of species *i* in haul *k*
n_{ijk}	fish number of species *i* and length class *j* in haul *k*
q_{ai}	normalized age–length-key
A	Area of the ICES rectangle
F	fish density
L_j	length in class *j*
M	number of hauls in the ICES rectangle
M_i	number of hauls containing species *i*
N_k	total fish number in haul *k*
N_{ik}	fish number of species i in haul *k*
N_i	abundance of species *i*
N_{ia}	abundance of age group a for species *i*
N	total abundance
s_A	nautical area scattering coefficient (NASC)
$s_A(k)$	NASC value during haul *k*
$s_A(i,k)$	NASC value of species i during haul *k*
W_j	mean weight in length class *j*
W_a	mean weight of age group *a*
Q_{ai}	biomass of age group a for species *i*
$<\sigma>$	mean cross section
$<\sigma_i>$	mean cross section of species *i*

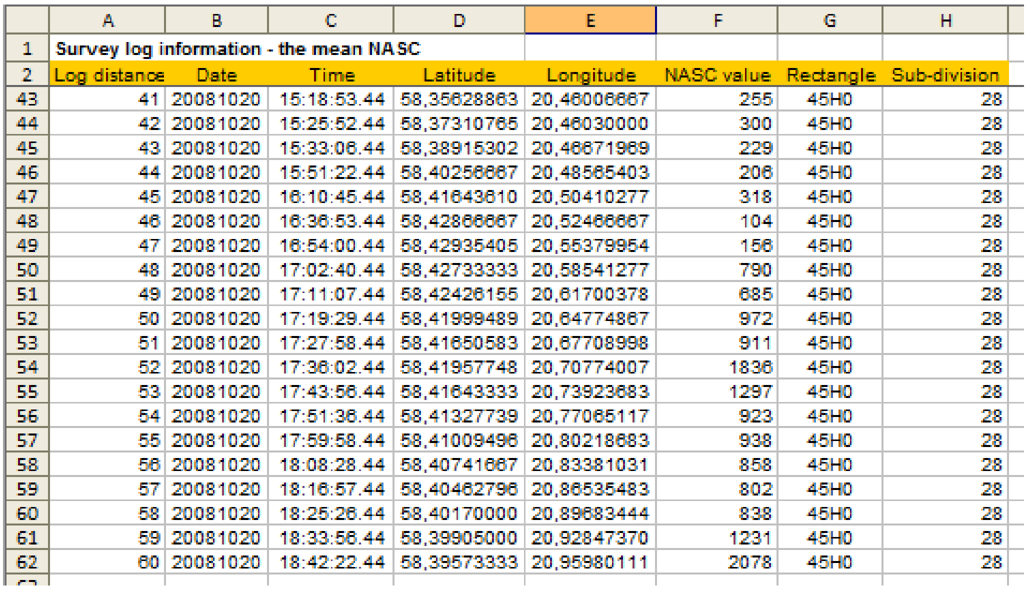
Note: more information about definitions and symbols used in fisheries acoustics is presented e.g. in MacLennan *et al.* (2002), and about sources of error in acoustic estimation of fish abundance – in Aglen (1994).

Annex 2: The example of calculation method and formulas used for fish stocks abundance and biomass

Survey log information – the mean NASC

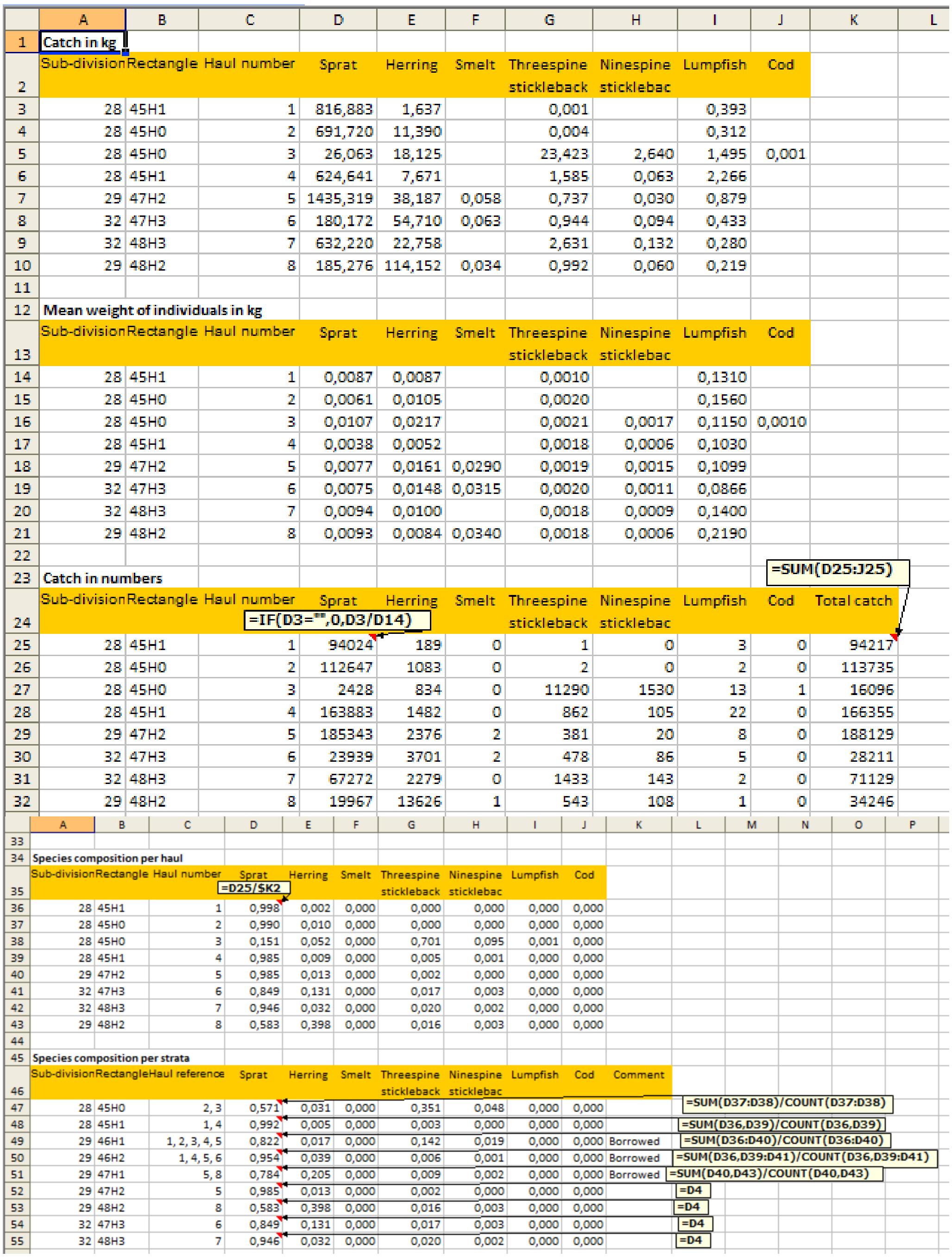


	A	B	C	D	E	F	G	H	I	J	K	L	M
1	Survey log information - the mean NASC									Mean NASC per strata			
2	Log distance	Date	Time	Latitude	Longitude	NASC value	Rectangle	Sub-division		Sub-division	Rectangle	Mean NASC	
3	1	20081020	09:33:49.44	58,08396667	20,99566667	5776	45H0	28		28	45H0	1283,850	
4	2	20081020	09:41:00.44	58,08213333	20,96420000	6361	45H0	28					
5	3	20081020	09:48:13.44	58,08026667	20,93280000	4297	45H0	28			=MEAN(F3:F62)		
6	4	20081020	09:55:30.44	58,07958277	20,90128108	3399	45H0	28					
7	5	20081020	10:05:57.44	58,08291667	20,88315000	7909	45H0	28					
8	6	20081020	10:26:00.44	58,08855000	20,91295082	3119	45H0	28					
9	7	20081020	10:46:05.44	58,09280000	20,94375000	1511	45H0	28					
10	8	20081020	11:18:55.44	58,09970000	20,96985000	580	45H0	28					
11	9	20081020	11:27:21.44	58,09785000	20,93844444	825	45H0	28					
12	10	20081020	11:34:48.44	58,09575000	20,90707085	1525	45H0	28					
13	11	20081020	11:42:16.44	58,09323170	20,87579345	384	45H0	28					
14	12	20081020	11:49:51.44	58,09016667	20,84468300	3346	45H0	28					
15	13	20081020	11:57:22.44	58,08690000	20,81365999	3101	45H0	28					
16	14	20081020	12:04:50.44	58,08359811	20,78269242	1613	45H0	28					
17	15	20081020	12:12:32.44	58,08091667	20,75154068	1281	45H0	28					
18	16	20081020	12:20:07.44	58,08073333	20,71996632	876	45H0	28					
19	17	20081020	12:27:53.44	58,08060000	20,68834957	1085	45H0	28					
20	18	20081020	12:35:34.44	58,08056667	20,65677575	784	45H0	28					
21	19	20081020	12:43:18.44	58,08038333	20,62512587	343	45H0	28					
22	20	20081020	12:51:11.44	58,08013333	20,59351632	2842	45H0	28					
23	21	20081020	12:58:59.44	58,07975000	20,56188299	1203	45H0	28					
24	22	20081020	13:06:48.44	58,07931939	20,53032244	2644	45H0	28					
25	23	20081020	13:14:42.44	58,07943333	20,49872244	84	45H0	28					
26	24	20081020	13:22:37.44	58,07965000	20,46706118	97	45H0	28					
27	25	20081020	13:30:02.44	58,08903878	20,45043333	661	45H0	28					
28	26	20081020	13:36:44.44	58,10578878	20,45058333	518	45H0	28					
29	27	20081020	13:43:27.44	58,12252708	20,45220347	760	45H0	28					
30	28	20081020	13:50:09.44	58,13920728	20,45430000	500	45H0	28					
31	29	20081020	13:56:51.44	58,15587395	20,45650000	349	45H0	28					
32	30	20081020	14:03:32.44	58,17255747	20,45890000	608	45H0	28					
33	31	20081020	14:10:18.44	58,18928923	20,45968333	344	45H0	28					
34	32	20081020	14:17:06.44	58,20607256	20,45931667	98	45H0	28					
35	33	20081020	14:23:54.44	58,22279462	20,45801667	162	45H0	28					
36	34	20081020	14:30:38.44	58,23952806	20,45611667	319	45H0	28					
37	35	20081020	14:37:26.44	58,25624472	20,45470000	336	45H0	28					
38	36	20081020	14:44:18.44	58,27302806	20,45305000	609	45H0	28					
39	37	20081020	14:51:13.44	58,28975543	20,45168333	125	45H0	28					
40	38	20081020	14:58:11.44	58,30647185	20,45228506	373	45H0	28					
41	39	20081020	15:04:56.44	58,32277266	20,45941667	396	45H0	28					
42	40	20081020	15:11:50.44	58,33952266	20,45946667	161	45H0	28					
43	41	20081020	15:18:53.44	58,35628863	20,46006667	255	45H0	28					



	A	B	C	D	E	F	G	H
1	Survey log information - the mean NASC							
2	Log distance	Date	Time	Latitude	Longitude	NASC value	Rectangle	Sub-division
43	41	20081020	15:18:53.44	58,35628863	20,46006667	255	45H0	28
44	42	20081020	15:25:52.44	58,37310765	20,46030000	300	45H0	28
45	43	20081020	15:33:06.44	58,38915302	20,46671969	229	45H0	28
46	44	20081020	15:51:22.44	58,40256667	20,48565403	206	45H0	28
47	45	20081020	16:10:45.44	58,41643610	20,50410277	318	45H0	28
48	46	20081020	16:36:53.44	58,42866667	20,52466667	104	45H0	28
49	47	20081020	16:54:00.44	58,42935405	20,55379954	156	45H0	28
50	48	20081020	17:02:40.44	58,42733333	20,58541277	790	45H0	28
51	49	20081020	17:11:07.44	58,42426155	20,61700378	685	45H0	28
52	50	20081020	17:19:29.44	58,41999489	20,64774867	972	45H0	28
53	51	20081020	17:27:58.44	58,41650583	20,67708998	911	45H0	28
54	52	20081020	17:36:02.44	58,41957748	20,70774007	1836	45H0	28
55	53	20081020	17:43:56.44	58,41643333	20,73923683	1297	45H0	28
56	54	20081020	17:51:36.44	58,41327739	20,77065117	923	45H0	28
57	55	20081020	17:59:58.44	58,41009496	20,80218683	938	45H0	28
58	56	20081020	18:08:28.44	58,40741667	20,83381031	858	45H0	28
59	57	20081020	18:16:57.44	58,40462796	20,86535483	802	45H0	28
60	58	20081020	18:25:26.44	58,40170000	20,89683444	838	45H0	28
61	59	20081020	18:33:56.44	58,39905000	20,92847370	1231	45H0	28
62	60	20081020	18:42:22.44	58,39573333	20,95980111	2078	45H0	28

The species composition - Catch in kg; Mean weight of individuals in kg; Catch in numbers; Species composition per haul; Species composition per strata



Catch in kg

Sub-division	Rectangle	Haul number	Sprat	Herring	Smelt	Threespine stickleback	Ninespine stickleback	Lumpfish	Cod
28	45H1	1	816,883	1,637		0,001		0,393	
28	45H0	2	691,720	11,390		0,004		0,312	
28	45H0	3	26,063	18,125		23,423	2,640	1,495	0,001
28	45H1	4	624,641	7,671		1,585	0,063	2,266	
29	47H2	5	1435,319	38,187	0,058	0,737	0,030	0,879	
32	47H3	6	180,172	54,710	0,063	0,944	0,094	0,433	
32	48H3	7	632,220	22,758		2,631	0,132	0,280	
29	48H2	8	185,276	114,152	0,034	0,992	0,060	0,219	

Mean weight of individuals in kg

Sub-division	Rectangle	Haul number	Sprat	Herring	Smelt	Threespine stickleback	Ninespine stickleback	Lumpfish	Cod
28	45H1	1	0,0087	0,0087		0,0010		0,1310	
28	45H0	2	0,0061	0,0105		0,0020		0,1560	
28	45H0	3	0,0107	0,0217		0,0021	0,0017	0,1150	0,0010
28	45H1	4	0,0038	0,0052		0,0018	0,0006	0,1030	
29	47H2	5	0,0077	0,0161	0,0290	0,0019	0,0015	0,1099	
32	47H3	6	0,0075	0,0148	0,0315	0,0020	0,0011	0,0866	
32	48H3	7	0,0094	0,0100		0,0018	0,0009	0,1400	
29	48H2	8	0,0093	0,0084	0,0340	0,0018	0,0006	0,2190	

Catch in numbers

=IF(D3="",0,D3/D14)

=SUM(D25:J25)

Sub-division	Rectangle	Haul number	Sprat	Herring	Smelt	Threespine stickleback	Ninespine stickleback	Lumpfish	Cod	Total catch
28	45H1	1	94024	189	0	1	0	3	0	94217
28	45H0	2	112647	1083	0	2	0	2	0	113735
28	45H0	3	2428	834	0	11290	1530	13	1	16096
28	45H1	4	163883	1482	0	862	105	22	0	166355
29	47H2	5	185343	2376	2	381	20	8	0	188129
32	47H3	6	23939	3701	2	478	86	5	0	28211
32	48H3	7	67272	2279	0	1433	143	2	0	71129
29	48H2	8	19967	13626	1	543	108	1	0	34246

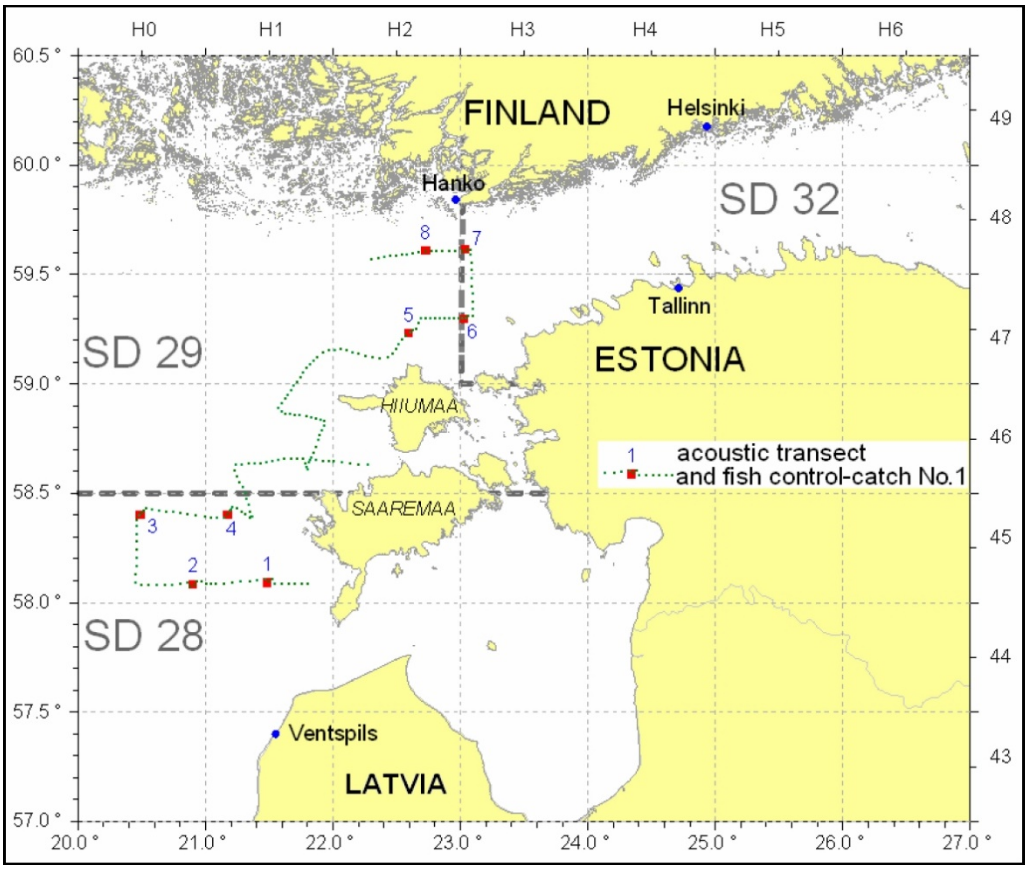
Species composition per haul

=D25/$K2

Sub-division	Rectangle	Haul number	Sprat	Herring	Smelt	Threespine stickleback	Ninespine stickleback	Lumpfish	Cod
28	45H1	1	0,998	0,002	0,000	0,000	0,000	0,000	0,000
28	45H0	2	0,990	0,010	0,000	0,000	0,000	0,000	0,000
28	45H0	3	0,151	0,052	0,000	0,701	0,095	0,001	0,000
28	45H1	4	0,985	0,009	0,000	0,005	0,001	0,000	0,000
29	47H2	5	0,985	0,013	0,000	0,002	0,000	0,000	0,000
32	47H3	6	0,849	0,131	0,000	0,017	0,003	0,000	0,000
32	48H3	7	0,946	0,032	0,000	0,020	0,002	0,000	0,000
29	48H2	8	0,583	0,398	0,000	0,016	0,003	0,000	0,000

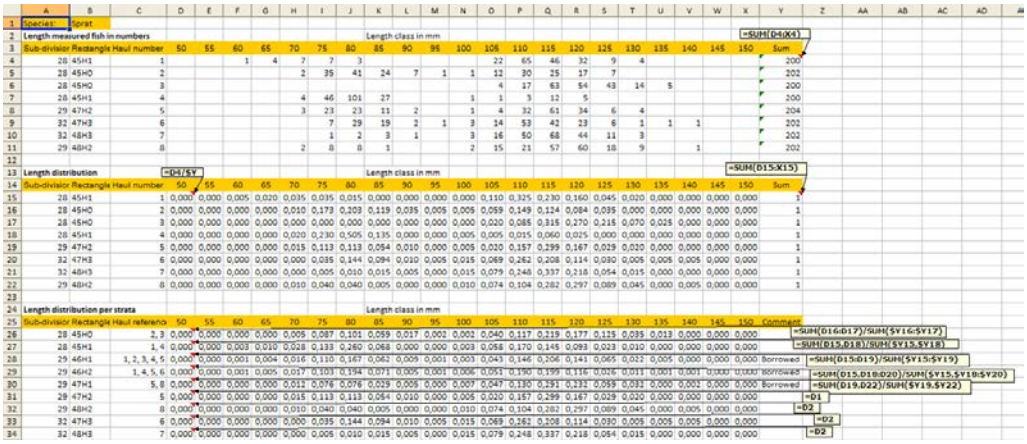
Species composition per strata

Sub-division	Rectangle	Haul reference	Sprat	Herring	Smelt	Threespine stickleback	Ninespine stickleback	Lumpfish	Cod	Comment	
28	45H0	2, 3	0,571	0,031	0,000	0,351	0,048	0,000	0,000		=SUM(D37:D38)/COUNT(D37:D38)
28	45H1	1, 4	0,992	0,005	0,000	0,003	0,000	0,000	0,000		=SUM(D36,D39)/COUNT(D36,D39)
29	46H1	1, 2, 3, 4, 5	0,822	0,017	0,000	0,142	0,019	0,000	0,000	Borrowed	=SUM(D36:D40)/COUNT(D36:D40)
29	46H2	1, 4, 5, 6	0,954	0,039	0,000	0,006	0,001	0,000	0,000	Borrowed	=SUM(D36,D39:D41)/COUNT(D36,D39:D41)
29	47H1	5, 8	0,784	0,205	0,000	0,009	0,002	0,000	0,000	Borrowed	=SUM(D40,D43)/COUNT(D40,D43)
29	47H2	5	0,985	0,013	0,000	0,002	0,000	0,000	0,000		=D4
29	48H2	8	0,583	0,398	0,000	0,016	0,003	0,000	0,000		=D4
32	47H3	6	0,849	0,131	0,000	0,017	0,003	0,000	0,000		=D4
32	48H3	7	0,946	0,032	0,000	0,020	0,002	0,000	0,000		=D4



The example of map reflecting location of the BIAS survey acoustic transects and fish catch-stations.

Length distribution - Length measured fish in numbers; Length distribution; Length distribution per strata; on the example of sprat



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y
1	Species:	Sprat																							
2	Length measured fish in numbers										Length class in mm														
3	Sub-divisior	Rectangle	Haul number	50	55	60	65	70	75	80	85	90	95	100	105	110	115	120	125	130	135	140	145	150	Sum
4	28	45H1	1			1	4	7	7	3					22	65	46	32	9	4					200
5	28	45H0	2					2	35	41	24	7	1	1	12	30	25	17	7						202
6	28	45H0	3												4	17	63	54	43	14	5				200
7	28	45H1	4					4	46	101	27			1	1	3	12	5							200
8	29	47H2	5					3	23	23	11	2		1	4	32	61	34	6	4					204
9	32	47H3	6						7	29	19	2	1	3	14	53	42	23	6	1	1	1			202
10	32	48H3	7						1	2	3	1		3	16	50	68	44	11	3					202
11	29	48H2	8					2	8	8	1			2	15	21	57	60	18	9		1			202
12																									
13	Length distribution										Length class in mm														
14	Sub-divisior	Rectangle	Haul number	50	55	60	65	70	75	80	85	90	95	100	105	110	115	120	125	130	135	140	145	150	Sum
15	28	45H1	1	0,000	0,000	0,005	0,020	0,035	0,035	0,015	0,000	0,000	0,000	0,000	0,110	0,325	0,230	0,160	0,045	0,020	0,000	0,000	0,000	0,000	1
16	28	45H0	2	0,000	0,000	0,000	0,000	0,010	0,173	0,203	0,119	0,035	0,005	0,005	0,059	0,149	0,124	0,084	0,035	0,000	0,000	0,000	0,000	0,000	1
17	28	45H0	3	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,020	0,085	0,315	0,270	0,215	0,070	0,025	0,000	0,000	0,000	1
18	28	45H1	4	0,000	0,000	0,000	0,000	0,020	0,230	0,505	0,135	0,000	0,000	0,005	0,005	0,015	0,060	0,025	0,000	0,000	0,000	0,000	0,000	0,000	1
19	29	47H2	5	0,000	0,000	0,000	0,000	0,015	0,113	0,113	0,054	0,010	0,000	0,005	0,020	0,157	0,299	0,167	0,029	0,020	0,000	0,000	0,000	0,000	1
20	32	47H3	6	0,000	0,000	0,000	0,000	0,000	0,035	0,144	0,094	0,010	0,005	0,015	0,069	0,262	0,208	0,114	0,030	0,005	0,005	0,005	0,000	0,000	1
21	32	48H3	7	0,000	0,000	0,000	0,000	0,000	0,005	0,010	0,015	0,005	0,000	0,015	0,079	0,248	0,337	0,218	0,054	0,015	0,000	0,000	0,000	0,000	1
22	29	48H2	8	0,000	0,000	0,000	0,000	0,010	0,040	0,040	0,005	0,000	0,000	0,010	0,074	0,104	0,282	0,297	0,089	0,045	0,000	0,005	0,000	0,000	1
23																									
24	Length distribution per strata										Length class in mm														
25	Sub-divisior	Rectangle	Haul referenc	50	55	60	65	70	75	80	85	90	95	100	105	110	115	120	125	130	135	140	145	150	Comment
26	28	45H0	2, 3	0,000	0,000	0,000	0,000	0,005	0,087	0,101	0,059	0,017	0,002	0,002	0,040	0,117	0,219	0,177	0,125	0,035	0,013	0,000	0,000	0,000	
27	28	45H1	1, 4	0,000	0,000	0,003	0,010	0,028	0,133	0,260	0,068	0,000	0,000	0,003	0,058	0,170	0,145	0,093	0,023	0,010	0,000	0,000	0,000	0,000	
28	29	46H1	1, 2, 3, 4, 5	0,000	0,000	0,001	0,004	0,016	0,110	0,167	0,062	0,009	0,001	0,003	0,043	0,146	0,206	0,141	0,065	0,022	0,005	0,000	0,000	0,000	Borrowed
29	29	46H2	1, 4, 5, 6	0,000	0,000	0,001	0,005	0,017	0,103	0,194	0,071	0,005	0,001	0,006	0,051	0,190	0,199	0,116	0,026	0,011	0,001	0,001	0,000	0,000	Borrowed
30	29	47H1	5, 8	0,000	0,000	0,000	0,000	0,012	0,076	0,076	0,029	0,005	0,000	0,007	0,047	0,130	0,291	0,232	0,059	0,032	0,000	0,002	0,000	0,000	Borrowed
31	29	47H2	5	0,000	0,000	0,000	0,000	0,015	0,113	0,113	0,054	0,010	0,000	0,005	0,020	0,157	0,299	0,167	0,029	0,020	0,000	0,000	0,000	0,000	
32	29	48H2	8	0,000	0,000	0,000	0,000	0,010	0,040	0,040	0,005	0,000	0,000	0,010	0,074	0,104	0,282	0,297	0,089	0,045	0,000	0,005	0,000	0,000	
33	32	47H3	6	0,000	0,000	0,000	0,000	0,000	0,035	0,144	0,094	0,010	0,005	0,015	0,069	0,262	0,208	0,114	0,030	0,005	0,005	0,005	0,000	0,000	
34	32	48H3	7	0,000	0,000	0,000	0,000	0,000	0,005	0,010	0,015	0,005	0,000	0,015	0,079	0,248	0,337	0,218	0,054	0,015	0,000	0,000	0,000	0,000	

=SUM(D4:X4)

=D4/$Y

=SUM(D15:X15)

=SUM(D16:D17)/SUM($Y16:$Y17)

=SUM(D15,D18)/SUM($Y15,$Y18)

=SUM(D15:D19)/SUM($Y15:$Y19)

=SUM(D15,D18:D20)/SUM($Y15,$Y18:$Y20)

=SUM(D19,D22)/SUM($Y19,$Y22)

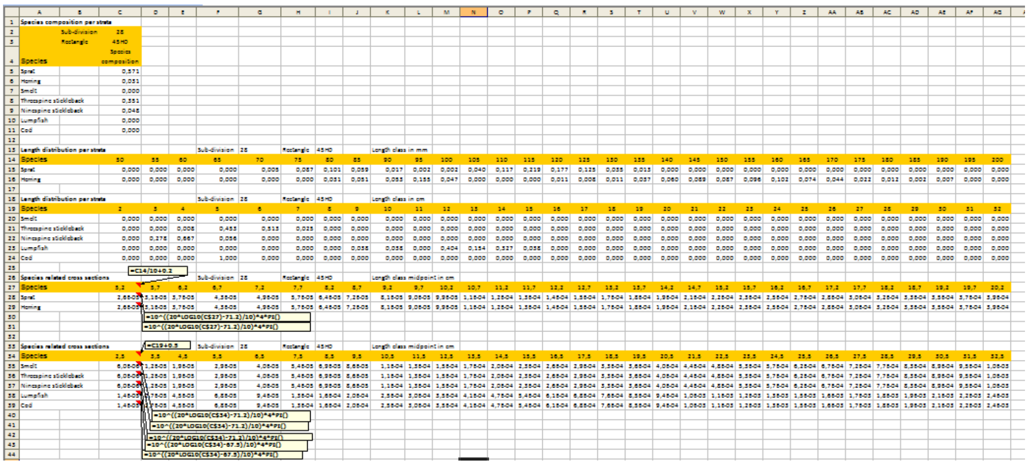
=D1

=D2

=D2

=D2

The mean cross section



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG
1	Species composition per strata																																
2		Sub-division	28																														
3		Rectangle	45H0																														
4	Species		Species composition																														
5	Sprat		0,571																														
6	Herring		0,051																														
7	Smelt		0,000																														
8	Threespine stickleback		0,331																														
9	Ninespine stickleback		0,048																														
10	Lumpfish		0,000																														
11	Cod		0,000																														
12																																	
13	Length distribution per strata					Sub-division	28	Rectangle	45H0		Length class in mm																						
14	Species		50	55	60	65	70	75	80	85	90	95	100	105	110	115	120	125	130	135	140	145	150	155	160	165	170	175	180	185	190	195	200
15	Sprat		0,000	0,000	0,000	0,000	0,005	0,087	0,101	0,059	0,017	0,002	0,002	0,040	0,117	0,219	0,177	0,125	0,035	0,013	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000
16	Herring		0,000	0,000	0,000	0,000	0,000	0,000	0,051	0,051	0,053	0,155	0,047	0,000	0,000	0,000	0,011	0,008	0,011	0,037	0,060	0,089	0,087	0,096	0,102	0,074	0,044	0,022	0,012	0,002	0,007	0,000	0,000
17																																	
18	Length distribution per strata					Sub-division	28	Rectangle	45H0		Length class in cm																						
19	Species		2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
20	Smelt		0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000
21	Threespine stickleback		0,000	0,000	0,008	0,455	0,515	0,025	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000
22	Ninespine stickleback		0,000	0,278	0,667	0,056	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000
23	Lumpfish		0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,038	0,038	0,000	0,404	0,154	0,327	0,038	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000
24	Cod		0,000	0,000	0,000	1,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000
25																																	
26	Species related cross sections					Sub-division	28	Rectangle	45H0		Length class midpoint in cm																						
27	Species		5,2	5,7	6,2	6,7	7,2	7,7	8,2	8,7	9,2	9,7	10,2	10,7	11,2	11,7	12,2	12,7	13,2	13,7	14,2	14,7	15,2	15,7	16,2	16,7	17,2	17,7	18,2	18,7	19,2	19,7	20,2
28	Sprat		2,6E-05	3,1E-05	3,7E-05	4,3E-05	4,9E-05	5,7E-05	6,4E-05	7,2E-05	8,1E-05	9,0E-05	9,9E-05	1,1E-04	1,2E-04	1,3E-04	1,4E-04	1,5E-04	1,7E-04	1,8E-04	1,9E-04	2,1E-04	2,2E-04	2,3E-04	2,5E-04	2,7E-04	2,8E-04	3,0E-04	3,2E-04	3,3E-04	3,5E-04	3,7E-04	3,9E-04
29	Herring		2,6E-05	3,1E-05	3,7E-05	4,3E-05	4,9E-05	5,7E-05	6,4E-05	7,2E-05	8,1E-05	9,0E-05	9,9E-05	1,1E-04	1,2E-04	1,3E-04	1,4E-04	1,5E-04	1,7E-04	1,8E-04	1,9E-04	2,1E-04	2,2E-04	2,3E-04	2,5E-04	2,7E-04	2,8E-04	3,0E-04	3,2E-04	3,3E-04	3,5E-04	3,7E-04	3,9E-04
30																																	
31																																	
32																																	
33	Species related cross sections					Sub-division	28	Rectangle	45H0		Length class midpoint in cm																						
34	Species		2,5	3,5	4,5	5,5	6,5	7,5	8,5	9,5	10,5	11,5	12,5	13,5	14,5	15,5	16,5	17,5	18,5	19,5	20,5	21,5	22,5	23,5	24,5	25,5	26,5	27,5	28,5	29,5	30,5	31,5	32,5
35	Smelt		6,0E-06	1,2E-05	1,9E-05	2,9E-05	4,0E-05	5,4E-05	6,9E-05	8,6E-05	1,1E-04	1,3E-04	1,5E-04	1,7E-04	2,0E-04	2,3E-04	2,6E-04	2,9E-04	3,3E-04	3,6E-04	4,0E-04	4,4E-04	4,8E-04	5,3E-04	5,7E-04	6,2E-04	6,7E-04	7,2E-04	7,7E-04	8,3E-04	8,9E-04	9,5E-04	1,0E-03
36	Threespine stickleback		6,0E-06	1,2E-05	1,9E-05	2,9E-05	4,0E-05	5,4E-05	6,9E-05	8,6E-05	1,1E-04	1,3E-04	1,5E-04	1,7E-04	2,0E-04	2,3E-04	2,6E-04	2,9E-04	3,3E-04	3,6E-04	4,0E-04	4,4E-04	4,8E-04	5,3E-04	5,7E-04	6,2E-04	6,7E-04	7,2E-04	7,7E-04	8,3E-04	8,9E-04	9,5E-04	1,0E-03
37	Ninespine stickleback		6,0E-06	1,2E-05	1,9E-05	2,9E-05	4,0E-05	5,4E-05	6,9E-05	8,6E-05	1,1E-04	1,3E-04	1,5E-04	1,7E-04	2,0E-04	2,3E-04	2,6E-04	2,9E-04	3,3E-04	3,6E-04	4,0E-04	4,4E-04	4,8E-04	5,3E-04	5,7E-04	6,2E-04	6,7E-04	7,2E-04	7,7E-04	8,3E-04	8,9E-04	9,5E-04	1,0E-03
38	Lumpfish		1,4E-05	2,7E-05	4,5E-05	6,8E-05	9,4E-05	1,3E-04	1,6E-04	2,0E-04	2,5E-04	3,0E-04	3,5E-04	4,1E-04	4,7E-04	5,4E-04	6,1E-04	6,8E-04	7,6E-04	8,5E-04	9,4E-04	1,0E-03	1,1E-03	1,2E-03	1,3E-03	1,5E-03	1,6E-03	1,7E-03	1,8E-03	1,9E-03	2,1E-03	2,2E-03	2,4E-03
39	Cod		1,4E-05	2,7E-05	4,5E-05	6,8E-05	9,4E-05	1,3E-04	1,6E-04	2,0E-04	2,5E-04	3,0E-04	3,5E-04	4,1E-04	4,7E-04	5,4E-04	6,1E-04	6,8E-04	7,6E-04	8,5E-04	9,4E-04	1,0E-03	1,1E-03	1,2E-03	1,3E-03	1,5E-03	1,6E-03	1,7E-03	1,8E-03	1,9E-03	2,1E-03	2,2E-03	2,4E-03
40																																	
41																																	
42																																	
43																																	
44																																	

=C14/10+0.2

=10^((20*LOG10(C$27)-71.2)/10)*4*PI()

=10^((20*LOG10(C$27)-71.2)/10)*4*PI()

=C19+0.5

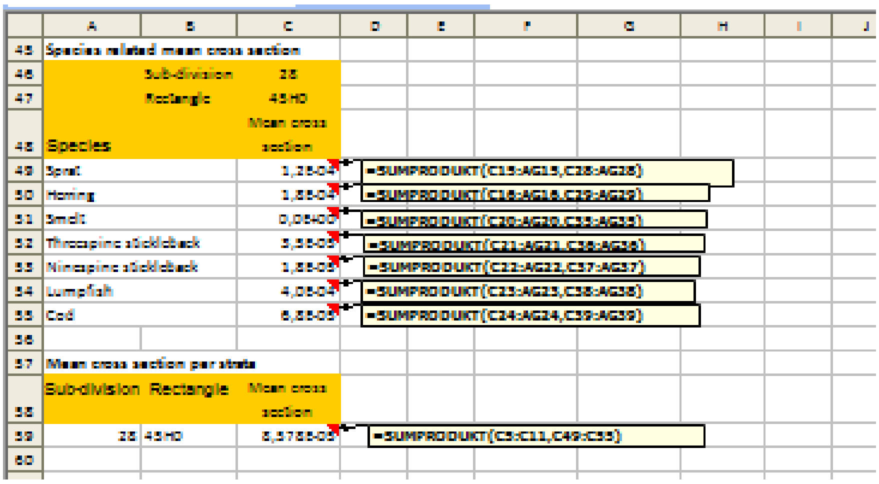
=10^((20*LOG10(C$34)-71.2)/10)*4*PI()

=10^((20*LOG10(C$34)-71.2)/10)*4*PI()

=10^((20*LOG10(C$34)-71.2)/10)*4*PI()

=10^((20*LOG10(C$34)-67.5)/10)*4*PI()

=10^((20*LOG10(C$34)-67.5)/10)*4*PI()



	A	B	C
45	Species related mean cross section		
46		Sub-division	28
47		Rectangle	45H0
48	Species		Mean cross section
49	Sprat		1,2E-04
50	Herring		1,8E-04
51	Smelt		0,0E+00
52	Threespine stickleback		3,5E-05
53	Ninespine stickleback		1,8E-05
54	Lumpfish		4,0E-04
55	Cod		6,8E-05
56			
57	Mean cross section per strata		
58	Sub-division	Rectangle	Mean cross section
59	28	45H0	8,3788E-05
60			

=SUMPRODUKT(C15:AG15,C28:AG28)

=SUMPRODUKT(C16:AG16,C29:AG29)

=SUMPRODUKT(C20:AG20,C35:AG35)

=SUMPRODUKT(C21:AG21,C36:AG36)

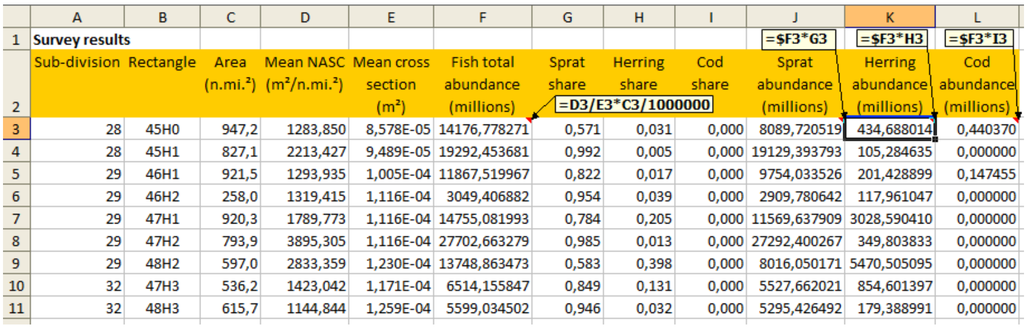
=SUMPRODUKT(C22:AG22,C37:AG37)

=SUMPRODUKT(C23:AG23,C38:AG38)

=SUMPRODUKT(C24:AG24,C39:AG39)

=SUMPRODUKT(C5:C11,C49:C55)

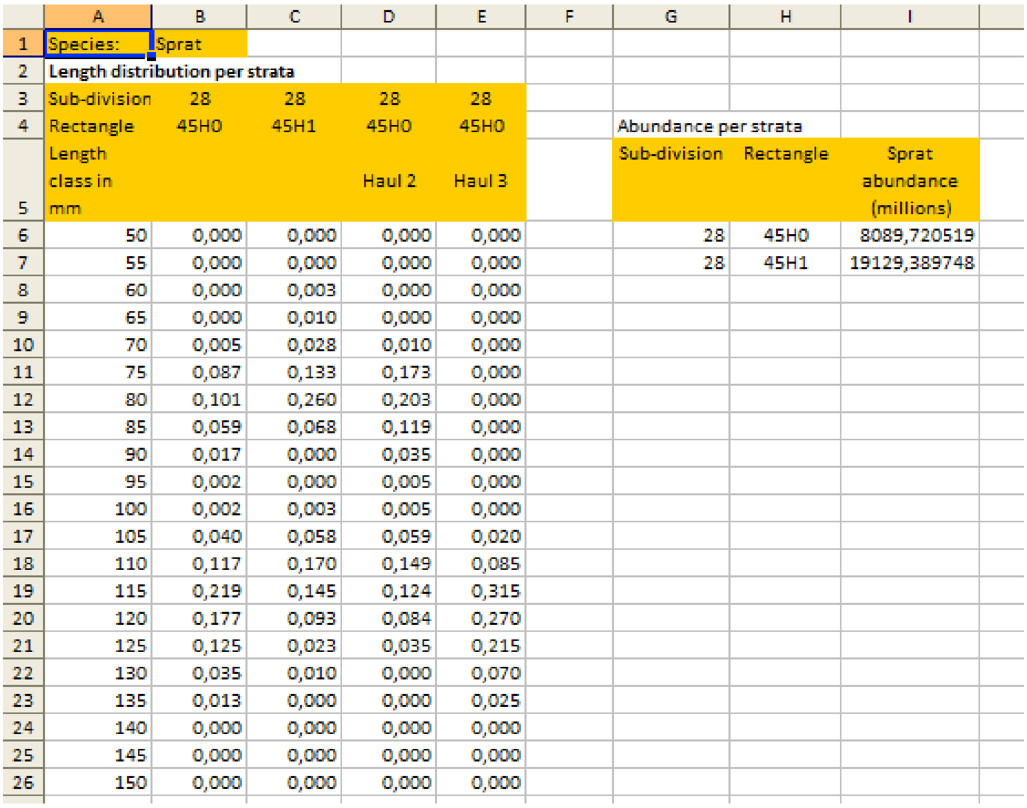
Abundance estimation



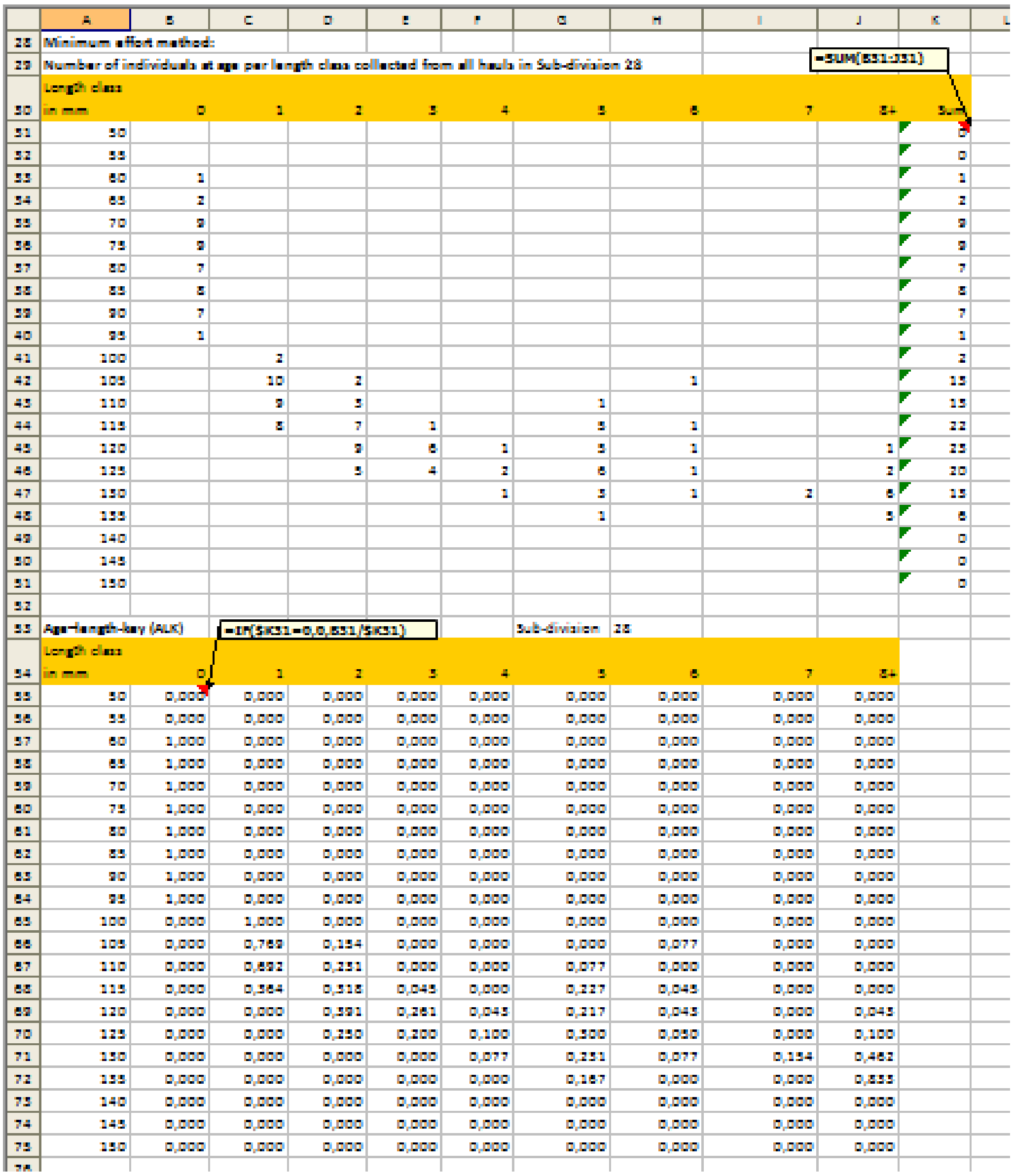
	A	B	C	D	E	F	G	H	I	J	K	L
1	**Survey results**									=$F3*G3	=$F3*H3	=$F3*I3
2	Sub-division	Rectangle	Area (n.mi.²)	Mean NASC (m²/n.mi.²)	Mean cross section (m²)	Fish total abundance (millions)	Sprat share	Herring share	Cod share	Sprat abundance (millions)	Herring abundance (millions)	Cod abundance (millions)
3	28	45H0	947,2	1283,850	8,578E-05	14176,778271	0,571	0,031	0,000	8089,720519	434,688014	0,440370
4	28	45H1	827,1	2213,427	9,489E-05	19292,453681	0,992	0,005	0,000	19129,393793	105,284635	0,000000
5	29	46H1	921,5	1293,935	1,005E-04	11867,519967	0,822	0,017	0,000	9754,033526	201,428899	0,147455
6	29	46H2	258,0	1319,415	1,116E-04	3049,406882	0,954	0,039	0,000	2909,780642	117,961047	0,000000
7	29	47H1	920,3	1789,773	1,116E-04	14755,081993	0,784	0,205	0,000	11569,637909	3028,590410	0,000000
8	29	47H2	793,9	3895,305	1,116E-04	27702,663279	0,985	0,013	0,000	27292,400267	349,803833	0,000000
9	29	48H2	597,0	2833,359	1,230E-04	13748,863473	0,583	0,398	0,000	8016,050171	5470,505095	0,000000
10	32	47H3	536,2	1423,042	1,171E-04	6514,155847	0,849	0,131	0,000	5527,662021	854,601397	0,000000
11	32	48H3	615,7	1144,844	1,259E-04	5599,034502	0,946	0,032	0,000	5295,426492	179,388991	0,000000

=D3/E3*C3/1000000

Length-age distribution – on the example of sprat



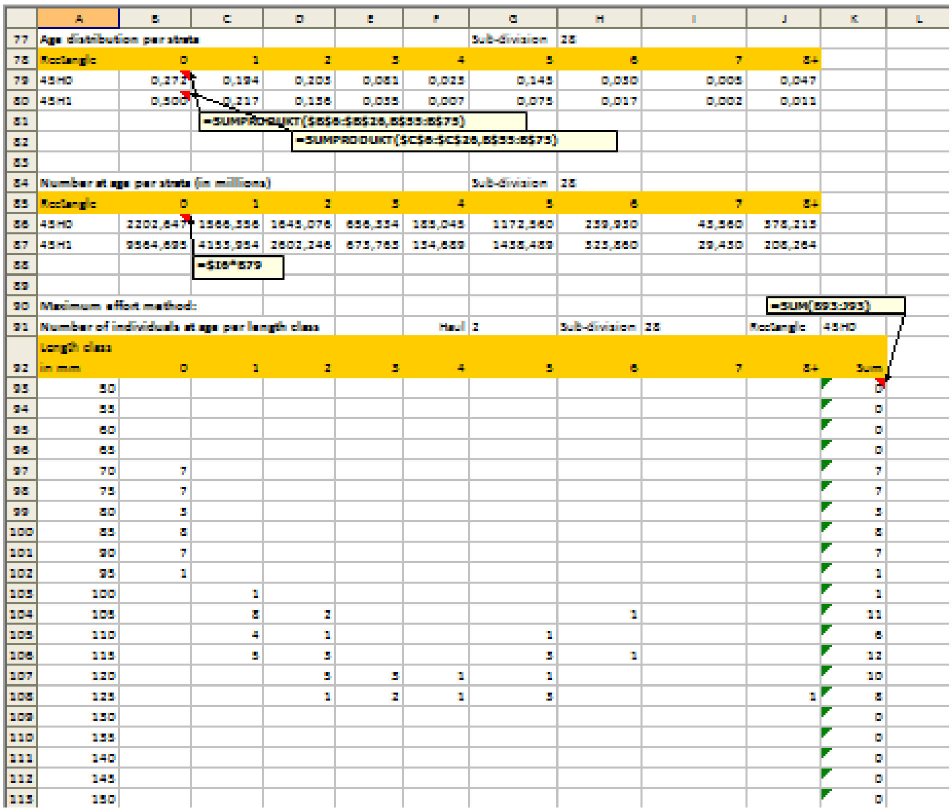
	A	B	C	D	E	F	G	H	I
1	Species:	Sprat							
2	Length distribution per strata								
3	Sub-division	28	28	28	28				
4	Rectangle	45H0	45H1	45H0	45H0		Abundance per strata		
5	Length class in mm			Haul 2	Haul 3		Sub-division	Rectangle	Sprat abundance (millions)
6	50	0,000	0,000	0,000	0,000		28	45H0	8089,720519
7	55	0,000	0,000	0,000	0,000		28	45H1	19129,389748
8	60	0,000	0,003	0,000	0,000				
9	65	0,000	0,010	0,000	0,000				
10	70	0,005	0,028	0,010	0,000				
11	75	0,087	0,133	0,173	0,000				
12	80	0,101	0,260	0,203	0,000				
13	85	0,059	0,068	0,119	0,000				
14	90	0,017	0,000	0,035	0,000				
15	95	0,002	0,000	0,005	0,000				
16	100	0,002	0,003	0,005	0,000				
17	105	0,040	0,058	0,059	0,020				
18	110	0,117	0,170	0,149	0,085				
19	115	0,219	0,145	0,124	0,315				
20	120	0,177	0,093	0,084	0,270				
21	125	0,125	0,023	0,035	0,215				
22	130	0,035	0,010	0,000	0,070				
23	135	0,013	0,000	0,000	0,025				
24	140	0,000	0,000	0,000	0,000				
25	145	0,000	0,000	0,000	0,000				
26	150	0,000	0,000	0,000	0,000				



=SUM(B31:J31)

=IF($K31=0,0,B31/$K31)

	A	B	C	D	E	F	G	H	I	J	K
28	Minimum effort method:										
29	Number of individuals at age per length class collected from all hauls in Sub-division 28										
30	Length class in mm	0	1	2	3	4	5	6	7	8+	Sum
31	50										0
32	55										0
33	60	1									1
34	65	2									2
35	70	9									9
36	75	9									9
37	80	7									7
38	85	8									8
39	90	7									7
40	95	1									1
41	100		2								2
42	105		10	2				1			13
43	110		9	3			1				13
44	115		8	7	1		5	1			22
45	120			9	6	1	5	1		1	23
46	125			5	4	2	6	1		2	20
47	130					1	3	1	2	6	13
48	135						1			5	6
49	140										0
50	145										0
51	150										0
52											
53	Age-length-key (ALK)						Sub-division	28			
54	Length class in mm	0	1	2	3	4	5	6	7	8+	
55	50	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	
56	55	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	
57	60	1,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	
58	65	1,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	
59	70	1,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	
60	75	1,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	
61	80	1,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	
62	85	1,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	
63	90	1,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	
64	95	1,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	
65	100	0,000	1,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	
66	105	0,000	0,769	0,154	0,000	0,000	0,000	0,077	0,000	0,000	
67	110	0,000	0,692	0,231	0,000	0,000	0,077	0,000	0,000	0,000	
68	115	0,000	0,364	0,318	0,045	0,000	0,227	0,045	0,000	0,000	
69	120	0,000	0,000	0,391	0,261	0,043	0,217	0,043	0,000	0,043	
70	125	0,000	0,000	0,250	0,200	0,100	0,300	0,050	0,000	0,100	
71	130	0,000	0,000	0,000	0,000	0,077	0,231	0,077	0,154	0,462	
72	135	0,000	0,000	0,000	0,000	0,000	0,167	0,000	0,000	0,833	
73	140	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	
74	145	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	
75	150	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	



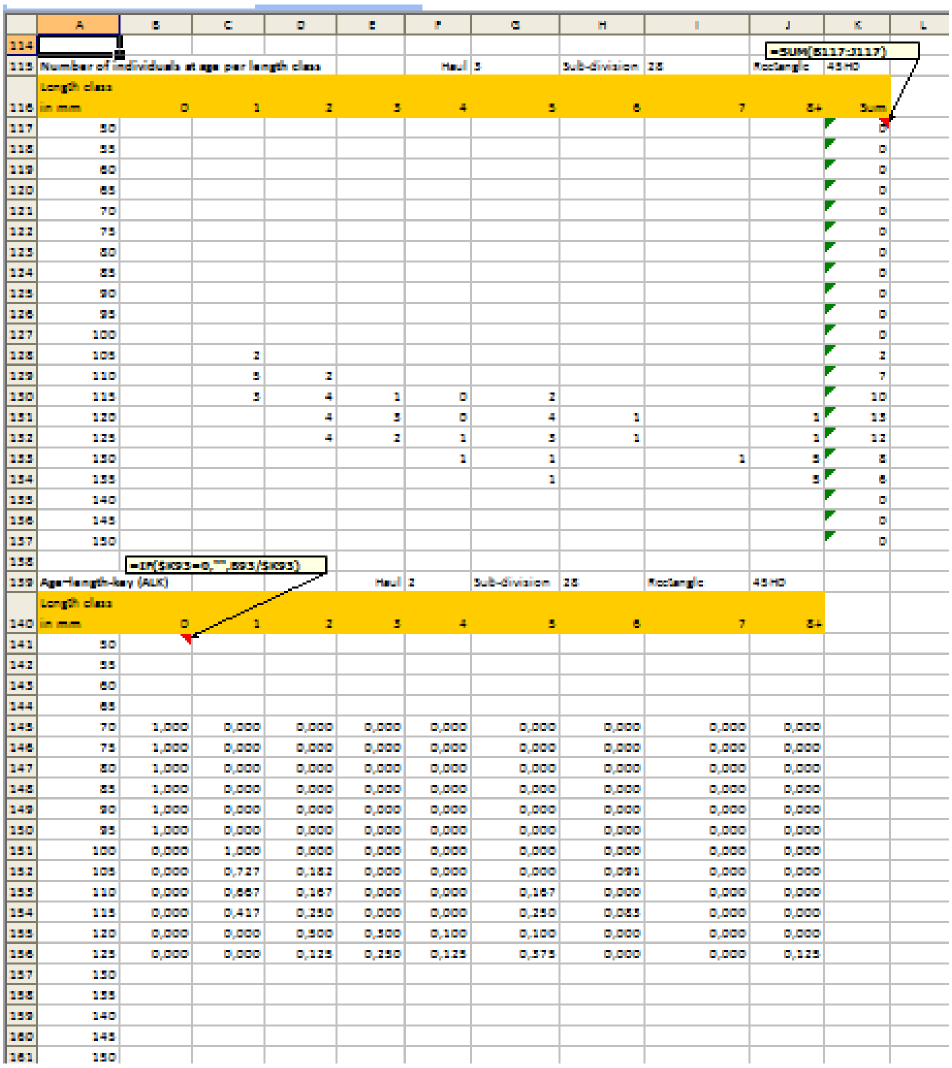
=SUMPRODUKT($B$8:$B$28,B$53:B$73)

=SUMPRODUKT($C$8:$C$28,B$53:B$73)

=$I8*B79

=SUM(B93:J93)

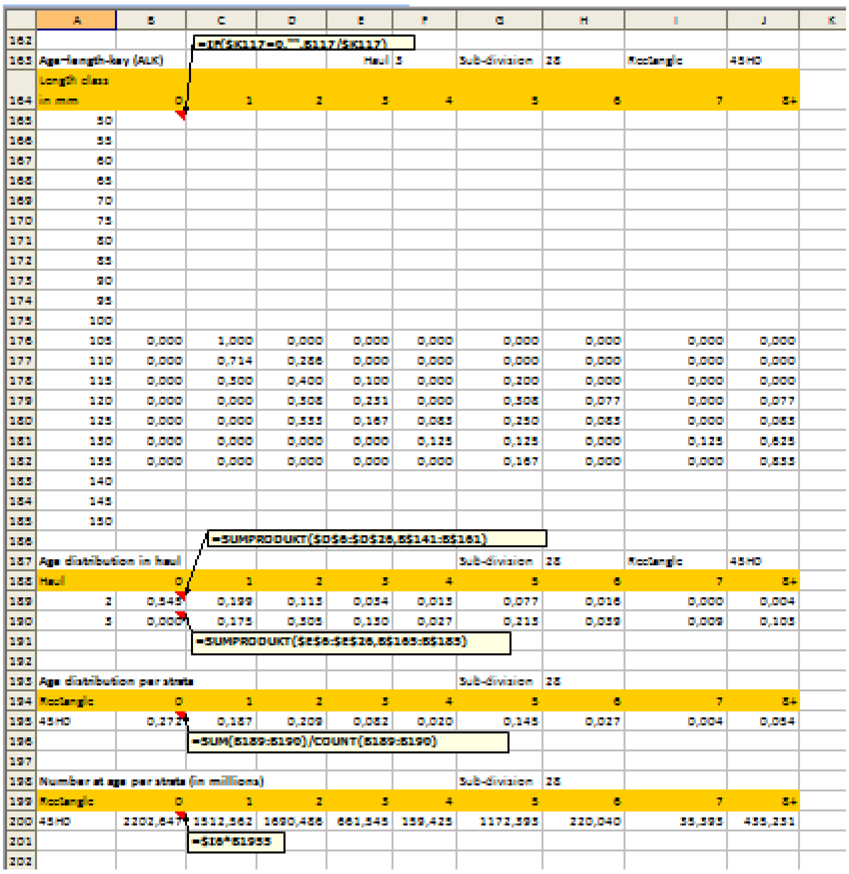
	A	B	C	D	E	F	G	H	I	J	K	L
77	Age distribution per strata						Sub-division	28				
78	Rectangle	0	1	2	3	4	5	6	7	8+		
79	45H0	0,272	0,194	0,203	0,081	0,023	0,145	0,030	0,005	0,047		
80	45H1	0,500	0,217	0,136	0,035	0,007	0,075	0,017	0,002	0,011		
81												
82												
83												
84	Number at age per strata (in millions)						Sub-division	28				
85	Rectangle	0	1	2	3	4	5	6	7	8+		
86	45H0	2202,647	1568,358	1645,076	656,334	185,045	1172,560	239,930	43,560	378,213		
87	45H1	9564,695	4155,954	2602,246	673,763	134,689	1438,489	323,860	29,430	208,264		
88												
89												
90	Maximum effort method:											
91	Number of individuals at age per length class					Haul	2	Sub-division	28	Rectangle	45H0	
92	Length class in mm	0	1	2	3	4	5	6	7	8+	Sum	
93	50										0	
94	55										0	
95	60										0	
96	65										0	
97	70	7									7	
98	75	7									7	
99	80	3									3	
100	85	8									8	
101	90	7									7	
102	95	1									1	
103	100		1								1	
104	105		8	2				1			11	
105	110		4	1			1				6	
106	115		5	3			3	1			12	
107	120			5	3	1	1				10	
108	125			1	2	1	3			1	8	
109	130										0	
110	135										0	
111	140										0	
112	145										0	
113	150										0	



=SUM(B117:J117)

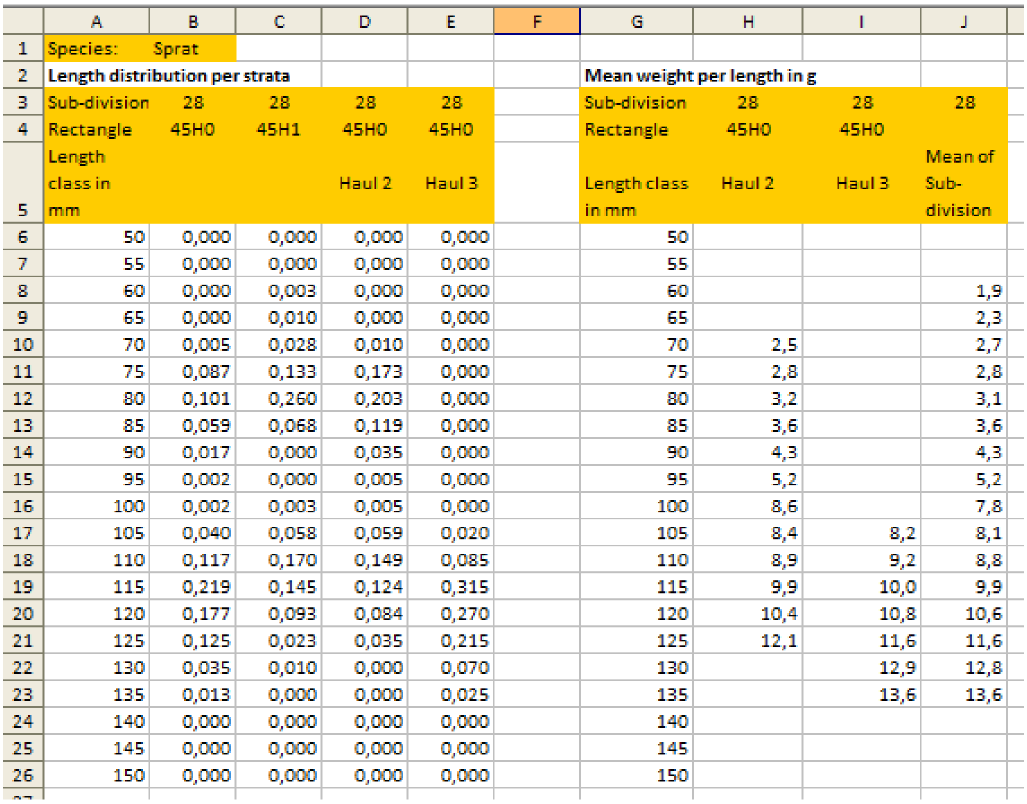
=IF($K93=0,"",B93/$K93)

	A	B	C	D	E	F	G	H	I	J	K	L
114												
115	Number of individuals at age per length class					Haul	3	Sub-division	28	Rectangle	45H0	
116	Length class in mm	0	1	2	3	4	5	6	7	8+	Sum	
117	50										0	
118	55										0	
119	60										0	
120	65										0	
121	70										0	
122	75										0	
123	80										0	
124	85										0	
125	90										0	
126	95										0	
127	100										0	
128	105		2								2	
129	110		5	2							7	
130	115		3	4	1	0	2				10	
131	120			4	3	0	4	1		1	13	
132	125			4	2	1	3	1		1	12	
133	130					1	1		1	5	8	
134	135						1			5	6	
135	140										0	
136	145										0	
137	150										0	
138												
139	Age-length-key (ALK)				Haul	2	Sub-division	28	Rectangle	45H0		
140	Length class in mm	0	1	2	3	4	5	6	7	8+		
141	50											
142	55											
143	60											
144	65											
145	70	1,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000		
146	75	1,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000		
147	80	1,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000		
148	85	1,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000		
149	90	1,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000		
150	95	1,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000		
151	100	0,000	1,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000		
152	105	0,000	0,727	0,182	0,000	0,000	0,000	0,091	0,000	0,000		
153	110	0,000	0,667	0,167	0,000	0,000	0,167	0,000	0,000	0,000		
154	115	0,000	0,417	0,250	0,000	0,000	0,250	0,083	0,000	0,000		
155	120	0,000	0,000	0,500	0,300	0,100	0,100	0,000	0,000	0,000		
156	125	0,000	0,000	0,125	0,250	0,125	0,375	0,000	0,000	0,125		
157	130											
158	135											
159	140											
160	145											
161	150											

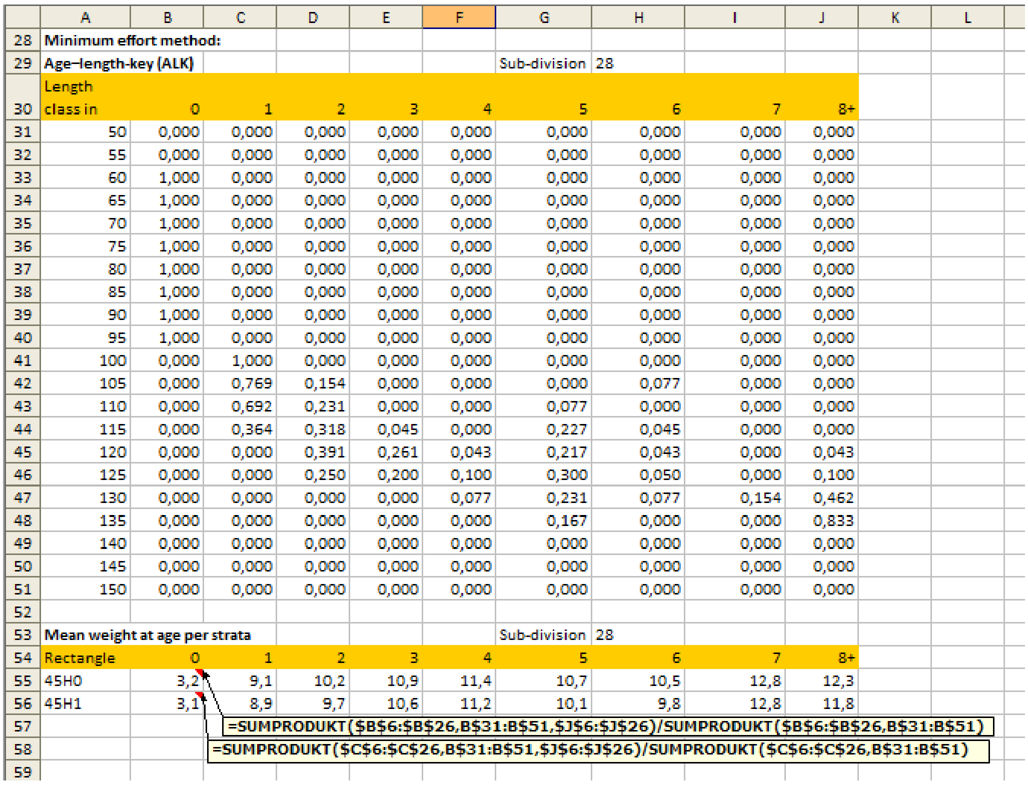


	A	B	C	D	E	F	G	H	I	J
162			=IF($K117=0,"",B117/$K117)							
163	Age-length-key (ALK)				Haul	3	Sub-division	28	Rectangle	45H0
164	Length class in mm	0	1	2	3	4	5	6	7	8+
165	50									
166	55									
167	60									
168	65									
169	70									
170	75									
171	80									
172	85									
173	90									
174	95									
175	100									
176	105	0,000	1,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000
177	110	0,000	0,714	0,286	0,000	0,000	0,000	0,000	0,000	0,000
178	115	0,000	0,300	0,400	0,100	0,000	0,200	0,000	0,000	0,000
179	120	0,000	0,000	0,308	0,231	0,000	0,308	0,077	0,000	0,077
180	125	0,000	0,000	0,333	0,167	0,083	0,250	0,083	0,000	0,083
181	130	0,000	0,000	0,000	0,000	0,125	0,125	0,000	0,125	0,625
182	135	0,000	0,000	0,000	0,000	0,000	0,167	0,000	0,000	0,833
183	140									
184	145									
185	150									
186			=SUMPRODUKT($D$6:$D$26,B$141:B$161)							
187	Age distribution in haul						Sub-division	28	Rectangle	45H0
188	Haul	0	1	2	3	4	5	6	7	8+
189	2	0,543	0,199	0,113	0,034	0,013	0,077	0,016	0,000	0,004
190	3	0,000	0,173	0,305	0,130	0,027	0,213	0,039	0,009	0,103
191			=SUMPRODUKT($E$6:$E$26,B$165:B$185)							
192										
193	Age distribution per strata						Sub-division	28		
194	Rectangle	0	1	2	3	4	5	6	7	8+
195	45H0	0,272	0,187	0,209	0,082	0,020	0,145	0,027	0,004	0,054
196			=SUM(B189:B190)/COUNT(B189:B190)							
197										
198	Number at age per strata (in millions)						Sub-division	28		
199	Rectangle	0	1	2	3	4	5	6	7	8+
200	45H0	2202,647	1512,582	1690,486	661,345	159,425	1172,393	220,040	33,393	433,231
201			=$I8*B195							
202										

Weight distribution – on the example of sprat

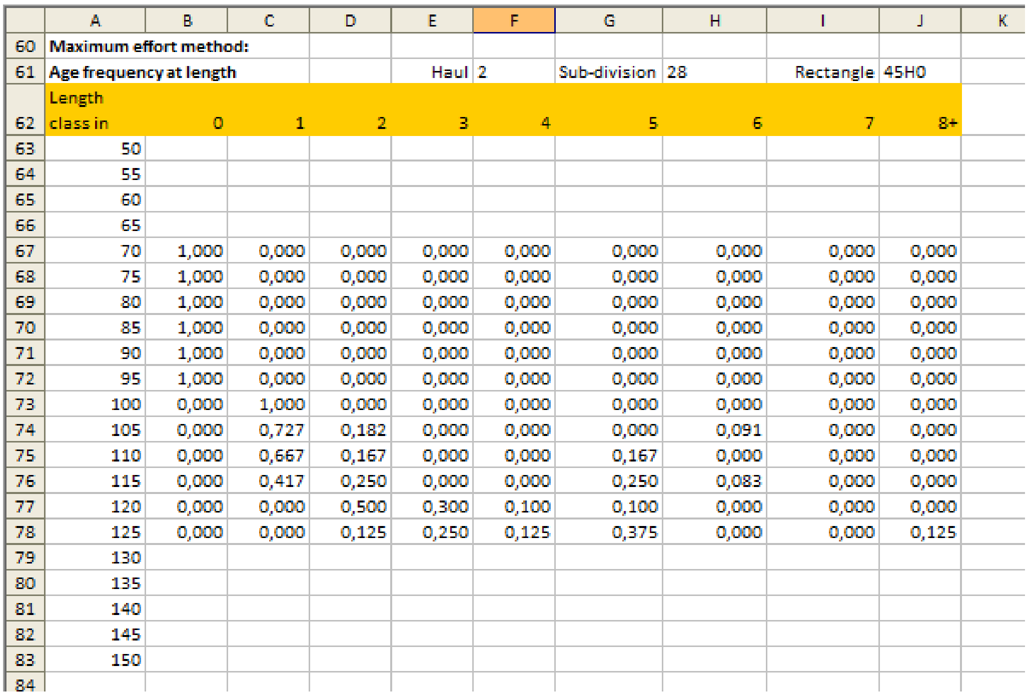


	A	B	C	D	E	F	G	H	I	J
1	Species:	Sprat								
2	Length distribution per strata						Mean weight per length in g			
3	Sub-division	28	28	28	28		Sub-division	28	28	28
4	Rectangle	45H0	45H1	45H0	45H0		Rectangle	45H0	45H0	
5	Length class in mm			Haul 2	Haul 3		Length class in mm	Haul 2	Haul 3	Mean of Sub-division
6	50	0,000	0,000	0,000	0,000		50			
7	55	0,000	0,000	0,000	0,000		55			
8	60	0,000	0,003	0,000	0,000		60			1,9
9	65	0,000	0,010	0,000	0,000		65			2,3
10	70	0,005	0,028	0,010	0,000		70	2,5		2,7
11	75	0,087	0,133	0,173	0,000		75	2,8		2,8
12	80	0,101	0,260	0,203	0,000		80	3,2		3,1
13	85	0,059	0,068	0,119	0,000		85	3,6		3,6
14	90	0,017	0,000	0,035	0,000		90	4,3		4,3
15	95	0,002	0,000	0,005	0,000		95	5,2		5,2
16	100	0,002	0,003	0,005	0,000		100	8,6		7,8
17	105	0,040	0,058	0,059	0,020		105	8,4	8,2	8,1
18	110	0,117	0,170	0,149	0,085		110	8,9	9,2	8,8
19	115	0,219	0,145	0,124	0,315		115	9,9	10,0	9,9
20	120	0,177	0,093	0,084	0,270		120	10,4	10,8	10,6
21	125	0,125	0,023	0,035	0,215		125	12,1	11,6	11,6
22	130	0,035	0,010	0,000	0,070		130		12,9	12,8
23	135	0,013	0,000	0,000	0,025		135		13,6	13,6
24	140	0,000	0,000	0,000	0,000		140			
25	145	0,000	0,000	0,000	0,000		145			
26	150	0,000	0,000	0,000	0,000		150			

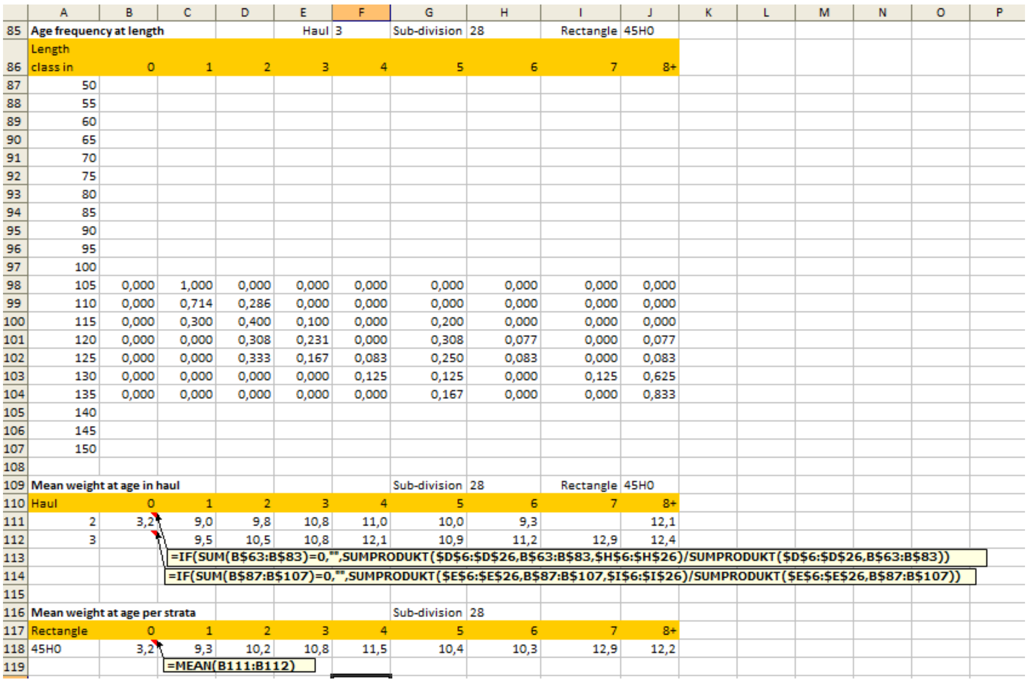


	A	B	C	D	E	F	G	H	I	J	K	L
28	**Minimum effort method:**											
29	**Age–length-key (ALK)**						Sub-division	28				
30	Length class in	0	1	2	3	4	5	6	7	8+		
31	50	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000		
32	55	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000		
33	60	1,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000		
34	65	1,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000		
35	70	1,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000		
36	75	1,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000		
37	80	1,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000		
38	85	1,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000		
39	90	1,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000		
40	95	1,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000		
41	100	0,000	1,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000		
42	105	0,000	0,769	0,154	0,000	0,000	0,000	0,077	0,000	0,000		
43	110	0,000	0,692	0,231	0,000	0,000	0,077	0,000	0,000	0,000		
44	115	0,000	0,364	0,318	0,045	0,000	0,227	0,045	0,000	0,000		
45	120	0,000	0,000	0,391	0,261	0,043	0,217	0,043	0,000	0,043		
46	125	0,000	0,000	0,250	0,200	0,100	0,300	0,050	0,000	0,100		
47	130	0,000	0,000	0,000	0,000	0,077	0,231	0,077	0,154	0,462		
48	135	0,000	0,000	0,000	0,000	0,000	0,167	0,000	0,000	0,833		
49	140	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000		
50	145	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000		
51	150	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000		
52												
53	**Mean weight at age per strata**						Sub-division	28				
54	Rectangle	0	1	2	3	4	5	6	7	8+		
55	45H0	3,2	9,1	10,2	10,9	11,4	10,7	10,5	12,8	12,3		
56	45H1	3,1	8,9	9,7	10,6	11,2	10,1	9,8	12,8	11,8		
57												
58												
59												

```
=SUMPRODUKT($B$6:$B$26,B$31:B$51,$J$6:$J$26)/SUMPRODUKT($B$6:$B$26,B$31:B$51)
=SUMPRODUKT($C$6:$C$26,B$31:B$51,$J$6:$J$26)/SUMPRODUKT($C$6:$C$26,B$31:B$51)
```

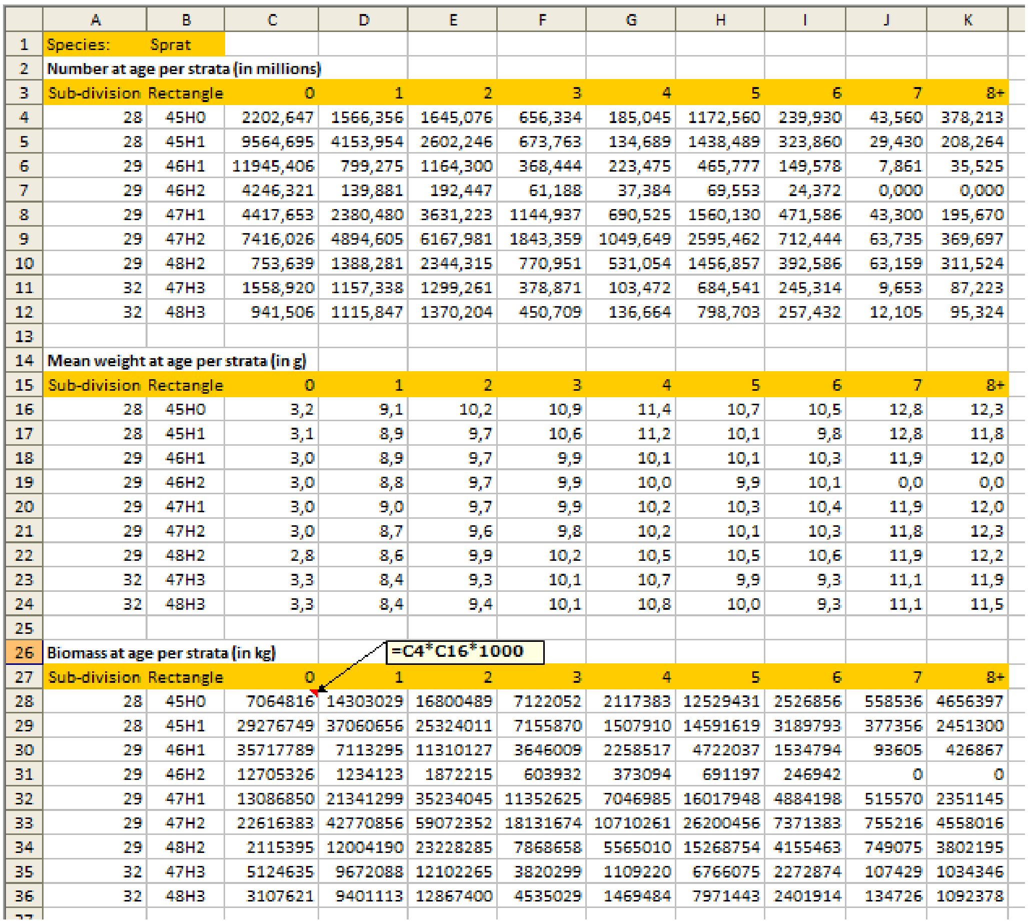


	A	B	C	D	E	F	G	H	I	J	K
60	**Maximum effort method:**										
61	**Age frequency at length**				Haul	2	Sub-division	28	Rectangle	45H0	
62	Length class in	0	1	2	3	4	5	6	7	8+	
63	50										
64	55										
65	60										
66	65										
67	70	1,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	
68	75	1,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	
69	80	1,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	
70	85	1,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	
71	90	1,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	
72	95	1,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	
73	100	0,000	1,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	
74	105	0,000	0,727	0,182	0,000	0,000	0,000	0,091	0,000	0,000	
75	110	0,000	0,667	0,167	0,000	0,000	0,167	0,000	0,000	0,000	
76	115	0,000	0,417	0,250	0,000	0,000	0,250	0,083	0,000	0,000	
77	120	0,000	0,000	0,500	0,300	0,100	0,100	0,000	0,000	0,000	
78	125	0,000	0,000	0,125	0,250	0,125	0,375	0,000	0,000	0,125	
79	130										
80	135										
81	140										
82	145										
83	150										
84											



	A	B	C	D	E	F	G	H	I	J
85	**Age frequency at length**				Haul	3	Sub-division	28	Rectangle	45H0
86	Length class in	0	1	2	3	4	5	6	7	8+
87	50									
88	55									
89	60									
90	65									
91	70									
92	75									
93	80									
94	85									
95	90									
96	95									
97	100									
98	105	0,000	1,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000
99	110	0,000	0,714	0,286	0,000	0,000	0,000	0,000	0,000	0,000
100	115	0,000	0,300	0,400	0,100	0,000	0,200	0,000	0,000	0,000
101	120	0,000	0,000	0,308	0,231	0,000	0,308	0,077	0,000	0,077
102	125	0,000	0,000	0,333	0,167	0,083	0,250	0,083	0,000	0,083
103	130	0,000	0,000	0,000	0,000	0,125	0,125	0,000	0,125	0,625
104	135	0,000	0,000	0,000	0,000	0,000	0,167	0,000	0,000	0,833
105	140									
106	145									
107	150									
108										
109	**Mean weight at age in haul**						Sub-division	28	Rectangle	45H0
110	Haul	0	1	2	3	4	5	6	7	8+
111	2	3,2	9,0	9,8	10,8	11,0	10,0	9,3		12,1
112	3		9,5	10,5	10,8	12,1	10,9	11,2	12,9	12,4
113			=IF(SUM(B$63:B$83)=0,"",SUMPRODUKT($D$6:$D$26,B$63:B$83,$H$6:$H$26)/SUMPRODUKT($D$6:$D$26,B$63:B$83))							
114			=IF(SUM(B$87:B$107)=0,"",SUMPRODUKT($E$6:$E$26,B$87:B$107,$I$6:$I$26)/SUMPRODUKT($E$6:$E$26,B$87:B$107))							
115										
116	**Mean weight at age per strata**						Sub-division	28		
117	Rectangle	0	1	2	3	4	5	6	7	8+
118	45H0	3,2	9,3	10,2	10,8	11,5	10,4	10,3	12,9	12,2
119			=MEAN(B111:B112)							

Biomass estimation – on the example of sprat



	A	B	C	D	E	F	G	H	I	J	K
1	Species:	Sprat									
2	Number at age per strata (in millions)										
3	Sub-division	Rectangle	0	1	2	3	4	5	6	7	8+
4	28	45H0	2202,647	1566,356	1645,076	656,334	185,045	1172,560	239,930	43,560	378,213
5	28	45H1	9564,695	4153,954	2602,246	673,763	134,689	1438,489	323,860	29,430	208,264
6	29	46H1	11945,406	799,275	1164,300	368,444	223,475	465,777	149,578	7,861	35,525
7	29	46H2	4246,321	139,881	192,447	61,188	37,384	69,553	24,372	0,000	0,000
8	29	47H1	4417,653	2380,480	3631,223	1144,937	690,525	1560,130	471,586	43,300	195,670
9	29	47H2	7416,026	4894,605	6167,981	1843,359	1049,649	2595,462	712,444	63,735	369,697
10	29	48H2	753,639	1388,281	2344,315	770,951	531,054	1456,857	392,586	63,159	311,524
11	32	47H3	1558,920	1157,338	1299,261	378,871	103,472	684,541	245,314	9,653	87,223
12	32	48H3	941,506	1115,847	1370,204	450,709	136,664	798,703	257,432	12,105	95,324
13											
14	Mean weight at age per strata (in g)										
15	Sub-division	Rectangle	0	1	2	3	4	5	6	7	8+
16	28	45H0	3,2	9,1	10,2	10,9	11,4	10,7	10,5	12,8	12,3
17	28	45H1	3,1	8,9	9,7	10,6	11,2	10,1	9,8	12,8	11,8
18	29	46H1	3,0	8,9	9,7	9,9	10,1	10,1	10,3	11,9	12,0
19	29	46H2	3,0	8,8	9,7	9,9	10,0	9,9	10,1	0,0	0,0
20	29	47H1	3,0	9,0	9,7	9,9	10,2	10,3	10,4	11,9	12,0
21	29	47H2	3,0	8,7	9,6	9,8	10,2	10,1	10,3	11,8	12,3
22	29	48H2	2,8	8,6	9,9	10,2	10,5	10,5	10,6	11,9	12,2
23	32	47H3	3,3	8,4	9,3	10,1	10,7	9,9	9,3	11,1	11,9
24	32	48H3	3,3	8,4	9,4	10,1	10,8	10,0	9,3	11,1	11,5
25											
26	Biomass at age per strata (in kg)				=C4*C16*1000						
27	Sub-division	Rectangle	0	1	2	3	4	5	6	7	8+
28	28	45H0	7064816	14303029	16800489	7122052	2117383	12529431	2526856	558536	4656397
29	28	45H1	29276749	37060656	25324011	7155870	1507910	14591619	3189793	377356	2451300
30	29	46H1	35717789	7113295	11310127	3646009	2258517	4722037	1534794	93605	426867
31	29	46H2	12705326	1234123	1872215	603932	373094	691197	246942	0	0
32	29	47H1	13086850	21341299	35234045	11352625	7046985	16017948	4884198	515570	2351145
33	29	47H2	22616383	42770856	59072352	18131674	10710261	26200456	7371383	755216	4558016
34	29	48H2	2115395	12004190	23228285	7868658	5565010	15268754	4155463	749075	3802195
35	32	47H3	5124635	9672088	12102265	3820299	1109220	6766075	2272874	107429	1034346
36	32	48H3	3107621	9401113	12867400	4535029	1469484	7971443	2401914	134726	1092378