Baltic Committee **ICES CM 1999/H:7**
Ref.: B

REPORT OF THE

WORKSHOP ON BALTIC TRAWL EXPERIMENTS

Rostock, Germany
11-14 January 1999

International Council for the Exploration of the Sea

Conseil International pour l'Exploration de la Mer

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Palægade 2–4 DK–1261 Copenhagen K Denmark

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1 INTRODUCTION

1.1 List of Participants

Böttcher, Uwe	Germany
Ernst, Peter (Co-Chairman)	Germany
Frieß, C.-Christian	Germany
Hovgard, Holger (Co-Chairman)	Denmark
Järvik, Ahto	Estonia
Larsson, P.O.	Sweden
Müller, Hildrun	Germany
Netzel, Jan	Poland
Nielsen, Rasmus	Denmark
Oeberst, Rainer	Germany
Plikshs, Maris	Latvia
Rehme, Wolfgang	Germany

1.2 Terms of Reference

According to the resolution C.Res. 1998/2:64 adopted at the 1998 ICES Annual Science Conference (86th Statutory Meeting, Cascais/Portugal) it was decided to held a Workshop on Baltic Trawl Experiments (WKBTE) under the Co-Chairmanship of H. Hovgard, Denmark and P. Ernst, Germany in Rostock (Germany) from 11-14 January 1999 to:

a) Organise experiments for 1999 with the objective to optimise the rigging and gear protocol for the new standard trawl;

b) plan intercalibration experiments between vessels equipped with the new standard trawl;

c) compile depth strata information and identify appropriate trawls tracks, indicating these depth strata.

WKBTE will report to the Baltic and Fisheries Technology Committees at the 1999 Annual Science Conference.

Based on the discussion the participants of the workshop noted that the TOR b) is not in accordance with previous discussion in the BIFS WG meeting (ICES CM 1998/H: 4, Karlskrona, Sweden 8–13 June 1998). Therefore participants of the present WKBTE suggested specifying the TOR b) into:

b) Plan intercalibration experiments between the traditional and the new standard bottom-trawl on board of the involved research vessels

Since ICES at its 1998 Annual Science Conference decided on the present workshop an international survey co-operation has been established under the auspices of the EU study program (ISDBITS). This project includes the same parties and scientist as are presently co-operating within the ICES BIFS framework. The present meeting was therefore arranged to allow discussions relevant for the contents and organisation of the EU Study programme. These discussions are summarised within the present report.

2 Optimisation of gear design and rigging (TOR item a)

The aim of this work is to optimise the trawl gear design and rigging as well as standardisation of operation details of the trawls for BITS. This includes testing of the TV3 trawls in model and full scale.

<u>Flume tank experiments with model TV3 trawls</u>

The EU ISDBITS Study Project includes Flume Tank tests and measurements of model TV3 trawls. DIFTA, Hirtshals and IFH, Hamburg already have started this testing process in January 1999.

<u>Model building</u>: Models has been build in the middle of January 1999 of the two selected types and sizes of the TV3 trawl and the trawl doors. The models have been scaled down to fit the size of the tank (large trawl scale 1:8; small trawl scale 1:6).

Test period: The practical model testing will be performed in the Flume Tank at DIFTA 21 and 22 January 1999. Of the 3 days of testing of the two nets included in the EU ISDBITS Study Project two days will be used in January 1999 – one for each trawl – and then spare one day for additional testing at a later stage when the first full-scale tests have been completed.

Trawls to be tested, trawl design and actual tests of the trawls: The model TV3 trawls to be tested will follow the recommended trawl design in the report from the 2nd Workshop on Standard Trawls for Baltic International Fish Surveys (WKBIFS)(ICES CM1998/H:1). The model testing in the tank will focus on optimising the performance and investigating gear parameters known to influence trawl selectivity: basic design and overall geometry of the trawl (height and spread of the net, use of fly meshes or non-use of fly meshes along the headline and foot rope, mesh opening, inclination of netting panels, etc.), bottom contact (distance during operation between ground rope and sea bed), and sensitivity of the net to changes in the rigging (minor changes in floatation, length of the bridles and sweeps, spread of the doors, etc.).

Results from the flume tank experiments: The tests will produce the results necessary to adjust the rigging of the full-scale trawls and to give a description of the performance of the gear. Alterations will probably be made to the models and those giving the best results will be transferred to the specifications for the full-scale nets. The results from the flume tank experiments will be made available in due time for the trawl manufacturing. The flume tank tests will be recorded on video.

Production and procurement of full scale TV3 trawls

All needed trawls for the 1st quarter 1999 survey will be made available for the relevant research vessels at Bornholm before survey start in March 1999. The trawl manufacturer has in January 1999 started the production of the trawls for Dana, Argos and Solea. The trawls for Baltica, ATLANTNiro and the Latvian research vessel will be delivered in spring and the trawls for the Estonian research vessel to be used in 3rd quarter 1999 survey will subsequently follow.

Testing of the full scale TV3 trawl at sea

Fishing gear technologists will join on the first field tests with the full scale TV3 trawls in order to monitor the dimensions, handling and performance of the full scale nets and compare the results with the results from the flume tank model testing.

Test period: This testing will be performed on board Dana, Solea and Argos during the 1st quarter 1999 BITS surveys (March 1999) when performing inter-calibration experiments. Basically, the gear monitoring will not interfere with the overall program and planning for the inter-calibration experiments and occupy much separate time. However, it might be necessary to use one day on board both Dana and Solea exclusively performing trawl measurements. The latter will be discussed and agreed upon by DIFTA, Hirtshals and IFH, Hamburg before survey start.

Tests to be performed: Tests on board will be made using Scanmar systems or similar systems to monitor the performance of the gear. Video recordings of the full-scale trawl performance at sea will be made by Sweden on board Argos. Gear technologists from DIFTA, Hirtshals will participate in and make measurements during the Dana March 1999 survey, while gear technologists from IFH, Hamburg will do the same during the Solea March 1999 survey.

During the 1st WKBIFS (ICES CM1997/J:6) the ground gear was discussed in relation to bottom topography. In relation to this discussion the present WKBTE group raised the question that the TV3 trawl rockhopper gear may have a risk of digging into the mud at soft bottom localities. On that basis tests will be made on board Argos of possible digging of the TV3 trawl in soft bottom areas in relation to towing speed, acceleration and amount of chain on the trawl. This will be done during the inter-calibration part of these surveys. Dana, Solea and Argos will survey during the same period during March 1999.

Optimising the gear rigging of the small TV3-trawl

As documented by the WGBIFS (ICES, 1998) the small TV3-trawl with the rigging used in the Danish cutter survey in SD21-23 (BITS) was highly efficient for catching flatfish and small cod. In the present rigging the sweep lines are very short, 15 fathoms equivalent to a door spread of only 55 m. Trials with longer sweep lines have indicated that the catches of especially the larger cod may be improved considerable.

The workshop recommends that experiments be carried out to optimise the sweep line length of the small TV3 trawl prior to fixing of the standard rigging of this trawl. As inter-calibrations between the large and small TV3-trawls are

planned to be carried out in March 2000 these experiments should be finalised during 1999. The workshop recommends that the experiments be carried out by the Danish Institute for Fisheries Research.

3 Intercalibration experiments (TOR item b)

The present ICES/EU-study program activities aims at introducing new standard trawls (vis. a small and a large TV3-trawl) to be used in the annual BITS surveys. To allow for a concurrent use of new and historic survey information for assessment purposes it is necessary to calibrate the catch information from the new standard trawls against those hitherto used. When the calibrations have been commenced all existing survey information will be expressed in units corresponding to the large TV3-trawl.

The intercalibration requires that each country carry out comparative fishing with its historical used gear and the new TV3-trawl. It is recommended that the comparative trawling with the new and old gear should be made on the same trawl track lines, which are covered by trawling in the same direction. The second haul should be made immediately after the first. In order to balance out any possible effects of 1st and 2nd trawl coverage's the order of the gears should alternate between stations, i.e. following the sequence shown in the table below.

Station	1	2	3	Etc
Gear used	New-Old	Old-New	New-Old	Etc.

The duration of the two comparative trawls should be set at 0.5 hours each, with identical trawling speed (ca. 3.5 knots).

The present workshop has not decided on the exact procedure for deriving the conversion factors but it appears evident that the conversion factors will be size dependent. The catch information must therefore be reported per length groups (cm or semi-cm groups).

As noted in the EU-study project the 1999 BITS activities include both a survey, conducted with the historically used trawls, and between trawl intercalibrations experiments. The workshop recommended that the intercalibrations should be made after completing the traditional survey. The information on stock distribution derived from the surveys may then be used to select the areas suited for the intercalibrations. Good areas for the calibration studies are those where high densities of cod and flounder can be expected. It may be necessary to perform the intercalibrations in various areas to ensure coverage of all size classes.

The workshop notes that it may at present be difficult to find cod concentration of sufficient magnitudes for calibration purposes in the eastern part of the Baltic Sea, notable in SD 26 North, SD28 and SD29. If the surveys in these areas run into high densities of cod the calibration studies should not be postponed. This may imply organising the calibration activities on single days within the survey period.

If suitable cod densities are not found in the eastern areas precise conversion factors can not be derived for some of the important survey trawls, vis. the Latvian trawl, which was used in the historically important USSR surveys. In this case it may be necessary to perform the calibration experiments in more western areas, e.g. in SD 22 or SD 24.

The experience from the trawl comparison made on R/V SOLEA in 1998 indicate that vessels equipped with two net-drums should be able to conduct three comparisons per day when the fishing stations are selected close to each other.

4 Depth strata information (TOR item c)

The international trawl surveys is expected carried out in the form of a stratified random survey. As stratification criteria the squares of the ICES Sub-divisions or the depth layers are possible. In both cases the areas of the strata are necessary. Since different estimates exist for the different areas it was necessary to recommend which values should be used in the trawl surveys.

The following depth information data were available at the meeting:

1. Swedish data using planimeter measurements covering the statistical rectangles of the ICES sub-divisions 23- 29, 32. The depth information is aggregated by useable for 10 m depth layers.

2. Danish data using planimeter covering parts of ICES Sub-divisions 21 and 23. These data were compiled for special investigations and do not cover the whole Sub-divisions.

3. Polish data using planimeter measurements covering parts of ICES Sub-divisions 25 and 26. These data are used for special investigations and do not cover the whole Sub-divisions.

4. German data using vessel depth-measurements and map information which are compiled using mathematical models (Seifert et al. 1995). This information covers ICES sub-divisions 21 - 29. The smallest resolutions of the data are 1' of longitude and 0.5' of latitude for the Belts and the Arkona Sea and 2' of longitude and 1' of latitude for all other areas. Dr. Hinrichsen, Ins. Für Meereskunde, Kiel made these data available. The depth information was provided by 5 m depth layers and quarters of statistical rectangles.

Since the data from Denmark and Poland do not cover whole ICES Sub-divisions only the data from Sweden (S) and Germany (D) were considered appropriate for the present task.

A comparison between the German and Swedish data showed small differences in areas. This is to be anticipated due to the difference in approaches and maps used. The magnitudes of differences are illustrated in Table **1,** which summarise the areas in nm² for ICES sub-divisions 24 - 28. The comparison is also shown in Figure 1 where the proportions of the depth layers are shown. The ICES Sub-divisions 23 and 29 are excluded because the coverage of these areas is different between Sweden and Germany.

Table 2 presents a comparison of the data of the ICES Sub-division 24 at a square by square basis. These estimates are comparable, too. This appears clearly when the proportions of the different depth layers are compared.

The workshop was not able to evaluate which of the two data sets were giving the most reliable estimate of the depth layer information. For several reasons the workshop recommend that the German depth information to be used at this stage. The German approach is well documented and is based on computerised information. This implies that depth information may be manipulated easily, which allow a flexible construction of dept-strata - the depth resolution is 1m and areas may be defined freely by the user. The German depth information may also easily be updated by including new depth data. However, for ICES Sub-division 32 and for some squares of ICES Sub-division 29 only Swedish data are available. The workshop recommend that the Swedish data for these areas to be used.

Appendix 1 provides the areas of the depth layers per ICES squares aggregated on 10 m depth layers. Additional information on a finer aggregation scale (areas per 5 m depth layers per quarters of the ICES squares) were delivered to the workshop participants in the form of an EXCEL file. The Danish Institute (S. Neuenfeldt) and the Institute of Baltic Resarch Warnemünde (T. Seifert) are available for inquiries relating to the depth information.

Table 1. Comparison between the areas in nm² as given by Sweden and Germany for the ICES Sub-divisions 24 - 28

Swedish data	SD24	SD25	SD26	SD27	SD28[1]	Sum	%
Total	**6692.9**	**12646.1**	**11130.4**	**8903.7**	**11528.5**	**50901.6**	
depth range							
0 – 9	883.6	277	170	832.8	336.4	2499.8	4.9
10 – 19	2319.6	1049.2	433.8	731.9	662.9	5197.4	10.2
20 – 29	1342.1	1751.6	1047.8	645.6	1318.2	6105.3	12.0
30 – 39	579.7	1674.3	828.3	362.6	562.1	4007.0	7.9
40 – 49	1396.6	2292.8	1106.7	702.1	1266.3	6764.5	13.3
50 – 59	164.3	1240.4	717.5	613.2	634.4	3369.8	6.6
60 – 69	7.0	1693.8	923.3	506.8	545.3	3676.2	7.2
70 – 79	0.0	1388.4	995.0	549.7	356.8	3289.9	6.5
80 – 89	0.0	809.9	1551.1	565.4	511.7	3438.1	6.8
90 – 99	0.0	459.5	1048.6	837.7	606.2	2952.0	5.8
100 – 150	0.0	9.2	2308.3	1760.9	3089.1	7167.5	14.1
> 150	0.0	0.0	0.0	795.0	1639.1	2434.1	4.8

[1] The Gulf of Riga is not included.

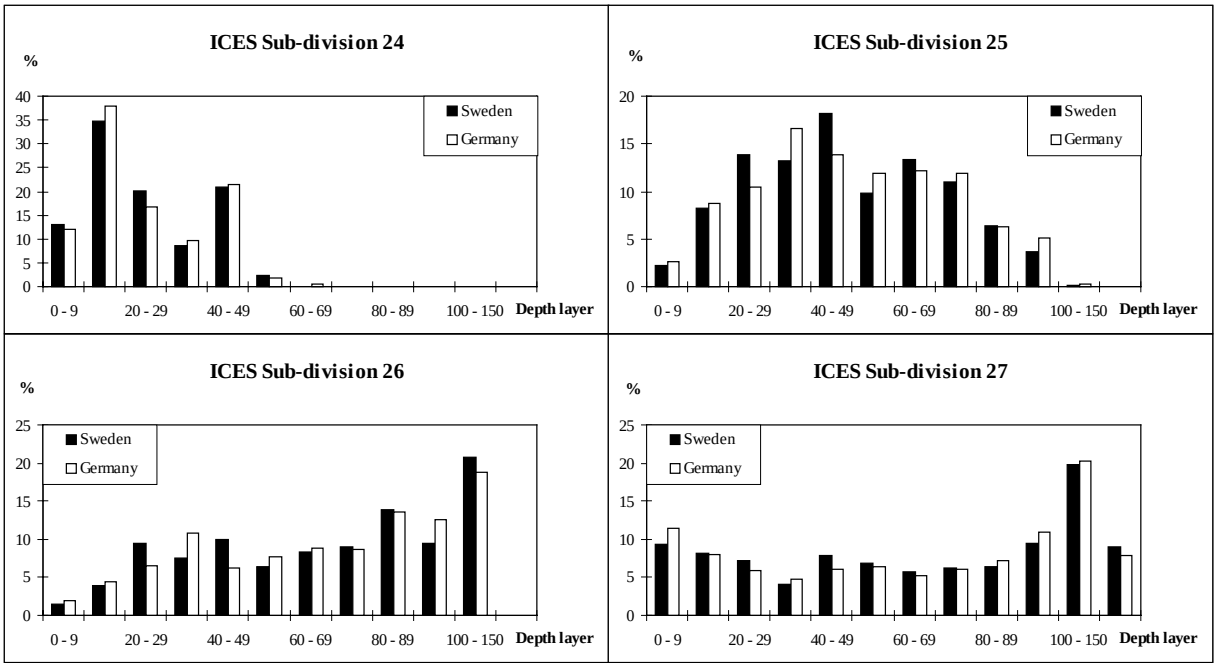
German data	SD24	SD25	SD26	SD27	SD28[1]	Sum	%
Total	**6509.3**	**12615.9**	**11312.3**	**8826.6**	**11398.4**	**50662.5**	
depth range							
0 – 9	785.4	332.5	222.7	1014.8	353.5	2708.9	5.3
10 – 19	2461.5	1110.7	486.3	700.5	733.7	5492.7	10.8
20 – 29	1091.3	1324.6	734.7	525.3	974.3	4650.2	9.2
30 – 39	621.4	2096.5	1230.4	415.7	881.0	5245	10.4
40 – 49	1396.6	1749.4	695.1	538.2	772.7	5152	10.2
50 – 59	124.3	1504.4	873.5	562.5	825.2	3889.9	7.7
60 – 69	28.8	1531.6	998.3	463.9	621.4	3644	7.2
70 – 79	0.0	1505.4	972.6	532.3	479.7	3490	6.9
80 – 89	0.0	797.5	1531.2	634.0	614.3	3577	7.1
90 – 99	0.0	638.2	1422.8	961.6	774.5	3797.1	7.5
100 – 150	0.0	25.1	2144.7	1782.0	2935.0	6886.8	13.6
> 150	0.0	0.0	0.0	695.8	1433.1	2128.9	4.2

[1] The Gulf of Riga is not included.

Table 2. Comparison between the areas in nm² given by Sweden and Germany for individual squares in ICES Sub-divisions 24

Swedish data	**SD24**	**39G2**	**39G3**	**39G4**	**38G2**	**38G3**	**38G4**	**37G2**	**37G3**	**37G4**
Total	**6692.9**	**543.6**	**805.0**	**540.0**	**944.3**	**956.4**	**1045.0**	**340.9**	**496.6**	**1021.1**
Depth range										
0 – 9	**883.6**	105.8	25.1	11.4	91.7	74.7	9.0	135.9	313.7	116.3
10 – 19	**2319.6**	158.5	76.8	66.6	554.8	75.7	197.5	168.7	158.3	862.7
20 – 29	**1342.1**	228.7	130.6	58.6	257.4	214.1	349.7	36.3	24.6	42.1
30 – 39	**579.7**	49.5	143.5	86.2	40.4	130.0	130.1	0.0	0.0	0.0
40 – 49	**1396.6**	1.1	427.9	286.2	0.0	446.9	234.5	0.0	0.0	0.0
50 – 59	**164.3**	0.0	1.1	31.0	0.0	15.0	117.2	0.0	0.0	0.0
60 – 69	**7.0**	0.0	0.0	0.0	0.0	0.0	7.0	0.0	0.0	0.0
70 – 79	**0.0**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
80 – 89	**0.0**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
90 – 99	**0.0**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
German data										
Total	**6509.3**	**430.9**	**819.7**	**598.5**	**948.9**	**939.6**	**1038.9**	**266.4**	**461.5**	**1004.9**
Depth range										
0 – 9	**785.4**	88.9	31.9	21.7	85.4	78.5	2.3	92.3	271.1	113.3
10 – 19	**2461.5**	205.2	76.4	83.2	557.5	99.3	255.1	136.7	182.3	865.8
20 – 29	**1091.3**	127.7	114.0	63.8	252.8	170.8	292.0	37.4	8.2	24.5
30 – 39	**621.4**	9.1	176.7	65.0	49.6	152.4	167.4	0.0	0.0	1.2
40 – 49	**1396.6**	0.0	420.7	328.3	3.5	438.6	205.5	0.0	0.0	0.0
50 – 59	**124.3**	0.0	0.0	28.5	0.0	0.0	95.8	0.0	0.0	0.0
60 – 69	**28.8**	0.0	0.0	8.0	0.0	0.0	20.8	0.0	0.0	0.0
70 – 79	**0.0**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
80 – 89	**0.0**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
90 – 99	**0.0**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Figure 1. Comparison between the proportion of the various 10 m depth layers given by Sweden and Germany for ICES Sub-divisions 24 - 27



4.1 Clear tow trawl track library (TOR item c)

At present research survey trawling is typically carried out by using track-lines recorded by various GPS systems. It was agreed to establish a library containing computerised track lines useful for the future survey work.

The group recognised that a number of practical problems may be expected in this compilation:

1. A number of areas may possess difficult bottom condition restricting the possibilities for selecting trawl track-lines.

2. In some countries the GPS positioning systems may not be a commonly used in the commercial fisheries.

3. Several different GPS positioning systems are in present use. A creation of a common library requires that information can be converted between the different systems.

At present the group can not precisely evaluate the amount of practical problems associated with the compilation of the library of track lines.

Distribution and amount of track lines

The sampling schemes for the future common survey has not been decided. Moreover, it is possible that the scheme initially chosen may subsequently be changed when information from the new survey is accumulating. For this reason it was decided to establish a collection of track-lines with a broad geographical coverage and reflecting the differences in depth.

It was agreed to base the track-line library on the following principles.

1. Ten track-lines are to be selected within each quarter of ICES squares. A quarter of a square (QSQ) are of a magnitude of 15’ Latitude * 30’Longitude, i.e. of an area size of approximately 15 * 15 nm. For QSQ’s containing lesser sea area the nos. of track lines may be reduced accordingly. The workshop acknowledge that this may not be possible in all areas and may not be needed in deep water areas (depth<150 m).

2. Each track-line should be attempted placed within 10 m depth zone, (0-9m, 10-19m, 20-29m, etc.) The length of the track-lines should correspond to a half-hours tow, i.e. ca. 2 nm.

3. The track-lines within each QSQ should be selected to reflect the depth distribution in the QSQ.

4. Within each QSQ the track-lines should be numbered (between 1 and 10) and labelled with the depth strata to which it belongs. This information should be provided on a track-line diskette as well as listed in an ASCII file (format: QSQ, track-number, depth zone, start position (latitude, longitude)).

The amount of information required to meet the above stated scheme corresponds to some 2000-3000 track-lines for the entire Baltic Sea.

Conversions and compilations

Each participating country is responsible for the collection and compilation of the track-lines found within its national fishing zone. As most track-lines are expected to be collected from commercial fishing vessels the individual countries should ascertain that the collected track-lines are based on gears compatible to the TV3 survey gear.

Pilot studies, carried out by the Danish Institute for Fisheries Research, have shown some problems regarding the compatibility between various GPS systems. E.g. 'QuatFish' information can be converted to 'Sodema' whereas the reverse may be difficult. Also the 'Shipmate' and 'Furono' systems can be converted to 'Sodema'.

According to the EU-survey project the Swedish Institute of Marine Research, Lysekil, are organising the conversion and compilation of the track line information. All countries are therefore to submit their data to Sweden who will chose the appropriate format to be used for the track-line library. Sweden subsequently provides the participating countries with copies in the format needed for their survey work.

To enhance the compilation work each country is urged to send a sample of track line to the Swedish institute as quickly as possible.

Time limits

If a common survey design is to be introduced in year 2000 a first track-line collection should be available no later than December 1999. To meet this deadline the work need to be organised according to the following timetable:

- Each participating country submits samples of track line information to Sweden before 31st January 1999.
- All available track-line information is submitted to Sweden no later than 1 June 1999. The information is provided on diskettes and also indicated in an ASCII formatted file.
- Sweden scrutinises the ASCII listing and notes the gaps in area covered. Sweden contacts countries, which potentially may be able to fill out gaps in the submitted information.
- The track-line library is presented at the EU-project meeting held at Lysekil in December 1999.

5 Other matters

Analysis of historical survey data

In order to optimise the BITS survey to obtain higher precision in the estimates of cod stock size various stratification schemes should be evaluated. The historical survey information can not be used directly due to the difference in gear used.

An evaluation of various survey stratification schemes was made for SSB and the recruiting age 2 cod in Anon. (1996). This was based on standardising the historical survey CPUE data to Swedish units using the relative fishing power by nation obtained from GLM-analyses.

Using the GLM procedures to evaluate between vessel differences in fishing power implicitly assumes that differences in catch rates only depend on vessel/gear differences, i.e. that the fisheries in different subdivisions take place in the same areas and at the same time. However, due to the lack of survey co-ordination this has rarely been the case.

The uncertainties connected to the GLM conversions may be avoided if evaluating the historical information on a national basis.

The workshop notes that various hydrographic data may also be useful for describing the observed variabilities in stock densities.

Planning of the survey in year 2000

With the establishment of the EU-project by January 1999 it will be possible to arrange a co-ordinated survey for the year 2000. A detailed survey planing, including a more comprehensive area coverage, should be discussed at the BIFS meeting in August, 1999, and be finally planned at the EU-project meeting in December, 1999. This would require that the participating institutes, as early as possible, reserve the needed research vessel resources for year 2000. The workshops discussed the appropriate survey timing and recommend that:

- The spring survey activities are to be carried out in the period 15th February to 25th March
- The autumn survey activities are to be carried out in the period 1St November to 30th November.

6 References

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APPENDIX

Areas of the different depth layers in the Baltic Sea (in nm^2)

The depth information is separated by 10 m depth layers and by ICES squares for ICES Sub-divisions 21 – 29 and 32. In ICES Sub-division 28 the Gulf of Riga is not included. Most data are based on the German information. For some squares of the ICES Sub-division 29 and for all squares of ICES Sub-division 32 Swedish values were used. These squares are marked in the tables with S.

Since the area information used is based on quarters of squares (QSQ) it is not possible to split all areas according to the exact ICES subdivisions borders. This is especially affecting the boundaries in the western part of the Baltic Sea. The first table show how each QSQ has been assigned to ICES subdivisions.

Agreed during the meeting of the
Rostock, Germany
11 - 14 January 1999

Assignment of the quarters of squares to the ICES subdivisions

			10°00				12°00				14°00				16°00				18°00				20°00					
		F9	F9	G0	G0	G1	G1	G2	G2	G3	G3	G4	G4	G5	G5	G6	G6	G7	G7	G8	G8	G9	G9	H0	H0	H1	H1	H2	H2
	50																												
60°30	50																												
	49																			29	29	29	29	29	29	29	29	29	29
60°00	49																			29	29	29	29	29	29	29	29	29	29
	48																					29	29	29	29	29	29	29	29
59°30	48																				29	29	29	29	29	29	29	29	29
	47																			27	27	29	29	29	29	29	29	29	29
59°00	47																			27	27	29	29	29	29	29	29	29	29
	46																	27	27	27	27	29	29	29	29	29	29	29	29
58°30	46															27	27	27	27	27	27	29	29	29	29	29	29	29	29
	45															27	27	27	27	27	27	28	28	28	28	28	28		
58°00	45																27	27	27	27	27	28	28	28	28	28	28		
	44					21	21									27	27	27	27	27	27	28	28	28	28	28	28		
57°30	44				21	21	21										27	27	27	27	28	28	28	28	28	28	28		
	43				21	21	21	21								27	27	27	27	27	28	28	28	28	28	28	28		
57°00	43			21	21	21	21	21								27	27	27	27	27	28	28	28	28	28	28			
	42			21	21	21	21	21	21							27	27	27	27	28	28	28	28	28	28	28			
56°30	42			21	21	21	21	21	21							27	27	27	27	28	28	28	28	28	28	28			
	41				21	21	21	21	21							25	25	25	25	26	26	26	26	26	26				
56°00	41			22	22	21	21	23	23			25	25	25	25	25	25	25	25	26	26	26	26	26	26	26			
	40			22	22	22	22	23	23			25	25	25	25	25	25	25	25	26	26	26	26	26	26	26			
55°30	40		22	22	22	22		23	23			25	25	25	25	25	25	25	25	26	26	26	26	26	26	26			
	39		22		22	22		23	23	24	24	24	25	25	25	25	25	25	25	26	26	26	26	26	26	26			
55°00	39		22	22	22	22	22	24	24	24	24	24	24	25	25	25	25	25	25	26	26	26	26	26	26				
	38		22	22	22	22	22	24	24	24	24	24	24	25	25	25	25	25	25	26	26	26	26	26					
54°30	38		22	22	22	22	22	24	24	24	24	24	24	25	25	25	25	25		26	26	26	26	26	26				
	37			22	22	22	22	24	24	24	24	24	24	25	25	25					26	26	26						
54°00	37				22	22	22	24		24	24	24	24	25	25														
	36				22																								
	36																												
		F9	F9	G0	G0	G1	G1	G2	G2	G3	G3	G4	G4	G5	G5	G6	G6	G7	G7	G8	G8	G9	G9	H0	H0	H1	H1	H2	H2

Strata	**SD 21**	44G0	44G1	43G0	43G1	43G2	42G0	42G1	42G2	41G0	41G1	39G0
Depth interval												
total	**6123.3**	**233.7**	**612.6**	**507.4**	**926.1**	**143.9**	**662.3**	**980.3**	**647.0**	**62.2**	**993.3**	**354.4**
0 - 9	**1166.6**	12.8	79.0	278.0	214.2	35.7	355.3	92.1	37.3	13.3	31.1	17.8
10 - 19	**1677.5**	39.5	44.8	143.9	121.2	37.9	307.0	438.6	154.6	41.1	298.9	50.0
20 - 29	**1419.5**	100.3	12.8	46.5	77.9	27.0	0.0	182.0	198.5	7.8	575.6	191.1
30 - 39	**846.8**	75.8	81.1	31.4	109.3	15.1	0.0	196.3	162.3	0.0	83.3	92.2
40 - 49	**467.7**	5.3	120.6	7.6	168.8	16.2	0.0	58.1	83.3	0.0	4.4	3.3
50 - 59	**255.1**	0.0	106.7	0.0	123.3	11.9	0.0	3.3	9.9	0.0	0.0	0.0
60 - 69	**100.1**	0.0	43.8	0.0	50.8	0.0	0.0	4.4	1.1	0.0	0.0	0.0
70 - 79	**79.4**	0.0	47.0	0.0	30.3	0.0	0.0	2.2	0.0	0.0	0.0	0.0
80 - 89	**46.1**	0.0	28.8	0.0	16.2	0.0	0.0	1.1	0.0	0.0	0.0	0.0
90 - 99	**32.1**	0.0	23.5	0.0	7.6	0.0	0.0	1.1	0.0	0.0	0.0	0.0
100 - 150	**32.1**	0.0	24.5	0.0	6.5	0.0	0.0	1.1	0.0	0.0	0.0	0.0
> 150	**0.0**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

strata	**SD 22**	41G0	40F9	40G0	40G1	39F9	39G0	39G1	38F9	38G0	38G1	37G0	37G1	36G0
Depth interval														
total	**5162.8**	**186.7**	**90.0**	**790.1**	**282.5**	**263.3**	**338.6**	**412.7**	**90.0**	**928.1**	**528.7**	**278.1**	**820.2**	**153.7**
0 - 9	**1489.5**	32.2	21.4	238.6	117.1	83.2	99.2	161.9	27.7	166.2	334.8	72.4	99.3	35.5
10 - 19	**2132.9**	55.6	67.5	327.5	159.8	91.2	142.5	206.3	30.0	417.9	105.0	171.8	243.0	114.7
20 - 29	**1436.9**	94.4	1.1	184.6	4.5	84.4	90.1	31.9	32.3	312.8	85.4	33.9	477.9	3.5
30 - 39	**92.3**	3.3	0.0	32.6	1.1	4.6	6.8	9.1	0.0	31.2	3.5	0.0	0.0	0.0
40 - 49	**10.1**	1.1	0.0	6.8	0.0	0.0	0.0	2.3	0.0	0.0	0.0	0.0	0.0	0.0
50 - 59	**0.0**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
60 - 69	**1.1**	0.0	0.0	0.0	0.0	0.0	0.0	1.1	0.0	0.0	0.0	0.0	0.0	0.0
70 - 79	**0.0**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
80 - 89	**0.0**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
90 - 99	**0.0**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
100 - 150	**0.0**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
> 150	**0.0**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

strata	**SD 23**	41g2	40g2	39g2
Depth interval				
total	**896.5**	**186.7**	**384.9**	**324.9**
0 - 9	**319.2**	32.2	200.3	86.6
10 - 19	**403.4**	55.6	165.5	182.4
20 - 29	**166.1**	94.4	15.8	55.9
30 - 39	**6.7**	3.3	3.4	0.0
40 - 49	**1.1**	1.1	0.0	0.0
50 - 59	**0.0**	0.0	0.0	0.0
60 - 69	**0.0**	0.0	0.0	0.0
70 - 79	**0.0**	0.0	0.0	0.0
80 - 89	**0.0**	0.0	0.0	0.0
90 - 99	**0.0**	0.0	0.0	0.0
100 - 150	**0.0**	0.0	0.0	0.0
> 150	**0.0**	0.0	0.0	0.0

strata	**SD 24**	39G2	39G3	39G4	38G2	38G3	38G4	37G2	37G3	37G4
Depth interval										
total	**6509.3**	**430.9**	**819.7**	**598.5**	**948.9**	**939.6**	**1038.9**	**266.4**	**461.5**	**1004.9**
0 - 9	**785.4**	88.9	31.9	21.7	85.4	78.5	2.3	92.3	271.1	113.3
10 - 19	**2461.5**	205.2	76.4	83.2	557.5	99.3	255.1	136.7	182.3	865.8
20 - 29	**1091.3**	127.7	114.0	63.8	252.8	170.8	292.0	37.4	8.2	24.5
30 - 39	**621.4**	9.1	176.7	65.0	49.6	152.4	167.4	0.0	0.0	1.2
40 - 49	**1396.6**	0.0	420.7	328.3	3.5	438.6	205.5	0.0	0.0	0.0
50 - 59	**124.3**	0.0	0.0	28.5	0.0	0.0	95.8	0.0	0.0	0.0
60 - 69	**28.8**	0.0	0.0	8.0	0.0	0.0	20.8	0.0	0.0	0.0
70 - 79	**0.0**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
80 - 89	**0.0**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
90 - 99	**0.0**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
100 - 150	**0.0**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
> 150	**0.0**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

strata	**SD 25**	41G4	41G5	41G6	41G7	40G4	40G5	40G6	40G7	39G4	39G5	39G6	39G7	38G5	38G6	38G7	37G5	37G6
Depth interval																		
total	**12615.9**	**113.3**	**307.8**	**876.7**	**1000.0**	**747.4**	**1013.0**	**1013.0**	**1013.0**	**249.7**	**986.1**	**1026.0**	**1026.0**	**1038.9**	**940.8**	**475.6**	**657.8**	**130.9**
0 - 9	**332.5**	41.1	88.9	88.9	0.0	39.4	1.1	0.0	0.0	2.3	4.6	0.0	0.0	1.2	10.4	20.8	24.5	9.3
10 - 19	**1110.7**	21.1	57.8	132.2	26.7	122.7	7.9	0.0	63.0	2.3	4.6	8.0	0.0	3.5	188.2	118.9	289.8	64.3
20 - 29	**1324.6**	20.0	61.1	101.1	140.0	135.1	11.3	0.0	115.9	11.4	6.8	51.3	0.0	4.6	207.8	277.0	140.2	40.9
30 - 39	**2096.5**	31.1	82.2	250.0	358.9	86.7	88.9	185.7	318.5	10.3	9.1	67.3	78.7	33.5	301.3	58.9	119.2	16.4
40 - 49	**1749.4**	0.0	17.8	128.9	231.1	162.1	221.7	261.1	118.2	36.5	18.2	78.7	183.5	86.6	151.2	0.0	53.7	0.0
50 - 59	**1504.4**	0.0	0.0	96.7	184.4	70.9	139.6	174.5	129.4	47.9	34.2	109.4	189.2	249.3	48.5	0.0	30.4	0.0
60 - 69	**1531.6**	0.0	0.0	72.2	57.8	46.1	180.1	171.1	243.1	53.6	49.0	199.5	119.7	322.1	17.3	0.0	0.0	0.0
70 - 79	**1505.4**	0.0	0.0	6.7	1.1	75.4	228.5	197.0	24.8	73.0	169.9	249.7	239.4	223.9	16.2	0.0	0.0	0.0
80 - 89	**797.5**	0.0	0.0	0.0	0.0	9.0	115.9	23.6	0.0	12.5	212.0	158.5	151.6	114.3	0.0	0.0	0.0	0.0
90 - 99	**638.2**	0.0	0.0	0.0	0.0	0.0	18.0	0.0	0.0	0.0	457.1	103.7	59.3	0.0	0.0	0.0	0.0	0.0
100 - 150	**25.1**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20.5	0.0	4.6	0.0	0.0	0.0	0.0	0.0
> 150	**0.0**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

strata	**SD 26**	41G8	41G9	41H0	41H1	40G8	40G9	40H0	40H1	39G8	39G9	39H0	39H1	38G8	38G9	38H0	37G8	37G9
Depth interval																		
total	**10967,1**	**1000,0**	**1000,0**	**982,2**	**15,6**	**1013,0**	**1013,0**	**1013,0**	**69,8**	**1026,0**	**1026,0**	**877,8**	**11,4**	**698,4**	**922,3**	**40,4**	**107,5**	**150,7**
0 - 9	**218,0**	0,0	0,0	37,8	8,9	0,0	0,0	4,5	28,1	0,0	0,0	11,4	4,6	60,0	21,9	9,2	18,7	12,9
10 - 19	**475,3**	2,2	0,0	123,3	6,7	0,0	0,0	28,1	14,6	0,0	0,0	46,7	4,6	110,8	50,8	23,1	46,7	17,5
20 - 29	**713,9**	85,6	0,0	157,8	0,0	0,0	0,0	48,4	27,0	4,6	0,0	177,8	2,3	121,2	48,5	8,1	15,2	17,5
30 - 39	**1189,8**	142,2	0,0	355,6	0,0	0,0	0,0	208,2	0,0	25,1	2,3	274,7	0,0	78,5	68,1	0,0	11,7	23,4
40 - 49	**674,0**	78,9	7,8	81,1	0,0	0,0	0,0	203,7	0,0	17,1	9,1	177,8	0,0	35,8	32,3	0,0	5,8	24,5
50 - 59	**844,5**	72,2	95,6	101,1	0,0	39,4	65,3	206,0	0,0	36,5	17,1	101,5	0,0	31,2	54,3	0,0	7,0	17,5
60 - 69	**966,4**	32,2	137,8	58,9	0,0	85,5	182,3	141,8	0,0	69,5	76,4	66,1	0,0	46,2	38,1	0,0	2,3	29,2
70 - 79	**944,4**	47,8	63,3	36,7	0,0	68,7	194,7	100,2	0,0	148,2	102,6	17,1	0,0	39,2	117,7	0,0	0,0	8,2
80 - 89	**1488,2**	48,9	54,4	18,9	0,0	168,8	328,7	72,0	0,0	438,9	204,1	4,6	0,0	45,0	103,9	0,0	0,0	0,0
90 - 99	**1383,4**	104,4	61,1	10,0	0,0	210,5	192,5	0,0	0,0	283,9	336,3	0,0	0,0	71,6	113,1	0,0	0,0	0,0
100 - 150	**2069,2**	385,6	580,0	1,1	0,0	440,1	49,5	0,0	0,0	2,3	278,2	0,0	0,0	58,9	273,6	0,0	0,0	0,0
> 150	**0,0**	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0

strata	**SD 27**	42G6	42G7	43G6	43G7	43G8	44G6	44G7	44G8	45G6	45G7	45G8	46G6	46G7	46G8	47G8
Depth interval																
total	**8826.6**	**427.7**	**986.9**	**389.5**	**945.6**	**189.3**	**331.9**	**960.5**	**435.4**	**194.7**	**947.2**	**947.2**	**78.2**	**598.1**	**915.9**	**478.6**
0 - 9	**1014.8**	150.2	0.0	108.2	26.0	66.0	121.7	0.0	8.5	117.9	28.4	0.0	36.5	121.9	28.1	201.4
10 - 19	**700.5**	111.8	0.0	60.6	45.4	53.0	61.9	1.1	10.7	42.1	36.8	0.0	28.1	102.1	28.1	118.6
20 - 29	**525.3**	31.8	3.3	114.7	41.1	30.3	44.8	1.1	11.7	20.0	46.3	0.0	8.3	91.7	20.8	59.3
30 - 39	**415.7**	23.0	14.3	70.3	47.6	38.9	27.7	3.2	8.5	10.5	33.7	1.1	4.2	74.0	20.8	37.8
40 - 49	**538.2**	23.0	24.1	32.5	92.0	1.1	55.5	24.5	18.1	4.2	92.6	13.7	1.0	75.0	54.2	26.6
50 - 59	**562.5**	25.2	205.1	3.2	76.8	0.0	17.1	45.9	9.6	0.0	52.6	13.7	0.0	51.1	45.8	16.4
60 - 69	**463.9**	23.0	168.9	0.0	66.0	0.0	3.2	39.5	10.7	0.0	52.6	11.6	0.0	26.1	57.3	5.1
70 - 79	**532.3**	38.4	190.8	0.0	100.6	0.0	0.0	50.2	23.5	0.0	57.9	23.2	0.0	14.6	26.1	7.2
80 - 89	**634.0**	1.1	201.8	0.0	110.4	0.0	0.0	64.0	54.4	0.0	91.6	42.1	0.0	19.8	43.8	5.1
90 - 99	**961.6**	0.0	154.6	0.0	145.0	0.0	0.0	233.7	124.9	0.0	90.5	144.2	0.0	15.6	53.1	0.0
100 - 150	**1782.0**	0.0	24.1	0.0	194.7	0.0	0.0	399.1	154.7	0.0	280.0	521.0	0.0	6.3	201.1	1.0
> 150	**695.8**	0.0	0.0	0.0	0.0	0.0	0.0	98.2	0.0	0.0	84.2	176.8	0.0	0.0	336.6	0.0

strata	**SD 28**	42G8	42G9	42H0	42H1	43G8	43G9	43H0	43H1	44G8	44G9	44H0	44H1	45G9	45H0	45H1
Depth interval																
total	**11398.4**	**963.9**	**986.9**	**982.5**	**75.7**	**347.3**	**973.7**	**973.7**	**434.9**	**100.3**	**923.1**	**960.5**	**887.9**	**937.7**	**947.2**	**903.0**
0 - 9	**353.5**	9.9	0.0	18.6	28.5	41.1	1.1	0.0	38.9	13.9	34.2	0.0	72.6	16.8	0.0	77.9
10 - 19	**733.7**	62.5	0.0	66.9	30.7	56.3	2.2	5.4	117.9	22.4	44.8	4.3	180.4	28.4	0.0	111.6
20 - 29	**974.3**	239.0	0.0	84.4	16.4	59.5	10.8	40.0	114.7	39.5	30.9	4.3	151.5	25.3	0.0	157.9
30 - 39	**881.0**	227.0	0.0	102.0	0.0	56.3	18.4	64.9	49.8	24.5	63.0	2.1	112.1	31.6	14.7	114.7
40 - 49	**772.7**	117.3	0.0	89.9	0.0	35.7	19.5	97.4	26.0	0.0	60.8	25.6	112.1	62.1	23.2	103.1
50 - 59	**825.2**	68.0	0.0	112.9	0.0	33.5	30.3	94.1	28.1	0.0	65.1	37.4	149.4	46.3	25.3	134.7
60 - 69	**621.4**	23.0	0.0	73.5	0.0	17.3	40.0	51.9	54.1	0.0	57.6	55.5	76.8	51.6	41.0	78.9
70 - 79	**479.7**	48.2	0.0	65.8	0.0	11.9	44.4	49.8	5.4	0.0	53.4	52.3	14.9	53.7	42.1	37.9
80 - 89	**614.3**	36.2	0.0	38.4	0.0	8.7	59.5	82.2	0.0	0.0	73.6	60.8	13.9	58.9	147.3	34.7
90 - 99	**774.5**	37.3	0.0	37.3	0.0	8.7	71.4	73.6	0.0	0.0	105.7	122.7	4.3	89.5	175.8	48.4
100 - 150	**2935.0**	95.4	540.6	219.3	0.0	18.4	440.3	135.2	0.0	0.0	265.7	470.6	0.0	301.0	445.2	3.2
> 150	**1433.1**	0.0	446.3	73.5	0.0	0.0	235.9	279.1	0.0	0.0	68.3	124.9	0.0	172.6	32.6	0.0

strata	**SD 29**	49G8	49G9	49H0	49H1	49H2	48G8	48G9	48H0	48H1	48H2	47G9	47H0	47H1	47H2	46G9	46H0	46H1	46H2
Depth interval		S	S	S	S	S													
total	**12196.0**	**115.5**	**723.6**	**666.4**	**652.9**	**242.0**	**95.7**	**672.0**	**693.2**	**692.2**	**683.1**	**920.3**	**920.3**	**920.3**	**887.6**	**933.8**	**933.8**	**929.6**	**513.6**
0 - 9	**1437.2**	65.3	84.0	155.9	124.6	67.2	54.4	110.8	41.3	162.2	140.1	55.2	0.0	0.0	102.3	0.0	0.0	11.4	262.5
10 - 19	**1542.7**	37.3	100.8	336.6	294.7	85.2	30.2	113.9	73.6	103.8	83.6	48.1	4.1	1.0	101.2	3.1	0.0	33.2	92.3
20 - 29	**1185.0**	10.5	119.5	101.9	133.3	58.0	9.1	91.7	137.0	113.9	109.8	81.8	10.2	3.1	86.9	7.3	0.0	45.7	65.4
30 - 39	**750.2**	1.2	45.8	34.0	30.1	12.8	1.0	57.4	123.9	58.4	81.6	70.6	14.3	9.2	54.2	7.3	0.0	65.4	83.0
40 - 49	**829.5**	0.0	66.8	26.0	51.1	12.9	0.0	80.6	111.8	61.5	86.6	92.0	49.1	26.6	30.7	16.6	0.0	106.9	10.4
50 - 59	**860.2**	1.2	23.9	6.0	11.1	4.3	1.0	55.4	71.5	86.6	102.8	102.3	108.4	79.8	33.7	24.9	5.2	142.1	0.0
60 - 69	**595.8**	0.0	21.9	4.0	6.0	0.9	0.0	52.4	20.2	36.3	29.2	75.7	119.6	62.4	53.2	16.6	9.3	88.2	0.0
70 - 79	**688.0**	0.0	10.0	2.0	1.0	0.9	0.0	39.3	16.1	17.1	24.2	77.7	87.9	102.3	116.6	13.5	37.4	142.1	0.0
80 - 89	**728.4**	0.0	4.0	0.0	1.0	0.0	0.0	20.2	15.1	10.1	21.2	91.0	95.1	87.9	67.5	29.1	122.4	163.9	0.0
90 - 99	**745.3**	0.0	9.0	0.0	0.0	0.0	0.0	8.1	8.1	17.1	4.0	136.0	91.0	103.3	112.5	68.5	113.1	74.7	0.0
100 - 150	**2243.4**	0.0	74.4	0.0	0.0	0.0	0.0	35.3	43.3	25.2	0.0	90.0	330.3	410.0	128.8	656.8	403.6	45.7	0.0
> 150	**590.2**	0.0	163.5	0.0	0.0	0.0	0.0	7.1	31.2	0.0	0.0	0.0	10.2	34.8	0.0	90.3	242.8	10.4	0.0

strata	**SD 32**	**47H3**	**47H4**	**48H3**	**48H4**	**49H3**	**49H4**
Depth interval		S	S	S	S	S	S
total	**2605.6**	**665.3**	**131.1**	**757.7**	**888.7**	**18.1**	**144.7**
0 - 9	**259.1**	109.6	14.4	50.5	33.3	7.1	44.2
10 - 19	**423.6**	79.5	37.9	172.0	80.0	10.0	44.2
20 - 29	**241.9**	54.6	17.4	45.6	86.1	1.0	37.2
30 - 39	**133.8**	9.2	6.1	51.8	55.6	0.0	11.1
40 - 49	**248.3**	45.3	23.6	72.0	100.4	0.0	7.0
50 - 59	**211.5**	23.6	5.1	86.5	95.3	0.0	1.0
60 - 69	**398.1**	64.7	12.3	92.7	228.4	0.0	0.0
70 - 79	**235.8**	64.7	3.1	118.2	49.8	0.0	0.0
80 - 89	**347.2**	130.1	9.2	66.4	141.5	0.0	0.0
90 - 99	**83.9**	70.7	0.0	0.0	13.2	0.0	0.0
100 - 150	**22.4**	13.3	2.0	2.0	5.1	0.0	0.0
> 150	**0.0**	0.0	0.0	0.0	0.0	0.0	0.0