Baltic Fish Committee

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REPORT OF THE STUDY GROUP ON ASSESSMENT-RELATED RESEARCH ACTIVITIES RELEVANT TO BALTIC FISH RESOURCES

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International Council for the Exploration of the Sea

Conseil International pour l'Exploration de la Mer

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1.1 List of participants

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1.2 Terms of Reference

As a resolution adopted at the 82nd Statutory Meeting it was decided that (C.Res. 1994/2:39):

A Study Group on Assessment-Related Research Activities Relevant to Baltic Fish Resources (excluding salmonids) will be established under the chairmanship of Mr H. Sparholt (ICES) and will meet in Riga, Latvia from 23 February to 1 March 1995 to:

a) provide a detailed description of research activities and information needed to carry out reliable assessments of the fish resources in the Baltic Sea taking into account the potential environmental influences on population parameters;

b) evaluate the present system of sampling the commercial fisheries (species composition, length and age compositions etc.) and the existing research vessel activity in relation to item a);

c) initiate co-ordination of national research vessel surveys and of the sampling programme of commercial catches;

d) prepare specification of the Young Fish Survey database (including resource implications) for possible transfer to the ICES Secretariat;

e) prepare a standard format for the results of hydroacoustic surveys in order to facilitate data exchange and merging data into a common database and prepare specifications of the database (including resource implications) for possible transfer to the ICES Secretariat;

f) report to the Baltic Fish Committee, ACFM, and ACME.

The above terms of reference are set up to provide ACFM with the information required to respond to the request for advice from the International Baltic Sea Fishery Commission.

The Group finds it important both to make plans for research and sampling in the future (for about the coming decade) and to tidying up data collected in the most recent years (age determination problems, misreporting, and errors in survey data bases).

The structure of the report follows to a large extent the structure of the listed terms of reference. Section 2 deals with "what is needed". Section 3 with the current situation. Section 4 to 6 discuss and describe what should be done to meet the needs. Recommendations and conclusions can be found in Section 7.

1.2.1 Back ground

1.2.2 Requests from the IBSFC

The IBSFC has in its requests to ICES for scientific advice to its twenty-first session (Draft No. 3 16.09.94 11.00 a.m.) included:

"a description and review of the research activities and information needed to carry out reliable assessments of the fish resources in the Baltic Sea and initiate co-ordination of existing national research surveys with the objective of establishing international surveys."

Thus, our report can be seen as a direct reaction to this request, although the actual motivation for it has come from encountered problems in the assessment working groups and from improved possibilities for collaboration between the Baltic countries in the most recent years.

1.2.3 Critique of ICES sprat assessment in 1993 and 1994

ICES has been criticised by fishermen's organisations and managers in news papers and in other informal ways for its assessment of sprat in Sub-divisions 22-32 in 1993 and 1994 before, during and after the IBSFC twentieth session in Poland in September 1994. The reason being that our perception of the stock size changed significantly from 1993 to 1994 for the most recent years. For instance our estimation of the SSB in 1993 changed from 2.3 million t in the 1993 assessment to 1.0 million t in the 1994 assessment. The main back ground for our change was a change in predation mortalities used in the VPA and assessment data for one more year. The predation mortalities was overestimated in the 1993 assessment. Even though the 1994 ACFM report explained this quite extensively and states that the assessment is uncertain due to low F values the ACFM management advice for 1994 (given in 1993) was that "..long-term yield could be raised by increasing fishing mortality towards that level (HS: $F_{0.1}$)." According to the forward projections this corresponded to a catch of 902 000 t in 1994. In the 1994 assessment SSB 1994 was 1.0 million t and thus if our advice was followed almost the total stock would have been fished. Clearly we were thus not cautious enough in our advice in 1993.

1.2.4 Problems with age determination in cod

It has been discovered that there are inconsistencies in age determination of cod between countries. This regards both of the cod stocks in the Baltic. At least data from 1991 and onwards are "contaminated". A Workshop on Baltic Cod Age Reading was help in 1994 and comparative age readings clearly showed the disagreement between countries in age determination (Anon. 1994a). A Study Group on Baltic Cod Age-Reading (Chairman J. Netzel) will work by correspondence in 1995 and report to the 1995 Annual Science Conference.

The uncertainties in age determination has been shown by the Baltic Demersal Working Group and ACFM to have a large impact on the VPA and it is therefore of great importance that this problem is resolved. It is important that the present Group considers research activities which can prevent this from happening in the future. According to the TOR for the Study Group on Baltic Cod Age-Readings they should "plan for a Workshop in 1996 with the view to

1. establishing a reference collection of otoliths from different Sub-divisions, seasons, and length groups of cod,
2. reaching a common interpretation of otolith structures, i.e. first hyaline ring, double rings, edge formation,
3. standardising the reading procedure,
4. compiling a manual on age readings of cod otoliths."

The present Group assumed that the suggested manual will only consider cod in the Baltic. The present Group strongly supports these plans and consider them sufficient to secure consistency in age determination for cod for the time to come.

When common interpretation of otolith structures have been agreed it will be necessary to reconsider the age determinations for at least 1991-1994. Either should each country make a new age determinations from the otoliths if these still exist or some common ALKs by area and season should be applied on length samples.

1.2.5 Problems with misreporting of cod catches

Under-reporting of commercial cod catches in 1993 was significant. ACFM states that while the official reported catch for cod in central Baltic (Sub-divisions 25-32) was 25,000 t the actual catch was probably 40,000 t or 50,000 t. For the western Baltic the official reported catch was 14,500 t the likely catch was rather 18,000 t. The under-reporting in 1992 is uncertain but unlikely to be as bad as in 1993 because the TAC was not fished in 1992 (ACFM catch 70,000 t and TAC 100,000 t for total Baltic), although Denmark fished its quota.

Clearly, this uncertainty about the commercial catch figures results in great uncertainties in the VPA, in the assessment and to some extent also in catch projections. However, if the problem is appearing in only one single year there are ways of repairing for it in future assessments, but if the under-reporting continues to take place it will prevent ICES from doing analytical assessment of the Baltic cod stocks. The indications for 1994 is that the under-reporting has continued. For 1995 underreporting is likely to be minor because the agreed TAC is very high 100,000 t compared to the catch possibilities.

In future years underreporting is unfortunately likely to be a problem as the present control (or lack of control) system seems to be continued in the future.

1.3.5 Previous Working, Planning, and Study Groups with similar TOR

Within the most recent years the following Working, Planning, and Study Groups have been dealing with items similar to the TOR for the present Study Group:

1. Steering Group on Fisheries/Environmental Management Objectives and Supporting Research Programs in the Baltic Sea (Anon. 1993b).
2. Study Group on the Evaluation of Baltic Fish Data (Anon. 1993c).

3. Planning Group for Hydroacoustic Surveys in the Baltic (Anon. 1993d).

4. Study Group on Young Fish Surveys in the Baltic (Anon. 1993a).

5. Planning Group for Hydroacoustic Surveys in the Baltic (Anon. 1994c).

6. Workshop on Baltic Cod Age Reading (Anon. 1994a).

7. Study Group on the Evaluation of Baltic Fish Data (Anon. 1994d).

8. Planning Group for Herring Surveys (Anon. 1994e).

Group 1) regarded the temporal and spatial distribution pattern and trends in stock abundance for cod, herring, sprat and salmon as well known and adviced to focus on the relationship between environmental and hydrographical factors and the demographics of fish stocks. However, they also stated that multispecies models including early life stages is important, that more predators should be included and a finer spatial and temporal structure should be considered. The latter has some implications for the present Group because we then have to consider commercial catch data and survey data by finer spatial and temporal scales.

Group 1) dealt mainly with long-term plans, say for the next decade or more. Things which are important are for instance water circulation studies and relations to cod recruitment, effect of eutrofication on fish growth and spawning, fish food organism, effect of fishing activity by gear type on the ecosystem, etc. The present Group does not regard dealing with this long time horizon to be its primarily objective.

Group 2) discussed the short-comings of the present system of data storage of the bottom trawl data and strongly recommends improvements. They suggests that the ICES N. Sea IBTS database structure could be applied for the Baltic data as well.

Group 2) further described and evaluated the sampling of commercial catch of cod, herring, and sprat by country. They noted that the official catch statistics have deteriorated in recent years and noted this as a problem for the assessment. The Group revealed large differences between countries in sampling schemes and recommended a standard international protocol to be made, a common alk database to be established and that technical data on vessels should be collected. They noted that discarding was a common practice in three countries and that these were poorly sampled. The Group recommended that discards be sampled in the three countries.

Group 3) identified the need for standardized and uniform methodology for hydroacoustic surveys in the Baltic. They furthermore stated that in future surveys it is very important that some rectangles are surveyed by more than one vessel in order to be able to contrast and compare the results.

Group 4) also meet in 1988 and 1991. At the meeting in 1992 reported in 1993/J:7 the Group concentrated on further improvement of the data base for cod and the inclusion of herring and sprat. The Group identified several problems in the survey. One was disagreement in cod otolith age interpretation between countries. Another one was lack of revision of the data for several countries. They furthermore recommended that it was important to include detailed data about age-length in a database and that comparative cod otolith age readings should be conducted. A comprehensive overview of surveys data available was given.

Group 5) stressed the need for overlap in coverage in hydroacoustic surveys and intercalibrations. Furthermore, standardization is needed. The Group started on defining standard format for data from trawling and acoustic data to be held in common databases. A discussion about the timing of the survey was also included in their report. The Group concluded that a change of the timing of the surveys in the Baltic from October to July (the time for the surveys in Div. IIIa and the North Sea) would not be appropriate because 0- and 1-group herring and sprat would then not be covered in the Baltic. These age groups are distributed on shallow waters in July.

Group 6) dealt with problems in cod age determination. They described otolith types and problems with false rings and how to interpret the edge. They furthermore conducted comparative age readings and found deviations between countries which could not be resolved during the meeting. It was recommended by the Group that 1) a standard otolith sample (reference sample) should be collected, 2) a standard way of preparing the otolith should be agreed, 3) agreement should be reached on how to interpret otolith structures and 4) a manual should be made. They recommended that a new Workshop meeting in 1996 could accomplish this. ICES adopted these ideas and a Study Group is working by correspondence in 1995 in order for preparing for such a Workshop meeting in 1996 (Council Resolution 1994/2:40).

Group 7) worked by correspondence in 1994 and due to the lack of reporting to the chairman their TOR could not be fulfilled. They repeated a previous recommendation that standard commercial sampling protocol should be made.

Group 8) considered the synchronization of the Baltic hydroacoustic surveys with the North Sea and Div. IIIa surveys and concluded that the gains would not outweigh the losses. The losses is the less precise estimates of 0- and 1-group herring and sprat in the Baltic if these surveys are moved to July. The Group considered the establishment of common databases for hydroacoustic data and concluded that for now these data should be stored on a local basis because ".. to establish a database that works properly for the users require thorough planning....". However, the Group suggested "...that some kind of standardization can be done, e.g. by storing the estimated number of fish by age group by rectangle and agreed that this should be done from now on."

In addition to the above given groups the Working Group on the Assessment of Demersal Stocks in the Baltic recommended that the Baltic trawl surveys are much better coordinated. The needs for a standard trawl, precise specifications of rigging and sampling, coordination of survey areas by country/survey, and determination of when to conduct the survey were mentioned.

2 ASSESSMENTS NEEDS (TOR A)

The assessment of a fish stock can be separated into three phases: 1) a description of the past, 2) a forward projection of the coming 1-2 years, and 3) long-term forward projections.

The task of this Group is to describe the research activities and information needed to carry out reliable assessments. It is important first to consider what a reliable assessment is. To the knowledge of the Group there are no firm guidelines to what a reliable assessment is. It will therefore probably be difficult to decide on things like confidence limits of parameters, which correspond to reliable assessments. Furthermore, if these limits were given it would often be difficult to estimate whether they were obtained because methods and software to calculate uncertainties for the various parameters are hardly developed. The XSA program gives estimates of cv for estimated survivors but these are almost certainly underestimates, because they are based on the assumption that the catch data are 100% precise. Furthermore, model mis-specification is not included. Software for estimating precision of the forward projections (TAC) are scarce and very much in the developing phase.

In the following it has therefore been necessary to take a pragmatic approach. We have used as a guidance the experience from the past in the Baltic as well as in other parts of the ICES area about precision in surveys and commercial catch data. Especially, the North Sea stocks have been used in this regards.

Useful for estimation of uncertainties in assessments are independent measurements of a given fish stock. These are available in quite a few cases. The N.Sea Herring Assessment Working Group has in several years made RCT3 correlation analysis between the VPA SSB estimates and estimates from the IBTS surveys, from herring larvae surveys and from acoustic surveys. Robin Cook has recently published in a Working Group Doc. to the Method Working Group a way of estimating SSB and F from surveys for N.Sea demersal species. Furthermore, RCT3 analysis have been made by many Working Groups with VPA numbers against survey young fish indices. In those RCT3 analysis where the VPA numbers are taken from the converged part of the analysis, the estimated CV 's of the survey indices can probably be regarded as a upper limit of the variability of the surveys. The reason being that the variability in the VPA numbers (which in the analysis are regarded as 0) must be responsible for a part of the estimated variability of the surveys.

2.1 Historical stock development

Usually, the stock development is described by changes over the past years in total commercial catch (C), Fishing mortality (F), Spawning Stock Biomass (SSB), and Recruitment (R). The last three parameters are normally estimated by VPA analysis.

The precision of the description of the past depends on the precision of the parameters C, F, SSB, and R, i.e. the official landings or WG corrected catches and the VPA. There are no firm guidelines for what precision level ACFM needs in order to be able to accept a VPA.

2.1.1 Survey data

Figure 2.1.1.1 shows the relationship between the VPA SSB and RV cpue of SSB for cod in central Baltic (Sub-divisions 25-32). In Table 2.1.1.1 are shown RCT3 analysis results. From these it can be seen that the slope is estimated to be 0.88. The fact that the slope is estimated to be less than 1 indicates that , the RV data signal larger changes in SSB over the period (1982-1992) than the VPA. The R-square is around 0.88 which is quite high compared to many other stocks but it must here be noted that the dynamic range of SSB is quite large. The std.error of the slope is around 0.23. This means that the standard deviation of the SSB value from the surveys are exp(0.23) times the estimate of SSB, for SSB estimates close to the mean SSB for the time period. Thus the 95% confidence level are +58% and -37% of the estimate of SSB. If the estimated SSB value is either much lower or much higher than the mean the confidence limits becomes wider.

The above used survey indices for SSB is obtained from GLM analysis of the data file used by the Baltic Demersal Working Group during its meeting in April 1994. The results are given in Table 2.1.1.2. From a quick inspection of the basic data it was discovered that all the Danish data from 1983 were erroneously assigned to only one depth stratum, the most shallow one. By discarding the 1983 data all together the correlation to the VPA was improved significantly. Table 2.1.1.3 shows that R-square increased to 0.91 and the slope to 1.00 and cv decreased to 0.19. Thus, even a very quick and rough check of the basic data resulted in a big improvement of the analysis. It is therefore worthwhile to make a thorough check of the basic data in the near future.

Compared to similar analysis for other stocks it can be mentioned that even for N.Sea herring the data are better (CV of slope 0.22 and R-square 0.90). Compared to N.Sea cod, the analysis done by Cook (Working Group Doc #5) gave relationships between VPA SSB and IBTS survey SSB which were slope=1.30, cv of slope .37 and r-square 0.43. For the English Groundfish survey (EGFS) and the Scottish Groundfish survey (SGFS) the R-square values were, however, much higher, around 0.90. The reason for the IBTS to perform poorly on N.Sea cod is not well known. According to personal communication with Robin Cook explanations of this are for the time being mainly speculation. Possible reasons could be 1) that February is a bad time for the survey as it is close to the spawning season (where cod aggregates in spawning schools), 2) errors is the IBTS database, or 3) that the GOV is a bad gear for cod in the North Sea. The last point is, however, not very likely as the GOV trawl usually is a very stable gear and the average catch per hour of cod is about 50 % higher than in the EGFS(Granton trawl). The EGFS changed gear a few years ago from the Granton trawl to the GOV and the timeseries of the EGFS is continued by the use of conversion factors between GOV and Granton. The SGFS uses the "Aberdeen" trawl which also is a smaller trawl than the GOV. The poor performance of the GOV is especially surprising because the number of haul made per year in the IBTS is about 400 while they are less than 100 in the two other surveys. According to personal communication with Niels Daan and Henk Heessen the timing of the survey is the likely reason for the poor performance of the GOV as they have observed large catches of spawning aggregations. Neither N.Daan, H. Heessen or R. Cook think that the GOV gear is to "blame"; on the contrary they would all recommend that this trawl is also used in the Baltic, if possible.

A <u>cv of not more than 0.10 for cod SSB</u> might be adequate for the central Baltic cod stock. Given the present survey this will roughly speaking mean a doubling of the number of hauls. However, if the survey standardization and design are improved a smaller increase will be needed.

As mis-reporting in the cod fishery might occur in the future as well (probably not in 1995 as the agreed TAC is so high that it is unlikely to be very restrictive) ways need to be found in order to assess the stocks with the needed precision under the circumstances of misreporting. In the N.Sea the bottom trawl surveys were intensified partly as a results of problems with increased mis-reporting. Intensifying the surveys in the Baltic is therefore a possibility.

In order to evaluate possible differences between VPA and surveys regarding historical stock development Cook (Working Group Doc #5) has shown the usefulness of having at least two independent surveys. By the use of two independent surveys Cook was able to demonstrate that the commercial catch data for haddock in the North Sea probably contain errors. Thus, if x number of trawl hauls can be afforded per year it is probably better to use these in two surveys separated in time rather than in one, given that 0.5*x hauls are covering the total distribution area of the given stock.

As increased survey effort and co-ordination will only influence the future there is also a need to improve the analysis of the data collected in the past. This regards 1) conversion factors between an "old" gear type used and a new gear type to be used by all vessels (see later), 2) obvious errors observed in the past (like the above mentioned problem with the Danish data from 1983; the GLM analysis and LSMEANS used by the Assessment Working Group are dubious due to variable "cell size" and variable spatial distribution of cod, etc.), 3) corrections for areas with low oxygen content not fished in some years, 4) a thorough scrutinization and analysis (GLM or similar type) of data from the past with the aim to improve the precision in the estimated SSB index (and recruitment, see below) etc.

Regarding herring in 25-29+32 the acoustic survey seems to give estimates of stock numbers which are not too bad, CV values around 0.3 per age group and slopes close to 1 according to the latest XSA (Anon. 1994b). F is however rather low and thus the VPA not converging very strongly. Therefore, the CV values of about 0.3 might be underestimates (or overestimates of the precision) as the XSA fits the stock numbers to the acoustic values in most of the years and for several age groups. Furthermore, the acoustic survey is sensitive to technical problems. In 1993 the survey results were not considered reliable and not used, because one vessel had technical problems. The effort by the rest of the vessels was therefore wasted.

For sprat in Sub-divisions 22-32 the XSA cv values are small and the retrospective analysis made by the

Working Group is good. The XSA cv values are, however, likely to be underestimates due to the fact that the VPA is not converging very well (F low compared to M). The fact that all three tuning data series have severe outliers (large q residuals) indicates that the assessment is not as good as one might think by looking at the XSA cv values and the retrospective analysis.

As F for the time being is low for Baltic herring and sprat the need for very precise VPA tuning data is not needed every year. It would probably suffice with one reasonable precise acoustic survey every second year. In this connection it can be mentioned that an improved survey design for the bottom trawl survey is likely to result in useful estimates of herring and sprat, which can supplement the acoustic surveys and which are conducted at least once per year.

2.1.2 Commercial catch data

The precision needed in the total commercial catch data is usually high. These data are often a total account of the catch based on sale slips or logbook data. In the VPA these data are assumed to be exact. Of course this is not the case but at least the variation in these data should be significant less than the variance of other types of data. Thus, a cv value of less than 0.05 is probably needed. These data have at least in 1993 been biased for cod due to mis-reporting. The Baltic Demersal Working Group guestimated that for the central Baltic at least 15,000 t and more likely 25,000 t should be added to the official figure of 25,000 t. It is of course of paramount importance to be able to estimate the misreporting. If this is not possible all the biological sampling of the commercial catches for age determination are almost wasted effort and the stock assessments would have to rely mainly on survey data and will become significantly more uncertain.

It is therefore worth considering how mis-reporting could be estimated. Several Working Groups have been able to estimate mis-reporting (Arctic Fisheries Working Group, North Sea Demersal Working Group, N.Sea Herring Working Group, Northern Shelf Working Group). It is however resource demanding and it is difficult to give guidelines to how it should be done because it depends very much on how the mis-reporting takes place and what the possibilities are. For instance estimates of mis-reporting have been obtained from comparing figures of fish files production with catch figures, from using logbook data on days at sea combined with average catch per days at sea of those data where mis-reporting can be disregarded, by doing alternative sampling and compilation to that of the control offices etc.

It is a fundamental problem that the official catch statistics are often based on samples collected by the control office. As the control office often must have strong evidence for mis-reporting before they regard it as misreporting, there is a tendency that the official statistics are biased. One solution to this is to have two separate systems: one for control and one for statistics. It has been tried in some countries but it is a costly system and is often difficult to explain to the administrators and fishermen.

An actual sampling of the total catch is another possibility. This is likely to give a low precision but should in theory be unbiased. However, if it can be coupled to total statistics of for instance logbook data of days at sea (or other reliable logbook data), it might be worthwhile to consider.

Age disaggregated commercial catch data are needed for the VPA. The precision of these not only depends on the precision of the total catch data but also of the precision of the age determination of the otoliths, the biological samples and the compilation procedure used. Large variation in interpretation of Baltic cod otoliths have been revealed in the later years (at least since 1991) and in sprat otoliths. Systematic differences between countries have been found. It is apparent that real expertise is needed. This is an argument for concentrating the age determination on few laboratories, for instance cod otoliths could be the job of two or three laboratories which would then work tight together securing consistency in the procedures. Other laboratories would then have to send the otolith to those laboratories. At each of the selected institutes there should then be at least two persons being experts in how to interpret the otoliths. For herring and sprat other laboratories could be appointed in order to spread the work load. However, there might be other ways of securing the needed expertise.

The number of samples needed is sometimes given, as a rule of thump for herring, as about 200 fish per 1000 t landed (see e.g. the N.Sea Herring Working Group Report 1991/Assess:15). For cod in the Baltic more samples might be needed as there are more fleet categories than usually in the herring fisheries and because the cod stocks are under heavier fishing pressure and therefore fluctuating more widely than the herring stocks. For cod about 300 fish aged per 1000 t might be reasonable. To optimize the sampling according to cod size categories, fleets, seasons, and area complicated estimation procedures have in the past been attempted. One major problem is however to apply relative weights to the importance of getting precise estimates of recruitment, the VPA, the forecast projection etc. In most cases it has been the experience that it is not "totally stupid" to use the relative weight of a particular catch category as the weighting factor, i.e. sampling in proportion to the landed weight.

Length measurements without age determinations are usually of little value when the landings are done by size categories (Sparholt 1988). However, if the landings are unsorted or if it is decided that only a few countries should do the age determination of a given fish species it might be a good idea that the rest of the countries are measuring the length of the fish landed and maybe then they need not send otoliths to other countries. In the developing phase of such a system it might, however, be prudent to do both.

2.2 Short-term projections

Reliable recruitment estimates are important for the short-term projections.

The bottom trawl survey in March gives a poor estimate of 1 year old cod which therefore never has been used in the assessment. Compared to the North Sea, 1-group cod in the first quarter of the year in the central Baltic are small and therefore difficult to catch in the survey. As the cod stocks in the Baltic are composed of more age groups than in the North Sea it is of course of less importance to have a good 1-group estimate in the Baltic than in the North Sea.

The Baltic Demersal Working Group has used GLM to obtain 2-group indices. According to their RCT3 analysis the R-square value is about 0.90, the slope 0.83, and cv of slope 0.26 (n=12). This is not too bad compared to most other surveys. For instance it is comparable to the best surveys for age 2 cod in the North Sea. An important difference is, however, that for N.Sea cod there are 5 good surveys and the combined indices have a precision around cv = 0.15. For Icelandic cod the precision of their recruitment estimate is around cv= 0.20 for age 3. For arctic cod the recruitment estimate has a cv = 0.10 (survivors of age 2 from the XSA). A reasonable goal for the precision of the Baltic cod 2-group index might be a **cv of the slope of about 0.15**. This will mean approximately a doubling of the number of hauls but lees if the surveys are more standardized.

Regarding experience from other cod stocks in the North Atlantic area it might be worthwhile to mention the problems they had at Newfoundland with their cod stock. It seemed that their bottom trawl survey in one or two critical years when the cod stock was steeply declining, overestimated the stock significantly. The reason for this is not certain but it is not unlikely that the catchability (q) of cod in those two years were abnormal (J.J. Maguire pers comm.). Their cod are some times pelagic or semi pelagic and this makes q likely to vary by year and season. The Baltic cod is pelagic or semipelagic as well at certain times of the year and this has to be taken into consideration when designing the future surveys.

Herring and sprat in the Baltic lack at the moment reliable recruitment indices. The acoustic surveys are not covering 0-, 1-, 2-, and 3-ringers very well. According to the XSA diagnostics the catchability, q, increases up to age 5. At the moment recruitment values are, however, not very important because the stocks are composed of many age groups and F is low. As mentioned above it is not unlikely that a new improved survey design for the bottom trawl survey will give useful estimates of recruitment of herring and sprat at least once per year.

2.3 Long-term projections

For long-term projections multi-species interactions, stock-recruitment, and discards becomes important.

For cod in the central Baltic Sparholt (Working Group Doc #4 and #5) has shown that a target stock size of about 0.5 million t SSB gives on average the highest number of recruits at age 3 and thus the maximum yield, given that the exploitation pattern is "sensible". Cod cannibalism is taken into account as well as SSB-R relationships. The target stock size of 0.5 million t is shown to be independent of environmental conditions (salinity, oxygen content and sprat predation) but these effects will influence the actual catch possibilities. Sparholt also shows that this SSB target size can be reached even with the low recruitment level prevailing in the most recent years if F is reduced to less than 40% of the current level.

Such a target level has of course to be evaluated against management objectives (if they exist) and social-economical and political considerations.

MBAL (Minimum Biological Acceptable Level) as defined by ACFM has not yet been set for cod, herring or sprat in the Baltic. ACFM has only said that at present the cod stock in the central Baltic is outside safe biological limits because the SSB is at a historical low level, the F is high and recruitment is low. What is an appropriate MBAL for the two cod stocks has to be decided. For herring and sprat this is not so urgent because these stocks are not overexploited.

Technical measures are also important for advising on appropriate mesh sizes etc. to use in the fisheries. It is difficult to plan the reseach needed on these matters because the technological development and the gears preferred by the fishermen are difficult to predict. The best way to deal with technical measures is probably on an *ad hoc* basis. It might, however, be an idea to keep records of meshsizes used when sampling commercial catch data by gear type.

It is very difficult to state firmly the needed precision of the multispecies estimates (are more stomach data needed, better estimates on cod consumption rations, more spatial disaggregated models etc.). The Working Group on Baltic Multispecies Assessment, however, concluded that there is no need to sample stomach data for the time being. The model of constant suitability has been verified both for the North Sea and the Baltic MSVPA. Tests have shown that the precision in the about 50 000 cod stomach sampled in total is very good. Regular updates of cod stomach data say every 10 years was however recommended in order to check whether the assumption of constant suitabilities holds over a longer time scale. Minor checks as for instance evaluating the stomach data from the western part of Sub-divisions 26 and 28 and from Sub-division 27 are still needed, however. The spatial distribution of cod might change from time to time and this will influence the results. Therefore a more spatial disaggregated model seem worthwhile to develop. Another problem is the changed herring growth which might influence the suitabilities (which are on an age basis). At present quite extensive research about cod consumption rates is ongoing in Denmark, Germany and Norway. This research has in Denmark and Germany focused on meal size effects, prey type and single meal vs multiple meals. The results of this research will be published soon (this year) and there will be a basis for revising the data used in the MSVPA for the Baltic. This revision is regarded by the present Group to have high priority. The job which will have to be done is to take a new improved evacuation model and apply it to the Baltic data on cod stomach content using appropriate sea temperatures. More long-term research in this field will be effects on cod consumption/evacuation from low oxygen conditions, low salinity, Baltic cod sub-species, extrapolation to large cod (these are few in the evacuation experiments) and the evacuation dynamics of *Saduria entomon*.

To extent the MSVPA back in time from 1977 and backwards is also considered important. This will give SSB-R relationship analysis a better data base and in general improve our perception of the stock sizes in the past. Especially, the herring and sprat VPA part of the MSVPA will be important because the MSVPA is less sensitive to input F than the VPA for these stocks (Sparholt 1995).

Furthermore, SSB-R relationships for cod, herring and sprat are not included in the MSVPA/MSFOR model. For herring and sprat this is probably not very important as the SSBs have not varied much in the past and as the exploitation of these stocks is light. For cod, however, this is very important.

It is important to know the amount of fish discarded when attempting to estimate the long-term effect of various mesh size regulations and other technical regulations. If the amount is small annual data on discards need not be sampled, but if discarding is significant annual sampling would be needed. Previously, discards of cod were included in the Sub-division 22 assessment but due to lack of data for Sub-division 24 it is not included in the combined assessment of Sub-divisions 22-24. Discards in Sub-division 22 amounted to 0 and 22% of the weight landed. Discards data for Latvia have been sampled at sea in 1993 and 1994 for Sub-divisions 26 and 28. The results indicate that up to 7 % of the catch in weight might be discarded in the gillnet fishery. Considering that the abundance of small cod has been small in 1993 and 1994 discarding might be significant in some years. Also Denmark has carried out at sea sampling of discards but the data were not available to the Group. It can be concluded that discarding is a potential problem and discard data for cod are needed.

Herring growth changes is still largely an unsolved problem. According to a Nordic Council project it is due to changed cod predation rates or/and changed feeding conditions.

2.4 Effects on Assessments of Environmental conditions

Present models, both Single-species and Multispecies models, are constructed for estimating the influence of fishing on stock size. All other factors causing mortality are included in the value(s) of natural mortality. In the Multispecies models natural mortality is divided into predation mortality and residual mortality. Other causes of mortality, such as diseases could, if sufficient data were available be estimated separately.

Cod

It has been shown experimentally (e.g. Nissling & Westin, 1991, Westin & Nissling, 1991) that survival of cod eggs is dependent on salinity and oxygen concentration. Definitions of the water masses suitable for cod egg survival has been suggested and the volume of it - the "spawning volume" has been calculated (e.g. Plikshs *et al.* 1993, Bagge, O. 1993).

A model for cod recruitment was suggested by Sparholt to this meeting (Working Group Doc # 4 and #5). The model accounted for spawning stock size of cod (in Subdivisions 25-32), an approximation of the predation on cod eggs by sprat expressed as spawning stock size of sprat and "spawning volume" as an expression of the annual spawning condition in terms of salinity and oxygen concentrations. Regression technique was used to estimate the parameters. All three factors were shown to be statistically significant and the auto-correlation between stock and recruitment that has made simpler models unrealistic seems to be overcome in this model. It was further shown that the effects of cannibalism on young cod on the recruitment, as expressed by the Multispecies VPA, have great influence on the results. Even if the presented model can explain about 75% of the observed variation in the recruitment of 0-group cod, it has rather low precision in predicting recruitment in a given year.

Future work should aim at improving the model by Sparholt or other similar models. Suggested lines of action are: 1) improve the measure of sprat predation on cod eggs by taking into account the timely and spatial distributions of eggs and predators, 2) refine the measurements of "spawning volume" for cod by including data from more hydrographical stations and by making the border between suitable to non-suitable more gradual, and 3) take into account the relation between size of spawning fish and egg quality.

Herring

Attempts have been made to make predictions of year-class strength from regression analyses containing one or many environmental variables (Kaleis and Ojaveer 1989 , Kornilovs in manus etc.). The results has so far not been sufficient for use in routine predictions. The water temperature during spring seems to be one of the factors that may deserve further studies in order to be incorporated in a prediction model.

A joint effort was made during 1990-1994 by scientists from Denmark, Estonia, Finland, Latvia and Sweden to investigate the causes for observed changes in mean size-at-age in samples both from research surveys and from commercial catches (Sparholt *et al.* 1994)TemaNord 1994:532). Their main conclusion was that the great changes in predation of cod on certain length groups (irrespective of age) have influenced the proportions of slow-growing and fast-growing herring populations/stocks and therefore also the measured size-at-age. Furthermore, it was documented that (in some areas of the Baltic) amounts of suitable food for herring had undergone substantial changes and may have influenced the size-at-age. It is at present not possible to predict weight at age.

Further studies of herring size at age and growth should consider the following items: 1) compare the conditions in Sub-divisions 30 and 31 with those in the Baltic Proper concerning hydrographical factors, food amount and suitability and predator influences (this should be of interest as no changes in size-at age have been observed in the northern waters), 2) monitor the occurrence of so-called "meager" herring in time and space, 3) analyse the data on both herring and sprat from the database established on stomach contents, and 4) analyse the data from the established database on zooplankton.

2.5 Assessment methodology

The assessment of the fish stocks in Baltic is carried out, in general, by using the XSA method (Shepherd, 1992) and MSVPA. ICA (Patterson, 1993) has been used for some herring stock assessments.

The information needed for stock assessment when using these methods is: catch and weight at age, indices of abundance reflecting stock size and some population parameters. MSVPA require data on food consumption. It is worth mention that MSVPA does not have any tuning module yet.

Some of the main problems in stock assessment in the Baltic are:

- a poor quality of fishery statistics (misreporting, discards);
- errors in age determinations;
- poor quality of fishery effort data;
- problems in stock identifications.

Carefully tested methods for stock assessments, which do not use catch statistics as a main part of the input data are not yet available. The approach proposed by Cook (Working Group DOC 5) is very interesting, but it needs further investigations and development.

In order to determine the influence of misreporting and discards it is worth to investigate sensitivity of the methods used at present to corresponding errors in catches.

Because of errors in catch at age data it may be worthwhile to carry out special investigation methods based on length composition of the catches (Shnute 1987, Fournier and Doonan 1987).

The requirements to accuracy of the input data are determined by the requirements to accuracy of the assessment results and TAC. It is important to carry out correspondent investigations to construct such dependencies.

A possible way of improving the assessment in the Baltic may be by using some other methods, different from XSA. It is known that in international fishery commissions the scientists use a variety of methods for stock assessment. ICES prefer XSA. NAFO, CCAMLR, ICCAT mainly use the adaptive framework (Gavaris 1988). In Pacific the scientists use CAGEAN (Deriso *et al.*, 1985).

The main ideas of these methods are very close, but some differences in model formulations and in implementations can by important when applied to concrete stock. Diagnostics and statistical properties of these estimates may help choosing the method. As a criterion it is possible to use 1) fixed level of result's accuracy and 2) maximum accuracy of estimates.

May be it is worthwhile to develop procedures for model discrimination. This was the experience in ICSEAF when stock assessment was made by using dynamic production models (Butterworth 1987, Anon. 1989). The list of parameters for comparison should be extended by including bias estimates (Gavaris 1993), and sensitivity to misreporting and discards.

Some additional problems which are important for stock assessment are the following:

- the problem of model formulation;
- the problem of multipliers in the object function when using data of different scales and variability;
- the problem of stability of the estimates.

The object functions of the XSA model include weighted sum of squared differences of log abundance estimates derived from VPA and log observed indices. ICA gives more flexibility in constructing the model, assuming seperability of fishing mortality, several types of catchability relationships, stock/ recruitment relationship and options for weighting multipliers.

The object function of the model developed by Fournier and Archibald (1983) assuming seperability and stock/recruitment relationships include squared residuals from relationship between fishing effort and fishing mortality coefficients. This model gives the opportunity to take into account the errors in age determinations.

The adaptive framework with APL implementation gives the way for flexible construction and amendment of the models adapting the object function for special features of fishery object.

The problems of determining multipliers in the XSA object function is important because in the traditional version of the model these multipliers are estimated using the samples of small size and then have the random errors. The statistical properties of such estimates are not very good.

One of the way to improve this part of the model is using robust estimates of variances or using nonparametric approach such as jackknifing (Efron 1981, Working Group DOC 7).

The purpose of shrinkage to the mean procedure in XSA is to reduce the estimate's instability. The alternative approach to stabilize stock estimates is to utilize the methods of ill-posed task solution (Working Group DOC 8). These methods are based on replacement of the object function by smoothing functional with some auxiliary member, a stabilizer, with a specific multiplier, the regularization parameter.

The main problem in ill-posed task solution is estimation of this parameter. It can be achieved by coordination the observational errors and models' errors. Such solution gives the stable estimates (Tikhonov and Arsenin, 1986).

The problems of weighting multipliers and regularization parameter are general for XSA, ADAPT, ICA. The solution to these problems can be implemented with the same procedure based on the crossvalidation method (Efron, 1981). The indirect results of this procedure are the statistical characteristics of the unknown parameters and the estimates of bias in these parameters (Gasjukov, 1995).

Risk analysis are not dealt with here because guidelines are expected to come soon from the long-term Management Measures Working Group and ACFM.

2.6 Effects on Assessments of Stock Structure

The decision on what stock structure that should be used in the assessments have to be a compromise between the theoretical-biological views and the practical aspects such as in what units catch figures are reported and in what units management is carried out.

The Baltic spring spawning herring is at present assessed as four different stocks:

- herring in Sub-divisions 22-24 and in Division IIIa and eastern part of Division IVa,
- herring in Subdivisions 25-29 and 32 (Gulf of Riga included),
- herring in Sub-division 30,
- herring in Subdivision 31.

In addition the so called Gulf herring in the Gulf of Riga is assessed separately.

Sprat in Baltic Sub-divisions 22-32 is assessed as a single unit.

Cod in Sub-divisions 22 and 24 is assessed as one unit and in Sub-divisions 25-32 as another. Cod in Sub-division 23 is not included at all.

The proper way of defining assessments units for herring has been discussed for a long time. The actual units used has changed several times since the end of the 1970's . The presently used "lumped" stock in the Baltic Proper has aroused arguments along several lines:

1. Data used for tuning of the VPA/XSA (in the form of Acoustic Surveys) for the Sub-divisions 25-29, 32 do not comprise the whole area. These surveys do not cover neither Sub-division 32 (Gulf of Finland) nor the Gulf of Riga.

2. It could be difficult to discover an overexploitation of a part of the total stock if the parts are not assessed separately.

3. The pronounced heterogeneity in mean weight-at-age for herring from different parts of the area may cause errors in the assessment.

There is a tradition in some countries to routinely allocate sampled herring to separate sub-populations or stocks (Gulf of Riga herring, open sea herring, Gulf of Finland herring, coastal herring in Sub-division 26 and autumn spawning herring). Such separations are made on the basis of differences in otolith structure. There is an increasing risk that as these data are not used for the assessments, resource priorities may cause this work to stop, which may lead to significant losses of biological information.

The use of the concept of a single herring stock unit for the total assessment gives a wrong pattern of herring stock age structure. This comes due to smoothing of the differences in the strength of year -classes as regards different sea regions. The smoothing begins at the stage of aggregation of national data on catch-at-age. Furthermore, the use of hydroacoustic data for tuning even more leads to averaging the age structure because acoustic surveys are carried out in the period of maximum mixing of herring from different Baltic Sea regions.

Since the biostatistical material for some regions of the Baltic sea is insufficient it is necessary to extrapolate data from one sub-division for another. For instance the results of sprat abundance in young fish surveys in Sub-divisions 26+28 are often used for the prediction of recruitment in the whole Baltic which might not be correct. The year-class of 1986 was very rich in Sub-divisions 26+28, but a poor one in Sub-divisions 22-25, the year-class of 1984 was under average in Sub-divisions 22-25, average in Sub-divisions 26+28 and a rich one in Sub-divisions 27,29,32. Essential faults could arise in cases where the VPA tuning is made on the base of hydroacoustic surveys which have not covered the whole Baltic Sea.

Cod caught in Sub-divisions 22 and 23 may at times be a mixture of indigenous fish and cod coming from the Kattegat. It is also known that inflows of water from the Kattegat to Sub-divisions 23 and 24 can contain large amounts of cod eggs.

Research needed for improving our perception of the stock structure is the following:

Herring

1. Locate and map herring spawning grounds around the Baltic coasts.

2. Assess the magnitude of the spawning stocks connected to the various grounds. A combination of diving investigations (ref. Latvian papers) and larval surveys designed to register small herring larvae should make it possible to estimate spawning stock size connected with the various spawning areas.

3. Characterize spawning populations in terms of age composition , size at age, morphometrics, otolith form, parasites and other features that could improve the discrimination between stocks.

4. Map the seasonal distribution of herring in the Baltic based on data from surveys (acoustic, young fish etc.).

5. Describe migration patterns of herring from results of tagging experiments and stock distribution .

6. Map catches seasonally and characterize catches in such details that they can be allocated to proper stock units.

Sprat:

Sprat stock structure could be studied by analysis of the existing published and unpublished data concerning this question, by seasonal hydroacoustic surveys (May, October) to follow the changes of stock size and its age structure in different Sub-divisions, and by investigations of natural tags of sprat (as the first growth zone of otoliths) which can allow to estimate the migrations and mixing of sprat in the Baltic sea.

Cod:

1. Tagging experiments on a scale sufficient to allow quantitative estimations of mixing.

2. Electronical tagging like done for N.Sea plaice.

3. Electrophoresis analysis of genetical differences between sub-stocks.

By using simulations it should be possible to quantify the errors in stock estimates associated with lumping of separate stocks and from the splitting of a stock into several assessment units.

It should also be investigated with what precision and accuracy the various methods for allocating single fish to stocks works.

In the present system in which fisheries are regulated by yearly TACs set by species and area should, ideally, the management areas should coincide with the stock area (assessment unit). In the Baltic this is not the case. The International Baltic Sea Fishery Commission has established areas for which they set TACs irrespective of the stock structure and assessment units. For herring two TACs are set: (Baltic Proper Sub-division 22-29, 32 and the Gulf of Bothnia together with the Bothnian Sea, Sub-divisions 30, 31) based on the assessments of four stocks. Management of sprat and cod are by single TACs for the whole area. Cod is assessed as two stocks and sprat as one. Salmon TACs, given separately for the Gulf of Finland and for all other areas, are, however, in accordance with the assessment units used.

Each TAC is split by the Commission into national quotas to be caught in the fishing zone of each country. (It is common that the states use part of their quota for exchanging fishing rights in each others zones.)

The major principle when the Commission allocates national quotas is historical catch levels. It is thus not quite obvious how - in the present management system - it should be possible to manage a single stock that is combined with others in a management unit.

Such aspects should be taken into account when the actual units of assessment (stocks) are decided upon.

3 PRESENT SITUATION (TOR B)

3.1 Sampling of commercial catch

In the "Report of the Study Group on the evaluation of Baltic fish data" (C.M.1993/J:5) sampling scheme, quality of the sampling and quality of landings statistics for each country are described. Summarising information on the quality of the landings statistics, the conclusion is, that for all countries there are uncertain landings statistics. For some countries reliability on the landings statistics has been poor for the last 6-8 years and for others countries a decreasing tendency first started when the severe restrictive regulations especially for the cod fishery were introduced in the late 1980s.

During the latest years the quality of the biological sampling of commercial landings has for many countries not been improved. Especially the cod landings have been poorly sampled and the landings statistics is not reliable due to misreporting between areas and in total catch figures. Changes in gear type from trawls towards gill-nets has also complicated the sampling and in some countries both gear types has not been sampled in all years.

A main problem in sampling commercial catches from the Baltic area arise when vessels land their catch in ports outside the home country. The landings in foreign port are normally not sampled by the institute in the home country because of logistic problems. At the same time, the institute in the receiver country often is not prepared to undertake additional sampling of foreign landings. The end result is that such landings are not covered by any biological sampling system.

In the past some national institutes have collected other sorts of information as effort data and discard data. Effort and discard data has been used in the Assessment Working Groups but not in the latest years. The reliability of these data are also influenced by misreporting and are therefore rather unreliable.

The sampling level by country in 1993 is given in Table 3.1. From this table it can be seen that the numbers of fish aged per 1000 tons caught differ very much by country for the various species. For cod is must be remembered that due to mis-reporting the actual catch is probably about twice as high as given here. Thus, the number of aged fish per 1000 t caught should be divided by 2.

Age reading of herring, sprat and cod from the Baltic area is a difficult task. Especially age reading of cod has shown to be a problem. "The Report of the Workshop on Baltic Cod" (C.M.1994/J:5) show, that in only 25% of the otoliths read on the Workshop there were fully agreement during the first round of reading. After collective readings and presentation of personal interpretation a 75% equality of readings was achieved. It should be remembered, that it is the results of the first round of reading that are used if there is no re-reading of the otoliths in the different institutes. In 1992 a Workshop on age reading of sprat was held. Result from this Workshop also indicate severe problems with the age reading of this species.

At present all countries uses their own age/length keys when calculating commercial catches into numbers by age, quarter and area.

Therefore, facing all these uncertainties the participants of this Study Group felt, that initiatives to make a new and more robust system has to be introduced.

The Group had a brief discussion about the resources used and needed on sampling commercial catch data. Time did not allow the Group to go into an estimation of this but it was the feeling that the commercial catch sampling programs were relatively cheap compared to research vessel surveys. A more thorough analysis is needed in order to assess the resources used and needed on commercial sampling compared to the resources needed for doing research vessel surveys if the question of moving resources from sampling the commercial catches over to doing more RV trawl hauls can be answered.

3.2 Research vessels activities

3.2.1 Bottom trawl surveys

Systematized ground fish surveys in the Baltic have been performed since the first standard trawl (the Sonderborg trawl) was developed in the late 1950's. A first comprehensive description of national bottom trawl surveys was given in the reports of the Ad Hoc Working Group on Young Fish Trawl Surveys in 1985 and its subsequent meetings (Anon. 1985, 1986, 1987, 1993a). The reports contain detailed information on vessel characteristics, gears employed, sample design and methods of analysis.

Since then, there has been substantial changes in the design and proficiency of some national surveys and a brief update of the present situation is motivated. An overview of the present programs is given in Table 3.2. It should be noted that whereas several surveys are designed to cover both pelagic and demersal fish species, their overall objective are targeted towards cod recruitment.

The Danish surveys, which started in 1982, are based on a depth stratification scheme (30-100m) and cover Subdivisions 24-28. Surveys are performed with the R/V DANA (78 m and 4500 HP engine) using a modified Granton trawl with 40 cm bobbins. Meshsize in the codend is 18 mm bar length. Standard haul time is 0.5 hours. Despite low vertical opening and bobbins the R/V DANA surveys seem to have a comparatively good precision in SSB and 2-group cod estimates (see later).

The Latvian survey database contains demersal trawling results from 1982 and onwards. Monthly surveys from January to April and from September to December were conducted on R/V Zvedzda Baltiki and R/V Baltijas Petnieks (both: 55 m, 1000 HP engine) in Sub-division 26, 28 and 29, with a few visits to Sub-division 25. A modified commercial bottom trawl type 28/33.6 with rockhoppers (codend 8-10 mm) was employed. Trawling was set at 0.5 hours. Sampling was stratified by seven depth transects covering 20 to 120 m. In 1994, the survey from Sub-division 28 occurred in April on board the R/V Monokristal (55 m, 1000 HP engine) with a 28/37 demersal trawl (codend meshsize 6 mm). A total of 25 demersal hauls were taken, using a haul duration of 0.5 hours.

Two German surveys have been conducted, one from the Rostock and one from the Kiel Institute, since the early 1980s. Since 1990 all demersal surveys in the Baltic has been organized from the Rostock Institute. The investigations are presently carried out by the R/V Solea (39m, 1050 HP engine) in Sub-divisions 22, 24 and 25. Since 1983 a modified bottom trawl for herring, type HG 20/25 (codend meshsize 10 mm) was adopted after performance testing during several years (Schultz and Grygiel, 1984). Random stratified distributions were used to create a stratified trawl survey of fixed stations. The design is applied for both the western and eastern cod stocks and in 1993 a total of 82 hauls were taken. In 1994 the number of hauls in the Sub-division 22 were decreased, using regression techniques to validate the station by station performance (Müller and Frieß, Working Group DOC #9).

The Polish surveys started already in 1962, but the survey machinery has subsequently been altered at several occasions. The present database starts at 1981. The above mentioned herring trawl was introduced in 1979 with a 6 mm meshsize and adopted as standard gear after three years of calibration. The trawl was further modified (groundrope) with the introduction of the new R/V Baltica (41 m, 1500 HP engine) in 1993. The originally swept area design is presently based on four transects covering fixed depth stations from 20 to 100m in the SE Sub-division 26. Occasional survey extensions to the Slupsk Furrow and the Bornholm basin has been possible. Haul duration is 0.5 hours and a total of 72 hauls were made in the 1st quarter, 1994.

The Russian surveys started in 1992. Individual haul data are available from 1993 and cover mainly Sub-divisions 26. The surveys are performed in March-April with the R/V Monokristal (54.8 m, 1000 HP engine) using a bottomtrawl type 28/37 (codend 6.5 mm mesh bar). Due to rough bottoms the groundrope was equipped with 400 mm bobbins. The sample design were based on regular depth transects covering 20 to 120 m. A total of 26 demersal hauls in 1994 were taken using a haul duration of 0.5 hour.

The Swedish surveys, targeted at cod recruitment, begun in 1986. The investigations cover Sub-divisions 23 to 28 and a total of 43 stations were visited during March 1994. Since 1989 a complementary young cod survey has been performed each November. The R/V Argos (61m, 1800 HP engine) was originally equipped with a modified commercial cod trawl (codend 11 mm meshsize) which still are used at a few rough bottoms in Sub-divisions 26 and 28. In 1989 a GOV trawl was introduced, rigged and handled according to the North Sea IBTS manual, except regarding the haul duration which was 1 hour instead of 0.5 hour as in the IBTS.

Above listed surveys represent national research efforts and are accordingly designed to provide single recruitment indices by year. Survey design and gears employed have been adapted to characteristics of the nearby and known sea bed due to national concern or limited vessel resources. Hence, several gear types are used and little coordination between surveys have been accomplished.

A first attempt to coordinate gears were initiated by discussions within the Ad Hoc Working Group on Young Fish Trawl Surveys in 1986 (Anon. 1986). It was agreed that gear standardization was questionable due to the different bottom typography of the different survey coverage and the various size categories of available research vessels. Instead a gear calibration survey was set up including six research vessels. The intercalibration took place the same year but the results could not be used to estimate gear differences (Anon., 1987). The failure was attributed to low cod abundance (i.e. low catches) and unsuitable trawl bottoms at the chosen site. GLM models have, however, afterwards been shown to be able to do the job (see for instance Tables 2.1.1.2, 4.2.1.1 and 4.2.1.2).

Lumped together, the surveys represent a substantial international effort (Table 3.2). By the establishment of a simple age based database in 1988, each single haul have since been available for recruitment and SSB estimates within the Baltic assessment WG. The estimates of recruitment are now routinely calculated from a GLM-model, which incorporates vessel, gear, season, area and depth effects. However, an international cooperation already during the design process would increase the precision of these calculations. The assessment WG should also benefit from the inclusion of additional parameters, such as length and maturity distributions, in the present database.

The above database of nationally conducted young fish surveys in the Baltic includes CPUE by age group and by individual hauls since 1982. Through time a number of errors have been detected and the contents need to be scrutinized and corrected. It is recommended that a CHECK ALL coordinator should be appointed to check, correct and update the database and report to the meeting of the Baltic assessment WG in 1995 and in 1996. Joana Tomkiewitz) was appointed by the group.

Trawl station coverage from all national surveys appears to be accurate from a map over the number of hauls by rectangle (Figures 3.2.1.1 and 3.2.1.2). However, a plot of available trawl stations (Fig. 3.2.1.3) reveals gaps in the sampling coverage. The southern part of Sub-division 27 and the western part of Sub-division 26 are poorly represented. Both are characterized by rough bottoms but while commercial fishing in Sub-division 27 is small, fishing is common in the western Sub-division 26. Hence, a thorough discussion and analysis of the international coverage is appropriate.

The environmental impact (i.e. oxygen deficiency and low salinity levels) have been debated within the assessment WG but satisfactory procedures to guide the survey sampling have so far not been decided upon. The area with sufficient oxygen and salinity for cod egg survival have varied drastically in the main basin during the last 10 years. Impact on cod distribution have been recorded as extremely low catches from bottoms which are temporary contaminated by H_2S. It should be noted that all present survey protocols include temperature and salinity measurements by haul and oxygen measurements by at least depth strata.

3.2.2 Acoustic surveys

Table 3.2.2.1 gives a list over acoustic surveys conducted in the Baltic since 1978 and details about equipment, survey design etc.

3.3 Causes for the problems

Regarding herring in 25-29+32 the acoustic survey seems to give estimates of stock numbers which are not too bad, CV values around 0.3 per age group and slopes close to 1 according to the latest XSA (Anon. 1994b). F is however rather low and thus the VPA not converging very strongly. Therefore the CV value of 0.3 might be underestimates (or overestimates of the precision) as the XSA might fit the stock numbers to the acoustic values in many of the years and for several age groups. Figure 3.2.2.1 shows that both the yearly variation and the level of the stock biomass estimates from the XSA and the acoustics surveys differs.

The Baltic Pelagic Working Group used the ICA program in 1994 to evaluate the tuning data. They showed that F in the last year was very poorly determined by the acoustic data (the SSQ plot showed that a minimum was either poorly defined or not existent, Figure 3.3.14 and 3.3.16 in the Working Group Report).

3.3.1 Sprat in 22-32

Figure 3.2.2.2 shows the trends in SSB from the MSVPA, the acoustic survey in 26+28 (October) and in 24-29 (October), and these can be seen to be quite different. The MSVPA estimates were used rather than the VPA because the MSVPA estimates are less sensitive to input F (predation can be regarded as a "fishing fleet"). The RCT3 analysis made by the Baltic Pelagic Working Group indicated that the acoustic estimates of 0-groups in Sub-divisions 26+28 correlated well with the VPA (slope=0.53, se=.29, r^2=0.84, and n=7). This analysis should, however, be evaluated on the background of the fact that the hydroacoustic data were used in the tuning of the VPA.

The acoustic stock estimates by age-groups, could, either they are regarded as estimates of absolute stock size or as indices of stock abundance give information on the mortality. The change in abundance of a year-class from one year to the next yields (when expressed as logarithmic difference) an estimate of its total mortality. Tables 3.2.2.2 and 3.2.2.3 show such mortality estimates for herring and sprat. The variation in mortality are large both for single cohorts and for yearly means. The numerous positive values for herring of age 1-3 indicates that there is recruitment and/or immigration of herring to the surveyed areas. It is generally thought that the survey results are not fully representative for the youngest age-groups (ages 0-1) due to their distribution on shallow waters not covered by the surveys. The **inadequate coverage of the 2 and 3 year old herring is a cause of concern**, since these groups makes up a significant part of the stock.

The acoustic survey is sensitive to technical problems. In 1993 the survey results were not considered reliable and not used, because one vessel had technical problems and dropped out of the survey and no other vessel took over the task of surveying the area that vessel should have covered. The effort by the rest of the vessels can therefore be regarded as wasted in 1993.

Large deviations between ships has been revealed by intercalibrations and overlapping survey areas.

Of logistical causes for the encountered problems are: 1) national difficulties in making medium-term plans, 2) severe economical constrains, 3) insufficient communication between participating laboratories, 4) imperfect international co-ordination of surveys and compilation of results, and 5) adoption of a survey strategy in which each vessel are exclusively responsible for a given area. The last point has a consequence that the total result is jeopardised if one vessel (= one area) fails.

Of technical causes can be mentioned: 1) changes of equipment, 2) instability in calibration results, 3) operational mistakes (i.e. threshold settings), 4) differences between vessels in equipment, frequencies used, methods of calculating biomass, survey designs (day/night operation), trawl gear, procedures for splitting measured echoes into species and size, target species, target strength applied, and 5) lacking corrections for intercalibration differences.

3.3.2 Coverage in relation to stock distribution

The surveys have covered - to a varying extent - Sub-divisions 22,24 and 25-29. Sub-division 32 (Gulf of Finland has not been included, neither has Gulf of Riga). The yearly variation in total coverage has varied between 52,100 and 60,300 square nautical miles. Here is given the raising factors per year and sub-division for the yearly values to the maximum area for 1982-1991:

AREA:	Year factors based on areas surveyed rel. to max. area per SD.									
	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
24	1,152	1,000	1,178	1,311	1,293	1,293	1,248	1,465	1,293	#####
25	1,136	1,000	1,038	1,089	1,048	1,034	1,022	1,124	1,022	1,077
26	1,296	1,129	1,125	1,126	1,128	'1,123	1,207	1,207	1,207	1,000
27	1,077	1,000	1,090	1,046	1,031	1,034	1,047	1,028	1,046	1,090
28	1,101	1,130	1,348	1,082	1,065	1,066	1,178	1,079	1,069	1,000
29S	1,155	1,169	1,334	1,249	1,154	1,611	1,993	1,144	1,144	1,000
Sum	1,122	1,050	1,132	1,078	1,051	1,090	1,158	1,087	1,063	1,000

In the most recent years the coverage has decreased significantly to 51,541 nm^2 in 1992 and only 21,385 nm^2 in 1993.

The surveys should in principle cover the whole area of distribution of the stock(s) it will estimate. Alternatively should it cover the same proportion of the stock each year. These conditions have not been fulfilled with the acoustic surveys in the Baltic. The influence from this feature is most important for the herring assessment(s). Herring spawning in both the Gulf of Finland and the Gulf of Riga appear in the autumn to a varying degree in the Baltic Proper. This phenomenon will undoubtedly contribute to the variation / noise / inconsistencies seen in the results.

4 COORDINATION OF SAMPLING AND SURVEYS (TOR C).

The number of countries around the Baltic is large. Today each country aims at being an expert and a participant in all aspects of sampling and surveys in the Baltic. It was briefly discussed whether this was actually the most appropriate approach. It was speculated that if only one country was responsible for the fish stocks in the Baltic this country would probably concentrate the various tasks on one or a few laboratories. The question was therefore raised whether it would be prudent to concentrate the various tasks of sampling and surveys in the Baltic on fewer laboratories, e.g. whether it would be a good idea to have only two or three laboratories involved in cod age readings, another set of two or three laboratories involved in herring age readings, a third set in hydroacoustic surveys etc. The aim should be to concentrate the expertise and thereby increase the quality of the work.

This would be a radically new strategy and the Group did not feel that it was realistic to attempt to take the international collaboration this far for the time being.

4.1 Commercial sampling

4.1.1 Protocol

4.1.1.1 Landings statistics

The problems with the uncertainties of the landings statistics are essential and has to be resolved. As for cod landings, many rumours about the amount of the misreporting circulates. Attempts to estimate misreporting in the Baltic cod stocks has never been actually performed and at least for 1993 the misreporting was probably significant. Prior to that misreporting has been at a lower level and is not supposed to have been large as the TAC was not fished. Hopefully there will be an efficient management system in the future and unfortunately this will probably mean severe catch restriction. It is therefore worthwhile to discuss what could be done to estimate misreporting. The following are ideas only and they have to be seen in connection with possibilities in each country:

1. Compare data on fish filet production from various factories with official landings data.

2. Estimate total catch by sub-sampling procedures. These samples could for instance be obtained from observers on board vessels in connection with discards investigations. It might furthermore be possible to merge these data with logbook data on days at sea. A potential problem is, however, whether fishermen will behave "normally" when having observers on board.

3. Judge the individual landings reported from "neighbouring" areas and species and allocate them to the right species and area.

Misreporting of herring and sprat are at a much lower level than that of cod.

It was shortly discussed weather it is the responsibility of biologists to produce accurate landings statistics or whether that is the responsibility of the administration in each country. There were no agreement in the group on that subject.

A description of the fisheries and national sampling systems is included in the "Report of the Study Group on the evaluation of Baltic fish data" (C.M.1993/J:5). However, it is important, before an international protocol for sampling and compilation can be made, to have a more detailed and precise description on how this is at present performed in each country.

Therefore, the following subjects should be described for each country:

- **Description of the fisheries where cod, herring, sprat and flatfish are caught.**

  Following subject to be described:

  - The fleets, gear-type, mesh-size, etc.

- **Regulations pertaining to the fisheries for cod, herring, sprat and flatfish.**

  Following subject to be described:

  - Licenses, technical regulations, quotas, closures, by-catch regulations, etc.

- **Description of the national authorities monitoring system.**

  Following subject to be described:

  - Uses of logbooks, sales slips. Port and sea control. Registration of data (who and how).

- **Evaluation of the national authorities monitoring system for management purposes.**

  Following subject to be described:

  - Problems or errors in the system. Differences between official landings figure and figures uses in ICES WG.

These descriptions should be send to ICES as soon as possible so they can be used in the Assessment Working Groups dealing with the Baltic area.

4.1.1.2 Biological sampling

One problem is to get samples from landings in ports outside the country of origin of fishing vessels. This Study Group recognises the need for a better formulation of the responsibility for the biological sampling. It suggests that the obligation for the biological sampling rests on the country where the vessel is registered, and not on the country in which the catch is being landed. Recognising that the responsibility remains with the flag country, logistic reasons make it desirable that the scientific sampling of foreign landings should be delegated to authorities in the country where the landing occurs. It is, therefore, proposed that the national programmes be extended to routinely sample all landings irrespective of the flag of the vessel. Collaboration with the biologists in the home country of the vessels landing in foreign ports would often be needed in order to allocate the landing to the correct area.

It should be stressed, that it is important that all gear types are sampled, as the length distribution is different from gear type to gear type.

A description of the national sampling systems can be found in the "Report of the Study Group on the evaluation of Baltic fish data" (C.M.1993/J:5). However, it is important to has a more detailed and precise description in order to organise the international collaboration in this field. Furthermore, it is essential to have these information when compiling data within the ICES assessment Working Group.

Therefore, following subjects should be described for each country.

- **Description of the scientific sampling system of the commercial landings of cod, herring, sprat and flatfish.**

  Following subject to be described:

  - What is collected and how. Which information is used (sales slips, logbook, etc.). What is recorded and how.

- **The use of the scientific sampling system of commercial landings for assessment purposes.**

  Following subject to be described:

  - How the landings are aggregated into numbers caught by age etc. (examples could be described). Effort data calculations.

- **Evaluation of the scientific sampling system of commercial landings for assessment purposes.**

  Following subject to be described:

  - Uncertainties etc.

These descriptions should be send to ICES as soon as possible so they can be used in the Assessment Working Groups dealing with the Baltic area.

As mentioned earlier, the problems with ageing fish from the Baltic area has to be resolved.

The present Group therefore stresses, that it is important to have a quality control system which should consist of frequent exchange of otolit samples and comparative readings as well as workshops when problems are encountered. The present Group finds that the four tasks listed in the TOR for the Study Group on Baltic Cod Age-Readings are also important for Baltic herring and sprat.

Currently all countries are measuring the length of a large amount of fish and are ageing round 60,000 fish per year. If the rule of thumb is 200 fish sampled per 1000 t landed and as the annual landings in the Baltic is about 0.5 to 1.0 million t this means that between 100 000 and 200 000 fish should be examined per year. Clearly this is a big task and it is therefore important to consider ways of optimising this.

One possibility could be to make international age/length keys for each area by month or quarter. Each country should be responsible for sampling otoliths for a specific area and there should be overlap with at least one other country. Then, the number of otoliths to be read can be reduced and more effort could be put into re-reading of otoliths and into making more measurement of fish from landings from the different fleets irrespective of the origin of the vessel.

Data to the age/length keys could either come from commercial landings or from research vessel surveys.

These age/length keys might be situated at ICES and all these data could be send from ICES to the various countries regularly.

Information from Latvian and Danish investigations indicate that for assessment purposes it is very important to collect data on discards for various fleets fishing cod, as discards seem to be on an significant amount of the total catches. It has been observed that not only small cod are discarded but also large cod in cases where a vessel has caught cod in excess of their trip quota.

It is therefore recommended, that all national institutes implement systems to sample discard data in the cod fishery. This sampling should be done by fleet types: bottom trawlers, pelagic trawlers and gill-netters and by area and season.

4.1.2 International data base

The goals of an international data base on commercial catch data are:

1. Allow alternative aggregations by area (the "stock unit problem"), use of alternative ALKs (for instance international aggregated ones by appropriate strata) for a given species. An example of the problems with the present situation is that the VPA and the MSVPA catch data in numbers and weight by age differ because when compiling the MSVPA data it has been impossible to reproduce the compilation done by the single species assessment WGs in the past years.

2. Facilitate comparisons and quality control of the data.

3. The usual data base advantages like data integrity, documentation, quick recompilation possibilities etc.

There are resource implications for such a data base system. The development of the system will be quite demanding; in the order of 1 man year. The maintenance of the system including testing and loading of new data, compilation of data, reporting, and software maintenance will probably be in the order of 1/4 man year per year. The ideal place to have the data base will probably be the ICES Secretariat but the resources needed is a potential problem. To split the responsibility between countries would not be very easy due to the "nature" of the task. Check programs which could be used by individual nations could, however, be developed seperately and that would spread a part of the task.

It might be possible to use software already developed in some institutes. The Group was informed that DIFMAR was planing to develop software which will be able to do similar things as outlined above and it might be an idea to liaise with DIFMAR.

What details are needed?:

a) Consistency between MSVPA data and VPA data. That means that catch in weight, in numbers by age, weight by age, and maturity by age have to be stored by species, year, quarter, and Sub-division.

b) Data on catch in numbers by length is needed if ALKs data collected by one or several countries should be used on another country's length data. These data on length and ALKs should be disaggregated by species, year, quarter, sub-division, and fleet type.

Exchange data records:

Three record types are needed: one with the total commercial catch in weight by country, species, year, quarter, sub-division, and fleet type (TON (tons landed) record type), one with catch in numbers by length and by country, species, year, quarter, sub-division, and fleet type (LEN (length data) record type), and ALK data with the age determinations by country, species, year, quarter, and sub-division (ALK (age data) record type). Table 4.1.1 gives details of exchange record formats. It was discussed whether to included landings categories in the database, but it was considered too difficult due to different definitions of the landing categories between countries. Instead each country could and probably should sample by landing category but compile the data in an aggregated form before submitting the data to the database.

It was agreed that from 1996 and onwards data on commercial catches should be reported to the Baltic Assessment Working Group in the exchange format. In 1996 data from 1994 and 1995 should be reported. This would make the "ball rolling" and it will make it possible to apply *ad hoc* compilations programs and get some results even if a database is still not developed at that time.

4.2 Research vessel surveys

Access rights to other countries EEZs has become much easier for research vessels in the most recent years due to the political changes in the Baltic states.

4.2.1 Bottom trawl surveys

It was agreed that the aim of internationally coordinated surveys could be split into short and long-term objectives:

The immediate needs are to:

- estimate recruitment of 1- (western) and 2-group cod (eastern cod stock);
- estimate indices for older cod for XSA tuning;
- estimate mean weights in the sea of cod;
- estimate maturity ogives of cod;
- investigate flatfish distributions.

Due to the present deterioration of the catch data on cod it is expected that accurate fishery-independent estimators will be required in future assessments as well as increased knowledge of recruitment processes. Thus, the long-term needs are to:

- estimate SSB levels of cod and possibly of flatfishes;
- estimate distribution and abundance of 1-group cod in the eastern stock;
- estimate SSB levels, distribution and possibly recruitment of herring and sprat.

The present timing of the surveys (i.e. 1st and 4th quarter) were considered sufficient to estimate yearclass strength of cod from Sub-divisions 25 to 32. Spawning starts in April-May and prolongs through the 2nd and 3rd quarters. Therefore, an accurate sampling of SSB levels in these areas should not be done in these quarters. In Sub-divisions 22 and 24 spawning aggregations in March - April may obstruct the sampling objectives of a survey. Previous German studies indicate that trawling in the 2nd and 3rd quarter is unsuitable for abundance estimates. Hence, both SSB and recruitment surveys of the western stock should be performed very early in the year or by the previous 4th quarter. As discussed in Section 2 there is a need for 2 surveys and more trawl hauls and it is therefore proposed that each nation should attempt to do two BITS (Baltic International Trawl Survey) cruises each year. Annual estimation of the distribution of cod by age have been estimated from survey data (cp. Sparholt *et al.*, 1991). It is suggested that this task could be exercised annually by the assessment WG meetings.

In order to assess the present precision by vessel it is important that the overlap between the different surveys increases. Ideally, allocation of areas should be distributed so that each individual vessel can cover the total distribution of cod. It is then possible 1) to compare and continuously evaluate the performance of individual vessels and 2) to be less sensitive to incidental drop-outs of a vessel. In practice this ideal goal is not obtainable in the Baltic. The implication was also considered precocious, since the smaller vessels (<40m) are highly restricted by weather conditions. Larger coverage along the coastline are, however, possible. The larger vessels could also extend their present survey area in order to increase overlap. The main drawback is less trawl stations in a previously dense station net. Exchange of accurate trawl positions between vessels could lessen the problem. Therefore, an appointed "CLEAR TOW" coordinator is suggested which should specify, collect and distribute exchange data. The data should be based on satellite (GPS) determined tracks. Additional trawl positions should be explored in areas with low survey coverage but with commercial fishing (e.g. western part of Sub-division 26).

In order to fully integrate the national surveys a common sampling scheme must be agreed. Most surveys are presently based on some depth stratification. Sampling could also be based on density estimates or the inverse variance of density estimates by rectangle. A third more pragmatic approach could be to take 3-4 hauls in each rectangle. Each of these possibilities should be evaluated from the available database. It was agreed that the pragmatic approach should be adopted for the time being, since it will reduce the problems of reallocating haul stations between vessels and years. Investigations of the 0- and 1-group dynamics and distribution will probably require specially tailored surveys connected to studies of cannibalism.

Coordination between national surveys implies the use of a single standard gear. A major benefit is the ease to compare results between different vessels, areas and season. Less research effort is required on gear performance (because only one gear has to be analysed) and exchange of experience between scientists and research crews is facilitated. A lower production cost per trawl unit might also be expected. The previous mentioned GLM analysis would also benefit from this as one parameter less, the country parameter, would have to be estimated and in that way several degrees of freedom will be gained. The main drawback by the introduction of a new trawl is the interruption of obtained time series and to some extent the additional expenses for a new trawl.

The GOV (Grand Overture Verticale) trawl is a strong candidate, since it has been tested thoroughly and there are more than a decade of scientific experience of its qualities in the North Sea, Skagerak, Kattegat, and the Baltic. Furthermore Sweden has used it as their standard gear in the Baltic since 1989. Its a stable and robust gear without bobbins. However, there are at least two drawbacks: it may not be used on rough bottoms, which are common in Sub-divisions 26 and 28 and it is also a large gear, which might be difficult to handle for the smaller vessels.

An alternative could be a specifically constructed trawl for the Baltic Sea. The GOV trawl is essentially a modified bottomtrawl for herring. Its "grand" vertical opening are no longer impressive, compared to recent commercial products. Even larger openings are desired for the Baltic environment. However, the construction and design of a new gear would require a durable effort from involved gear scientists. Detailed descriptions of research vessels and their rigging possibilities must be provided. The objective should be to find a trawl, that besides acceptable fishing behavior, must be suitable to both smaller and larger research vessel.

It was agreed that measures to introduce a new standard gear should be initiated. As a first step technical information from the various research vessels should be produced in order to select an appropriate gear adapted to fit the behavior and requirements from individual vessels. Information should be provided by individual laboratories on:

- size, engine, machinery of the used research vessel;
- a technical description and drawing of the fishing deck;
- rigging on deck, type of winches, netdrums, etc.;
- a comprehensive description of the nationally employed young fish trawl.

A GEAR coordinator should be appointed, who should further specify and collect the relevant vessel information. He should then contact the FTFB WG and other appropriate gear experts and apply for suggestions for suitable gears (or criteria for gears). Reports should be prepared for the meeting of the Baltic assessment WG.

The selected standard trawl should have a good robust performance on soft as well as on rough bottoms (with the same type of groundrope) and a vertical net opening no less than 5 m in order to allow for catches of herring and sprat.

The presently available candidates for a new standard trawl were discussed. It is suggested that the previously tested HG 20/25 and a new Danish trawl, labeled TV, should be considered for cod investigations in the Sub-divisions 22 and 24. In Sub-divisions 25 to 32 the tested GOV trawl and the HG 20/25 should be considered. The ground rope would have to be modified in order to operate consistently over both rough and soft bottoms. Other trawl types might be considered as well.

The transition to international standard trawls in the Baltic will require substantial performance and calibration experiments as well as an extensive evaluation. Thus, the standardization should be considered as a long-term assignment. It was agreed that any changes in the national surveys included introduction of new gears should be monitored through the suggested WG on trawl surveys in the Baltic (see below). In principle, unchanged survey methods and gears are preferred until a standard gear and procedures have been adopted.

The performance of used trawls in the Baltic can be evaluated by the use of a GLM analysis (SAS, 1988). As the nations included in the present database all use different gears, the variability of the catches can be described by the residuals of a performed GLM analysis, provided that each individual nation has used the same gear in the selected years. In Table 4.2.1.1 is given the standard deviation of the residuals from the GLM of SSB per hour by country (for 1986-1994 which are the years where Sweden has participated. However, including all years in the GLM gave almost identical results) and it can be seen that Sweden and Germany residuals are large (std = 1.6) while the Danish residuals are small (std = 1.3). It is a bit surprising that the GOV (Sweden) catches are so variable as the GOV catches are the largest (together with the Latvian catches) as can be seen from the GLM parameter estimates. One reason for this might however be that Sweden in some years actually has used another gear at some stations with rough bottom. Unfortunately these stations can not be identified in the current database. Table 4.2.1.2 gives similar data for a GLM model of 2-group cod. This is more or less the same story. The Danish survey show the smallest variation and the Swedish the highest. As the Danish Granton trawl has large bobbins and thus expected to be less efficient in catching small cod the low variability of the Danish catches is therefore surprising.

Introduction of a new standard trawl will require some calibration experiments by parallel trawling or likewise. However, the above GLM analysis might also be used provided that the introduction of a new gear is limited to one or two boats for some years. The GLM estimates can then be used to validate the new gear in relation to "older" gears.

Progress in the coordination process requires continuity. A multilateral or an ICES Working Group should be established consisting of relevant scientists from the concerned institutes. The group should meet annually or biannually and its prime task should be to:

- coordinate the future Baltic International Trawl Survey (BITS).
- update and be responsible for the survey manual and the database (see below)

It was further agreed that the chairman for the suggested Working Group should be a SURVEY coordinator. His term should last for at least three Working Group meetings. Selection of a new SURVEY coordinators should be the responsibility of the Baltic Assessment Working Groups or the Baltic Fish Committee. The coordinator's terms of reference should include:

- analyze data from previous years surveys;
- suggest relevant trawl stations for the coming season;
- operate as contact person during the surveys;
- collect survey reports by participating nations;
- make a preliminary analysis and report to the appropriate Baltic WG;

4.2.1.1 Survey manual

There was a general consensus that a survey manual should be constituted for demersal surveys in the Baltic. The ultimate goal is to secure standard fishing and handling procedures among national groundfish surveys. The manual should be under the auspices of the BITS WG. The daily responsibility could be given to the chairman of the BITS Working Group.

The manual should consist of three essential parts. The first part should specify the survey design, standard methods, gears and handling. The second part should describe recommended measurements and sampling of individual fishes. A last part should contain exchange formats and codes for all data that should be entered into the planned database.

Detailed instructions in the survey manual should be formulated and agreed after relevant analysis by the BITS WG. It is important that the present national surveys should be fully described and supplied to the BITS WG. In particular, the construction and rigging of the applied trawls should be given in both figures and text by each participant engaged in Baltic trawl surveys.

Guidelines on some relevant issues in the suggested survey manual is given below.

All survey tows should be monitored by satellite (GPS) navigation and recorded for further usage. New or unreported trawl tracks should be reported to the assigned CLEAR TOW coordinator.

A pragmatic sample design is recommended, consisting of 3-4 fixed trawl stations per rectangle and research vessel. Overlap between participating vessels should be secured. Depth stratification is necessary and an evaluation on the allocation of hauls by depth should be conducted by the BITS WG.

A standard trawl tow should in the future last for 30 minutes and be performed at 3.5 or 4.0 knots over ground. If possible, doorspread and vertical net opening should be measured as means over 5 minutes intervals. It was suggested that future trawl stations should be separated by at least 5 nautical miles. Trawling might have to be restricted to daylight time but further analysis is needed.

Bottom temperature and salinity should be registered by each trawl station. Level of oxygen content close to the bottom (<0.5 m) should be sampled by depth strata or if possible by each trawl station. The aim is to be able to map the area with too low oxygen concentration for holding cod so that the final indices can be corrected for changes in suitable cod areas. Data from other sources than the BITS might be considered as well. Quite a few hydrographical profiles are available in ICES hydrographical database which might be explored. As an example the stations sampled in June, July, and August 1992 which was a typical year, are shown in Figure 4.1. These data are also relevant for a spawning volumen calculation. Each haul should be assigned a validity code based on the oxygen levels.

Length distribution should be recorded for all fish species caught. Sprat and herring should be measured as total length to 0.5 cm below and all other species to 1 cm below. Sex by length group should be subsampled for all flatfish species.

Subsamples may be taken in case of large catches or extremely narrow length distributions. These subsamples should contain at least 100 fishes. However, all cod specimen exceeding 30 cm in total length should be measured.

Otolith sampling should be made by predefined sub-areas for cod, herring, sprat and flounder catches. The samples could consist of 10 otoliths per lengthgroup. Alternatively the required number of otoliths by lengthgroup could be estimated from inverse variance allocation (i.e. less variance in the smaller sizegroups would imply reduced number of otoliths taken in these groups). Otolith sampling from other species are encouraged.

Measurements of sex and maturity should accompany the individual sampling of otoliths. Maturity stages should be classified according to an agreed 2, 4, 6, or 8 point scale. For assessment purposes only a 2 point scale is needed, i.e. immature or mature.

The various national and international systems to record parasites and diseases should be evaluated and standard measurements might be agreed upon. Alternatively, these things should be registered on a national level.

4.2.2 Acoustic surveys

It is considered important when planning the acoustic survey in the Baltic that the <u>entire distribution area</u> of herring and sprat in Sub-division 22-29 and 32 is covered. It is also considered important that there are <u>significant overlap in space between the areas surveyed by the individual vessels</u> in order to validate and continuously control the performance of each vessel. Furthermore, the survey should be designed so that the an incidental drop out of one vessel can be compensated by redistribution of the rest of the vessels. Ideally, each area is surveyed by at least two vessels so that two independent estimates of stock sizes are obtainable. Experience has shown that overlap in survey areas between vessels is a necessary extra spending of resources.

Standardization of technical aspects of acoustic surveys is considered important in order to benefit from each others experience, develop common expertise, facilitate quality control, decrease problems in cases of vessel replacement, facilitate the localization of courses of inconsistencies in results if that happens to be the case, etc.

This present Group made a preliminary proposal for standardization of methods and equipment (Table 4.2.2). There are still several methodological problems about the best standard procedure to adopt for conducting acoustic surveys in general and in the Baltic in special. Time and research are needed to resolve these problems. The present Group was not in a position to recommend a specific way of organizing this but could only suggest that for instance a Workshop be set up with this as its TOR, that the Fish Capture Committee is consulted in order to get as broad and as much expertise in acoustic surveys involved as possible, or that the Planning Group for Hydroacoustic Surveys in the Baltic be reestablished with this tasks as an additional task to the more routinely tasks of compiling and planning the annual survey.

The tasks to consider are:

1. Intercalibration, overlapping, survey design.
2. Data handling (acoustical and biological samples).
3. Standardization of equipment's and methods.
4. Time period of the surveys (herring and sprat are the target species).
5. TS - measurement or calculations ?
6. Biological samples.
7. Species allocation.
8. Search for explanation of the differences between VPA and acoustic results in the past.

5 PREPARE SPECIFICATION OF THE BALTIC INTERNATIONAL TRAWL SURVEYS (TOR D)

Previous Baltic study groups has repeatedly called for a consistent and persistent organization to administrate results from demersal research surveys in the Baltic. It has been recommended (e.g. Anon., 1993a) that the task should be assigned to the ICES Secretariat mainly because the surveys are designed to provide some necessary background data for fish stock assessments within the ICES machinery. It was agreed that this approach would be ideal for future maintenance and access to the planned database. However, such action needs a detailed specification of data formats as well as some indication of required resources in terms of manpower and computer facilities.

5.1 Specification of formats for data exchange and storage

It was agreed that data formats specified in the Manual for the IBTS in the North Sea (Anon., 1992) could be used as a template for the BITS database. Utilizing available data structures should facilitate a new database construction and maintenance. Hence, the following specifications were adopted:

5.1.1 Exchange medium

ASCII coded data should be supplied on 3.5 inch diskettes or electronically (Internet), formatted in DOS.

5.1.2 Data and file structures

Three record types A, B and C were recognized, each containing 100 positions. Each haul should be hierarchically represented by one record type A, followed by one to several record type B, and one to several record type C.

TYPE A records including detailed haul information. Entered positions should correspond to the IBTS record type 1, with the exception of position 57-64, which should be used for hydrographical measurements and position 99-100, which should indicate Baltic Sub-division:

Positions	Variable	Representation
57-59	bottom temperature in °C	00
60-61	bottom salinity in per mile	00
62-64	bottom oxygen in mg/l	0.0
99-100	Baltic Sub-division (range 22-32)	00

It was assumed that detailed hydrographic information by hauls could be obtained from the present Hydrographic database at ICES, provided that such national data are provided on a haul by haul (= station) basis.

TYPE B records describing the length frequency distribution. The IBTS record type 2 was adopted. An extended validity code might be considered, e.g. to take account of environmental impact (low oxygen or salinity levels) on haul success. However, this issue must be discussed and analyzed thoroughly prior to any firm recommendation.

TYPE C records with information on number fish by sex, maturity, age and length. The IBTS record type 4 was adopted, with the exception of positions 48-49. These positions should be used to designate Baltic Sub-division codes. The incorporation of Sub-divisions will facilitate the construction of ALK reports by area from the database.

It was recognized that the maturity indices (position 56) should be changed for records containing cod measurements. Accordingly, the IBTS format should be exchanged to the six graded scale employed for Baltic cod. Similar changes of the maturity codes for sprat, herring and flatfish records must be considered.

Alpha codes gears, etc. as well as NODC codes for species recommended in the IBTS manual were adopted. Some additional coding were recognized, such as extended vessel and gear codes. The ISO3166 country codes should be used (see Table 4.1.1).

Further elaboration on the record contents and applied codes should be considered by a temporarily assigned DATABASE coordinator (see section 5.2). The coordinator should operate in close connection to concerned laboratories until the recommended BITS WG may take charge of the database.

5.2 Transfer to the ICES Secretariat

The BITS WG can assume responsibility for the maintenance of a BITS database as soon as the WG has been established within the ICES community. However, the construction, updating, report development and transfer to ICES computer environment will require major efforts.

Based on experiences from the IBTS implementation, it is estimated that a minimum of 0.5-1.0 man-year would be required in order to:

- construct a functional database from the IBTS "template";
- discuss and implement necessary output reports;
- check and load national data from 1982-1995 to the database.

In addition, each laboratory must be responsible for updating, checking and deliving previous survey results. This will require at least 1 man-month per laboratory during the first few years of implementation.

Thus, a total of 1.0-1.5 man-years will be required. Although, technical and some personal support from the ICES secretariat will be inevitable, these resources have to be supplied by individual laboratories.

It was agreed that a swift construction and transfer to an ICES based database on demersal trawl surveys in the Baltic should be given high priority. It was therefore decided that a temporary DATABASE coordinator should be assigned until the recommended BITS WG are operational. The coordinator should suggest database contents and formats and be responsible for a consensus on these issues between concerned laboratories. He/she should further supervise database establishment and programming within the ICES and collect and make initial tests with real data. The coordinator will have to spend 1 to several months at ICES headquarters depending on the progress of the project.

Computer facilities at the ICES Headquarters were considered sufficient. The BITS database should be based on the available software used to construct and maintain the IBTS database.

6 PREPARE SPECIFICATION OF THE HYDROACOUSTIC SURVEYS (TOR E)

6.1 Specification of sampling

The estimate of number of fish in a rectangle should be done as:

$$N = (A * SA) / avg(\sigma),$$

where N = number of fish in a rectangle, A = area (nm^2), SA = area back scattering, avg(σ) = scattering cross section of a "mean" fish in the whole stratum. The scattering cross section of a "mean" fish is the arithmetic mean of the scattering cross sections of fish from all hauls in the rectangle.

Calculation for each rectangle:

$$\sigma(i,j,k) = a(j) * L(i,k)^2,$$

where i = length class, j = species, k = haul, L = fish length (cm), $a(j) = 4\pi * 10^{-(b(j)/10)}$, b(j) = 71.2 for clupeids (Anon. 1983), b(j) = 67.5 for gadoids (Foote, et al. 1986).

Calculation mean of the scattering cross sections for a haul:

$$\sigma(k) = \Sigma_j h(j) * \Sigma_i h(i,j) * a(j) * L(i,k)^2$$

where h(j) = the frequency of species j, h(i,j) = the frequency of species j in the length class i. Furthermore:

$$avg(\sigma) = (1/K) * \Sigma_k \sigma(k),$$

where K = number of hauls in a rectangle.

The number, N in the rectangle is splitted into species classes N(j) by:

$$N(j) = N * (1/K) * \Sigma_k h(j).$$

The abundance of species j, N(j), is divided into age - classes, N(a,j), according to the age distribution h(a) in each stratum, N(a,j) = N(j) * h(a).

6.2 Transfer to the ICES Secretariat

The format for the exchange of results is defined in Tables 6.2.1 - 6.2.5. It is important to have the estimated numbers by ICES rectangles in order to be able to use the data for special analysis like sprat predation on cod eggs. For the survey statistics it is important to have these by rectangle <u>and by vessel</u> in order to be able to compare results from different vessels. Whether depth strata should be included as well has to be investigated.

The structure of raw acoustic data (SA) for acoustic surveys data sets is defined in Table 6.2.6.

It was regarded as a long-term goal to store data in a common database. For catch data the format from the IBTS (Anon.1992) could be used with minor modifications. The resource implications for the trawl catch database would probably be similar to those for the BITS database although some time might be saved if the BITS database will be developed first, because it will then be possible to "build" on that in stead of on the IBTS database. The field "distance" in record Type 1 could for instance be changed to "head rope depth". Special programs would have to be developed for example for extracting data in a form that can be used on the SA data. Eventually, the database should be held at the ICES Secretariat.

7 RECOMMENDATIONS AND CONCLUSIONS

Agreed points are in the following stated as recommendations if they are considered very important and need immediate action, and as conclusions if they do not need immediate action or if they are considered less important. Several minor points not mentioned here were agreed at during the meeting and these can be found in the main text of the report.

Recommendations

1. A BITS (Baltic International Trawl Survey) database should be established with the ultimate aim of being maintained by the ICES Secretariat.

2. A BITS Working Group should be established with the tasks of finalizing the work on a survey manual which is started by the present Group and be responsible for the survey and the database.

3. Countries should report data to the BITS data base; old data back to and including 1982 as well as new data. A "DATABASE" coordinator should be appointed and she/he should be responsible for starting the database development and for receiving and checking data delivered in the new format, until the chairman of the BITS Working Group is appointed and can take over.

4. The "old" BITS database should be checked and analyzed in more details in order to improve the assessments in the short-term. A "CHECK ALL" coordinator should be appointed and she/he should be responsible for this until the chairman of the BITS Working Group is appointed and can take over.

5. An appropriate Group under the Fish Capture Committee should be asked to advice on which standard trawl to use in the BITS. A "GEAR" coordinator should be appointed and she/he should make the needed background information available to the appropriate Group.

6. Descriptions of the commercial catch data monitoring, of the biological sampling, and of the compilation of the catch data should be made by each country and send to the Baltic Assessment WG 1995, and a protocol for commercial sampling should be made based on these descriptions by the Baltic Assessment Working Group.

7. Data on commercial catches should be submitted to the Baltic Assessment WG in 1996 and onwards in the exchange format, agreed upon during the present meeting. In 1996 data for 1994 and 1995 should be reported.

8. Each country should sample landings by fleet type including those of foreign vessels.

9. The commercial sampling in each country having a significant cod fishery should include at sea sampling of cod discards.

10. A Study Group should be established with the aim of specifying the research needed for improving the acoustic surveys in the Baltic.

Conclusions

1. One standard trawl gear (including groundrope rigging) should be used in the BITS in Sub-divisions 25-32 and possibly another one in Sub-divisions 22-24.

2. In the long-term a database should be established on commercial catch data.

3. Descriptions of research vessels specifications should be send to the "GEAR" coordinator or to the BITS WG Chairman if/when such a group is established.

4. A BITS secure trawl stations ("CLEAR-TOW") coordinator should be appointed for a three year term and data on secure trawl statioins send to him.

5. In periods where F is low for herring and sprat it might be enough for assessment purposes with acoustic surveys every second year. In alternate years the resources might be better spend on doing special cruises with the aim of improving the survey design and ultimately the precision of the acoustic survey. Improved survey design of the BITS survey is likely to result in useful indices of herring and sprat, which

can supplement the acoustic estimates and which will be available at least once per year.

6. Environmental data related to cod reproduction success and to herring growth should sampled and analyzed.

7. Stock delimitations for cod, herring, sprat and may be flatfish as well should be further investigated.

8. All fish species caught on the BITS should be length measured (and weighted if possible) and reported to the database.

9. Regular otolith exchange programs and frequent Workshop on otolith reading should be a part of an international protocol for sampling and processing of commercial catch data.

10. It is necessary to extend investigations that utilize methods which are not dependent of possibly biased catch statistics for stock assessment. The approach proposed by R. Cook (WP # 5) is recommended for further development and testing on the Baltic fish stocks. It is desirable to have the software for this approach available at the meeting of the Baltic Assessment Working Group.

11. Another way of improving the assessments of fish in the Baltic is to use alternative methods, which specifically deals with uncertain age determination of older fish. It is for instance worth to test and compare some methods utilized in other international fishery organizations (NAFO, CCAMLR, ICCAT) for stock assessments.

12. The present Group appoints the following coordinators:

"CHECK ALL"	Jonna Tomkiewitz, Denmark.
"DATABASE"	" " , "
"GEAR"	Johan Modin, Sweden
"CLEAR TOW"	Jørgen Dalskov, Denmark.

8 ACKNOWLEDGMENT

The Group would like to thank the Latvian Fisheries Research Institute for inviting the Group to Riga, Latvia, for providing good working facilities, for quick assistance with printing and photocopying and for their very friendly, relaxed and enthusiastic attitude.

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Table 2.1.1.1

```
cod 25-32, henrik s for sgarbf, VPA SSB and byfs SSB
1 11 2
1982 806     4.44
1983 783     5.05
1984 758     4.54
1985 615     4.16
1986 451     3.91
1987 372     3.37
1988 354     3.76
1989 284     3.19
1990 217     3.35
1991 148     2.78
1992 77      1.71
GLMssb
```

```
 Analysis by RCT3 ver3.1 of data from file :

 byfsssb1.txt

 cod 25-32, henrik s for sgarbf, VPA SSB and byfs SSB

 Data for    1 surveys over   11 years :  1982 - 1992

 Regression type = C
 Tapered time weighting not applied
 Survey weighting not applied
 Final estimates not shrunk towards mean
 Estimates with S.E.'S greater than that of mean
+                                                        included
 Minimum S.E. for any survey taken as    .00
 Minimum of   3 points used for regression

 Forecast/Hindcast variance correction used.

 Yearclass =   1990

          I-----------Regression----------I  I-----------Prediction---------I

 Survey/  Slope  Inter-   Std  Rsquare  No.  Index Predicted   Std     WAP
 Series          cept   Error           Pts  Value   Value    Error   Weights

 GLMssb     .71   3.39    .17   .868      8   3.35    5.75     .227    1.000

                                        VPA Mean =    6.25     .409     .000


 Yearclass =   1991

          I-----------Regression----------I  I-----------Prediction---------I

 Survey/  Slope  Inter-   Std  Rsquare  No.  Index Predicted   Std     WAP
 Series          cept   Error           Pts  Value   Value    Error   Weights

 GLMssb     .83   2.84    .22   .838      9   2.78    5.16     .319    1.000

                                        VPA Mean =    6.15     .478     .000
```

Cont'd....

Table 2.1.1.1 (Cont'd)

Yearclass = 1992

	I---------Regression---------I					I---------Prediction---------I			
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
GLMssb	.88	2.65	.23	.881	10	1.71	4.15	.369	1.000
					VPA Mean =		6.04	.579	.000

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
1990	314	5.75	.23	.00	.00	218	5.38
1991	173	5.16	.32	.00	.00	148	5.00
1992	63	4.15	.37	.00	.00	78	4.36

Table 2.1.1.2

General Linear Models Procedure
Class Level Information

Class	Levels	Values
YEAR	13	1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994
COUNTRY	6	DENMARK GDR GERMANY LATVIA POLAND SWEDEN
SUBDIV	3	25 26 28
DSTR	5	1 2 3 4 5
QUARTER	2	1 4

Number of observations in data set = 2398

NOTE: Due to missing values, only 2338 observations can be used in this analysis.

General Linear Models Procedure

Dependent Variable: LOGTOTW

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	24	3667.89378791	152.82890783	69.34	0.0001
Error	2313	5098.11983577	2.20411580		
Corrected Total	2337	8766.01362367			

R-Square	C.V.	Root MSE	LOGTOTW Mean
0.418422	39.47049	1.48462648	3.76135826

Source	DF	Type I SS	Mean Square	F Value	Pr > F
YEAR	12	1596.43904046	133.03658671	60.36	0.0001
COUNTRY	5	1715.92686098	343.18537220	155.70	0.0001
SUBDIV	2	55.14471593	27.57235796	12.51	0.0001
DSTR	4	286.46690678	71.61672669	32.49	0.0001
QUARTER	1	13.91626376	13.91626376	6.31	0.0120

Source	DF	Type III SS	Mean Square	F Value	Pr > F
YEAR	12	1587.12355528	132.26029627	60.01	0.0001
COUNTRY	5	1066.16923300	213.23384660	96.74	0.0001
SUBDIV	2	52.42341127	26.21170563	11.89	0.0001
DSTR	4	283.25936942	70.81484236	32.13	0.0001
QUARTER	1	13.91626376	13.91626376	6.31	0.0120

Parameter		Estimate	T for H0: Parameter=0	Pr > |T|	Std Error of Estimate
INTERCEPT		3.283362655 B	12.37	0.0001	0.26535735
YEAR	1982	1.389156312 B	7.98	0.0001	0.17398593
	1983	1.996484750 B	12.16	0.0001	0.16421216
	1984	1.488837030 B	8.76	0.0001	0.16990021
	1985	1.113759305 B	6.48	0.0001	0.17200070
	1986	0.861146237 B	4.42	0.0001	0.19501478
	1987	0.319811904 B	1.90	0.0580	0.16864639
	1988	0.711878766 B	4.53	0.0001	0.15705355
	1989	0.140211987 B	0.88	0.3767	0.15859748
	1990	0.298336159 B	1.92	0.0544	0.15498672
	1991	-0.268279055 B	-1.77	0.0768	0.15155816
	1992	-1.339239808 B	-7.72	0.0001	0.17349799
	1993	-0.958417645 B	-5.61	0.0001	0.17096030
	1994	0.000000000 B	.	.	.
COUNTRY	DENMARK	-0.108292055 B	-0.89	0.3743	0.12186935
	GDR	-1.059404429 B	-5.51	0.0001	0.19210682
	GERMANY	-0.449114829 B	-3.54	0.0004	0.12687538
	LATVIA	-0.065495816 B	-0.48	0.6288	0.13548267
	POLAND	-2.224229854 B	-14.68	0.0001	0.15151692
	SWEDEN	0.000000000 B	.	.	.
SUBDIV	25	0.457958877 B	3.94	0.0001	0.11614561
	26	0.510869450 B	4.57	0.0001	0.11171122
	28	0.000000000 B	.	.	.

Cont'd....

Table 2.1.1.2 (Cont'd)

DSTR	1	-0.842526661 B	-3.84	0.0001	0.21924929
	2	0.143848838 B	0.68	0.4959	0.21121025
	3	0.230431665 B	1.07	0.2830	0.21458397
	4	0.285471279 B	1.41	0.1601	0.20314284
	5	0.000000000 B	.	.	.
QUARTER	1	0.262142834 B	2.51	0.0120	0.10432631
	4	0.000000000 B	.	.	.

NOTE: The X'X matrix has been found to be singular and a generalized inverse was used to solve the normal equations. Estimates followed by the letter 'B' are biased, and are not unique estimators of the parameters.

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General Linear Models Procedure
Least Squares Means

YEAR	LOGTOTW LSMEAN	Std Err LSMEAN	Pr > |T| HO:LSMEAN=0
1982	4.43888869	0.13374963	0.0001
1983	5.04621712	0.11338168	0.0001
1984	4.53856940	0.12648521	0.0001
1985	4.16349168	0.12878526	0.0001
1986	3.91087861	0.15380593	0.0001
1987	3.36954428	0.13358377	0.0001
1988	3.76161114	0.11691760	0.0001
1989	3.18994436	0.11569491	0.0001
1990	3.34806853	0.11691211	0.0001
1991	2.78145332	0.10855523	0.0001
1992	1.71049257	0.14024297	0.0001
1993	2.09131473	0.13493519	0.0001
1994	3.04973237	0.13486003	0.0001

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General Linear Models Procedure
Class Level Information

Class	Levels	Values
YEAR	12	1982 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994
COUNTRY	6	DENMARK GDR GERMANY LATVIA POLAND SWEDEN
SUBDIV	3	25 26 28
DSTR	5	1 2 3 4 5
QUARTER	2	1 4

Number of observations in data set = 2181

NOTE: Due to missing values, only 2122 observations can be used in this analysis.

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General Linear Models Procedure

Dependent Variable: LOGTOTW

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	23	3135.98053088	136.34697960	61.53	0.0001
Error	2098	4648.78109513	2.21581558		
Corrected Total	2121	7784.76162601			

R-Square	C.V.	Root MSE	LOGTOTW Mean
0.402836	41.19096	1.48856158	3.61380607

Source	DF	Type I SS	Mean Square	F Value	Pr > F
YEAR	11	1096.37292993	99.67026636	44.98	0.0001
COUNTRY	5	1599.73241209	319.94648242	144.39	0.0001
SUBDIV	2	84.83732544	42.41866272	19.14	0.0001
DSTR	4	353.55506057	88.38876514	39.89	0.0001
QUARTER	1	1.48280285	1.48280285	0.67	0.4134

Cont'd....

Table 2.1.1.2 (Cont'd)

Source	DF	Type III SS	Mean Square	F Value	Pr > F
YEAR	11	1119.94995089	101.81363190	45.95	0.0001
COUNTRY	5	911.21433762	182.24286752	82.25	0.0001
SUBDIV	2	88.27108642	44.13554321	19.92	0.0001
DSTR	4	348.52924204	87.13231051	39.32	0.0001
QUARTER	1	1.48280285	1.48280285	0.67	0.4134

Parameter		Estimate	T for H0: Parameter=0	Pr > |T|	Std Error of Estimate
INTERCEPT		3.517953748 B	12.92	0.0001	0.27230999
YEAR	1982	1.336182210 B	7.62	0.0001	0.17527081
	1984	1.448318427 B	8.47	0.0001	0.17099523
	1985	1.063971125 B	6.14	0.0001	0.17321110
	1986	0.795086415 B	4.04	0.0001	0.19656490
	1987	0.278382358 B	1.64	0.1006	0.16948730
	1988	0.684971334 B	4.34	0.0001	0.15788434
	1989	0.089190248 B	0.56	0.5762	0.15953203
	1990	0.266781586 B	1.71	0.0869	0.15575203
	1991	-0.311725338 B	-2.05	0.0408	0.15231942
	1992	-1.337138710 B	-7.68	0.0001	0.17414644
	1993	-0.955715937 B	-5.56	0.0001	0.17177350
	1994	0.000000000 B	.	.	.
COUNTRY	DENMARK	-0.206808245 B	-1.67	0.0949	0.12377721
	GDR	-1.046753846 B	-5.11	0.0001	0.20500992
	GERMANY	-0.421354518 B	-3.25	0.0012	0.12980215
	LATVIA	0.021865477 B	0.16	0.8755	0.13952616
	POLAND	-2.153490283 B	-13.83	0.0001	0.15572734
	SWEDEN	0.000000000 B	.	.	.
SUBDIV	25	0.639514266 B	5.27	0.0001	0.12142670
	26	0.697400231 B	5.85	0.0001	0.11916241
	28	0.000000000 B	.	.	.
DSTR	1	-1.288862226 B	-5.59	0.0001	0.23067413
	2	-0.105975680 B	-0.49	0.6274	0.21828686
	3	0.005207979 B	0.02	0.9813	0.22157747
	4	0.124496142 B	0.60	0.5519	0.20921757
	5	0.000000000 B	.	.	.
QUARTER	1	0.093505167 B	0.82	0.4134	0.11430381
	4	0.000000000 B	.	.	.

NOTE: The X'X matrix has been found to be singular and a generalized inverse was used to solve the normal equations. Estimates followed by the letter 'B' are biased, and are not unique estimators of the parameters.

General Linear Models Procedure
Least Squares Means

YEAR	LOGTOTW LSMEAN	Std Err LSMEAN	Pr > |T| H0:LSMEAN=0
1982	4.45907638	0.13537267	0.0001
1984	4.57121260	0.12763790	0.0001
1985	4.18686530	0.12979686	0.0001
1986	3.91798059	0.15462977	0.0001
1987	3.40127653	0.13523731	0.0001
1988	3.80786550	0.11891095	0.0001
1989	3.21208442	0.11738489	0.0001
1990	3.38967576	0.11919128	0.0001
1991	2.81116883	0.11073547	0.0001
1992	1.78575546	0.14266954	0.0001
1993	2.16717823	0.13692239	0.0001
1994	3.12289417	0.13745227	0.0001

Table 2.1.1.3

```
cod 25-32, henrik s for sgarbf, VPA SSB and byfs SSB
1 11 2
1982 806      4.45
1983 783      -11
1984 758      4.57
1985 615      4.19
1986 451      3.92
1987 372      3.40
1988 354      3.81
1989 284      3.21
1990 217      3.39
1991 148      2.81
1992 77       1.79
GLMssb
```

Analysis by RCT3 ver3.1 of data from file :

yfsssb2.txt

cod 25-32, henrik s for sgarbf, VPA SSB and byfs SSB

Data for 1 surveys over 11 years : 1982 - 1992

Regression type = C
Tapered time weighting not applied
Survey weighting not applied
Final estimates not shrunk towards mean
Estimates with S.E.'S greater than that of mean included
Minimum S.E. for any survey taken as .00
Minimum of 3 points used for regression

Forecast/Hindcast variance correction used.

Yearclass = 1990

	I-----------Regression----------I					I-----------Prediction---------I			
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
GLMssb	.83	2.93	.14	.909	7	3.39	5.74	.191	1.000
					VPA Mean =		6.25	.409	.000

Yearclass = 1991

	I-----------Regression----------I					I-----------Prediction---------I			
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
GLMssb	.99	2.27	.20	.867	8	2.81	5.04	.302	1.000
					VPA Mean =		6.15	.478	.000

Cont'd.....

Table 2.1.1.3 (Cont'd)

Yearclass = 1992

Survey/ Series	I---Regression Slope	Inter- cept	Std Error	Rsquare	No. Pts---I	I---Prediction Index Value	Predicted Value	Std Error	WAP Weights---I
GLMssb	1.00	2.21	.19	.914	9	1.79	4.00	.333	1.000
						VPA Mean =	6.04	.579	.000

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
1990	309	5.74	.19	.00	.00	218	5.38
1991	155	5.04	.30	.00	.00	148	5.00
1992	54	4.00	.33	.00	.00	78	4.36

Table 3.1 Number of samples, fish measured, fish aged and number of fish aged per 1,000t landed from commercial landings Sub-area 22-32 in 1993.

Species: COD

Denmark					
Quarter	1	2	3	4	Total
Landings in tons ('000)	6.9	3.4	1.1	0.2	11.6
Number of samples	19	8	2	11	40
Number of fish measured	2,044	1,218	297	310	3,869
Number of fish aged	2,041	1,217	297	310	3,865
Aged per 1,000 t landings	296	358	270	1550	333

Estonia					
Quarter	1	2	3	4	Total
Landings in tons ('000)	Not available				0
Number of samples	Not available				0
Number of fish measured	Not available				0
Number of fish aged	Not available				0
Aged per 1,000 t landings					0

Finland					
Quarter	1	2	3	4	Total
Landings in tons ('000)	??	??	??	??	0.2
Number of samples	2	6	2	10	20
Number of fish measured	111	359	54	166	690
Number of fish aged	111	359	54	166	690
Aged per 1,000 t landings					3450

Germany					
Quarter	1	2	3	4	Total
Landings in tons ('000)	2.8	1.4	0.3	0.6	5
Number of samples	12	12	10	0	34
Number of fish measured	2209	5168	1909	0	9286
Number of fish aged	631	658	276	0	1565
Aged per 1,000 t landings	228	482	948	0	313

Latvia					
Quarter	1	2	3	4	Total
Landings in tons ('000)	0.5	0.1	0.3	0.5	1.4
Number of samples	6	0	20	15	41
Number of fish measured	3,293		2,840	3,178	9,311
Number of fish aged	200		335	340	875
Aged per 1,000 t landings	400	0	1,117	680	643

Poland					
Quarter	1	2	3	4	Total
Landings in tons ('000)	??	??	??	??	8.9
Number of samples	15	9	6	6	36
Number of fish measured	4,370	3,191	3,505	1,509	12,575
Number of fish aged	397	679	494	334	1,904
Aged per 1,000 t landings					214

Russia					
Quarter	1	2	3	4	Total
Landings in tons ('000)	Not available				0.9
Number of samples	Not available				0
Number of fish measured	Not available				0
Number of fish aged	Not available				0
Aged per 1,000 t landings					0

Sweden					
Quarter	1	2	3	4	Total
Landings in tons ('000)	3.8	1.1	5.4	1.6	11.9
Number of samples	92	32	82	0	206
Number of fish measured	7,650	3,333	7,188		18,171
Number of fish aged	789	426	545		1,760
Aged per 1,000 t landings	208	387	101	0	148

Cont'd....

Table 3.1 (Cont'd). Number of samples, fish measured, fish aged and number of fish aged per 1,000t landed from commercial landings Sub-area 22-32 in 1993.

Species: HERRING

Denmark					
Quarter	1	2	3	4	Total
Landings in tons ('000)	21.5	11.6	8.5	8.8	50.4
Number of samples	30	12	2	1	45
Number of fish measured	1,281	6,043	1,529	129	8,982
Number of fish aged	651	1,102	200	126	2,079
Aged per 1,000 t landings	30	95	24	14	41

Estonia					
Quarter	1	2	3	4	Total
Landings in tons ('000)	6.5	15.4	1.9	8.8	32.6
Number of samples	41	66	16	45	168
Number of fish measured	4,144	6,732	1,632	4,590	17,098
Number of fish aged	4,044	6,600	1,602	4,500	16,746
Aged per 1,000 t landings	622	429	843	511	514

Finland					
Quarter	1	2	3	4	Total
Landings in tons ('000)	13.7	38.6	12.7	9.7	74.7
Number of samples	52	165	49	41	307
Number of fish measured	2,597	8,279	4,013	2,048	16,937
Number of fish aged	2,597	8,279	4,013	2,048	16,937
Aged per 1,000 t landings	190	214	316	211	227

Germany					
Quarter	1	2	3	4	Total
Landings in tons ('000)	4.2	5.8	+	+	10
Number of samples	11	28	0	3	42
Number of fish measured	3,336	8,567		??	11,903
Number of fish aged	1,290	1,934		??	3,224
Aged per 1,000 t landings	307	333	0	0	641

Latvia					
Quarter	1	2	3	4	Total
Landings in tons ('000)	5.2	5.3	1.3	9.4	21.2
Number of samples	21	44	15	48	128
Number of fish measured	2,100	4,400	1,500	4,800	12,800
Number of fish aged	1,800	2,900	1,000	3,100	8,800
Aged per 1,000 t landings	346	547	769	330	415

Poland					
Quarter	1	2	3	4	Total
Landings in tons ('000)	6.0	20.2	14.2	12.6	53.0
Number of samples	6	32	13	11	62
Number of fish measured	1,200	12,420	6,619	3,744	23,983
Number of fish aged	90	2,295	1,104	864	4,353
Aged per 1,000 t landings	15	114	78	69	82

Russia					
Quarter	1	2	3	4	Total
Landings in tons ('000)	3.4	9.3	0.9	4.5	18.1
Number of samples	27	36	5	38	106
Number of fish measured	8,210	10,800	1,550	11,230	31,790
Number of fish aged	686	2,906	395	2,667	6,654
Aged per 1,000 t landings	202	312	439	593	368

Sweden					
Quarter	1	2	3	4	Total
Landings in tons ('000)	31.6	26.6	6.9	21.8	86.9
Number of samples	22	19	19	31	91
Number of fish measured	4,308	3,855	4,068	4,287	16,518
Number of fish aged	1,280	1,143	1,055	1,266	4,744
Aged per 1,000 t landings	41	43	153	58	55

Cont'd....

Table 3.1(Cont'd). Number of samples, fish measured, fish aged and number of fish aged per 1,000t landed from commercial landings Sub-area 22-32 in 1993.

Species: SPRAT

Denmark					
Quarter	1	2	3	4	Total
Landings in tons ('000)	14.0	1.3	0.2	2.8	18.3
Number of samples	15	1	0	2	18
Number of fish measured	1,529	97		168	1,794
Number of fish aged	340	94		168	602
Aged per 1,000 t landings	24	72	0	60	33

Estonia					
Quarter	1	2	3	4	Total
Landings in tons ('000)	2.4	0.4	0.6	2.5	5.9
Number of samples	14	10	6	18	48
Number of fish measured	1,400	1,000	602	1,780	4,782
Number of fish aged	1,400	1,000	602	1,780	4,782
Aged per 1,000 t landings	583	2,500	1,003	712	811

Finland					
Quarter	1	2	3	4	Total
Landings in tons ('000)	0	0	1	1	2
Number of samples	11	6	7	8	32
Number of fish measured	442	242	811	331	1,826
Number of fish aged	442	242	811	331	1,826
Aged per 1,000 t landings	1,473	605	1,622	662	1,074

Germany					
Quarter	1	2	3	4	Total
Landings in tons ('000)	0	0	+	0	1
Number of samples	1	4	0	1	6
Number of fish measured	??	3,448		??	3,448
Number of fish aged	??	302		??	302
Aged per 1,000 t landings	??	3,020		??	431

Latvia					
Quarter	1	2	3	4	Total
Landings in tons ('000)	4.1	4.0	1.2	3.3	12.6
Number of samples	10	8	0	19	37
Number of fish measured	900	800		1,900	3,600
Number of fish aged	500	400		1,900	2,800
Aged per 1,000 t landings	122	100	0	576	222

Poland					
Quarter	1	2	3	4	Total
Landings in tons ('000)	8.8	13.4	2.7	6.3	31.2
Number of samples	3	12	4	7	26
Number of fish measured	450	4,143	352	1,388	6,333
Number of fish aged	150	901	66	209	1,326
Aged per 1,000 t landings	17	67	24	33	43

Russia					
Quarter	1	2	3	4	Total
Landings in tons ('000)	4.2	4.4	0.8	1.8	11.2
Number of samples	3	9	0	6	18
Number of fish measured	600	1,800		1,200	3,600
Number of fish aged	150	400		600	1,150
Aged per 1,000 t landings	36	91	0	333	103

Sweden					
Quarter	1	2	3	4	Total
Landings in tons ('000)	39.8	10.4	0.2	42.1	92.5
Number of samples	0	0	0	0	0
Number of fish measured					0
Number of fish aged					0
Aged per 1,000 t landings	0	0	0	0	0

Table 3.2 Compilation of national surveys for stock assesments in the Baltic

COUNTRY	ICES SD	SAMPLE DESIGN	TIME: INVESTIGATION	TIME: RANGE	GEAR	NUMBER OF HAULS	INVESTIGATED SPECIES	DATA: TYPE	DATA: BASE(available)
DANMARK	24,25, 26,28	Bottom trawl (fixed station)	February/March	since 1982	Granton (bobbins)	40-50	Cod all species	catch by species biological data recruitment indices hydrological data	DIFMAR -"- -"-/ICES -"-
ESTONIA	29	Pelagic fish survey	April	1980-1988	pelagic trawl	10	Herring Spratt	catch by species biological data recruitment indices	Estonian Marine Institut
	32	Pelagic fish survey	September Nov./December	since 1988	pelagic trawl	12	Herring, Spratt Smelt	catch by species biological data recruitment indices	-"- -"- -"-
GERMANY	22	Groundfish survey	March November	since 1982 since 1993	Sonderborger Trawl	12 7	Cod, Flatfishes	catch by species biological data recruitment indices	Institut Rostock -"- -"-/ICES
	22,24	Stratified groundfish survey (fixed station)	Jan./February Nov./December	1978-1990 (since1992 only Nov./Dec.)	HG 20/25	43	Cod, Flatfishes, Clupeidae other fishes	catch by species biological data recruitment indices hydrological data	Institut Rostock -"- -"-/ICES -"-
	24,25	Stratified groundfish survey (fixed station)	Feb./March	SD 24 since 1978 SD 25 1978-1989 since 1993 new design		63	Cod, Flatfishes, Clupeidae other fishes	catch by species biological data recruitment indices hydrological data	Institut Rostock -"- -"-/ICES -"-
	22	Joint Danish-German Hydroacoustic survey	October	since 1989	Blacksprutte	variable identification of echotraces	Herring,Spratt	catch by species biological data hydroacoustic data	Institut Rostock -"- -"-
	21,23, 24	-"-	-"-	since 1987	-"-	-"-	-"-	-"-	-"-
LATVIA	26,28	Young fish survey	Dec./January March/April	1967-1991 1992-1994	bottom trawl	20	Cod, Flatfishes, Clupeidae	recruitment indices catch by species hydrological data biological data	LATFRI/ICES LATFRI LATFRI LATFRI
		Ground fish survey	Sep, November (sporadicaly)	1960-1992	bottom trawl	20	Cod, Flatfishes	catch by species biological data hydrological data	LATFRI LATFRI LATFRI
		Hydroacoustic survey	Sept./Oct. May	1983-1991, 1993 1978-1986	pelagic trawl "	30 30	Herring , Sprat Sprat	catch by species and biological data	

Cont'd.....

Table 3.2 (Cont'd)

	ICES	TIME				NUMBER	INVESTIGATED	DATA	
COUNTRY	SD	SAMPLE DESIGN		RANGE	GEAR	OF HAULS	SPECIES	TYPE	BASE(available)
POLAND	25,26	Young fish survey	Jan.,March,Dec.	1962-1983	Sonderborg	up to 120	Cod, Flatfishes	catch by species	MIR Gdynia
								biological data	-''-
								recruitment indices	-''-
	25,26	Ground fish survey	Jan.,March,Dec.	since 1978	HG 20/25	up to 150	Cod, Flatfishes,	catch by species	-''-
							Clupeidae,	biological data	-''-
							other species	hydrografical data	-''-
								recruitment indices	-''- /ICES
	25,26	Hydroacustic survey	May, October	since 1982	pelagic	up to 40	Herring,Spratt	hydroacoustic data	-''-
		(stratified ICES			trawl		Cod	total catch	-''-
		rectangles)						catch by species	-''-
								biological data	-''-
RUSSIA	26,28	Stratified ground fish	March, April	since 1992	28/37 bottom	56	Cod, Flatfishes	catch by species	AtlantNIRO
		survey			trawl		Clupeidae	biological data	AtlantNIRO
								recruitment indices	AtlantNIRO/ICES
								hydrolog.data T,O,S	AtlantNIRO/ICES
		Acoustic survey	October	since 1992	RT/TM 33C	35-60	Spratt,Herring	stocks biomass	AtlantNIRO/ICES
		(regular transect			pelagic trawl			stocks at age numbers	
		design)	May	since 1993	-''-		Spratt	stocks biomass	AtlantNIRO/ICES
								stocks at age numbers	
								hydrolog.data T,O,S	AtlantNIRO
SWEDEN	23-28	Fixed Station	March	since 1986	GOV	43	Cod=Target	catch by species	IMR
			August	since 1988	codtrawl("Foto")		Flounder=	recruitment indices	-''-/ICES
			November	since 1988	-''-		Distrib.	hydrolog.data T,O	-''-
								(selected stations)	
								ichthyoparas.data	-''-

3.2.2.1 Acoustic surveys
(present situation)

	Germany/Denmark	Latvia	Poland	Russia	Sweden
1.List of surveys	R/V Solea, Oct.,1987,1989-1994	R/V Zwiezda Baltiki, may 1978-86 R/V Issled.Baltiki, oct.,1983-91,93 R/V Monokristall, oct.,1994	R/V Prof.Siedlecki, Oct.,May, 1982-1990 R/V Baltica, Oct-1994 biomas est., acc. to ICES	R/V Monokristall, may,oct,1992-1994	R/V Argos, since 1979
2.Acoustical equipment	EK500, BI500	echosounder SARGAN , 19.7 kHz integrator SIORS amplifier to interface data sistem with sonar signals USOD	echosonder EK400, 38 kHz integrator QD with preproc.QX computer PC (HP)	echosounder FQ-70 Furuno, 50 kHz, 200 kHz integrator FQ-70 Furuno PC building in to FQ-70, type PC9801 RX,NEC	EK400 and Nord computer EK500 since 1994
3.Unit of acoustical samples	SA (m^2/nm^2)	deflection(mm), thickness(m)	Sv (dB), deflection(mm) , thickness (m)	SS (dB/m^2), TS in-situ (dB)	SA (m^2/nm^2)
4.Method of transects and intertransects planning	irregular	parallel W-E, and perpend. at ends 1/4 grad. latitude	paraller N-S, and perpend. at ends 1/2 grad. longitude	regular transect design	inregulars
5.Transect form	60 nm per ICES rectangle	regular since 1978	regular, aproxim. constant since 1982	rectangle regular grid of parallel tran-sects intertransects segment 15 nm	60 nm / ICES rect.
6.Equipment of calibration	cupper sphere , 38 kHz	sphere, Hoegoen Sweden	cupper sphere, Hoegoen Sweden	on base standard cupper sphere for 50 kHz	standard copper sphere
7.Method of post-survey stratification	ICES rectangles SD 22, 4 geografical units	rectangles of ICES	rectangles of ICES	startification in rectangles with dimen-sions are defined by ICES as enume-rated strata 30 min. in latitude and 1 grad in longitude	ICES rectangles

Continued

Table 3.2.2.1 (Cont'd)

	Germany/Denmark	Latvia	Poland	Russia	Sweden
8.Survey manual			Orlowski A.,1992. Acoustic survey of fish stock abundance in Polish fisheries zone- October 1990.ICES C.M.1992/J:19 ICES recommendation	Johannesson K.A. and Mitson R.B, 1983 "A practical manual...", FAO (240),Rome Simmonds E.J., at all.,1991, "Review of good practice", ICES, C.M.1991/B:54	
9.Determination of target strenghts	clupeids: TS=20 LOG L - 70.8 gadoids: TS=20LOG L - 67.5	by calulation	acc. to ICES formule	by mesurememt in-situ by calculation	gadoids: TS=21.8 LOG L - 72.7 clupeids: TS= 20 LOG L - 71.2 fish without swimbl.: TS= 20 LOG L - 76.7
10.Layers and integration step	BI 500, 1 nm	integration step - 1000 pings 10-20,20-40,40-60,60-80,80-bottom	1 nm as ESDU 10-20,20-30,30-40,40-50,50-60,60-70,70-80,80-110,and from bottom 0.1-1,1-4	integration of all layer within echo-recording integration step 4 nm	1 nm,
11.Characteristic of precision and accuracy of density				standart error, variance, variation s coefficient (c.v.) confidence interval (c.i.)	
12.Time of acoustic sampling	only night surveys	day time	day and night, 24h	light day survey	day and night
13.Number of hauls per unit of area	2 hauls per ICES rectangle	1994 , 2.5 hauls per rectangle	in 1994, 1.8 hauls per rectang.	2 hauls per 1 ICES rectangle	2 hauls / ICES rectan.
14.Hauls duration, speed or distance	30 minutes, 4 kn	about 30 min., 3.5-4 kn	about 30 min., hauls in day time full recording results of haul in sense table 5.7 WGfPHS	30 minut, 3.5 kn	duration 30 min., speed 4 kn
15.Criteria of chosing the place, depths and time of hauls	aimed fishing on characteristic echo traces	due to fish recording	1)acc. to plane 2) acc. to present type and depths of echotraces	fish record	aimed fishing an specific echo traces

Cont'd....

Table 3.2.2.1 (Cont'd)

16.Type, size and vertical openning of trawl	Blacksprutte, pel. trawl 664 meshes 100 mm, 11 m vertical	pelagic trawl, vertical openning 15-20 m	pelagic trawl, type /64 net openning 25-30 m speed 3.5 kn	RT/TM 33C pelagic trawl, 33 m, vertical openning 18-20 m	Foto trawl, 62 # of 1600 mm
	Germany/Denmark	Latvia	Poland	Russia	Sweden
17.Method of averaging biological sampling	unweighted mean of TS form all hauls in the stratum	averaging of density by rectangle	for each rectangle cummulative species composition, lenght dis-tributions and ALK with equal weighting factor	weighted by number of species in the catch and averaging of density by rectangle	

Table 3.2.2.2. HERRING in Sub-divisions 25-29. Z estimated from acoustic data.									
Acoustic Survey Estimates (in numbers at age)									
AGE	**1982**	**1983**	**1984**	**1985**	**1986**	**1987**	**1988**	**1989**	**1990**
0	758	860	1110	540.1	4803.3	381.5	1573.2	4538.7	4273.4
1	4593.7	3022.7	5341	2896.8	3304.9	5286.6	1172.5	4785.9	9043.5
2	6382.9	4861.5	4932.3	6526.4	7493.2	2099.3	3752.8	2256.2	7628.1
3	2315.5	4986.4	5042.4	3542.4	8223.4	4412.2	1875.4	6270.4	4548.3
4	1334.5	2175.4	4024.4	2986.9	3737	4554.7	4168.5	2536.5	4108
5	1300.4	1392	1364.7	1021.4	2611.3	1735.9	3506.5	3795.2	2408.9
6	994.3	1210.8	844.1	469.8	830.2	1012.8	1434.8	2208.9	1983.6
7	580.3	1062.7	575.8	359.6	341.5	320.8	719.5	896.6	1018.9
8	378.6	669.6	375.5	201.8	204.9	100.6	210.1	311.4	468.4
9	251.2	411.2	189.3	128.8	101.8	32.1	83.7	69	194.7
10+	299	650.1	305.6	147.3	170.9	35.6	75.2	43.5	200.9

Estimates of Z										
AGE	**1982**	**1983**	**1984**	**1985**	**1986**	**1987**	**1988**	**1989**	**1990**	Mean
0										
1		**-1.38**	**-1.83**	**-0.96**	**-1.81**	**-0.10**	**-1.12**	**-1.11**	**-0.69**	**-1.13**
2		**-0.06**	**-0.49**	**-0.20**	**-0.95**	0.45	0.34	**-0.65**	**-0.47**	**-0.25**
3		0.25	**-0.04**	0.33	**-0.23**	0.53	0.11	**-0.51**	**-0.70**	**-0.03**
4		0.06	0.21	0.52	**-0.05**	0.59	0.06	**-0.30**	0.42	0.19
5		**-0.04**	0.47	1.37	0.13	0.77	0.26	0.09	0.05	0.39
6		0.07	0.50	1.07	0.21	0.95	0.19	0.46	0.65	0.51
7		**-0.07**	0.74	0.85	0.32	0.95	0.34	0.47	0.77	0.55
8		**-0.14**	1.04	1.05	0.56	1.22	0.42	0.84	0.65	0.71
9		**-0.08**	1.26	1.07	0.68	1.85	0.18	1.11	0.47	0.82
10+										
Mean		**-0.15**	0.21	0.57	**-0.13**	0.80	0.09	0.04	0.13	0.19

Table 3.2.2.3 Sprat. Z estimated from acoustic data.

SPRAT										Issledovatel Baltiki			
											Monocrystal(Argos		
26+28	SD 24-29S Issledovatel Baltiki											Baltijas Petnieks	
AGE	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	
0	0									31190		1488	
1	0	21087	16531	9752	5604	23035	741	22461	22837	30060	23758	11620	
2	0	2066	12765	7748	5351	2246	14404	433	16790	15080	16947	11673	
3	0	1938	981	7174	5283	2992	1251	8394	170	12210	13439	5984	
4	0	501	441	663	4693	2489	1667	681	3885	311	5223	4608	
5	0	166	61	357	107	2341	1451	875	380	2486	1008	1789	
6	0	20		37	175	110	1301	934	485	284	1757	342.7	
7	0	69		58	19	81	59	825	491	218	155	559.8	
8	0	231	38	150	24	41	60	142	609	592	73	441	
9	0												
10+	0												
Sum	0	26078	30817	25939	21256	33335	20934	34745	45647	61241	62360	37017	
KTon >0		238	309	325	259	351	304	499	573	763	780	421	
Internat Survey: [Argos, Eisbär, Hel 100]													
	SD 24-29S									Issledovatel Baltiki			
AGE	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991			
0	0		745.2	146.8	3520	33.3	7426	12233	5220	39296			
1	0	34442	12411	3718	1234	11203	643.5	29866	9763	35131			
2	0	8912	19142	10968	6256	2899	5131	2093	21665	27411			
3	0	7997	4827	8455	8530	6307	3194	18258	4690	30336			
4	0	1989	1673	1920	2496	2675	3580	3323	3768	1482			
5	0	310	188.6	269.1	359.3	961.6	1569	2129	1457	6261			
6	0	192	44.8	74.7	25.5	184.8	195.3	1641	728.4	1258			
7	0	111	66.6	56.3	20	19.3	29.9	1591	174.9	1350			
8	0	7	55.3	44.4	33.9	13.9	7.8	249.9	43.4	2273			
9	0		0	23.1	13.5	66	1.1	0	14.1	0			
10+	0		5.5	11.8	3.1	5.5	0	0	9.4	0			
	0	53960	39160	25687	22491	24368	21777	71384	47532	1E+05			
KTon >0		665	497	364	309	310	269	886	631	1420			

Cont'd....

Table 3.2.2.3 (cont'd)

SPRAT Z-values													
26+28													
AGE	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	Mean(84-93)
0													
1													
2			0.74	0.58	0.38	0.58	0.59	0.54	0.93	0.32	0.12	1.04	0.58
3			1.48	0.39	0.42	0.75	0.58	0.61	0.77	-0.60	0.85	1.07	0.63
4			2.11	0.21	1.82	0.70	0.54	0.64	0.58	0.45	-1.18	1.07	0.69
5				0.50	0.71	-0.03	0.59	0.44	0.59	0.29	0.35	1.08	0.50
6					0.67	0.77	0.62	0.46	0.64	0.80	0.61	1.14	0.71
7			0.60		0.88	-0.77	0.30	-0.88	0.30	-0.19	1.09	-1.05	0.03
mean (3-6)			1.79	0.37	0.91	0.55	0.58	0.54	0.65	0.23	0.16	1.09	0.69
XSA 94:													
M(1-7)+ F(3-5)			0.81	0.77	0.71	0.69	0.69	0.62	0.45	0.45	0.44	0.38	0.60
Internat Survey: [Argos, Eisbär, Hel 100]													
AGE	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991			Mean
0													
1													
2			0.61	0.82	0.25	-0.01	-0.10	-1.27	-0.81	-0.34			-0.10
3			1.56	0.92	1.22	1.16	0.57	-0.04	1.58	1.15			1.02
4			2.36	1.83	1.68	0.95	0.53	0.52	0.82	-0.51			1.02
5			1.93	0.93	2.36	0.66	1.59	-0.05	1.07	0.15			1.08
6			1.06	-0.23	1.32	0.28	1.82	-2.10	2.24	-0.62			0.47
7			0.70	0.41	0.51	0.36	0.91	-2.12	3.60	-2.56			0.22
8				0.87	1.19	-0.67	2.54		2.87				1.36
9					2.01	0.90							
Mean (3-6)			1.73	0.86	1.64	0.76	1.13	-0.42	1.43	0.04			0.90

Table 4.1.1 Record specification for an international data base on commercial catch data

Record type 1

Specifications for total catch in weight

Position name	Name	Type	M/O	Range	Comments
1-3	Record type	3A	M		Fixed value to TON
4-6	Country	3A	M	See footnote 1	ISO code for countries
7-16	Species	10N	M	See Anon. 1992/H.3	NODC codes
17-20	Year	4N	M	1950-2100	
21	Quarter	1N	M	1 to 4	
22-24	Sub-division	3AN	M	22 to 32	28R is Gulf of Riga
25-30	Fleet type	6A	O	See footnote 2	Gillnets, botm. and pel. trawl
31-36	Catch in tons	6N	M	1 to 999999	No reporting of catches less than 1 t

Record type 2

Specifications for total catch in length at age.

Position name	Name	Type	M/O	Range	Comments
1-3	Record type	3A	M		Fixed value to LEN
4-6	Country	3A	M	See footnote 1	ISO code for countries
7-16	Species	10N	M	See Anon. 1992/H:3	NODC codes
17-20	Year	4N	M	1950-2100	
21	Quarter	1N	M	1 to 4	
22-24	Sub-division	3AN	M	22 to 32	28R is Gulf of Riga
25-30	Fleet type	6A	O	See footnote 2	
31-36	Catch in tons	6N	M	1 to 999999	In tonnes
37-41	Number measured	5N	O	1 to 99999	In all relevant samples
42-46	Weight of samples	5N	O	1 to 99999	In kg of sum of samples
47	Length code	1AN	M	., 0, 1, 5, 9	1mm=. scm=0 cm=1 5cm=5 plus length group =9
48-50	Length class	3N	M	1 to 999	Identifier:lower bound of size class, eg. 65-70cm =65
51-60	No at length	10N	M	1 to 9999999999	Length classes with zero catch excluded
61	Sex	1A	O	M, F, I	M=male, F=female, I=indetermined

Record type 3

Specifications for age-length keys.

Position name	Name	Type	M/O	Range	Comments
1-3	Record type	3A	M		Fixed value to ALK
4-6	Country	3A	M	See footnote 1	ISO code for countries
7-16	Species	10N	M	See Anon. 1992/H:3	NODC codes
17-20	Year	4N	M	1950-2100	
21	Quarter	1N	M	1 to 4	
22-24	Sub-division	3AN	M	22 to 32	28R is Gulf of Riga
25	Length code	1AN	M	., 0, 1, 5, 9	1mm=. scm=0 cm=1 5cm=5 plus group =9
26-28	Length class	3N	M	1 to 999	Identifier:lower bound of size class, eg. 65-70cm =65
29	Sex	1A	M	M, F, I	
30	Maturity	1AM	O	1 to 4	See Anon. 1992/H.3
31-35	Mean weight	5N	O	1 to 99999	See footnote 3.
36	Ident. +gr	1A	M	space or +	Plus group=+ else space
37-38	Age/Rings	2N	M	0 to 99	For herring use rings
39-43	Number	5N	O	1 to 9999	
44-46	Age reader	3A	O		Initials of responsible age reader

The country codes are according to ISO 3166

1) DNK, EST, FIN, GDR (GERMAN DEMOCRATIC REP.), DEU (GERMANY, FEDERAL REP.), LVA, LTU, POL, RUS, SWE, USS (the former Soviet Union).

2) Gillnetters: GILNET; Bottom trawlers: BTRAWL; Pelagic trawlers: PTRAWL.

3) The mean weight should be by the sex, maturity and age, ie mean weight of the number of fish given in position 39-43.

Table 4.2.1.1 SSB values, cod.

General Linear Models Procedure
Class Level Information

Class	Levels	Values
YEAR	12	1982 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994
COUNTRY	6	DENMARK GDR GERMANY LATVIA POLAND SWEDEN
SUBDIV	3	25 26 28
DSTR	5	1 2 3 4 5
QUARTER	2	1 4

Number of observations in data set = 2181

NOTE: Due to missing values, only 2122 observations can be used in this analysis.

General Linear Models Procedure

Dependent Variable: LOGTOTW

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	23	3135.98053088	136.34697960	61.53	0.0001
Error	2098	4648.78109513	2.21581558		
Corrected Total	2121	7784.76162601			

R-Square	C.V.	Root MSE	LOGTOTW Mean
0.402836	41.19096	1.48856158	3.61380607

Source	DF	Type I SS	Mean Square	F Value	Pr > F
YEAR	11	1096.37292993	99.67026636	44.98	0.0001
COUNTRY	5	1599.73241209	319.94648242	144.39	0.0001
SUBDIV	2	84.83732544	42.41866272	19.14	0.0001
DSTR	4	353.55506057	88.38876514	39.89	0.0001
QUARTER	1	1.48280285	1.48280285	0.67	0.4134

Source	DF	Type III SS	Mean Square	F Value	Pr > F
YEAR	11	1119.94995089	101.81363190	45.95	0.0001
COUNTRY	5	911.21433762	182.24286752	82.25	0.0001
SUBDIV	2	88.27108642	44.13554321	19.92	0.0001
DSTR	4	348.52924204	87.13231051	39.32	0.0001
QUARTER	1	1.48280285	1.48280285	0.67	0.4134

Parameter		Estimate	T for H0: Parameter=0	Pr > |T|	Std Error of Estimate
INTERCEPT		3.517953748 B	12.92	0.0001	0.27230999
YEAR	1982	1.336182210 B	7.62	0.0001	0.17527081
	1984	1.448318427 B	8.47	0.0001	0.17099523
	1985	1.063971125 B	6.14	0.0001	0.17321110
	1986	0.795086415 B	4.04	0.0001	0.19656490
	1987	0.278382358 B	1.64	0.1006	0.16948730
	1988	0.684971334 B	4.34	0.0001	0.15788434
	1989	0.089190248 B	0.56	0.5762	0.15953203
	1990	0.266781586 B	1.71	0.0869	0.15575203
	1991	-0.311725338 B	-2.05	0.0408	0.15231942
	1992	-1.337138710 B	-7.68	0.0001	0.17414644
	1993	-0.955715937 B	-5.56	0.0001	0.17177350
	1994	0.000000000 B	.	.	.
COUNTRY	DENMARK	-0.206808245 B	-1.67	0.0949	0.12377721
	GDR	-1.046753846 B	-5.11	0.0001	0.20500992
	GERMANY	-0.421354518 B	-3.25	0.0012	0.12980215
	LATVIA	0.021865477 B	0.16	0.8755	0.13952616
	POLAND	-2.153490283 B	-13.83	0.0001	0.15572734
	SWEDEN	0.000000000 B	.	.	.
SUBDIV	25	0.639514266 B	5.27	0.0001	0.12142670
	26	0.697400231 B	5.85	0.0001	0.11916241
	28	0.000000000 B	.	.	.
DSTR	1	-1.288862226 B	-5.59	0.0001	0.23067413

Cont'd.....

Table 4.2.1.1 (Cont'd)

	2	-0.105975680 B	-0.49	0.6274	0.21828686
	3	0.005207979 B	0.02	0.9813	0.22157747
	4	0.124496142 B	0.60	0.5519	0.20921757
	5	0.000000000 B	.	.	.
QUARTER	1	0.093505167 B	0.82	0.4134	0.11430381
	4	0.000000000 B	.	.	.

NOTE: The X'X matrix has been found to be singular and a generalized inverse was used to solve the normal equations. Estimates followed by the letter 'B' are biased, and are not unique estimators of the parameters.

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General Linear Models Procedure
Least Squares Means

YEAR	LOGTOTW LSMEAN	Std Err LSMEAN	Pr > |T| H0:LSMEAN=0
1982	4.45907638	0.13537267	0.0001
1984	4.57121260	0.12763790	0.0001
1985	4.18686530	0.12979686	0.0001
1986	3.91798059	0.15462977	0.0001
1987	3.40127653	0.13523731	0.0001
1988	3.80786550	0.11891095	0.0001
1989	3.21208442	0.11738489	0.0001
1990	3.38967576	0.11919128	0.0001
1991	2.81116883	0.11073547	0.0001
1992	1.78575546	0.14266954	0.0001
1993	2.16717823	0.13692239	0.0001
1994	3.12289417	0.13745227	0.0001

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Analysis Variable : RES

Residuals by country: 1986 - 1994

COUNTRY=DENMARK

N	Mean	Std Dev	Minimum	Maximum
395	-0.0475523	1.2560997	-4.1449711	5.2002805

COUNTRY=GDR

N	Mean	Std Dev	Minimum	Maximum
45	-0.0066862	1.3876680	-3.6248316	2.6730920

COUNTRY=GERMANY

N	Mean	Std Dev	Minimum	Maximum
295	0.1479841	1.6254676	-4.9140436	2.8406726

COUNTRY=LATVIA

N	Mean	Std Dev	Minimum	Maximum
254	-0.0822379	1.3993706	-3.7941303	3.1933962

COUNTRY=POLAND

N	Mean	Std Dev	Minimum	Maximum
401	-0.0091841	1.4709719	-3.4275117	3.9991584

COUNTRY=SWEDEN

N	Mean	Std Dev	Minimum	Maximum
255	4.48443E-14	1.6133628	-4.9450134	4.4561671

Table 4.2.1.2 Cod 2-groups

General Linear Models Procedure
Class Level Information

Class	Levels	Values
YEAR	13	1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994
COUNTRY	5	DENMARK GERMANY LATVIA POLAND SWEDEN
SUBDIV	3	25 26 28
DSTR	5	1 2 3 4 5
QUARTER	2	1 4

Number of observations in data set = 2244

NOTE: Due to missing values, only 2221 observations can be used in this analysis.

General Linear Models Procedure

Dependent Variable: LOGAGE2

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	23	2909.99248232	126.52141227	38.92	0.0001
Error	2197	7142.92492572	3.25121754		
Corrected Total	2220	10052.91740804			

R-Square	C.V.	Root MSE	LOGAGE2 Mean
0.289467	66.27587	1.80311329	2.72061790

Source	DF	Type I SS	Mean Square	F Value	Pr > F
YEAR	12	1444.00349599	120.33362467	37.01	0.0001
COUNTRY	4	973.91538352	243.47884588	74.89	0.0001
SUBDIV	2	27.14915898	13.57457949	4.18	0.0155
DSTR	4	444.38447278	111.09611820	34.17	0.0001
QUARTER	1	20.53997105	20.53997105	6.32	0.0120

Source	DF	Type III SS	Mean Square	F Value	Pr > F
YEAR	12	1303.61613728	108.63467811	33.41	0.0001
COUNTRY	4	472.96603856	118.24150964	36.37	0.0001
SUBDIV	2	0.56386597	0.28193298	0.09	0.9169
DSTR	4	423.89185014	105.97296254	32.59	0.0001
QUARTER	1	20.53997105	20.53997105	6.32	0.0120

Parameter		Estimate	T for H0: Parameter=0	Pr > |T|	Std Error of Estimate
INTERCEPT		2.552010650 B	9.69	0.0001	0.26334858
YEAR	1982	1.780198695 B	8.94	0.0001	0.19918027
	1983	1.017058432 B	5.05	0.0001	0.20151670
	1984	0.541613617 B	2.56	0.0107	0.21195196
	1985	0.546731009 B	2.56	0.0107	0.21391248
	1986	0.171822785 B	0.70	0.4862	0.24672845
	1987	0.538685613 B	2.62	0.0089	0.20580285
	1988	0.802766335 B	4.15	0.0001	0.19346535
	1989	-0.506455837 B	-2.61	0.0091	0.19410591
	1990	-0.206181428 B	-1.10	0.2733	0.18814906
	1991	-1.163878569 B	-6.27	0.0001	0.18576654
	1992	-0.256852441 B	-0.87	0.3851	0.29566578
	1993	0.671595279 B	3.50	0.0005	0.19169602
	1994	0.000000000 B	.	.	.
COUNTRY	DENMARK	-0.311610699 B	-2.05	0.0407	0.15214390
	GERMANY	-0.885503801 B	-5.50	0.0001	0.16087898
	LATVIA	-0.178464834 B	-1.04	0.2965	0.17089266
	POLAND	-1.527239876 B	-8.37	0.0001	0.18245675
	SWEDEN	0.000000000 B	.	.	.
SUBDIV	25	0.058914718 B	0.40	0.6863	0.14586620
	26	0.021420699 B	0.16	0.8757	0.13695324
	28	0.000000000 B	.	.	.
DSTR	1	-0.026530964 B	-0.15	0.8776	0.17230822

Cont'd....

Table 4.2.1.2 (Cont'd)

2	1.216188362 B	7.86	0.0001	0.15481250
3	1.092904145 B	6.67	0.0001	0.16392051

General Linear Models Procedure

Dependent Variable: LOGAGE2

Parameter		Estimate	T for H0: Parameter=0	Pr > |T|	Std Error of Estimate
DSTR	4	0.830972212 B	5.64	0.0001	0.14735992
	5	0.000000000 B	.	.	.
QUARTER	1	-0.327012830 B	-2.51	0.0120	0.13010317
	4	0.000000000 B	.	.	.

NOTE: The X'X matrix has been found to be singular and a generalized inverse was used to solve the normal equations. Estima followed by the letter 'B' are biased, and are not unique estimators of the parameters.

General Linear Models Procedure
Least Squares Means

YEAR	LOGAGE2 LSMEAN	Std Err LSMEAN	Pr > |T| H0:LSMEAN=0
1982	4.23762431	0.13826690	0.0001
1983	3.47448405	0.13801918	0.0001
1984	2.99903923	0.16332844	0.0001
1985	3.00415662	0.16454226	0.0001
1986	2.62924840	0.20111773	0.0001
1987	2.99611123	0.15553962	0.0001
1988	3.26019195	0.14153097	0.0001
1989	1.95096978	0.13549637	0.0001
1990	2.25124419	0.13595988	0.0001
1991	1.29354705	0.12878138	0.0001
1992	2.20057317	0.26860792	0.0001
1993	3.12902090	0.13922760	0.0001
1994	2.45742562	0.15945905	0.0001

Analysis Variable : RES

Residuals by country:

COUNTRY=DENMARK

N	Mean	Std Dev	Minimum	Maximum
551	1.193641E-15	1.5689470	-4.7741604	5.0491037

COUNTRY=GERMANY

N	Mean	Std Dev	Minimum	Maximum
441	-5.17399E-15	1.7353536	-4.2870929	5.1983912

COUNTRY=LATVIA

N	Mean	Std Dev	Minimum	Maximum
443	-2.66153E-15	1.7532782	-6.0595452	4.3817943

COUNTRY=POLAND

N	Mean	Std Dev	Minimum	Maximum
551	-1.54134E-14	1.6938066	-4.5573865	5.5887397

COUNTRY=SWEDEN

N	Mean	Std Dev	Minimum	Maximum
235	2.31138E-13	1.8376018	-4.3894868	3.8787542

4.2.2. Coordination of acoustic surveys

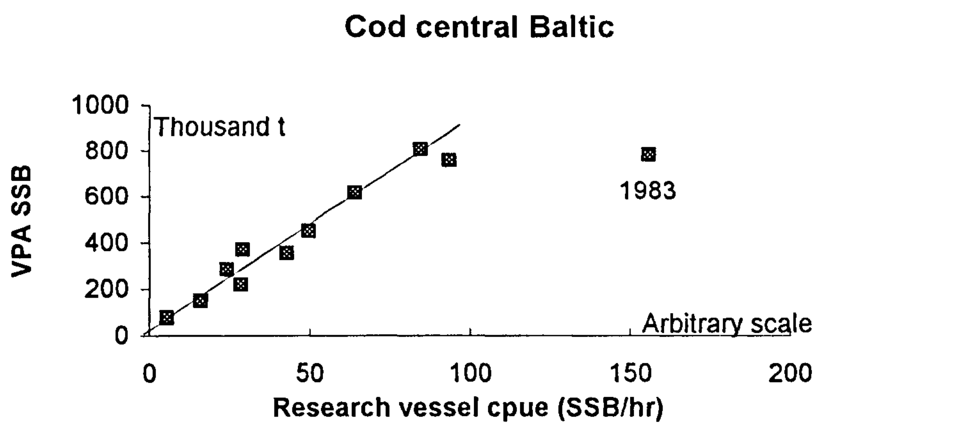
(Proposals to standardization of methods and equipment)

1.Echosounder with split-beam transducer	EK-500, Simrad EK-400, Simrad
2. Integrator for pelagic and demersal integration	EK-500 with BI500 QD Simrad
3.Unit of acoustical samples	SA (m^2/nm^2)
4.Determination of target strenghts	TS=20 LOG L - 71.2
5. Work frequency at echosurvey	38 kHz or 120 kHz
6.Transect form	regular rectangle grid of parallel 15 nm, transects not at boundary of rectangle (inrregular in SD 22 and SD 23)
7. Integration step and layers	ESDU = 1nm all layers within echorecords
8.Equipment of calibration	standard copper sphere acc. to ICES CRR no 144, 1987
9.Method of post-survey startification	ICES rectangles in SD 22 and SD 23 - geografical area
11.Characteristic of precision and accuarcy of density	for investigated
12. Number of hauls per unit of area	minimum 2 in each rectangle
13. Hauls duration and speed	30 minut and 4 kn
14. Criteria of chosing the place, depths and time of hauls	non random aimed to identification fish records
15.Mesh size of trawl	6 mm
16. Method of averaging biological sampling	

Hydroacoustic result exchange formats.

Table 6.2.1		estimated number (milloins) of herring											
SD	Rectangle	total	age0	age1	age2	age3	age4	age5	age6	age7	age8	age9	age10+
Table 6.2.2		estimated mean weight (gram) of herring											
SD	Rectangle	total	age0	age1	age2	age3	age4	age5	age6	age7	age8	age9	age10+
Table 6.2.3		estimated number (milloins) of sprat											
SD	Rectangle	total	age0	age1	age2	age3	age4	age5	age6	age7	age8+		
Table 6.2.4		estimated mean weight (gram) of sprat											
SD	Rectangle	total	age0	age1	age2	age3	age4	age5	age6	age7	age8+		
Table 6.2.5		survey statistics											
Vessel	SD	Rectangle	area	mean SA	sigma	total abundance		species composition (%)					
			in nm^2	m^2/nm^2	m^2	in millon		herring	sprat	other fish			
Table 6.2.6		Structure for acoustic surveys data sets											
A1	date	UTC	night	no. log	dist.step	latitude	longitude	avg. dept	haul	comment	validity		
			day	nm	nm	deg. min	deg. min	m	no.				
A2	upper limit:		lower limit:		integrator value (SA):								

Figure 2.1.1.1



Source: ICES WG On Demersal Stocks in the Baltic 1993/Assess:16

Figure 3.2.1.1 Bottom trawl surveys. Total number of stations per rectangle in a given year.

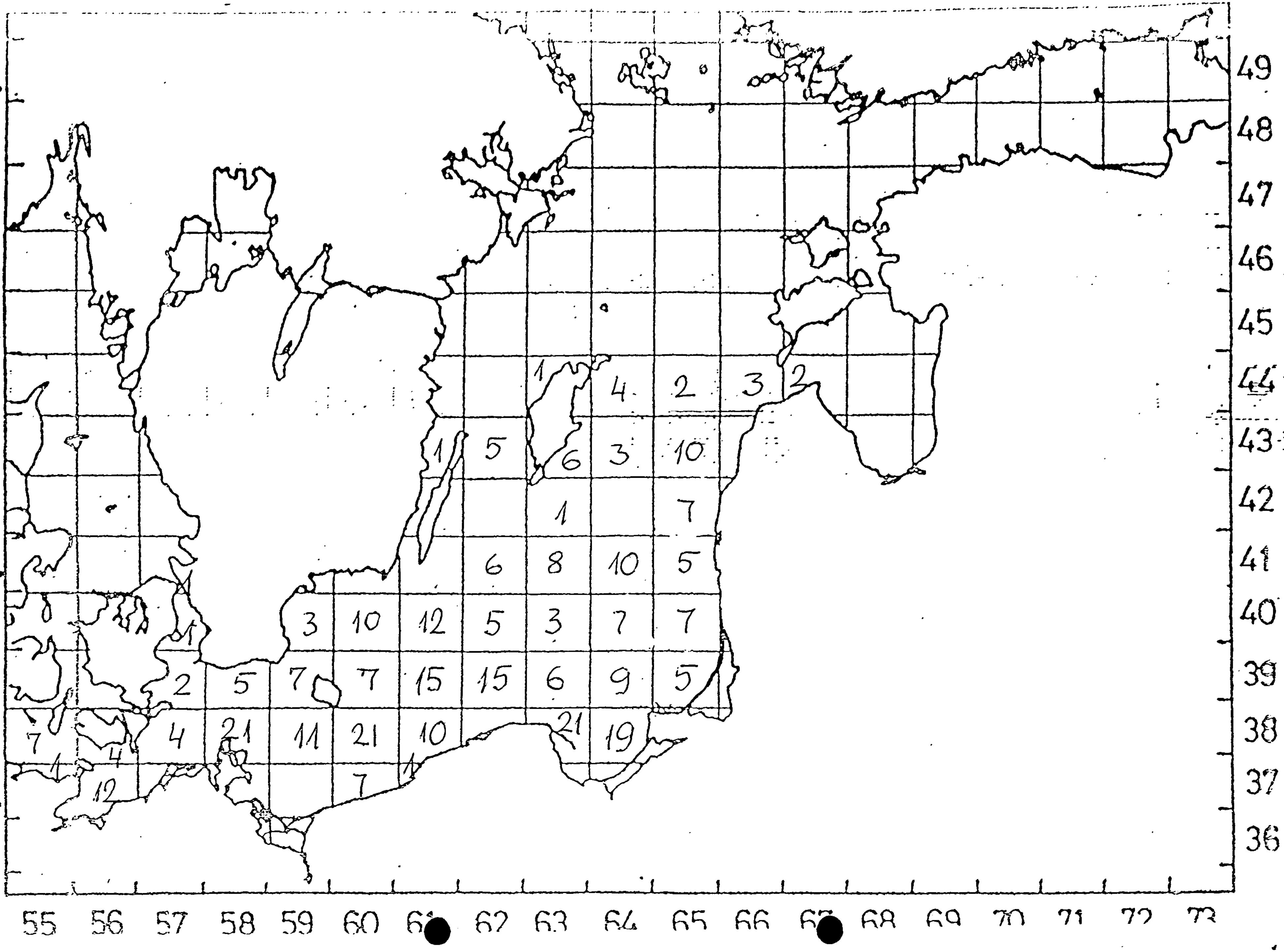


Figure 3.2.1.2 Bottom trawl surveys. Total number of stations by country per rectangle in a given year.

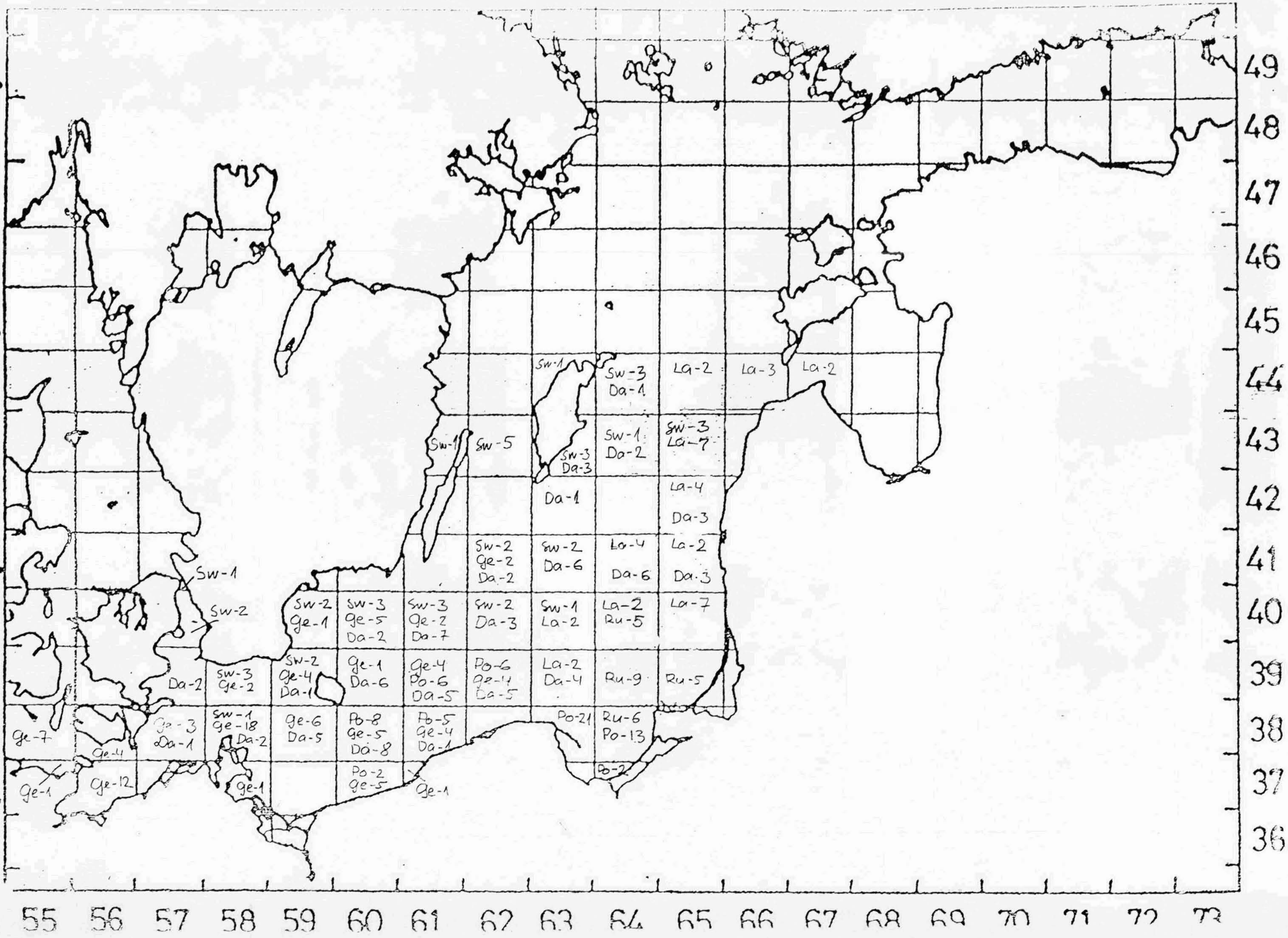


Figure 3.2.1.3 Available trawl stations in Sub-divisions 25 to 29 in 1993 (except for Poland 1994 and Sweden 1992)

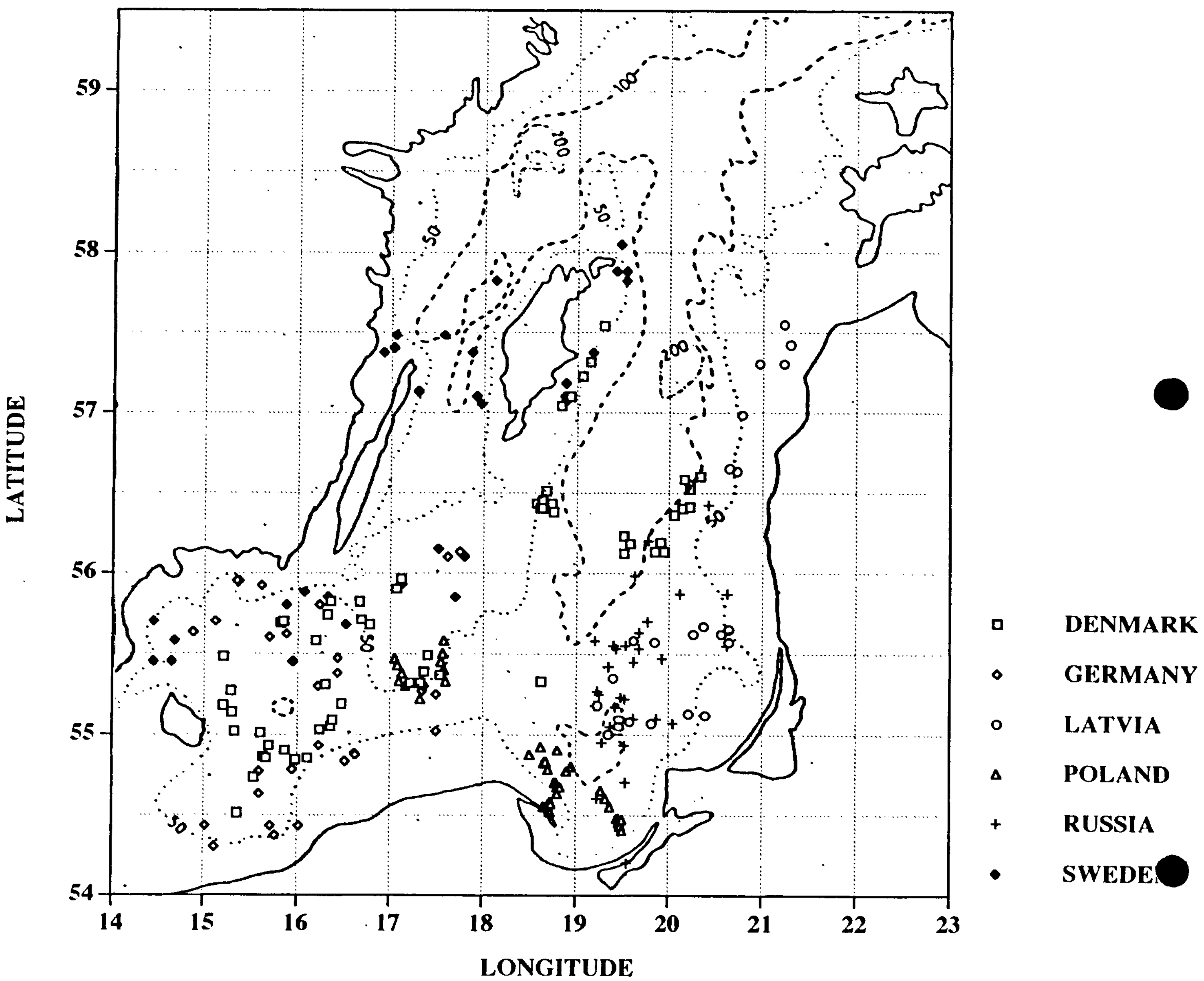


Figure 3.2.2.1

SD 25-29 AGE	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
AC Tot	1406	1448	1001	747	1195	782	923	1147	1204		
AC ≥ 3	822	1187	724	494	794	596	726	889	730		
Ac Corr	1626	1577	1189	818	1293	872	1070	1287	1326	1467	
XSA93 T	3592	3020	2953	2524	1906	2120	2433	2900	3179	3862	
XSA94 T	2850	2611	2488	2248	1859	1843	1771	1862	2062	2041	1968

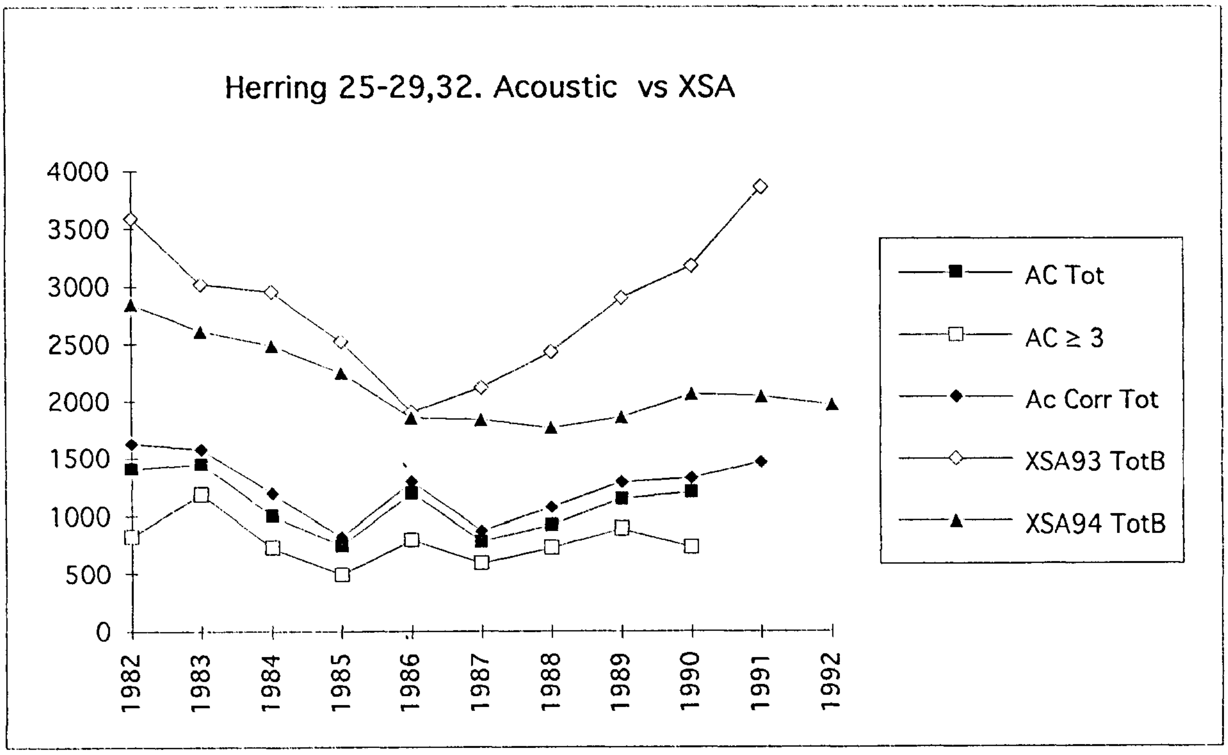
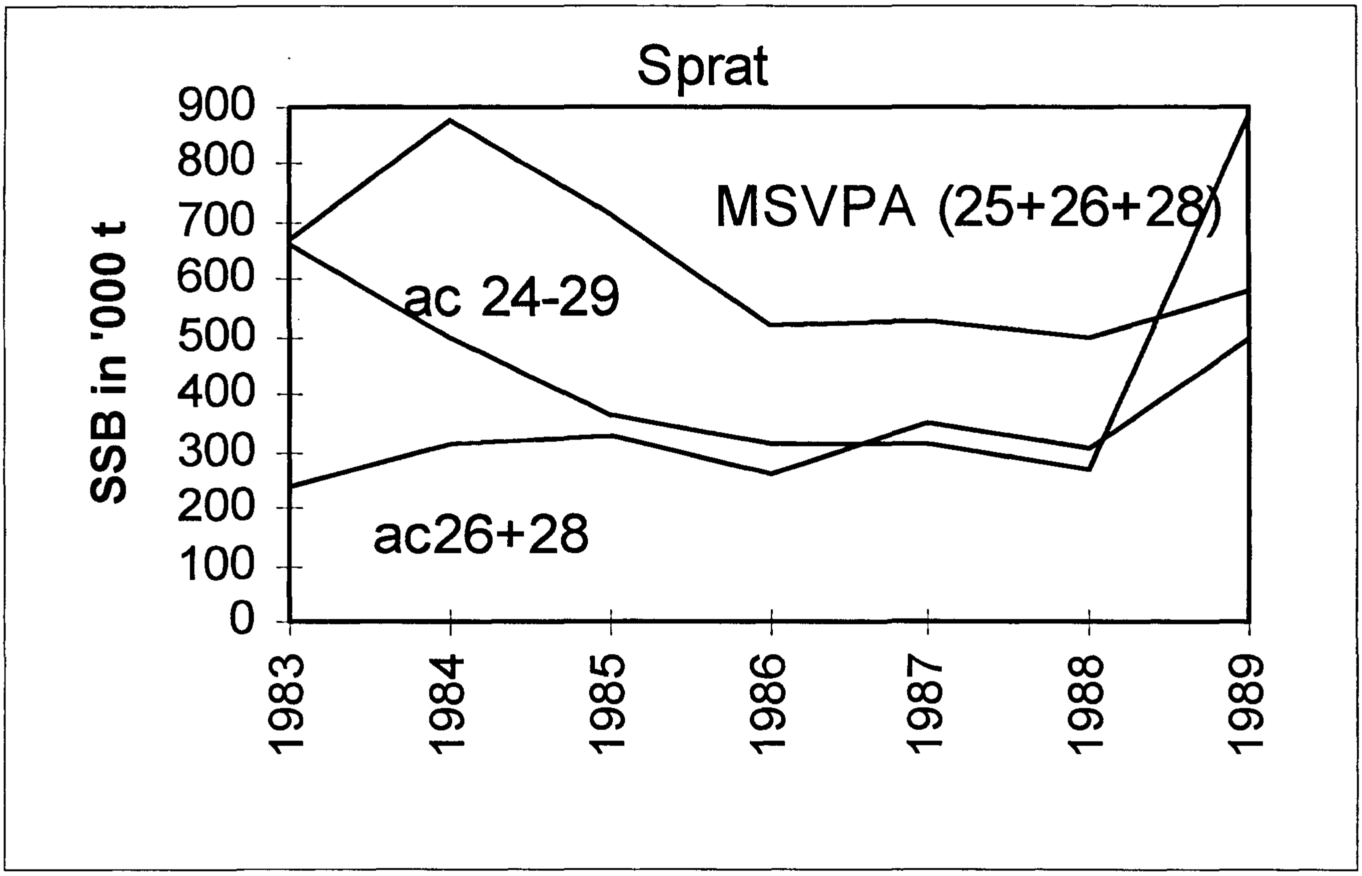


Figure 3.2.2.2


Sprat
SSB in '000 t
900
800
700
600
500
400
300
200
100
0
MSVPA (25+26+28)
ac 24-29
ac26+28
1983
1984
1985
1986
1987
1988
1989

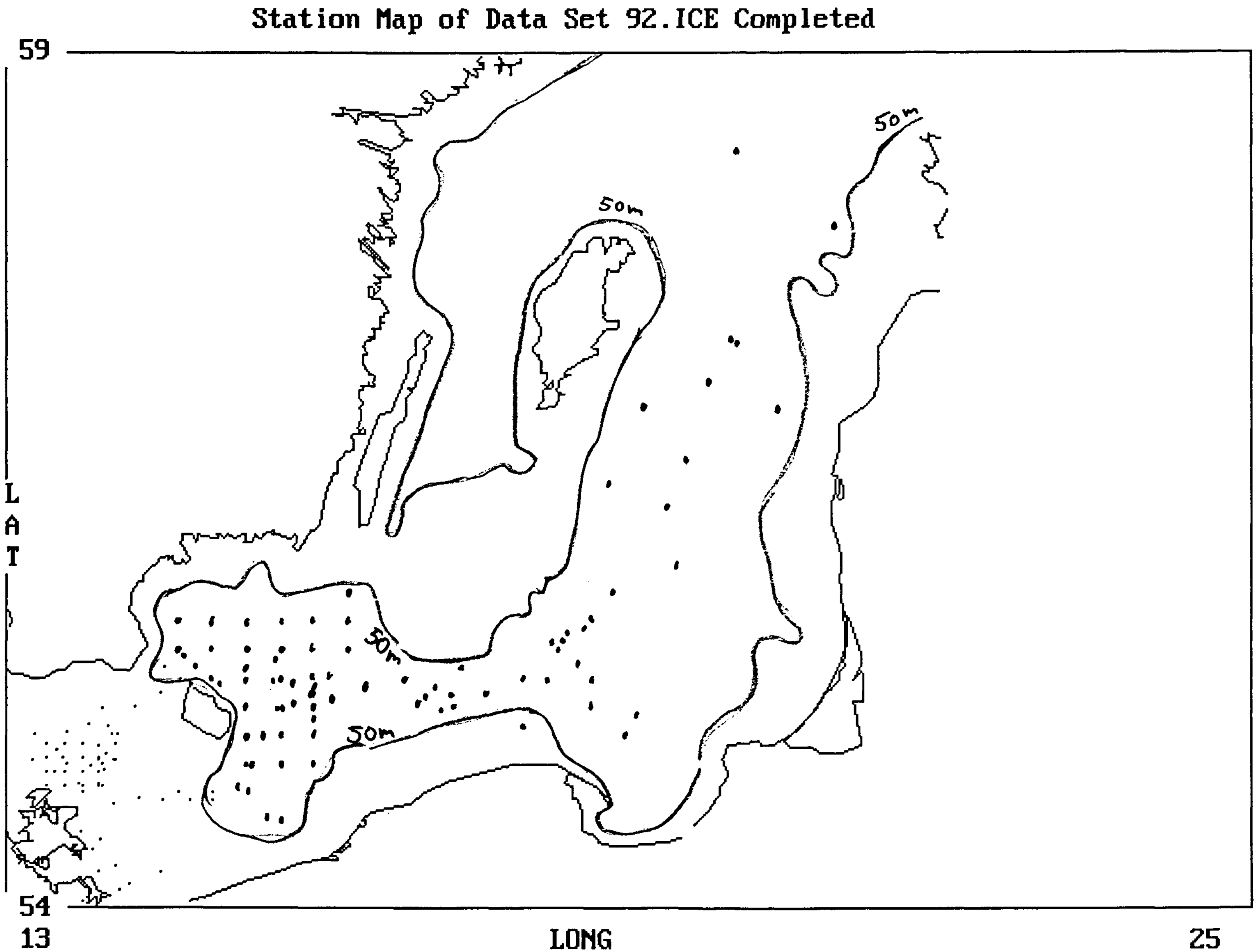


Figure 4.1 Hydrographical profiles taken in June, July, and August 1992 in Sub-divisions 25, 26 and 28.