Baltic Committee

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REPORT OF THE

Baltic International Fish Survey Working Group

Karlskrona, Sweden
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International Council for the Exploration of the Sea

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1.2 Terms of reference

As a resolution adopted at the 1997 Annual Science Conference (85 th Statutory Meeting) it was decided that (C. Res. 97/2:43):

The Baltic International Fish Survey Working Group [WGBIFS] (Chairman: Mr J. Modin, Sweden) will meet in Karlskrona, Sweden from 1–5 June 1998 to

a) adopt the recommendation of the Workshop on Standard Trawls for Baltic International Fish Surveys (WKBIFS) on the type and specifications of standard trawls for survey purposes;

b) continue to plan intercalibration programmes for the introduction of new standard gears;

c) evaluate the continuation of existing survey practice until results from the new standard surveys have accumulated into a sufficiently long time series to be used for assessment purposes;

d) continue the work to optimise the sampling procedures for both cod and other target species including a critical inventory of the current coding procedures for maturity stages;

e) review and evaluate the effects of biological sampling and TS conversion formulas on the results of acoustic stock levels and biomass estimates;

f) finalise the Manual for Baltic International Acoustic Surveys (BIAS) based on a draft made by the Study Group on Baltic Acoustic Data (SGBAD);

g) evaluate the progress made in the acoustic databases (BAD1 and BAD2);

h) plan and decide on acoustic surveys and experiments to be conducted in 1998 and 1999.

WGBIFS will report to WGBFAS and to the Baltic Committee at the 1998 Annual Science Conference and to ACFM. To facilitate the set up of the database, a representative of the ICES Secretariat will participate in the meeting.

After the approval of WGBIFS members, the dates of the meeting were later changed to 8–12 June 1998.

1.3 Overview

The WGBIFS was initiated in 1996 to promote co-ordination and standardisation of national research surveys in the Baltic (ICES C.M. 1995/J:1). The first Working Group meeting (ICES C.M. 1996/J:1) considered the design of trawl surveys for cod assessment, established a bottom trawl manual and outlined problems in hydroacoustic surveys. The second meeting (ICES C.M. 1997/J:4) gave advice on intercalibration between research vessels, described sampling protocols of sprat and flounder and evaluated historical data from hydroacoustic investigations on herring. Both meetings dealt with the introduction of modern standard bottom trawls for resource surveys in the Baltic. Expertise advise on the choice of standard trawls has been provided by two gear workshops (ICES C.M. 1997/J6; 1998/H:1).

The contents of this reports largely follow the sequence of the Terms of Reference:

Section 2 contains considerations for bottom trawl surveys. The working group has agreed on the common use of a standard trawl available in two size categories for the larger and for the smaller research vessels, respectively. The agreed trawl material, construction and rigging is specified in the Report of the 2 nd Workshop on standard Trawls for Baltic International Fish Surveys (ICES CM 1998/H:1). In situ experiments will be needed to optimise the gear performance and evaluate comparability between vessels. Intercalibration between traditional and new standard trawls during regular surveys will shorten the transition period for a new time series of resource data. Smaller research vessels may be utilised more cost-effective along the coastline instead of larger vessels. Available research vessel resources are more than sufficient to survey the Baltic with 4 hauls per ICES Statistical rectangle up to 58o 00' N. Clear haul information should be exchanged in a digital format.

Section 2 also contains aspects on the biological sampling. An evaluation on the sub-sampling of ages is provided based on a two stage sampling regime by length distributions and age-length keys. Simulations based on Swedish survey data on cod showed that the number of required otoliths increased substantially as precision decreased below 0.05. Results indicated that otoliths should be sampled proportional to the length distribution of individual hauls. A comprehensive literature review on maturity stages were presented and a five stage maturity key was established for macroscopic classification of the maturity stages of herring, sprat, cod and flatfishes.

Section 3 contains considerations for hydroacoustic surveys. The review on TS conversion formulas confirmed that avoidance reactions and individual fish condition (swim bladder) will effect estimates of biomass and age distributions. Field studies are recommended to perform a sensitivity analysis on the influence of applied TS values. A preliminary manual for the Baltic International Acoustic Surveys has been adopted and will be tested during regular surveys in autumn 1998. A fully operational manual can then be agreed at the next WGBIFS meeting in 1999. The old hydroacoustic database, BAD1 has been updated to include all data from 1990 to 1997. The format for the detailed database (based on ESDU resolution) was reviewed. The applicability of the database will be tested using results from the German and Swedish surveys in 1998. Planning of the 1998 research surveys have been completed.

The working group discussed the future organisation and tasks of the WGBIFS. It was agreed that the working group should be responsible for considerations on survey design, sampling protocols and allocation of research resources. Time and money constraints experienced by individual members suggest that all matters relating to Baltic resource surveys should be assigned to one working group meeting per year. However, practical preparations on research experiments, compilation of results and expert consultations would interfere with the more general responsibility of the WGBIFS. It was agreed that the SGBAD should continue to prepare results for the WGBFAS. In addition, an ad hoc workshop should be established in 1999 to organise trawl experiments with the new standard gears to be conducted during spring 1999.

2 TRAWL SURVEYS

2.1 Survey design

2.1.1 Timing of the survey

The Working Group recommends that the new gear and the survey design suggested in this report should be introduced in 1999. It is however anticipated that few countries will be able to take part in the new survey in 1999 (Sections 2.1.7–2.1.8).

At present several countries conduct biannual surveys in spring and autumn (March and November) in accordance to the recommendation of ICES in "Report of the Baltic International Fisheries Survey Working Group (ICES C.M. 1996/J:1).

The data from the spring survey are worked up for use by the Working Group on Baltic Fisheries Assessment immediately after the survey and thus contains the most recent information available for assessment. The spring survey is also important for collecting information on maturity of cod especially in the western part of the Baltic Sea. Information on the size of the 0-group is however not available and the catches of the 1-group are usually low in the Eastern areas. Experience has shown that these age-groups are more accurately surveyed in the autumn. For these reasons the WGBIFS has recommended that two annual surveys are conducted – one in February-March and one in November-December.

2.1.2 Area covered

Historical records show occurrence of a substantial cod fisheries as far north as the Bothnian Sea (Sub-division 30). At present however the cod stock north of Sub-divisions 27 and 28 is considered to be insignificant.

The areas covered by Denmark, the GDR, Germany, Latvia, Poland and Sweden in previous surveys were presented to the Working Group in a Working document called "Overview of Survey information in the Baltic" (Hovgård 1998). The coverage of the Eastern Baltic Sea (Sub-divisions 25–31) of each country (except the GDR) are presently constricted to the area south of 58° 00' N (Figure 2.1). It is recommended that the new survey should cover the area up till 58° 00'N. The option to alter the area surveyed should however be available if the distribution pattern of the cod stocks changes.

2.1.3 Haul allocation/stratification schemes

At present the national bottom trawl surveys are carried out using different haul allocation schemes, e.g., as transects, fixed stations and random stratification, the latter being based either on the ICES rectangles or by dept strata.

The Working Group discussed the various methods available for allocation of trawl hauls. Although calculations on the existing survey information does not provide strong evidence of the importance of depth stratification (ICES C.M. 1996/J:1) the WGBIFS recommends that hauls are allocated proportional to dept strata sizes. To provide an even coverage of the survey area the haul allocation should attempt an about equal numbers of hauls to be taken in each ICES statistical rectangles. Considering that few demersal species (cod and flatfishes) are assessed it may be possible to further develop the stratification scheme when a sufficient amount of stock distribution data will be available.

Stations should be fixed prior to the commencement of each survey. To take account for the bottom conditions it is suggested that the hauls are randomly selected from the library of possible hauls-tracks, see Section 2.1.6. The selection of trawl hauls and the distribution of hauls between the participating countries will require international co-operation. Within the first years the group recommend that this co-operation is carried out in the form of a work-shop (see section 2.1.8). When the survey procedures have been properly established the co-operation may be made by correspondence headed by a co-ordinator as is currently done in the IBTS surveys in the North Sea.

2.1.4 Use of large and small research vessels

The surveys in the Baltic Sea and in the transition area (Kattegat and the Danish Belts) have usually been carried out by the use of relative large research vessels (Argos, Baltic, Dana, Solea etc.). Since 1994 the Danish Fisheries Research Institute has conducted a biannual survey using of a small cutter (R/V Havfisken, length: 13 m, 180 HP, crew 3 including scientist) to cover Sub-divisions 21–23. The use of a small research cutter allows a far better geographical coverage as the vessel can trawl at depths below 5 m. A supplementary benefit is the reductions in cost as the price of each covered station is less than 25% of that of the larger vessels. The cutter survey has been conducted successfully in all years and the catch efficiency of the TV3 type trawl used has proven to match that of the larger research vessels with regard to cod and flatfish (Section 2.2.2). There are of course limitations in work possibilities connected to the use of small vessels – a need for daily return to harbours, a higher dependence on weather conditions and restrictions in the types of sampling which may be carried out.

Several of the Baltic countries have access to smaller vessels for research purposes may be used to cover the coastal areas. The small TV3/520 trawl used in the Danish survey in Sub-divisions 21–23 is recommended as the standard gear for the small vessels (ICES C.M. 1998/H:1). This gear is not much smaller than the gears used presently on the large research vessels (ICES C.M. 1997/J:6) and requires a considerable sized net-drum and an engine power not lower than 180 HP.

2.1.5 Number of hauls per survey

The precision of survey abundance estimates are primarily dependent on the effort applied and may be expected to decline proportional of to the square root of the number of hauls. Cost on the other hands is linearly dependent on the effort level implying a diminishing return of the marginal effort. Choosing the number of hauls therefore requires evaluation of cost and benefits. The working groups have not attempted to specify criteria's for any optional effort level.

The present surveys are concentrated in areas of interest for the nations involved i.e., typically covering areas close to the individual countries (Figure 2.1). In some areas the total density of hauls are found very high. In recent years the total number of hauls being deployed during spring has amounted to about 320 (average of the effort by Denmark, Germany, Latvia, Poland, Russia and Sweden, 1992–1996).

The benefits associated with the standardisation of the gears and a joint station allocation implies that a lower number of stations are required to reach a precision similar to the present. A potential survey effort level could be to make four hauls within each ICES square. This sample intensity is similar to that of the Danish cutter survey in Sub-divisions 21–23 and about twice the level used in the North Sea. Below table provides the estimated number of hauls per Sub-division according to this sampling intensity.

Table showing the effort needed to achieve a sampling level of 4 hauls per ICES square. The areas are measured in the units of ICES rectangles and do not include the parts of Sub-divisions north of 58° 00' nor the Gulf of Riga. The splitting on vessel sizes is approximate.

Sub-division	# ICES rectangles	# hauls	# hauls of small vessels	# hauls of large vessels
21	6.5	26	26	0
22	5.5	22	22	0
23	1.5	6	6	0
24	7.5	30	15	15
25	14.0	56	18	38
26	11.5	46	16	30
27	5.5	22	6	16
28	9	36	6	30
total	61	244	115	129

Assuming an average number of hauls taken by small vessels of two per day and of large vessels of three per day (i.e., allowing for stops in fisheries due to weather conditions or technical breakdowns), the suggested haul number is equivalent to an estimated effort of about 43 large vessel days and 60 small vessel days. For the large vessels this implies that the survey may be covered by two vessels each fishing for tree weeks. Small vessels, which are to cover coastal/shallow area are needed in four regions:

1) Sub-divisions 21–23,
2) along the Swedish cost of Sub-divisions 24,25,27,
3) along the southern shore of Sub-divisions 25–26 and
4) along the eastern shore of Sub-divisions 26–27.

2.1.6 Compilation of clear tow information

In the previous Manual for the Baltic International Trawl Survey (addendum to ICES C.M. 1997/J:4) the information of clear tow information should be provided as a list of start/end co-ordinates. This format is out-dated as detailed track-lines are now available based on satellite communication.

The Danish Fisheries Research Institute has in later years been collecting several thousand satellite based track-lines from the Danish commercial fisheries covering of Sub-divisions 21–24 and including parts of Sub-division 25. This has recently been supplemented by German and Swedish track-lines available on the research vessels from these countries. The WGBIFS recommends that the Danish Fisheries Research Institute continues this work and expands the coverage to include information from the areas presently not covered.

For the use in the Baltic survey it is recommended that a subset of this data are made available to all participating research vessels and for the scientist planning the haul allocation. This subset of data should include a limited number of track-position for each ICES square. It is recommended that 5 tracks of approximately 0.5 hours are selected for each ICES sub-rectangle. This corresponds to 20 haul tracks for each ICES square or to approximately 1200 haul-tracks for the total area surveyed. For use in survey haul allocation these tracks should be assigned to the different depth strata.

The compilation of haul tracks in the Baltic Sea is impeded by the fact that several software systems are in use in the Baltic. Most of the Danish fishermen are using the Sodena navigation system, which is also used by some of the research vessels. The QuotFish and MaxSea system is however also used by a number of research vessels. For survey use it is necessary to be able to convert the information between these systems.

2.1.7 The transition period and the need for intercalibrations

A new survey will not be of use for assessment purposes before the time series has a length of at least five years. It is therefore necessary to address the question on how to derive survey information for stock assessment use in the transition period where the new time series is inadequate. The WGBIFS identified two approaches:

Approach I) Some of the existing surveys are continued whereas others are changed to the new gear and design. With this set-up both groups of surveys need to include some of the larger surveys covering the main part of the present distribution area of the cod stock.

Approach II) National intercalibration between the new and the existing trawls are carried out. The existing national survey time series are converted to the units of the new trawl during forthcoming surveys.

The WGBIFS notes that the transition period of Approach I will be five years whereas it may be considerable shorter using Approach II.

The between gear intercalibrations may be carried out in the form of an experimental surveys designed specifically to derive conversion factors between the new and the old gears. This approach is considered optimal, as it will be possible to select areas/periods where good concentrations of fish may be available. Designated experimental surveys are however costly and it will not be possible for a number of countries to finance such activities within the near future. An alternative approach is to include the intercalibrations in the existing survey programmes. This may be done by making alternative hauls with the two gears on each station fished. This will result in N/2 comparisons of the efficiencies of the two gears where N is the number of hauls. Some, and probably a high proportion, of these comparisons may be of little use for the calibrations due to too low catches of fish. The incorporation of the calibrations into the existing survey programme will imply a halving of the number of hauls conducted with the existing gear. This will correspond to a reduction in the precision of the traditional survey abundance estimates by a factor of $\sqrt{2}$.

The use of two different size of trawls also requires that intercalibrations are carried out between these. As it is anticipated that some adaptations in the gear rigging may occur within the first year it may be prudent to postpone such intercalibrations to year 2000.

2.1.8 The practicalities associated with starting a new survey in 1999.

Work is needed for the establishment of a concrete survey plan for a survey starting in 1999, i.e., to establish the haul positions to be covered. This work can not be carried out before it is known which countries are able to participate in the new survey. The WGBIFS recommends to establish an ad hoc planning group, co-chaired by Peter Ernst and Holger Hovgård to organise the 1999 activities. It is suggested that the meeting should take place at The Institute for Baltic Sea Fisheries Rostock, Germany, during four days in January.

Introducing new standard gears and the calibration of this against the presently used ones are costly. It can be anticipated that most of the countries involved will have difficulties to find funding to purchase of the new gear/gears and to allocate the necessary ship resources for the calibration experiments. This will lead to the unfortunate situation that the research vessel capacity and the experiences of a number of countries can not be utilised. This will result in a period where the survey is conducted by few countries and where the full use of the historical databases cannot be made.

2.2 The new standard trawls for new bottom-trawl surveys.

2.2.1 Suggestions on the new standard trawl

Following a formal request from the WGBIFS in 1996, the discussion on the new standard gear were initiated on a workshops held in Gdynia Poland, 8–10 January 1997 (ICES C.M. 1997/J:6). The recommendations regarding the new gears were later discussed in the FTFB WG and in the WGBIFS during 1997 (ICES C.M. 1997/B:2 and ICES C.M. 1997/J:4) and evaluated by the Baltic Fish Committee during its 1997 session (ICES ASC, Baltimore, USA, 25 September - 3 October 1997). The Baltic Fish Committee found that more precise specifications were needed and therefore initiated a second gear Workshop in Gdynia, Poland, 23–24 February 1998. This Workshop has provided a detailed description of the new gears (ICES C.M. 1998/H:1)

The discussions of new the gears may be summarised as follows:

a) It was recognised that the research vessels available in the Baltic differ considerable with regard to size and engine power. To make use of the vessel potential it was recommended that two gear sizes were used - one for vessels below 400 HP and one for vessels above 400 HP (ICES C.M. 1998/H:1).

b) The catchability of small cod and flatfish are known to be very dependent on a good bottom contact which are associated with using light ground rope arrangements in the trawls. The bottom conditions are however difficult in many Baltic Sea areas implying a need for using heavy grounds rope arrangements (large bobbins/rock hopper discs). The ICES workshop recognises that the choice of ground gear is a trade off between efficiency and in the versatility in the areas that may be covered. The final recommendations for the ground rope arrangements for the two sizes of trawls are provided in ICES C.M. 1998/H:1.

The ICES 2 nd workshop (ICES C.M. 1998/H:1) also recommended that modern four panel's trawls are used in the survey and suggested the use of the TV3 trawl type. Two size categories were recommended the TV3/520 and the TV3/930 for the smaller and larger vessels respectively. The workshop further noted that the trawls should be thoroughly tested in model and full scale in orders to optimise the rigging.

2.2.2 Practical test of the TV3/520 trawl

The Danish surveys using of the smaller TV3/520 trawl have shown that the gear was capable of catching high quantities of small cod but the fishing power relative to other gears are not known. Available survey information showed that the most efficient of the existing alternate trawls for catching small cod were the HG 20/25 trawl used in the German and Polish research surveys.

For this reason the catch efficiency of TV3/520 trawl were compared with that of the HG 20/25 trawl. The experiments were made on board the German RV "Solea" on a three days study during the German bottom trawl survey in March 1998 by a combined German Danish team. The first day were used for measuring the trawl performance of the two gears using Scanmar equipment. The results of this experiment showed the following

- the handling of both gears was uncomplicated and was carried out without problems
- both gears remained geometrical stable at the tested ranges of towing speeds.
- the opening of the HG 20/25 trawl was about 3 m and the TV3/520 trawl 2 m. The effect of difference in the vertical opening was higher catches of pelagic fish in the HG 20/25 trawl.
- the wing spread of the TV3/520 were 17.5 m as opposed to 15 m in the HG 20/25 trawl
- the door spread of the TV3/520 trawl was 55 m as opposed to 80 m in the HG 20/25 trawl. This difference may be attributed to differences in sweep length, which were 15 fathoms and 25 fathoms for the TV3/520 and HG 20/25 trawls respectively.

During the next days the catch efficiencies of the two gear were compared by fishing the same trawl tracks alternatively by the two gears. In total four stations were fished. The procedure and rigging were those used in the two respective surveys. Beside the difference in sweep length (see above) the speed differed - being 3.5 knots for the HG 20/25 and 2.8 knots for the TV3/520 trawl. Both trawls were equipped with ground rope arrangements of the light type - a rubber snake for the HG 20/25 trawl and a small rock hopper for the TV3/520 trawl.

The results of the fishing are presented in Table 2.1 and shown in Figures 2.2–2.4. In all four experiments the catches of cod and flounder were highest in the TV3/520 trawl being in average 2.3 times higher for cod and 3 times higher for flounder. A further evaluation the cod catches showed that the higher catches of cod in the TV3/520 trawl are caused by a more efficient catch of cod of a size of less than 30 cm. The catches for cod in the size range 30–40 cm were equal whereas the catches of cod above 40 cm is slightly higher in the HG 20/25 trawl.

The conclusion of the short experiments was that the TV3/520 trawl possesses qualities, which have been requested by the WGBIFS with regard to high efficiencies for small cod and flatfish. The experiments however also raise a number of questions:

1) Is the high efficiency of the TV3/520 trawl towards small cod and flatfish due to a good bottom contact caused by the relative low speed used? Can this efficiency be maintained at the higher speeds suggested in the WGBIFS manual?

2) Can the catches of larger fish in the TV3/520 trawl be increased by the use of longer sweeps this increasing the door-spread and hence enlarging the area from where cod are herded into the trawl path?

It is planed to carry out small experiments regarding these issues within the current survey programmes. It should however be noted that the resources available for such trials are very limited within the current Danish and German programmes.

2.3 The importance of the new standard survey for the cod stock assessment

The present assessment of the cod stock in the Baltic Sea depend on the use of survey stock abundance estimates to determine the recent levels of stock sizes and fishing mortalities. The present surveys are not co-ordinated and are covering different areas that are surveyed in different periods. The gears used differs significantly both with regard to their overall efficiency as well as their selection properties towards various ages. Recent attempts have used GLM procedures to evaluate between vessel differences in fishing power, implicitly assuming that differences in catch rates only depends on vessel/gear differences. However, due to the lack of survey co-ordination, such estimates may be expected to be dubious as the estimated vessel power effects, used for the calculation of standardised effort, is confounded with effects of time and area.

To achieve better quality data for calibrating the stock assessment it is necessary to establish a well co-ordinated international survey using the same trawls and standardised operational procedures. New trawls have been recommended by an ICES Workshop in February (ICES C.M. 1998/H:1). The WGBIFS have discussed various aspects of the survey design and recommends that a International survey in the Baltic is initiated within 1999, assuming that the necessary resources are available.

However, the WGBIFS anticipates that unless determined action are taken the establishment of a new survey may well take several years. This pessimism is based on the fact that only few research institutes will be able to acquire the new gear within the coming year, primarily due to economic constraints.

The new survey will not be of use for assessment purposes before a time series of at least five years is available. This period may be shortened considerable if experiments are carried out for calibrating the catch efficiency of the new gears to those of the existing gears. However, considering the constraint of survey time found for most institutes it is likely that few experiments will be carried out on less ship resources are specifically allocated to this end. If calibrations are not carried out survey resources must be deployed for a maintenance of the present trawl surveys for a substantial transition period to produce data for calibration of the cod stock assessments.

The available information indicates that the recommended new trawls possess the major qualities that have been stipulated by the WGBIFS. It would however be prudent to attempt to optimise several gear parameters, such as the ground rope arrangement, the sweep length and towing speed before fixing the standard procedures. Experiments of these gear parameters should be carried out as quickly as possible and preferably within the first half of 1999.

2.4 Conclusions regarding survey design and survey implementation

1) Two annual surveys should be carried out, one in February/March and one in October/November.
2) The area covered should include Sub-divisions 21–26 and the parts of Sub-divisions 27 and 28 south of 58°00'N
3) Hauls should be allocated proportional to depth strata areas and be evenly spaced on ICES statistical Rectangles.
4) Stations should be randomly selected among a selection of possible trawl-tracks

5) Clear tow trawl track lines based on satellite positioning measurements should be collected to enhance survey planning and operation.

6) The surveys should be carried out by using a combination of large and small research vessels. A good survey coverage may be achieved by using two large an four small research vessels.
7) The result from a co-ordinated international survey may be useful for the assessments at year 2005. If designated calibration experiments are carried out the results may be used within two years.
8) The TV3-trawl is recommended as the new standard trawl for Baltic bottom trawl surveys. To versions of this trawl, the TV3/930 and the TV3/520 is available for the use on the large and small research vessels respectively.
9) The rigging and operation details of the gear should be optimised by experiments. These experiments should be finalised as soon as possible.
10) The implementation of the forthcoming surveys may require annual planning meetings for the initial years.

2.5 Evaluation of strategies for otolith sampling

The working group examined the effectiveness of the present sampling scheme for otolith collections by using the method described by Rainer Oeberst in an ICES working paper (Oeberst 1995). The aim of the method is to optimise the sample effort on age composition using a length stratified subsampling of ages (otoliths). The method was applied on Swedish cod data from Sub-Division 25 collected in quarter one during the years 1988 to 1998.

The method was implemented in an Excel spreadsheet. The spreadsheet calculated the optimum number of otoliths and length measurements based on the calculated precision in the observed age-length keys.

Optimal sampling schemes can be defined in terms of precision or by constraining total costs. The precision can be defined in two different ways (relative precision CV, and absolute precision). The working group focused on precision levels of absolute values, where the absolute precision should be the same for all age groups.

Optimal sampling implies that important length groups and length groups containing several ages will be sampled more intensively. In length groups containing more than one age group, Oeberst suggested that at least 5 otoliths should be sampled. The smallest two-year-old cod seen in the historical data were 14–15 cm. The presented calculations assumed that two otoliths are taken in the length group 12–13 cm and no otoliths for fish smaller than that (assumed to be 1 years old).

2.5.1 Results from estimates of optimal sampling

The estimated optimum number of otoliths was calculated for four different precision levels: 0.01, 0.05, 0.1 and 0.15. As the level of precision increased the estimated optimum number of otoliths increased and the optimum numbers were estimated to be considerable at precision levels larger than 0.05 (Figure 2.5).

The allocation of the estimated optimum number of otoliths and length measurements (absolute precision equals 0.05 for all ages) was compared to the actual sampling during 1996 to 1998. Results indicated that most length groups were sampled more than the optimum strategy suggested. In contrast, the few dominating length groups were sampled less than the optimal strategy suggested (Fig. 2.6).

The applied method assumed that an ALK must be specified to calculate the optimal number of otoliths to be sampled. Insufficiently sampled ALK may effect the calculations. It was observed that the optimum number decreased in the 40–41 cm length group during 1997 (Figure 2.6 middle). This anomaly can be explained as the length group is dominated by only one age group, while other neighbouring length groups in the ALK included more variation between ages.

Results indicated that an optimum sampling strategy is very close to a strategy, where the numbers of otoliths sampled is proportional to the length distribution. It should be noted that the results are based on the assumption of an absolute precision equal for all ages.

Number of sampled otoliths and estimated optimum number (based on a 5% absolute precision) was plotted against sampling year 1988 to 1998 (Figure 2.7). The plot indicates that the Swedish sampling program was insufficient from 1988 to 1992, while it was more than sufficient in subsequent years.

There was a significant correlation between sampled and estimated optimal numbers (Fig. 2.7). The reason may be that during years with low sampling intensity several length groups will be represented by few or only one age group, i.e., the input ALK will contain fewer observations. Thus, applying the present method (with given variation between ages in the ALK) will result in estimates of lower optimal number of otoliths. The result indicates that the method requires sufficiently sampled ALKs.

The spreadsheet calculates a cost function based on the ratio of the expenses of otolith readings compared to length measurements. The same precision can be reached in different ways. If only a few length measurements are done, relatively many otoliths have to be read and vice versa. The simulation indicated that the number of otolith readings decreased very slowly while the number of length measurements increased rapidly (Figure. 2.8).

2.5.2 Further work on sampling strategies

Assuming that the expenses of reading otoliths are 20 times the expenses of length measurements, the minimisation of the cost function yielded a number of length measurements which should be about 3 times the number of otoliths read. This ratio deviates from the current procedures and it is a question if the cost function can be set up as simple as that. In general, length measurements can be relatively cheap provided that more length samples can be taken by increased sample sizes from the catch. However, if the increase in length measurements requires more hauls to be taken, then the expenses will increase.

There are some doubtful assumptions in the present method. It is based on the observed ALK during the last year and not on what to be expected in the present sampling year. Therefore interannual changes in year class strength or in growth patterns must be assumed to be negligible.

The method may be improved using the results from conventional cohort analysis. Such analysis provides additional information about the stock size and age structure in the following year, i.e., information about the future stock composition and possibly strong year classes becomes available. The analysis can be incorporated in the present method.

The evaluation of the Swedish data indicated that a sampling scheme based on proportional sampling of length groups may be an optimal sampling strategy, when absolute precision is wanted.

Other input ALK's should be considered in order to improve the stratification of the sampling scheme.

2.6 Considerations on maturity staging

The reason for including maturity data in the BITS data base is to have the possibility to construct maturity ogives for the calculation of the spawning stock size of commercially important fish species. During the last meeting of the WGBIFS it was decided to use a 5-stage key as a basis for this purpose (ICES CM 1997/J:4).

Since the reproductive cycle is continuous, any classification into discrete stages requires some amount of subjectivity. Differently interpreted maturity keys have been established and used for routine monitoring. Most of the present national keys used for the Baltic fish species are based on Maier's (1908) 8-stage key. Maier modified the maturity stages described by Heinke (1898) for herring so that the maturity classification could be used for other species. Later, several scientist modified the description further to fit explicitly for certain species.

A comprehensive literature review of maturity staging was presented to the working group. The references are given in Section 6.1. More information on maturity stages and their micro- and macroscopic characteristics of Baltic fish species can be obtained from national experts around the Baltic.

The current classification of Baltic fishes are summarised in the BITS manual (addendum 2). These tables also indicate how national codes should be converted into the agreed BITS coding. The tables should be used by national scientists to classify the maturity stages into "mature and "immature" if the proportion of spawners in the sea should be calculated. The information is based on an inquire to specialists working at national laboratories that perform resource assessment on Baltic fishes.

2.7 Revision of the BITS manual

The BITS manual is intended to provide protocols and standardisation on board research vessels which operate on behalf of national laboratories. Currently 8 research vessels representing 7 nations conduct national trawl surveys in the

Baltic. Results from these surveys are used for international resource assessment of the cod and to some extent the herring stocks. It is imperative that quality assurance and consistency between research vessels can be co-ordinated.

The elaboration of the BITS manual has been hampered by discrepancies in traditional procedures which have developed at national laboratories. Standard protocols are often based on pragmatic rather than well documented research. Therefore, progress of the BITS manual towards a full Quality Assurance Handbook will depend on the achievement of new agreements on protocols by participating laboratories. The working group has chosen to implement new protocols gradually so that the BITS Manual is fully operational during all times of its development. The 1998 edition (appended to this report) is in force from 1 July 1998. It is expected that a major revision will be considered during the next WGBIFS meeting.

The agreed revisions during the 1998 meeting included:

1. The notation that a new standard trawl has been adopted. Reference on specifications and construction is made to the Report of the 2 nd Workshop of Standard Trawls for Baltic Fish Surveys (ICES CM 1998/H:1).
2. Incorporation of special chapters on the sampling of catch weights and species composition as well as some minor changes in the sampling of the length distribution.
3. Minor corrections in the reporting format for record type 1, 1A and 4. The specific changes are noted in Table 2.2.
4. The exclusion of the Appendix 1 containing specifications for a clear haul list. This list was based on simple co-ordinates of the shoot and haul positions. This format is presently of little use and should be replaced with more precise haul tracks delivered in digital exchange format. Such information is currently assembled by the Danish Institute for Fisheries Research, Denmark.
5. New tables describing the national coding of maturity stages for cod, flounder, herring, and sprat in relation to the five-stage scale requested in the BITS exchange format.
6. The inclusion of an overview information that should accompany the national survey data that are reported to the BITS database at the ICES headquarters.

3 ACOUSTIC SURVEYS

3.1 Biological sampling

A significant problem within acoustic surveys is the ability to obtain representative trawl samples to associate with allocated acoustic information. The problem is related to the specific selectivity of the applied trawl gear which may bias (1) the length distribution of target species and (2) the species composition and (3) the age distribution.

It was agreed to design field experiments in order to investigate the fishing performance of different gears with the aim to identify and quantify sampling errors due to selectivity problems. Furthermore intercalibration experiments should be organised for different trawl types. The trawl investigations will be conducted during the acoustic surveys in autumn 1998. Results from these investigations will be used to discuss a standardisation of a pelagic trawls.

3.2 Target strength conversions

In the application of acoustic fish abundance estimation, the target strength of the fish is a crucial parameter for the conversion of integrated acoustic energy to absolute fish abundance. One of the most important factors influencing the final results is related to target strength conversion formulas. By convention the target strength conversion is expressed as the averaged function of fish length. The actual target strength constants applied since 1983 for the Baltic Sea acoustic surveys are in reality estimates obtained for North Sea herring.

In recent years several authors have expressed concern that the applied target strength estimates may not be accurate. Therefore, a critical approach should be practised for all target strength calculations until target detection methods have improved. The ICES Baltic International Fish Survey Working Group (ICES CM 1997/J:4) have previously recommended a review on the target strength conversion formulas to be applied for acoustic stock estimations. One conclusion from the review (addendum I) is that the observed hydrographical and biological variability in back-scattering strength might obscure the use of fixed target strength constants. In addition to above review, two different reviews will be presented in the near future; one in the ICES Cooperation Research Report Series (edited by Egil Ona, Bergen, Norway) and one prepared by the FAST WG (Chairman: I. McQuinn, Quebec, Canada). These reviews are expected to further elucidate the pitfalls in the estimation of target strength constants. The conclusions and recommendations will be used to plan specific experiments to further study the target strength of the Baltic clupeid stocks.

3.3 The Baltic International Acoustic Survey (BIAS) manual

During the SGBAD meeting in 1998, a preliminary version of a Manual for the Baltic International Acoustic Surveys (BIAS) was discussed and improved. A further updated version is presented as Addendum III to this report. The participants of the 1998 BIAS are recommended to conduct their surveys according to this manual. Experiences from the practical application will be used to evaluate the outline and content of a refined Manual for the Baltic International Acoustic Surveys.

3.4 Database administration

3.4.1 Aggregated database (BAD1)

The BAD1 database contains age-aggregated data on abundance and biomass for Baltic herring and sprat as estimated from 1991 to 1997. Due to differences in instrumentation and unavailability of data the WGBIFS decided that this database should not be extended further backwards in time than to 1991. It was also agreed that the BAD1 should be updated continuously. Some obvious errors have been found in the present data set and therefore the WGBIFS stresses the need for checking and corrections by contributing parties. The Study Group on Baltic Acoustic Data (ICES CM 1998/H:3) has recommended that the necessary corrections should be delivered to the chairman of the SGBAD before September 1998.

3.4.2 Detailed database (BAD2)

A new detailed database for acoustic data and biological sampling for the Baltic International Acoustic Survey (BAD2) should be established (ICES C.M. 1997/J:4).

A comparable database is currently under construction to manage the results from the international co-ordinated acoustic survey for the North Sea and West of Scotland. The structure of this database and plans for exchange format were presented to the Study Group on Baltic Acoustic Data by the coordinator, Karl-Johan Stæhr during the study group meeting in Gdynia April 1998. This database will contain acoustic data expressed as SA values at the level of Elementary Sampling Distance Unit (ESDU). The data base will be able to deal with SA values for herring, sprat and mixed layers, respectively. The biological information from trawl hauls will be stored in a db structure similar to the BITS database format.

The WGBIFS recognised that the data base specified for the North Sea would be suitable for the Baltic Sea. Not all data types specified for the North Sea is of the same importance for the data from the Baltic but the group did find it important that the structure of the data base for the results from the acoustic surveys for both the Baltic and the North Sea are stored in the same format.

As the exchange format and procedures are under preparation and are expected to be ready for a test using the data from the North Sea early in the autumn 1998, the study group did not find it appropriate to elaborate on analogous protocols. It was recommended that further work on a detailed data base for the results from the acoustic surveys in the Baltic should be postponed until the data exchange format has been finally developed for the North Sea acoustic data base.

However, the WGBIFS recommended that the data from the 1998 International Acoustic Survey for the Baltic should be used to test the suggested exchange data format. National results from survey participants should therefore be corresponded to the Institute of Marine Research, Sweden not later than two month before next years meeting of the Study Group on Baltic Acoustic Data.

In order to test the compatibility for formats of historical data, the Swedish and German survey results should be provided in the BAD2 format for survey years previous to 1999.

3.5 Planning of the 1998 BIAS

A survey plan covering ICES subdivisions 21–29S was agreed during the meeting. The allocation of areas is similar to the one used in 1996.

Cruise planning 1998

Country	Ship	Dates	Areas	Remarks
Latvia/Russia	AtlantNiro	October	26, 28	
Germany	Solea	1998-10-02 - 1998-10-20	21, 22, 23, 24	
Sweden	Argos	1998-09-28 - 1998-10-16	25, 27, 28,29S	
Poland	Baltica	1998-10-05 - 1998-10-18	24, 25, 26	Only in Polish EEZ

4 RECOMMENDATIONS

4.1 General recommendations

1) The Baltic International Fish Survey Working Group should meet in August 1999 at an exact time and place to be decided at the ICES Annual Science Conference 1999 to:

   a) suggest detailed protocols on fishing methods, sampling, report formats, etc. for trawl surveys in the Baltic in order to implement a quality assurance to the BITS manual (intersessional and preparatory work should be organised by the national laboratories in Denmark, Estonia and Poland);
   b) compare results from concurrent survey activities by the traditional and the new standard trawls and plan the following inter-calibration programs.
   c) develop effective and operational sampling procedures for the collection of SMALK information;
   d) plan experiments to evaluate the biological sampling and TS conversion formulas presently applied in the Baltic during hydroacoustic surveys;
   e) evaluate the Manual for Baltic International Acoustic Surveys (BIAS) from practical experiences obtained during the 1998 hydroacoustic surveys;
   f) establish an acoustic database BAD2 (including the information on ESDU and biological sampling) which should replace the existing database BAD1

2) The Study Group on Baltic Acoustic Data (Chairman: Dr Eberhard Götze) should meet during March 1999 in Copenhagen at an exact date to be decided at the ICES Annual Science Conference 1998 to:

a) combine and analyse the results of the 1998 acoustic surveys and report to the Baltic Fisheries Assessment Working Group;
b) correct errors in and update the hydroacoustic database BAD1 for the years 1991 to 1998.
c) plan and decide on acoustic surveys and experiments to be conducted in 1999 and 2000.

3) A Workshop on Baltic Trawl Experiments (co-chairmen: Dr Holger Hovgård, Dr Peter Ernst) should be established and meet in January at an exact place and venue to be decided at the ICES Annual Science Conference 1998 to

a) organise experiments for 1999 with the objective to optimise the rigging and gear protocol for the new standard trawl.
b) plan intercalibration experiments between vessels equipped with the new standard trawl.
c) compile depth strata information and identify appropriate trawl tracks, indicating these depth strata.

4.2 Specific recommendations

a) In order to fully record annual changes in both SSB and recruitment levels it is recommended to conduct two surveys per year; one in February-March and one in October-November.
b) Designated intercalibration experiments are recommended if the new bottom trawl results are to be used for assessment purposes before the year 2005.
c) Due to the large variability in the fish stock abundance estimation the WGBIFS reiterates the recommendation that a full coverage BIAS should be performed each year.
d) A main part of the uncertainty in acoustic surveys is related to variability in the biological sampling compared to acoustic sampling. The influence of different trawl gears and procedures must be investigated and as a result the standardisation of the gears should be discussed.
e) The variability in the results of the acoustic surveys should be analysed. For this work the BAD1 must be continued and updated.

f) The WGBIFS recommend that data from the 1998 international acoustic survey for the Baltic will be used as a test for the exchange of data from the individual national acoustic surveys to the forthcoming data base. National data shall therefore be exchanged to the Institute of Marine Research in Lysekil not later than two month before next years meeting of the Study Group on Baltic Acoustic Data.

5 ACKNOWLEDGEMENTS

The members of the working group gratefully acknowledge the organisation of the meeting and the excellent working facilities to the staff of the Baltic Laboratory in Karlskrona, Sweden.

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Table 2.1 Catches in numbers of cod and flatfish in trawling experiments comparing the TV3/520-trawl and the HG 20/25 trawl

Haul	Trawl	cod	flounder	turbot	plaice	dab
1	TV3/520	994	49	0	0	0
	HG 20/25	672	25	0	0	0
2	TV3/520	742	28	0	0	1
	HG 20/25	238	7	0	0	0
3	TV3/520	1196	28	2	0	0
	HG 20/25	270	9	0	0	0
4	TV3/520	783	38	2	4	0
	HG 20/25	404	6	2	0	1
total	TV3/520	3715	143	4	4	1
	HG 20/25	1584	47	2	0	1

Table 2.2 Corrections of the exchange formats in the BITS Manual version 1998.

Position	Character	Comment
Record Type 1 (HH)		
53–55	Depth	5–10 m option for Sub-division 22 and 24
56	Haul validation	option "no oxygen" coded as D
Record Type 1A (HE)		
34–35	Lat. min.	previously error ("day")
36–37	Lon. deg.	previously error ("time shot")
40	East/West	Should always be "E"
Record Type 4 (CA)		
1–2	Rec. type	Should be "CA" (not "HL")
57	Maturity	Maturity code ranges from 1 to 5

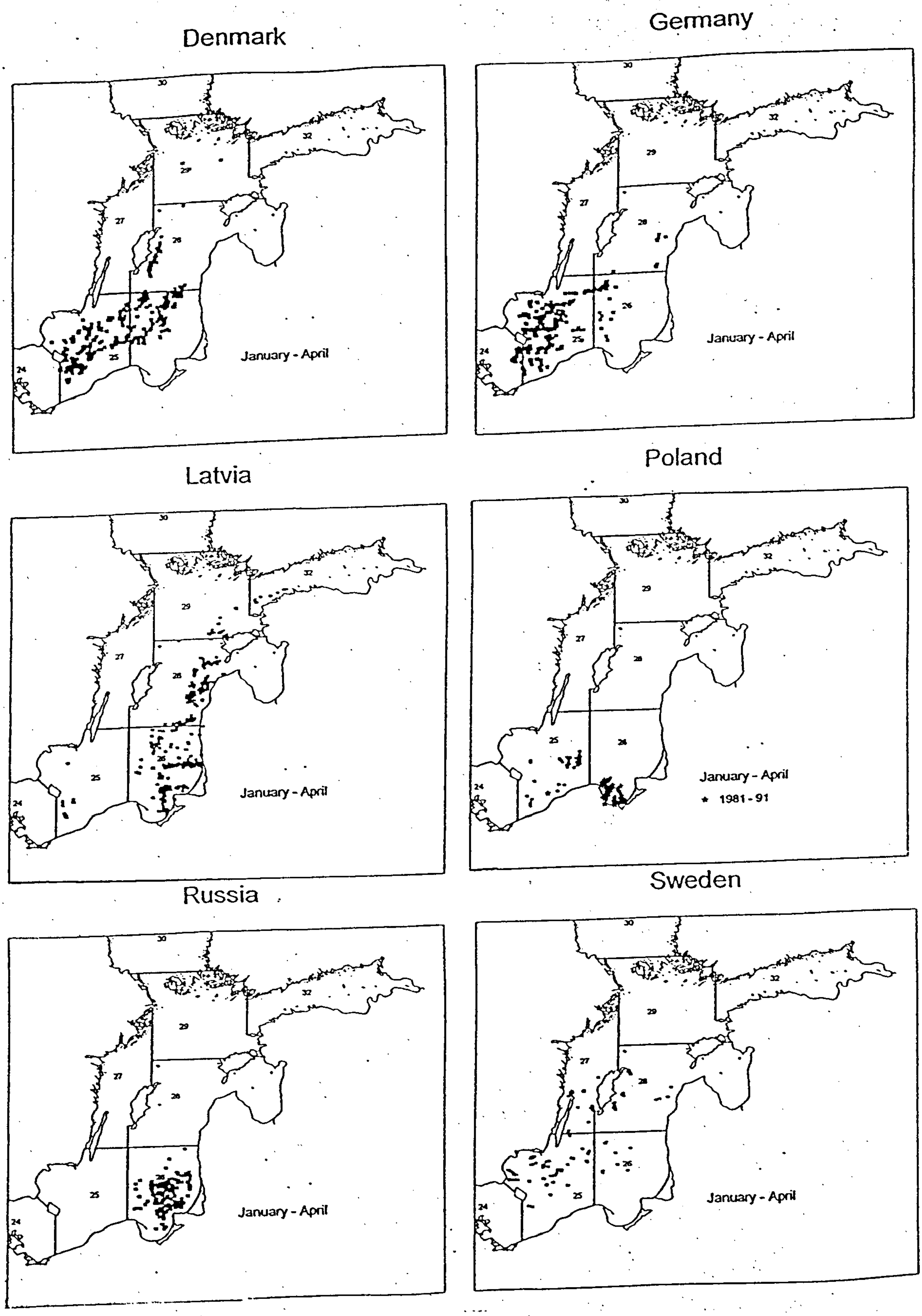

Figure 2.1 Coverage of bottom trawl surveys in Sub-divisions 25 to 32 by country in January-April (spring surveys). German data exclusive results from the GDR, Latvian data inclusive results from the USSR, Swedish data only inclusive results from GOV trawling. Adapted from Hovgård, 1998.

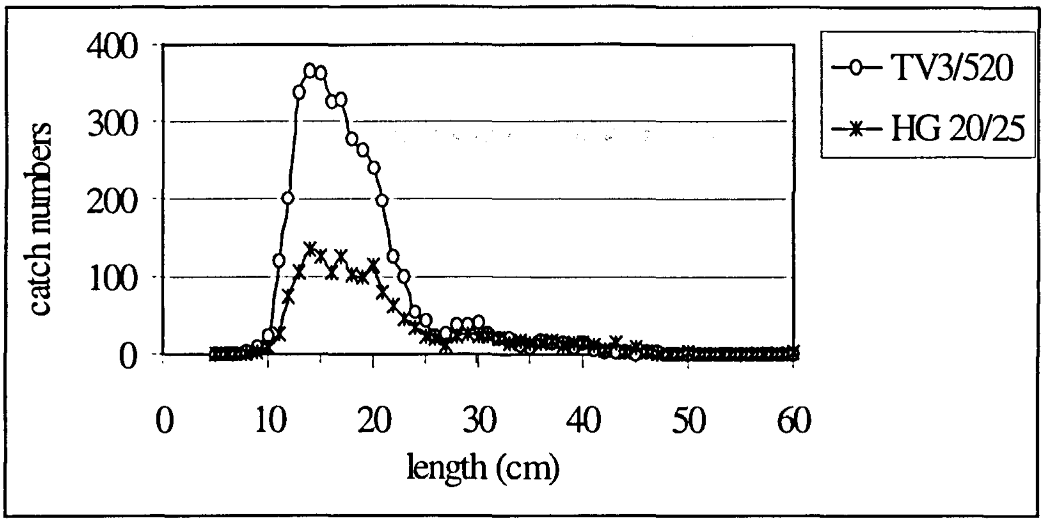

Figure 2.2 Length frequency distributions of cod in the catches from TV3/520 and HG 20/25 trawls, respectively.

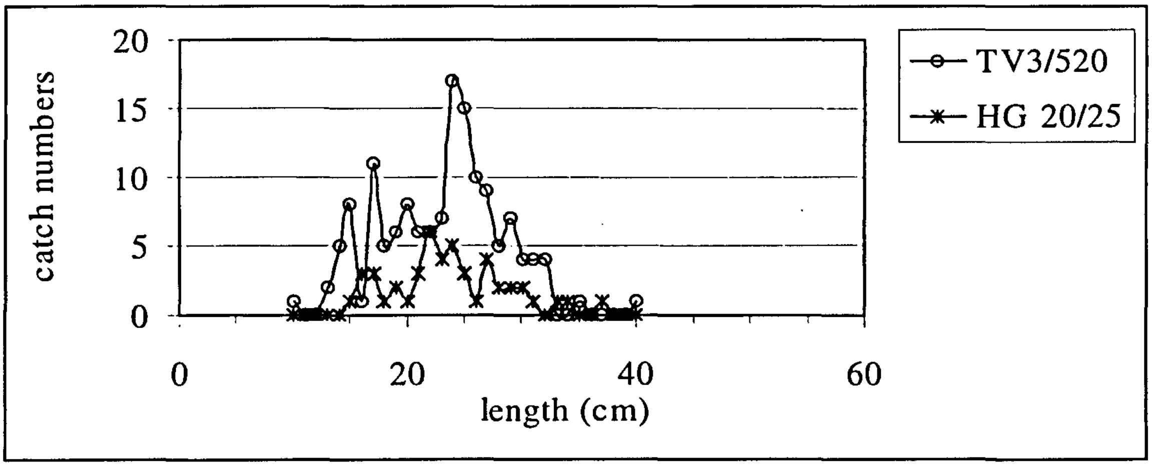

Figure 2.3 Length frequency distributions of flounder in the catches from TV3/520 and HG 20/25 trawls, respectively

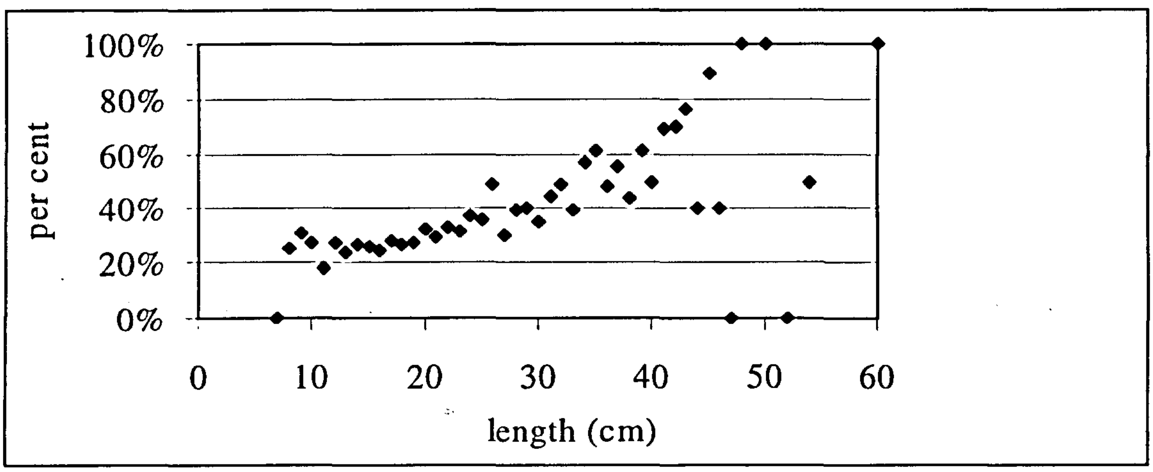

Figure 2.4 Ratio of catch of cod in numbers of HG 20/25 to (HG 20/25 + TV3/520.

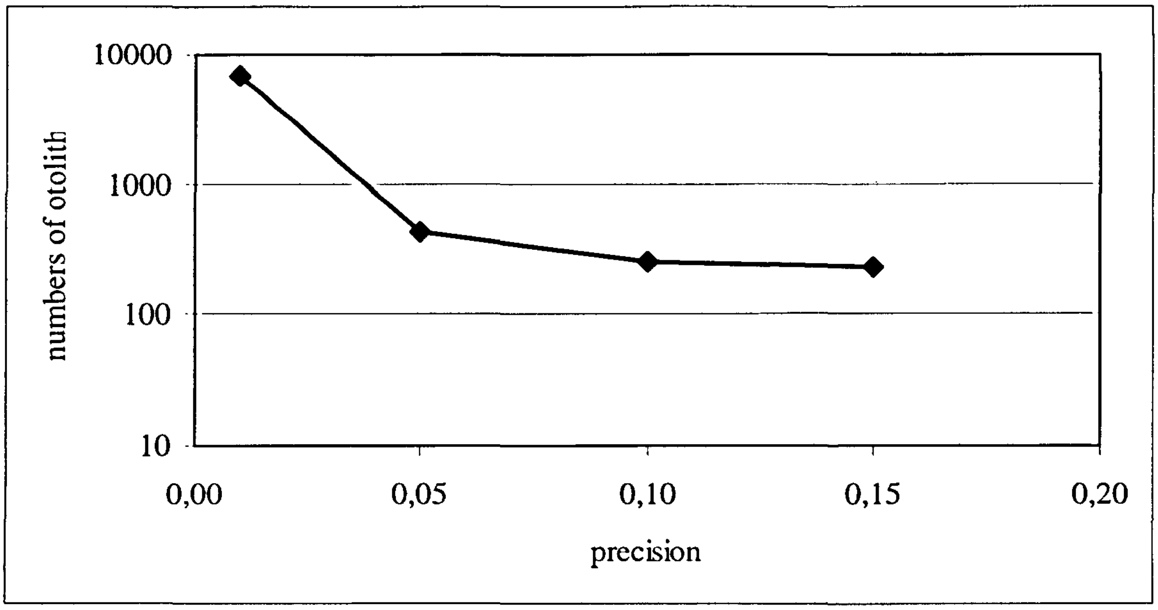

Figure 2.5 Average numbers of cod otoliths to be sampled at different precision levels. Data from Swedish surveys in Sub-division 25, quarter 1, 1988–1998.

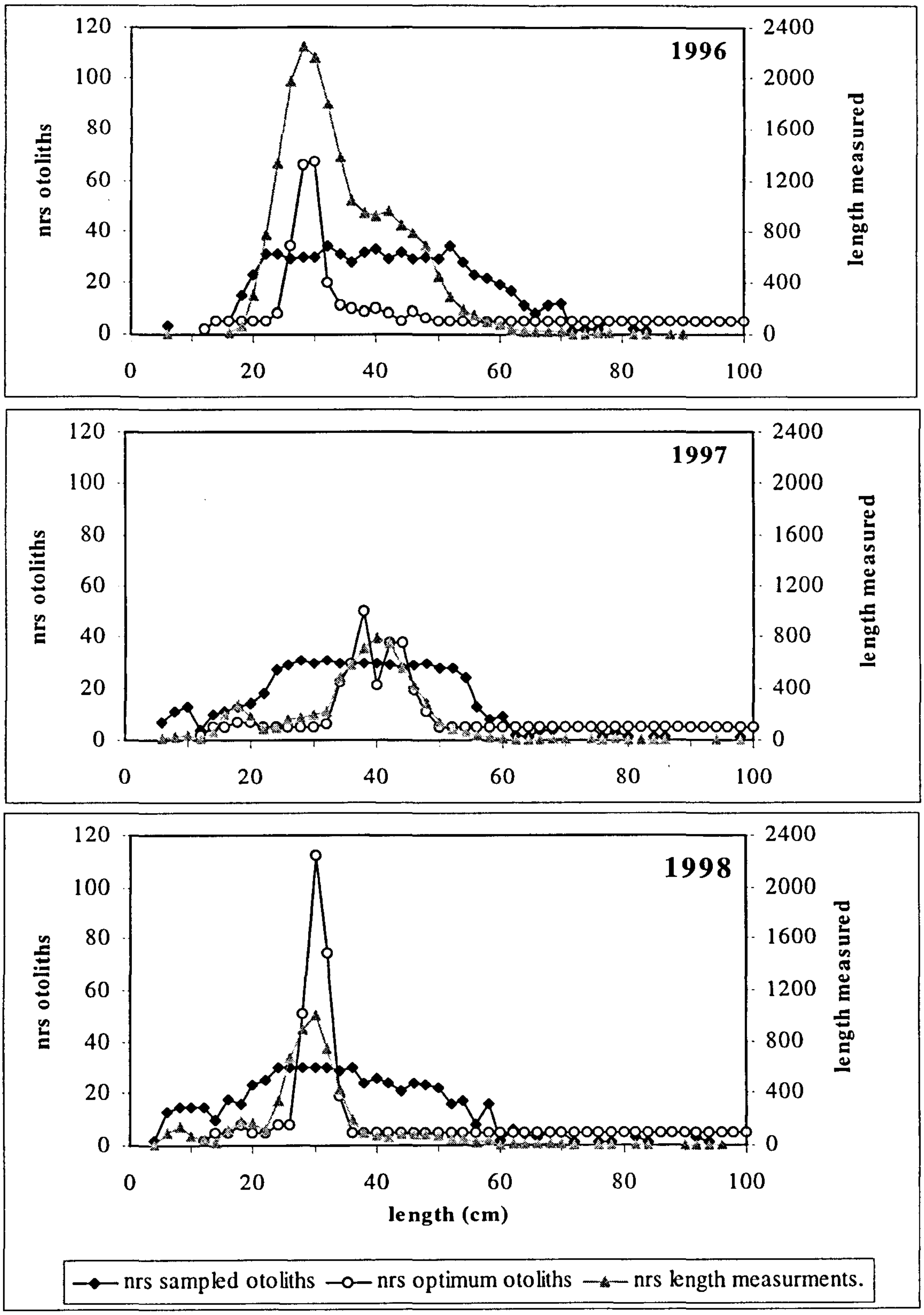

Figure 2.6. Comparison of actual number sampled otoliths, estimated optimum number and number of length measured fish for the years 1998, 1997 and 1996 (Swedish survey data on cod from Sub-Division 25, quarter one).

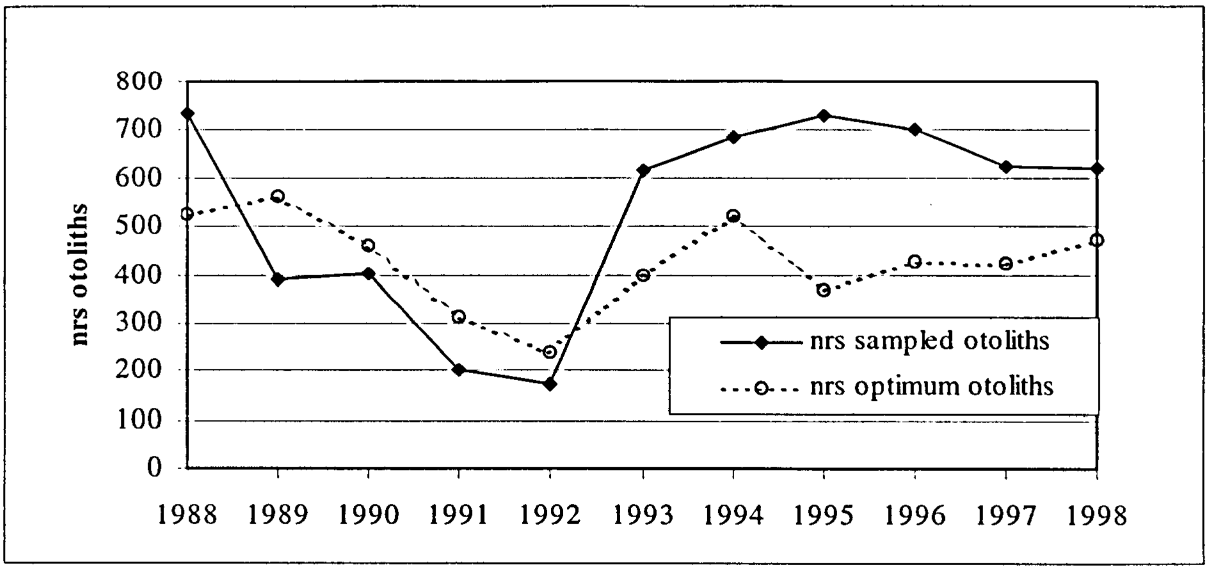

Figure 2.7 Comparison of number sampled and estimated optimum number of otoliths to be sampled for the years 1988 to 1998 (Swedish survey data on cod from Sub-Division 25, quarter one). Note the correlation between sampled and optimum number otoliths ($r^2 = 0.52$).

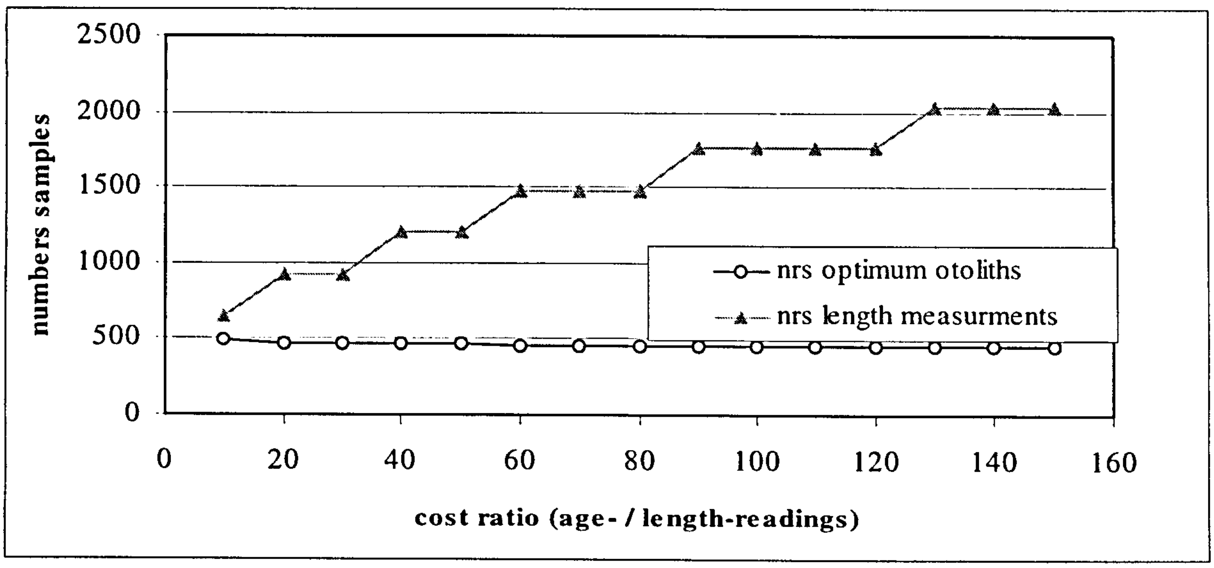

Figure 2.8. The ratio of the expenses of otolith readings compared to length measurements based on survey data of cod samples from year 1998.

APPENDIX 1

Working paper
Baltic International Fish Survey Working Group
Karlskrona, Sweden, June 1998.

The target strength conversion formula of Baltic herring (*Clupea harengus*)

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Introduction

In the application of acoustic fish abundance estimation, the target strength (TS) of the fish is an important parameter for the conversion of integrated acoustic energy to absolute fish abundance (MacLennan, 1990). Variability in acoustic estimates can be ascribed to several causes. High precision and comparability of acoustic measurements of isotropic standard targets are documented and verified (MacLennan and Simmonds, 1992). The main problem appears in the quantitative interpretation of acoustic echoes revived from targets of unknown reflecting characteristics. The same fish or school could produce very different acoustic echoes. The differences can be associated with pure stochastic reasons or with more systematic phenomena joint with behavioural reactions, controlled by basic biological rhythms and functions.

One of the most important factors influencing the final results is related to TS conversion formulas. By convention the TS conversion is expressed as the averaged function of fish length. The actual TS constants applied since 1983 for Baltic Sea acoustic surveys are in reality the North Sea herring properties. Therefore, the ICES Baltic International Fish Survey Working Group (Anon., 1997a) recommended a review on the influence of biological sampling and TS conversion formulas to the results of acoustic estimations.

Size-dependence of target strength

To estimate fish abundance in acoustic surveys, target strength (TS) must be known as a function of fish length (*L*). The form of this function is commonly assumed to be:

$$TS = 20 \text{ Log } (L) - b$$

where *b* is a constant (Foote, 1987). The value of *b* may be determined by comparing an observed TS histogram with the size distribution of the ensonified fish, obtained by trawling or other means (MacLennan and Simmonds, 1992). The TS to fish length relation at frequency 38 kHz currently applied is the one recommended by ICES (Anon., 1997b) for Baltic clupeids:

$$TS = 20 \log (L) - 71.2$$

The result is a result of a simple linear regression with the slope pre-set to 20. The regression was based mainly on *in situ* estimates made in the mid 1980s (Degnbol *et al.*, 1985; Lassen and Stæhr, 1985; Foote *et al.*, 1986). This equation is slightly modified compared with the formula, $TS = 20 \log (L) - 71.9$, recommended by Foote (1987) for clupeoids in general.

Major components that effect target strength

The swimbladder normally reflects 90% or more of the backscattered energy (Foote, 1980). However, there is considerable variation between individual fish, even those of the same size and species. The problem is that the echo depends on the internal physiology – the shape of the swimbladder, for example, which can be very different between fish which are similar in external appearance. Based on slicing and reconstructing methods, Ona (1990) found that both size and shape of the swimbladder could be significantly altered by stomach contents, gonad development and fat content of the fish. These in turn may cause diel as well as seasonal variations (including lunar cycle) of the TS of the fish (Orlowski, 1997). This suggests that the acoustic fish abundance estimates may be severely biased if one fixed TS-length relationship is to be used for all surveys and clupeoid species.

The TS depends also heavily upon fish behaviour, especially the orientation of the body in respect of the transmitted beam (MacLennan *et al.* 1990, Misund, 1997). The tilt angle is more uniform for a school that of a loose aggregation of individual fish (Blaxter and Batty, 1990). The distribution of tilt angles in the field is generally assumed to be approximately normal, where the distribution mean and standard deviation vary considerably depending upon escape response from a vessel, time of day, and whether the fish are resting, foraging or migrating, for example.

Target strength measurements technique

The scattering of sound by fish is too complicated for useful TS values to be derived from theoretical considerations alone. It is best to think the TS as a stochastic parameter. During an experiment, average number of echoes must be measured to establish the statistics of the TS distribution, and in particular, the mean value for the observed fish. Results from many experiments with different fish will be required to determine the TS properties of the population as a whole, the size dependence for example. For practical purposes, it is necessary to measure the TS by experiments. The essential requirements are calibrated echosounder and knowledge of the species, quantity and size distribution of the ensonified fish.

The TS is highly variable. Even for the same fish, the TS is unlikely to be constant, owing to changes in the orientation of the body, the physiology state of the swimbladder and possibly other factors (Zhao, 1996). Variations in mean TS are thought to be among the largest sources of non-survey error in acoustic abundance estimates (Rose, 1992). In addition the many factors, likely to influence TS may differ from time to time and place to place, thus making comparison difficult. For those reasons, the measurements of TS *in situ* where possible has been thought to be the optimal strategy (Foote 1987, MacLennan and Simmonds, 1992). In fact, *in situ* TS measurements have so far only been made using the pre-seining echo-integration technique (Hagström and Røttingen, 1982, Hamre and Dommasnes, 1994). However, most *in situ* TS measurement technique requires that the fish aggregations are resolvable into single fish. This implies that each fish individual fish should be so far away from his or her neighbouring fish that only fish appears in the acoustic pulse volume, a condition seldom achieved by shoaling fish like herring.

Biological sampling

A significant problem with *in situ* TS measurements involves the ability to obtain a representative trawl sample to associate with collected TS information. Suitable fish aggregations must be located fairly close to the transducer due to the (1) the bias imposed against small targets at greater range due to the noise threshold and (2) the requirements that most of the fish be observed as single target. The latter requirements also restrict appropriate samples to fairly low density situations. In addition, to ensure that changes in selectivity of the trawl over the length captured do not signed bias the results.

Recent findings

In situ measurements with split-beam echosounders show a wide range of TS values that are generally more uniformly distributed with less pronounced modes than samples caught by fishing. This is explained by the stochastic nature of TS, which is highly variable even for the same species and size of fish (MacLennan and Metz, 1996). The total error of the abundance estimates is combined of several individual errors. The major sources of error between 0-50 % are the target. Random variation of an individual fish TS about an expected value has little effect on the estimation of fish density. However, systematic changes in TS will bias the survey results

In recent years several authors have expressed concern that their *in situ* TS estimates were higher than expected (Kautsky *et al.* 1991, Reynisson 1993, several recent ICES reports). It is recommended that a critical approach be applied to TS data collected *in situ* until such time as advantage improve the performance of the single target detection (Soule *et al.*, 1996, for suggestion regarding possible improvements). The precision of *in situ* TS estimates generated by TS analysers is directly related to the ability of single-target detection to reject multiple echoes in denser aggregations. This bias which may be large (Foote, 1994), is due to the acceptance of multiple TS echoes aggregated by algorithm-specific selection biases reported by Soule *et al.* (1995).

During the last two years, Egil Ona and colleagues in Norway have studied several of these problems thoroughly by controlled measurements on herring TS at three frequencies, 18, 38 and 120 kHz. They have also made an extensive series of vessel avoidance measurements, showing strong vessel avoidance in the shallow layers (0-250 m) at night, and less in the deeper layers (as earlier have been discussed by Misund, (1997)).

The gross result was that the TS as recorded in Austevoll, Norway is close to:

$$TS = 20 \log (L) - 68$$

with variation about this value caused by spawning, tilt angle, pressure and fat (Egil Ona, pers. comm). During the same time-period, Hamre and Dommasnes (1994) and Zhao (1996) also found that the TS of spent Norwegian spring-spawning herring was 2-4 dB lower than the one currently used based on experiments using the pre-seining echo-integration technique. Therefore, further knowledge on the species specific TS of fish is essential for the improvement of the acoustic assessment, hence proper management of fish stocks in each area.

However, the presently used TS seems to give reasonable total biomass estimates of Atlanto-Scandian herring in the Norwegian Sea, the lower value used now compensate for several other factors which should be compensated for elsewhere, namely day / night variations, and avoidance etc. (Egil Ona pers. comm). These findings in TS methodology will soon be published (ICES Coop. Res. Rep.) and it is now in the printing phase (hopefully!). In this, the methods to be used for *in situ* TS measurements are described in detail!

There is also work done inside the ICES FAST (Fisheries Acoustics Sciences and Technology) Working Group (WG). One of their main aims is to identify the outstanding problems in acoustic stock assessment and assess to what extent they can be resolved by further research. They are also looking at development of methods and tools for *in situ* measurements of fish behaviour. On the last FAST WG meeting in La Coruna, Spain a Study Group (SG) was set-up to investigate the effect of fish behaviour on acoustic surveys. The FAST WG considered that this field was very important, and therefore asked Dr. Ian McQuinn, Canada, to prepare a review on the field of fish avoidance, and the effects of fish behaviour on TS, identification of targets, biomass estimation etc., to be ready to the next WG meeting in April 1999.

Recommendations

The conclusion is that the TS is an important parameter of acoustic fish abundance estimation. TS is the **keystone** of fisheries acoustics and needs further works for all herring stocks, especially the stocks in the Baltic Sea. Our aim should be a continuing need for TS data to be collected on fish which are representative of those to be surveyed, and on other species which may present so that their contribution to the echo integration may be deducted accurately. As mentioned before, there will be work presented soon in the ICES Cooperative Research Report Series and also one review from the FAST WG. When these have been presented, maybe we will be able to have clearer ideas. Therefore, my recommendation for the WG BIFS is to wait for the results from these two reviews before we take any further actions on this matter. However, I still suggest some actions to be taken in the meantime:

- To seek funds to conduct adequate investigation in order to find and verify a new TS conversion formula which should aim to stabilisation of the effects of variability in reflecting properties.
- To organise a workshop in 1999 or in 2000, to discuss which methods to be used in sampling values by the stochastic nature of TS, which is highly variable even for the same species and size of fish.
- To declare a Baltic TS year (2001?).

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APPENDIX 2

MANUAL FOR THE BALTIC INTERNATIONAL TRAWL SURVEYS

Updated and agreed during the meeting of the Baltic International Fish Survey Working Group

Karlskrona, Sweden

8–12 June 1998

1 INTRODUCTION

At the ICES Annual Science Conference in September 1995, the Baltic Fish Committee decided, that a manual to be used at trawl surveys in the Baltic area should be elaborated (C. Res. 1995/2:41). This manual should in its context follow the format of the manual used for the International Bottom Trawl Surveys (IBTS).The new, updated manual was edited based on the previous version of the "Manual for the Baltic International Trawl Surveys" (Addendum to ICES CM 1996/J:1).

The objective of the BITS program is to standardise fishing gear and methods throughout all national surveys where data are used as indices for assessment purposes. However, it is anticipated that the required change from national gears to a common standard gear in some instances cannot be achieved immediately.

The present manual applies to all bottom trawl surveys that are conducted within the framework of the BITS. The standard sampling procedures are uniform for all surveys.

The manual is currently updated once a year. A crucial task is to implement all protocols into a comprehensive Quality Assured Handbook which should be mandatory for all participating national research vessels. It is expected that this work will result in further amendments to the present manual.

2 THE FISHING METHOD

2.1 Standard gears

Traditional trawls (Appendix IV) will be used in a transition period by certain countries until the switch to the new standard gear has been completed in all countries.

The recommended standard trawl TV3 is available in two size categories, the TV3/520 for the smaller research vessels (400 HP) and the TV3/930 for the lager vessels. The construction and rigging of the standard trawl are described in the Report of the 2nd Workshop on Standard Trawls for the Baltic International Fish Surveys (ICES CM 1998/H:1). The exact rigging of the trawl used by participating research vessels will be evaluated in calibration and performance experiments conducted during 1999.

2.2 Fishing positions

Vessels are free to choose fishing positions in the rectangles they have been allocated. For practical reasons they are encouraged to use positions from a list of clear haul data. This database is based on international information on clear trawling positions and which can be obtained from the Danish Institute for Fisheries Research, and which will be regularly updated. It is expected that these clear haul positions will be replaced by a requirement of detailed information of haul tracks in a digital exchange format. Such format has to be specified.

Stations in adjacent rectangles, worked by the same vessel, should be separated by at least 10 miles.

2.3 Standard fishing method

Standard fishing speed is 3 - 4 knots measured as trawl speed over the ground. The recommended speed is set as a target and actual (ground) speed and distance towed should be monitored and reported. It is also recommended that the speed of the trawl through the water should be monitored and reported.

Each haul is recommended to last for 30 minutes. Start time is defined as the moment when the vertical net- opening and door-spread are stable at a trawl speed of 3-4 knots. Stop time is defined as the start of pull back.

Vertical net opening and door-spread should be monitored at 30 second intervals and mean values should be reported. It is recommended that also wing spread is measured. These measurement may be recorded if a "Scanmar" or a similar system is available.

Maximum fishing depth in the Baltic is 150 m.

Trawling may only be carried out during day time. The daylight period is defined as the time between 15 minutes before sunrise until 15 minutes past sunset.

Fishing should not be directed towards fish shoals located by sonar or echo sounder.

3 SAMPLING OF TRAWL CATCHES AND SAMPLING AREAS

3.1 Estimating the total weight of the catch

The total catch weight must be estimated by one of the following methods.

1. Weighting the total catch by use of a balance.
2. Counting the number of standard filled baskets knowing the average weight of a standard filled basket.
3. By adding up the total estimated weight or weighted weight of each species (will often be achieved during estimation of the species composition).

The result is recorded in kilograms.

3.2 Estimating the species composition of the catch

All catch is sorted by species, storing different species separately in boxes or baskets for further analyses. In order to simplify further working up of the catch, only boxes or baskets of same size and material should be used.

Certain species that are hard to distinguish from each another may be grouped by genus or higher taxonomic units.

In cases of exceptionally big catch or other circumstances, not allowing the sorting of all catch, the species composition should be estimated using sub-sampling.

The principle of sub-sampling is demonstrated by the following example. The actual stratification of the sub-sampling is dependent of the characteristic of a given catch:

1. If some species appears in very low numbers in the catch, while other species appears in high numbers, sub-sampling of only the frequent species in the catch may be applied.

   A. The species appearing with low frequency are sorted out of the catch by species and weighted.

   B. From the rest of the catch (a) three sub-samples each weighting app. 10 kg's are sorted by species. The samples must be taken from the first, middle and last sections of the trawl cod-end. Be aware of, that the three sub-samples together should represent the whole catch.

   C. Each species from the three sub-samples are pooled and the weight of each species (c) is found separately.

   D. The total weight of all species (b) in the three sub-samples is estimated by adding the weight of the three samples.

   E. The total catch weight of each species sub-sampled is estimated by raising the sub-sample weight for a given species (c) with the ratio of the total catch weight deducted the weight of the species sampled without sub-sampling (a) and the weight of the sub-sample (b).

2. If all species appears fairly frequently in the catch, simultaneous sub-sampling of all species in the whole catch should be used. The sub-sampling procedure is in principle the same as described above.

Only fish species should be recorded and the total weight should be corrected accordingly.

3.3 Length composition

Length distributions are recorded for all fish species caught. Length is defined as total length (measured from tip of snout to tip of caudal fin). Length is measured to 0.5 cm below for herring and sprat, and to 1 cm below for all other species.

In case the catch of a certain species is too large to measure all individuals, a sub-sample may be taken which should contain at least 100 specimens of the main species (cod, herring, sprat and flounder). For other species at least 50 specimens should be measured.

If a certain species (notably cod) is caught in two clearly distinct size groups, each of these size groups should be sampled separately by measuring at least 100 fish from each of them. In case of large catches of cod ($n > 1000$), the subsamples should be doubled with the minimum size given above.

Certain related species that are hard to distinguish from one another may be grouped by genus or larger taxonomic unit.

3.4 Sampling for age, sex and maturity

Otolith samples are collected within each ICES Sub-Division. For all species the same areas are used.

If otolith samples are to be taken of the 4 target species the following minimum sampling levels should be maintained for each sampling area:

herring : 15 otoliths per 0.5 cm length-class,
sprat : 15 otoliths per 0.5 cm length-class,
cod : 10 otoliths per 1 cm length-class,
flounder : 10 otoliths per 1 cm length-class.

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

<u>It is recommended that each country collect otoliths by each haul, so the otolith sampling are distributed all over the Sub-Divisions.</u>

Sex and maturity data may be reported for each species for which age data are collected. Maturity stages should be classified according to the updated, simplified maturity scale given in Appendix I.

The conversion of the national maturity codes into the BITS five stage key should be done according to appendix II.

SMALK's should be collected by each ICES Sub-Divisions. If possible the SMALK information can be compiled on a haul by haul basis.

4 ENVIRONMENTAL DATA

At each haul, the following hydrographical data may be collected:

- surface temperature,
- bottom temperature,
- surface salinity,
- bottom salinity,
- bottom oxygen.

When using a CTD-probe for measuring temperature and salinity, the CTD should be calibrated against samples collected during the ongoing cruise. The ICES Hydrographer should be consulted for futrther specifications.

5 EXCHANGE SPECIFICATIONS FOR BITS DATA

5.1 Deadlines of reporting

It is the responsibility of the participating countries to bring preliminary data (age distribution by haul) in exchange format from the 1st quarter survey to the meetings of the Herring Assessment Working Group for the Area South of 62 ° N and the Baltic Fisheries Assessment Working Group meeting. At present both working groups meetings takes place in April.

Final data should be sent to ICES on 1 June at the latest, so that a report can be prepared for the Annual Science Conference.

The following deadlines were decided for sending data in exchange format to the ICES Secretariat:

Data	Deadlines
Preliminary data 1q (age distribution by haul)	Bring to the above two WG's meetings
Final data 1q	1st June
Final data 4q	1st April

When sending the data to the ICES Secretariat the form in section 5.5 has to be filled in and send together with the records. A checking program will be made available by the ICES Secretariat during autumn 1998. This will provide an overview of the data for later use and help the entering of the data to the database. The program is intended to provide means to monitor and correct erroneous data by the responsible scientists of individual surveys.

5.2 Floppy Disk Requirements

The data has to be send in ASCII coding on a 3.5 inch disks or by E-mail.

5.3 Format of data

Four distinct types of computer records have been defined for standard storage of the BITS data:

TYPE 1 : Record with detailed haul information
TYPE 1A: Record with additional haul information
TYPE 2 : Length frequency data
TYPE 4 : Sex-maturity-age-length keys (SMALK's) for ICES Sub-Division.

The detailed formats of these four record types are given section 5.4.1 - 5.4.4 of the present manual.

Details of environmental data should be submitted to the Hydrographic Service of ICES according to established procedures. The national hydrographic station number must be reported in Record TYPE 1 to enable the link to be made between haul data and environmental data.

5.4 File structure

The records must be ordered in such a way that each record of TYPE 1 is followed by a variable number of records of TYPE 2, ordered by species. The number and kinds of species recorded must agree with the species recording code as specified in record TYPE 1. For examples of the various codes see Appendix V.

Records of TYPE 4 should follow at the end of the file after the last species record of TYPE 2 for the last haul.

Records of TYPE 1A should be submitted in a separate file.

5.4.1 Record type 1

SPECIFICATIONS FOR RECORD TYPE 1 (Haul information)

POSITION	NAME	TYPE*	M/O**	RANGE	COMMENTS
1-2	Record type	2A	M	HH	Fixed value: HH
3	Quarter	1N	M	1 to 4	
4-6	Country	3A	M	See Appendix III	ICES alpha codes for countries
7-10	Ship	4AN	M	See Appendix III	
11-20	Gear	10AN	M	See Appendix IV	Preliminary code 1)
21-26	Station number	6AN	O		National coding system
27-29	Haul no	3N	M	1 to 999	Sequential numbering by cruise
30-31	Year	2N	M	65 to 99 or 00 to 20	
32-33	Month	2N	M	1 to 12	
34-35	Day	2N	M	1 to 28/29/30/31	
36-39	Time shot	4N	M	1 to 2400, 9999	In UTC
40-42	Haul duration	3N	M	5 to 90	In minutes
43	Day/night	1A	M	D, N, space	Not known = space filled
44-45	Lat. degrees	2N	M	53 to 66	Shooting position: Degree Lat.
46-47	Lat. minutes	2N	M	0 to 59	Shooting position: Minute Lat.
48-49	Lon. degrees	2N	M	11 to 31	Shooting position: Degree Lon.
50-51	Lon. minutes	2N	M	0 to 59	Shooting position: Minute Lon.
52	East/West	1A	M	E	Fixed value: E
53-55	Depth	3N	M	0, 10 to 150 5 to 150 in Sub-div. 22 + 24	Depth from surface in metres, 0=not known
56	Haul validity	1A	M	I, P, V, N	Invalid =I, Partly valid =P, Valid =V or no oxygen = N 2)
57-64	Hydrographic station number	8AN	M		Station no as reported to the ICES hydrographer
65-66	Species Recording Code	2N	M	See Appendix V	Use position 65 for standard and 66 for bycatch codes
67-69	Netopening	3N	O	15 to 100	In metres x 10
70-73	Distance	4N	O	1850 to 9999	Distance towed over ground
74-76	Warp lenght	3N	O	100 to 999	in metres
77-78	Warp diameter	2N	O	10 to 60	In millimetres
79-81	Door surface	3N	O	10 to 100	In squaremetres x 10
82-85	Door weight	4N	O	50 to 2000	In kilogrammes
86-89	Buoyancy	4N	O	50 to 200	In kilogrammes
90-91	Kite dimensions	2N	O	5 to 20	In squaremetres x 10
92-95	Weight ground rope	4N	O	0 to 300	In kilogrammes
96-98	Door spread	3N	O	25 to 180	In metres
99-100	Paddingfield	2A	M	Spaces	Filled up with spaces

* All numeric fields (N) right justified, except when spaces are used to indicate no information.
All alpha (A) and mixed alpha/numeric fields (AN) left justified, space filled.

** M=mandatory, O=optional.
For all optional fields spaces are valid and indicate not known.

COMMENTS:

1) ICES is maintaining this code list. Laboratories should ask the Secretariat for new codes, if the gear they report is not included in the list. Numerical information on gear aspects is defined in position 67-98 and is only required for the GOV trawl.

2) Code P is reserved for situations, when no liner has been used, ultimately this should be evident from the gear code. For the time being it seems appropriate to include it here. Code N is reserved for situations, where due to low oxygen, no hauls were made and fish abundance assumed to be zero.

NB: FOR INVALID HAULS NO SPECIES INFORMATION NEED TO BE GIVEN

5.4.2 Record Type 1A

SPECIFICATIONS FOR RECORD TYPE 1A (Haul information)

POSITION	NAME	TYPE*	M/O**	RANGE	COMMENTS
1-2	Record type	2A	M	HE	Fixed value: HE
3	Quarter	1N	M	1 to 4	
4-6	Country	3A	M	See Appendix III	ICES alpha codes for countries
7-10	Ship	4AN	M	See Appendix III	
11-20	Gear	10AN	M	See Appendix IV	Preliminary code 1)
21-26	Station number	6AN	O		National coding system
27-29	Haul no	3N	M	1 to 999	Sequential numbering by cruise
30-31	Year	2N	M	65 to 99 or 00 to 20	
32-33	Lat. degrees	2N	M	53 to 66	Hauling position: Degree Lat.
34-35	Lat. minutes	2N	M	0 to 59	Hauling position: Minute Lat.
36-37	Lon. degrees	2N	M	11 to 31	Hauling position: Degree Lon.
38-39	Lon. minutes	2N	M	0 to 59	Hauling position: Minute Lon.
40	East/West	1A	M	E	Fixed value: E
41-43	Towing direction	3N	O	1 to 360	
44-45	Ground speed	2N	O	20 to 60	Ground speed of trawl. Knots x 10
46-47	Seed through water	2N	O	10 to 99	Trawl speed through. Knots x 10
48-49	Wing spread	2N	O	12 to 30	Metres
50-52	Surface current direction	3N	O	0 to 360	Slack water =0
53-55	Surface current speed	3N	O	0 to 100	Metres per sec x 10
56-58	Bottom current direction	3N	O	0 to 360	Slack water =0
59-61	Bottom current speed	3N	O	0 to 100	Metres per sec x 10
62-64	Wind direction	3N	O	0 to 360	
65-67	Wind speed	3N	O	0 to 100	Metres per sec
68-70	Swell direction	3N	O	0 to 360	
71-73	Swell height	3N	O	0 to 999	Metres x 10
74-100	Paddingfield	25A	M	Spaces	Filled up with spaces

* All numeric fields (N) right justified, zero filled, except when spaces are used to indicate no information. All alpha (A) and mixed alpha/numeric fields (AN) left justified, space filled.

** M=mandatory, O=optional.
For all optional fields spaces are valid and indicate not known.

COMMENTS:
1) ICES is maintaining this code list. Laboratories should ask the Secretariat for new codes, if the gear they report is not included in the list. Numerical information on gear aspects is only required for the GOV trawl.

5.4.3 Record Type 2

SPECIFICATIONS FOR RECORD TYPE 2 (Length frequency distribution)

POSITION	NAME	TYPE*	M/O**	RANGE	COMMENTS
1-2	Record type	2A	M	HL	Fixed value: HL
3	Quarter	1N	M	1 to 4	See Record Type 1
4-6	Country	3A	M	See Appendix III	See Record Type 1
7-10	Ship	4AN	M	See Appendix III	See Record Type 1
11-20	Gear	10AN	M	See Appendix IV	See Record Type 1
21-26	Station number	6AN	O		See Record Type 1
27-29	Haul no	3N	M	1 to 999	See Record Type 1
30-31	Year	2N	M	65 to 99 or 00 to 20	See Record Type 1
32-41	Species code	10 A	M	See Appendix VII	Official NODC code
42-43	Validity code	2N	M	See Appendix VIII	
44-50	No/hour	7N	M	0 to 9999999	No specimen caught per hour
51-55	Catch weight/Hour	5N	M	0 to 99999, spaces	In 100g. Not known = spaces
56-58	No measured	3N	M	0 to 999, spaces	Not known = spaces
59	Length class code	1AN	M	., 0, 1, 2, 5, 9	0.1 cm length class=. 0.5 cm length class = 0 1 cm length class = 1 2 cm length class = 2 5 cm length class = 5 +group =9
60-62	Min. length class	3N	M	1 to 999, spaces	Identifier of lower bound of length distribution, eg. 65-70 cm=65 For classes less than 1 cm there will be an implied decimal point after the 2nd digit, eg. 30.5-31.0 cm=305
63-68	No at length	6N	M	1 to 999999, spaces	Length classes with zero catch should be excluded from the record (no/hour equals the sum of no at length).
69	Sex	1A	O		Male = M, Female =F
70-100	Paddingfield	25A	M	Spaces	Filled up with spaces

* All numeric fields (N) right justified, zero filled, except when spaces are used to indicate no information. All alpha (A) and mixed alpha/numeric fields (AN) left justified, space filled.

** M=mandatory, O=optional. For all optional fields spaces are valid and indicate not known.

COMMENTS:

1) Total catch weights should be given per hour fishing.
2) If the number measured is zero then the remainder of the record should be filled with spaces.
3) Size classes smaller than those defined in the BITS manual for reporting length distributions of the various species are allowed.

5.4.4 Record Type 4

SPECIFICATION FOR RECORD TYPE 4 (SMALK's)

POSITION	NAME	TYPE*	M/O**	RANGE	COMMENTS 1)
1-2	Record type	2A	M	CA	Fixed value: CA
3	Quarter	1N	M	1 to 4	See Record Type 1
4-6	Country	3A	M	See Appendix III	See Record Type 1
7-10	Ship	4AN	M	See Appendix III	See Record Type 1
11-20	Gear	10AN	M	See Appendix IV	See Record Type 1
21-26	Station number	6AN	O		See Record Type 1
27-29	Haul no	3N	M	1 to 999	See Record Type 1
30-31	Year	2N	M	65 to 99 or 00 to 20	See Record Type 1
32-41	Species code	10A	M	See Appendix VII	Official NODC code
42-43	Sub-Division area	2N	M	22 to 32, see Appendix IX	ICES Baltic Sub-Division code 7)
44-47	Rectangle area	4 AN	M	See Appendix IX	ICES Statistical Rectangles
48-51	Paddingfield	4 A	M	Spaces	Filled up with spaces
52	Length class code	1AN	M	., 0, 1, 2, 5	0.1 cm length class =. 0.5 cm length class = 0 1 cm length class = 1 2 cm length class = 2 5 cm length class = 5 (+group not allowed) 2)
53-55	Min. length class	3N	M	1 to 999, spaces	Identifier of lower bound of length distribution, eg. 65-70 cm=65 For classes less than 1 cm there will be an implied decimal point after the 2nd digit, eg. 30.5-31.0 cm=305
56	Sex	1A	M	M, F, space	Male = M, Female = F, Unknown = space
57	Maturity	1AN	M	1 to 5, space	See Appendix I 3)
58	+group identifier	1A	M	+, space	Plus group = +, else space 4)
59-60	Age	2N	M	0 to 99, spaces	Unknown age =spaces 5)
61-63	Number	3N	M	1 to 999	6)
64-100	Paddingfield	4 A	M	Spaces	Filled up with spaces

* All numeric fields (N) right justified, zero filled, except when spaces are used to indicate no information. All alpha (A) and mixed alpha/numeric fields (AN) left justified, space filled.

** M=mandatory, O=optional.
For all optional fields spaces are valid and indicate not known.

COMMENTS:

1) Otolith samples may refer to an individual haul or to groups of hauls in the same rectangle or within one sampling area, depending on the procedures on board. If detailed information is available, it would seem appropriate to refer back to the haul no and/or rectangle; these data are optional rather than mandatory.
2) See Record Type 2.
3) Sex maturity data are explicitly demanded for cod.
4) A plus group refers to the age indicated AND older, respectively to a reading of more than or equal to the specified number of rings.
5) For herring and sprat the number of rings must be recorded. For all other species the age.
6) An additional field has been reserved for no of fish, which allows the information to be presented in a more aggregated form, rather than that identical information has to be recorded for all individual fish of the same size, sex, maturity and age group.
7) Standard ICES Sub-Division (22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32)

5.5 Input BITS data

Checklist with detailed information per survey compiled by: ....date: ....

Year:
Quarter:
Country:
Vessel:
Fishing gear:
Mesh size in the codend (in mm):
Comments on gear:
Hydrography (y/n):
- Stations no.:
- CTD-probe (y/n):
- Surface temperature (y/n):
- Bottom temperature (y/n):
- Surface salinity (y/n):
- Bottom salinity (y/n):
- Bottom oxygen (y/n):

Haul duration:
Day/night (trawling):
Other comments:

ICES Sub-division:	22	23	24	25	26	27	28	29	30	31	32
Number of hauls:											

STANDARD SPECIES:	Measured (y/n)	Aged (n - no, o - otoliths, s - scale)	Aged plus group used	Grouped by what stratification? (depth or ICES-rec.)	Sex (y/n)	Maturity (y/n)	Fish health condition (y/n)	Stomach fullness (y/n)
Herring:								
Sprat:								
Cod:								
Flounder:								

BYCATCH	Measured (y/n)	Counted (y/n)	Aged (y/n)
Plaice:			
Dab:			
Turbot:			
Brill:			
Sole:			
All other bychatch:			

APPENDIX I MATURITY KEY

1.VIRGIN

Male:	Testes very thin translucent ribbon lying along an unbranched blood vessel. No sign of development.
Female:	Ovaries small, elongated, whitish, translucent. No sign of development.

2. MATURING

Male:	Development has obviously started, colour is progressing towards creamy white and the testes are filling more and more of the body cavity but sperm cannot be extruded with only moderate pressure.
Female:	Development has obviously started, eggs are becoming larger and the ovaries are filling more and more of the body cavity but eggs cannot be extruded with only moderate pressure.

3. SPAWNING

Male:	Will extrude sperm under moderate pressure to advanced stage of extruding sperm freely with some sperm still in the gonad.
Female:	Will extrude eggs under moderate pressure to advanced stage of extruding eggs freely with some eggs still in the gonad.

4. SPENT

Male:	Testes shrunken with little sperm in the gonads but often some in the gonoducts which can be extruded under light pressure.
Female:	Ovaries shrunken with few residual eggs and much slime. Resting condition, firm, not translucent, showing no development.

5. RESTING	(see remarks in ICES CM 1997/J1, chapter 2.5)
Male:	Testes firm, not translucent, showing no development.
Female:	Ovaries firm, not translucent, showing no development.

APPENIX II – CONVERSION TABLES FOR MATURITY KEYS

The table convert the codes of the national maturity keys into the codes of the BITS key for cod.

Country Species Source	BITS All ICES (1997)	Denmark Cod Modif. from Maier (1908), Berner (1960)	Estonia All Kiselevich (1923), Pravdin (1966)	Finland not available	Germany Cod Modif. from Maier (1908). Berner (1960)	Latvia Cod	Poland Cod Maier (1908), Chrzan (1951)	Russia not available	Sweden Cod Modif. from Maier (1908)
Maturity stage ([1])	Code								
VIRGIN (immature)	1	I,II	I		I	Juvenis	I		I
MATURING (mature)	2	III-V	II-IV		III-V	III-IV	III-V		III-V
SPAWNING (mature)	3	VI,VII	V		VI,VII	V	VI,VII		VI
SPENT (mature)	4	VIII	VI		VIII	VI	VIII		VII,VIII
RESTING (mature/ immature[2])	5	IX,X	II		II	II	II		II

[1]sexual maturity for estimating the proportion of spawners.
[2]should be used when the investigation was during the prespawning and early spawning time (still no spent individuals). Individuals will not contribute to the spawning stock in the present year.

The table convert the codes of the national maturity key into the codes of the BITS key for herring

Country Species Source	BITS All ICES (1997)	Denmark	Estonia All Kiselevich (1923), Pravdin (1966)	Finland not available	Germany Herring Modif. from Heincke (1998)	Latvia not available	Poland Herring Modif. fr. Maier. Popiel (1955) Strzyzewska(1969)	Russia not available	Sweden Herring ICES (1962)
Maturity stage ([1])	Code								
VIRGIN (immature)	1		I		I		I,II		I,II
MATURING (mature)	2		II-IV		III,IV		III-V		III-V
SPAWNING (mature)	3		V		V,VI		VI,VII		VI
SPENT (mature)	4		VI		VII,VIII		VIII		VII
RESTING (mature/ immature[2])	5		II		II		-		VIII

[1]sexual maturity for estimating the proportion of spawners.
[2]should be used when the investigation was during the prespawning and early spawning time (still no spent individuals). Individuals will not contribute to the spawning stock in the present year.

The table convert the codes of the national maturity key into the codes of the BITS key for sprat

Country Species Source	BITS All ICES (1997)	Denmark	Estonia All Kiselevich (1923), Pravdin (1966)	Finland not available	Germany Sprat Rechlin (unpublished)	Latvia not available	Poland Sprat Maier (1908), Elwertowski (1957)	Russia not available	Sweden not available
<u>Maturity stage</u> ([1])	<u>Code</u>								
VIRGIN (immature)	1		I		I		I		
MATURING (mature)	2		II-IV		III, IV		III-V		
SPAWNING (mature)	3		V		V, VI		VI, VII		
SPENT (mature)	4		VI		VII, VIII		VIII		
RESTING (mature/ immature[2])	5		II		II		II		

[1]sexual maturity for estimating the proportion of spawners (mature individuals).
[2]should be used when the investigation was during the prespawning and early spawning time (still no spent individuals) Individuals will not contribute to the spawning stock in the present year.

The table convert the codes of the national maturity key into the codes of the BITS key for flatfishes

Country Species Source	BITS All ICES (1997)	Denmark not available	Estonia All Kiselevich (1923), Pravdin (1966)	Finland not available	Germany Flatfish Maier (1908)	Latvia not available	Poland Flatfish Maier (1908)	Russia not available	Sweden not available
<u>Maturity stage</u> ([1])	<u>Code</u>								
VIRGIN (immature)	1		I		I		I		
MATURING (mature)	2		II-IV		III-V		III-V		
SPAWNING (mature)	3		V		VI,VII		VI,VII		
SPENT (mature)	4		VI		VIII		VIII		
RESTING (mature/ immature[2])	5		II		II		II		

[1] sexual maturity for estimating the proportion of spawners (mature individuals).
[2] should be used when the investigation was during the prespawning and early spawning time (still no spent individuals). Individuals will not contribute to the spawning stock in the present year.

APPENDIX III - ALPHA CODES FOR COUNTRIES AND SHIPS

COUNTRY	ICES CODE 1)	SHIP'S NAME	BITS CODE
Denmark	DEN	Dana (old)	DAN
		Dana (new)	DAN2
		J.C. Svabo	JCS
		Havfisken	HAF
		Havkatten	HAK
Germany	GFR	Anton Dohrn (old)	AND
		Anton Dohrn (new)	AND2
		Solea	SOL
		Walther Herwig	WAH
		Clupea	CLP
		Eisbär	EIS
Sweden	SWE	Thesis	THE
		Skagerak	SKA
		Argos	ARG
		Ancylus	ACY
Estonia	EST	Koha	KOH
Finland	FIN		
Latvia	LAT 1)	Baltijas Petnieks	BPE
		Issledovatel Baltiki	ISB
		Zvezda Baltiki	ZBA
Poland	POL	Baltica	BAL
		Doktor Lubecki	DLU
		Birkut	BIR
Russia	RUS	Monokristal	MON
		Atlantniro	ATL
Lithuania	LTU 1)	Darius	DAR

Note 1). Country code for Latvia and Lithuania codes refer to the FAO, ISO Alpha 3 code system.

APPENDIX IV – ALPHANUMERIC CODES

FOR BOTTOM TRAWL GEARS

TRAWL SPECIFICATION	TRAWL POPULAR NAME	RESEARCH VESSEL
DT	Russian bottom trawl	Monokristal
28/33,6	Latvian Bottom trawl	Baltijas Petnieks
GOV 36/47	Grand Overture Verticale	Argos, Dana
Granton	Danish bottom trawl	Dana
Expo	Danish winged bottom trawl	Dana
SON	Sonderborg trawl	Clupea, Solea
HG20/25	Herring ground trawl	Solea, Eisbär
P20/25	Herring bottom trawl	Doktor Lubecki, Baltica
TV1	Large TV trawl	Havfisken
TV2	Small TV trawl	Havkatten
FOT	Fotö bottom trawl	Argos
29,4/34,3	Lithuanian cod trawl	Darius
ESB	Estonian small bottom trawl	Koha

Within the gear field the following positions have been reserved for recording various types of rigging:
Position 14-16: Sweep length in m. (Numeric, right justified, zero filled. Spaces for unknown. Code 000 indicates the semi-pelagic rigging, this specification is associated with the GOV.)
Position 17: Exceptions (B=Bobbins used, D=Double sweeps, space=standard or not known).
Position 18: Door type (P=Polyvalent, V=Vee F=Flat, K=Karm Waco, space=others or not known).

Further quantitative numeric information on rigging of gear is defined in positions 74-95, in Record Type 1.

NB: This code must still be considered as a preliminary one. More detailed information on the gears used in the past is required before a completely comprehensive coding system can be developed.

APPENDIX V – RECORDED SPECIES CODES USED IN RECORD TYPE 1.

Standard species for Baltic International Trawl surveys are listed in Appendix VI. NODC species codes are given in Appendix VII.

NB: Zero catches of a particular species in a haul may be included in or excluded from the file. However, any species deliberately excluded from a subset, or an invalid species for a particular haul, should be included for each haul with a species validity code 0 !!.

RECORDED STANDARD SPECIES LIST CODES (POSITION 65)

0 = No standard species recorded		
1 = All (4) standard species recorded		
2 = Pelagic (2) standard species recorded	Note	1)
3 = Bottom (2) standard species recorded		1)
4 = Individual (1) standard species recorded		2)

RECORDED BY-CATCH SPECIES LIST CODES (POSITION 66)

0 = No by-catch species recorded
1 = Open ended by-catch list - All species recorded
4 = Closed by-catch list - Only flatfish (4) species recorded 1)

1) For definition see Appendix VI.
2) If this code is applied, zero catches of the species recorded must be recorded in Record Type 2 format.

APPENDIX VI – OFFICIAL 10-NUMERIC NODC SPECIES CODES FOR STANDARD AND CLOSED BY-CATCH LISTS

REPORTED GROUP	SPECIES	NODC code
Standard Pelagic species	Herring	8747010201
	Sprat	8747011701
Standard Bottom species	Cod	8791030402
	Flounder	8857041402
By-catch Flatfish	Plaice	8857041502
	Dab	8857040904
	Turbot	8857030402
	Brill	8857030403
	Sole	8858010601

APPENDIX VII – OFFICIAL NODC CODE FOR FISH SPECIES (IN TAXONOMIC ORDER)

8603010000	Petromyzonidae		
8603010200	Lampetra	8603010217	Lampetra fluviatilis
		8603010218	Lampetra planeri
8603010300	Petromyzon	8603010301	Petromyzon marinus
8606010000	Myxinidae		
8606010200	Myxine	8606010201	Myxine glutinosa
8705010000	Chlamydoselachidae		
8705010100	Chlamydoselach	8705010101	Chlamydoselach anguineus
8705020000	Hexanchidae		
8705020100	Hexanchus	8705020101	Hexanchus griseus
8707040000	Lamnidae		
8707040200	Cetorhinus	8707040201	Cetorhinus maximus
8707040300	Lamna	8707040302	Lamna nasus
8707040400	Alopias	8707040401	Alopias vulpinus
8707040500	Isurus	8707040501	Isurus oxyrhinchus
8708010000	Scyliorhinidae		
8708010200	Galeus	8708010203	Galeus melastomus
8708010300	Scyliorhinus	8708010306	Scyliorhinus caniculus
		8708010307	Scyliorhinus stellaris
8708010700	Pseudotriakis	8708010701	Pseudotriakis microdon
8708020000	Carcharinidae		
8708020100	Galeorhinus	8708020102	Galeorhinus galeus
8708020200	Galeocerdo	8708020201	Galeocerdo cuvier
8708020400	Mustelus	8708020408	Mustelus asterias
		8708020409	Mustelus mustelus
		8708020410	Mustelus punctulatus
8708020600	Prionace	8708020601	Prionace glauca
8708030000	Sphyrnidae		
8708030100	Sphyrna	8708030102	Sphyrna zygaena
		8708030103	Sphyrna lewini
		8708030105	Sphyrna tudes
8710010000	Squalidae		
8710010100	Somniosus	8710010102	Somniosus microcephalus
8710010200	Squalus	8710010201	Squalus acanthias
		8710010204	Squalus blainvillei
8710010300	Centrophorus	8710010301	Centrophorus granulosus
		8710010302	Centrophorus squamosus
		8710010303	Centrophorus uyato
8710010400	Dalatias	8710010401	Dalatias licha
8710010500	Etmopterus	8710010503	Etmopterus princeps
		8710010510	Etmopterus spinax
8710010700	Oxynotus	8710010702	Oxynotus centrina
		8710010703	Oxynotus paradoxus
8710010900	Centroscyllium	8710010901	Centroscyllium fabricii
8710011000	Echinorhinus	8710011001	Echinorhinus brucus
8710011200	Centroscymnus	8710011201	Centroscymnus coelolepis
		8710011202	Centroscymnus crepidater
8710011400	Deania	8710011401	Deania calceus
8710011600	Scymnodon	8710011601	Scymnodon ringens
		8710011602	Scymnodon obscurus
8711010000	Squatinidae		
8711010100	Squatina	8711010103	Squatina squatina
8713030000	Torpedinidae		
8713030100	Torpedo	8713030102	Torpedo nobiliana
		8713030104	Torpedo torpedo
		8713030105	Torpedo marmorata
8713040000	Rajidae		
8713040100	Raja	8713040134	Raja radiata
		8713040138	Raja brachyura

		8713040140	Raja microocellata
		8713040141	Raja montagui
		8713040142	Raja hyperborea
		8713040143	Raja batis
		8713040144	Raja nidarosiensis
		8713040145	Raja oxyrhynchus
		8713040146	Raja fullonica
8713040147	Raja circularis		
		8713040148	Raja naevus
		8713040150	Raja fyllae
		8713040151	Raja alba
		8713040153	Raja lintea
		8713040158	Raja undulata
		8713040159	Raja clavata
8713040800	Bathyraja	8713040801	Bathyraja pallida
		8713040803	Bathyraja spinicauda
8713050000	Dasyatidae		
8713050100	Dasyatis	8713050141	Dasyatis pastinacus
8713070000	Myliobatidae		
8713070200	Myliobatis	8713070204	Myliobatis aquila
8713080000	Mobulidae		
8713080200	Mobula	8713080205	Mobula mobular
8716020000	Chimaeridae		
8716020100	Hydrolagus	8716020103	Hydrolagus mirabilis
8716020200	Chimaera	8716020202	Chimaera monstrosa
8716030000	Rhinochimaeridae		
8716030200	Rhinochimaera	8716030201	Rhinochimaera atlantica
8729010000	Acipenseridae		
8729010100	Acipenser	8729010107	Acipenser sturio
8741010000	Anguillidae		
8741010100	Anguilla	8741010102	Anguilla anguilla
8741050000	Muraenidae		
8741050500	Muraena	8741050505	Muraena helena
8741120000	Congridae		
8741120100	Conger	8741120111	Conger conger
8741150000	Synaphobranchidae		
8741150100	Synaphobranchus	8741150104	Synaphobranchus kaupi
8741200000	Serrivomeridae		
8741200100	Serrivomer	8741200102	Serrivomer beani
		8741200104	Serrivomer parabeani
8741210000	Nemichthyidae		
8741210100	Avocettina	8741210102	Avocettina infans
8741210200	Nemichthys	8741210202	Nemichthys scolopaceus
8743030000	Notacanthidae		
8743030200	Polyacanthonotus	8743030204	Polyacanthonotus rissoanus
8743030300	Notocanthus	8743030301	Notocanthus chemnitzii
		8743030302	Notocanthus bonaparti
8747010000	Clupeidae		
8747010100	Alosa	8747010107	Alosa alosa
		8747010109	Alosa fallax
8747010200	Clupea	8747010201	Clupea harengus
8747011700	Sprattus	8747011701	Sprattus sprattus
8747012200	Sardina	8747012201	Sardina pilchardus
8747020000	Engraulidae		
8747020100	Engraulis	8747020104	Engraulis encrasicolus
8755010000	Salmonidae		
8755010100	Coregonus	8755010115	Coregonus oxyrhynchus
		8755010116	Coregonus albula
8755010200	Oncorhynchus	8755010201	Oncorhynchus gorbuscha
		8755010202	Oncorhynchus keta
8755010300	Salmo	8755010302	Salmo gairdneri

		8755010305	Salmo salar
		8755010306	Salmo trutta
8755010400	Salvelinus	8755010402	Salvelinus alpinus
		8755010404	Salvelinus fontinalis
8755010700	Thymallus	8755010704	Thymallus thymallus
8755010800	Hucho	8755010801	Hucho hucho
8755030000	Osmeridae		
8755030200	Mallotus	8755030201	Mallotus villosus
8755030300	Osmerus	8755030301	Osmerus eperlanus
8756010000	Argentinidae		
8756010200	Argentina	8756010203	Argentina silus
		8756010237	Argentina sphyraena
8758010000	Esocidae		
8758010100	Esox	8758010101	Esox lucius
8758020000	Umbridae		
8758020100	Umbra	8758020101	Umbra pygmaea
8758020103	Umbra krameri		
8759010000	Gonostomatidae		
8759010500	Maurolicus	8759010501	Maurolicus muelleri
8759020000	Sternoptychidae		
8759020100	Argyropelecus	8759020107	Argyropelecus olfersii
8760010000	Alepocephalidae		
8760010300	Alepocephalus	8760010302	Alepocephalus rostratus
		8760010305	Alepocephalus bairdi
8762070000	Paralepididae		
8762070200	Notolepis	8762070201	Notolepis rissoi
8762070400	Paralepis	8762070402	Paralepis coregonoides
8762140000	Myctophidae		
8762140300	Lampanyctus	8762140317	Lampanyctus crocodilus
8784010000	Gobiesocidae		
8784010600	Lepadogaster	8784010601	Lepadogaster candollei
		8784010603	Lepadogaster lepadogaster
8784010700	Diplecogaster	8784010701	Diplecogaster bimaculata
8784010800	Apletodon	8784010801	Apletodon microcephalus
8786010000	Lophiidae		
8786010100	Lophius	8786010103	Lophius piscatorius
		8786010104	Lophius budegassa
8787020000	Antennariidae		
8787020200	Histrio	8787020201	Histrio histrio
8787020200	Antennarius	8787020203	Antennarius radiosus
8788030000	Himantolophiidae		
8788030200	Himantolophus	8788030201	Himantolophus groenlandicus
8788100000	Linophrynidae		
8788100100	Linophryne	8788100102	Linophryne lucifer
8791010000	Moridae		
8791010100	Antimora	8791010101	Antimora rostrata
8791010200	Laemonema	8791010203	Laemonema latifrons
8791010400	Mora	8791010401	Mora moro
8791010500	Lepidion	8791010501	Lepidion eques
8791010600	Halargyreus	8791010601	Halargyreus affinis
8791030000	Gadidae		
8791030200	Boreogadus	8791030201	Boreogadus saida
8791030400	Gadus	8791030402	Gadus morhua
8791030800	Lota	8791030801	Lota lota
8791030900	Pollachius	8791030901	Pollachius virens
		8791030902	Pollachius pollachius
8791031100	Brosme	8791031101	Brosme brosme
8791031300	Melanogrammus	8791031301	Melanogrammus aeglefinus
8791031500	Rhinonemus	8791031501	Rhinonemus cimbrius
8791031600	Phycis	8791031602	Phycis blennoides
8791031700	Trisopterus	8791031701	Trisopterus minutus

		8791031702	Trisopterus luscus
		8791031703	Trisopterus esmarki
8791031800	Merlangius	8791031801	Merlangius merlangus
8791031900	Molva	8791031901	Molva molva
		8791031902	Molva dipterygia
		8791031904	Molva macropthalma
8791032000	Gaidropsurus	8791032001	Gaidropsurus vulgaris
		8791032002	Gaidropsurus mediterraneus
8791032100	Gadiculus	8791032101	Gadiculus argenteus
8791032200	Micromesistius	8791032201	Micromesistius poutassou
8791032300	Raniceps	8791032301	Raniceps raninus
8791032400	Ciliata	8791032401	Ciliata mustela
		8791032402	Ciliata septentrionalis
8791032500	Onogadus	8791032501	Onogadus argenteus
8791032600	Antonogadus	8791032601	Antonogadus macropthalmus
8791040000	Merluccidae		
8791040100	Merluccius	8791040105	Merluccius merluccius
8792010000	Ophidiidae		
8792010600	Ophidion	8792010607	Ophidion barbatum
8792020000	Carapidae		
8792020200	Echiodon	8792020202	Echiodon drummondi
8793010000	Zoarcidae		
8793010500	Lycenchelys	8793010513	Lycenchelys sarsi
8793010700	Lycodes	8793010724	Lycodes vahlii
		8793010725	Lycodes esmarkii
8793012000	Zoarces	8793012001	Zoarces viviparus
8794010000	Macrouridae		
8794010100	Coryphaenoides	8794010117	Coryphaenoides rupestris
8794010600	Malacocephalus	8794010601	Malacocephalus laevis
8794010800	Nezumia	8794010801	Nezumia aequalis
8794011500	Trachyrhynchus	8794011501	Trachyrhynchus trachyrhynchus
		8794011502	Trachyrhynchus murrayi
8794011600	Macrourus	8794011601	Macrourus berglax
8803010000	Exocoetidae		
8803010100	Cypselurus	8803010101	Cypselurus heterurus
		8803010106	Cypselurus pinnatibarbatus
8803010500	Danichthys	8803010501	Danichthys rondeletii
8803010700	Exocoetus	8803010701	Exocoetus obtusirostris
8803020000	Belonidae		
8803020500	Belone	8803020502	Belone belone
8803030000	Scomberesocidae		
8803030200	Scomberesox	8803030201	Scomberesox saurus
8805020000	Atherinidae		
8805021000	Atherina	8805021002	Atherina boyeri
		8805021003	Atherina presbyter
8810010000	Diretmidae		
8810010100	Diretmus	8810010101	Diretmus argenteus
8810020000	Trachichthyidae		
8810020100	Gephyroberyx	8810020101	Gephyroberyx darwini
8810020200	Hoplostethus	8810020201	Hoplostethus atlanticus
		8810020202	Hoplostethus mediterraneus
8810050000	Berycidae		
8810050100	Beryx	8810050101	Beryx decadactylus
		8810050102	Beryx splendens
8811030000	Zeidae		
8811030300	Zeus	8811030301	Zeus faber
8811060000	Caproidae		
8811060300	Capros	8811060301	Capros aper
8813010000	Lampridae		
8813010100	Lampris	8813010102	Lampris guttatus
8815020000	Trachipteridae		

8815020100	Trachipterus	8815020102	Trachipterus arcticus
8815030000	Regalecidae		
8815030100	Regalecus	8815030101	Regalecus glesne
8818010000	Gasterosteidae		
8818010100	Gasterosteus	8818010101	Gasterosteus aculeatus
8818010200	Pungitius	8818010201	Pungitius pungitius
8818010500	Spinachia	8818010501	Spinachia spinachia
8819030000	Macrorhamphosidae		
8819030100	Macrorhamphosus	8819030101	Macrorhamphosus scolopax
8820020000	Syngnathidae		
8820020100	Syngnathus	8820020119	Syngnathus rostellatus
		8820020120	Syngnathus acus
		8820020123	Syngnathus typhle
8820020200	Hippocampus	8820020209	Hippocampus hippocampus
		8820020210	Hippocampus ramulosus
8820022100	Entelurus	8820022101	Entelurus aequoreus
8820022200	Nerophis	8820022201	Nerophis lumbriciformis
		8820022202	Nerophis ophidion
8826010000	Scorpaenidae		
8826010100	Sebastes	8826010139	Sebastes marinus
		8826010151	Sebastes mentella
		8826010175	Sebastes viviparus
8826010300	Helicolenus	8826010301	Helicolenus dactylopterus
8826010600	Scorpaena	8826010628	Scorpaena scropha
		8826010629	Scorpaena porcus
8826011100	Trachyscorpia	8826011101	Trachyscorpia cristulata
8826020000	Triglidae		
8826020300	Peristedion	8826020316	Peristedion cataphractum
8826020500	Trigla	8826020501	Trigla lucerna
		8826020503	Trigla lyra
8826020600	Eutrigla	8826020601	Eutrigla gurnardus
8826020700	Trigloporus	8826020701	Trigloporus lastoviza
8826020800	Aspitrigla	8826020801	Aspitrigla cuculus
		8826020802	Aspitrigla obscura
8831010000	Icelidae		
8831010100	Icelus	8831010101	Icelus bicornis
8831020000	Cottidae		
8831020300	Artediellus	8831020308	Artediellus europaeus
8831020800	Cottus	8831020825	Cottus gobio
8831022200	Myoxocephalus	8831022205	Myoxocephalus quadricornis
		8831022207	Myoxocephalus scorpius
8831023800	Triglops	8831023807	Triglops murrayi
8831024600	Taurulus	8831024601	Taurulus bubalis
		8831024602	Taurulus lilljeborgi
8831080000	Agonidae		
8831080800	Agonus	8831080801	Agonus decagonus
		8831080803	Agonus cataphractus
8831090000	Cyclopteridae		
8831090200	Careproctus	8831090232	Careproctus longipinnis
		8831090233	Careproctus reinhardi
8831090800	Liparis	8831090828	Liparis liparis
		8831090860	Liparis montagui
8831091500	Cyclopterus	8831091501	Cyclopterus lumpus
8835020000	Serranidae		
8835020100	Morone	8835020102	Morone saxatilis
8835020400	Epinephelus	8835020435	Epinephelus guaza
8835022300	Serranus	8835022316	Serranus cabrilla
8835022800	Polyprion	8835022801	Polyprion americanus
8835160000	Centrarchidae		
8835160200	Ambloplites	8835160201	Ambloplites rupestris
8835160500	Lepomis	8835160505	Lepomis gibbosus

8835160600	Micropterus	8835160601	Micropterus dolomieui
		8835160602	Micropterus salmoides
8835180000	Apogonidae		
8835180400	Epigonus	8835180403	Epigonus telescopus
8835181200	Rhectogramma	8835181201	Rhectogramma sherborni
8835270000	Echeneidae		
8835270100	Remora	8835270103	Remora remora
8835280000	Carangidae		
8835280100	Trachurus	8835280103	Trachurus trachurus
		8835280105	Trachurus mediterraneus
		8835280106	Trachurus picturatus
8835280800	Seriola	8835280801	Seriola dumerili
8835280900	Trachinotus	8835280911	Trachinotus ovatus
8835281500	Naucrates	8835281501	Naucrates ductor
8835282400	Lichia	8835282401	Lichia amia
8835330000	Caristiidae		
8835330100	Caristius	8835330101	Caristius macropus
8835430000	Sparidae		
8835430100	Dentex	8835430102	Dentex macropthalmus
		8835430105	Dentex dentex
8835430600	Pagrus	8835430601	Pagrus pagrus
8835430800	Pagellus	8835430801	Pagellus bogaraveo
		8835430804	Pagellus erythrinus
8835430900	Boops	8835430901	Boops boops
8835431100	Sparus	8835431101	Sparus aurata
		8835431102	Sparus pagurus
8835431200	Spondyliosoma	8835431201	Spondyliosoma cantharus
8835440000	Sciaenidae		
8835441100	Umbrina	8835441107	Umbrina canariensis
		8835441108	Umbrina cirrosa
8835442700	Argyrosomus	8835442701	Argyrosomus regium
8835450000	Mullidae		
8835450200	Mullus	8835450202	Mullus surmuletus
		8835450203	Mullus barbatus
8835700000	Cepolidae		
8835700100	Cepola	8835700102	Cepola rubescens
8835710000	Bramidae		
8835710100	Brama	8835710102	Brama brama
8835710300	Pterycombus	8835710301	Pterycombus brama
8835710400	Taractes	8835710401	Taractes longipinnis
		8835710403	Taractes asper
8835720000	Dicentrarchidae		
8835720100	Dicentrarchus	8835720101	Dicentrarchus labrax
		8835720102	Dicentrarchus punctatus
8836010000	Mugilidae		
8836010100	Mugil	8836010101	Mugil cephalus
8836010700	Chelon	8836010704	Chelon labrosus
8836010900	Liza	8836010901	Liza ramada
		8836010902	Liza auratus
8839010000	Labridae		
8839012300	Coris	8839012306	Coris julis
8839013300	Crenilabrus	8839013301	Crenilabrus melops
8839013400	Centrolabrus	8839013401	Centrolabrus exoletus
8839013500	Ctenolabrus	8839013501	Ctenolabrus rupestris
8839013600	Labrus	8839013603	Labrus berggylta
		8839013605	Labrus mixtus
8839013700	Acantholabrus	8839013701	Acantholabrus palloni
8840060000	Trachinidae		
8840060100	Trachinus	8840060101	Trachinus vipera
		8840060102	Trachinus draco
8842010000	Blenniidae		

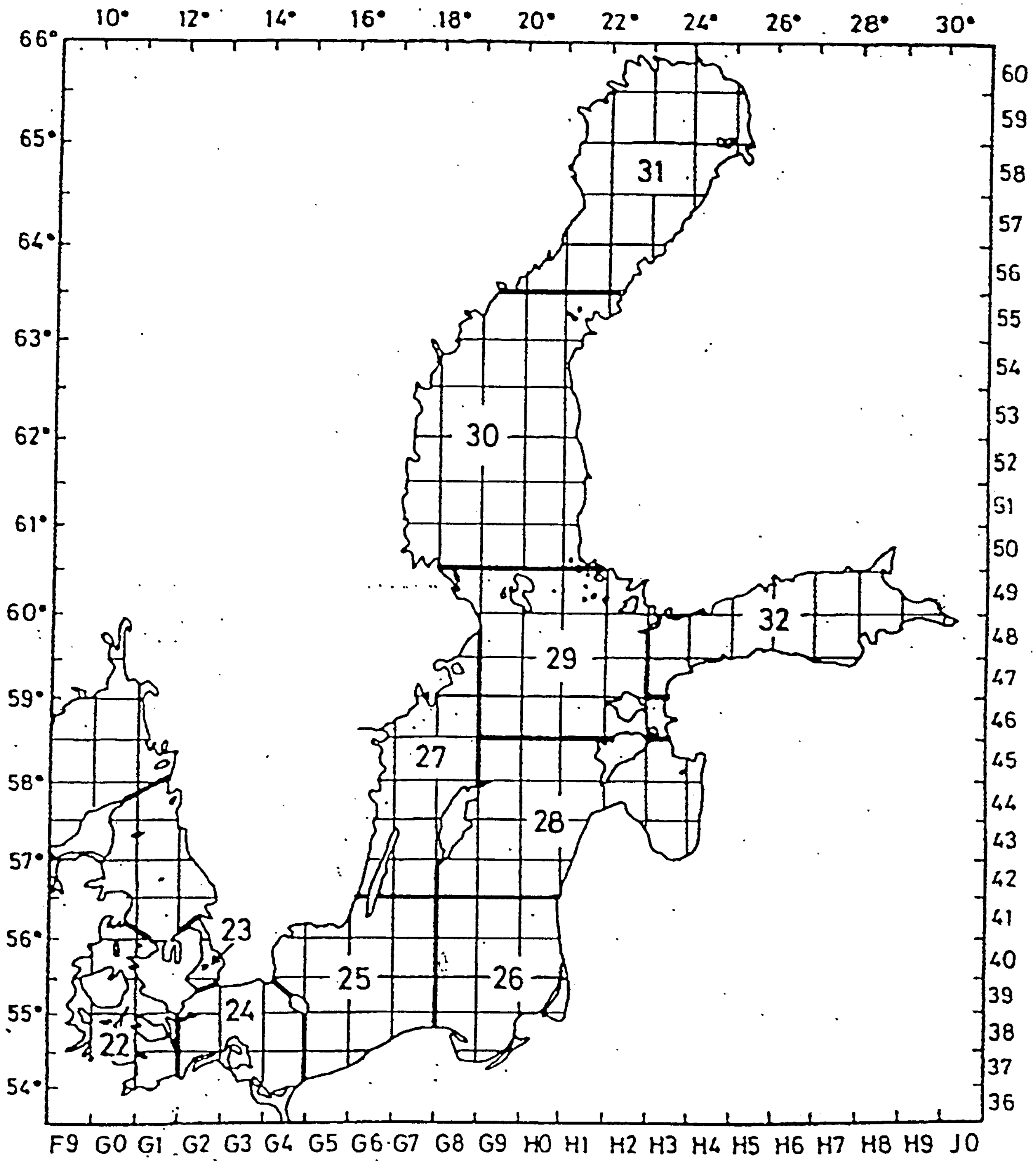
8842010100	Blennius	8842010104	Blennius ocellaris
		8842010110	Blennius gattorugine
		8842010115	Blennius pholis
8842012400	Coryphoblennius	8842012401	Coryphoblennius galerita
8842020000	Anarhichadidae		
8842020100	Anarhichas	8842020102	Anarhichas denticulatus
		8842020103	Anarhichas lupus
		8842020104	Anarhichas minor
8842120000	Stichaeidae		
8842120500	Chirolophis	8842120505	Chirolophis ascanii
8842120900	Lumpenus	8842120905	Lumpenus lampretaeformis
8842121800	Leptoclinus	8842121801	Leptoclinus maculatus
8842130000	Pholididae		
8842130200	Pholis	8842130209	Pholis gunnellus
8845010000	Ammodytidae		
8845010100	Ammodytes	8845010105	Ammodytes tobianus
		8845010106	Ammodytes marinus
8845010200	Gymnammodytes	8845010201	Gymnammodytes semisquamatus
8845010300	Hyperoplus	8845010301	Hyperoplus lanceolatus
		8845010302	Hyperoplus immaculatus
8846010000	Callionymidae		
8846010100	Callionymus	8846010106	Callionymus lyra
		8846010107	Callionymus maculatus
		8846010120	Callionymus reticulatus
8847010000	Gobiidae		
8847011300	Gobius	8847011304	Gobius auratus
		8847011307	Gobius cobitis
		8847011308	Gobius cruentatus
		8847011316	Gobius niger
		8847011320	Gobius paganellus
		8847011325	Gobius gasteveni
8847014900	Crystallogobius	8847014901	Crystallogobius linearis
8847015000	Gobiusculus	8847015001	Gobiusculus flavescens
8847015100	Pomatoschistus	8847015101	Pomatoschistus minutus
		8847015102	Pomatoschistus pictus
		8847015103	Pomatoschistus microps
		8847015104	Pomatoschistus norvegicus
8847016500	Lebetus	8847016501	Lebetus orca
		8847016502	Lebetus guilleti
8847016600	Aphia	8847016601	Aphia minuta
8847016700	Lesueurigobius	8847016702	Lesueurigobius friesii
8847016800	Buenia	8847016802	Buenia jeffreysii
8847016900	Thorogobius	8847016901	Thorogobius ephippiatus
8850010000	Gemplydae		
8850010400	Ruvettus	8850010401	Ruvettus pretiosus
8850010700	Nesarchus	8850010701	Nesarchus nasutus
8850020000	Trichiuridae		
8850020100	Benthodesmus	8850020101	Benthodesmus simonyi
8850020200	Trichiurus	8850020201	Trichiurus lepturus
8850020300	Aphanopus	8850020301	Aphanopus carbo
8850020400	Lepidopus	8850020401	Lepidopus caudatus
8850030000	Scombridae		
8850030100	Euthynnus	8850030101	Euthynnus pelamis
		8850030105	Euthynnus quadripunctatus
8850030200	Sarda	8850030202	Sarda sarda
8850030300	Scomber	8850030301	Scomber colias
		8850030302	Scomber scombrus
8850030400	Thunnus	8850030401	Thunnus alalunga
		8850030402	Thunnus thynnus
		8850030403	Thunnus albacares

		8850030404	Thunnus obesus
8850030700	Auxis	8850030701	Auxis rochei
		8850030702	Auxis thazard
8850031200	Orcynopsis	8850031201	Orcynopsis unicolor
8850040000	Xiphiidae		
8850040100	Xiphias	8850040101	Xiphias gladius
8850050000	Luvaridae		
8850050100	Luvarus	8850050101	Luvarus imperialis
8850060000	Istiophoridae		
8850060100	Istiophorus	8850060101	Istiophorus platypterus
8850060300	Tetrapterus	8850060301	Tetrapterus albidus
8851010000	Centrolophidae		
8851010300	Centrolophus	8851010301	Centrolophus niger
8851020000	Nomeidae		
8851020200	Cubiceps	8851020203	Cubiceps gracilis
8851030000	Stromateidae		
8851030200	Hyperoglyphe	8851030201	Hyperoglyphe perciforma
8851030400	Schedophilus	8851030401	Schedophilus medusophagus
8857030000	Bothidae		
8857030400	Scophthalmus	8857030402	Scophthalmus maximus
		8857030403	Scophthalmus rhombus
8857031700	Arnoglossus	8857031702	Arnoglossus laterna
		8857031703	Arnoglossus imperialis
		8857031706	Arnoglossus thori
8857032100	Zeugopterus	8857032101	Zeugopterus punctatus
8857032200	Phrynorhombus	8857032201	Phrynorhombus norvegicus
		8857032202	Phrynorhombus regius
8857032300	Lepidorhombus	8857032301	Lepidorhombus boscii
		8857032302	Lepidorhombus whiffiagonis
8857040000	Pleuronectidae		
8857040500	Glyptocephalus	8857040502	Glyptocephalus cynoglossus
8857040600	Hippoglossoides	8857040603	Hippoglossoides platessoides
8857040900	Limanda	8857040904	Limanda limanda
8857041200	Microstomus	8857041202	Microstomus kitt
8857041400	Platichthys	8857041402	Platichthys flesus
8857041500	Pleuronectes	8857041502	Pleuronectes platessa
8857041800	Reinhardtius	8857041801	Reinhardtius hippoglossoides
8857041900	Hippoglossus	8857041902	Hippoglossus hippoglossus
8858010000	Soleidae		
8858010600	Solea	8858010601	Solea solea
		8858010610	Solea lascaris
8858010800	Buglossidium	8858010801	Buglossidium luteum
8858010900	Microchirus	8858010902	Microchirus azevia
		8858010903	Microchirus variegatus
8858011000	Bathysolea	8858011001	Bathysolea profundicola
8858011100	Dicologlossa	8858011101	Dicologlossa cuneata
8858020000	Cynoglossidae		
8858020200	Cynoglossus	8858020201	Cynoglossus browni
8860020000	Balistidae		
8860020200	Balistes	8860020205	Balistes carolinensis
8860020500	Canthidermis	8860020501	Canthidermis maculatus
8861010000	Tetradontidae		
8861010100	Lagocephalus	8861010102	Lagocephalus lagocephalus
8861040000	Molidae		
8861040100	Mola	8861040101	Mola mola
8861040200	Ranzania	8861040201	Ranzania laevis

APPENDIX VIII – SPECIES VALIDITY CODE

0 =	INVALID INFORMATION	Information lost
1 =	VALID INFORMATION	No per hour and total length composition recorded; applies also when No per hour is zero.
2 =	PARTLY VALID INFORMATION	Refers to haul validity code P; only valid for fish over 20 cm because no liner has been used; applies also when No per hour is zero.
3 =	LENGTH COMPOSITION INCOMPLETE	Only part of the catch has been measured
4 =	TOTAL NO PER HOUR ONLY	Catch sampled for No per hour only; no length measurements.
9 =	VALID INFORMATION AVAILABLE BUT NOT RECORDED ON THE FILE	Data no processed on the file

APPENDIX IX – SUB/DIVISIONS AND RECTANGELS CODES



APPENDIX 3

MANUAL FOR THE BALTIC INTERNATIONAL ACOUSTIC SURVEYS (BIAS)

VERSION 0.6

Updated and agreed during the meeting of the Baltic International Fish Survey Working Group

Karlskrona, Sweden

8–12 June 1998

1 INTRODUCTION

Hydroacoustic 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 and sprat in the Baltic Main basin (Hakansson *et al.* 1979). Since then there has been at least one annual hydroacoustic survey for Baltic herring and sprat stocks mainly for assessment purposes and results have been reported in journals to the Planning Group for Hydroacoustic Surveys in the Baltic and to ICES Annual Science Conferences (Anon. 1994a, 1995a, 1995b, Hagström *et al.* 1991).

At the ICES Annual Science Conference in September 1997, the Baltic Fish Committee decided, that a manual to be used at international acoustic trawl surveys in the Baltic area should be elaborated. This manual should in its context follow the format of the manual used for the Baltic International Trawl Surveys (BITS).

The objective of the Baltic International Acoustic Surveys (BIAS) program is to standardise survey design, acoustic measurements, fishing method and data analysis throughout all national surveys where data are used as indices for assessment purposes.

The present manual applies to all hydroacoustic pelagic trawl surveys that are conducted within the framework of the BIAS. The standard sampling procedures should be uniform for all surveys. In order to obtain a standardisation for all ICES acoustic surveys some demands from the Manual for Herring Acoustic Surveys in ICES Divisions III, IV and VI (Anon, 1994b) are adopted.

2 SURVEY DESIGN

2.1 Area of observation

It is assumed that the effective acoustic surveys cover only the area below 10m depth in each stratum.

2.2 Stratification

The stratification in the Baltic is based on ICES statistical rectangles with a range of 0.5 degrees in latitude and 1 degree in longitude. The areas of all strata limited by the 10 m depth line are given in the Report of the Baltic International Fish Survey Working Group, 1997 (ICES CM 1997/J:4, Table 3.3.2.1).

2.3 Transects

Parallel transects are spaced on regular rectangle basis at a maximum distance of 15 nautical miles.
The transect density shall be about 60 nm per 1000 nm^2. In the vicinity of islands and in sounds the strategy of parallel transects leads to an unsuitable coverage of the survey area. In this case a zig-zag course should be used to achieve a regular covering. The length of the survey track should be chosen proportional to the parallel case.

2.4 Observation time

The acoustic surveys in the Baltic Sea (including Sub-divisions 21-32) are carried out in October. It is assumed that during this time of the year there is little or no emigration or immigration so that the estimates are representing a good 'snapshot' of the resources.

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 visible for the echosounder. This leads to an underestimation of fish. Therefore the survey can be carried out only during night-time.

3 ACOUSTIC MEASUREMENTS

3.1 Equipment

The standard equipment used for the survey are the echosounder SIMRAD EK/EY-500 or SIMRAD EK-400.
The standard frequency used for the survey is 38 kHz.

3.2 Instrument settings

A whole string of instrument settings can influence the acoustic measurements in a dangerous way. Particularly the right calibration settings in the ***Transceiver Menu*** are essential for the correct function of the acoustic device:

Max. Power
2-Way Beam Angle
Sv Transd. Gain
TS Transd. Gain

Additional in the split-beam case:

Angle Sens.Along
Angle Sens.Athw.
3dB Beamw.Along
3dB Beamw.Athw.
Alongship Offset
Athw.ship Offset

The following ***Transceiver Menu*** settings are recommended:

Absorption coef.	3 dBkm
Pulse Length	Medium
Bandwidth	Wide

and in the ***Layer Menu***:

Threshold	-60 dB
Bottom margin	0.5

It is recommended to record these settings regularly to have a log about the main function of the acoustic measuring system. It is also recommended that each year the same settings (Min Sv = -60dB) are used for the printer in order to facilitate comparison of echogrammes.

3.3 Sampling unit

The Elementary Sampling Distance Unit (ESDU) is the length of cruise track along which acoustic measurements are averaged to give one sample. It is recommended to use in the Baltic the averaging unit of 1 nm.

3.4 Calibration

A calibration of the transducer is conducted at least once during the survey. If possible, the transducer is calibrated both at the beginning and the end of the survey. Calibration procedures are described in Foote *et al.* (1987) and in the EK 500 manual.

4 FISHERY

4.1 Gear

Trawling is done with different pelagic gears in the midwater as well as in the near bottom. The stretched mesh size in the codend of the trawl shall be 20 mm. It is anticipated that a standard gear and protocols for gear handling shall be agreed between survey participants.

4.2 Method

The collection of biological samples in the Baltic is done to determine the species composition and length, age and weight distributions of target species detected by the echosounder system.
It is recommended to sample a minimum of 2 hauls per stratum.
Standard fishing speed is 3 - 4.5 knots.
Each haul is recommended to last for 30 minutes.

4.3 Samples

4.3.1 Species composition

In principal the total catch shall be sorted into all species. The weight of the total catch and the weight per species shall be registered.

If the catch consists of a mixture of clupeoids and few larger species the total catch can be sorted into species for the larger fish species and a mixture of clupeoids. The total weight per species for the larger species and the total weight of the mixture of clupeoids for the total catch shall be registered.

A subsample of at least 100 kg of the mixture of clupeoids shall be sorted for the estimation of the species composition of clupeoids in the mixture. The weight of the subsample, and the total weight per species in the subsample shall be registered.

4.3.2 Length composition

Length distributions are recorded for all fish species caught. Length is defined as total length (measured from tip of snout to tip of caudal fin). Length is measured to 0.5 cm below for herring and sprat, and to 1 cm below for all other species.

In case the catch of a certain species is too large to measure all individuals, a sub-sample may be taken which should contain at least 100 specimens of the main species (herring and sprat). For other species at least 50 specimens should be measured.

If a certain species (notably herring) is caught in two clearly distinct size groups, each of these size groups should be sampled separately by measuring at least 100 fish from each of them. In case of large catches of herring (n > 1000), the subsamples should be doubled with the minimum size given above.

Certain related species that are hard to distinguish from one another may be grouped by genus or larger taxonomic unit.

4.3.3 Weight distribution

The mean weight per length group for herring and sprat shall be measured for each trawl haul.
Herring and sprat shall be sorted into 0.5 cm length groups and weighted.

The total weight of the sample used for length-weight distribution for a given species shall be registered together with the number and sample weight per length group.

4.3.4 Age distribution

Otolith samples are collected within each ICES Sub-division. For all species the same areas are used.

If otolith samples are to be taken of the 2 target species herring and sprat the number of otoliths per length-class are not fixed by a constant figure. Nevertheless the following minimum sampling levels should be maintained for each sampling area:

herring	:	5 otoliths per 0.5 cm length-class
sprat	:	5 otoliths per 0.5 cm length-class for l<10cm
		10 otoliths per 0.5 cm length-class for l>10cm

For the smallest size groups, that presumably contain only one age group, the number of otoliths per length class may be reduced. It is recommended that each country collect otoliths by each haul, so the otolith sampling are distributed all over the Sub-Divisions.

4.4 Environmental data

Environmental data should be measured. The ICES Hydrographer should be contacted for further specifications.

5 DATA ANALYSIS

5.1 Species composition

Trawl catches within each stratum are combined to give an average species composition of the catch. Each trawl catch is given equal weight, unless it is decided that a catch is not representative for the fish concentrations sampled. In this case, the catch is not used. The species frequency f_i of species i can be estimated by

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

where n_{ik} the fish number of species i in the trawl k and N_k the total fish number in this haul.

5.2 Length distribution

It is assumed that catch rates are poorly related to abundance. In this case each trawl catch is given equal weight. Very small samples are considered as non representative and excluded from the calculation. We find the length frequency f_{ij} in the length class j as the mean over all M_i trawl catches containing the species i

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

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

All sampled otoliths within each Sub-division are assumed to be representative for the species age distribution within this area. The age-length-key in this Sub-division indicates the frequencies f_{aj} or the normalised quantities q_{aj} with the age a in the length class j. The multiplication of the normalised age length matrix $A=(q_{aj})$ for the whole Sub-division with the length vector $L=(f_j)$ from a specific stratum results in the age distribution f_a for this stratum

$$f_a = \sum_j q_{aj} \cdot f_j \quad (5.3)$$

5.4 Weight distribution

For the calculation of the weight distribution per age group W_a we use also the normalised age-length-key q_{aj} (see 5.3) and the mean weight per length group W_j.

$$W_a = \sum_j q_{aj} \cdot f_j \cdot W_j \quad (5.4)$$

5.5 Lack of sample hauls

In the case of lack of sample hauls inside individual ICES rectangle (small bottom depth, weather or other limitations) - sample hauls made in the vicinity are allowed to be taken into account.

5.6 Allocation of records

In the Baltic Sea including the area in Kattegat and Skagerrak herring and sprat normally cannot be distinguished from other species by visual inspection of the echogramme. 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 that stratum.

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 i'th species and L is the length of the individual fish in cm.

The equivalent formula for the cross-section is:

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

Normally we assume a quadratic relationship, that means b_i is 20. Than we get the simple formula:

$$\sigma_{ij} = d_i \cdot L_j^{\,2} \qquad (5.7.3)$$

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

5.8 Estimation of the mean cross section in the stratum

The basis for the estimation of total fish density F from the measured area scattering cross section S_a is the conversion factor c.

$$F = S_a \cdot c = \frac{S_a}{<\sigma>} \qquad (5.8.1)$$

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

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

where L_j is the mid point of the j-th length class and f_{ij} the respective frequency.

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

$$<\sigma> = \sum f_i \sigma_i = \sum_i f_i \sum_j f_{ij} d_i L_j^2 \quad (5.8.3)$$

5.9 Abundance estimation

The total number of fish in the stratum has to be estimated as:

$$N = F \cdot A = \frac{S_a}{<\sigma>} \cdot A \qquad (5.9.1)$$

This total abundance is split into species classes N_i by

$$N_i = N \cdot f_i \quad (5.9.2)$$

especially in abundance of herring N_h and sprat N_s.

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

$$N_{ia} = N_i \cdot f_{ia}. \qquad (5.9.3)$$

5.10 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

$$Q_{ai} = N_{ai} \cdot W_a \qquad (5.10.1)$$

6 DATA EXCHANGE AND DATABASE

6.1 Exchange of survey results

The main results of BIAS should be summarised and reported to the Acoustic Survey coordinator not later as January of the next year. These results are intended for the information of the Assessment Groups and should contain the following documents :

- the map of the cruise track and the fishery stations (with a listing of the track and haul positions)
- a short description of the survey
- the table of the basic values for the abundance estimation (survey statistics)
- tables of the abundance of herring and sprat per age group
- tables of the mean weights of herring and sprat per age group

The standard exchange format for the documents is described in table 6.1.

6.2 The database BAD1

The database BAD1 is the collection of results from the Baltic International Acoustic Surveys (BIAS). The sampling unit is the stratum (section 2.2). The contents of the database are similar to the standard data exchange format (section 6.1) for the BIAS. The database BAD1 consists of the following six tables:

AH Abundance (in millions) of herring per age group
AS Abundance (in millions) of sprat per age group
ST Basic values for the computation of the abundance
SU Description of the different surveys
WH Mean weights of herring per age group
WS Mean weights of sprat per age group

The inner structure of the tables is summarised in table 6.2. The Acoustic Survey coordinator is responsible for the update of the database.

7 REFERENCES

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Table 5.7 Target strength parameters

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
Trachurus trachurus	-71,2	20	9,533E-07
Scomber scombrus	-84,9	20	4,066E-08

Table 6.1 Data exchange format

Table 3.x.1 Estimated numbers (millions) of herring r/v "XXXX" October YYYY

SD	rect	total	age 0	age 1	age 2	age 3	age 4	age 5	age 6	age 7	age 8	age 9	age 10+

Table 3.x.2 Estimated mean weight (gram) of herring r/v "XXXX" October YYYY

SD	rect	total	age 0	age 1	age 2	age 3	age 4	age 5	age 6	age 7	age 8	age 9	age 10+

Table 3.x.3 Estimated numbers (millions) of sprat r/v "XXXX" October YYYY

SD	rect	total	age 0	age 1	age 2	age 3	age 4	age 5	age 6	age 7	age 8+

Table 3.x.4 Estimated mean weight (gram) of sprat r/v "XXXX" October YYYY

SD	rect	total	age 0	age 1	age 2	age 3	age 4	age 5	age 6	age 7	age 8+

Table 3.x.5 Survey statistics r/v "XXXX" October YYYY

ICES SD	ICES Rect.	Area (nm^2)	Sa (m^2/nm^2)	? cm^2	N total (million)	herring (%)	sprat (%)

Table 6.2. Structure of BAD1

Structure of the table AH

Field	Type	Length	Decimals	Description
CCODE	C	7		Survey code
SD	C	4		ICES Sub-division
RECT	C	5		ICES rectangle
NHTOT	N	8	2	Total herring abundance (millions)
NH0	N	8	2	Abundance of herring age group 0 (millions)
NH1	N	8	2	Abundance of herring age group 1 (millions)
NH2	N	8	2	Abundance of herring age group 2 (millions)
NH3	N	8	2	Abundance of herring age group 3 (millions)
NH4	N	8	2	Abundance of herring age group 4 (millions)
NH5	N	8	2	Abundance of herring age group 5 (millions)
NH6	N	8	2	Abundance of herring age group 6 (millions)
NH7	N	8	2	Abundance of herring age group 7 (millions)
NH8	N	8	2	Abundance of herring age group 8 (millions)
NH9	N	8	2	Abundance of herring age group 9 (millions)
NH10	N	8	2	Abundance of herring age group 10+ (millions)

Structure of the table AS

Field	Type	Length	Decimals	Description
CCODE	C	7		Survey code
SD	C	4		ICES Sub-division
RECT	C	5		ICES rectangle
NSTOT	N	8	2	Total sprat abundance (millions)
NS0	N	8	2	Abundance of sprat age group 0 (millions)
NS1	N	8	2	Abundance of sprat age group 1 (millions)
NS2	N	8	2	Abundance of sprat age group 2 (millions)
NS3	N	8	2	Abundance of sprat age group 3 (millions)
NS4	N	8	2	Abundance of sprat age group 4 (millions)
NS5	N	8	2	Abundance of sprat age group 5 (millions)
NS6	N	8	2	Abundance of sprat age group 6 (millions)
NS7	N	8	2	Abundance of sprat age group 7 (millions)
NS8	N	8	2	Abundance of sprat age group 8+ (millions)

Table 6.2. Structure of BAD1 (continued)

Structure of the table WH

Field	Type	Length	Decimals	Description
CCODE	C	7		Survey code
SD	C	4		ICES Sub-division
RECT	C	5		ICES rectangle
WHTOT	N	7	2	Total mean weight of herring (gram)
WH0	N	7	2	Mean weight of herring age group 0 (gram)
WH1	N	7	2	Mean weight of herring age group 1 (gram)
WH2	N	7	2	Mean weight of herring age group 2 (gram)
WH3	N	7	2	Mean weight of herring age group 3 (gram)
WH4	N	7	2	Mean weight of herring age group 4 (gram)
WH5	N	7	2	Mean weight of herring age group 5 (gram)
WH6	N	7	2	Mean weight of herring age group 6 (gram)
WH7	N	7	2	Mean weight of herring age group 7 (gram)
WH8	N	7	2	Mean weight of herring age group 8 (gram)
WH9	N	7	2	Mean weight of herring age group 9 (gram)
WH10	N	7	2	Mean weight of herring age group 10+ (gram)

Structure of the table WS

Field	Type	Length	Decimals	Description
CCODE	C	7		Survey code
SD	C	4		ICES Sub-division
RECT	C	5		ICES rectangle
WSTOT	N	7	2	Total mean weight of sprat (gram)
WS0	N	7	2	Abundance of sprat age group 0 (gram)
WS1	N	7	2	Abundance of sprat age group 1 (gram)
WS2	N	7	2	Abundance of sprat age group 2 (gram)
WS3	N	7	2	Abundance of sprat age group 3 (gram)
WS4	N	7	2	Abundance of sprat age group 4 (gram)
WS5	N	7	2	Abundance of sprat age group 5 (gram)
WS6	N	7	2	Abundance of sprat age group 6 (gram)
WS7	N	7	2	Abundance of sprat age group 7 (gram)
WS8	N	7	2	Abundance of sprat age group 8+ (gram)

Table 6.2. Structure of BAD1 (continued)

Structure of the table ST

Field	Type	Length	Decimals	Description
CCODE	C	7		Survey code
SD	C	4		ICES Sub-division
RECT	C	5		ICES rectangle
AREA	N	7	1	Area [nm^2] see
SA	N	7	1	Mean Sa [m^2/nm^2]
SIGMA	N	7	3	Mean s [m^2/nm^2] see (5.8.3)
NTOT	N	8	2	Total number of fish (millions) see equation 5.9.1
HH	N	7	3	Percentage of herring
HS	N	7	3	Percentage of sprat

Structure of the table SU

Field	Type	Length	Decimals	Description
CCODE	C	7		Survey code
SHIP	C	20		Name of the vessel
YEAR	C	5		Survey year

Appendix 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 stratum
F fish density
L_j length in class j
M number of hauls in the stratum
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 area scattering cross section
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