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Third Interim Report of the Working Group on International Deep Pelagic Ecosystem Surveys (WGIDEEPS)

4-6 August 2015

Reykjavík, Iceland

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Conseil International pour l'Exploration de la Mer

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Executive Summary

The Working Group on International Deep Pelagic Ecosystem Surveys (WGIDEEPS) met in Reykjavík, Iceland, 4–6 August 2015. The meeting, chaired by Kristján Kristinsson, was attended by three participants from Germany and Iceland. During the meeting, the group prepared the report on the results from the pelagic redfish (*Sebastes mentella*) survey conducted in the Irminger Sea and adjacent waters in June/July 2015.

The trawl-acoustic survey on pelagic redfish in the Irminger Sea and adjacent waters was carried out by Iceland and Germany. The participation of Russia was cancelled at the beginning of May because of reasons not specified. The scope of the survey had to be altered and the emphasis was on covering the deep pelagic stock found below 500 m. Important areas of redfish above 500 m were omitted.

About 200 000 NM^2 were covered, covering the main distribution area of the deep pelagic stock found deeper than 500 m. As relative survey indices, a total biomass of 196 000 t was estimated deeper than 500 m by the trawl method. This is about 80 000 t less than recorded in 2013. Although much less area was covered in 2015 compared to previous year the biomass estimation is considered to be adequate, but is likely to be underestimated by 5–10%. The highest concentrations of redfish were found in the northeast survey area as observed in previous surveys. No biomass estimates of redfish were derived at depths shallower than the deep scattering layer (DSL) by hydro-acoustic measurements or within the DSL shallower than 500 m by a trawl method. The reason is that the geographical distribution were omitted. Furthermore, the acoustic measurement results for 2015 are considered highly uncertain. This is because of mixing with smaller scatter over a large area and the intermixing of redfish and jellyfish, especially in the south part of the research area, making it difficult to distinguish between redfish and other scatters.

The Working Group on International Deep Pelagic Ecosystem Surveys (WGIDEEPS) recommends that the survey should be continued with at least three vessels to cover the distribution area of redfish in the area. The Icelandic participant informed the group in February that Iceland will only participate in the survey every third year instead of biennially that has been the practise since 1999. The timing of the survey should, however, be kept in June/July. The Group recommends that further nations should participate in the next surveys and that chartering of additional vessels and cost share should be considered as alternative to direct participation.

1 Introduction

1.1 Terms of Reference

According to **2013/2MA/SSGESST01** "The **Working Group on International Deep Pelagic Ecosystem Surveys** (WGIDEEPS; formerly the Working Group on Redfish Surveys (WGRS)) chaired by Kristján Kristinsson, Iceland, will meet in Reykjavík, Iceland, 4–6 August 2015.

The Terms of Reference applicable for the August meeting are:

a) prepare the report of the outcome of the 2015 Irminger Sea survey.

WGIDEEPS will report by 1 September 2015 (August meeting via SSGIEOM) for the attention of SCICOM and ACOM.

1.2 Cancellation of the Russia's participation

The Russian Delegation sent an official letter on 8 May 2015 via e-mail to the co-chair of WGIDEEPS, Kristján Kristinsson, informing that the Russian Federation was not able to participate in the international redfish survey in the Irminger Sea and adjacent waters in 2015. No particular reason was given for the cancellation, but said it was "due to objective reasons".

It is the view of the Group that the withdrawal of Russia from the international redfish survey in the Irminger Sea and adjacent waters was very unfortunate and reported to the group at a very late stage. No alternatives could be arranged for compensating the corresponding loss of survey coverage at that time. For this reason the Icelandic and German participants decided to focus only on surveying the deep pelagic stock (below 500 m) with two vessels from Germany and Iceland. This meant that the geographical distribution of the shallow pelagic redfish stock would not be covered.

With only two vessels participating in the 2015 survey, the quality of the survey is seriously hampered and it will also undermine any scientific advice that ICES may provide to national and international management bodies.

1.3 Participants

Eckhard Bethke	Germany
Klara Jakobsdóttir	Iceland
Kristján Kristinsson (Chair)	Iceland

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

The attendance and expertise in the Group was adequate for addressing the Terms of Reference, as all cruise leaders and specialists on biology and hydroacoustics were present. However, no specialist in oceanography was present at the meeting.

2 Report on the international trawl-acoustic survey on pelagic redfish in the Irminger Sea and adjacent waters in June/July 2015

2.1 Historical development of the survey

Several acoustic surveys have been conducted on pelagic redfish in the Irminger Sea and adjacent waters. During the period of commercial fishery in the area, which commenced in 1982, the former Soviet Union, and later Russia, carried out acoustic surveys annually until 1993. These surveys provided valuable information on the distribution and relative abundance of oceanic redfish and on the biology of the species as well as on the oceanographic conditions of the area surveyed (e.g. Shibanov *et al.*, 1996b). The acoustic measurements were, however, not considered sufficient for stock assessment purposes (ICES, 1991).

In 1991, Iceland (6–26 June in the field) conducted a national survey on pelagic redfish with a very limited area coverage of 60 000 NM^2 (Magnússon *et al.*, 1992a).

In 1992, Iceland and Russia conducted a joint acoustic survey on oceanic redfish in the Irminger Sea from 26 May-11 July in the field. The results of the survey were presented in Magnússon *et al.* (1992b). It became obvious from the surveys in 1992 that for an acoustic assessment, two vessels were hardly sufficient to cover the whole area of distribution within a reasonable period (ICES, 1993).

In 1993, Russia conducted a survey in the Irminger Sea in field from 7 June–8 July (Shibanov *et al.*, 1994). Iceland carried out a short survey in September in the same year (ICES, 1994a) with no reliable stock size estimate, since the area coverage was limited.

In 1994, Iceland and Norway carried out a survey with two vessels, covering the main distribution area down to 500 m depth (Magnússon *et al.*, 1994). The vessels were in the field from 24 June-17 July. Approximately 190 000 NM^2 were covered, resulting in a stock size estimate of about 2.2 million t or 3.5 billion individuals. Most of the fish was measured in the area east of Cape Farewell. In the report from the survey, the view of the ICES Study Group on Redfish Stocks (ICES, 1994) that the entire area of distribution could not be covered sufficiently by only two vessels (ICES, 1993), was supported.

In 1995 (25 June-30 July in the field), Russia carried out a single vessel survey for redfish, covering the main distribution area down to 500 m depth. The stock was estimated to be 2.5 million t and 4.1 billion individuals (Shibanov *et al.*, 1996a). As the survey was only covered by one vessel, the NWWG meeting in 1996 (ICES, 1996), considered the results to be unreliable.

In 1996 (19 June – 22 July in the field), Iceland, Germany and Russia carried out the survey in June/July. Approximately 250 000 NM^2 were covered. The acoustic assessment yielded a stock size of about 1.6 million t or 2.6 billion individuals at depths down to 500 m (Magnússon *et al.*, 1996). This estimate was considered to be an underestimation of the stock, due to mixture of the redfish towards depths below 500 m. The oceanic redfish concentrations were densest between 200 and 300 m depth, mainly within a temperature range of 3.5°C to 5°C. Temperatures recorded during the survey were somewhat higher than observed during previous acoustic surveys.

In 1997 (21 June-21 July in the field), Russia carried out a single vessel survey in June/July, resulting in a stock estimate of 1.2 million t down to 500 m depth (Melnikov *et al*., 1998).

In 1999 (18 June-10 July in the field), an international acoustic survey on pelagic redfish was carried out in the Irminger Sea and adjacent waters, with participation of Iceland, Germany and Russia. The acoustically estimated biomass of the oceanic *S. mentella* in the upper 500 m of the water column was 0.6 million t (Sigurðsson *et al*., 1999). The observed decrease in survey abundance compared with the years 1994–1996 was very drastic and exceeded the removed biomass by the fishing fleets. The area covered was the most extensive in the time-series until then, but covered only a portion of the horizontal distribution of the oceanic stock. Therefore, the biomass estimate was considered as an underestimate. The stock above 500 m was observed more southwesterly and deeper than it had been during former acoustic surveys, and a gradual increase in temperature in the observation area was observed. This was considered to have influenced the distribution pattern of the redfish, as the highest concentrations were found in the colder waters, i.e. southwestern part of the survey area.

During all the surveys until 1999, oceanic redfish was only measured by acoustics down to approximately 500 m depth. Attempts have been made to measure below that depth (see Section 2.2.3), but basically without success in obtaining any reliable stock size estimate. The reason is mainly due to the "deep scattering layer" (DSL), which is a mixture of many vertebrate and invertebrate species (Magnússon, 1996) mixed with redfish. Although several attempts have been made by Russia and Iceland to map the distribution of pelagic redfish at depths below 500 m (Shibanov *et al*., 1996a; ICES, 1998; Sigurðsson and Reynisson, 1998), the 1999 survey provided for the first time an estimate on the abundance of the pelagic *S. mentella* >500 m depth in the order of 0.5 million t. Hydrographic observations indicated that the highest concentrations of redfish below 500 were associated with eddies and fronts.

In 2001 (19 June-14 July in the field), a trawl-acoustic survey was carried out by Germany, Iceland, Russia and Norway. Approximately 420 000 NM^2 were covered. The stock size measured with acoustic instruments was assessed to be about 715 000 t at depths down to the DSL (or about 350 m), with redfish having a mean length of 34.6 cm. Highest concentrations of redfish were found in the SW part of the covered survey area. In addition to the acoustic measurements, an attempt was made to estimate the redfish within and below the deep scattering layer with so-called "trawl method" (see Section 2.2.3). This was done by correlating catches and acoustic values at depths between 100 and 450 m. The obtained correlation was used to transfer the trawl data at greater depths to acoustic values then to abundance. A total biomass of approximately 1.1 million t was estimated to be at depths between 0 and 500 m and 1.1 million t shallower than 500 m depth by the use of the "trawl method". Deeper than 500 m, the densest concentrations were found in the NE part of the area. The average length of the fish caught deeper than 500 m was 38.3 cm. It was further suggested that the estimated abundance derived from the trawl data should be treated with great caution (ICES, 2002).

The basic area coverage during the recent surveys was determined to be extended from what has previously been used and was defined in ICES (1995). As the results from the surveys in 1999 and 2001 indicated that the covered area did not reach the boundary of the distribution area of pelagic redfish in the acoustic layer, the PGRS in 2003 (ICES, 2003a) felt it was necessary to expand the area both to the south and west.

As the fishery had also changed towards greater depths in later years, it was also considered important to continue expansion of the vertical coverage to assess the stock that is below the acoustic layer (below 500 m depth). The results of that survey were presented in ICES (2003b). Germany, Iceland and Russia participated in the international survey in May/June 2003 (28 May-30 June in the field). Approximately 405 000 NM^2 were covered. A total biomass of less than 100 000 t was estimated at depths between 0 and 500 m and about 700 000 t deeper than 500 m by the use of a standardized "trawl method". The redfish biomass of 100 000 t estimated acoustically down to the deep-scattering layer or about 350 m, with redfish having a mean length of 35.3 cm, was the lowest ever obtained since the beginning of the joint measurements. The highest concentrations of redfish were found around 60°N, east of Cape Farewell. Deeper than 500 m, the densest concentrations were found in the NE part of the area. The estimated abundance derived from the trawl data were considered highly uncertain. The results of the 2003 survey were regarded as inconsistent and thus did hardly indicate the actual stock status of pelagic redfish. To which extent seasonal effects contributed to this inconsistency, is unknown (see ICES, 2003b).

The international trawl-acoustic survey on pelagic redfish in June/July 2005 (18 June-18 July in the field) was carried out by Germany, Iceland and Russia (ICES, 2005). Nearly 400 000 NM^2 were covered. A total biomass of 551 000 t was estimated at depths shallower than the "deep scattering layer" (DSL) by hydroacoustic measurements, and about 674 000 t within and deeper than the DSL by the "trawl method". In both depth layers, the highest concentrations of redfish were found in the western and southwestern part of the survey area. Although the estimates divided by depth layers were not comparable between years due to changes in the depth range covered in the deeper layer in the 2005 survey, the total estimates of the shallower and deeper layer combined can be compared between years. The total biomass estimate of 1.2 million t, encompassing the shallower and the deeper layer, represented a value within the range of the 1999 and 2001 estimates. Along with the trawl and acoustic measurements since 1992, hydrographic data had been obtained. The results indicated a relationship between the hydrography and distribution of redfish in the survey area.

The international trawl-acoustic survey in June/July 2007 (23 June – 24 July in the field) was carried out by Iceland and Russia (ICES, 2007b). The usual participation of Germany had to be cancelled due to short-term technical problems of their vessel. The German participant, however, compensated the Russian participant by funding additional days in the field, in order to ensure the complete survey area coverage. Nearly 350 000 NM^2 were covered, with only slightly increased distances between hydroacoustic tracks and trawl hauls, compared to previous surveys. As relative survey indices, a total biomass of 372 000 t was estimated at depths shallower than the "deep scattering layer" (DSL) by hydroacoustic measurements, and about 854 000 t within and deeper than the DSL by an experimental "trawl method". In the shallower layer, the highest concentrations of redfish were found southeast of Cape Farewell and in the southwestern survey area. In the deeper layer, high concentrations were also found southeast of Greenland, but as well in the northeastern survey area. Although the estimates divided by depth layers are not strictly comparable between years due to changes in the depth range covered in the deeper layer in the 2005 and 2007 surveys, the total estimates of the shallower and deeper layer combined can be compared between years. The total relative biomass value of 1.2 million t derived in 2005 and 2007, encompassing the shallower and the deeper layer, represents a value within the range of the 1999 and 2001 estimates.

The international trawl-acoustic survey in June/July 2009 (11 June – 19 July in the field) was carried out by Iceland and Germany (ICES, 2009cb). The usual participation of Russia was cancelled because of a number of reasons not specified. About 360 000 NM² were covered, with increased distances between hydroacoustic tracks and trawl hauls, compared to previous surveys. As relative survey indices, a total biomass of 108 000 t was estimated at depths shallower than the "deep scattering layer" (DSL) by hydroacoustic measurements, the lowest in the time-series (excluding the 2003 estimate). About 278 000 t were estimated within the DSL shallower than 500 m by a trawl method and 458 000 t deeper than 500 m by the trawl method. In the shallower layer (both acoustic and trawl method), the highest concentrations of redfish were found southeast of Cape Farewell. In the layer deeper than 500 m, highest concentrations were found in the northeastern survey area and southeast of Cape Farewell. The estimated biomass and abundance of redfish within the DSL shallower than 500 m and deeper than 500 m derived from the trawl data, however, is considered highly uncertain because of the large error involved in the estimation. The total relative biomass value of 845 000 t derived in 2009 (to make the 2005 and 2007 estimates comparable with other years), encompassing the shallower and the deeper layer, was the lowest value recorded excluding the 2003 estimate.

The international trawl-acoustic survey in June/July 2011 (6 June – 18 July in the field) was carried out by Iceland, Germany and Russia (ICES, 2011a). About 343 000 NM² were covered. As relative survey indices, a total biomass of 123 000 t was estimated at depths shallower than the "deep scattering layer" (DSL) by hydroacoustic measurements, about 309 000 t within the DSL shallower than 500 m by a trawl method, and 475 000 t deeper than 500 m by the trawl method. In the shallower layer (both acoustic and trawl method), the highest concentrations of redfish were found southeast and south of Cape Farewell. In the layer deeper than 500 m, highest concentrations were found in the northeastern survey area. The total relative biomass value of 907,000 t was 62,000 t higher than in 2009.

The international trawl-acoustic survey in June/July 2013 was carried out by Iceland, Germany and Russia (ICES, 2013). About 340 000 NM² were covered. As relative survey indices, a total biomass of 91 000 t was estimated at depths shallower than the "deep scattering layer" (DSL) by hydroacoustic measurements, about 201 000 t within the DSL shallower than 500 m by a trawl method, and 280 000 t deeper than 500 m by the trawl method. In the shallower layer (both acoustic and trawl method), the highest concentrations of redfish were found southeast and south of Cape Farewell. In the layer deeper than 500 m, highest concentrations were found in the northeastern survey area.

2.2 Material and methods

The planning of the survey and detailed description of the sampling methodology was done during the WGIDEEPS planning meeting in Tromsø, Norway, from 3–5 February 2015 (ICES, 2015). During the meeting in February a manual of the survey was written to be published in Series of ICES Survey Protocols (SISP).

Since Russia cancelled its participation the area coverage and planned cruise tracks were changed. It was decided by Germany and Iceland to survey the deep pelagic stock (found deeper than 500 m mainly in the northeast and southeast areas) and leave out important areas where the shallow pelagic stock is found (mainly southeast of Cape Farwell, Greenland). The geographical area covered was therefore smaller than in the surveys 1999–2013.

2.2.1 Vessels, timing and survey area

Table 1 describes the extent, coverage and the trawl specification of the survey. The Icelandic part of the survey was carried out by the Marine Research Institute (MRI), Reykjavík, with the RV "Árni Friðriksson" from 10–30 June with 17 days in field. The German part was carried out by the Johann Heinrich von Thünen Institute (vTI), Institute of Sea Fisheries, Hamburg, with the RV "Walther Herwig III" during the period 18 June to 20 July, with 16 days in the field.

The vessels covered an area of approximately 200 000 NM^2 within the boundaries of about 55°N to 65°N and 26°W to 42°W, on transects 30–60 NM apart (Figure 1). The planned transects (ICES, 2015) were altered and rescheduled prior to and during the survey, mainly due to cancellation of Russia, but also due to bad weather. Areas C-F (Figure 2) were not surveyed.

2.2.2 Acoustic assessment

A 38 kHz Simrad EK60 split-beam echosounder was used for the acoustic data collection on RV "Árni Friðriksson" and RV "Walther Herwig III". Prior to the survey, the acoustic equipment on all vessels was calibrated with the standard sphere method (Foote *et al.,* 1987). The settings of the acoustic equipment used during the survey are given in Table 2. During the survey on board of the Icelandic and German vessels the post-processing system (EchoView V5.3) was used for scrutinising the echograms. Mean integration values of redfish per 5 NM were used for the calculations.

Earlier investigations (Magnússon *et al.,* 1994; Magnússon *et al.,* 1996; Reynisson and Sigurðsson, 1996) have shown that the acoustic values obtained from oceanic redfish exhibit a clear diurnal variation, due to a different degree of mixing with smaller scatter as well as changes in target strength. In order to compensate for these effects to some degree, the acoustic data obtained during periods of the most pronounced mixing, i.e. during the darkest hours of the night, were discarded and to estimate the values within the missing sections by interpolation.

In further data processing, the number of fish was calculated for statistical rectangles, the size of which was 1 degree in latitude and 2 degrees in longitude. A length based target strength (TS) model was used for all length groups for the estimation of the number of pelagic redfish in the survey area: $TS = 20 \times \lg(L) - 71.2$ dB.

The total number of fish within subareas A-F (Figure 2) was then obtained by summation of the individual rectangles. The acoustic results were further divided into the number of individuals and biomass based on the biological samples representative for each subarea.

For the entire survey area, single-fish echoes from redfish were expected to be detectable down to 350 m. In order to include all echoes of interest, a low integration threshold was chosen. As shown in Table 2, the integration threshold was set at -80 $dB//m^3$ for echo integration. Based on the depth distribution of redfish observed during the survey and the expected target strength distribution, the method outlined by Reynisson (1996) was used to estimate the expected bias due to thresholding. The results of the biomass calculations were adjusted accordingly.

2.2.2.1 Noise measurements

The measurements of echosounders can be disturbed by noise and reverberation. Reverberation consists of echoes reflected from unwanted targets and cannot be avoided. For noise, we distinguish between ambient noise (rain, wind-induced noise, thermal noise) and vessel noise (propeller noise, turbulent flow noise). Ambient noise cannot be avoided, whereas vessel noise can be minimized by constructive measures. The German RV "Walther Herwig III" can only detect redfish echoes down to approximately 450 m. In the latter case, the reason is the relatively unfavourable location of the transducers. The results of the measurements show that the Icelandic RV "Árni Friðriksson", optimized for acoustic measurements, can detect redfish echoes down to 950 m and the Russian RV "Vilnyus" down to 1,100 m under good weather condition.

Whereas noise is always present and influences the echo integration results, echoes of redfish are much more seldom. Therefore, already very small noise can prevent the measurements. For the improvement of the signal to noise ratio, a threshold is usually applied. The amplitude of the signal decreases with depth whereas the amplitude of noise increases due to time varied gain. Accurate results can only be obtained by applying a threshold adapted to the analysed depth range. Even if redfish are still visible on the echogram, an accurate measurement may be not possible. The applied threshold preventing the influence of noise is optimized for a depth of 250 m (Bethke, 2004).

2.2.2.2 Echo counting

The EK500 echosounder, used for scientific work since the middle of the 1980s, has replaced by Simrad EK60 echosounder on the Icelandic vessel and before this survey on the German vessel. The new sounder can be handled in a more convenient way and is equipped with an improved calibration program, allowing the calibration also under rough weather conditions. The EK500 and EK60 can detect individual targets based on the amplitude and width of the echo. It is no surprise that technological progress leads to advantages in functionality of equipment. However, this is not the case for the echosounder EK60 with regard to the single target detection capability needed for echo counting. In one experiment involving 1000 ensonifications of the same target near or on the transducer axis by each echosounder, the number of single-target detections was 932 with the EK500 and 220 with the EK60 (Mark I; Jech *et al.*, 2005). This is not sufficient for echo counting and it is probably not possible to obtain sufficient reliable results for assessment work with the EK60/BI60 system. The Echo counting has indisputable advantages in the stock assessment of redfish, but due to the replacement of the older EK500 the counting method it is no longer applicable. Future scientific echosounders are likely able to identify and count targets again. Then this measuring method could be re-considered.

2.2.3 Abundance estimation by the trawl method

The classic method of continuous echo integration deeper than 350 m (within and deeper than DSL) is applicable only under very specific conditions. Because of the increased influence of the vessel's noise, as well as the mixing of redfish with various components of DSL (Magnússon, 1996), this is almost impossible. An additional difficulty is due to the decrease of the effective angle of the transducer beam, especially for single fish registration at great depths. This in particular demands for a lower Sv-threshold, down to (-85) – (-90) dB for correct echo integration. For hull-mounted transducers, this may cause problems with noise. Therefore, acoustic estimation of redfish with a hull mounted transducer in depths exceeding 350 m is very difficult (Dalen *et al.*, 2003).

As in the surveys in 1999–2013, a trawl method was therefore used to calculate abundance of redfish within and deeper than DSL. The method is based on a combination of standardized survey catches and the acoustic data, where the correlation between catch and acoustic values during trawling in the shallower layer is used to obtain acoustic values for the deeper layer, based on catches in the deeper layer. To be able to make the calculations, hauls were carried out at different depth intervals, evenly distributed over the survey area.

The sampling was carried out as follows (ICES, 2015):

1) **Type 1 tow:** Trawling takes place at depths shallower than the DSL where and when redfish has been acoustically identified. Trawling distance is 4 NM calculated with GPS;

2) **Type 2 tow:** Trawling takes place at depths shallower than 500 m and within the DSL. The trawling distance is 4 NM, calculated with GPS. The haul is divided into two parts of equal distance of 2 NM each. First, the headrope is at the top of the DSL and the second stage is at depth of 450 m.

3) **Type 3 tow:** Trawling takes place at depths deeper than 500 m depth. The deep identification hauls should cover the following 3 depth layers (headline): 550 m, 700 m, and 850 m. The total trawling distance is 6 NM calculated with GPS and the trawling distance at each depth layer is 2 nautical miles.

The towing speed of all trawls was 3.0–3.5 knots.

The net used on RV "Árni Friðriksson" and RV "Walther Herwig III" was a Gloria type #1024, with a vertical opening of 45-50 m (Table 1). The codend of the pelagic trawls were equipped with multi-sampler, which consists of 3 codends (Engås *et al.,* 1997). The stretched mesh size of the codend is 23 mm. This equipment allows for more intensive sampling and better vertical resolution. In particular, it is possible to carry out several trawl types within a single trawl haul (i.e. different codends correspond to distinct depth strata).

During the survey, the vessels employed a total of 14 type 1 trawl hauls on redfish above the DSL which were acoustically identified, 49 type 2 trawl hauls in the depth range from the top of the DSL down to 500 m and 50 type 3 trawls hauls in the depth range from 550–900 m, which were relatively evenly distributed over the survey area (Figure 1). The catches were standardized by 1 NM and converted into acoustic values using a linear regression model between catches and acoustic values at depths shallower than the DSL.

A linear regression model between the acoustic values and catches (in kg/NM) of Type 1 trawls (shallower than the DSL) was applied to predict the acoustic values for each Type 2 and Type 3 trawls. Acoustic values for the Type 1 trawls were obtained from exactly the same position and depth range covered by the trawl.

Because few Type 1 trawls were taken in 2015 (13 for RV "Walther Herwig III" and only 1 for RV "Árni Friðriksson), the Type 1 trawls from the surveys in 2001, 2003, 2005, 2007, 2009 2011 and 2013 were used in the regression analysis. This made the total Type 1 trawls for Iceland 46 (from the 2005, 2007, 2009, 2011 and 2013 surveys, the Type 1 trawl in 2015 was excluded) and 47 trawls for Germany (from the 2001, 2005, 2009, 2011, 2013 and 2015 surveys). The results of the geometric mean linear regressions between the acoustic values and the catches recorded shallower than the DSL for each vessel are given in Figure 7 and the models output in Annex 4.

The linear regression model for the Type 1 trawls is:

$$s_{A_{tr}}=\beta_0+\beta_1 C$$

where $s_{A_{tr}}$ is the surface density of fish distribution in the Type 1 trawl, *C* is the catch (kg/NM) and β_0 and β_1 are the intercept and slope respectively. To ensure that zero catch of the Type 2 and Type 3 trawls will be with zero s_A value, the intercept of 0 is forced ($\beta_0 = 0$) which gives:

$$s_{A_{tr}}=\beta_1 C$$

Estimation of redfish distribution by the trawl method for Type 2 and Type 3 trawls is done by conversion of catches (catch in kg per NM) to equivalent acoustic estimates by predicting the s_A values using the obtained correlation for each vessel:

$$\widehat{s_{A_T}} = \beta_1 * C_T$$

where C_T is the catch of either Type 2 or Type 3 trawls in kg/NM and $\beta_1$is the coefficient from the regression

The obtained s_A values were then adjusted for the vertical coverage of the trawls and the depth range of each haul ($\Delta D/H_{tr}$ where ΔD is the difference between maximum and minimum depth of each haul and H_{tr} is the vertical opening during each tow). The s_A value for each trawl is:

$$s_{A_T} = C * K * K_H$$

where *C* is the catch in kg per NM of each Type 2 and Type 3 trawls, *K* is the coefficient of the trawl obtained from the linear regression and K_H is the width of the depth range towed defined as:

$$K_H = (H_{MAX} - H_{MIN} + \mathrm{d}H_T)/\mathrm{d}H_T$$

where H_{MAX} and H_{MIN} are the maximum and minimum depths of the headline of a trawl type during a tow and $\mathrm{d}H_T$ is the mean vertical opening of the trawl. For all trawls $\mathrm{d}H_T$ is 50 m. For Type 3 hauls H_{MIN} was 550 m and H_{MAX} was 850 m. For Type 2 H_{MAX} trawls is either 400 or 450 m but H_{MIN} varies and depends on the minimum depth of the DSL layer.

Based on the linear regressions, confidence limits for the estimates were also calculated.

After having calculated the s_A values from the catches of each haul, the estimation of the abundance and biomass was calculated using the same target strength equation for redfish (20Lg (L) – 71.3) and the same algorithm as used for the acoustic estimation. The area coverage was considered to be the same as for the acoustic results and applied to all subareas.

2.2.4 Biological sampling of redfish

Standard biological observations of redfish needed for the acoustic assessment were carried out (ICES, 2015). In addition, otoliths were collected, and stomach fullness as well as parasite infestation, pigment patches and muscular melanosis were recorded according to an approved method (Bakay and Karasev, 2001). A summary of biological sampling in 2015 is given in Table 3. Otoliths were collected from all the individuals and individual length, weight, sex, maturity, parasites and pigmentation recorded.

2.2.5 Species composition in the trawls

The total catch was split into species or appropriate taxonomic group. Catch weight and number of all species was recorded for each haul. The weight of jelly fish was recorded. Shrimps were reported in one group, but krill were reported in a separate category.

2.2.6 Hydrographic measurements

Temperature and salinity measurements were made with CTD probes at the corners of each transects and at each trawl station down to 1000 m depth (Figure 1). The hydrographic 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 were used in the data analysis. A total of 71 CTD stations were conducted during the survey, with 38 carried out by RV "Árni Friðriksson" and 33 by RV "Walther Herwig III". Due to the early stage of processing of CTD data, only temperature is included in this report.

2.3 Other work

Several other projects were carried out during the surveys and are listed below:

Whale Sighting. Whale sightings were carried out on RV "Árni Friðriksson" which was part of the North Atlantic Sightings Survey (NASS) for 2015.

Oceanography sampling conducted by Dalhousie University (Canada). On both research vessels, water samples were taken at every CTD station to analyse the amount of inorganic carbon (DIC and TA) and nutrients to study freshwater sources and their connection to Labrador Sea, as well as inorganic carbon and nutrient dynamics and their interactions. The samples will be analysed at Dalhousie University (Canada) and the Marine Research Institute (Iceland).

Mesopelagic fish. The aim of the project, which was carried onboard on RV "Walther Herwig III", was to gain an impression on the mesopelagic species community in a subpolar region and for a broader understanding of the mesopelagic ecosystem functioning and to increase taxonomic expertise.

Fish systematics. The objective was to collect fish species for analysing the systematic structure of various fish species. During the survey on RV "Walther Herwig III" more than seven species from three families of the Alepocephaloidei were caught. In addition, many deep-sea species from families like Stomidea, Myctophidae, Melamphaidea were sampled for the collection of the Deutsches Meeresmuseum in Straslund, Germany.

Parasitological examinations. During the survey on RV "Walther Herwig III" samples of 13 fish species were collected. The samples will be part of parasitological examination and stomach content analyses to get insights in the feeding ecology of the targeted fish species and to describe their parasite diversity, abundance and infection intensity.

Cephalopods research. On RV "Walther Herwig III" more than 1,300 specimen of squids and pelagic octopods from at least seven species belonging to six families were analysed.

2.4 Results

The acoustic measurement results for 2015 are considered highly uncertain. The is because of mixing with smaller scatter over a large area and the intermixing of redfish and jellyfish, especially in the south part of the research area. Furthermore, only Areas A and B were surveyed and important areas of the redfish stock above 500 m were not covered (Areas C-F, see Figure 2). For these reasons no reliable acoustic measurements were obtained.

The average depth of the DSL and the corresponding confidence limits are shown in Figure 6, combined for the two vessels. The depth of the layer in which redfish can be detected is, on average, around 50–150 m during the night-time but increases to its maximum between 275 and 325 m around noon. As a consequence, the redfish is hard to detect and measure below those depths.

2.4.1 Abundance estimation by the trawl method

Figure 3 shows the redfish distribution within the DSL above 500 m, based on the regression between the catches and the measured s_A values in the layer shallower than the DSL. The circles indicate converted units of s_A. The highest values (s_A up to 3.2 m^2/NM^2) were observed in the northeast area (subarea A) between latitudes 62° and 63°.

Figure 4 shows the redfish distribution at depths from 550 m to 900 m. The highest values (s_A up to 8 m^2/NM^2) were observed at latitude of between 61°N and 63°N in the northeast area.

The abundance estimation by subareas is given in Tables 5 and 7 for within the DSL (shallower than 500 m) and deeper than 500 m, respectively, and disaggregated by length groups in Tables 12a and 12b.

No reliable assessment of the redfish stock distributed within the DSL and shallower than 500 m was obtained during this survey as the distribution area of the stock was not covered (Areas C-F were not surveyed). There is, however, a sharp decrease in biomass in Areas A and B compared to 2009-2013 (Table 6) and the decrease is more than twofold between 2013 and 2015.

The assessment of the redfish stock distributed below 500 m constituted 196 000 t (0.29 billion individuals; Table 7). Applying the 95% confidence level to the data, the biomass estimate ranges from 162 000 to 229 000 t. Note that only Areas A and B were covered. In the surveys for 2011 and 2013, less than 5% of the total biomass were observed in areas C-F (Figure 2). The coverage of the stock below 500 m in 2015 is therefore considered adequate.

For comparison, the results of the surveys 1999–2013 are given in Table 8. The depth coverage of the deep trawls was changed to 350–950 m in 2005 (ICES, 2005a) and again in 2009 to 500–950. The survey estimates are therefore not strictly comparable between years, but attempt was made in 2014 to get estimates for the stock below 500 m for 2005 and 2007 (ICEC, 2014). The estimates for 1999 and 2013 were also revised in 2014 (ICES, 2014).

The results show that biomass decreased by approximately 40% in 2015 compared to 2013 and is the lowest observed in the time-series. There was a decrease in both Area A (the main fishing area) and Area B (Table 8).

2.4.2 Biological data

2.4.2.1 Sex composition, length and weight

At depths shallower than 500 m, the percentage of males (58.6%) exceeded that of the females (41.4%). The proportion of females increased compared to 2011 and 2013 and was the highest the time-series (Table 9). In the layer deeper than 500 m, the sex ratio was different, compared to that of the shallow layer (68.7% males, 31.3% females), and the proportion of females gradually decreased since 1999.

Fish length in the catches ranged from 21 to 48 cm. The mean length of redfish in the shallower layer was 34.9 cm, 0.6 cm smaller than in 2013, and the mean individual weight was 529 g compare to 556 g in 2013. In the deeper layer, the mean length was 38.5 cm which was same as in 2013, and the mean weight was 672 g compared to 701 g in 2013. In the northeast (NE) area (Tables 10a and 10b), redfish caught in the shallower layer were on average about 3.4 cm shorter than in the deeper layer which is similar difference as in 2013. In the southeast (SE) area (Tables 11a and 11b), redfish from the shallower layer were 2.6 cm shorter than from the deeper layer.

The length frequencies from the trawl stations are illustrated in Figures 7 and 8 and length-disaggregated abundance data are given Tables 12a and 12b. In depths shallower than 500 m (Figure 7), the peak of the length frequency distribution is around 35 cm, which is similar to the 2009–2013 surveys. In the layer deeper than 500 m, the length distribution shows a broad maximum around 35–42 cm (Figure 8), with a distinctive peak of fish 35 cm in the SE area.

2.4.2.2 Feeding

An overview on the stomach fullness is given in Table 12. In both the shallower and deeper layer, the majority of the redfish stomachs (64% shallow layer, 88% deep layer) were everted. In total 23% of the investigated redfish from the shallower layer and 4% in the deeper layer had food items in their stomachs. In the shallow and deep pelagic layer, the number of fish with little content was highest (12.0 and 1.7% respectively) with a decreasing trend towards high contents.

2.4.2.3 Maturity

The great majority of the males were identified as maturing, whereas most of the females were in the post-spawning stage, as expected from earlier investigations.

2.4.3 Species composition

Sixty-six species of fish were identified in both surveys combined belonging to 29 families and 14 orders. The most species rich families were Myctophidae with 7 species and Platytroctidae with 8 species. 59 fish species were found in the Icelandic survey and 38 in the German survey. Extended list of fish species is given in Appendix 4.

S. mentella was found in 90% of all trawl samples. Other species were mainly small non-commercial species belonging to the mesopelagic fauna, mainly myctophids. Numerous species were commonly observed throughout the sampling area i.e. *Bathylagus euryops*, *Serrivomer beani*, *Stomias boa ferox*, *Chauliodus sloani* and the myctophids *Lampanyctus macdonaldi* and *Notoscopelus kroeyeri*.

The 16 most frequent species throughout the sampling area are listed in Table 14. Type 1 and Type 2 tows were combined to represent trawl samples taken above 500 m for a comparison of depth below 500 m (Type 3 tow). Other groups belonging to the mesopelagic fauna were present in majority of all trawl samples. Cnidarians (jellyfish) occurred on average in 89% throughout the survey area and make up the majority of bycatch biomass (Icelandic part of the survey). Small cephalopods and crustaceans were also commonly present (on average 86% and 93% respectively).

2.4.4 Hydrography

During the survey 71 oceanographic stations were carried out. Oceanographic investigations were conducted in the area between 55°44'N and 64°45'N and from the Reykjanes Ridge westward to 42°W. The covered area was significantly smaller in this year due to the cancellation of participation of the Russian partner. Therefore, a comparison of the results with the results from previous years has not been performed. It was paid special attention to depict the hydrographic results in relation to fishing results. The results are shown in Figure 9.

2.5 Discussion

2.5.1 Acoustic assessment

The survey covered 200 000 NM², which is much less than in previous years where around 340 000 NM² were covered. The reason for less area coverage in 2015 was the withdrawal of Russia from the survey. It is not possible to cover the distribution area of pelagic redfish stocks in the Irminger Sea and adjacent waters with only two vessels in the scheduled time interval. Therefore, it was decided to focus only on estimating the stock biomass of the deep pelagic stock found below 500 m and is measured with the trawl method. Important areas of the shallow pelagic stock found above 500 m and is estimated with acoustic method were omitted (Areas C-F shown in Figure 2). In addition, the acoustic measurement results for 2015 are considered highly uncertain. This is because of mixing with smaller scatter over a large area and the intermixing of redfish and jellyfish, especially in the south part of the research area, which was not possible to distinguish when the acoustic data were scrutinized. For these reasons no reliable acoustic measurement was obtained.

2.5.2 Abundance estimation by the trawl method

During Russian trawl-acoustic surveys in 1995 and 1997, attempts were made to assess the redfish deeper than 500 m by acoustic methods. According to an expert estimation in 1995, the stock constituted nearly 900 000 t (Shibanov *et al.*, 1996a), and in 1997, it was estimated to be 500 000 t (Melnikov *et al.*, 1998). In the joint survey in 1999, an attempt was made to estimate the abundance deeper than 500 m based on a similar method as presented here.

Table 8 shows the total biomass estimates from the biennial surveys in 1999-2015. Note that the biomass estimates for 1999 and 2013 were revised in 2014 (ICES, 2014). Furthermore, attempts were made to estimate the total biomass of redfish below

500 m from the 2005 and 2007 surveys (ICES, 2014). As described in Section 2.1 the trawling was conducted differently in 2005 and 2007 than in 2001–2003 and 2009-2015. The difference is that in the 2005 and 2007 the trawling was from 350–950 m in a single tow. In the other surveys the trawling was in two separate tows, i.e. one tow from 350-500 m and one tow from 550 m down to 950 m. This means that in 2005 and 2007 both pelagic stocks were sampled simultaneously. The biomass estimates for 2005 and 2007 shown in Table 8 are based on the outcome of these re-calculations (ICES, 2014).

About 935 000 t were estimated deeper than 500 m when the trawl method was used for the first time in 1999 and about 1 million tonnes in 2001. Since then the biomass has decreased substantially. A total biomass of 280,000 t was estimated in 2013, significantly below the 474,000 t of 2011. The total biomass decreased further in 2015 and was estimated to be 196 000 t. It should be noted that Areas C-F (Figure 2) were not covered in 2015. In previous years (excluding the 2005 and 2007 estimates), subareas A and B together contained 90–95% of the biomass in the deeper layers (Table 8). The biomass estimation in 2015 is therefore considered adequate, but is likely to be underestimated by 5–10%. The results showed large biomass declines the areas surveyed in 2015, i.e. Areas A and B (Table 8).

The quality of the trawl method cannot be verified as the dataseries is relatively short. Such evaluation on the consistency of the method can therefore not be done until more data points are available. Therefore, as has been stated in earlier reports of the PGRS/SGRS, the abundance estimation by the trawl method must only be considered as a rough attempt to measure the abundance within the DSL and deeper than 500 m. In addition, the codend of the trawl was replaced by the multi-sampler system for the Icelandic trawl in 2009 and for the German trawl in 2011. This may affect the slope of the regression line (Figure 5). It is not possible to obtain reliable results without comparing the two trawl system with large number of trawls stations. This can only be done step by step.

2.5.3 Biology

Due to the difference in depth layers observed, compared to 2005 and 2007 when the layers were 'shallower than' and 'within and deeper than the DSL', the length distribution data are not comparable to some of the last surveys. The differences in mean length between the layers <500 m and >500 m in all areas, however, display the pattern observed in the commercial fisheries and in surveys prior to 2005, especially in the northeastern area. The relatively high amount of redfish of 33–37 cm length (peak at 35 cm) in the shallow layer of the NE and SE areas have been observed in the survey 2009 and 2011 and coincide with recently observed large numbers of demersal *S. mentella* on the East Greenland shelf (ICES, 2011b) that are probably partly migrating eastwards into the pelagic waters at that size.

As in previous years, the majority of the fish caught had everted stomachs, and only few stomach content data could be collected, thus the feeding condition and food composition could not be fully evaluated. However, stomach samples were taken and will be analysed accurately. From the observations made so far, redfish are opportunistic feeders that graze within the DSL (Magnússon, 1996) and feed on invertebrate species and small fish in the layers shallower and deeper than the DSL.

2.5.4 Hydrography

Due to lack of expertise in oceanography during the meeting, the Group did not evaluate any anomalies in water temperature.

3 Future of the survey and participation

During the February meeting in Tromsø, Norway in 2015, the participant from Iceland informed the group the decision that Marine Research Institute in Iceland will from now on only participate in the survey conducted in the Irminger Sea every third year, and not biennially as has been the practise since 1999.

The objective of the group is to provide sound, credible, timely, peer-reviewed, and integrated scientific advice on fishery management. The surveys are primary basis for the advice on the stock status of pelagic redfish in the areas. The Group is particularly concerned with the decreased data quality and higher uncertainty in the derived data series and consequently the advice on the stock status. Regardless of these concerns, both Germany and Russia will continue their participation in the International Deep Pelagic Ecosystem Survey in the Irminger Sea.

The Group confirms its 2005 recommendations (ICES, 2005a: 2005b) that the survey should be continued, that it should be carried out with as many vessels as possible to improve the quality of the derived estimates, and that the timing of the survey should be kept in June/July.

On three of the last five surveys (2007, 2009 and 2015), the redfish distribution area was only covered with a relatively low density of hydroacoustic tracks and trawl hauls by two vessels, due to the cancellation of the German part in 2007 and the Russian part in 2009 and 2015. The Group would like to express its severe worries about the insufficient survey participation of ICES countries involved in the pelagic redfish fisheries in the Irminger Sea and adjacent waters. The Group is particularly concerned with the decreased data quality and higher uncertainty (on top of the methodological drawbacks) in the derived dataseries and corresponding low credibility in the Group's work and consequently the advice on the stock status.

4 Acknowledgements

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The meeting was hosted by the Marine Research Institute in Reykjavík, Iceland. Many thanks for their great hospitality and technical organization of the meeting.

5 Recommendations

Recommendation	Action
Continue international trawl-acoustic survey on pelagic redfish in the Irminger Sea and adjacent waters; change survey frequency to every third year; participation of as many vessels as possible; keep timing of the survey (June/July)	ICES Secretariat, ICES Delegates, ICES Member Countries
Consider 2015 survey results for advice on pelagic redfish (shallow and deep stocks) to be given in October 2015	ACOM, NWWG
Involve more countries in the Irminger and Norwegian Seas surveys	ICES Secretariat, ICES Delegates
Secure appropriate funding to support the WGIDEEPS in the Norwegian and Irminger Seas	NEAFC Coastal States
To transfer survey data from 1999 to 2015 to ICES DATRAS	WGIDEEPS members / ICES DATRAS

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7 Tables

Table 1. Extent, coverage and trawl specification of the international redfish survey in the Irminger Sea and adjacent waters in June/July 2015.

COUNTRY	GERMANY	ICELAND
Vessel	RV Walther Herwig III	RV Árni Friðriksson
Call code/ICES country code	DBFR / 6	TNFA / 46
Days in field	17	17
Type of trawl	Hampidjan / Gloria 1024	Hampidjan / Gloria 1024
Number of hauls	13 T1; 13 T2; 13 T3 = 39	1 T1; 36 T2; 37 T3 = 74
Opening / Width	50 m / 50 m	50 m / 50 m
Codend	Multisampler (3 bags), 23 mm codend	Multisampler (3 bags), 23 mm codend
Distance for acoustic registrations	2,145 NM	2,097 NM
Area surveyed	120,500 NM^2	88,632 NM^2
Number of CTD casts	33	38

Table 2. Instrument settings of the acoustic equipment on board the participating vessels. The sound speed value is approximate for the prevailing hydrographic condition in the survey area.

VESSEL	WALTHER HERWIG III	ÁRNIFRIÐRIKSSON
Echosounder Integrator	Simrad EK60 EchoView 5.3 (Myriax)	Simrad EK60 EchoView 5.3 (Myriax)
Frequency	38 kHz	38 kHz
Transmission power	2000 W	2000 W
Absorption coefficient	9.4 dB/km	10 dB/km
Pulse length	1.0 ms	1.0 ms
Bandwidth	2.43 kHz	2.43 kHz
Transducer type	ES38-B	ES38-B
Two-way beam angle	-20.6 dB	-20.9 dB
Integration Threshold	-80 dB/m^3	-80 dB/m^3
Sound speed	1494 m/s	1483 m/s
Transducer Gain SV (s_A correction)	0.63 dB	-0.62 dB
Transducer Gain TS	23.22 dB	24.37 dB

Table 3. Summary of biological sampling in the international redfish survey in the Irminger Sea and adjacent waters in June/July 2015.

Country	Germany	Iceland
Total number / biomass of redfish caught	608 ind. / 341 kg	1,038 ind. / 662 kg
Number of length measurements	608	1,032
Number of pairs of otoliths collected	608	1,019
Number of feeding analysis	608	1,019
Number of parasites analysis	608	1,019
Individuals with genetics	0	0

Table 4. Results (biomass in ´000 t) for the international surveys conducted 1994–2013, for redfish shallower than the DSL for each subarea and total. No estimate was available in 2015.

	Sub area						
Year	A	B	C	D	E	F	Total
1994	673	1228	-	63	226		2190
1996	639	749	-	33	155		1576
1999	72	317	16	42	167		614
2001	88	220	30	267	103	7	716
2003	32	46	1	2	10	0	89
2005	121	123	0	87	204	17	551
2007	80	95	0	53	142	3	372
2009	39	48	4	1	15	1	108
2011	5	74	0	3	40	1	123
2013	9	33	2	5	42	0	91

Table 5. Results from experimental estimation of redfish within the DSL and shallower than 500 m in June/July 2015. Areas C-F (see Figure 2) were not surveyed.

	A	B	C	D	E	F	TOTAL
Area (NM²)	113,450	87,994					201,444
Mean length (cm)	35.5	34.1					34.7
Mean weight (g)	536	521					526
No. fish ('000)	55,487	72,802					128,289
Biomass (t)	**31,288**	**37,899**					**69,187**
Lower CL	26,361	29,592					55,953
Upper CL	36,215	46,206					82,421

Table 6. Results (biomass in ´000 t) for the international surveys conducted since 2001, 2009, 2011, 2013 and 2015 for redfish within the DSL layer and shallower than 500 m for each subarea and the total. Areas C-F (see Figure 2) were not surveyed in 2015.

	SUBAREA						
YEAR	A	B	C	D	E	F	TOTAL
2001	23	40	45	399	54	5	565
2009	136	68	0	25	48	0	278
2011	69	185	1	30	76	0	309
2013	71	94	0	9	26	1	201
2015	31	38					69

Table 7. Results from trawl estimation of redfish deeper than 500 m in June/July 2015. Areas C-F (see Figure 2) were not surveyed.

	A	B	C	D	E	F	TOTAL
Area (NM²)	113,450	87,994					201,444
Mean length (cm)	38.6	37.2					38.3
Mean weight (g)	673	668					672
No. fish ('000)	227,131	64,234					291,365
Biomass (t)	**152,775**	**42,919**					**195,694**
Lower CL	128,853	33,511					162,364
Upper CL	176,697	52,327					229,024

Table 8. Results (biomass in ´000 t) for the international surveys conducted since 1999, for redfish deeper than 500 m (1999–2003 and 2009–2015), deeper than 350 m (2005 and 2007) for each subarea, and total, and the depth range covered. (+) Estimates for 1999 and 2013 were revised in 2014 (ICES, 2014). (*) Attempts were made to estimate biomass below 500 m for the surveys conducted in 2005 and 2007 (ICES, 2014).

	Subarea							
Year	A	B	C	D	E	F	Total	Depth (m)
1999+	277	568	12	27	52	0	935	500–950
2001	497	316	28	79	64	18	1001	500–950
2003	476	142	20	13	27	0	678	500–950
2005*	221	95	0	8	65	3	392	(350–950)
2007*	276	166	1	5	92	11	522	(350–950)
2009	291	121	0	8	37	1	458	550-900
2011	342	112	0	1	18	0	474	550–900
2013	193	75	0	2	10	0	280	550-900
2015	153	43					196	550-900

Table 9. Sex ratio of redfish above and below 500 m from the international redfish surveys 1999–2015.

	<500m		>500 m	
Year	Males	Females	Males	Females
1999	61.8	38.2	59.7	40.3
2001	64.8	35.2	59.5	40.5
2003	63.1	36.9	61.7	38.3
2005	64.9	35.1		
2007	60.1	39.9		
2009	65.0	35.0	67.0	33.0
2011	61.0	39.0	58.0	42.0
2013	61.5	38.5	66.6	33.4
2015	58.6	41.4	68.7	31.3

Table 10a. Redfish trawl data < 500 m. Northeast area. Mean weight and individuals by length (cm below).

	Males		Females		Total	
Length (cm)	Weight (g)	Numbers	Weight (g)	Numbers	Weight (g)	Numbers
26	295	1			295	1
27	216	1	218	2	217	3
28	244	4	270	3	255	7
29	279	2	288	4	285	6
30	303	6	305	3	304	9
31	338	15	333	4	337	19
32	391	11	363	8	379	19
33	397	17	397	3	397	20
34	477	29	464	18	472	47
35	500	28	516	18	506	46
36	548	21	537	12	544	33
37	597	25	561	11	586	36
38	637	14	634	9	636	23
39	652	10	652	6	652	16
40	729	10	696	4	719	14
41	803	3	824	6	817	9
42	878	5	850	2	870	7
43			996	1	996	1
44	948	2			948	2
45	1236	1			1236	1
46	1111	1			1111	1
Total number		**206**		**114**		**320**
Avg. weight	**524**		**518**		**522**	
Avg. length		**35.25**		**35.20**		**35.23**

Table 10b. Redfish trawl data > 500 m. Northeast area. Mean weight and individuals by length (cm below).

	Males		Females		Total	
Length (cm)	Weight (g)	Numbers	Weight (g)	Numbers	Weight (g)	Numbers
26			214	1	214	1
27	222	2	197	1	213	3
28			234	1	234	1
29	266	3			266	3
30	306	8	286	2	302	10
31	333	5	327	2	331	7
32	365	12	328	2	360	14
33	399	15	407	15	403	30
34	446	34	424	13	440	47
35	484	36	463	14	478	50
36	529	38	518	21	525	59
37	568	47	558	23	564	70
38	627	54	620	20	625	74
39	674	58	665	25	671	83
40	718	61	730	29	722	90
41	794	52	758	25	783	77
42	869	49	818	17	856	66
43	922	34	873	20	904	54
44	999	37	1002	9	1000	46
45	1057	15	999	3	1048	18
46	1146	3	1106	2	1130	5
47						
48	1197	1	1255	1	1226	2
Total number		**564**		**346**		**810**
Avg. weight	**682**		**652**		**673**	
Avg. length		**38.71**		**38.48**		**38.64**

Table 11a. Redfish trawl data < 500 m. Southeast area. Mean weight and individuals by length (cm below).

	Males		Females		Total	
Length (cm)	Weight (g)	Numbers	Weight (g)	Numbers	Weight (g)	Numbers
21			202	1	202	1
22						
23						
24						
25						
26	246	1	230	1	238	2
27	248	2	242	2	245	4
28	270	4	275	7	274	11
29	289	3	325	2	303	5
30	455	2	325	7	354	9
31	400	10	382	7	393	17
32	417	20	415	13	416	33
33	460	21	447	13	455	34
34	504	30	484	20	496	50
35	543	50	526	28	537	78
36	620	40	595	34	609	74
37	652	24	627	24	639	48
38	686	6	717	11	706	17
39	694	2	749	9	739	11
40	834	1	755	5	768	6
41			745	1	745	1
42	888	1			888	1
43						
44						
45						
46						
47						
48	1659	1			1659	1
Total number		**218**		**185**		**403**
Avg. weight	**538**		**532**		**535**	
Avg. length		**34.48**		**34.64**		**34.55**

Table 11b. Redfish trawl data > 500 m. Southeast area. Mean weight and individuals by length (cm below).

	Males		Females		Total	
Length (cm)	Weight (g)	Numbers	Weight (g)	Numbers	Weight (g)	Numbers
28			296	1	296	1
29	291	1			291	1
30	549	1	336	2	407	3
31			353	1	353	1
32	426	1	426	1	426	2
33	464	1	382	1	423	2
34	494	8	513	3	499	11
35	535	13	540	4	536	17
36	622	9	584	5	608	14
37	642	5	654	5	648	10
38	686	7	648	2	678	9
39	756	6	713	6	735	12
40	825	7	810	4	820	11
41	788	2	877	3	841	5
42	990	5	904	3	958	8
43	1062	2	953	2	1008	4
44	1106	2			1106	2
Total number		**70**		**43**		**113**
Avg. weight	**677**		**653**		**668**	
Avg. length		**37.23**		**37.12**		**37.19**

Table 12a. Length distribution (numbers of fish in '000 per cm class) of redfish by area, derived from the trawl within the DSL and shallower than 500 m.

Length (cm)	A	B	Total
21	0	319	319
22	0	0	0
23	0	0	0
24	0	0	0
25	0	0	0
26	208	639	847
27	208	1,277	1,485
28	1,247	3,193	4,440
29	1,039	1,597	2,636
30	1,247	1,277	2,524
31	2,909	3,832	6,741
32	3,325	7,025	10,350
33	3,325	7,025	10,350
34	8,728	8,621	17,349
35	8,105	11,495	19,600
36	6,027	12,772	18,799
37	7,274	7,983	15,257
38	4,364	2,235	6,599
39	3,117	1,916	5,033
40	2,909	958	3,867
41	0	0	0
42	1,455	319	1,774
43	0	0	0
44	0	0	0
45	0	0	0
46	0	0	0
47	0	0	0
48	0	319	319
Total	**55,487**	**72,802**	**128,289**
Mean length	**35.5**	**34.1**	**34.7**
Mean weight (g)	**536**	**521**	**527**

Table 12b. Length distribution (numbers of fish in '000 per cm class) of redfish by area, derived from the trawl estimate ≥500 m.

Length (cm)	A	B	Total
26	280	0	280
27	841	0	841
28	280	568	848
29	841	568	1,409
30	2,804	1,705	4,509
31	1,963	,568	2,531
32	3,926	1,137	5,063
33	8,412	1,137	9,549
34	13,179	6,253	19,432
35	14,021	9,664	23,685
36	16,544	7,958	24,502
b37	19,629	5,685	25,314
38	20,750	5,116	25,866
39	23,274	6,821	30,095
40	25,237	6,253	31,490
41	21,592	2,842	24,434
42	18,507	4,548	23,055
43	15,142	2,274	17,416
44	12,899	1,137	14,036
45	5,047	0	5,047
46	1,402	0	1,402
47	0	0	0
48	561	0	561
Total	**227,131**	**64,234**	**291,365**
Mean length	**38.6**	**37.2**	**38.3**
Mean weight (g)	**673**	**668**	**672**

Table 13. Redfish trawl data. Observations on stomach contents, from fish caught shallower and deeper than 500 m.

< 500 m	Area					
	Northeast		Southeast		Total	
	No.	%	No.	%	No.	%
Everted	226	82.2	195	47.9	461	63.8
Empty	23	7.3	74	19.2	97	13.4
Little	15	4.7	72	17.7	87	12.0
Medium	7	2.2	56	13.8	63	8.7
High	5	1.6	10	2.5	15	2.1
Total	316		406		723	
With content	27	**8.5**	138	33.9	165	22.8

> 500 m	Area					
	Northeast		Southeast		Total	
	No.	%	No.	%	No.	%
Everted	723	91.4	74	65.5	797	88.2
Empty	50	6.3	24	21.2	74	8.2
Little	8	1.0	7	6.2	15	1.7
Medium	8	1.0	6	5.3	14	1.5
High	2	0.3	2	1.8	4	0.4
Total	791		113		904	
With content	18	2.3	15	13.3	33	3.7

Table 14. Trawl data. The most frequent species/groups in the survey conducted in the Irminger Sea and adjacent waters in June/July 2015. #: Tows with species precent. FO (%): Frequency of occurrence.

Survey	Árni Friðriksson				Walther Herwig III			
Depth of tows	<500		>500		<500		>500	
Number of tows	37		37		13		13	
Species/family	#	FO (%)	#	FO (%)	#	FO (%)	#	FO (%)
Sebastes mentella	30	81	71	96	12	92	12	92
Arctozenus risso	11	30	20	27	12	92	10	77
Bathylagus euryops	17	46	57	77	11	85	12	92
Benthosema glaciale	37	100	67	91	6	46	3	23
Chauliodus sloani	7	19	53	72	7	54	11	85
Borostomias antarcticus	2	5	33	45	3	23	12	92
Lampadena speculigera	0	0	9	12	1	8	7	54
Lampanyctus macdonaldi	23	62	71	96	12	92	12	92
Malacosteus niger	1	3	30	41	0	0	9	69
Myctophum punctatum	0	0	0	0	6	46	7	54
Normichthys operosus	2	5	40	54	1	8	4	31
Notoscopelus kroeyeri	35	95	40	54	12	92	11	85
Scopelogadus beani	5	14	38	51	7	54	10	77
Serrivomer beani	19	51	60	81	9	69	12	92
Stomias boa ferox	20	54	48	65	11	85	12	92
Xenodermichthys copei	8	22	18	24	6	46	2	15
Myctophidae	37	100	74	100	12	92	12	92
Cnidaria	32	86	69	93	12	92	12	92
Crustacea	36	98	73	99	12	92	12	92
Cephalopoda	29	78	69	93	12	92	12	92

8 Figures

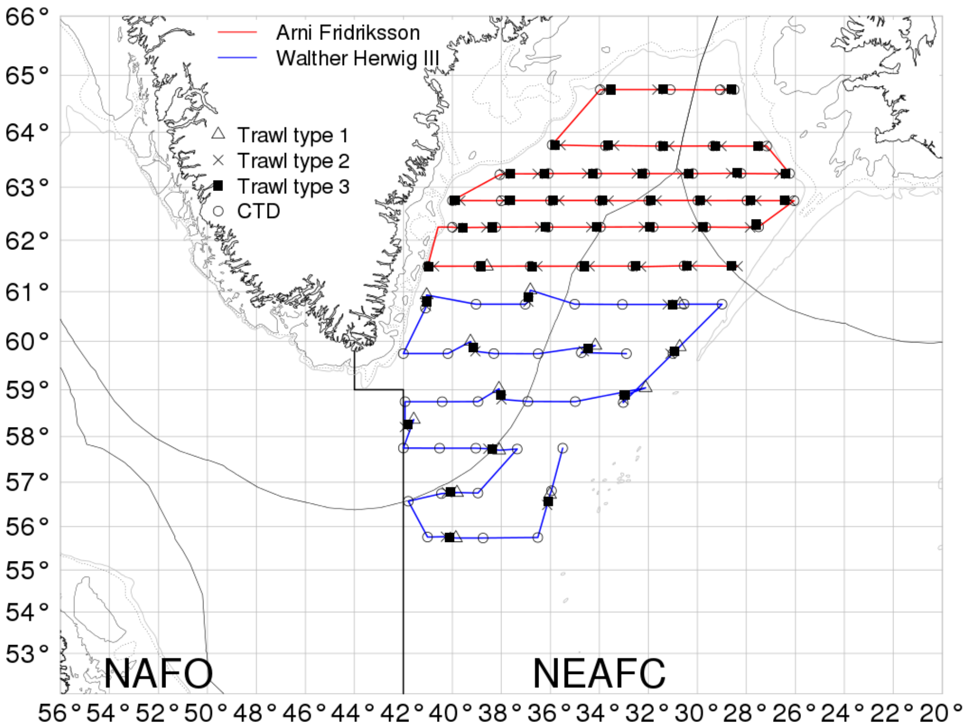

Figure 1. Cruise tracks and stations taken in the joint international redfish survey in June/July 2015.

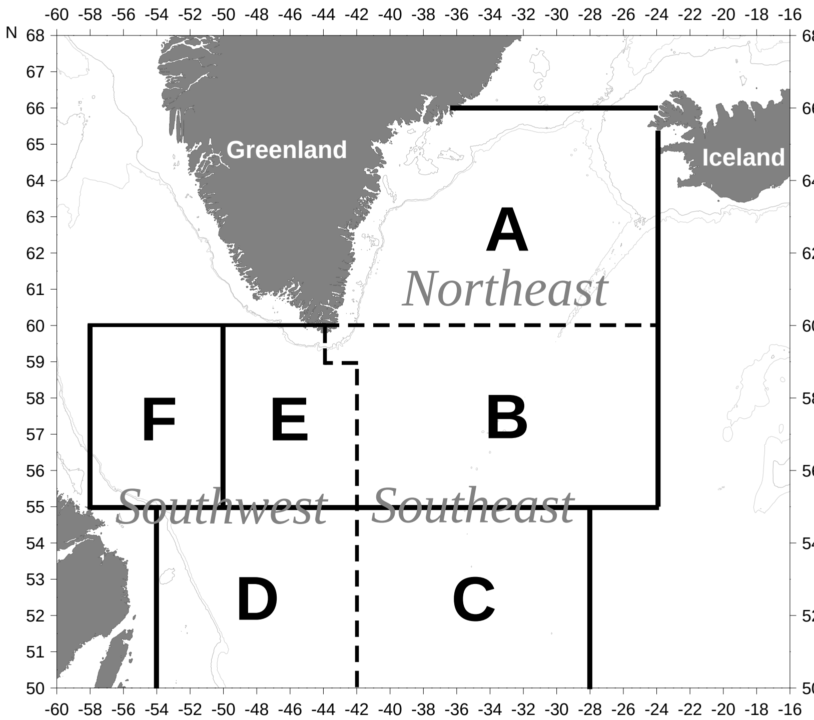

Figure 2. Sub-areas A-F used on international surveys for redfish in the Irminger Sea and adjacent waters, and divisions for biological data (Northeast, Southwest and Southeast; boundaries marked by broken lines).

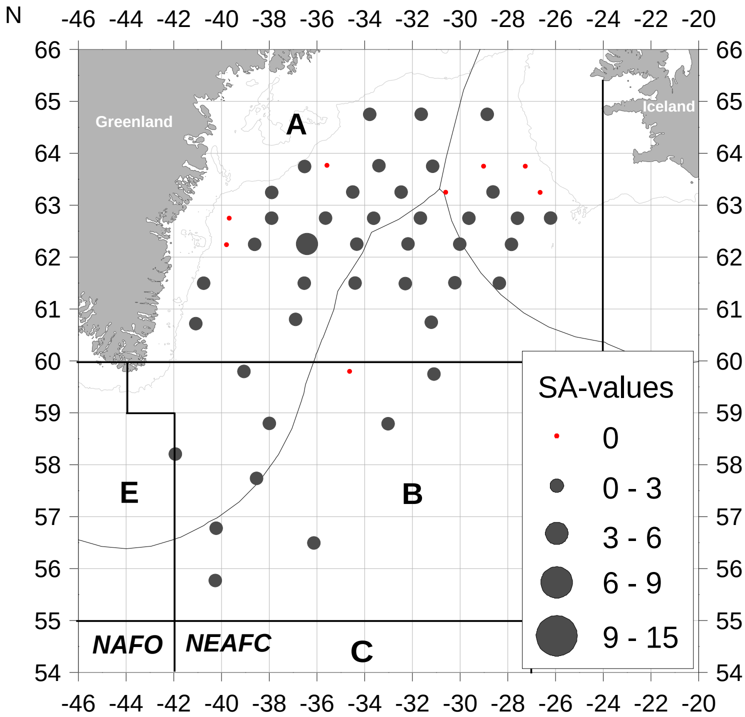

Figure 3. Redfish trawl estimates within the DSL and shallower than 500 m (type 2 trawls). sA values calculated by the trawl method (Section 2.2.3) during the joint international redfish survey in June/July 2015.

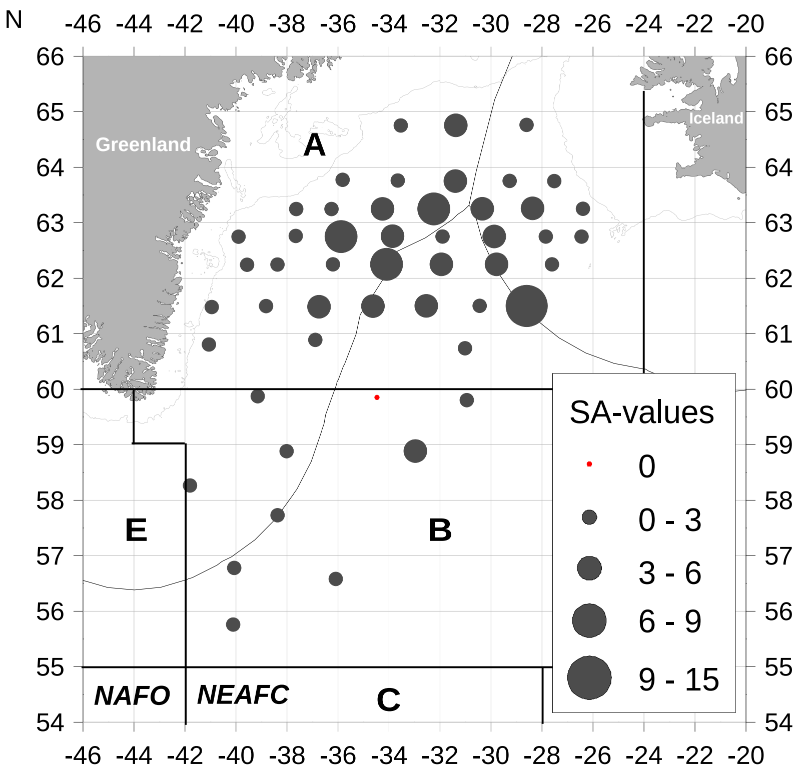

Figure 4. Redfish trawl estimates deeper than 500 m (type 3 trawls). sA values calculated by the trawl method (Section 2.2.3) during the joint international redfish survey in June/July 2015.

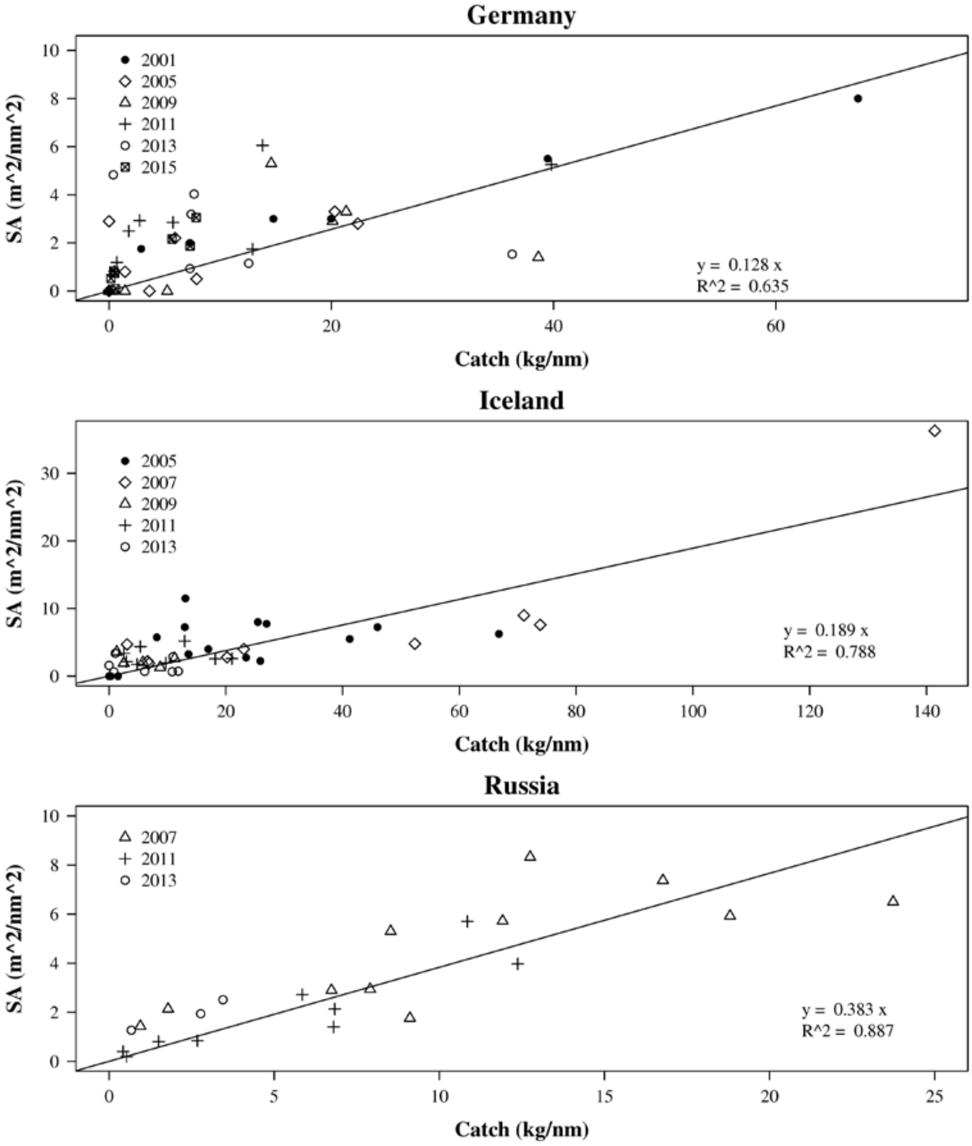

Figure 5. Regressions between catches and observed hydroacoustic s_A values, observed on the German, Icelandic and Russian vessels shallower than the DSL and used in the biomass calculations. For German trawl types 1 for the years 2001, 2005, 2009, 2011, 2013 and 2015 were used for the regression, the years 2005, 2007, 2009, 2011 and 2013 for the Icelandic vessel and 2007, 2011 and 2013 for the Russian vessel.

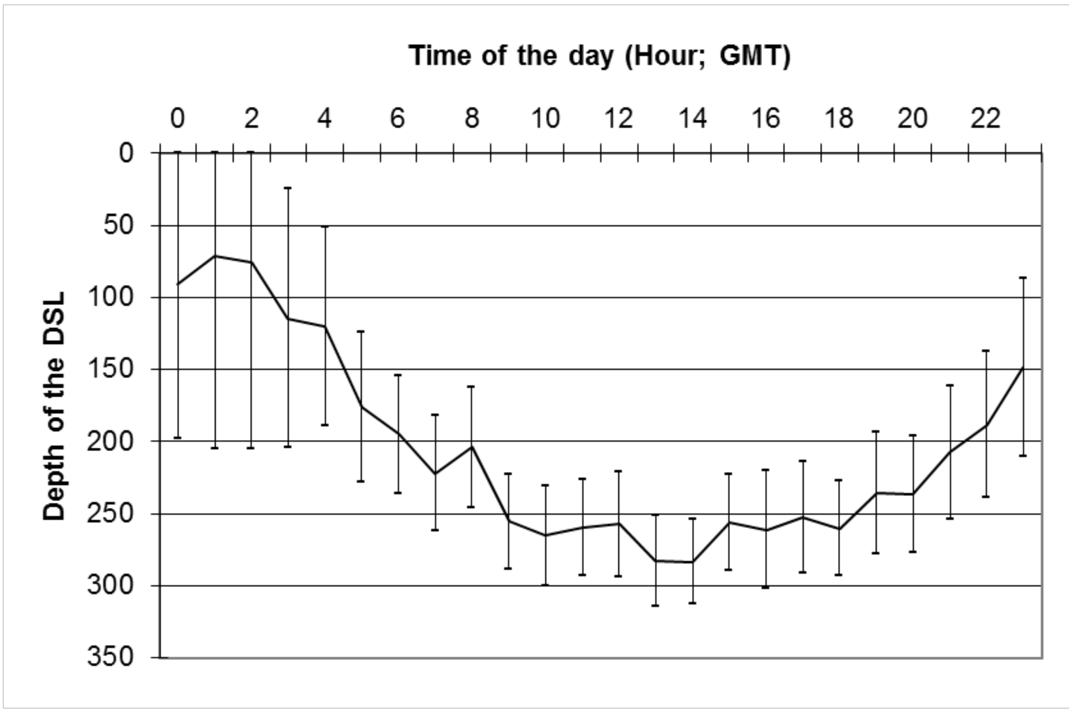

Figure 6. Average depth and standard deviation of the DSL during the survey in June/July 2015.

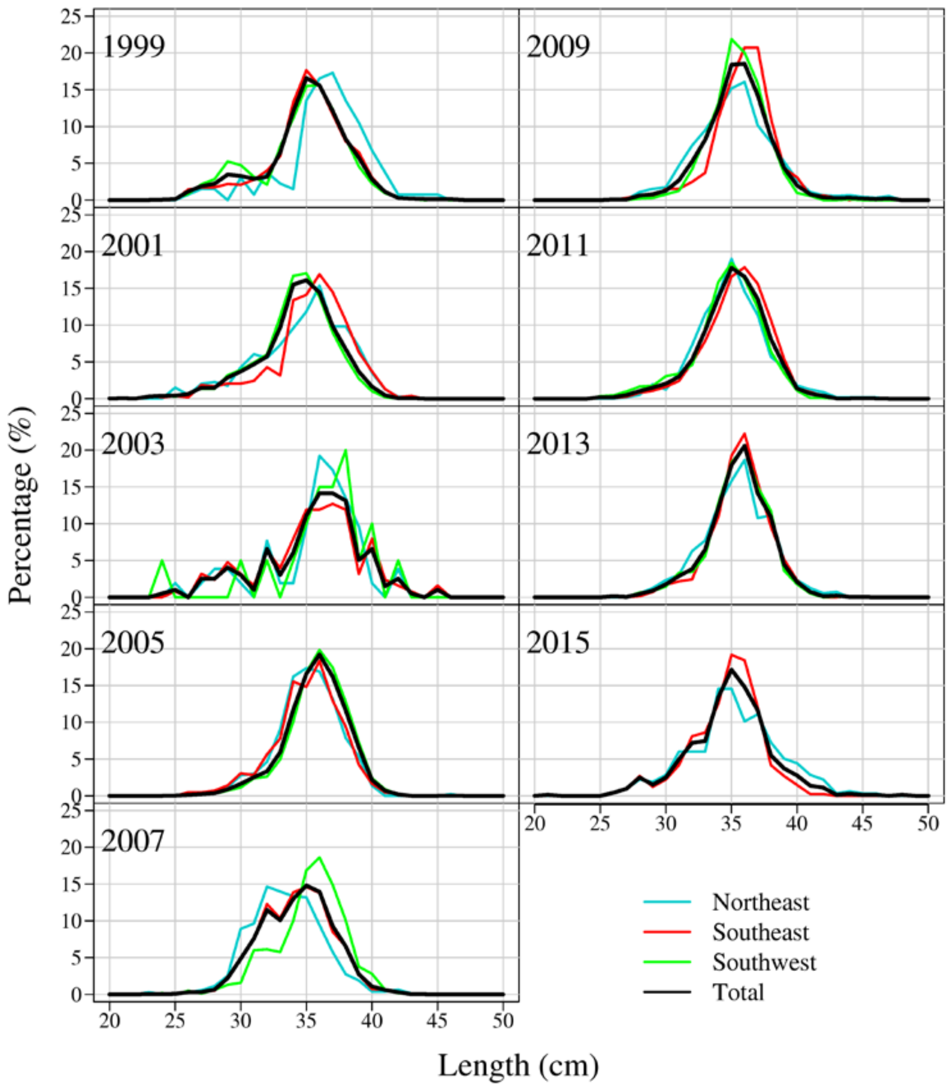

Figure 7. Length distribution of redfish in the trawls, by geographical areas (see Figure 2) and total, from fish caught shallower than 500 m 1999–2015.

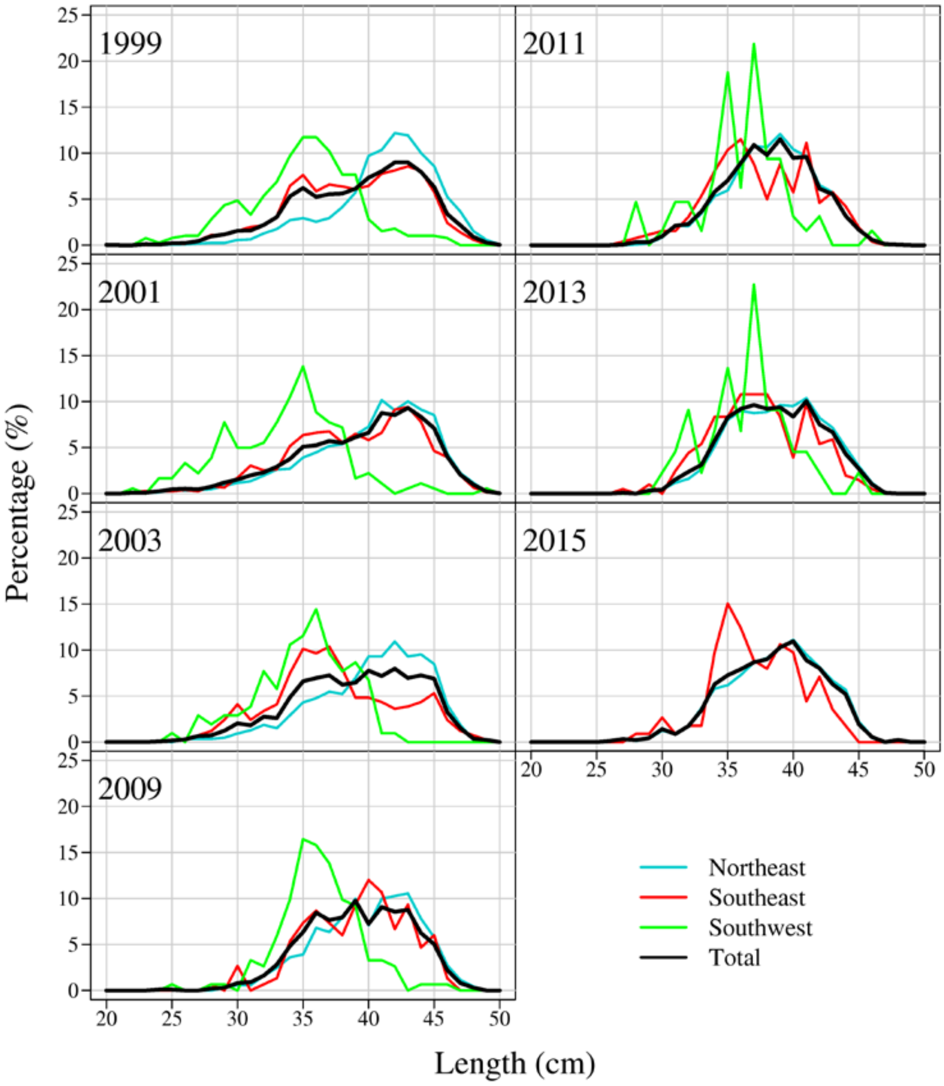

Figure 8. Length distribution of redfish in the trawls, by geographical areas (see Figure 2) and total, from fish caught deeper than 500 m 1999–2003 and 2009–2015.

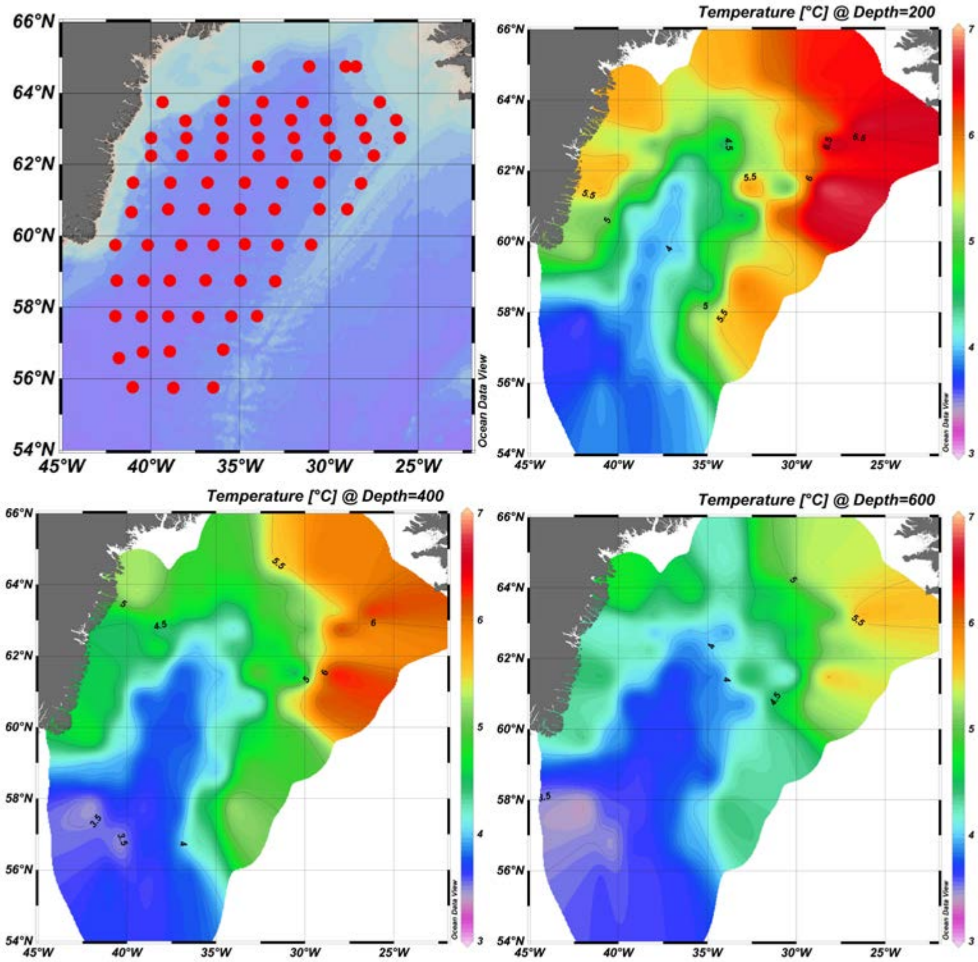

Figure 9. Positions of CTD stations and temperature distribution (°C) at 200 m, 400, m and 600 m depth in the survey area of the international hydroacoustic-trawl redfish survey on redfish in the Irminger Sea and adjacent waters in June/July 2015 (plotted with ODV, Schlitzer, R., Ocean Data View, odv.awi.de, 2015).

Annex 1: List of participants

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Annex 2: Agenda of the meeting

ICES Working Group on International Deep Pelagic Ecosystem Surveys (WGIDEEPS) meeting

Reykjavík, Iceland, 4–6 August 2015

Chair: Kristjan Kristinsson, Iceland

Provisional Agenda

ToR (Recommendation 2013/MA2/SSGESST01):
b. at the 4-6 August meeting prepare the report of the outcome of the 2015 Irminger Sea survey.

Tuesday, 4 August 2015

09:00 Start of the meeting

- Housekeeping, network access
- Suggestions for venues of lunch breaks and dinner
- Adoption of the agenda

09:30 Plenary:

- Discussion of logistic and technical issues during the survey
  - Coverage deficiencies due to damages, bad weather, lack of time etc.
  - Deviations from survey planning (tracks, depth and duration of trawling)
  - Hydroacoustics: transducer frequency and bandwidth, echo counting(?), noise measurements
  - Biological sampling; unusual observations
  - Hydrography: short description of the situation during the survey
- Other relevant observations during the survey (e.g. intensity of fishery activities, reports on catch rates of the fleet, targeted areas, depth zones etc.)
  - Genetic sampling
  - Echosounder comparison
- Preliminary biomass and abundance estimates, draft of main tables and figures

12:00–13:00 Lunch break

13:00–17:00 Individual/subgroup work:

- *Kristján:*
  - cruise track plot
  - biomass and abundance estimation from acoustic method (shallower than DSL) and from trawl-acoustic method (within and below DSL)
  - regression analyses
- *Eckhard:*
  - echo counting results
  - report drafting for hydroacoustics section
  - environmental conditions, temperature contour plots at 200/400/600 m depth
  - report drafting for hydrography section
- *Matthias*:
  - plots of SA values by 5 NM and by trawl estimates
  - biological results
  - report drafting for biological and general sections
  - parasite infestation
- *Klara*:
  - compile data on other species than redfish (new)

Wednesday, 5 August 2015

09:00 Plenary:

- Drafts of tables and figures for hydroacoustic estimation, trawl estimation, biology, environmental conditions
- Error estimation for abundance and biomass values
- Description of uncertainties of the survey index

10:30 Continue individual/subgroup work (report drafting)

12:00–13:00 Lunch break

13:00 Plenary: General issues:

- Participation of further countries
- Future of the survey, assessment relevance, financing, national interests/constraints
- Other issues

15:00 Continue individual/subgroup work (report drafting)

17:00 Start discussion on first draft of report

18:00 End of working day.

Thursday, 6 August 2015

09:00–11:00 Finish first draft of report

11:00 Plenary:

- Perception of the state of the stock and corresponding advice (advice in October)
- Recommendations

12:00–13:00 Lunch break

13:00 Discuss draft report, clarify outstanding issues,
14:00 Finish survey protocol for publication in the ICES series of survey protocols (SISP).

☞ Deadline for report: 1 September 2015

☞ Leave all material (data, tables, figures, text parts etc.) on the server and with Kristján

16:00 End of the meeting

Annex 3: Meeting dates and venue for next meeting

The **Working Group on International Deep Pelagic Ecosystem Surveys (**WGIDEEPS), Co-Chaired by Kristjan Kristinsson, Iceland and Benjamin Planque*, Norway will meet in ICES HQ, Copenhagen, Denmark, 28-30 January 2014; in Tromsø, Norway, 3–5 February 2015; in Reykjavik, Iceland, 4–6 August 2015; in (dates and venue to be decided) XXXX 2016 to:

	Meeting dates	Venue	Reporting details	Comments (change in Chair, etc.)
Year 2014	28-30 January	ICES Headquarters, Copenhagen	Interim report by 1 March 2014 SSGESST, SCICOM & ACOM	
Year 2015	3-5 February	Tromsø, Norway	Interim report by 27 March 2015 to SSGIEOM, SCICOM, & ACOM	
Year 2015	4-6 August	Reykjavik, Iceland	Interim report by 1 September to SSGIEOM, SCICOM, & ACOM	
Year 2016		By correspondence	Final report by 1 September 2016 to SSGIEOM, SCICOM, & ACOM	Meeting dates and venue for 2016 meeting still to be decided.

ToR descriptors

ToR	Description	Background	Science Plan topics addressed	Duration	Expected Deliverables
a	Transfer survey data from 2011 international redfish surveys coordinated by the group to ICES databases (January 2014 meeting)	Data is now stored by individual nations/participants. It is important to have the data within common database system for coordinated archiving and extraction.		Year 1 (2014)	WGIDEEPS 2104 report chapter database (various ICES databases) 15 March 2014 SSGESST
b	Transfer survey data from other years, when ICES data centre is ready			2015	Updated data base at ICES data centre
c	Develop the group strategy towards redfish assessment and ecosystem approach (January 2014 meeting). To evaluate and revise the data collection in the surveys and	The data collected during the surveys are used for assessment of the stocks in the areas and to map their horizontal and vertical distribution. No analytical assessment is conducted for the	112,113,121,123, 141,143,144,145, 152,153,161,162,	Year 1 (2014)	WGIDEEPS 2014 report chapter 15 March 2014 SSGESST

	assessment methodologies used for the deep-water redfish stocks (January 2014 meeting).	stocks in the Irminger Sea and their statuses are assessed from biomass trends derived from the survey indices. Little additional data are collected to understand the trophic interaction in the areas. By broadening the work of the WG towards redfish assessment and the study of the meso-pelagic ecosystem of the North Atlantic will lead to increased knowledge of the multiple components in the deep-water ecosystem of the areas and provide better assessment data for deep-water redfish.			
d	To publish the results from the deep-water ecological surveys in the Irminger Sea and the Norwegian Sea in a peer-reviewed journal (2016).	This ToR is conditional on available survey effort as outlined in ToR c.	112,113,121,123, 141,143,144,145, 152,153,161,162	Year 3 (2016)	Manuscript ready for submission in 2016
e	Plan the international deep pelagic ecosystem survey with special emphasis on redfish to be carried out in the Irminger Sea and adjacent waters in June/July 2015 (January 2015 meeting)	The WG has been responsible for the planning of the international trawl/acoustic surveys on pelagic redfish (Sebastes mentella) in the Irminger Sea and adjacent waters since 1994 and corresponding reports on the survey results.	112,113,121,123, 141,143,144,145, 152,153,161,162	2015	WGIDEEPS 2015 – 1 report chapter 15 March 2015 SSGESST
f	Plan the international deep pelagic ecosystem survey with special emphasis on redfish to be carried out in the	The WG has been responsible for the planning of the international trawl/acoustic surveys on pelagic	112,113,121,123, 141,143,144,145, 152,153,161,162	Year 2 (2015)	WGIDEEPS 2015 – 1 report chapter 15 March 2015 SSGESST

	Norwegian Sea and adjacent waters in August 2015 (January 2015 meeting)	redfish (Sebastes mentella) in the Norwegian Sea since 2008 and corresponding reports on the survey results.			
g	Prepare the report on the outcome of the 2015 Irminger Sea survey (August 2015 meeting)	a) Provide sound, credible, timely, peer-reviewed, and integrated scientific advice on fishery management and the protection of the marine environment. b) Redfish indices are being used by assessment working groups.	112,113,121,123, 141,143,144,145, 152,153,161,162,	Year 2 (2015)	WGIDEEPS 2015 – 2 report 1 September 2015 SSGESST
h	Prepare the report on the outcome of the 2015 Norwegian Sea survey (September 2015 meeting)	a) Provide sound, credible, timely, peer-reviewed, and integrated scientific advice on fishery management and the protection of the marine environment. b) Redfish indices are being used by assessment working groups.	112,113,121,123, 141,143,144,145, 152,153,161,162	Year 2 (2015)	WGIDEEPS 2015 – 3 report 1 October 2015 SSGESST
i	Prepare the survey protocol for publication in the ICES series of survey protocols (SISP)			Year 2 (2015)	SISP manuscript

Summary of the Work Plan

Year 1	Carry out ToR a, c
Year 2	Standard outputs for e-i.
Year 3	Carry out ToR b,c,d.

Supporting information

Priority	Essential, primary basis for the advice on the stock status of pelagic redfish in the Irminger Sea and adjacent waters and in the Norwegian Sea.
Resource requirements	N/A
Participants	<12 (incl. the cruise leaders of each vessel and the principle experts involved in abundance and biomass calculations and deep sea ecology).
Secretariat facilities	N/A
Financial	None.

Linkages to ACOM and groups under ACOM	NWWG, AFWG, WGDEC, WKFAST, WGOH, WGISDAA, WGBIODIV
Linkages to other committees or groups	SSGESST
Linkages to other organizations	NAFO, NEAFC.

Annex 4: Regression models used in biomass calculations

Model results for the Russian data

```
Call:
lm(formula = SaValue ~ kg.nm - 1, data = data[data$StType ==
    1 & data$Country == 90 & data$Year > 2005, ], na.action = na.omit)

Residuals:
    Min      1Q  Median      3Q     Max
-2.5981 -0.3366  0.3174  1.1124  3.4398

Coefficients:
      Estimate Std. Error t value Pr(>|t|)
kg.nm  0.38316    0.02918   13.13  6.9e-12 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 1.368 on 22 degrees of freedom
  (1 observation deleted due to missingness)
Multiple R-squared:  0.8869,  Adjusted R-squared:  0.8817
F-statistic: 172.5 on 1 and 22 DF,  p-value: 6.901e-12
```

Model results for the German data

```
Call:
lm(formula = SaValue ~ kg.nm - 1, data = data[data$StType ==
    1 & data$Country == 6, ], na.action = na.omit)

Residuals:
    Min      1Q  Median      3Q     Max
-3.5530  0.0000  0.4972  1.4061  4.7806

Coefficients:
      Estimate Std. Error t value Pr(>|t|)
kg.nm  0.12821    0.01434   8.942 1.26e-11 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 1.707 on 46 degrees of freedom
  (11 observations deleted due to missingness)
Multiple R-squared:  0.6348,  Adjusted R-squared:   0.6269
F-statistic: 79.96 on 1 and 46 DF,  p-value: 1.26e-11
```

Model reusults for the Icelandic data

```
Call:
lm(formula = SaValue ~ kg.nm - 1, data = data[data$StType ==
    1 & data$Country == 46 & data$Year != 2001, ], na.action = na.omit)

Residuals:
    Min      1Q  Median      3Q     Max
-6.3864 -1.1163  0.5587  2.6695  9.5377

Coefficients:
      Estimate Std. Error t value Pr(>|t|)
kg.nm  0.18925    0.01498   12.64  4.5e-16 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 3.274 on 43 degrees of freedom
  (2 observations deleted due to missingness)
Multiple R-squared:  0.7879,  Adjusted R-squared:  0.7829
F-statistic: 159.7 on 1 and 43 DF,  p-value: 4.504e-16
```

Annex 5: List of species identified in the WGIDEEPS in June/July 2015

Árni Friðriksson	Walther Herwig III	Family	Order
Alepisaurus brevirostris			
Anarhichas denticulatus	*Anarhichas denticulatus*	Anarhichadidae	Perciformes
Anoplogaster cornuta	*Anoplogaster cornuta*	Anoplogastridae	Beryciformes
	Anotopterus pharao	Anotopteridae	Aulopiformes
Arctozenus rissoi	*Arctozenus risso*	Paralepididae	Aulopiformes
Argyropelecus gigas		Sternoptychidae	Stomiiformes
Argyropelecus hemigymnus		Sternoptychidae	Stomiiformes
Bajacalifornia megalops		Alepocephalidae	Osmeriformes
Barbantus curvifrons		Platytroctidae	Argentiniformes
Bathylagus euryops	*Bathylagus euryops*	Bathylagidae	Argentiniformes
Benthosema glaciale	*Benthosema glaciale*	Myctophidae	Myctophiformes
Borostomias antarcticus	*Borostomias antarcticus*	Stomiidae	Stomiiformes
Ceratias holboelli	*Ceratias holboelli*	Ceratiidae	Lophiiformes
Chaenophryne draco		Oneirodidae	Lophiiformes
Chaenophryne longiceps	*Chaenophryne longiceps*	Oneirodidae	Lophiiformes
Chauliodus sloani	*Chauliodus sloani*	Stomiidae	Stomiiformes
	Chiasmodon niger	Chiasmodontidae	Perciformes
Coryphaenoides rupestris		Macrouridae	Gadiformes
Cryptopsaras couesi		Ceratiidae	Lophiiformes
	Cyclopterus lumpus	Cyclopteridae	Scorpaeniformes
Dericththys serpentus		Derichthyidae	Anguliiiformes
	Einara edentula	Alepocephalidae	Argentiniformes
Haplophryne mollis		Lynophrynidae	Lophiiformes
Himantolophus mauli		Himantolophidae	Lophiiformes
Holtbyrnia anomala	*Holtbyrnia anomala*	Platytroctidae	Argentiniformes
Holtbyrnia macrops	*Holtbyrnia macrops*	Platytroctidae	Argentiniformes
Lampadena speculigera	*Lampadena speculigera*	Myctophidae	Myctophiformes
Lampanyctus crocodilus		Myctophidae	Myctophiformes
Lampanyctus intricarius		Myctophidae	Myctophiformes
Lampanyctus macdonaldi	*Lampanyctus macdonaldi*	Myctophidae	Myctophiformes
	Macrourus berglax	Macrouridae	Gadiformes
Magnisudis atlantica		Paralepididae	Aulopiformes
Malacosteus niger	*Malacosteus niger*	Stomiidae	Stomiiformes
Mallotus villosus		Osmeridae	Osmeriformes
Maulisia mauli	*Maulisia mauli*	Platytroctidae	Argentiniformes
Maulisia microlepis		Platytroctidae	Argentiniformes
Maurolicus muelleri	*Maurolicus muelleri*	Sternoptychidae	Stomiiformes
	Micromesistius poutassou	Gadidae	Gadiformes
	Myctophum punctatum	Myctophidae	Myctophiformes
Nansenia groenlandica	*Nansenia groenlandica*	Microstomatidae	Osmeriformes
Nemichthys scolopaceus	*Nemichthys scolopaceus*	Nemichthyidae	Anguliiiformes

Árni Friðriksson	Walther Herwig III	Family	Order
Neonesthes capensis		Stomiidae	Stomiiformes
Nessorhamphus ingolfianus		Derichthydae	Anguliiiformes
Normichthys operosus	*Normichthys operosus*	Platytroctidae	Osmeriformes
Notoscopelus kroeyeri	*Notoscopelus e. kroeyeri*	Myctophidae	
Oneirodes anisacanthus		Oneirodidae	
Oneirodes carlsbergi		Oneirodidae	Lophiiformes
Oneirodes eschrichtii		Oneirodidae	Lophiiformes
Paralepis coregonoides		Paralepididae	Aulopiformes
Platyberyx opalescens	*Platyberyx opalescens*	Caristiidae	Perciformes
Polyipnus polli		Sternoptychidae	Stomiiformes
Poromitra crassiceps		Melamphaeidae	Stephanoberyciformes
Poromitra megalops	*Poromitra megalops*	Melamphaeidae	Stephanoberyciformes
Protomyctophum arcticum		Myctophidae	Myctophiformes
Rondeletia loricata	*Rondeletia loricata*	Rondeletiidae	Cetomimiformes
Sagamichthys schnakenbecki		Platytroctidae	Osmeriformes
Scopelogadus beanii	*Scopelogadus beani*	Melamphaeidae	Stephanoberyciformes
Scopelosaurus lepidus		Notosudidae	Aulopiformes
Searsia koefoedi	*Searsia koefoedi*	Platytroctidae	Argentiniformes
Sebastes mentella oceanus		Sebastidae	Scorpaeniformes
Sebastes mentella	*Sebastes mentella*	Sebastidae	Scorpaeniformes
Serrivomer beani	*Serrivomer beani*	Nemichthyidae	Anguliiiformes
Sternoptyx diaphana	*Sternoptyx diaphana*	Sternoptychidae	Stomiiformes
Stomias boa ferox	*Stomias boa ferox*	Stomiidae	Stomiiformes
Thalassobathia pelagica		Bythitidae	Ophidiiformes
Xenodermichthys copei	*Xenodermichthys copei*	Alepocephalidae	Osmeriformes