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Report of the Planning Group on Redfish Surveys (PGRS)

26–29 January 2009

ICES Headquarters, Copenhagen

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International Council for the Exploration of the Sea

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Contents

Executive Summary

The Planning Group on Redfish Surveys (PGRS) met in Copenhagen, Denmark from the 26-29 January 2009. The meeting, Co-Chaired by Andrey Pedchenko and Benjamin Planque was attended by ten participants from the Faroes, Germany, Iceland, Norway and Russia. The group planned two redfish surveys in 2009: in the Irminger Sea in June /July and in the Norwegian Sea in July/August.

The detailed planning of the international trawl/acoustic survey on pelagic redfish in the Irminger Sea and adjacent waters in June/July 2009 has been agreed by all participating countries. Three vessels from Germany, Iceland and Russia will participate in the survey and operate within an area of around 360 000 square nautical miles (NM^2) in the Irminger and Labrador Sea to estimate the abundance and biomass of pelagic redfish. In the depth zone that can be surveyed by hydroacoustic measurements, i.e. shallower than the deep-scattering layer (DSL; down to about 350 m), hydroacoustic measurements and identification trawls will be carried out. Within and below the DSL (down to about 950 m), redfish abundance will be estimated by trawls. The Group decided to keep the methods applied in the 2005-2007 surveys, but anticipates possible recommendation from ICES to study separately the stock shallower and deeper than 500m. As in the past surveys, biological data will be collected from the redfish caught in the pelagic trawls, and hydrographic measurements will be taken on regular stations on the survey tracks.

Hydroacoustics and biological sampling protocols were agreed on for the Norwegian Sea survey. The survey will be run on-board commercial fishing vessels. At the time of the meeting, Norway, Russia and the Faroes indicated that they will participate, but the group did not have specific information on the name of the participating vessels. The survey protocol is mostly based on the protocol used during the international survey carried out in the Norwegian Sea in 2008. The dates of the survey have been advance by two weeks to match the earlier start of the Olympic fishery in the Norwegian Sea international waters in 2009.

As in previous years, the Group recommended that more countries participate in the surveys to increase the density of the acoustic tracks and trawl hauls in order to improve the quality of the derived abundance and biomass estimates for redfish. ICES has made every effort possible to involve at least the main nations holding major shares in the redfish fisheries in the areas. Only one response, however, was received officially, rejecting a possible participation in redfish survey in Norwegian Sea. The Group decided to continue its efforts regarding the inclusion of further countries in the surveys on this important fishery resource.

Annex 12 is a statement by two Russian participants who propose to continue survey strategy applied for 2005 and 2006 into 2009.

1 Introduction

1.1 Terms of Reference

According to **2008/2/RMC04 "**The **Study Group on Redfish Stocks [SGRS]** will be renamed the **Planning Group on Redfish Surveys [PGRS]** (Co-Chairs: A. Pedchenko, Russia and Benjamin Planque, Norway) and will meet at ICES Headquarters, Copenhagen, from 27–30 January 2009, in Reykjavík, Iceland, from 28–30 July 2009, and in Bergen, Norway, from 1–3 September 2009.

Following the request from WKREDS to host a meeting with most of the participants from PGRS on the 22–23 January 2009, the PGRS meeting has been rescheduled to **26–29 January 2009** at ICES Headquarters, Copenhagen.

Terms of Reference:

a) evaluate the ICES need for surveys on redfish, with particular emphasis on the assessment and advice of redfish in the North Atlantic;

b) report on the most efficient and cost-effective method of providing time-series of redfish abundance for advice, and whether existing ICES International surveys can be used;

c) at the 26–29 January 2009 meeting plan:

  i) Report about international trawl/acoustic surveys on redfish in the Norwegian Sea and adjacent waters in August 2008

  ii) Planning joint international trawl/acoustic surveys (ITAS) on redfish stock in the Norwegian Sea and adjacent waters in August 2009

  iii) Planning joint international trawl/acoustic surveys (ITAS) on redfish stock in the Irminger Sea and adjacent waters in June/July 2009

d) initiate an international database for redfish surveys;

e) at the 28–30 July 2009 meeting report on the outcome of the 2009 Irminger Sea survey;

f) at the 1–3 September meeting report on the outcome of the 2009 Norwegian Sea survey;

g) provide a strategy for ICES and a framework for planning redfish surveys from 2010 onwards.

PGRS will report by 15 March 2009 (January meeting) and 15 August 2009 (July meeting); 15 October 2009 (September meeting) for the attention of the SCICOM and ACOM.

1.2 Participants

Matthias Bernreuther	Germany
Eckhard Bethke	Germany
Konstantin Drevetnyak	Russia
Kristján Kristinsson	Iceland
Sergey Melnikov	Russia
Kjell Nedreaas	Norway
Andrey Pedchenko (Co-Chair)	Russia
Benjamin Planque (Co-Chair)	Norway
Jákup Reinert	Faroes
Christoph Stransky	Germany

Detailed contact information of the participants is given in Annex 1.

The group lacked the attendance and expertise of a further country that is expected to participate in the Norwegian Sea redfish survey. Most cruise leaders and specialists on biology, hydroacoustics, and physical oceanography surveys were present.

1.3 Structure of the report

The main part of this report are divided into several sections, detailing the planning of the international trawl/acoustic surveys on redfish in the Irminger Sea and adjacent waters (Section 2) in June/July 2009 and in the Norwegian Sea (Section 3) in July/August 2009. Details about the participating vessels, surveys time, geographic distribution of surveys effort and data exchange are given in Sections 2.1–2.2, 3.1–3.2. In Sections 2.3–2.4 and 3.3, the hydroacoustic estimation methods and their practical arrangements are described, whereas Sections 2.5–2.6 and 3.4–3.5 provide the survey planning regarding the employed trawl hauls and biological sampling of the redfish caught in the pelagic nets. The recordings of environmental conditions are laid out in Sections 2.7 and 3.6. In Sections 2.8 and 3.7, further issues concerning the exchange of experts, the involvement of further nations are dealt with. The time schedules for reporting on the surveys are presented in Sections 2.9 and 3.8. In the Annexes, several reporting templates are displayed for consistent data recording and reporting.

1.4 Working documents and presentations

The first day of the meeting was dedicated to presentations by the participants of working documents and report from previous meetings. This included presentation by Christoph Stransky of the preliminary conclusions from the ICES-WKREDS workshop which was held at ICES the preceding week (22–23 January 2009), a presentation by Benjamin Planque of the update of the AGRED report on the international Norwegian Sea redfish survey conducted in August 2008, a presentation by Benjamin Planque of the results of the hydroacoustics scrutinizing workshop held in Tromsø in November 2008, a presentation by Benjamin Planque of the working document on otolith sampling strategy and a presentation by Eckhard Bethke and Benjamin Planque on a proposal for in situ redfish TS determination. A brief account of these presentations is given below.

1.4.1 WKREDS

At the time of the meeting, the final report from WKREDS was not available. The information presented to the group was therefore based on the draft recommendation from WKREDS. The main conclusion was the recommendation that redfish in the Irminger Sea should be considered in three management units that are:

A. The 'Deep Pelagic' Management Unit: the northeast Irminger Sea (Figure 6.2). The coordinates of the recommended boundary are in Table 6.1.

B. The 'Shallow Pelagic' Management Unit: NAFO areas 1 and 2, ICES areas Vb, XII, XIV outside the 'deep pelagic' management unit area defined in Figure 6.2. This area will include some mixed-stock catches of the 'deep pelagic' stock southwest of the Faroe Islands.

C. The 'Icelandic Slope' Management Unit: North and east of the existing 'redfish line' (Figure 6.2). This area will include some of the 'deep pelagic' stock that occasionally extends inside the boundary.

The implication for future surveys on redfish in the Irminger Sea is that these should be stratified by depth (i.e. <500 m and >500 m), and used to collect genetic samples to serve as baselines for genetic stock composition.

Annex 12 is a statement by two Russian participants who propose to continue survey strategy applied for 2005 and 2006 into 2009.

1.4.2 AGRED

The first report from AGRED (Ad Hoc Group on the International Redfish Survey in the Norwegian Sea) which was held in September 2008 needed revision because of incomplete hydroacoustic analysis, apparent discrepancies in the scrutinizing methodologies and lack of age determination. The analysis of hydroacoustics data for the southern part of the survey which was missing from the original report could unfortunately not be included in the revised version of the report, due to lack of resources/expertise to carry the necessary data analysis. The hydroacoustics scrutinizing for the northern (Norway) and central (Russia) parts of the survey were revised. New hydroacoustic estimates are 385,000 tons for Norway (previous estimate: 395,000) and 115,600 for Russia (previous estimate: 76,700), when the TS equation used is TS=20logL-68.0. However, the discrepancies in the scrutinizing between the two countries remain too high for the abundance estimate to be considered reliable. New data on age demonstrated that older individuals were found in the southern area of the study and in deeper layers. More than 90% of individuals were older than 15 years and reaching up to 55 years. The revised AGRED report is now available (ICES 2008).

1.4.3 Hydroacoustics scrutinizing workshop

In November 2008, IMR-Tromsø hosted an international workshop on the scrutinizing of hydroacoustics data collected during the Norwegian Sea redfish survey in 2008. During the workshop, the procedures used for scrutinizing were reviewed and comparative analyses of reference acoustic registrations were conducted. The comparative analysis clearly demonstrated that differences in scrutinizing methods have a very large affect on the abundance estimate of redfish. They probably constitute the major source of uncertainty for any quantitative estimate. Efforts towards standardization of scrutinizing procedures should be amplified or at least maintained. The executive summary of this report is given in Annex 9.

1.4.4 Otolith sampling strategy

Benjamin Planque and Alf Harbitz conducted statistical simulations to investigate the effect of random vs. length-stratified sampling for age determination of redfish. The results of the analysis show that stratified sampling does not outperform random sampling. In addition random sampling results in a dataset that can be analysed directly (i.e. without age-length-key), which is particularly useful if ALK varies with sex, geographical location, depth or time, as is likely the case for redfish in the Norwegian Sea. It was therefore recommended that future international surveys for redfish in the Norwegian Sea should commonly adopt a random sampling strategy for the collection of fish otoliths. The working document is given in Annex 10.

1.4.5 Method for in situ target strength determination of redfish

Benjamin Planque and Eckhard Bethke presented some preliminary work on a method for the determination of the hydracoustic target strength determination of redfish in situ. The methodological developments are still underway and it was felt by the group that the method requires further tests and validation before being used. This was seen however as an interesting development and generated discussions on the most appropriate ways of measuring redfish TS in situ. The exact value for redfish target strength is still debated and the group agreed that a workshop for the determination of redfish target strength should be organized. This is presented in recommendation set in Annex 11.

2 Planning of the international trawl/acoustic survey on redfish in the Irminger Sea and adjacent waters in June/July 2009

2.1 Vessels, timing and survey area

The main objective of this survey is the trawl-acoustic assessment of the pelagic redfish in the Irminger Sea and adjacent waters in June/July 2009. As the results of the last surveys indicated, the area covered did not reach the boundary of the distribution area of pelagic redfish on the west and southwest (ICES, 1999, 2002, 2005b, 2007). Therefore, the group agreed to continue to cover area from 52°30′N to 65°30′N and from the 24°W on the east till western boundary to 53°W. It is also considered important to continue the expansion of the vertical coverage to assess the redfish below the acoustic layer (within and deeper than the DSL; see Sections 2.4 and 2.5).

The following research vessels will participate in the survey:

Name of the vessel	Country	Period	Approx. working period in the field	Days in field
Árni Friðriksson	Iceland	26 June – 21 July	27 June – 18 July	22
Vilnius	Russia	15 June – 22 July	24 June – 14 July	21
Walther Herwig III	Germany	4 June – 6 July	10 – 29 June	19

The vessels will communicate daily via e-mail or telex or telephone. Information on the communication between vessels is given in Annex 2.

In Figure 1 and Table 1, the planned survey tracks are displayed for each participating vessel. The distribution of survey tracks within the distribution area of pelagic redfish was planned, on the basis of experience from the past surveys, fisheries information and expected hydrographic conditions.

"Árni Friðriksson" will cover the northern part of the survey area, "Vilnius" will cover the eastern and central parts, and "Walther Herwig III" the southwestern and west parts of the area. The total length of the planned survey tracks is about 8300 nautical miles (NM), divided between the vessels as follows:

"Árni Friðriksson" 3000 NM, "Vilnius" 2900 NM and "Walther Herwig III" 2400 NM.

The cruise leaders of these vessels will apply for entry into the relevant EEZs by notifications to Canada, Greenland and Iceland. The operations in the NAFO Convention Area will be notified to NAFO by each cruise leader.

As in previous surveys, the distance between the planned cruise tracks is 45 NM.

For evaluating the data, the subdivision of the survey area into subareas A-G will be kept as in previous surveys (Figure 2). For the aggregation of biological data, these subareas were summarized to three geographical units since the 2005–2007 surveys (ICES, 2005b; ICES 2007), namely a northeastern, southwestern and southeastern area.

2.2 Data exchange during the survey

The daily reporting on the data between the vessels will be performed in the sheet given in Annex 4. In addition, the range of the acoustic values between the positions of the stations of the most recent day shall be reported. Information about the data exchange after the survey is given in Section 2.9.

2.3 Acoustic estimation

2.3.1 Methodological aspects

The standard sphere calibration (Foote *et al.*, 1987) is a key procedure that contributes to the accuracy of the survey results in a fundamental way and is essential on each vessel. This procedure must be carried out at the start of a survey and repeated if there are any doubts about the achieved success (e.g. long term track record demonstrates larger changes, unexpected fish TS and density measurements).

The calibration of the sounder needs special care due to a bug in the sounder EK500. This bug is fixed for the widebandwidth for all firmware versions higher than 5.2. However, unfortunately not for the narrowbandwidth. The calibration is usually carried out at a small range between the calibration sphere and the transducer, but at those distances a filter delay causes a time variant gain (TVG) error and wrong calibration results. This can be avoided if the calibration is carried out at a large range, preferable a range larger than 25 m.

For the calibration, the lobe program (or a similar program) has to be used. To provide appropriate settings for calibration, it is necessary to adjust the angle sensitivity to the environmental conditions (Bodholt, 2002) before starting the calibration. For this procedure, the results of the calibration tank experiments delivered by Simrad with the transducer are needed. This ensures to be able to compensate the beam function of the transducer applied within the recorded data. The use of angle sensitivity of the specific transducer used within the survey instead of the default value can improve the accuracy of the hydroacoustic measurements.

All participating vessels will use scientific echosounder from Simrad (Germany: EK500, Russia and Iceland: EK 60 and the EI software BI500, EchoView or Famas). For the evaluation of acoustic data, the echo integration method is used. However, the recorded data are often disturbed by vessel noise especially in bad weather.

For thresholding during echo integration, the method derived in Bethke (2004), with modifications on the comparable evaluation system, should be used:

- Measure or calculate S_{vMax} for the smallest target (zoom function of the BI500 or EchoView or Equation 9 in Bethke (2004), $G_{env} = 1$)
- Calculate the maximum threshold value by subtracting 13 dB.
- Obtain the maximum range for the desired measurement accuracy (±10%) at that range where the noise and reverberation level is larger than the S_v threshold – 4dB. The maximum range has to be considered as the starting depth of the DSL.

The range dependency of the signal and noise can make it necessary to carry out the evaluation in several layers and in several steps. It is expected that when only applying EI data down to the upper limit of the DSL (night/day: ≈ 250/400 m), the applied EI threshold (-80 to -84 dB/m^3) should be sufficiently low. When having low densities and mainly smaller fish, one should have a more dynamic attitude of using a lower threshold.

The EK500/EK60 delivers target-strength measurements of single targets. These measurements can be analysed and converted into equivalent s_A measures (Bethke, 2004). Noise may disturb the single-target detection and decrease the computed s_A values, whereas the noise not removed by thresholding increases the computed s_A values for echo integration. Therefore, results obtained by echo integration usually overestimate the stock, whereas echo-counting results underestimate it. Both methods should be applied for the evaluation of acoustic data if possible.

To provide data collection for the development of echo counting, the target strength settings of the sounder should be the same on each vessel. At the moment, no professional echo counter is available; however, the integration software stores single fish data which can be applied for echo counting analyses and development work.

2.3.2 Practical arrangements

Acoustic data obtained when the mixing of the target fish with the components of the DSL is greatest (during the night) should be discarded in the biomass estimation. On sections along the survey tracks, where the available acoustic data are not satisfactory due to mixing, the integrator values will be estimated by interpolation (from values in the nearest vicinity).

The acoustic survey data will be divided into statistical rectangles, which are one degree in latitude and two degrees in longitude. The mean s_A value in each rectangle is estimated and subsequently, the number of fish. Values in rectangles which have not been covered, but are within the surveyed area, are estimated by interpolation from values obtained within rectangles in the nearest vicinity. The total number of fish is then obtained by summation of individual rectangles.

Acoustic data for redfish within and below the DSL shall be stored separately. This shall be done by scrutinizing the acoustic data in each depth category as a separate unit in the EI- post-processing software.

In order to measure the noise from the environment and vessel, participants integrate in passive mode in depth channels (25 m) from 250 m down to at least 750 m for at least 5 NM with a resolution of 1 NM. This could be done during night, using both bandwidths (wide and narrow), pulse lengths (1 and 3 ms) and thresholds used during the survey.

To be able to make a comparable “detailed report” in the post-processing, the height of the layers should be set to 25 m, and the registrations should be scrutinized and presented for every 5 NM. The data should, however, be stored for every 1 NM. In the acoustic report table (see Annex 7a), a column for including the upper depth limit of the DSL is added.

An effort should be made to estimate the effect of different thresholds at different depths on the integrator values from the acoustic equipment used on the three vessels. This is especially important for the low scattering values expected, as the threshold effect will vary with the pulse length, noise and depth used and may as well be dependent on the resolution of the S_v-values stored by the EI software system (stored depth interval/number of stored values per ping).

2.3.3 Instrumental settings, target strength, calibration

All participating vessels will use a 38 kHz Simrad EK500/EK60 split-beam echosounder and EchoView, FAMAS or a BI500/BI60 post-processor for echo integration.

The standardization of the setting of instruments was discussed and it was agreed to use an integration threshold of –80 to –84 dB//m^3, depending on the pulse length used and the system noise level according to the method derived in Bethke (2004). To collect experimental data on redfish echoes within and below the DSL, a pulse length of 3 ms and narrowbandwidth will be applied during night-time as an alternative to the standard setting of 1 ms and widebandwidth.

It was also agreed that the acoustic data should be stored down to the DSL and during night-time at least down to 750 m depth. In Table 2, the settings of instruments are given for each vessel. On all vessels hull-mounted transducers are used.

As the observed length range of the redfish in the 1999 acoustic survey has increased from previous years, a length based target strength model of TS=20 lgL-71.3 dB will be used for the estimation of the number of pelagic redfish in the survey area. This is the same TS model as was used in 2001, 2003, 2005 and 2007.

At the beginning of each national part of the survey, the calibration of the acoustic equipment on board each vessel will be carried out using a standard sphere calibration (Foote *et al.*, 1987; Section 2.3.1) or equivalent method, and applying both pulse length and bandwidth settings (1 ms wide, 3 ms narrow).

2.4 Abundance estimation deeper than the acoustic layer

The estimation of the redfish abundance within and deeper than the DSL is based on catches. The stock size shallower than the DSL is acoustically measured (see Section 2.3). The hydroacoustic measuring system (BI500/BI60/EchoView) is providing nautical area backscattering coefficients (NASC), expressed as s_A values, which are converted by means of the length distribution from the catches to fish density. It is assumed that the acoustically measured fish density values are more precise than fish density estimated from trawling (swept-area method), because relatively little is known about the catchability and effective area of the trawls. To obtain a correlation between catches and s_A values (calibration), the hydroacoustic measurements are carried out at the same time and depth as trawling shallower than the DSL. A problem with these data acquisition is that in some areas, the redfish occurs shallower than the DSL in very low densities and is frequently mixed with planktonic species inhabiting the DSL. Here, the challenge is to exclude these species from echo integration by means of the integration threshold to avoid overestimating the redfish density. Echo counting, however, doesn't overestimate the fish density disturbed by species of the DSL. To improve the accuracy of the measurements, the correlation between catches and s_A values should be calculated based on echo counting and echo integration.

As in previous surveys, the assessment of the redfish abundance within and deeper than the DSL will be attempted by two methods providing an absolute estimate (based on the acoustic data) and a survey trawl index. The catches in numbers per standardized tow will be converted to s_A values expected using trawl calibration results (regression analysis between s_A values – dependent variable and catches in standardized hauls performed – independent variable in the Layer shallower than the DSL). This requires the sufficient coverage of the variation in s_A values and catches between minimum and maximum values. Thereafter, the estimated total-s_A values will be converted to absolute fish numbers and fish biomass.

In order to study the relation between catch and acoustically measured values (calibration of trawls), additional measurements will be added successively and verified by calculations based on the echo counting method. The results of echo counting can be converted into equivalent s_A values, with the advantage that small single targets can be excluded more reliably from the echo integration. These computations must be done to a large extent manually. The German participant will do this after the survey. The other participants supply the catch data, trawl data and hydroacoustic data needed for this procedure. The settings for the EK500/EK60 will be specified before the survey.

An improved regression analysis, including the standard errors and the confidence intervals of the parameter estimates, as described in WD3 of ICES (2003a), will be used to predict the s_A values within and deeper than the DSL. This work will be carried out by the Icelandic participants.

2.5 Trawling

In the 2005 SGRS planning meeting, the design of the survey was reviewed thoroughly (ICES, 2005a). The group aimed at increasing the precision of the trawl estimates, and at the same time, to make best use of the limited available survey time. In the acoustic layer shallower than the DSL, several trawls are made to compare the trawl estimates with the s_A values. Within and deeper than the DSL, the trawling duration of the deeper hauls was expanded to at least 3 hours to increase the catch rates for more precise abundance estimation. This also increases the relative contribution of the pure trawling time to the whole time effort spent on each trawl, considering the time-consuming shooting and hauling procedures. As the redfish abundance within and deeper than the DSL can only be estimated by trawls and as the maximum depth of the upper part of DSL was around 350 m in previous surveys (e.g. ICES, 2002; ICES, 2005b), the group decided to start trawling at this depth and to continue stepwise down to approximately 1000 m (see below).

Based on these principles, the Group decided to keep the trawling methods employed in the 2005 survey (ICES, 2005a), i.e. applying only two trawl types during the upcoming survey: firstly, trawls shallower than the DSL, secondly, trawls within and deeper than the DSL.

Each vessel should identify the acoustic redfish records by trawl catches in two different types. The identification hauls should exclusively cover:

1) The depth zones shallower than the DSL, in which redfish could be acoustically identified. For abundance estimation, it is essential to integrate the s_A value over the trawled distance in the trawled depth zones shallower than the DSL and to report those s_A values in the specified format (Annexes 4a and 8). Trawling distance should be 4 NM.

2) The depth zones within and deeper than the DSL. These trawls should cover the following four depth layers (headline – from up to down): 400 m, 550 m, 700 m, 850 m. Trawling distance at each depth layer should be 3 NM calculated with GPS, excluding the setting and hauling of the net.

Both types of identification hauls should be evenly distributed in the survey area, with a minimum of twelve trawl hauls conducted for each depth layer. Ideally, the distance between trawls should not be greater than 45 NM, but due to the limited survey time, the distance will be considerably larger. Station data as well as total redfish catch in numbers and weight should be reported in accordance with Annex 4b. Changes in course shall also be registered in the sailing diary sheet (Annex 3).

However the group anticipated that, following the workshop on redfish stock structure (WKREDS) held in 22–23 January 2009, ICES may recommend that redfish above and below 500m be sampled separately. If this is the case, the sampling should be carried out as follows:

Each vessel should identify the acoustic redfish records by trawl catches in three different types. The identification hauls should exclusively cover:

1) The depth zones shallower than the DSL, in which redfish could be acoustically identified. For abundance estimation, it is essential to integrate the s_A value over the trawled distance in the trawled depth zones shallower than the DSL and to report those s_A values in the specified format (Annexes 4a and 8). Trawling distance should be 4 NM.
2) the depth zone shallower than 500 m, in which acoustic redfish registration is hampered by the deep scattering layer. The identification hauls may cover the following layer (headrope of the net): from the top of the DSL down to 450m. There should be no overlap between the sampling in layers 1 and 2. Trawling distance at each depth layer should be 2 nautical miles calculated with GPS.
3) the depth zones deeper than 500 m depth. The deep identification hauls should cover the following 3 depth layers (headline): 550 m, 700 m, 850 m. Trawling distance at each depth layer should be 2 nautical miles calculated with GPS.

All three types of identification hauls should be evenly distributed in the survey area, with a minimum of eight trawl hauls conducted for each depth layer. Station data as well as total redfish catch in numbers and weight should be reported in accordance with Annex 4. Changes of course shall also be registered in the sailing diary sheet (Annex 3 and 4).

If possible, the inflow of redfish into the trawl at the depth intervals described above should be estimated by a probe device mounted to the net.

In addition to the direct trawl estimates, the Group recommends keeping the calculation of s_A values from the regression between trawl abundance and s_A values in the hydroacoustic layer shallower than the DSL (see Section 2.4).

The net used on "Árni Friðriksson" and "Walther Herwig III" will be a Gloria type #1024, with a vertical opening of approximately 45 m. On "Vilnius", a Russian pelagic trawl (design 75/448) with a circumference of 448 m and a vertical opening of 47–50 m will be used. All vessels use a mesh opening of 40 mm in the codend.

2.6 Biological sampling

It was agreed to follow a similar procedure as used during the surveys since 1994 (ICES, 1993; ICES, 1994; ICES, 1999; ICES, 2002; ICES, 2003; ICES, 2005a and 2007a). The biological data mentioned below shall be exchanged by e-mail, using the database format given in Annex 4c (Excel spreadsheets).

Biological sampling should be conducted as follows:

1) In the case of subsampling, the ratio of the subsample to the total catch should be noted as "conversion factor" in the data recording sheet.
2) Individual data: The total length (cm below), individual weight, sex and stage of maturity should be measured on at least 300 redfish from each haul. The maturity scale given in Annex 6 will be used for data exchange. The Russian participants will use the maturity scale given in Annex 7 that will be converted to the one given in Annex 6.

3) Otolith sampling should be carried out at each station. Sampling will be conducted on 50 individuals following a random sampling procedure (i.e. not stratified by length). The otolith envelope should carry at least the station no. and fish ID no. given in the database to allow for allocation to the individual biological data. If possible, length and weight of individual fish should not be recorded on the otolith envelopes.

4) Stomach fullness, parasites and pigmentation: Observations on the stomach fullness, the location and size of skin/muscular pigments as well as infestation with *Sphyrion lumpi* and its remnants should be investigated on at least 50 randomly sampled fish from the subsample of each haul, according to the details given in Annex 5c (see also WD 2 in ICES, 1999). Registration of melanin shall also be recorded on a scale 1–4 (1= nothing, 2= little; 3= medium; 4= much).

5) Biological data as well as scales (and otoliths if possible) of roundnose grenadier (*Coryphaenoides rupestris*) should be collected by all participating nations according to WD3 of ICES (2005a). It was noted, however, that fish weight can only be recorded with a precision of 1 g on "Árni Friðriksson" and "Walther Herwig III", and that Russia should provide detailed maturity staging guidelines well in advance of the survey.

Genetic sampling:

On a limited number of stations (~5 for each vessel) genetic sampling will be carried out. For this purpose fin clips will be sampled from 100 fish (randomly sampled) and preserved in ethanol. Otoliths will be collected from all the individuals and individual length, weight, sex, maturity, parasites and pigmentation recorded. The genetic stations will be selected on an ad hoc basis so that they are located in different regions of the survey and depth strata. Only stations with at least 100 individuals (or close to) should be selected for genetics.

Sampling of stomachs for subsequent laboratory analysis, as well as plankton sampling, is optional.

2.7 Hydrography

All participants will carry out hydrographic observations using CTD probes down to 1000 m depth. The CTD stations should be taken at the corners of each transect and at each trawl station. The CTD stations should be divided evenly throughout the survey area but the distance between CTD should be not more than 60 NM.

The hydrographical data at depths of 0, 10, 20, 30, 50, 100, 200, 300, 400, 500, 600, 700, 800, 900 and 1000 m from each CTD station shall be included in daily report for exchange between the participants during the survey (Annex 3).

After the survey, when the data have been calibrated, the whole set of obtained information on pressure, temperature and salinity will be exchanged to each of the participating countries in CTD standard files (Annex 5).

The long-term hydrographical Russian 3K section (nine standard stations) in the Irminger Sea will be included in the joint survey programme and carried out by the Russian vessel.

2.8 Further issues

2.8.1 Exchange of experts

Germany, Iceland and Russia invited other participants to join their part of the survey. Russia accepted the invitation from Germany and will send a specialist with "Walther Herwig III". Furthermore, Russia offers to send a biologist with "Árni Friðriksson", which was accepted by Iceland. Due to staff limitations, the Icelandic and German cruise partners will not be able to send guest scientists from their labs onto other vessels.

2.8.2 Participation of further countries

The Group was again facing the problem of covering the entire survey area with only three vessels, resulting in a large spacing of survey tracks and trawl hauls. In order to improve the precision of the survey by increasing the density of the tracks and trawl stations, additional vessels should take part in the survey. The Group recommended as in 2005 (ICES, 2005a) that "at least four vessels should participate to allow a sufficiently dense coverage of the survey area and to permit an improvement in the quality of the derived abundance and biomass estimates. Thus, the efforts directed at involving other nations in the survey should be continued."

Notwithstanding the disappointing outcome of earlier attempts, the group will continue its efforts in involving further countries in the survey. The group also notes that other non-EU countries involved in the fishery should consider their participation in the survey.

2.9 Time schedule for the survey report

The final reporting will take place during the next PGRS meeting in Iceland from 28–30 July 2009. To finalize the work during three days, the following plan will be followed:

As soon as the vessel has finished scrutinising the acoustic data, after the survey tracks are finished, the data (according to Annex 8) must be sent to other participants. Not later than 22 July, all data shall be sent via e-mail to all cruise leaders and Co-Chairs. The data shall be sent in the format described in Annex 4a-c, 5 and 8 all participants shall have a copy in an electronic format.

Iceland will calculate the abundance estimation of the redfish within and deeper than the DSL, including writing of the material and methods, results and discussion.

Russia will work up the environmental data, including the drawing of pictures, writing of the material and methods, results and discussion.

Iceland will calculate and finalize the acoustic data, including writing of the material and methods, results and discussion. Iceland will also draw the cruise tracks and information on stations.

Germany will be responsible for writing about biological results, including writing of the material and methods, results and discussion. In addition, Germany will be responsible for the echo counting work described in Sections 2.3 and 2.4.

All drafts must be sent to the PGRS Co-Chairs before 24 July 2009.

3 Planning of the international trawl/acoustic survey on redfish in the Norwegian Sea in July/August 2009

The main objective of the survey is to provide information on the horizontal and vertical distribution and abundance of *S. mentella* in the Norwegian Sea. The survey is based on combined trawl and acoustic measurements assessment of the pelagic redfish stock in the Norwegian Sea in July/August 2009. A previous international survey was conducted in 2008 (ICES 2008). The planning of the current survey is constructed so that continuity in the protocols is ensured. At the same time, the recommendations from ICES (Section 3.3.3.2 in ICES Advice 2008 book 2) to improve the standardization of methodology is considered and common protocols are described in the following sections.

3.1 Vessels, timing and survey area

In 2008, a similar survey was conducted by Norway, Russia and the Faroes. In 2009, the group anticipated additional participation from Iceland and EU. However, at the time of the meeting, there was no confirmation that Iceland or EU will participate and the current survey plan has been designed with three vessels only. Additional participation is still being explored and will be welcome. This would allow for the improvement of the sampling methodology, in particular the total area coverage and the density of sampling. At present, it is anticipated that the survey will not fully cover the geographical extent of redfish in the Norwegian Sea and that the results obtained will be of reduced precision due to limited number of trawl samples and large distances between sampling transects. Norway, Russia and the Faroes will contribute with one commercial fishing vessel each, for two weeks (14 days at sea). The names of the vessels are still unknown.

The 27 July is proposed as the starting date for the survey. This might be altered according to commercial vessel constraints. The survey is scheduled to end before the opening of the redfish Olympic fishery in the international waters (15 August).

The geographical extent and survey tracks of each vessel are currently based on the sampling achieved in 2008 (Figure 3). However, the group recommends expanding to the north of 74N and to the west towards Jan Mayen. This may be achieved if EU participation is confirmed or by increasing the distance between tracks of the Norwegian survey. In addition, the possibility of adaptive sampling according to water temperature measurements is recommended. The western part of the survey is close to the polar front which separate Atlantic to the east from Arctic waters to the west. Redfish is usually not present in the Arctic waters. It is therefore recommended that when cold arctic water is detected before the end of a sampling transect the vessel to move directly to the next transect (north or south) without completion of the western part or the transect. This would free some time that could then be used for additional trawl sampling.

3.2 Data exchange during the survey

The daily reporting on the data between the vessels will be performed using the same protocols as in the Irminger Sea. However, the sheet given in Annex 4 will be modified as follows: The types of trawl in the Norwegian Sea are: 1: above DSL, 2: within DSL, 3: below DSL. Two columns will be added for registration of the different depths of trawling during one trawl haul See Section (3.4.2). A column will be added to register trawl catch in numbers.

3.3 Hydro-acoustics

3.3.1 Methodological aspects

The hydroacoustics will be carried out using split-beam transducer and 38kHz as the primary frequency. Particular attention should be paid to vessel acoustics characteristics when selecting the operating vessel. Registrations will be recorded down to at least 750m. Cruise leader should pay particular attention to possible interference with other echosounder(s) on board.

The calibration of the echosounder will be carried out by each vessel, at the beginning of the survey, using standardized sphere, as described in Foote *et al.* (1987).

The true value of the Target Strength for redfish in the Norwegian Sea is still debated. In the previous survey, Norway used the length based TS equation: TS=20logL-68, while Russia used the equation TS=20logL-71.2. PGRS recognizes that obtaining the correct estimate of TS is critical for the work carried by the group. The TS issue could not be solved during the meeting but the following strategy was adopted:

1) Use the equation TS=20logL-68 in 2009, for all participants.
2) Organise a workshop on *S. mentella* Target Strength determination in 2010. The objective of the workshop will be to provide an estimate of the TS based on the best available scientific literature and data to date. The proposed approach is a review of existing published material combined with an evaluation of the analysis of data collected in the Norwegian Sea. The group suggests that this workshop be chaired by a scientist external to research on *S. mentella*, and that it is organized in tight connection with WGFAST. This is developed in the recommendation presented in Annex 11.

An inter-vessel hydroacoustics comparison exercise will be carried out between pairs of vessels, i.e. with vessels steaming in parallel for at least 30NM and acquiring hydroacoustics data simultaneously (as described in Section 8.9.2 in Simmonds and MacLennan 2005).

3.3.2 Scrutinizing and data interpretation

Scrutinizing of hydroacoustic registrations will be carried out on distinct systems for each country: LSSS for Norway, FAMAS for Russia and EchoView for the Faroes. Although it has been recommended that the same scrutinizing software should be used for all participants, this appears difficult to achieve because of long standing experience of each participant in a specific system. However, both Russia and the Faroes are currently exploring the possibility of using LSSS and are in contact with the manufacturing company to use trial versions of the software.

The list of acoustic categories to be used was set according to the recommendations of the workshop on hydroacoustic scrutinizing (Annex 9): beaked redfish, blue whiting, herring and saithe should be the compulsory categories. Other fish categories are optional. Fish species which are not registered into a specific category should be listed as ‘Others’. The category ‘Plankton’ includes small targets, e.g. plankton, myctophids, ribbon barracudina.

For the most common species, the following TS equations should be used:

Redfish:	20logL-68
Blue whiting:	21.8logL-72.8

Herring: 20logL-71.9

Saithe: 20logL-68

Cod: 20logL-68

Scrutinizing/interpretation of data should be done separately in the three layers: above, within and below the DSL. The main thresholding level is set to -80dB.

In the layer above DSL: s_V thresholding is applied to remove reverberation due to plankton and other small targets (up to approx. -75dB). The remaining s_A is then allocated to fish according to s_A proportions in the nearest trawl haul.

In the layer within DSL two strategies may be applied:

- **Strategy 1:** s_V thresholding is applied to remove reverberation due to plankton and other small targets. The remaining s_A is allocated to fish according to s_A proportions in the nearest trawl haul. It is recognized that this procedure results in imprecise estimates due to uncertainty in the level of thresholding to apply. In addition, the resulting s_A allocated to various species may be underestimated due to removal of fish targets when thresholding or overestimated due to inclusion of small targets (DSL) in the s_A allocated to fish estimates. The layer may be divided in vertical sublayers (e.g. 50 m deep) in which different levels of thresholding are applied.
- **Strategy 2:** no scrutinizing / trawl estimate (s_{ATR}). In this procedure, the s_A allocated to the layer is directly derived from the species composition in the nearest trawl haul.

In the layer below DSL: strategy 1 for DSL (above) should be applied.

The partition of sA between species based on TS distribution should be avoided, as recommended by the workshop on hydroacoustic scrutinizing (Annex 9).

After the survey, the raw acoustic data should be exchanged between all parties (DVDs send by post or exchanged at the PGRS September 2009 meeting). The scrutinizing cross-comparison (as conducted during the hydroacoustic scrutinizing workshop) should be conducted systematically, as a measure of data qualification. Trawl catches should be compared to s_A estimates after the scrutinizing is completed and each party should provide regression plots between catches and s_A.

3.4 Trawling

3.4.1 Equipment

Hampidjan Gloria 2048 is adopted as the standard trawl by all countries. The codend should be fitted with and inner net of 40mm mesh opening. As in 2008, Norway will use a multisampler which permits the collection of samples in three separate codends. This equipment allows for more intensive sampling and better vertical resolution. The group recommends that all parties investigate the possibility of using similar equipment in future.

3.4.2 Location, depth and duration of trawl hauls

The geographical location of trawling will be decided by cruise leaders on an ad hoc basis. It is important that the trawl locations are regularly distributed geographically and cover three vertical layers: above the DSL, within the DSL and below the DSL.

These three layers will be sampled separately (i.e. a single trawl haul should not sample in two layers).

Above the DSL: trawling will be on registration. The depth and duration cannot be defined in advance but the trawl should remain above the DSL for the whole duration of trawling.

Within the DSL: trawling will be carried out by steps of 3NM, with one step for each 100m of DSL thickness. When the DSL is ~100m thick, trawling will be performed at one depth for 3NM. When the DSL is ~200m thick, trawling will be carried out first in the shallower part of the DSL for 3NM then 100m below for another 3NM. When the DSL is ~300m thick, trawling will be performed at three depths, first in the shallower, second in the middle and third in the deeper part of the DSL for 3NM in each depth. The trawl should remain within the DSL for the whole duration of trawling.

Below the DSL: The same procedure as for the DSL layer will apply. A maximum of three depths will be sampled and the deepest step will be 700m (headrope). The trawl should remain below the DSL for the whole duration of trawling.

3.5 Biological sampling

3.5.1 Species composition

Catch weight and number of all species will be recorded for each haul. The occurrence of species in the trawls will be reported. Ribbon barracudina is agreed as the common name used for *Arctozenus risso* (also named *Notolepis*). If possible, squids should be split by species and/or size. For specimen with uncertain taxonomic identification (e.g. blackfish, Cornish blackfish) a photograph should be taken and the specimen eventually frozen. Shrimps will be reported in one group, but krill will be reported in a separate category.

For large catches, the total number of fish can be derived from the total weight of the catch and the ratio between numbers and weight established from a subsample of the total catch. Commercial conversion factors should not be used. The weight of jelly fish should be recorded.

3.5.2 Length distribution

All length measurements are for total length and should be reported at the cm below. At least 100 redfish individuals per sample will be measured (33 individuals per codend when the multisampler is used)

3.5.3 Age distribution

Age distribution will be established from otolith reading. The sampling of otolith will be carried out following a random sampling strategy. The rational for choosing this strategy is outlined in the working document on otolith sampling in Annex 10. A minimum of 25 pairs of redfish otoliths (10 when multisampler is used) will be collected from the first 25 fish measured. There should be no selection of the fish based on size (i.e. one should not try to collect otoliths from a balanced sample of small, medium and large fish). This needs to be clearly explained to the scientists/technician responsible for the sampling on deck. If possible, length and weight of individual fish should not be written on the otolith envelopes, and otolith boxes can be used as an alternative. The absence of length/weight information on the envelope prevents from bias in age determination (due to preconception that small fish should be young and large fish should be old).

3.5.4 Sex and maturity

Sex and maturity will be determined for 100 redfish individuals. All participants will use the ICES maturity scale as a reference (Annex 6).

3.5.5 Parasites and pigmentation

Parasite infestation and pigmentation marks will be reported for 100 redfish individuals. The 2008 survey revealed inconsistencies in the parasite and pigmentation data from the different nations. This problem is believed to arise from differences in the methodologies used on each vessel. Each participant will ensure that the procedure is followed adequately as described in Bakai and Karazev (2001).

3.5.6 Genetics

On a limited number of stations (~5 for each vessel) genetic sampling will be carried out. For this purpose fin clips will be sampled from 100 fish (randomly sampled) and preserved in ethanol. Otoliths will be collected from all the individuals and individual length, weight, sex, maturity, parasites and pigmentation recorded. The genetic stations will be selected on an ad hoc basis so that they are located in different part of the survey and depth strata. Only stations with at least 100 individuals (or close to) should be selected for genetics.

3.6 Hydrography

Hydrographical measurements in the Norwegian Sea are a by-product of the survey. The group has agreed to obtain the best possible hydrographical data within the constrained time of the survey and considering the general lack of appropriate winch for CTD casts on commercial vessels. For this purpose, all hydrographical measurements will be made from a sensor attached to the trawl. Norway and the Faroes will use a SAIV AS/SD204 probe and Russia will use the Simrad temperature sensor. Temperature data will be reported in the daily report forms (Annex 3).

3.7 Further issues

3.7.1 Exchange of experts

Exchange of experts between countries/vessels has not been planned for the 2009 survey. This should be considered during later phases of the survey planning this year or at least for surveys conducted in future years.

3.7.2 Participation of further countries

As for the Irminger Sea, the group was facing the problem of covering the entire survey area with only three vessels, resulting in a large spacing of survey tracks and trawl hauls. In order to improve the precision of the survey by increasing the density of the tracks and trawl stations, additional vessels should take part in the survey. The group recommended that five vessels should participate to allow a sufficiently dense coverage of the survey area and to permit an improvement in the quality of the derived abundance and biomass estimates. The efforts directed at involving other nations in the survey should be pursued.

3.8 Time schedule for the survey report

The final reporting will take place during the third PGRS meeting in Bergen, Norway from 1–3 September 2009. To finalize the work during three days, the following plan will be followed:

As soon as the vessel has finished scrutinising the acoustic data, after the survey tracks are finished, the data (according to Annex 8) must be sent to other participants. Not later than 24 August, all data shall be sent via e-mail to all cruise leaders and Co-chairs. The data shall be sent in the format described in Annex 4a-c, 5 and 8 all participants shall have a copy in an electronic format.

Norway will analyse the vertical distribution of redfish and provide abundance estimates from trawl hauls. Norway will also draw the cruise tracks and information on stations and produce the table on species occurrence. Norway will be responsible for writing about biological results, including writing of the material and methods, results and discussion.

Russia will work up the environmental data, the parasite and pigmentation data, including the drawing of pictures, writing of the material and methods, results and discussion.

Faroes will calculate the abundance estimates based on the hydroacoustics.

Iceland will compute the age-structures and sex ratios for the different areas.

All results, tables, graphs and text drafts must be sent to the PGRS Co-Chairs before 28 August 2009.

4 Change of Chairship

Due to change in professional position, Andrey Pedchenko will not be able to pursue his duty as Co-Chair of PGRS after June 2009. The group proceeded to the election of a new Co-Chair. The group recommends that Kristján Kristinsson (Iceland) be formally appointed as the new Co-Chair of PGRS by ICES, starting in July 2009. The other Co-Chair (Benjamin Planque) remains unchanged.

5 Recommendations

RECOMMENDATION	ACTION
Involve more countries in the Irminger and Norwegian Seas surveys	ICES Secretariat, ICES Delegates
Nominate Kristján Kristinsson as new Co-Chair of PGRS, in replacement of Andrey Pedchenko.	ICES Statutory Meeting, ICES Council
Organise a workshop on the determination of acoustic TArget strength of Redfish (WKTAR) in 2010 in connection with WGFAST (see Annex 11).	ICES Statutory Meeting, ICES Council

6 References

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7 Tables

Table 1. Agreed preliminary cruise tracks for the international survey on redfish in June/July 2009.

Vilnius			Walther Herwig III			Árni Friðriksson		
Lat	Long	Distance	Lat	Long	Distance	Lat	Long	Distance
62.50	-26.00	Start	55.75	-37.50	Start	63.00	-26.00	Start
62.50	-33.00	194	53.75	-43.50	240	63.00	-34.00	218
62.25	-33.50	20	52.50	-48.00	178	62.00	-34.00	60
62.00	-33.00	21	52.50	-51.00	110	62.00	-27.00	197
59.67	-26.25	242	53.25	-52.00	58	61.50	-28.00	41
59.25	-30.00	117	53.25	-48.00	144	61.50	-35.50	215
57.00	-34.00	185	54.00	-45.25	108	60.75	-35.50	45
57.00	-51.00	554	54.00	-52.00	238	60.75	-28.00	220
57.75	-49.00	79	54.75	-52.00	45	60.00	-29.00	54
57.75	-35.00	447	54.75	-43.00	311	60.00	-42.00	389
58.50	-33.50	65	55.50	-40.50	97	60.75	-41.00	54
58.50	-48.00	454	55.50	-52.00	390	60.75	-36.50	132
59.25	-47.00	55	56.25	-50.75	62	61.50	-36.50	45
59.25	-32.00	459	56.25	-37.00	458	61.50	-41.00	129
						62.25	-40.00	53
						62.25	-35.00	140
						63.00	-35.00	45
						63.00	-40.00	136
						63.75	-38.00	70
						64.75	-36.00	79
						65.25	-33.00	82
						65.25	-28.00	126
						64.50	-28.00	45
						64.50	-34.00	155
						63.75	-36.00	69
						63.75	-27.00	239
Total sailing (NM)		2892			2438			3038
Days in the field		21			18.5			22
Average sailing/day		138			132			138

Table 2. Instrument settings of the acoustic equipment settings on-board the vessels participating in the international survey for redfish in June/July 2009. The sound speed setting used in the EK500 will be set at the beginning of the survey. The alternative pulse length and bandwidth settings given in parentheses will be applied during night-time to collect experimental data on redfish echoes within and deeper than the DSL.

	ÁRNI FRIÐRIKSSON	VILNIUS	WALTHER HERWIG III
Echo sounder/ integrator	Simrad EK60/ EK500 / EchoView	Simrad ER60/BI60 +FAMAS	Simrad EK500 /EchoView
Frequency	38 kHz	38 kHz	38kHz
Transmission power	2000 W	2000 W	2000 W
Pulse length	1.0 ms (3.0 ms)	1.0 ms (3.0 ms)	1.0 ms (3.0 ms)
Bandwidth	Wide (Narrow)	Wide (Narrow)	Wide (Narrow)
Transducer type	ES38-B	ES38-B	ES38-B
Integration threshold	-80 dB/m3	-80 dB/m3	-80 dB/m3

8 Figures

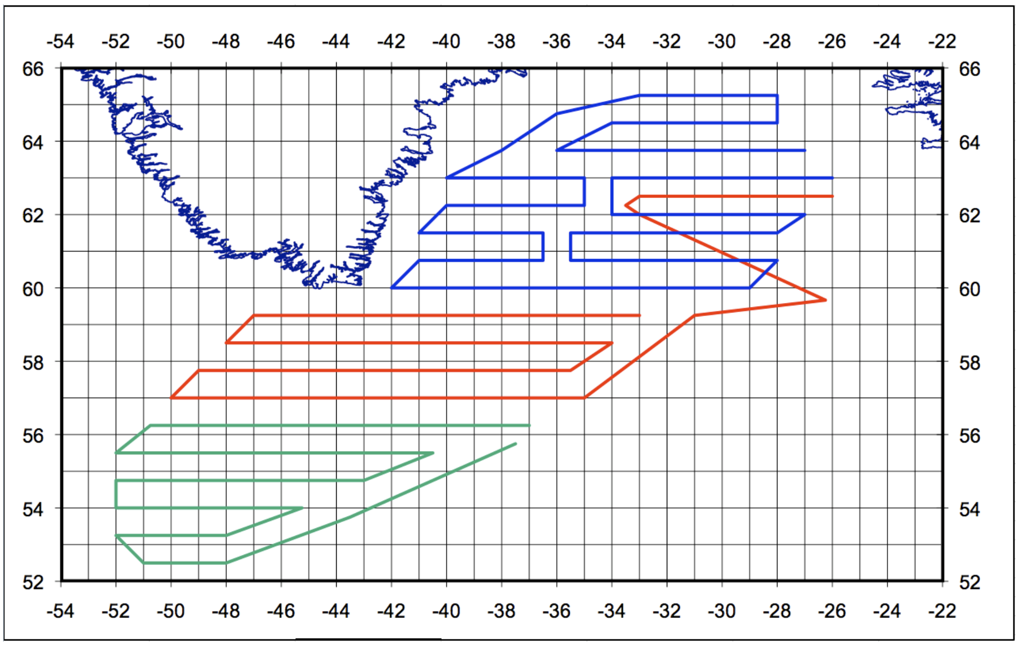

Figure 1. Preliminary cruise tracks of the international survey on redfish in June/July 2009. Blue: RV "A. Fridriksson", Red: RV "Vilnius". Green: RV "Walther Herwig III".

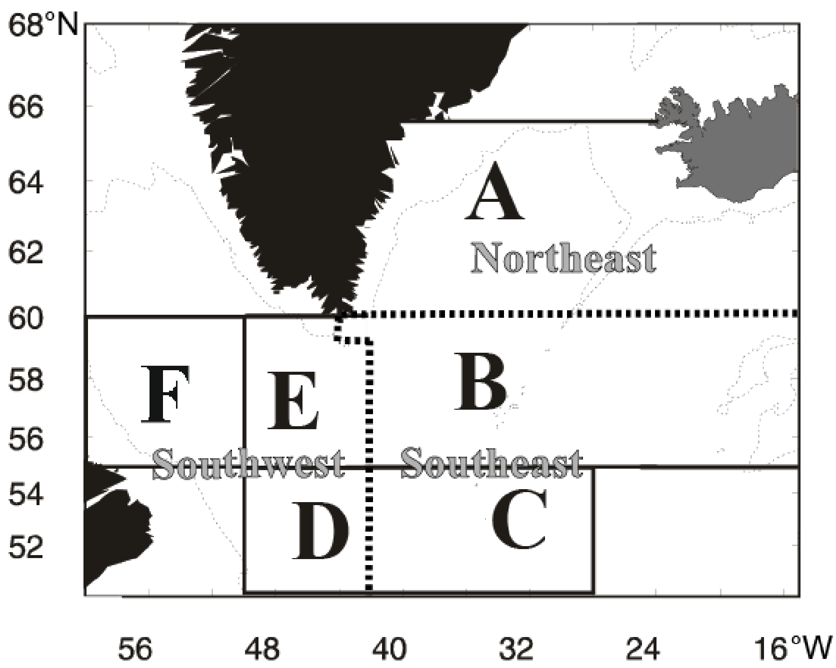

Figure 2. Sub-areas A-G, agreed to be used in the international survey on redfish in June/July 2009. Dashed area boundaries and grey area names relate to the geographic aggregation of biological data.

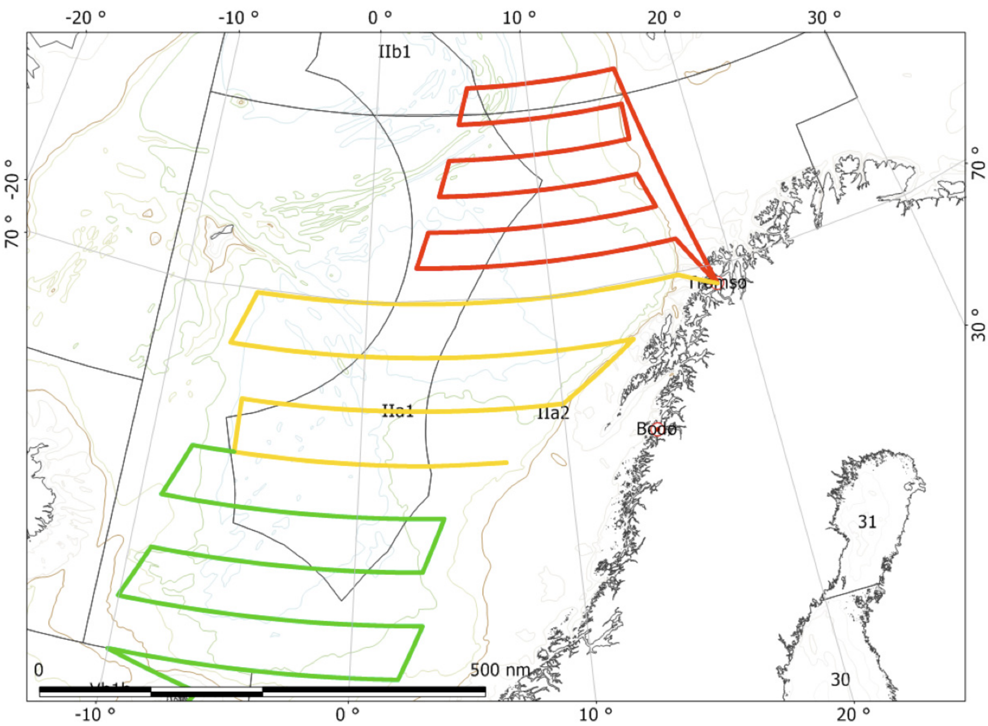

Figure 3. The cruise tracks from the Norwegian Sea redfish survey in 2008. These will serve as the preliminary basis for the cruise tracks in 2009.

Annex 1: List of participants

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Annex 2: Information on communication between vessels for the Irminger Sea survey

RV "Vilnius" (Russia) Call sign: UFJJ Telephone: +7 9212895200 +7 9542103641 Telefax: 54091 Inmarsat C (Telex): +581 427300660 E-mail: Vilnius@pinro.ru or Vilnius@marsatmail.ru	RV "Walther Herwig III" (Germany) Call sign: DBFR Telephone: 00870 763936068 Telefax: 00870 763936070 or 00870 600365043 Data: 00870 600365042 Inmarsat C (Telex): +581 421121550 e-mail: fahrtleiter@wh3.bfa-fisch.de (or: wh001.wherwig-ble@skyfile.de)
RV "Árni Friðriksson" RE 200 (Iceland) Call sign: TFNA Telephone: +354 8540535 Telefax: +354 8540532 Inmarsat C (Telex): +581 425150710 Inmarsat B (Tel.): 00874 325150710 Telefax: 00874 325150711 Data: 00874 325150712 Iridium (Tel.): 881-631426272 e-mail: arnif.bru@sjopostur.is	

Annex 3: Sheet used for daily reporting of data among the vessels

This example also demonstrates the format of the data. The data should be sent as ASCII text with semicolon (;) as a separator.

Daily reporting of data

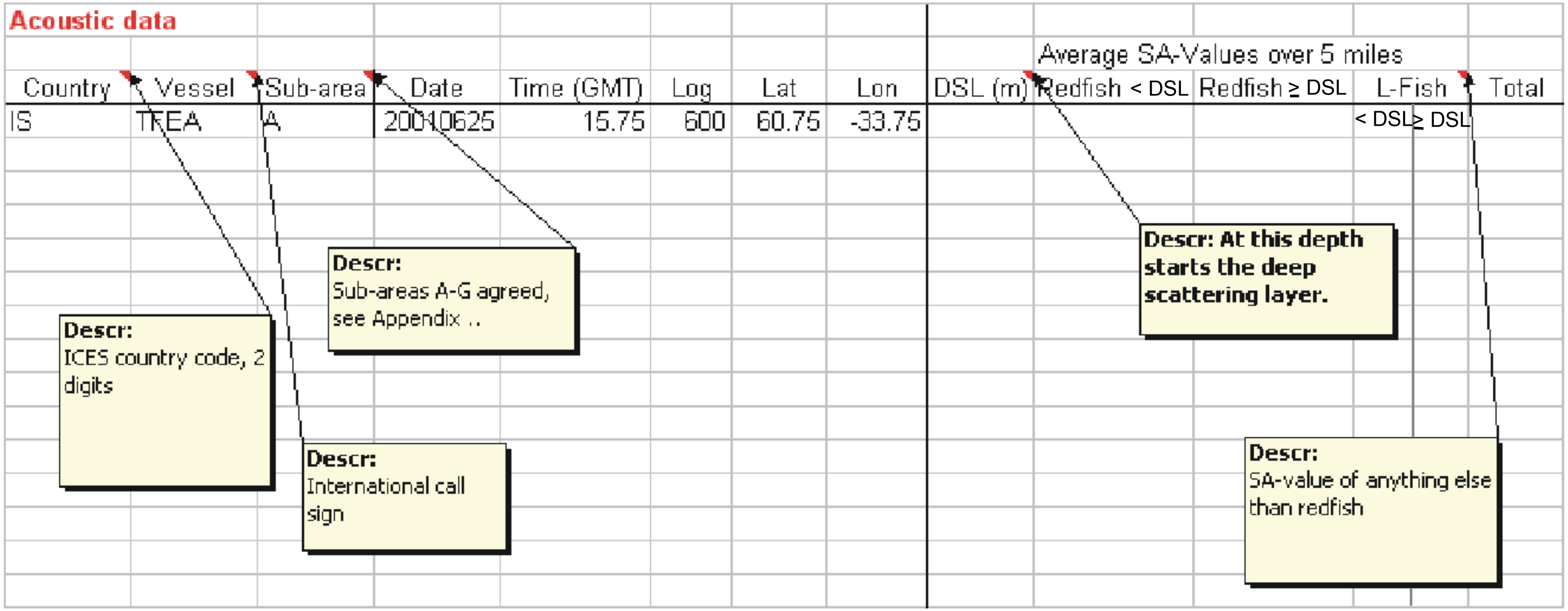
Vessel: vessel name

TEMPERATURE AT DUFFERENT DEPTHS

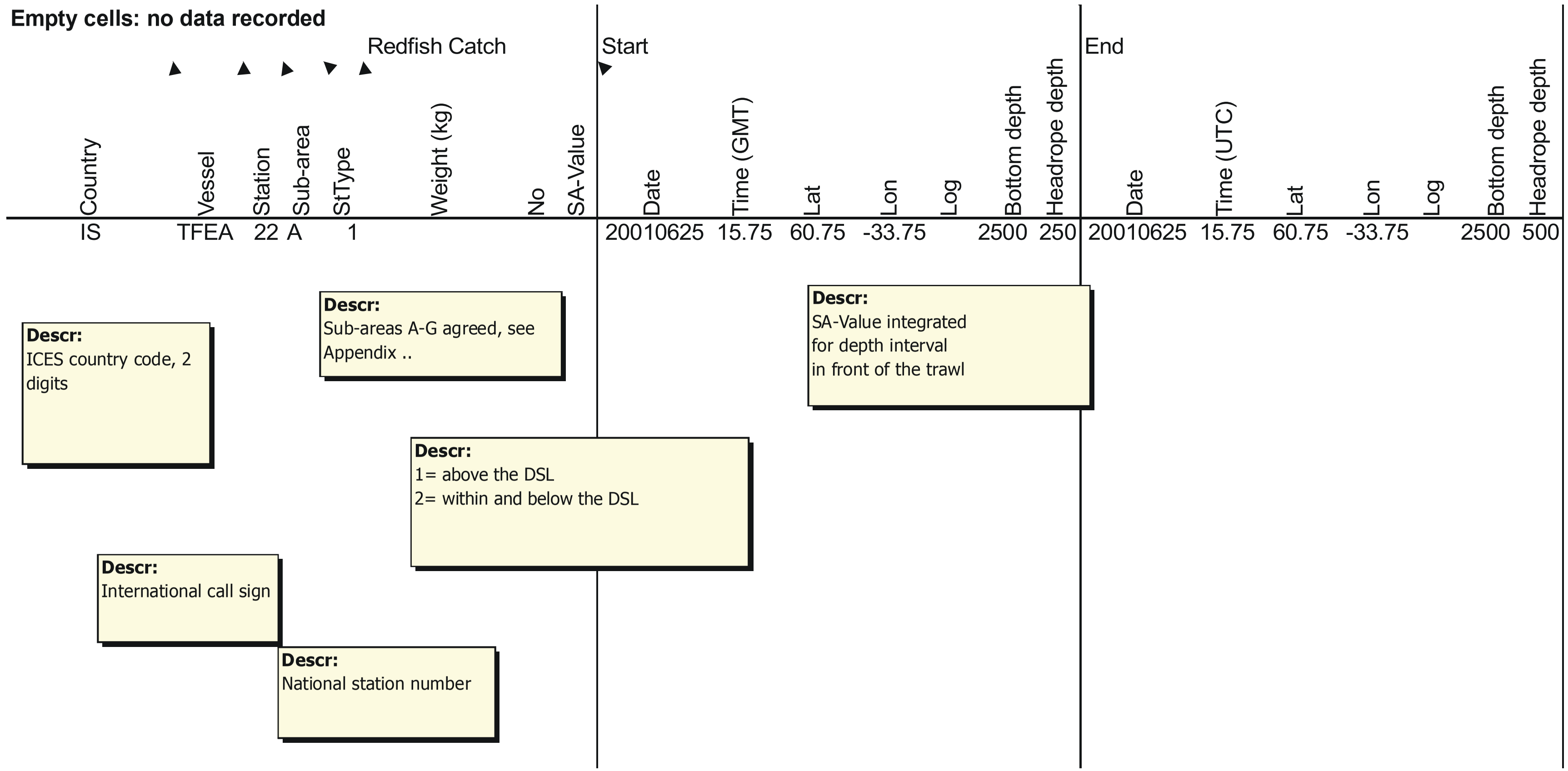
sent	N	Station number	Type of station	Log	Date	Position Lat	Position Lon	Time (GMT)	Catch (kg)	Sa range min	from last max	T0	T10	T20	T30	T50	T100	T200	T300	T400	T500	T600	T700	T800	T900	T1000
+	1		ch.course	160	22.06	6250	2710	1300		0	0															
+	2	273	ctd	180	22.06	6238	2742	1650		0	0	8.90	8.90	8.73	8.58	8.44	7.66	7.31	7.25	7.1	6.57	6.37	5.86	5.45	5.01	4.59
+	3		ch.course	184	22.06	6235	2748	1752		0	0															
+	4		ch.course	197	22.06	6226	2805	1907		0	0															
+	5	274	3	215	22.06	6219	2808	2130	103	0	0															
+	6	275	3	299	23.06	6230	2806	2300	186	0	0															
+	7	276	ctd	318	24.06	6233	2752	0316		0	0	9.30	9.29	9.94	8.60	8.46	7.47	7.15	6.89	7.05	6.85	6.56	6.23	5.58	5.02	4.64
+	8	277	1	369	24.06	6231	2600	0925	0	0	0															
+	9	278	3	416	24.06	6230	2440	1515	6	0	0															
+	10	279	ctd	436	24.06	6231	2427	1810		0	0	9.00	8.96	8.73	8.44	8.09	7.79	7.57	7.37	7.19	6.94	6.61	6.21	5.68	5.1	4.63
+	11	280	3	487	25.06	6230	2214	0145	6	0	0															
+	12	281	ctd	491	25.06	6230	2208	0340		0	0	9.70	9.66	9.64	9.30	8.49	7.96	7.71	7.47	7.28	7.07	6.87	6.23	5.6	5.1	4.7
+	13	282	ctd	548	25.06	6230	2011	0955		0	0	10.10	10.10	9.94	9.55	9.03	8.52	8.21	7.94	7.81	7.7	7.51	7.21	6.85	6.27	5.63
+	14	283	3	560	25.06	6218	2013	1200	0	0	0															
+	15	284	ctd	607	25.06	6130	2012	1847		0	0	10.60	10.55	10.25	9.74	9.31	8.6	8.28	8.1	7.91	7.75	7.57	7.32	6.85	6.27	5.6
+	16	285	3	625	25.06	6129	2046	2105	2	0	0															
+	17	286	2	636	26.06	6129	2108	0040	1	0	0															
+	18	287	3	723	26.06	6130	2407	0942	8	0	0															
+	19	288	ctd	729	26.06	6130	2415	1215		0	0	9.80	9.78	9.43	9.09	8.49	8.16	7.83	7.66	7.53	7.37	7.14	6.8	6.28	5.63	5.13
+	20	289	ctd	800	26.06	6130	2647	1925		0	0	9.80	9.70	9.30	9.10	8.46	7.82	7.37	7.21	7.03	6.95	6.69	6.31	5.86	5.54	
+	21	290	3	802	26.06	6130	2646	2000	4	0	0															
+	22	291	3	860	27.06	6130	2834	0323	14	0	0															
+	23	292	ctd	868	27.06	6130	2847	0610		0	0	9.80	9.82	8.70	8.09	7.26	6.5	6.05	5.71	5.17	4.93	4.83	4.55	4.44	4.17	3.98
+	24	293	3	948	27.06	6032	3027	1420	20	0	0															
+	25	294	ctd	958	27.06	6031	3018	1835		0	0	10.90	10.87	10.36	9.39	8.39	7.59	7.37	7.21	6.94	6.32	6.54	5.33	5.24	4.6	4.43
+	26	295	2	994	27.06	6030	2857	2228	0	0	0															
+	27	296	3	1016	28.06	6030	2815	0155	5	0	0															
+	28	297	ctd	1024	28.06	6030	2758	0457		0	0	10.90	10.89	10.67	9.69	8.86	8.03	7.58	7.47	7.35	7.22	6.9	6.57	5.97	5.47	4.83
+	29		ch.course	1064	28.06	6031	2630	0902		0	0															
+	30	298	3	1097	28.06	6004	2718	1210	6.2	0	0															
+	31	299	ctd	1107	28.06	5958	2735	1558		0	0	11.90	11.86	11.84	10.84	9.7	9.2	8.96	8.03	7.53	7.36	7.18	6.9	6.06	5.57	5
+	32	300	2	1213	29.06	5839	2950	0200	0	0	0															
+	33	301	ctd	1268	29.06	5800	3101	0800		0	0	11.10	11.12	10.81	9.69	8.63	7.95	7.61	7.51	7.35	7.01	6.69	6.7	6.11	5.44	5.03
+	34	302	3	1303	29.06	5800	3206	1155	8.5	0	0															
+	35	303	1	1390	29.06	5800	3449	2202	4.9	0	7															
+	36	304	3	1404	30.06	5800	3512	0215	8	7	20															
+	37	305	ctd	1409	30.06	5800	3518	0349				11.00	10.94	10.94	10.77	8.29	7.38	7.35	6.59	6.2	6.01	5.48	4.9	4.43	4.09	3.92

Annex 4: Various Sheets used for Observations

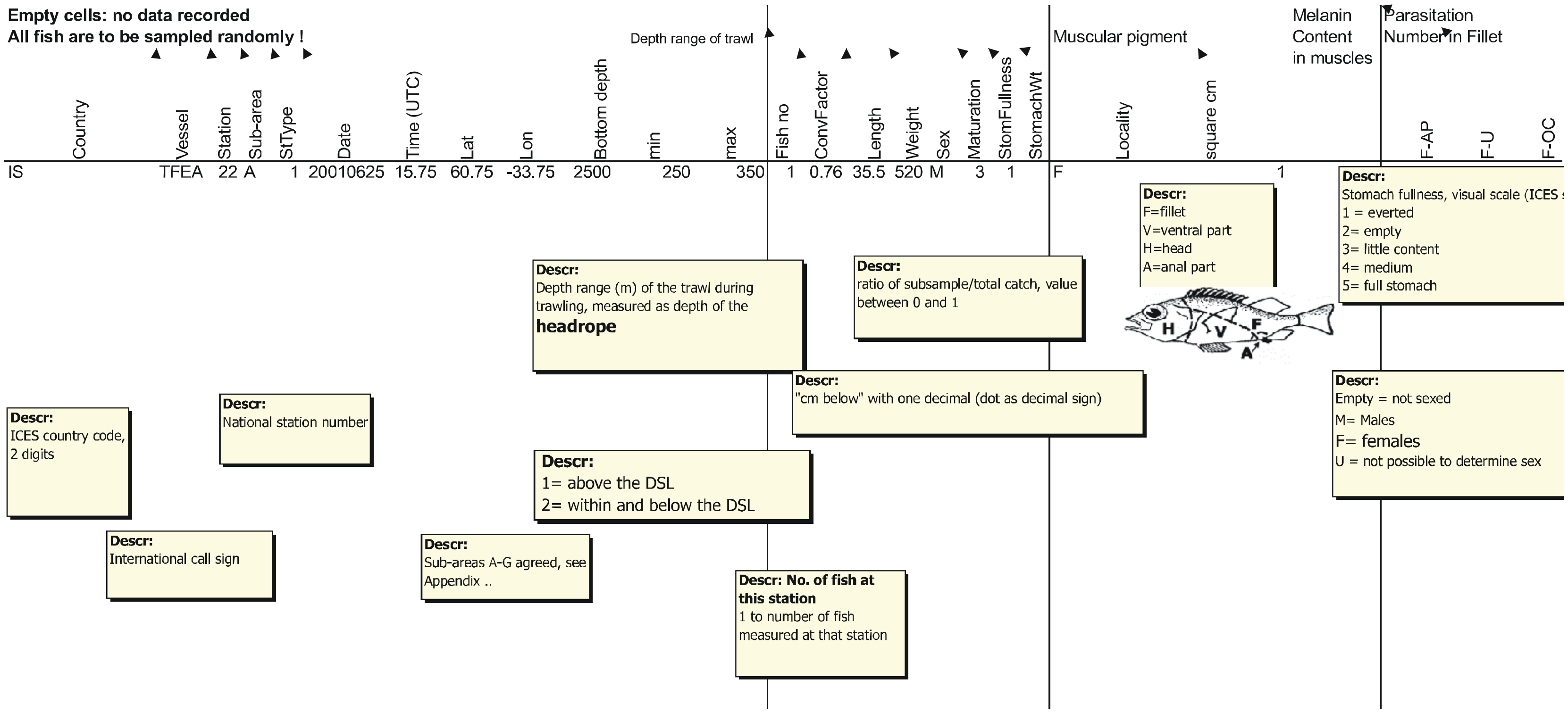
Annex 4a: Sheet used for exchange of acoustical observations



Annex 4b. Sheet used for exchange of station information and sailing diary



Annex 4c: Sheet used for exchange of biological observations



Annex 5: Sheet used for exchange of hydrographic observations

Form for hydrographic data exchange.
Vessel:
Station no:
Date:
Time:
Lat:
Lon:
Bottom depth:

Pressure	**Temp**	**Salinity**
db	**ITS-90**	**PSS-78**
5.000	2.5595	32.5555

Annex 6: Maturity scale agreed to be used in the international survey in June/July 2009 for redfish in the Irminger Sea and adjacent waters

MATURITY STAGES OF FEMALE REDFISH

Stage	Code	Ovaries description
Immature	1 (I)	Ovaries tubular, thin and small. Ovarian wall whitish and delicate. Without conspicuous blood vessels. If visible eggs occur, they are very small, whitish or pale yellowish. Pigmented eye larvae are never observed in the ovary.
Maturing/ Mature	2 (M)	The ovary has increased in size considerably and it is easy to distinguish in the body cavity. The ovary wall and eggs inside the ovary are clearly visible. Eggs are yellow and opaque.
Mature/ Fertilized	3 (F)	Ovaries are considerably bigger and occupy most of the body cavity. Colour is bright yellow. Many eggs are transparent (approx. 50%) because of yolk re-absorption the eye pigment of the larvae becomes visible.
Parturition	4 (P)	Ovary occupy practically the whole body cavity, it is delicate and the wall transparent and thin. The colour shift to a green-yellowish due to larval developing, the eyes are evident and there is little yolk. Larvae are easily released from the ovary when it is manipulated.
Post spawning	5 (S)	Ovary is flaccid, but still big. No visible larvae inside or just a remainder of them. The colour is purple or blackish, sometimes confused with the body cavity wall (peritoneum).
Recovery	6 (R)	Size is reduced to stage 3 or smaller, but no visible eggs, colour yellow to purple.

MATURITY STAGES OF MALE REDFISH

Stage	Code	Testes and genital papilla description
Immature	1 (I)	Testes are translucent, very thin and sometimes even difficult to detect, because it is confused with the mesentery. Width less than 1 mm. The penis is difficult to distinguish and easy to confuse with female genital papilla.
Maturing/ Mature	2 (M)	The testes are more easily distinguishable because of increasing size. They are white. Width more than 1.1–1.5 mm. There is no running sperm when the testes are cut. Penis is visible, and it is easy to identify sex externally.
Mature/ Fertilized	3 (F)	Testes are bright white. The sperm is observed inside the testes, but only when they are cut, i.e. sperm doesn't run out of the testes when they are pressed. Penis is thick, but no sperm is observed on it.
Parturition	4 (P)	Testes are big and with a cream colour. The sperm run out of the fish when belly is pressed. Penis is very conspicuous, with a purple tip and there are remains of sperm on it.
Post spawning	5 (S)	Testes are flaccid. The colour is still cream but with obvious dark (brown) patches. Practically no sperm inside the testes.
Recovery	6 (R)	Size of the testes has been reduced to stage 3, but the sperm is not visible. The colour is whitish.

Annex 7: Maturity scale used by Russia in the international survey in June/July 2009 for redfish in the Irminger Sea and adjacent waters

	MALES
Juvenile stage	Gonads are poorly developed, sex is indistinguishable. Specimens at this stage occur throughout a year.
Stage 1	Sex is distinguishable. Testicles are as thin long colourless bends and occur throughout a year.
Stage 2	Testicles are as thick long bends, on a cross section they are of irregular triangular shape of brownish colouring. Remnants of non-extruded sperm are available in repetitive-maturing specimens. December-March.
Stage 3	Testicles are large, elastic, coloured brown, in some cases they are of violet shade. Along a cross section they are of triangular shape with smoothed angles. March-June.
Stage 4	Testicles are large, of light-brown colouring, with a white colour being irregular in some areas. At the end of the stage the testicles are white due to the sperm formed. Along the cross section the sperm does not run. June-September.
Stage 5	Mating period. Testicles are of milky-white colour. When dissecting the external sides flow down and drops of sperm are released from spermatic duct. September-November.
Stage 6	Extrusion (after mating). Testicles are of brownish colour with white patches. Two zones are visible along a cross section, i.e. brown marginal and white middle zones. October-December.

	FEMALES
Juvenile stage	Gonads are poorly developed, sex is indistinguishable. Specimens at this stage occur all the year-round.
Stage 1	Ovaries are poorly developed, of light-yellowish colour; eggs are indistinguishable during a whole year.
Stage 2	(for repetitive-spawning fish – stage 9–2). Eggs are with 0.2–0.5mm diameter. In immature fish a membrane of ovaries is transparent, in repetitive-spawning specimens it is covered with black pigment. May-August.
Stage 3	Ovaries are bright-orange, egg diameter is about 1mm. August-September.
Stage 4	Ovaries occupy above a half of the body cavity, egg diameter is up to 1.5mm. September-December.
Stage 5	Ovaries are muddy-greenish, eggs are transparent. December-March.
Stage 6	Ovary membrane is strongly prolonged. The stage lasts from the moment of cleavage to the beginning of eye pigmentation in embryo. December-March.
Stage 7	Eye pigmentation begins in embryos owing to which ovaries gradually acquire black colouring. February-March.
Stage 8	Eyes acquire bright metallic shade. Embryos are well developed and mobile. The stage lasts until larvae extrusion.
Stage 9	Ovaries have fallen off, of bloody colouring. Single unextruded larvae occur. April-June.

Annex 8: Sheet used for registration of acoustic values of redfish during trawling at depths shallower than the DSL

			S_A values for redfish at the same location as the trawl haul							
Station No.	Depth of trawl (m)	Vertical opening	Inside the trawl opening	0-150 m	150-300	300-450	450-600	600-750	> 750 m	Comments

Annex 9: Summary of the workshop on hydroacoustic scrutinizing in the Norwegian Sea

During August 2008, Norway, Russia and the Faroes conducted a joint survey of redfish (*Sebastes mentella*) in the Norwegian Sea. Abundance estimates based combined trawling and hydroacoustics revealed important discrepancies and it was envisaged that these resulted from differences in the methodologies used for scrutinizing the hydroacoustic data. To resolve this issue, the hydroacoustic scrutinizing workshop was organized with the following objectives: (1) to review the scrutinizing procedures used by each participants, (2) to run parallel analysis of the hydroacoustic data on selected registrations, and (3) to advise on "good practice" for scrutinizing hydroacoustic data collected in the Norwegian Sea. The workshop was held in Tromsø (Norway) on the 25–27 November 2008 and attended by 9 participants from Norway, Russia, Germany and the Faroes.

The workshop report briefly presents the survey carried out in August 2008 and the methodology used to review and compare the different hydroacoustic scrutinizing methodologies. The results of the comparative analysis clearly show that differences in scrutinizing methods have a very large affect on the abundance estimate of redfish. They probably constitute the major source of uncertainty for any quantitative estimate. Efforts towards standardization of scrutinizing procedures should be amplified or at least maintained.

The report provides a series of 12 recommendations for the conduction of future international redfish surveys. These are as follows:

1) Hydroacoustics should be used as a complement to trawl based estimates. For that purpose, the number of trawl hauls should be maximized. The use of the multisampler by all participants is recommended.

2) All vessels/nation should use the same equipment for trawling (Gloria 2048), hydroacoustic registering (EK60) and scrutinizing.

3) Individual trawl hauls should be conducted in single vertical layers (e.g. above, within or below DSL)

4) Additional hydroacoustic observation methods should be considered (e.g. deep-towed transducer, multiple frequencies)

5) All vessels/nations should use a common set of acoustics categories

6) Species partition based on TS distribution should be avoided

7) The distance between acoustic tracks should be reduced as much as possible without compromising the survey extent. A distance of no more than 45 miles is recommended. This could be reduced in areas of high redfish densities.

8) 1–2 days should be allocated to inter-vessel comparison of acoustic systems and joint parallel trawls.

9) The scrutinizing cross-comparison (as conducted during the workshop) should be conducted systematically, as a measure of data qualification

10) Methods for automatic removal of noise should be implemented in the scrutinizing process

11) All vessels should start and end the survey simultaneously.

12) Data collected during the international redfish survey should be stored and made available through an international database

The report will shortly be available from the Institute of Marine Research, Norway (www.imr.no)

Annex 10: Working document: Otolith sampling strategy for redfish in the Norwegian Sea

Working document prepared by

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Summary

The collection of otoliths for the determination of redfish population age-structure can be carried out in two main ways: random or length-stratified. We present the rational for choosing one or the other method. Using statistical simulations, we compare the results from the two strategies. We show that stratified sampling does not outperform random sampling and in addition, random sampling results in a dataset that can be analysed directly (i.e. without age-length-key). This is particularly useful if ALK varies with sex, geographical location, depth or time, as is likely the case for redfish in the Norwegian Sea.

It is recommended that future international surveys for redfish in the Norwegian Sea should commonly adopt a random sampling strategy for the collection of fish otoliths.

Motivation for sampling otoliths

Otolith sampling during fish stock assessment surveys is commonly performed with the aim of determining age of individual specimens. The ultimate goals of individual age determination can however be multiple, including 1) the determination of population age structure, 2) the determination of growth or developmental rates (e.g. age at maturity), and 3) the construction of age-length keys. In addition, collected otoliths may be used for analysis of stock structure or reconstruction of environmental histories based on physical measurements (weight, shape, etc.) or determination of elemental composition using microchemistry.

Two sampling strategies: random and stratified

The purpose of this working document is to examine the effect of sampling strategies for redfish (*Sebastes mentella*) in the Norwegian Sea for the purpose of determining the age structure of the population. There are two main strategies commonly used. The first is based on random sampling of individual fish at each sampling station. In this document, we refer to this strategy as the 'random strategy'. The second one is a stratified sampling based on the body length (and sometimes sex) of individuals in each station. We refer to this strategy as the 'stratified strategy'.

In the random strategy, the total number of otoliths sampled is usually set in advance. The common practice is to collect all otoliths up to a maximum number (often 30 pairs). Random selection of individual fish can be achieved by selecting the first fish from the fishing baskets or carrying belt, assuming that these collecting devices are not size selective (e.g. all baskets contain random fish samples from the same length distribution).

In the stratified strategy, the total number of fish is not set in advance but depends on the length/sex composition of the catch. The common practice is to collect otolith from a pre-defined number (e.g. 1 or 2) of fish for each length group (of e.g. 1cm) and eventually each sex.

If the maximum (random strategy) or the pre-defined (stratified strategy) numbers of individuals is high and when the catches comprise a large number of individuals, the random strategy will favour collection of individuals that have the most frequent length, whereas the stratified strategy will spread the sampling effort among length (and eventually sex) groups. However, when most catches comprise a small number of individuals, the two strategies often yield very similar results with (nearly) all fish collected in both cases. It is important to note that the stratified strategy is stratified at the station level but not at the survey level, so that the sampling is not even among length and sex groups at the scale of the survey.

Deriving population age-structure from individual otolith reading and length measurements

Under the random strategy, the proportions at-age in the samples are assumed to be drawn directly from the proportions at-age in the population. The age structure of the population can therefore be directly inferred from the age readings alone (method 1 on fig 1). On the other hand, under the stratified strategy, the proportions at-age in the sample are not representative of the proportion at-age in the population and it is not possible to infer the population age structure directly from age reading alone. Instead, it is necessary to use the age-length key (ALK) to determine the population age structure (method 2 in Figure 1). This method is also applicable using the random strategy (method 2′ in Figure 1). The advantage of method 2 over 2′ is believed to reside in a better estimate of the ALK when the stratified strategy is used, because there is an even distribution of age reading across length groups.

Combining observations from different survey samples

The data collected to determine population age structure is generally not derived from a single survey sample (as depicted in Figure 1) but from a collection of samples (typically several trawling stations). These need to be combined before the age structure can be inferred. One simple way of doing this is to pool all the data into a common dataset or to average the proportions at-age calculated for each sample (following method 1, 2 or 2′). However, both methods give equal weights to samples in which small or large number of fish were caught and therefore lead to bias in the results, giving relatively great weight to samples collected in areas where the population is only present in small numbers. This is particularly problematic if the catch rate and age- or length-distributions are not independent, as is the case for redfish in the Norwegian Sea (with long/old individuals found in deeper waters where catch rates are low). To correct for this it is possible to weight each sample by its catch rate (total catch in number divided by sampling distance). This is the approached used here. The proportion of individuals in an age group in the population is given by:

$$p_a = \frac{\sum_{i=1}^{k}(CR_i p_{a,i})}{\sum_{i=1}^{k} CR_i} \quad \text{equation (1)}$$

where a is the age group, i is the station index, k is the number of stations, CR_i is the catch rate (number of individuals per unit distance) and $p_{a,i}$ is the proportion of fish of age a in station i.

Similarly, the proportion of individuals in a length group in the population is given by:

$$p_l = \frac{\sum_{i=1}^{k}(CR_i p_{l,i})}{\sum_{i=1}^{k} CR_i} \quad \text{equation (2)}$$

where l is the length group.

Statistical simulations framework

The simulation process to provide a random bootstrap sample (random draw with replacement) goes as follows:

1) Draw a random sample size n by bootstrapping among actual sample sizes

2) Bootstrap n random lengths from the pool of observed lengths.

3) Stratified sampling: Take one by one of the n lengths until at maximum two fish are taken per 5 cm interval, providing na lengths.

4) Random sampling: Draw randomly na lengths without replacement from the pool of n lengths from step 2.

5) For each of the na fish to be aged, bootstrap a random age among all actual measured ages at the actual length.

Steps 1–5 are then repeated as many times as there are trawl hauls to provide a simulated survey and corresponding estimated age distribution. By running replicates we can also assess the precision of such age distributions, including the uncertainty of the ALK by basing the latter on the simulations rather than the pure measurements.

Note that the number of observations per trawl haul to be aged by random sampling is deliberately chosen to be equal to the number of stratified age observations (step 4). This is in order to have a proper basis for comparison between the methods, and is not practical for implementation on the field. The sampling size by random sampling is in practice very flexible, and a future challenge will be to find an optimal procedure to determine random sample sizes.

The heterogeneous features of the age distributions are implemented in the simulations partly by stratification by depth, and partly by catch rate weighting. The depths are divided in 3 regions: headrope above 275 m (in practice, fish sampling is between 100 and 350 m), between 275 m and 575 m (fish sampling between 300 m and 650 m) and below 575 m (fish sampling between 600 m and 900 m). Some overlap is not avoidable, due to the trawl opening of 100 m and sampling resolution of 50 m.

For each of the depth layers a pool of sample sizes, lengths and ages are established as described previously, and the bootstrapping is run as before. Each simulated trawl haul, however, is now weighted by the catch rate measured for the trawl haul corresponding to the bootstrapped trawl haul size. At the end there is one catch-rate-weighted average age distribution for each depth layer. Each of these are at last weighted by a depth region weight proportional to the average catch rate in the depth region multiplied by the efficient thickness of the layer (ca. 250, 350 m and 300 m, respectively), to obtain weights proportional to abundance.

Results

The two designs are compared in Figures 2–5 for empirical and simulated age distributions. When the age structure of the population is determined from age readings only (i.e. ALK not used), we see (Figure 1) a more flat distribution based on the stratified sampling (black curve) as compared with the random design (red curve). This is as expected, and the stratified design is expected to provide a steadily more uniform age distributions as the sample size increases.

When the ALK is applied we see hardly any difference between the two designs (Figure 2). We also see no big difference between the two designs for standard deviation of the estimated age distribution at each age, neither for the age distributions obtained by pure read ages without ALK (Figure 4) and with random lengths combined with ALK (Figure 5). In the latter case we see that the standard deviation is at maximum below 0.1, corresponding to a CV below 20%.

When ALK varies with sex, geography, depth and time

The growth pattern of fish may vary with sex, geographical location or depth, which then results in the ALK being different for males and females or distinct geographical areas or depth stratum. When this is the case, the determination of age structure using ALK (method 2 and 2′ in Figure 1) need to be based on several ALKs constructed for each category (sex, area, depth). In addition, the use of ALK to estimate age structure in a following year(s) may not be applicable if growth patterns vary between years. The application of method 1 does not suffer from such variations in growth patterns because individuals are randomly sampled and only information from the current year is used for the age-structure determination. In the specific case of *S. mentella* in the Norwegian Sea, the growth patterns of males and females are different, so two ALK should be used, one for each sex. However, to infer the age distribution from ALK and population length distribution, it is necessary that all individuals that are measured are also sexed, which is often not the case.

Performance of random vs. stratified sampling

Work by Kimura (1977) has shown that under certain conditions, the age distribution estimated with ALK constructed from random sampling (method 2′) is better estimated than when the sampling is done in a length-stratified way (method 2). The work of Kimura was based on homogeneous sampling in which length and age measurements were considered as a unique sample. The present analysis demonstrates that under the current data collection scheme (i.e. data collected in 2008), empirical simulations do not contradict Kimura’s findings. The advantage of using a stratified simulation cannot be demonstrated. On the other hand, following a random sampling offers the possibility of analyzing the biological data to infer the age structure of the population directly (i.e. without using the ALK) or indirectly (using the ALK).

Conclusion

Random sampling allows individual age data to be used with or without ALK for the determination of age population structure whereas stratified sampling should only be used with ALK. The results from the simulations show that the performance of random sampling with ALK is similar to that of stratified sampling.

In conditions where ALK varies with sex, geographical location, depth or time, the direct determination of population structure is preferable to indirect methods using ALK, and this requires random sampling to be used.

We therefore recommend that future sampling of redfish otolith in the Norwegian Sea be conducted following a random sampling scheme.

Reference

Kimura, D.K. 1977. Statistical assessment of the Age-Length key. J Fish Res Bd Can 34:317–324.

Figures

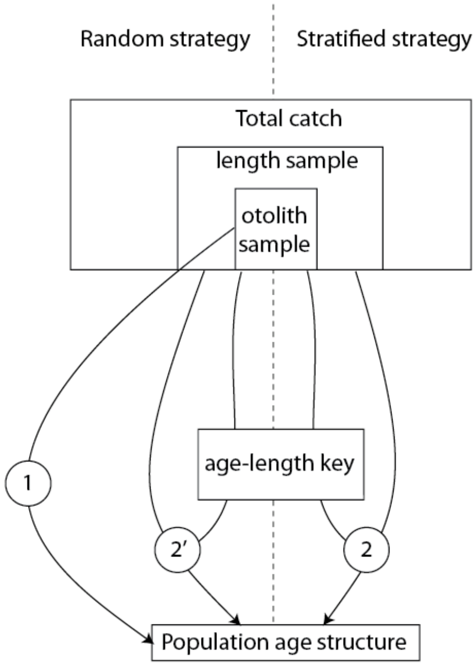

Figure 1. A schematic displaying three methods for the determination of population age structure. The age structure can be determined directly from age readings alone when the sampling is random (method 1). It can be determined from the ALK and the population length structure when the sampling is stratified (method 2) or random (method 2'). The total catch contains all measured fish (length sample), which in turn contains all aged fish (otolith sample). The ALK can be derived from the current otolith sample or from external data (e.g. previous surveys).

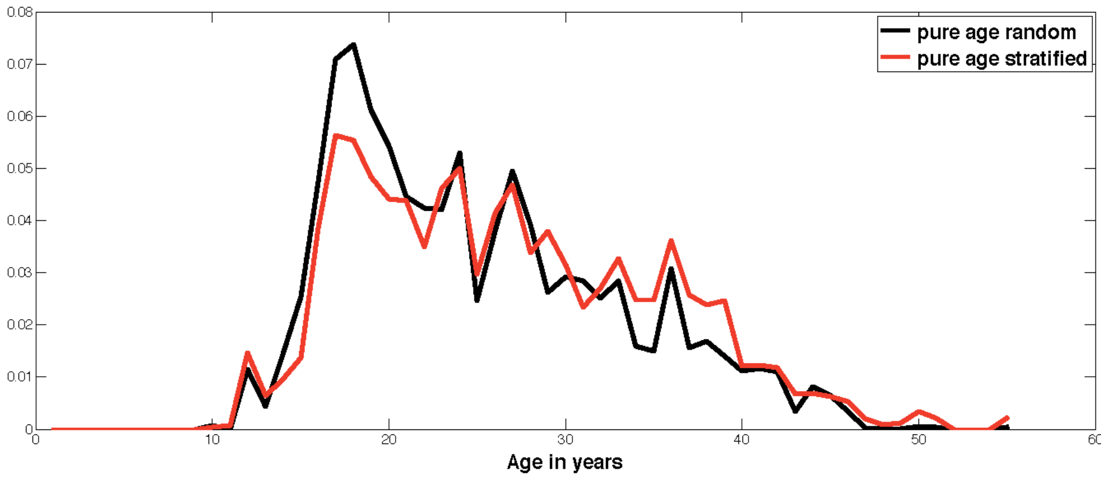

Figure 2. Black curve: Age distribution based on empirical age readings from a random sampling design. Red curve: Average over simulated age readings based on stratified design.

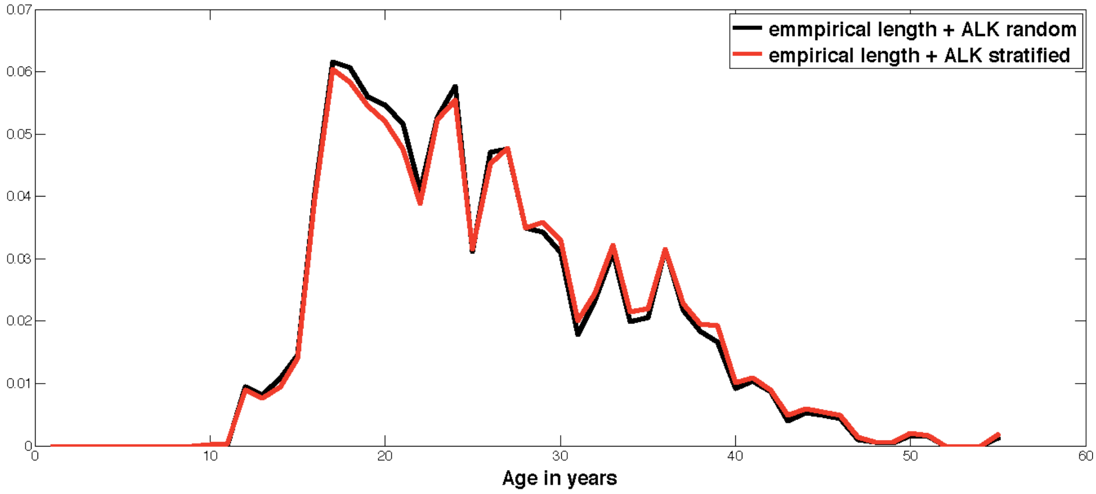

Figure 3. Black curve: Average over 100 simulations of age distribution based on random lengths and ALK for a random design. The ALK is estimated in each simulation. Red curve: Average over 100 simulations of age distribution based on random lengths and ALK for a stratified design.

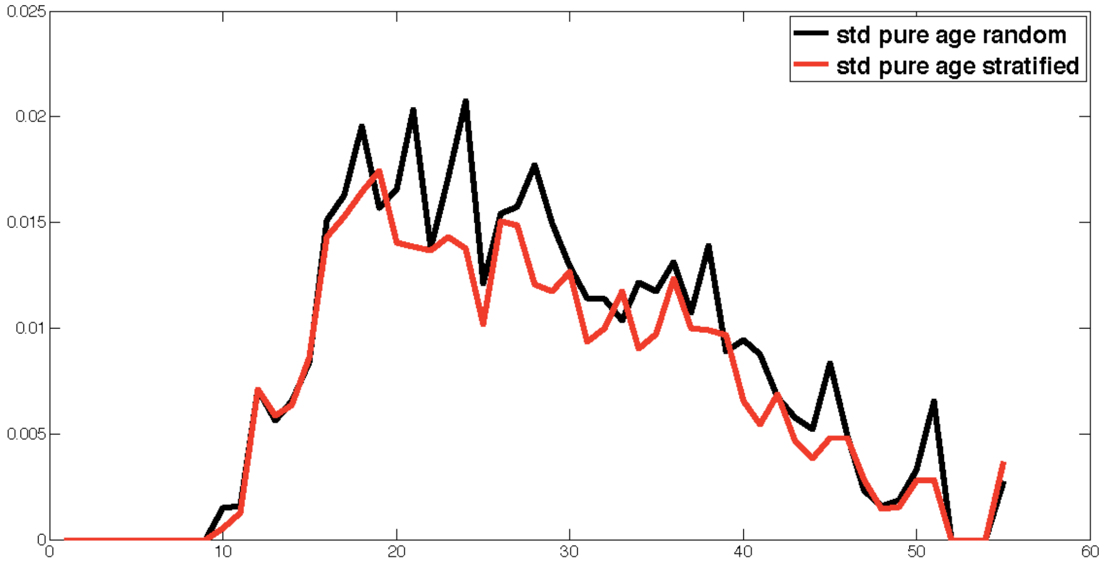

Figure 4. Black curve: Standard deviation of 100 simulated age distributions based on simulated aged otoliths, only, and a random design. Red curve: Same as black, but based on a stratified design.

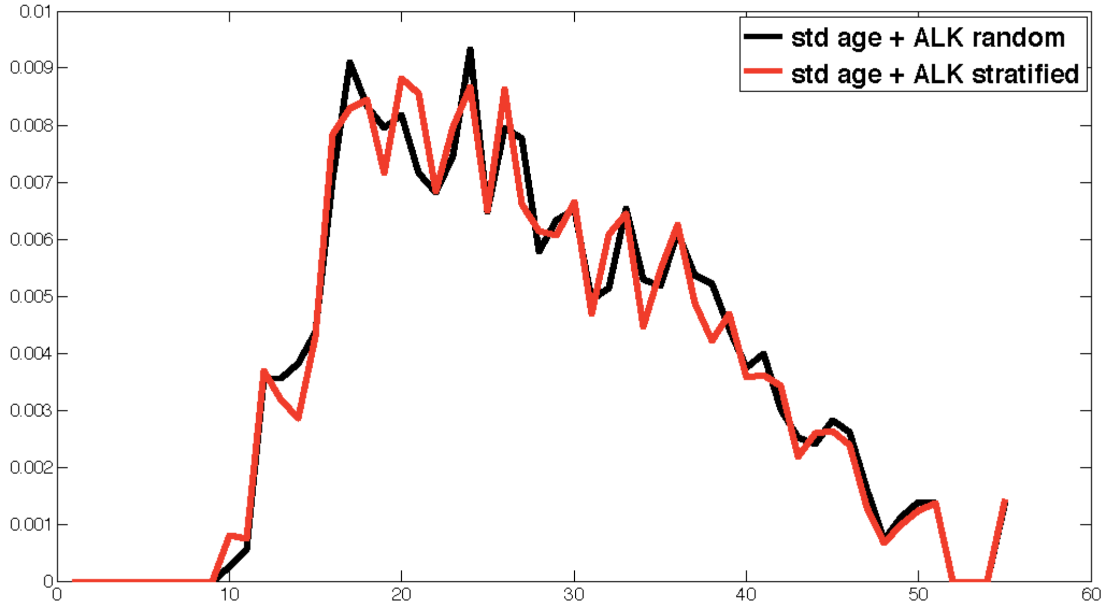

Figure 5. Black curve: standard deviation of age distribution based on random lengths and ALK, for a random design. Red curve: as the black curve, but based on a stratified design. 100 simulations for each sampling design.

Annex 11: Recommendation for WKTAR

The **Workshop on the determination of acoustic Target strength of Redfish [**WKTAR] (Chair: to be decided) will take place in venue to be decided from (3 days) dates to be decided, 2010 to:

a) Review published research relevant to the determination of acoustic target strength of beaked redfish (*Sebastes mentella*)

b) Review ongoing work relevant to the determination of acoustic target strength of beaked redfish

c) Propose a target strength equation for *S. mentella* based on the best available scientific knowledge

d) Describe and recommend additional research which may be required to improve the target strength equation.

WKTAR will report by date to be defined to the attention of the SCICOM.

Supporting Information

Priority:	The adopted TS equation will have direct implication for the assessment of redfish in the Arctic Fisheries Working Group and North Western Working Group. Consequently, these activities are considered to have a very high priority.
Scientific justification and relation to action plan:	The work of the Planning Group on Redfish Surveys requires that a reliable and commonly agreed equation for the target strength of redfish to be agreed. This is essential to hydroacoustic abundance estimates to be provided with a sufficient degree of accuracy. ToR a) A review of published methods and results on the target strength of S. mentella and other redfish species will be carried out. The result of this review will be a synthesis of available TS estimates and with what degree of confidence these can be applied to S. mentella in the North Atlantic. The review work will be conducted in advance of the workshop, but presented and discussed during the workshop. ToR b) Not all relevant data are already published in the scientific literature, and it is expected that new data on redfish target strength will be presented at the workshop. These data, and the methods used to obtain them will be presented and reviewed during the workshop. These will need be made available as working documents, prior to the meeting. ToR c) Based on the synthesis of the reviews carried out in ToRs a and b, a target strength equation for S. mentella will be proposed, from the best currently available scientific knowledge. ToR d) If the outcome from ToR c is believed to be of limited reliability due to lack of appropriate data, future research on how to improve target strength equation in future will be described and recommended.
Resource requirements:	The research programmes which provide the main input to this group are already underway, and resources are already committed. The workshop is expected to be chaired by an recognized acoustic expert with no existing connection to redfish in the North Atlantic. The cost of inviting the chair should be covered by ICES.
Participants:	The workshop is expected to be attented by 10 participants.
Secretariat facilities:	Use of sharepoint (PGRS). The meeting may be held at ICES HQ.

Financial:	The cost of inviting the external independent chair should be covered by ICES.
Linkages to advisory committees:	The result of the workshop are of direct relevance to AFWG and NWWG and therefore to ACOM.
Linkages to other committees or groups:	This workshop is tightly linked to activities conducted in PGRS, AFWG, NWWG, WGFAST, ACOM and SCICOM.
Linkages to other organizations:	NEAFC, NAFO.

Annex 12: Comments by Sergey Melnikov and Konstantin Drevetnyak (Russian participants)

With respect to the two trawling methods for the international redfish survey, the Russians participants of PGRS applying a compromise and pragmatic approach suggest to continue in 2009 with the method used in 2005 and 2007 for assessment of abundance and biomass of redfish in the Irminger Sea, given the disagreements about the stock structure that arose after the WKREDS meeting in January 2009. This would permit to continue the time series of abundance and biomass estimates by the same method. At the same time, it is also proposed to undertake additional trawlings in DSL to collect biological data to verify conclusions on the redfish stock structure drawn primarily on genetic information, i.e. microsatellite information.