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Manual for the International Deep Pelagic Ecosystem Survey in the Irminger Sea and Adjacent Waters

Version 1

Working Group on International Deep Pelagic Ecosystem Surveys

Corrigendum – 19/02/2021: Russian pelagic trawl design number corrected from 75/448 to 78.7/416.

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1 Introduction

The Working Group on Deep Pelagic Ecosystem Surveys (WGIDEEPS), formerly known as Working Group on Redfish Surveys (WGRS) and Planning Group on Redfish Surveys (PGRS), has the responsibility of coordinating international trawl-acoustic surveys on pelagic beaked redfish (*Sebastes mentella*) in the Irminger Sea and adjacent waters and in the Norwegian Sea.

Surveys on pelagic beaked redfish (*Sebastes mentella*) have been conducted since 1982 in the Irminger Sea and since 2007 in the Norwegian Sea (ICES, 2009b; 2013). These surveys have been conducted by individual nations or in collaboration between two or more nations. The area coverage and methodology however, have varied and often the area coverage was limited, especially in earlier years. The surveys are mainly hydroacoustic surveys, but since 1999, pelagic trawling has also been used to estimate biomass of pelagic beaked redfish when acoustic estimates are not possible. Over time, both the horizontal and vertical coverage have increased, as earlier surveys were not considered sufficient for stock assessment purposes (ICES, 2013). Furthermore, the survey has also moved from exclusively a redfish survey to an ecosystem survey.

This manual seeks to describe the survey conducted in the Irminger Sea and adjacent waters and its history, paying particular attention to the current practices in place (gears, area coverage, sampling methods). Description of acoustic equipment and trawl gears, areas covered, sampling methods, and data collected are described in detail.

2 IDEEPS Survey in the Irminger Sea and adjacent waters

2.1 Background

The primary objective of Working Group on International Deep Pelagic Ecosystem Surveys (WGIDEEPS) is to coordinate fishery-independent trawl-acoustic surveys on pelagic beaked redfish (*Sebastes mentella*) in the Irminger and Norwegian Seas basins. These surveys aim to provide ICES assessment and science groups with consistent and standardized data for examining spatial and temporal changes in (a) the distribution and relative abundance of pelagic beaked redfish; and (b) of the biological parameters for stock assessment purposes. The secondary objective is to collect additional information of the state of the ecosystem in the waters inhabited by beaked redfish, by measuring hydrological and biological conditions.

2.1.1 Main objectives

1) To provide survey biomass indices for the North Western Working Group (NWWG) to support advice on pelagic beaked redfish in the Irminger Sea and adjacent water;

2) To estimate the geographical and depth distribution and relative abundance of pelagic beaked redfish stocks;

3) To monitor changes in the stocks of pelagic beaked redfish independently of commercial fisheries data;

4) To collect data for the determination of biological parameters for beaked redfish stocks;

5) To collect hydrographical and environmental information;

6) To collect additional observations relevant to integrated ecosystem assessment in the area.

2.1.2 Spatial coverage and temporal resolution

The survey covers the open waters of the Irminger Sea and adjacent waters down to 1000 m from 52°30′N to 65°30´N and from 24°W to 58°W (Figure 2.3.1.1.). The IDEEPS in the Irminger Sea and adjacent waters is carried out biennially in June/July.

2.1.3 Target species

The target species is pelagic beaked redfish (*Sebastes mentella*). It is a highly migratory, long lived, late-maturing and slow-growing ovoviviparous fish species. Beaked redfish is widely distributed in boreal waters of the North Atlantic and adjacent seas of the Arctic Ocean.

2.1.4 List of survey gears and instruments

Large pelagic trawls (Gloria 1024 and Russian pelagic trawl (design 78.7/416), see Section 2.4.2.1), hull mounted hydroacoustics at 38kHz (see Section 2.4.1.1) and CTD for hydrographic observations (see Section 2.4.4).

2.1.5 History of the survey in the Irminger Sea and adjacent waters

Hydroacoustic surveys to derive biomass estimation on pelagic beaked redfish in the Irminger Sea and adjacent waters have been conducted since the commercial fishery commenced in 1982. From 1982 to 1993 the former Soviet Union, and later Russia, carried out acoustic surveys on pelagic beaked redfish annually in the area. These surveys provided valuable information on the distribution, relative abundance 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 however, were not considered sufficient for stock assessment purposes (ICES, 1991).

From 1991 to 1997, other nations also conducted hydroacoustic surveys in the Irminger Sea and adjacent water, on either individually or in collaboration between two or more nations. During this period, it came apparent that two vessels were hardly sufficient to cover the whole area of distribution within a reasonable period (ICES, 1993; ICES, 1994). In some years, the area coverage was limited with no reliable stock estimates.

Until 1999, pelagic beaked redfish was only surveyed by hydroacoustics down to an approximate depth of 500 m. As the fishery moved towards greater depths (500–1000 m) in the early 1990s it was considered important to expand the vertical coverage of the survey. Attempts to obtain reliable stock size estimates and map the stock distribution below that depth did not succeed (Shibanov *et al.*, 1996a; ICES, 1998; Sigurdsson and Reynisson, 1998), mostly due to the deep scattering layer (DSL) typically at depths between 300 m and 600 m, which is a mixture of many vertebrate and invertebrate species mixed with pelagic beaked redfish (Magnússon, 1996; Sigurðsson *et al.*, 2002). This mixture generates acoustic reverberation, which can hardly be separated from the individual pelagic beaked redfish target signal (Planque *et al.*, 2013). Furthermore, it is also difficult to acquire hydroacoustic registration below DSL with sufficient quality due to low signal-to-noise ratio.

In 1999, an international trawl-acoustic survey on pelagic beaked redfish was carried out in the Irminger Sea and adjacent waters, with participation of Iceland, Germany and Russia (ICES, 1999). The survey provided for the first time an estimate of the

abundance of the pelagic redfish within and below DSL to depths down to 950 m with a trawl method. Since 1999, this trawl-acoustic survey has been conducted in a similar way with few exceptions. Pelagic beaked redfish is measured by hydroacoustics down to 350 m and with the trawl method within the deep scattering layer (DSL) above 500 m depth and below 500 m (separate tows for 350–500 m and 500–950 m respectively). The surveys in 2005 and 2007 are not comparable with the other surveys because of changes in the depth range covered in the deeper layer (tows done from 350 m to 950 m).

The survey has been conducted biennially in June/July except in 2003 when the survey was conducted a month earlier (ICES, 2003). The hydroacoustic results of the 2003 survey were regarded as inconsistent and thus do not indicate the actual stock status of pelagic redfish.

The international surveys in the Irminger Sea and adjacent waters in 1999–2013 have been conducted by Germany, Iceland and Russia (with Norway participating in 2001) with two to five research vessels, covering area of approximately 350,000 square nautical miles.

Since 1992, hydrographic data have been collected in addition to trawl and acoustic measurements.

Annex 1 gives an overview of surveys on pelagic beaked redfish conducted in the Irminger Sea and adjacent waters 1982–2013.

2.1.6 List of countries involved

The survey is conducted with research vessels from Germany, Iceland and Russia. The history of national participation is given in Annex 1.

2.2 Data products

Primary data products

- Hydroacoustic data (Section 2.4.1);
- Catch data, which includes data on trawling (Section 2.4.2) and biological data (Section 2.4.3). The data should go to ICES DATRAS (Section 2.8.2);
- Hydrography data (CTD files) that should go to the relevant hydrography database (Section 2.4.4);
- Biomass and abundance indices to be reported to NWWG (Section 2.7.2 and 2.7.3);

Secondary data products

- Parasite infestation of redfish (Section 2.4.3);
- Stomach contents of redfish (Section 2.4.3);
- Species composition in the catch (Section 2.4.3):
- Marine mammal sightings.

2.3 Survey sampling design

2.3.1 Area of observation

The survey covers the international pelagic waters of the Irminger Sea and within the EEZ of Iceland, Greenland and Canada and hence, is conducted within both the NEAFC and NAFO convention areas. The survey area is in ICES Areas Vb, XII and XIV and NAFO Areas 1F, 2H, 2J and 3K (Figure 2.3.1.1.). The boundaries are partly determined by the continental slopes in the areas down to 1000 m.

Vessels participating in the survey must apply for entry into the relevant EEZs by notifications to Canada, Greenland and Iceland. The operations in the NAFO Convention Area is notified to NAFO by each cruise leader.

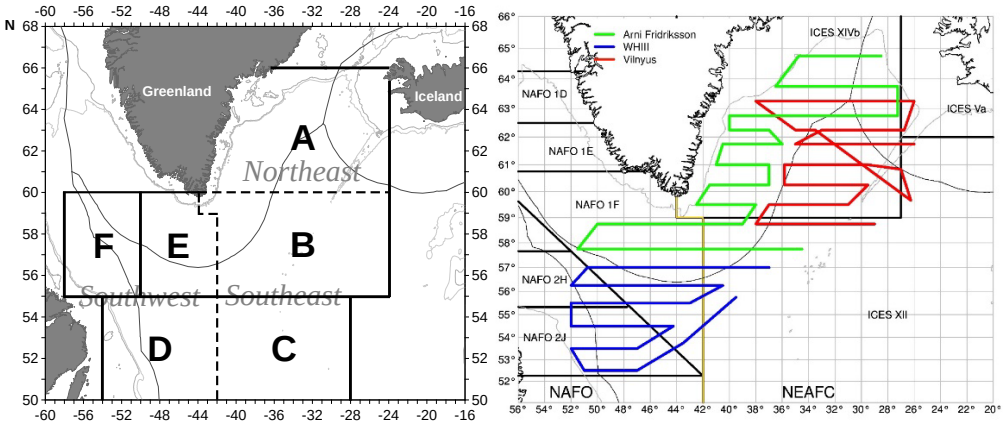


Figure 2.3.1.1. Area of observation in the international deep pelagic ecosystem survey in the Irminger Sea and adjacent waters. Left is the area definition divided into subareas A-F. Dashed area boundaries and grey area names relate to the geographic aggregation of biological data. On the right figure is the survey design of the international survey in June/July 2013 showing the acoustic transects. Green: RV "A. Fridriksson", Red: RV "Vilnyus". Blue: RV "Walther Herwig III". Also shown the statistical rectangles (one-degree latitude by 2 degrees longitude), ICES and NAFO areas and the division between NAFO and NEAFC convention areas. The boundaries of the survey area is partly determined by the continental slopes in the area down to 1000 m (thin grey lines).

2.3.2 Primary sampling unit

Hydroacoustics – Elementary sampling distance units (ESDU) is 1 square nautical miles (Section 2.4.1.8).

Trawling – Single haul or codend when using multi-sampler standardized to kg per square nautical miles (Section 2.4.2.1).

Hydrography – Vertical CTD profile to measure water temperature, salinity and pressure (Section 2.4.4).

2.3.3 Survey design strategy

The distribution of survey tracks within the distribution area of pelagic beaked redfish and the distance between them is based on experience from the past surveys, fisheries information, number of vessels participating in the survey and available vessel time. Parallel transects are spaced evenly in the research area with the distance between the planned cruise tracks of 30, 45 or 60 square nautical miles. Figure 2.3.1.1. shows the planned hydroacoustic transects of the 2013 survey. The mean distance between transects was 45 square nautical miles where less distance between transects was used in areas where denser concentration of pelagic beaked redfish was expected.

Transects can be shortened in case of continuous registrations with no redfish combined with very low catch rates and particular hydrographical conditions (low water temperature).

Sampling strategy by trawling is adaptive, i.e. trawling is conducted on redfish registration down to ca. 350 m. In addition, it is geographically stratified by statistical rectangles (one degree latitude by 2 degrees longitude) and vertically stratified by trawl type (see Section 2.4.2.2).

For the aggregation of biological data, these subareas were grouped into three larger geographical units (Figure 2.3.1.1.) since the 2005–2007 surveys (ICES, 2005b; 2007a), namely a northeastern (subarea A), southwestern (subareas D-F) and southeastern area (subareas B and C).

Hydrographical observations using CTD probes down to 1000 m depth are taken at the end of each transect and at each trawl station location.

2.3.4 Sampling effort

The total length of transects in the IDEEPS in the Irminger Sea has ranged between 7000 and 8000 nautical miles since 1999. The surveyed area is approximately 350 000 square nautical miles.

Identification trawl hauls Type 1, Type 2 and Type 3 (see Section 2.4.2.2 for definition of trawl types) should be distributed in the survey area with a minimum of one trawl per trawl type per vessel in each statistical rectangle.

The number of CTD stations is defined by the number of transects and trawl hauls (see Section 2.4.4).

2.3.5 Temporal aspects

The IDEEPS in the Irminger Sea and adjacent waters is carried out biennially in June/July. The area is surveyed both during day- and night-time.

Trawl Type 1 in the depth zones in which redfish can be acoustically identified should only be conducted during the daytime. This is because redfish is frequently mixed with planktonic species inhabiting the deep scattering layer (DSL) during the night.

2.3.6 Fall back options

In case of bad weather, ice or technical problems, the area coverage is reduced or the distance between transects is increased. Given the generally limited time of the participants in the survey area, the options for an adaption of transects are limited and have to be carried out on an ad hoc basis by the cruise leader in charge. Thus, an analysis of the impact of the different options on the survey CV have not been conducted.

2.3.7 Vessels, timing and survey area

Specific vessels, timing and survey area are revised before each survey.

Below, as an example, is the list of research vessels who will participate in the IDEEPS survey in the Irminger Sea and adjacent waters in June/July 2015, time period engaged to the survey and approximate time and number of days in the field:

Name of the vessel	Country	Period	Approx. working period in the field	Days in field
Árni Friðriksson	Iceland	10 – 30 June	11 – 28 June	18
Vilnyus	Russia	1 June – 25 July	12 June – 3 July	22
Walther Herwig III	Germany	18 June – 20 July	~25 June – 13 July	18

2.4 Observation methodology

2.4.1 Acoustic estimation

2.4.1.1 Hydroacoustic equipment

All participating vessels use Simrad EK60 split-beam echosounder and the standard frequency is 38 kHz with hull-mounted transducers. For post-processing EchoView or FAMAS can be used for echo integration.

2.4.1.2 Calibration

The standard sphere calibration should be performed as in Foote *et al.* (1987) and Simrad (2012), preferably at a range larger than 25 m and applying both pulse length and bandwidth settings used in the survey (e.g. 1 ms).

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 allows one 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.

2.4.1.3 Inter-Calibration

Inter-calibration between vessels can be performed on an *ad hoc* basis. This would require at least two vessels meeting in a location with appropriate densities of redfish and carrying out measurements simultaneously, in good weather conditions and for several hours. Preferably, the vessels should start and finish the inter-calibration with fishery hauls.

During the inter-calibration, one leading vessel should steam 0.5 nautical miles ahead of the other. The lateral distance between the survey tracks should be 0.3 nautical miles. The inter-calibration should be done with two 20 nautical miles transects covering approximately the same area. The first 20 nautical miles transect with one vessel leading and then turning around and having the other vessel lead (Simmonds and MacLennan, 2005).

The Standard least–square fitting is not applicable for data evaluation. The standard method is based on the assumption that the value of the independent variable is measured exact and only the dependent variable is uncertain. However, for data obtained during the inter-calibration between vessels both value series measured are uncertain to approximately the same amount. Therefore, least-square straight lines in the plane have to be computed. Details are given in Appendix in Bethke *et al.* (2010).

2.4.1.4 Instrument settings

The standard integration threshold is –80dB/m^3 and the pulse length is 1 ms.

The acoustic data should be stored down to at least 750 m depth.

The required settings of the instruments are given in Table 2.4.1.4.1.

Table 2.4.1.4.1. Instrument settings of the acoustic equipment on-board the vessels participating in the international survey for redfish in the Irminger Sea and adjacent waters.

	Settings
Echosounder	Simrad EK60
Integrator	EchoView or FAMAS
Frequency	38 kHz
Transmission power	2000 W
Pulse length	1.0 ms (or longer)
Transducer type	ES38-B
Integration threshold	-80 dB/m3
Ping interval	1 s or greater
Storage range depth	0–750 m or greater

To collect experimental data on redfish echoes within and below the DSL, a longer pulse length (and narrower bandwidth) can be applied during night-time as an alternative to the standard setting of 1 ms and wideband width as long as proper calibration has been conducted for these settings. In EK60 the pulse length may be changed, but the bandwidth is determined by matched filters.

2.4.1.5 Noise measurements

Noise measurements can be performed once in the survey or on an *ad hoc* basis. 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 nautical miles with a resolution of 1 nautical mile. This could be done during night, using bandwidths, pulse lengths and thresholds used during the survey.

2.4.1.6 Target strength and target-strength measurements

There have been several attempts to measure and compile data on the target strength of beaked redfish and these were reviewed by the workshop on the determination of acoustic target strength of redfish (WKTAR, ICES, 2010). In the Irminger Sea, the length based target strength (TS) model used for the estimation of the number of pelagic redfish in the survey area is:

$$TS = 20 * \log_{10} L - 71.3 \text{ dB}$$

where *L* is length of the fish in cm. This TS model has been used since 1999 (ICES, 1999).

This model is different from the model recommended by WKTAR ($TS = 10.6 * \log_{10} L - 55.4$ dB). However, for the range of fish lengths observed during the survey, the two models give close estimates of target strength, so the original equation is still used in order to ensure historical compatibility.

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).

In response to recommendation 1 from the WKTAR (ICES, 2010) to "ensure that high quality acoustic/biological data for TS determination are collected during redfish

surveys" specific sampling for target strength determination can be carried out when appropriate (good weather conditions, pure redfish scattered aggregations). In case additional time is required to carry out these measurements, this should be allocated for.

2.4.1.7 Thresholding and Scrutinizing

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 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 dependence 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 dB/m³) should be sufficiently low. When having low densities and mainly smaller fish, one should have a more dynamic attitude of using a lower threshold.

During scrutinizing of echograms, zoom function and graphical tools of scrutinizing software are used to delineate the redfish above DSL (Figure 2.4.1.7.1.). A layer tool is used for extended aggregations. A rectangle tool is more preferable for scattered individuals in order to avoid inclusion of other targets.

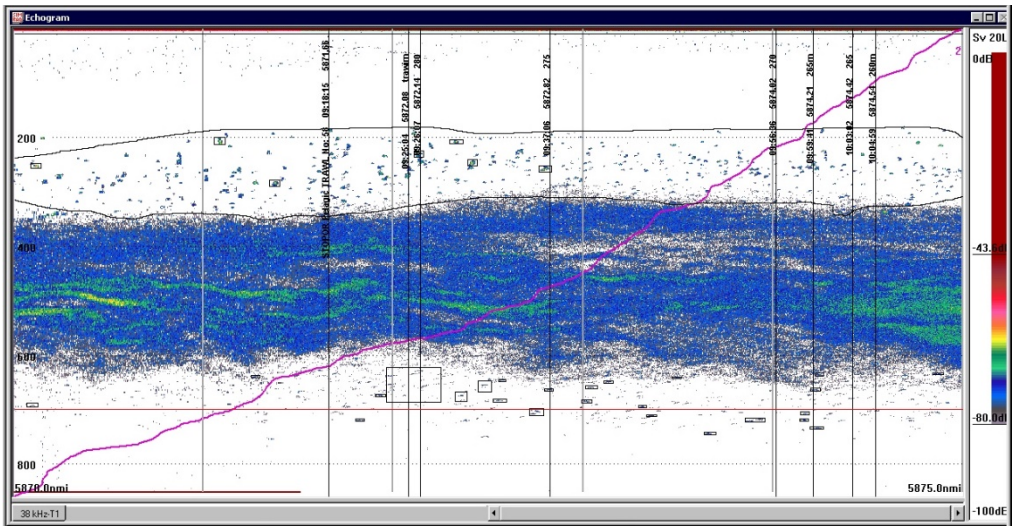


Figure 2.4.1.7.1. Echogram recorded by Russian RV "Smolensk" over 5 nautical miles during the summer 2007 survey in the Irminger Sea (38 kHz, pulse length 2 ms). The dense layer is the deep scattering layer (DSL) in which redfish are mixed with other small organisms. Pure redfish aggregations are distinctly visible above the DSL in the acoustic layer (indicated by layer tool of scrutinizing software). Single targets of redfish below DSL are also visible (indicated by rectangles). Reproduced from ICES (2007b).

2.4.1.8 Data processing

To be able to make a comparable "detailed report" in the post-processing, the height of the layers should be set to 25 m. The registrations of redfish should be scrutinized and averaged to give one value of nautical area scattering coefficient (MacLennan *et al.*, 2002) expressed as s_A values for every 5 nautical miles. The data should, however, be stored for every 1 nautical mile.

The values are recorded in relevant columns (done separately for redfish above the DSL and within and below the DSL) in the sheet presented in Annex 3a.

In the acoustic report table (see Annex 3a), the upper depth limit of the DSL is registered in the relevant column.

s_A values of organisms (called L-fish) other than redfish is recorded above the DSL, within, and below the DSL and registered in relevant columns in Annex 3a.

2.4.1.9 Storage and exchange of acoustic data

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

Archiving of raw data is the responsibility of individual nations. There is currently no common database for acoustic data collected during the survey.

Scrutinized data by 5 nautical miles in the form presented in Annex 3a is exchanged after the survey.

2.4.2 Trawling

2.4.2.1 Fishing gear

The fishing gear is a large pelagic trawl with vertical opening of 45–50 m. Recommended trawls are Gloria type #1024 and Russian pelagic trawl (design 78.7/416). Specifications of three pelagic trawls that have been used since 1999 are given in Annexes 8–10. The trawl and doors should be equipped with appropriate instruments to monitor headrope depth and geometry during towing.

The stretched mesh size of the pelagic trawl in the codend should be sufficiently small to ensure that all redfish specimens are retained. Conventionally the stretched mesh size is 40 mm.

A multi-sampler can be attached to the codend of a pelagic trawl. Usually it consists of three 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, see Section 2.4.2.2). Because of the distance between the vessel and the multi-sampler, the use of acoustic remote control is not possible. Instead, the multi-sampler should be programmed in advance for opening and closing at specific time. When using the multi-sampler, the biological sampling protocol described in Section 2.4.3 should be repeated for each sample or group of samples within the same depth strata (i.e. one biological sampling for each trawl type). Specification of the multi-sampler is given in Annex 11.

In cases when the trawl or the multi-sampler frame is twisted or for some other reasons making the trawl station unrepresentative, the data should not be used and trawling

should be repeated, if practically feasible. If repeating is impossible the trawl station should be marked in the exchange forms as unrepresentative in order to make interpolation between the nearest trawls during further biomass estimation.

2.4.2.2 Trawling method

Each vessel should identify the acoustic redfish records by trawl catches in three different trawl types. The trawl types 1 and 2 are sampling redfish at depths shallower than 500 m and type 3 is sampling deeper than 500 m:

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 nautical miles 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 nautical miles, calculated with GPS. The haul is divided into two parts of equal distance of 2 nautical miles 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 nautical miles calculated with GPS and the trawling distance at each depth layer is 2 nautical miles.

Up to three codends of the multi-sampler can be used either within one trawl type (for a higher vertical resolution regarding the species composition) or each codend is used for one trawl type within one trawl haul.

All trawling should be at towing speed of 3.0–3.5 knots.

For Trawl type 1, it is essential to integrate the s_A value over the trawled distance in the trawled depth and to report s_A values in the specified format given in Annex 3d.

2.4.3 Biological sampling

2.4.3.1 Species composition in the trawls

The total catch is divided into species or appropriate taxonomic group. Catch weight and number of all species is recorded for each haul. If possible, squids should be divided by species and/or size. The weight of jellyfish is recorded. Shrimps are reported in one group, but krill is reported in a separate category.

For specimen with uncertain taxonomic identification (e.g. blackfish, Cornish blackfish) a photograph should be taken and the specimen eventually frozen and subsequently identified in the laboratory down to the lowest possible taxonomic level.

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.

Ribbon barracudina is agreed as the common name used for *Arctozenus risso* (also named *Notolepis*).

Measurements (method and units) of the most common fish species to be expected in the survey is given in Annex 7.

Subsampling is done on individual species or taxon. The ratio of the subsample to the total catch of each species should be registered. For redfish, it is specifically recorded "subsampling factor" in the biological data recording sheet (Annex 3c).

2.4.3.2 Length, weight, sex and maturity measurements

For redfish, the total length (cm below) is measured on at least 300 redfish from each trawl type (as described in Section 2.4.2.2). When the multi-sampler is used and several codends belong to the same trawl type the number of redfish measured may be reduced to 100 individuals per codend (three codends in the same trawl type) or 150 individuals (two codends in the same trawl type). All the length-measured redfish are weighed to the nearest gram and sex and maturity determined. The maturity scale given in Annex 6 will be used for data exchange. Additionally, the Russian participants will also use the maturity scale given in Annex 6.

Length measurements for other species should preferably be conducted on at least 20 individuals per species per trawl type. Measurement units and method is given in Annex 7.

2.4.3.3 Otolith, parasites and pigmentation, and stomach contents

Otolith sampling, parasite and pigmentation observation, and stomach analysis are conducted on 50 individuals following a random sampling procedure (i.e. not stratified by length) for each haul type.

The otolith envelope should carry at least the station number and fish ID number given in the database to allow for allocation to the individual biological data. Preferably, length and weight of individual fish should not be recorded on the otolith envelopes.

Observations on the location and size of skin pigments as well as infestation with *Sphyrion lumpi* and its remnants is investigated according to the description given in Annex 4f and reported on the form given in Annex 3c. Registration of muscular melanin is recorded according to the description given in Annex 3f and reported on the form given in Annex 3c.

The stomach fullness and digestion grade is reported on the form given in Annex 3c. The scales are given in Annex 3e. Diet composition is analysed and recorded in the form given in Annex 3e.

2.4.3.4 Genetic sampling

On a limited number of stations (~5 for each vessel) genetic sampling is carried out. For this purpose fin clips or tissue from gill filaments are sampled from 100 randomly selected fish and preserved in ethanol. Otoliths are collected from all the individuals and individual length, weight, sex, maturity, parasites and pigmentation recorded. The genetic stations are 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.

2.4.4 Hydrography

All participants carry out hydrographical observations (temperature, salinity, pressure) using CTD probes down to 1000 m depth. Calibration and operation of the CTD is done by national standards. Table 2.4.4.1. shows the recommended minimum standard:

Table 2.4.4.1. Temperature and salinity sensor specifications.

Pressure resolution / accuracy	0.01 dbar / 0.1 dbar
Temperature resultution / accuracy	0.001°C / 0.01°C
Salinity resolution / accuracy	0.01 / 0.015

The CTD stations are taken at the corners of each transect and at each trawl station. The CTD station locations are distributed evenly throughout the survey area but the distance between CTD stations should not be more than 60 nautical miles.

The long-term hydrographical Russian 3K section (nine standard stations) in the Irminger Sea is included in the joint survey programme and carried out by the Russian vessel (Annex 12 provides the location of stations).

2.5 Data exchange during the survey

Daily reporting between the vessels is performed using the data sheet given in Annex 2. The sheet documents location of trawl and CTD stations as well as location of change of course. Redfish catch (in numbers and weight in kg), trawl type and trawling distance in nautical miles are reported for each trawl.

The temperature at depths of 0, 10, 20, 30, 50, 100, 200, 300, 400, 500, 600, 700, 800, 900 and 1000 m are reported for each CTD station to the accuracy of 0.01°C.

2.6 Caveats

Multi-sampler

The use of a multi-sampler instead of a standard codend may change the catchability of the trawl. For the measurement of these changes, a greater number of hauls would have to be carried out. Due to time constraints, however, this is usually not possible within the survey.

2.7 Analysis

2.7.1 Species composition

The frequency of occurrence (number/no of trawls) of all species is reported by vessel and combined for all vessels participating in the survey.

2.7.2 Acoustic abundance and biomass estimation of beaked redfish

A length based target strength (TS) model is used for the estimation of the number of pelagic redfish in the survey area:

$$TS = a + b * \log L$$

where a and b are constants and L is the length of individual fish in cm.

The equivalent formula for the cross section for length i is:

$$\sigma_i = 4\pi * 10^{\frac{a}{10}} * L_i^{b/10}.$$

Normally, a quadratic relationship is assumed that means b is 20 (Simmonds and Maclennan, 2005) which gives the formula:

$$\sigma_i = d * L_i^2.$$

Target strength parameters for beaked redfish in the Irminger Sea are therefore:

PARAMETERS	TARGET STRENGTH
a	-71.3
b	20
d	9.316E-07

The basis for the estimation of total fish density F from the measured nautical area scattering coefficient s_A is the conversion factor c (MacLennan *et al.,* 2002):

$$F = s_A * c = \frac{s_A}{<\sigma>}$$

where s_A is the mean in a given area.

The cross section $<\sigma>$:

$$<\sigma_i>= \sum_i f * \sigma = \sum_i f_i * d * L_i^2$$

where L_i is the midpoint of the *i*-th length class and f_i is the respective frequency.

The total number of fish in an area is estimated as:

$$N = F * A = \frac{S_A}{<\sigma>} * A$$

where A is the size of an area in nautical miles squared and s_A is the mean in the respective area. The total abundance is divided into size classes by:

$$N_i = N * f_i$$

The total biomass Q in an area is calculated from the abundance N and the mean weight (W) per length group:

$$Q = \sum N_i W_i$$

2.7.3 Trawl abundance and biomass estimation of beaked redfish

In this method, the catch (kg/NM) of the Type 2 and Type 3 tows is converted to s_A values using linear regression. Absolute abundance and biomass are then estimated in the same way as the estimation based on the acoustic method (Section 2.7.2).

A linear regression model between the acoustic values and catches (in kg/NM) of Type 1 trawls (shallower than the DSL and within redfish concentration) is applied to predict the acoustic values for Type 2 and Type 3 trawls. Because only limited number of Type 1 trawls are conducted each survey, the Type 1 trawl data from previous surveys are used in the regression model. Furthermore, the regression model is defined and applied separately for each country. Acoustic values for the Type 1 trawls were obtained from exactly the same position and depth range covered by the trawl.

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 β_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 nautical miles 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 for each haul the estimation of the abundance and biomass was calculated using the same formulas as described in Section 2.7.2.

2.7.4 Biological data on redfish

2.7.4.1 Length, weight, sex composition and maturity

For each three defined subareas (Figure 2.3.1.1.), mean weight and number of individuals by length and sex (and total) is summarized in a table for trawls taken above and below 500 m. The length distribution by subarea and total for fish caught shallower and deeper than 500 m is also presented in figures.

Maturity ogives (ICES scale) by sex are presented, shallower and deeper than 500 m.

2.7.4.2 Feeding

Observations on stomach fullness (number and percentage) by area (Figure 2.3.1.1.) and total, from fish caught shallower and deeper than 500 m, are presented in a table.

2.7.4.3 Parasite infestation

Table showing infestation with the copepod *Sphyrion lumpi* (according to remains of the parasite present) and skin pigment spots for fish caught shallower and deeper than 500 m, divided by sex (males, females, total) and area (Figure 2.3.1.1.). The table should include: the number of fish examined, number and percentage of fish with *S. lumpi*

and/or remnants, number of *S. lumpi* and/or remnants, abundance index of *S. lumpi* invasion, number and percentage of fish with external pigment spots.

2.7.5 Hydrography

Following figures are produced:

The temperature (°C) distribution in the survey area for the following depths: Surface, 200 m, 400 m, and 600 m (four figures).

Temperature (°C) anomaly between current survey and last survey for these four depth ranges (one figure).

Russian 3K oceanographic section (three figures): Vertical temperature (°C) distribution, vertical temperature (°C) deviation and temperature (°C) anomaly between current survey and last survey.

2.8 Reporting and archiving of results

Data on redfish (acoustic data, trawl data, station data and biological data) is exchanged between all participants in the format shown in Annex 3a-f and Annex 4 after the survey. The exchanged data are stored in the responsible data sections of the relevant institutes of each participating country. The trawl data are subsequently archived in ICES DATRAS (see Section 2.8.2).

After the survey, the whole set of obtained information on pressure, temperature and salinity is exchanged between each participating countries in CTD standard files (an example is provided in Annex 4).

The members of the group and selected cruise participants will meet to finalize the analyses and write the report within three weeks after the end of the survey (last participating research vessel concluding the sampling).

2.8.1 Archiving of hydroacoustic data

No agreed protocol for archiving of hydroacoustic data.

2.8.2 Archiving of trawl data

Three distinct types of computer records have been defined for standard storage of trawl data of the IDEEPS in the Irminger Sea and to be stored in ICES DATRAS:

Type 1: HH – Record with detailed haul information (Annex 13).

Type 2: HL – Length frequency data (Annex 14).

Type 3: CA – Sex-maturity-age-length-keys (SMALK; Annex 15).

The summaries of the formats of these record types are given in the Annexes given above, and detailed description can also be found at the ICES web page: http://dome.ices.dk/datsu/selRep.aspx

2.8.3 Archiving of hydrography data

No agreed protocol for archiving of hydroacoustic data. The data are archived in relevant databases and not coordinated between survey participants.

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Annex 1: History of the international deep-water surveys in the Irminger Sea and adjacent waters

History of the trawl-acoustic surveys conducted in the Irminger Sea and adjacent waters 1982–2013. The surveys 1982–1997 were acoustic surveys whereas the surveys 1999–2013 were both acoustic and trawl surveys. In all surveys CTD station were taken down to 1000 m. AC=Acoustic survey; TR/AC=Trawl-acoustic survey; RUS=Russia; ICE=Iceland; GER=Germany; NOR=Norway.

Year	Time	Type	Area Surveyed NM^2	Depth (M)	Nation	Reference
1982		AC	40 000		RUS	Pavlov and Mamylov, 1989
1983		AC	50 000		RUS	Pavlov and Mamylov, 1989
1984		AC	55 000		RUS	Pavlov and Mamylov, 1989
1985		AC	71 000		RUS	Pavlov and Mamylov, 1989
1986		AC	117 000		RUS	Pavlov and Mamylov, 1989
1987		AC	215 000		RUS	Pavlov and Mamylov, 1989
1988		AC	163 000		RUS	Pavlov and Mamylov, 1989
1989	June/July	AC	148 000		RUS	Shibanov *et al.,* 1996a
1990	June/July	AC	73 000		RUS	Shibanov *et al.,* 1996a
1991	June/July	AC	105 000		RUS	Shibanov *et al.,* 1996a
1991	June	AC	60 000	0–500	ICE	Magnússon *et al.,* 1992a
1992	May/July	AC	190 000	0–500	ICE/RUS	Magnússon *et al.,* 1992b
1993	June/July	AC	121 000		RUS	Shibanov *et al.,* 1996a
1994	June/July	AC	190 000	0–500	ICE/NOR	Magnússon *et al.,* 1994
1995	June/July	AC	168 000	0–500	RUS	Shibanov *et al.*, 1996b
1996	June/July	AC	253 000	0–500	GER/ICE/RUS	Magnússon *et al.,* 1996
1997	June/July	AC	158 000	0–500	RUS	Melnikov *et al.,* 1998
1999	June/July	TR/AC	296 000	0–950	GER/ICE/RUS	Sigurdsson *et al.*, 1999
2001	June/July	TR/AC	420 000	0–950	GER/ICE/RUS/NOR	ICES, 2002
2003	May/June	TR/AC	405 000	0–950	GER/ICE/RUS	ICES, 2003
2005	June/July	TR/AC	386 000	0–950	GER/ICE/RUS	ICES, 2005a
2007	June/July	TR/AC	349 000	0–950	ICE/RUS	ICES, 2007a
2009	June/July	TR/AC	360 000	0–950	GER/ICE	ICES, 2009a
2011	June/July	TR/AC	343 000	0–950	GER/ICE/RUS	ICES, 2011
2013	June/July	TR/AC	340 000	0–950	GER/ICE/RUS	ICES, 2013

Annex 2: Sheet used for daily reporting of data among the vessels

This example demonstrates the format of the data that is exchanged between vessels during the survey.

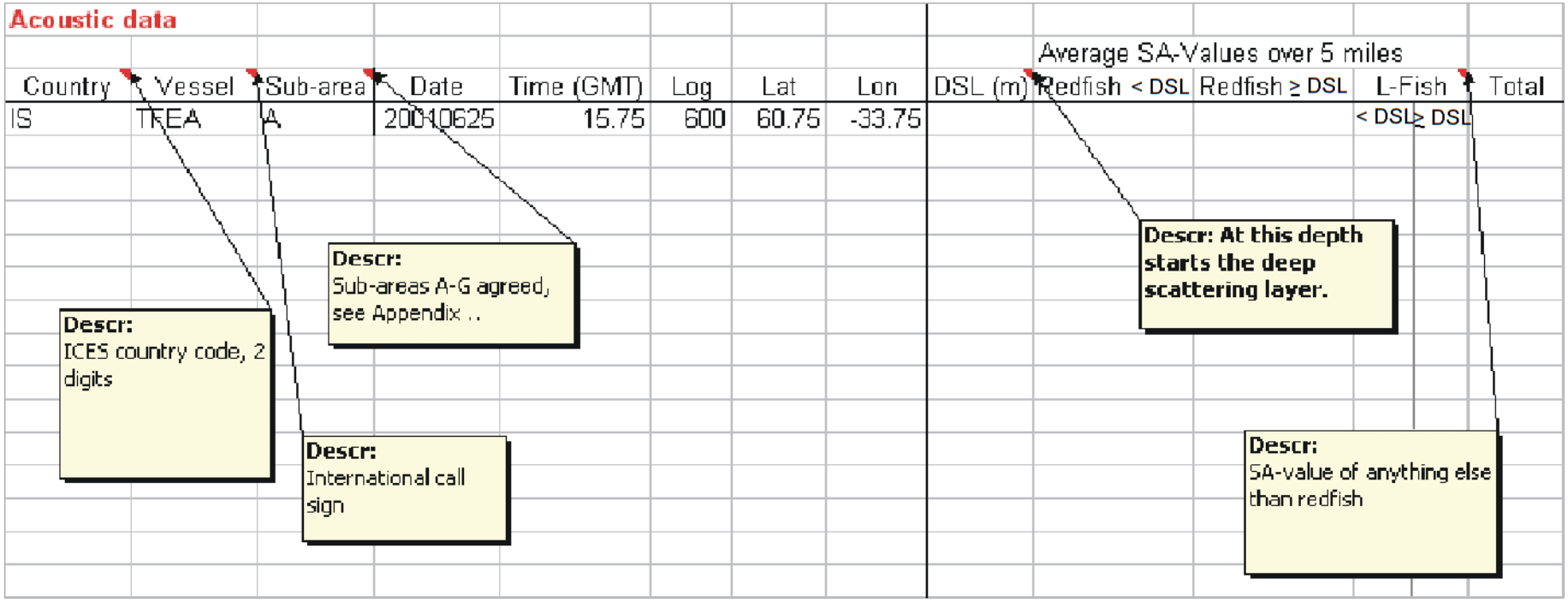
Daily reporting of data

Vessel: vessel name

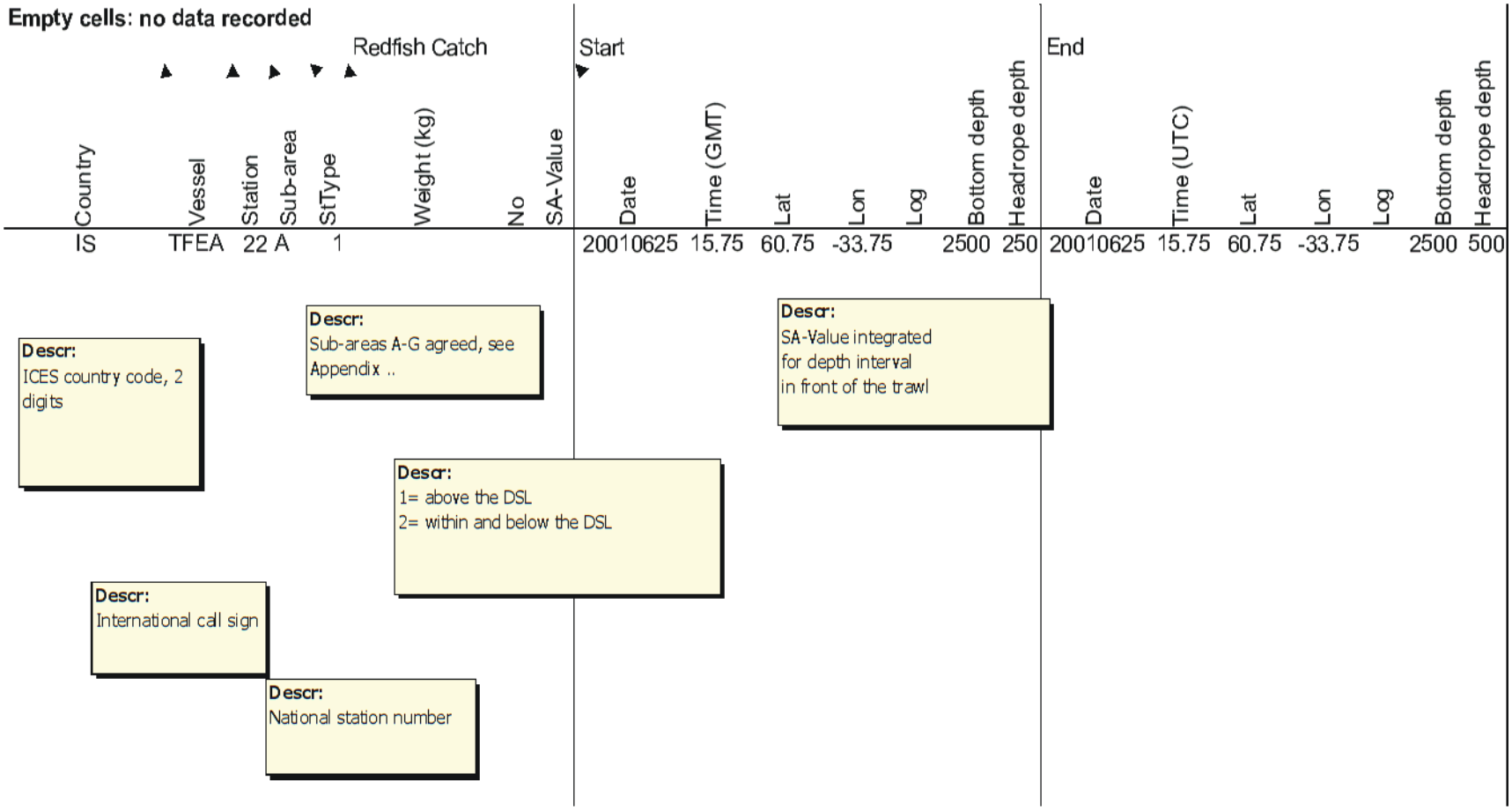
sent	N	Station number	Type of station	Log	Date	Position Lat	Position Lon	Time (GMT)	Catch (kg)	Sa range min	Sa range max	TEMPERATURE AT DUFFERENT DEPTHS T0	T10	T20	T30	T50	T100	T200	T300	T400	T500	T600	T700	T800	T900	T1000
+	1		ch.course	160	22.06	6250	2710	1300		0	0															
+	2	273	ctd	180	22.06	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 3: Various Sheets used for Observations

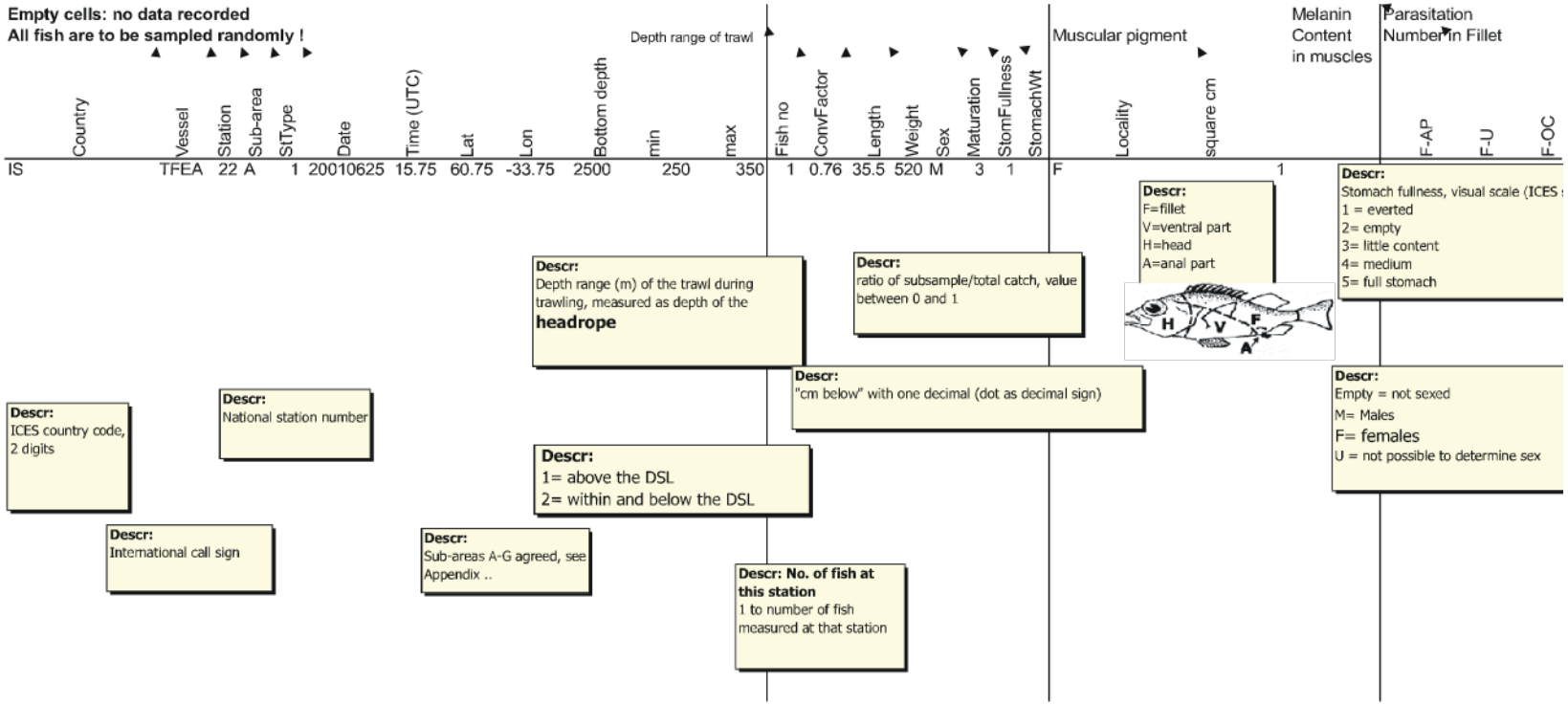
Annex 3a: Sheet used for acoustical observations



Annex 3b. Sheet used for station information and sailing diary



Annex 3c: Sheet used for biological observations



Annex 3d: 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 m	300-450 m	450-600 m	600-750 m	> 750 m	Comments

Annex 3e: Sheet and protocol for diet analysis of beaked redfish

cruise:	
station:	
depth zone:	

stomach ID:	
stomach weight full (g):	
stomach fullness index (0–5):	

processor:	
date(s):	

food item	digestion grade	size (mm)	weight (g)	number	percentage	comments

Stomach fullness index (SFI), after the method (Hyslop, 1980) and PINRO standard method.

Stomach fullness index	Description
0	Stomach completely empty, not even mucus present. Stomach wall completely contracted
1	1–20% of stomach filled. Usually only mucus or well-digested organisms present. < 10% of the stomach wall relaxed
2	20–70% of stomach filled. Up to 80% of stomach wall relaxed
3	> 70% of stomach filled. 80–100% of stomach wall relaxed
4	100% of stomach filled. Stomach walls are expanded and food transpires through walls
5	Stomach regurgitated

Digestion grades, after the points method (Hyslop, 1980).

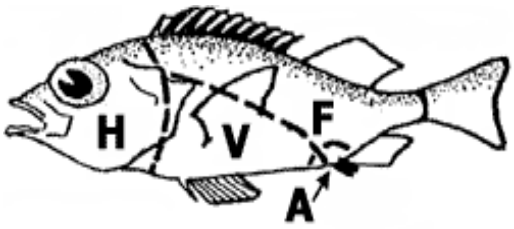
Digestion grade	Description
1	Organism completely or almost completely preserved (> 95% intact), no or very slight digestion or mechanical deformation perceptible. Skin/cuticula almost completely intact, coloration pattern almost completely preserved.
2	> 80% of organism still intact, skin/cuticula mostly intact, coloration pattern still discernible.
3	50–80% of organism intact, most of skin already destroyed, coloration pattern still discernible.
4	< 50% of organism remaining. Often in pieces, single body parts frequently (e.g. the whole head) missing. Coloration in most cases not discernible.
5	< 5% of organism remaining. Often only hard parts. Fish otoliths, bones, eye lenses and scales; crustacean exoskeletons and complex eyes, cephalopod beaks and eye lenses; bivalve shells; bryozoa/stone coral branches.

Annex 3f: Parasite (Sphyrion lumpi) infestation and pigmentation

The analysis of parasite infestation and pigmentation is based on Bakay and Karasev, (2001).

1. Check for parasites and count the parasites per part:

- F = fillet
- V = ventral part
- H = head
- A = anal part
- AP = alive parasites
- U = visible remains of parasites ("ulcers")
- OC = old cephalothoraxes



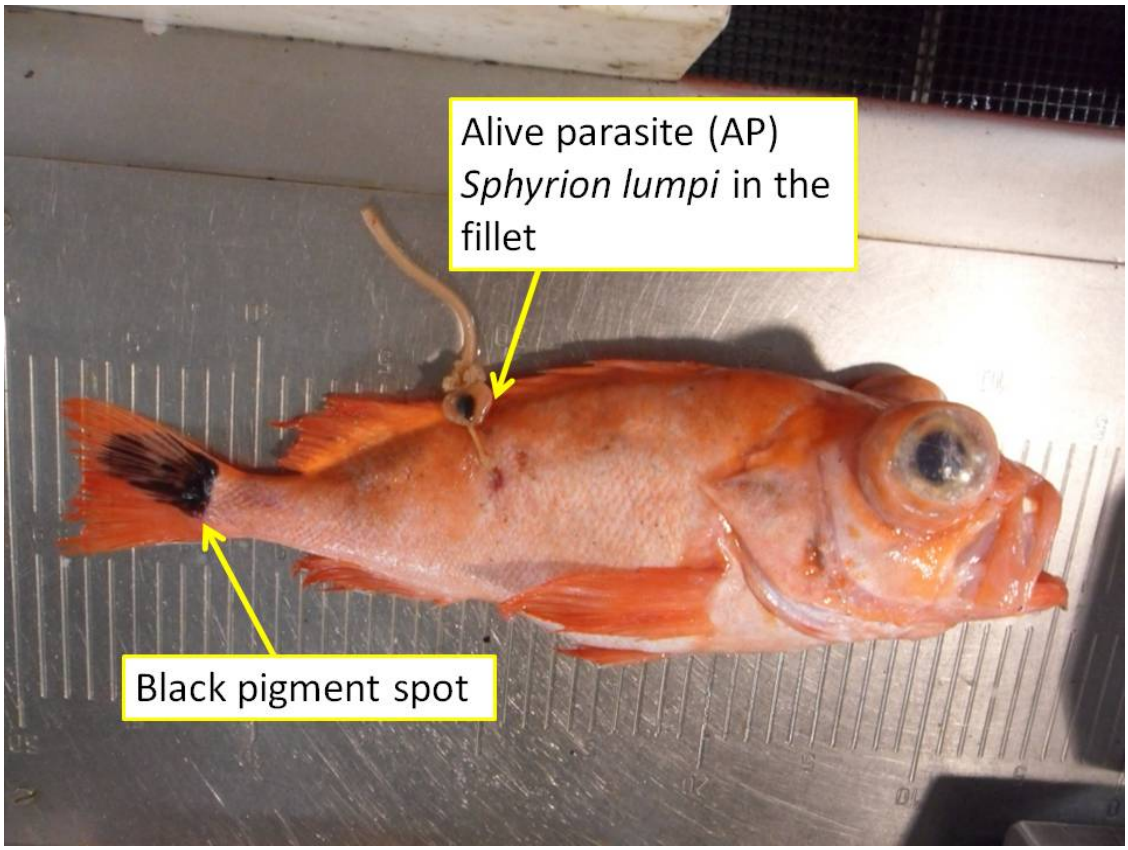
For **alive parasites (AP)**, a **six-digit code** is used. For example, if there are two *S. lumpi* in the ventral part of a redfish of stage 2 (see stages below) and one *S. lumpi* of stage 4, then record under V-AP in the protocol the six digit code 020100 (the first digit is stage one, the second digit is stage two etc. The numbers filled in are the numbers per stage). For the description of the stages check the extra protocol ("Stages Sphyrion lumpi").

Visible remains of parasites ("ulcers") are easily detected; they **are visible** to the eye. For the detection of **old cephalothoraxes**, you have to "**scan**" the fish **by hand**. Just move your hand across the complete body of the fish and you will explicitly **feel a hard elevation or hump**. Cut into the hump with a knife and count the numbers of old cephalothoraxes (Several can be present under one hump).

2. Check for pigment spots and note the color under F-color and the area (in cm^2) under F-area (e.g. if there are pigment spots in the fillet!). The same procedure is of course valid for the other parts of the fish as well.
   - R = red
   - B = black
   - RB = red and black

3. Take a sharp knife and make a cut left or right of the dorsal fin towards the tail fin. The length of the cut will be between 10 and 15 cm and should be 3 to 5 cm deep. Place the cut as if you were filleting the fish. Check for greyish muscular pigment (melanin) spots.
   - 1 = none
   - 2 = few
   - 3 = medium
   - 4 = much

Example of *S. mentella* with pigment spot and alive *Sphyrion lumpi* parasite.



Survey:					Station:				Net-No.:	Date:	Conversion factor (if >300 fish):								Recorder:			Page-No.:							
					Maturity		StomFullness			Parasites												Pigment spots							
Fish No	Length (cm)	Weight (g)	Gutted weight (g)	Sex (M, F, U)	ICES scale	PINRO scale	ICES scale	PINRO scale	Stomach contents	F-AP	F-U	F-OC	V-AP	V-U	V-OC	H-AP	H-U	H-OC	A-AP	A-U	A-OC	F-area (cm^2)	F-colour	V-area (cm^2)	V-colour	H-area (cm^2)	H-colour	Muscular pigment

Maturity (ICES):
1 = Immature
2 = Maturing/Mature
3 = Mature/Fertilized
4 = Parturition
5 = Post spawning
6 = Recovery

Stomach fullness:
1 = everted
2 = empty
3 = little content
4 = medium
5 = full stomach

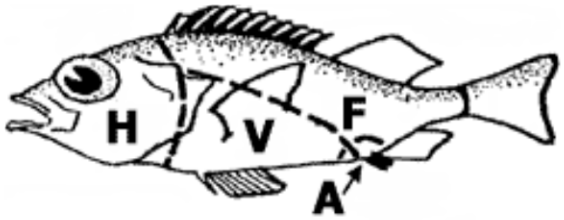
Food item codes:
1 Copepoda (*Calanus* etc.)
2 Chaetognatha (*Sagitta* etc.)
7 Polychaeta (Tomopteridae etc.)
9 Euphausiacea
10 Amphipoda (*Temisto* etc.)
13 Decapoda (shrimps)
38 Scyphozoa (jellyfish)
43 Cephalopoda (squid; *Loligo* etc.)

33 Other fish (deep-sea fish)
53 Anguilliformes (snipe-eels, gulper eels)
61 Fish larvae
64 Paralepidae (barracudinas; *Paralepis* etc.)
65 Myctophidae (lanternfishes)
72 Searsiidae (*Holtbyrnia*, *Searsia* etc.)
107 Wolffish (*Anarhichas*)

34 Digested fish
83 Digested food (undetermined)

Parasites:
F = fillet
V = ventral part
H = head
A = anal part

AP = alive parasites
(indicate no. of *S. lumpi* in each stage 1-6)
U = visible remains of parasites ("ulcers")
OC = old cephalothoraxes

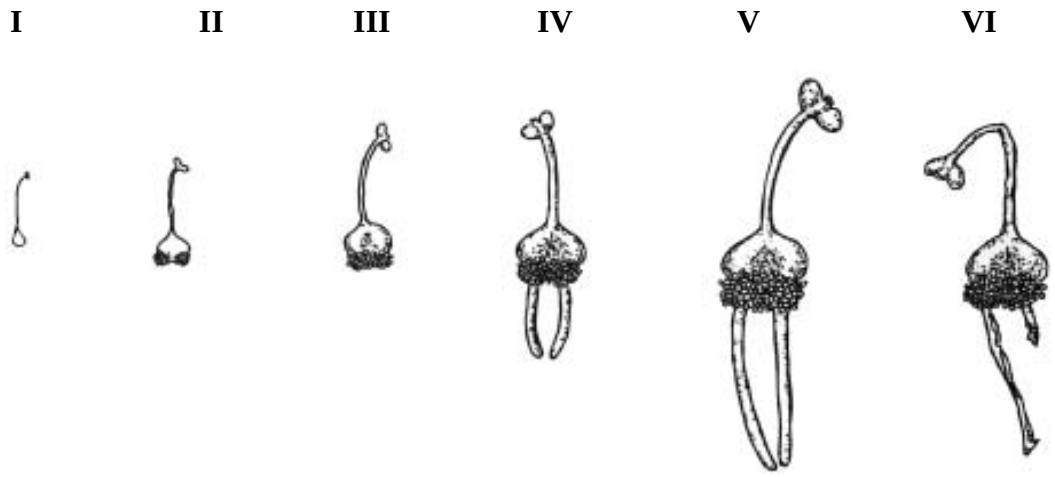


Pigment spots (skin), colour:
R = red
B = black
RB = red & black

Muscular pigment (melanin; in fillet):
1 = none
2 = few
3 = medium
4 = much

Conventional stages of development of *Sphyrion lumpi*

STAGE I	the parasite recently settled on the fish body; the body is semitransparent, like glassy, poorly visible on the fish skin; the fish body length is 1.0–1.5 cm; "the neck" is relatively elongated, filiform; its body is oblong (5 mm long).
STAGE II	the neck and the trunk are thicker, compared to the stage I, is not transparent, whitish, conjugate branchy organ is at the trunk end; the trunk length is 2–3 cm.
STAGE III	the length body is 3.5–4.0 cm, its morphology and color are close to mature stage, however no egg sacs are available.
STAGE IV	mature form, short (1–3 cm long) egg sacs are present, which are filled up with small (0.1–0.3 mm diameter) eggs, the length of the body, including the egg sacs, is on the average 4.5–6.0 cm.
STAGE V	mature "prespawning" form, the egg sacs (4–6 cm long) are filled with ripe (0.4–0.5 mm in diameter) eggs ready for extrusion and hatching of embryos; the chephalothorax and branchy organ are much developed, the trunk is dorsoventrally slightly thickened.
STAGE VI	"spawning" and "post-spawning" forms; the egg sacs are opened and partially or completely free of eggs or fallen off; the trunk is dorsoventrally flattened. Further, the trunk shrinks, dies off and as a rule falls off, breaking in the neck area, with the parasite cephalothorax remaining in the fish body.



Annex 4: Sheet used for hydrographical observations

Provide actual file, not the one shown here:

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 5: Maturity scale used in the international survey 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 6: Maturity scale used by Russia in the international survey 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 un-extruded larvae occurs. April-June.

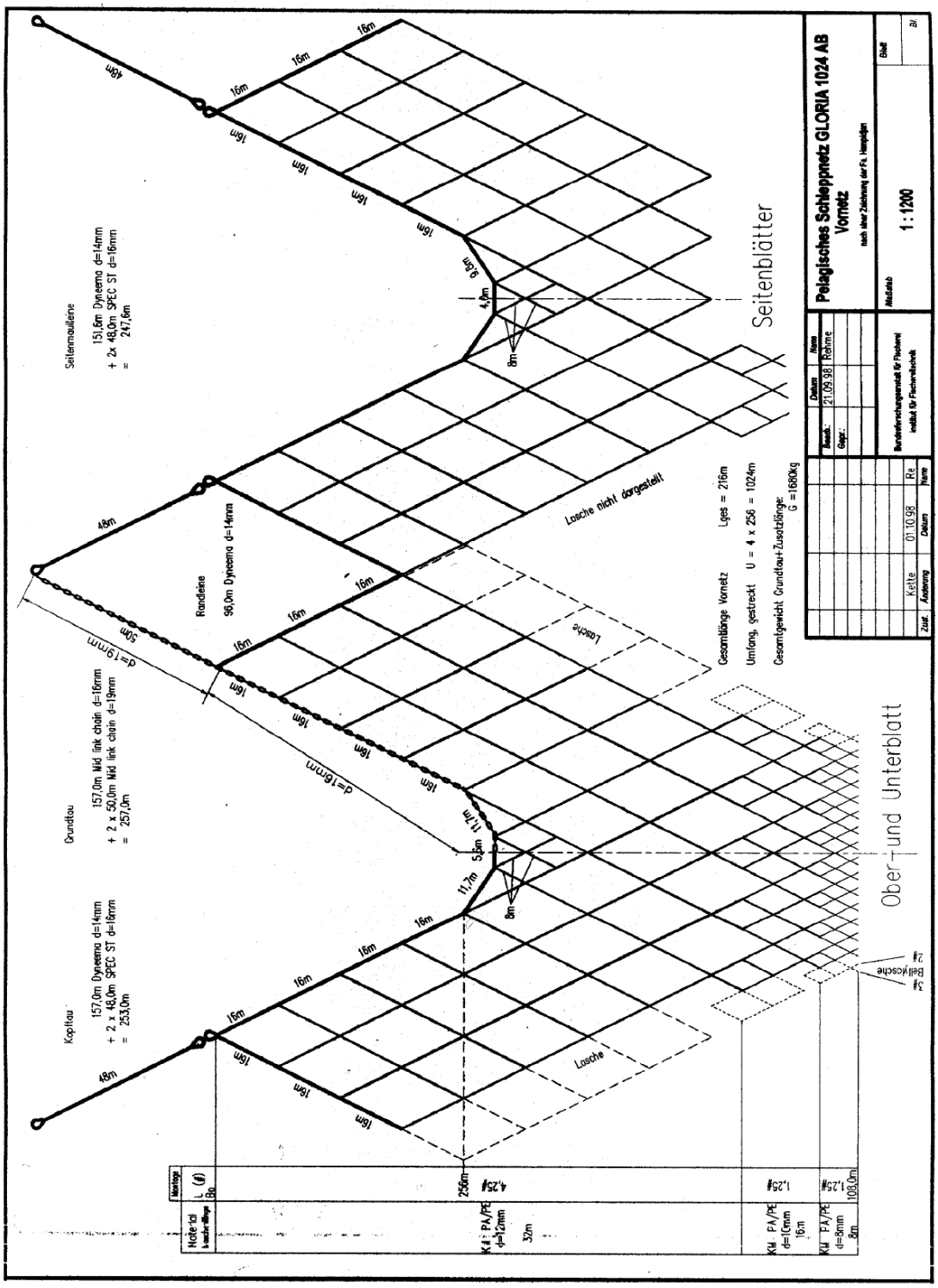
Annex 7: Species list

Species list, method of measurement (Total – Total length; Standard – Standard length; PAFL – Pre Anal Fin Length) and units (cm or mm). The list is not comprehensive.

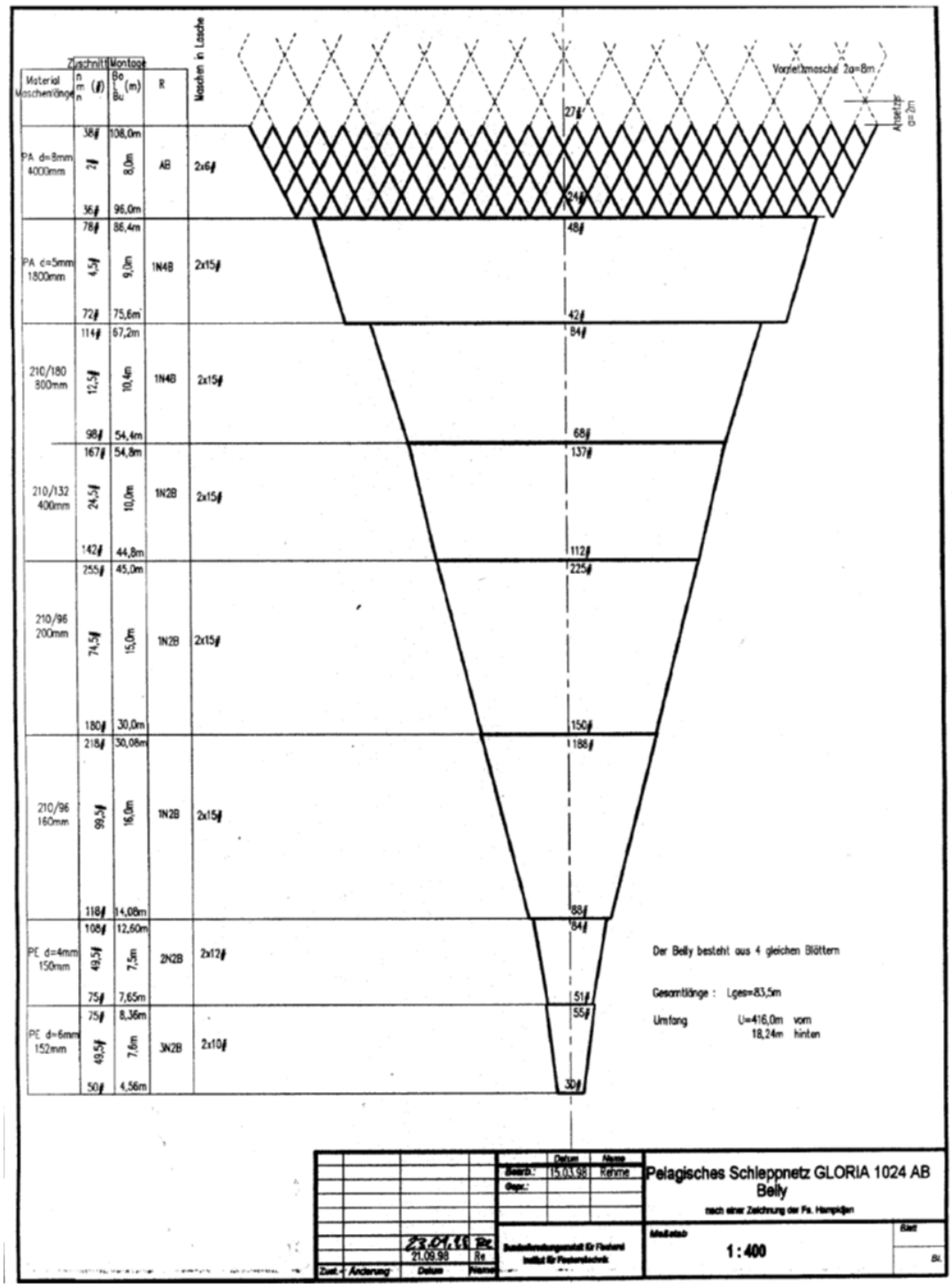
Scientific Name	English Name	AphiaID	Method	Unit
Alepocephalus agassizii	Agassiz´ smoothhead	126681	Standard	cm
Alepocephalus rostratus	Risso's smooth-head	126684	Standard	cm
Alepocephalus bairdii	Baird´s smoothhead	126682	Standard	cm
Anarhichas denticulatus	Northern wolffish	126757	Total	cm
Anoplogaster cornuta	Fangtooth, ogrefish	126393	Total	cm
Anotopterus pharao	Daggertooth	126334	Total	cm
Aphanopus carbo	Black scabbard fish	127085	Total	cm
Arctozenus rissoi	White barracudina	299946	Total	cm
Argyropelecus gigas	Greater silver hatchetfish	127308	Total	mm
Argyropelecus hemigymnus	Short silver hatchetfish	127309	Total	mm
Argyropelecus olfersii	Silver hatchetfish	274967	Total	mm
Bajacalifornia megalops	Bigeye smoothhead	126687	Standard	cm
Barbantus curvifrons	Palebelly searsid	126738	Standard	mm
Bathylagus euryops	Goitre blacksmelt	126719	Standard	cm
Bathytroctes microlepis	Smallscale smooth-head	126693	Standard	cm
Benthosema glaciale	Glacier lanternfish	126580	Standard	mm
Bonapartia pedaliota	Longray fangjaw	127281	Standard	mm
Borostomias antarcticus	Antarctic snaggletooth	127334	Standard	cm
Ceratias holboelli	Deep sea angler	126537	Total	cm
Chaenophryne draco	Smoothheaded dreamer	126559	Total	cm
Chaenophryne longiceps	Smooth dreamer, can opener	126560	Total	cm
Chauliodus sloani	Sloane´s viperfish	127338	Total	cm
Chiasmodon niger	Black swallower	126840	Total	cm
Coryphaenoides rupestris	Roundnose grenadier	158960	PAFL	cm
Cryptopsaras couesi	Lesser deep sea angler, triplewart seadevil	400722	Total	cm
Cyclopterus lumpus	Lumpsucker	127214	Total	cm
Cyclothone microdon	Veiled anglemouth	127286	Standard	mm
Derichthys serpentinus	Narrownecked oceanic eel	126291	Total	cm
Einara edentula	Toothless smooth-head	126700	Standard	cm
Entelurus aequoreus	Snake pipefish	127379	Total	cm
Eurypharynx pelecanoides	Pelican eel, pelican gulper	127165	Total	cm
Evermannella balbo	Pink sabertooth	126338	Standard	cm
Gigantactis vanhoeffeni	Whipnose	126542	Total	cm
Gonostoma bathyphilum	Spark anglemouth	127294	Standard	mm
Gonostoma elongatum	Longtooth anglemouth	127296	Standard	mm
Gonostomatidae	Bristlemouths	125601	Standard	mm
Haplophryne mollis	Soft leafvent angler	126547	Total	cm
Himantolophus albinares	Whitemarked football fish	126543	Total	cm
Himantolophus groenlandicus	Atlantic footballfish	126545	Total	cm
Holtbyrnia anomala	Bighead searsid	126739	Standard	mm
Holtbyrnia macrops	Bigeye searsid	126740	Standard	mm
Lampadena speculigera	Mirror lanternfish	126608	Standard	mm
Lampanyctus crocodilus	Jewel lanternfish	126612	Standard	mm
Lampanyctus intricarius	Diamondcheek lanternfish	126615	Standard	mm
Lampanyctus macdonaldi	Rakery beaconlamp	126617	Standard	mm
Linophryne lucifer	Forkbarbel throat, forkbarbel netdevil	126550	Total	cm

Scientific Name	English Name	AphiaID	Method	Unit
Macrouridae	Grenadiers	125471	PAFL	cm
Magnisudis atlantica	Atlantic barracudina	126359	Total	cm
Malacosteus niger	Lightless loosejaw	127358	Total	cm
Maulisia mauli	Maul´s searsid	126742	Standard	mm
Maulisia microlepis	Smallscale searsid	126743	Standard	mm
Maurolicus muelleri	Pearlsides	127312	Standard	mm
Melamphaes microps	Numerous helmetfish	127268	Standard	mm
Melanocetus johnsoni	Black devil	221410	Total	cm
Melanostomias bartonbeani	Scaleless black dragonfish	127359	Standard	cm
Melanostomiidae	Scaleless black dragonfish	196075	Standard	cm
Micromesistius poutassou	Blue whiting	126439	Total	cm
Myctophidae	Lanternfish	125498	Standard	mm
Myctophum affine	Metallic lanternfish	158902	Standard	mm
Myctophum punctatum	Spotted lanternfish	126627	Standard	mm
Nannobrachium atrum	Dusky lanternfish	158909	Standard	mm
Nansenia groenlandica	Greenland argentine, large eyed argentine	126725	Total	cm
Nansenia oblita		126728	Total	cm
Nemichthys scolopaceus	Slender snipe eel	126306	Total	cm
Nessorhamphus ingolfianus	Duckbill oceanic eel	126292	Total	cm
Normichthys operosus	Multipore searsid	126745	Standard	mm
Notoscopelus kroeyeri	Kroeyer´s lanternfish	400473	Standard	mm
Oneirodes eschrichtii	Bulbous dreamer	126572	Total	cm
Oneirodidae	Dreamers	125496	Total	cm
Paralepididae	Barracudinas	125447	Total	cm
Paralepis coregonoides	Barracudina	126361	Total	cm
Photostylus pycnopterus	Starry smooth-head	126707	Standard	mm
Platyberyx opalescens		221507	Standard	cm
Platytroctidae	Tubeshoulders	125514	Standard	mm
Polyipnus polli	Poll´s hatchetfish	127313	Total	mm
Poromitra crassiceps	Crested bigscale	127273	Standard	mm
Poromitra megalops	Largeeyed rhinofish	127274	Standard	mm
Protomyctophum arcticum	Arctic telescope	158917	Standard	mm
Rouleina attrita	Softskin smoothhead	126709	Standard	mm
Saccopharynx ampullaceus	Gulper eel	127171	Total	cm
Sagamichthys schnakenbecki	Schnakenbeck´s searsid	126748	Standard	mm
Schedophilus medusophagus	Cornish blackfish, brown ruff	126833	Total	cm
Scopelogadus beanii	Squarenose helmetfish	127278	Standard	mm
Scopelosaurus lepidus	Blackfin waryfish	126349	Total	cm
Searsia koefoedi	Koefoed´s searsid	126749	Standard	mm
Sebastes mentella	Beaked redfish	127254	Total	cm
Serrivomer beani	Beans´s sawtoothed eel, stout sawpalate	183420	Total	cm
Sternoptyx diaphana	Dollar hatchetfish, transparent hatchetfish	127314	Total	mm
Sternoptyx pseudobscura	Highlight hatchetfish	127315	Total	mm
Stomias boa ferox	Boa dragonfish	158737	Total	cm
Stomiidae	Barbeled dragonfish	125604	Total	cm
Thalassobathia pelagica		126660	Total	cm
Trachipterus arcticus	Deal fish, ribbon fish	126527	Total	cm
Trigonolampa miriceps	Threelight dragonfish	127377	Standard	cm
Xenodermichthys copei	Bluntsnout smoothhead	126714	Standard	cm

Annex 8: Net specifications of the pelagic trawl used by Germany (Gloria 1024)

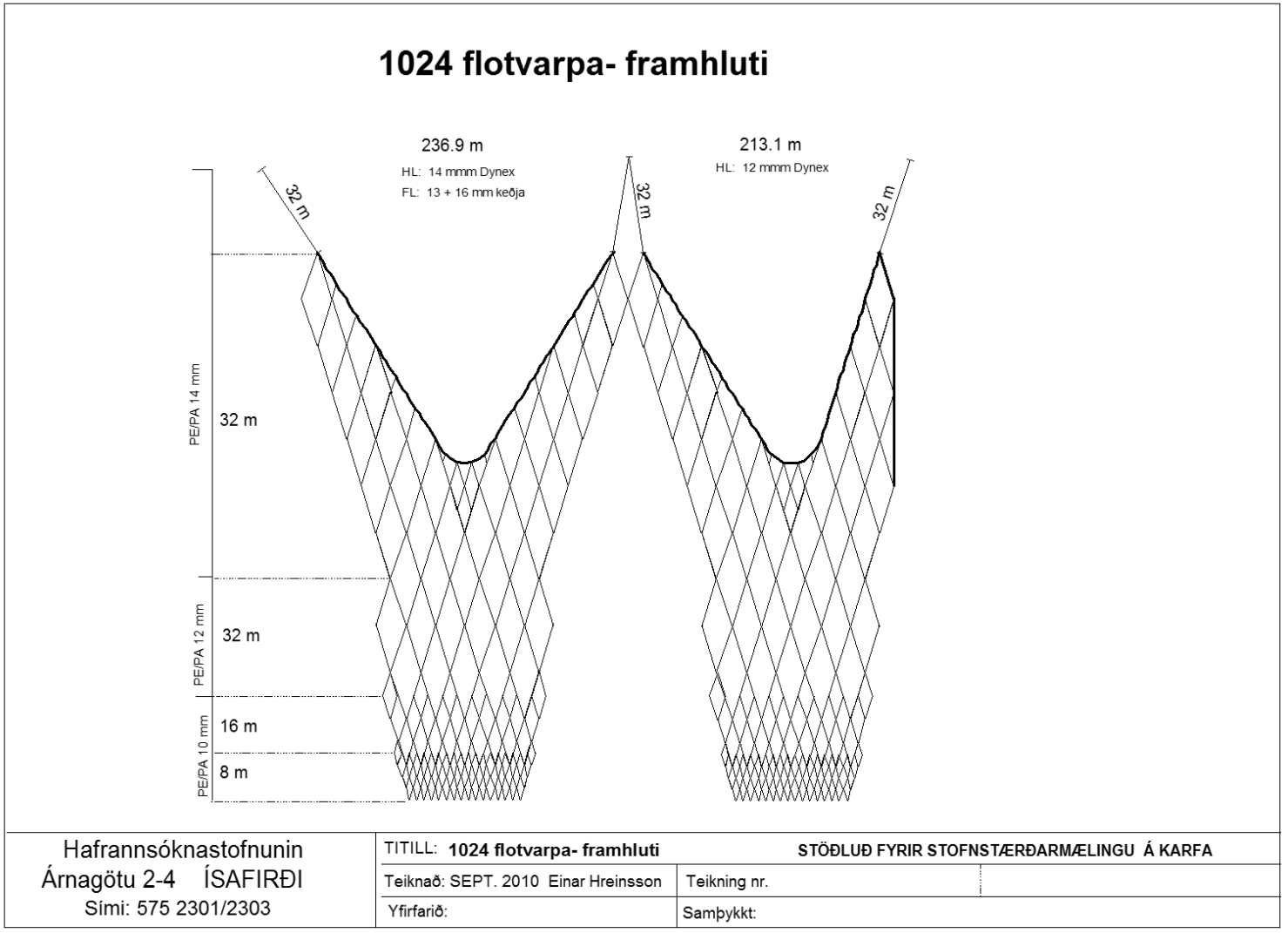


Gloria-type 1024 pelagic trawl. Front part.

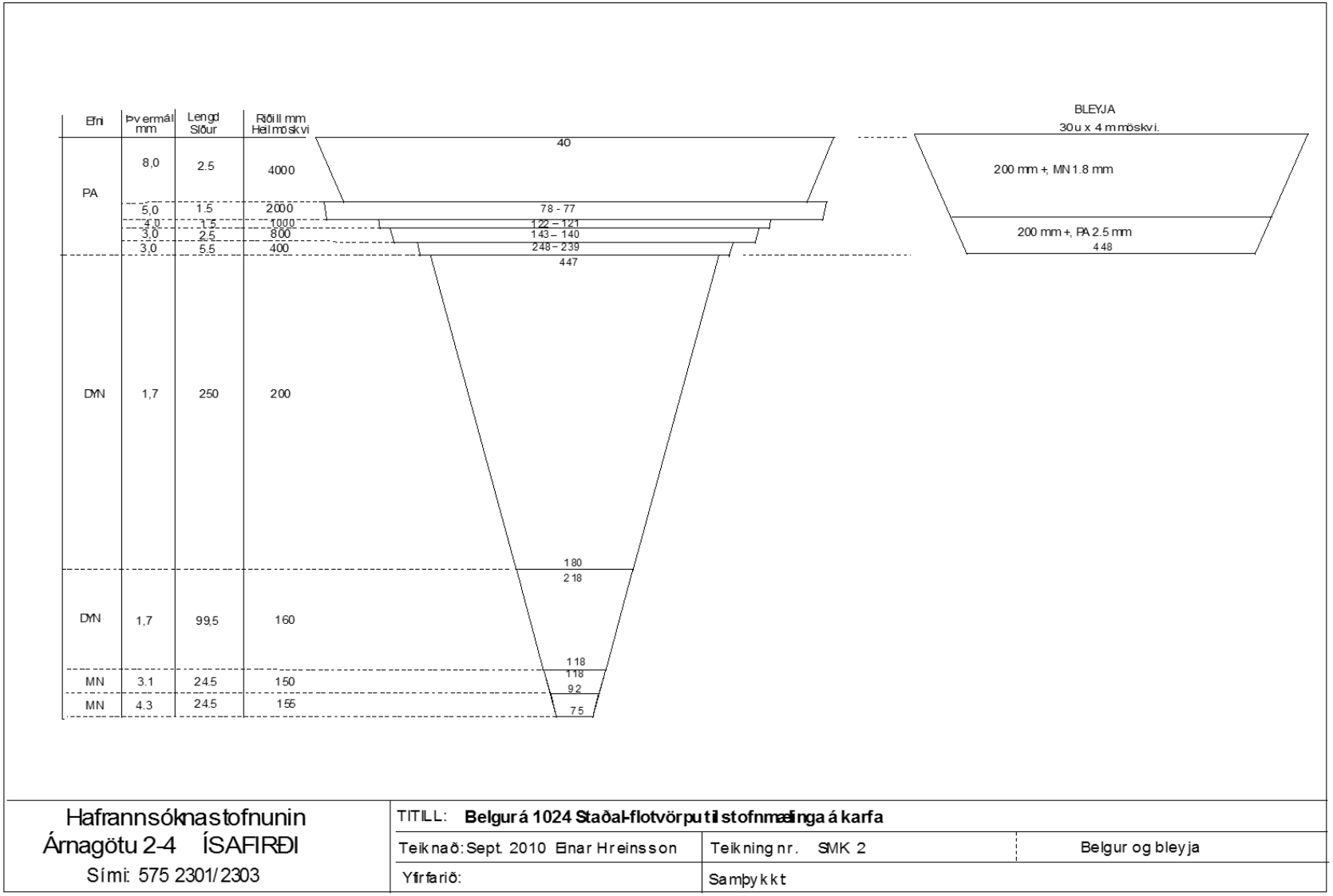


Gloria-type 1024 pelagic trawl. Back part.

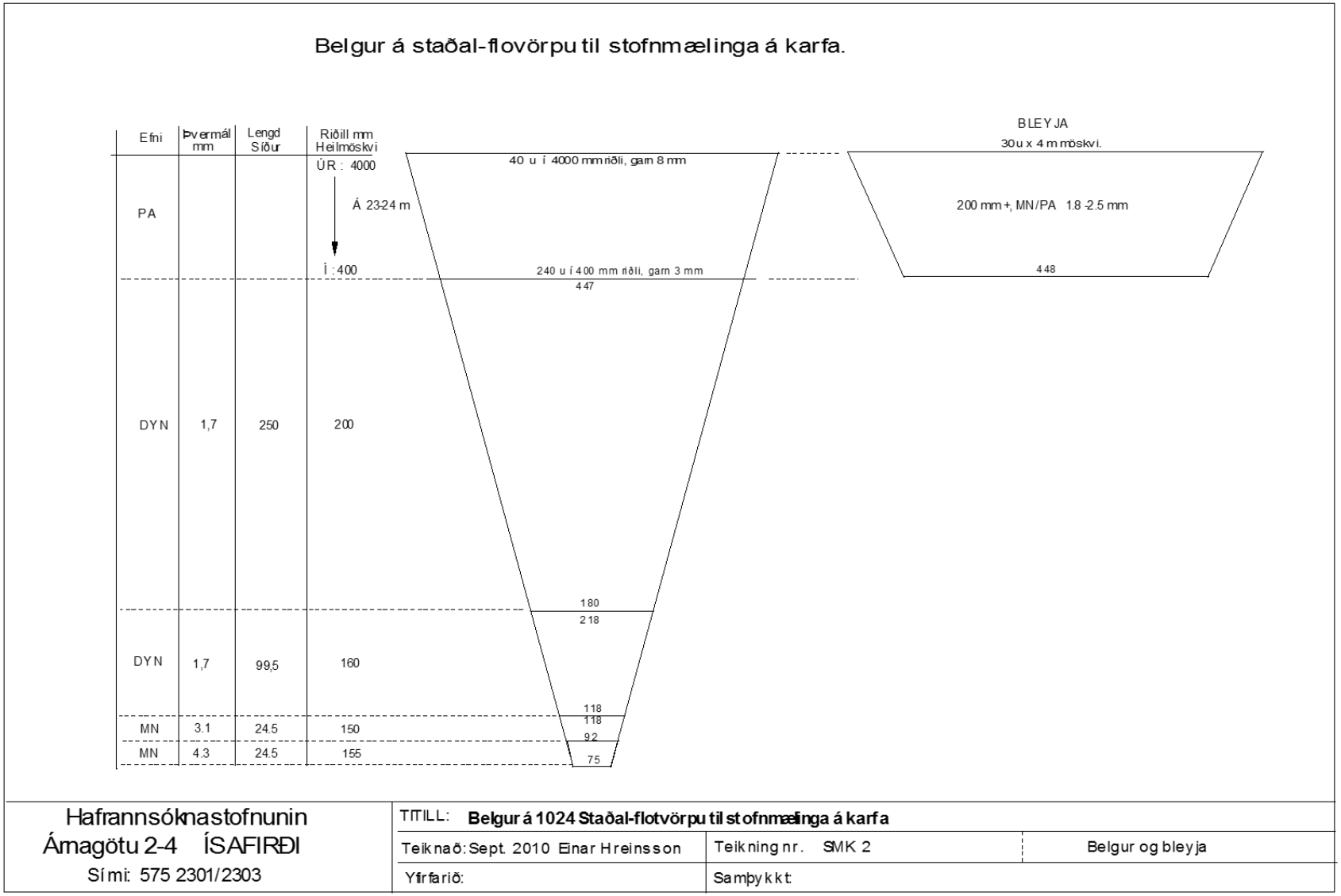
Annex 9: Net specifications of the pelagic trawl used by Iceland (Gloria 1024)



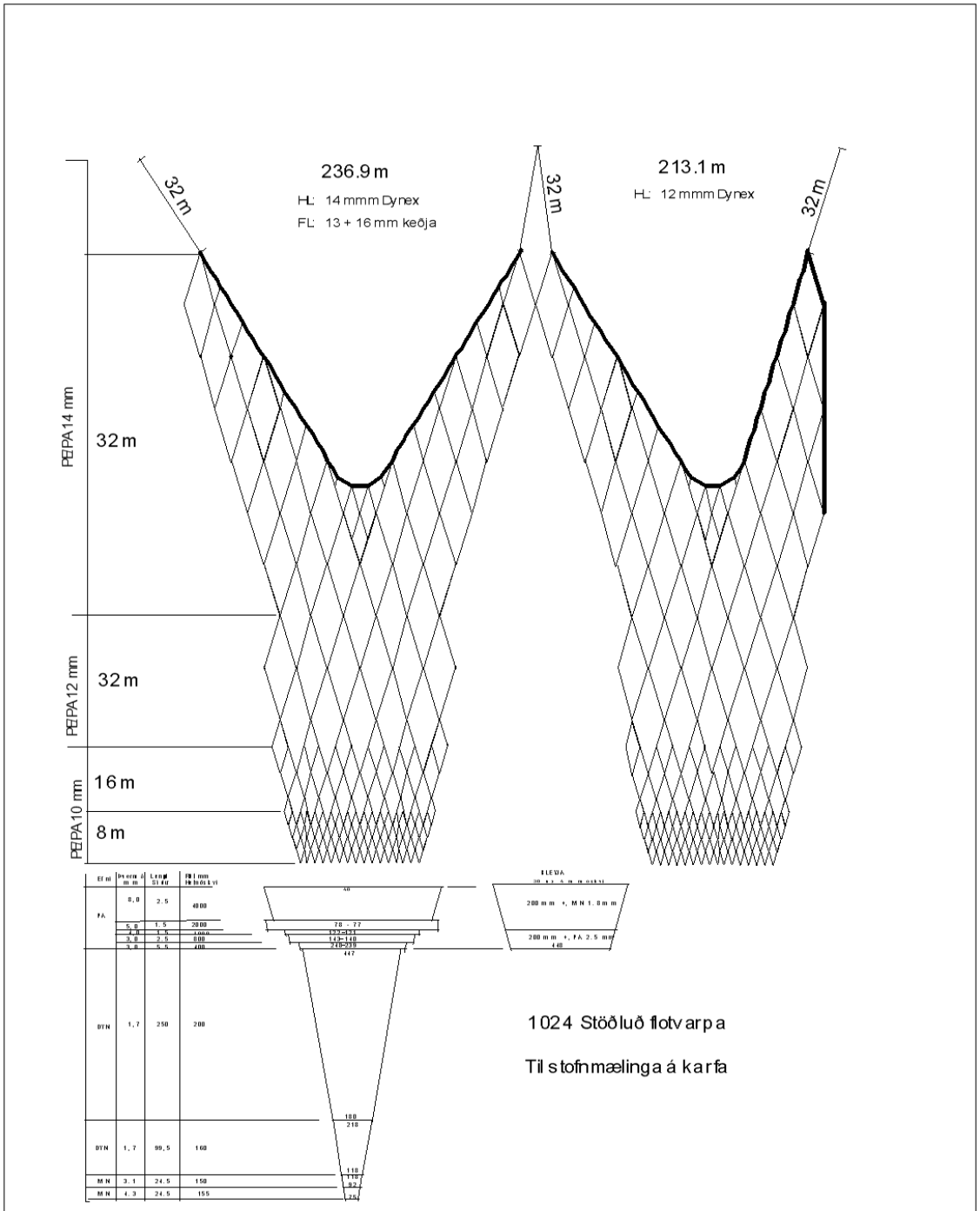
Gloria 1024 pelagic trawl – Front part.



Gloria 1024 pelagic trawl.

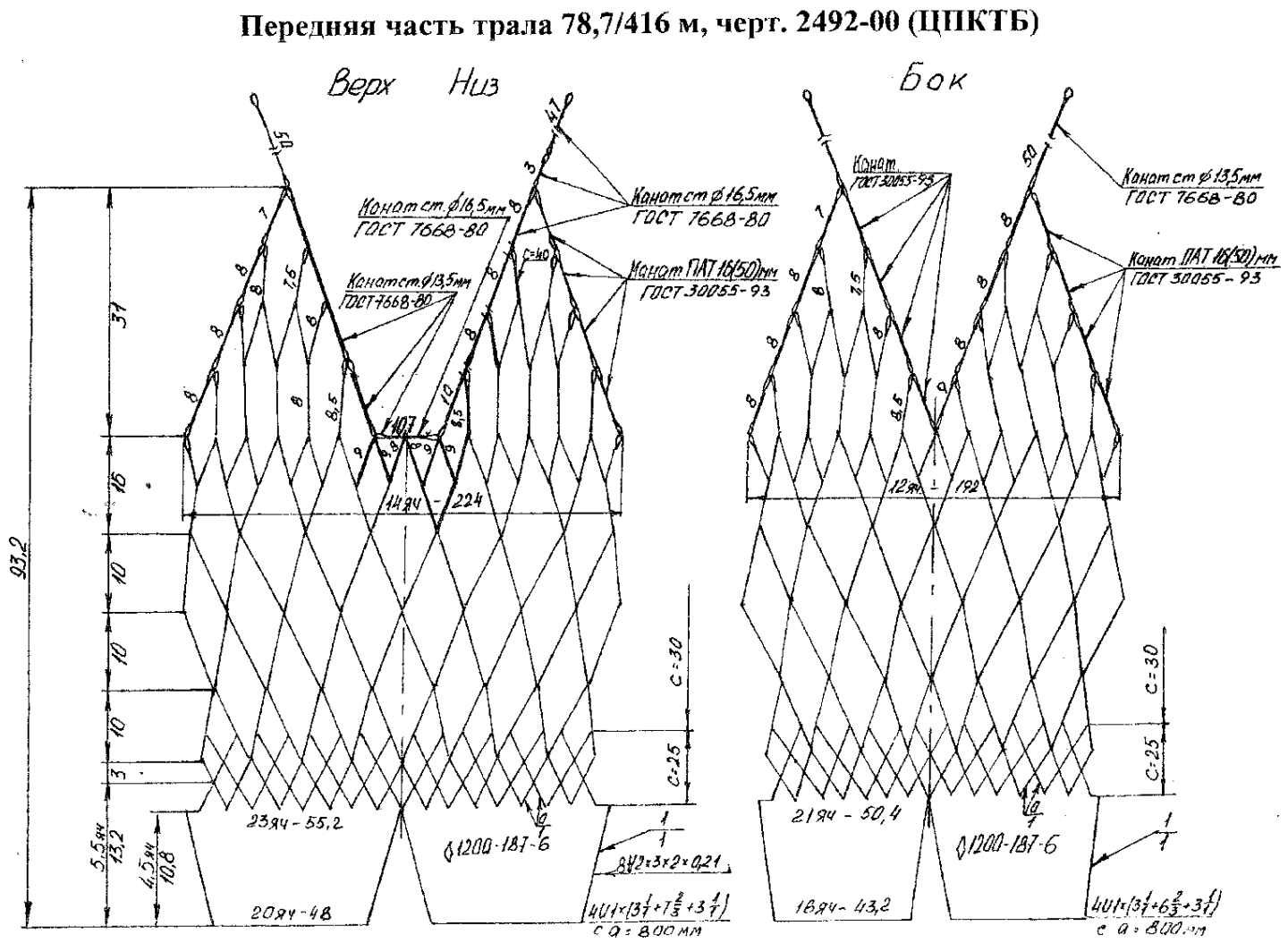


Gloria 1024 pelagic trawl.



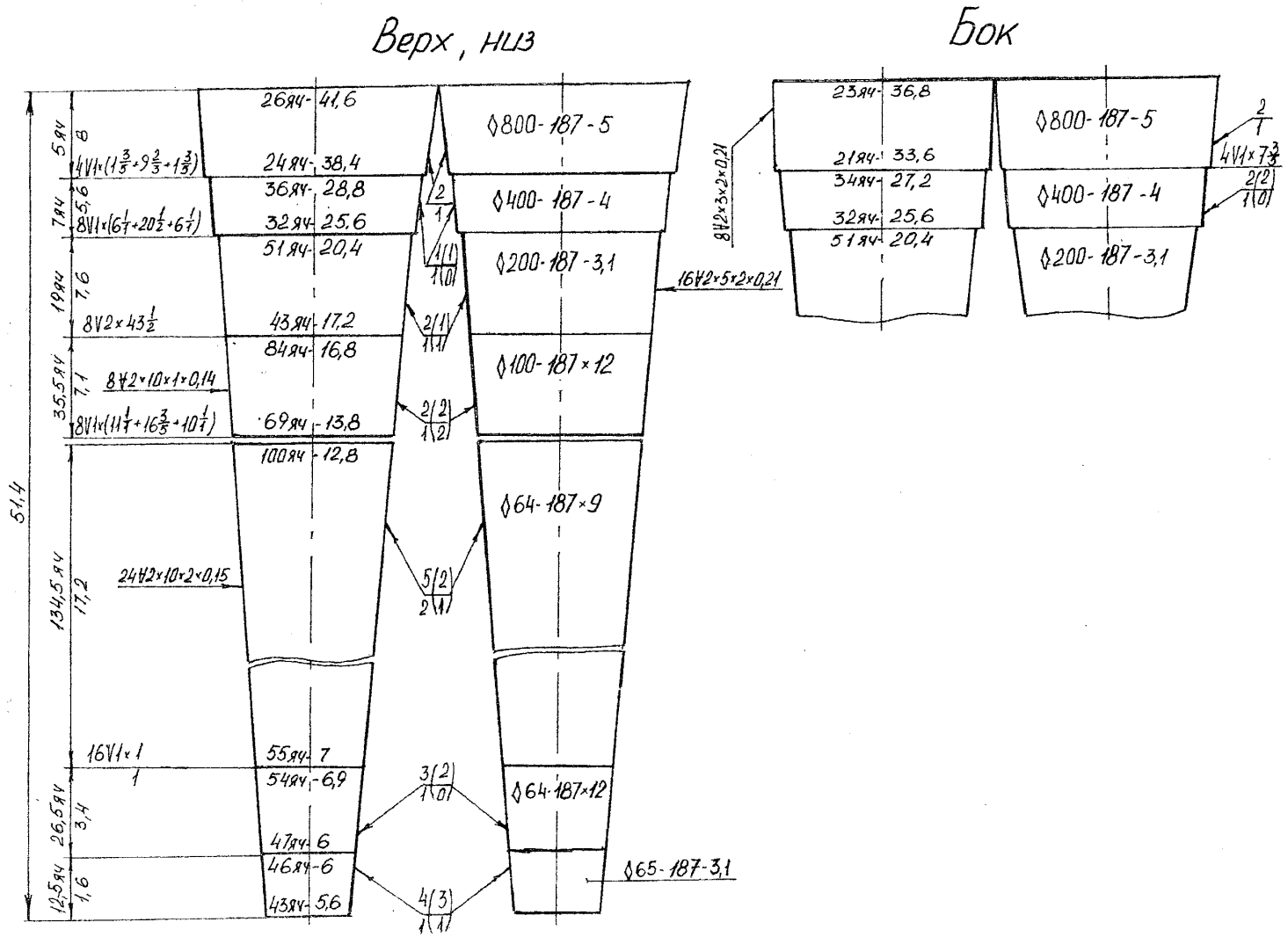
Gloria 1024 pelagic trawl.

Annex 10: Net specifications of the pelagic trawl used by Russia (78.7/416)



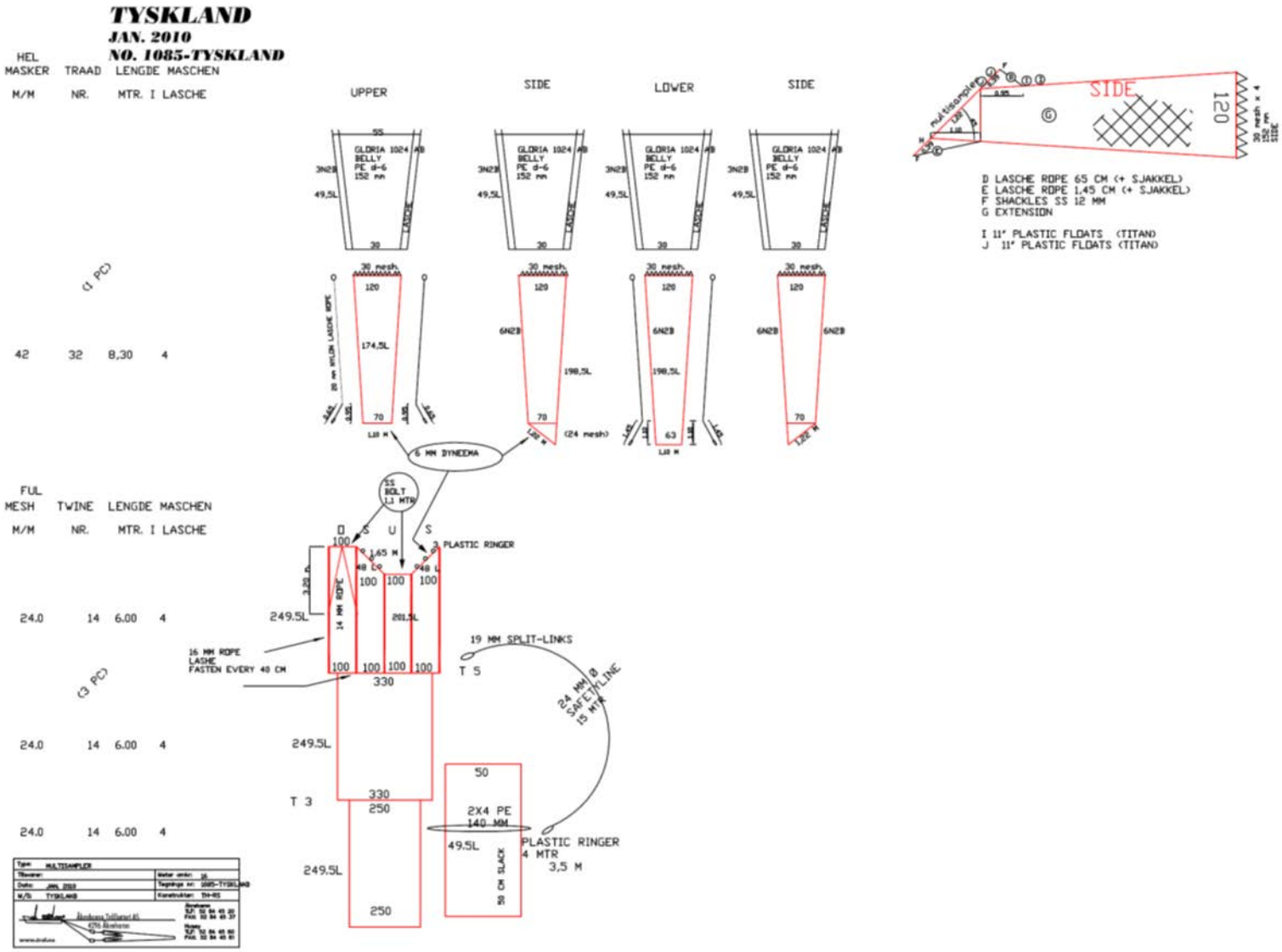
Pelagic trawl

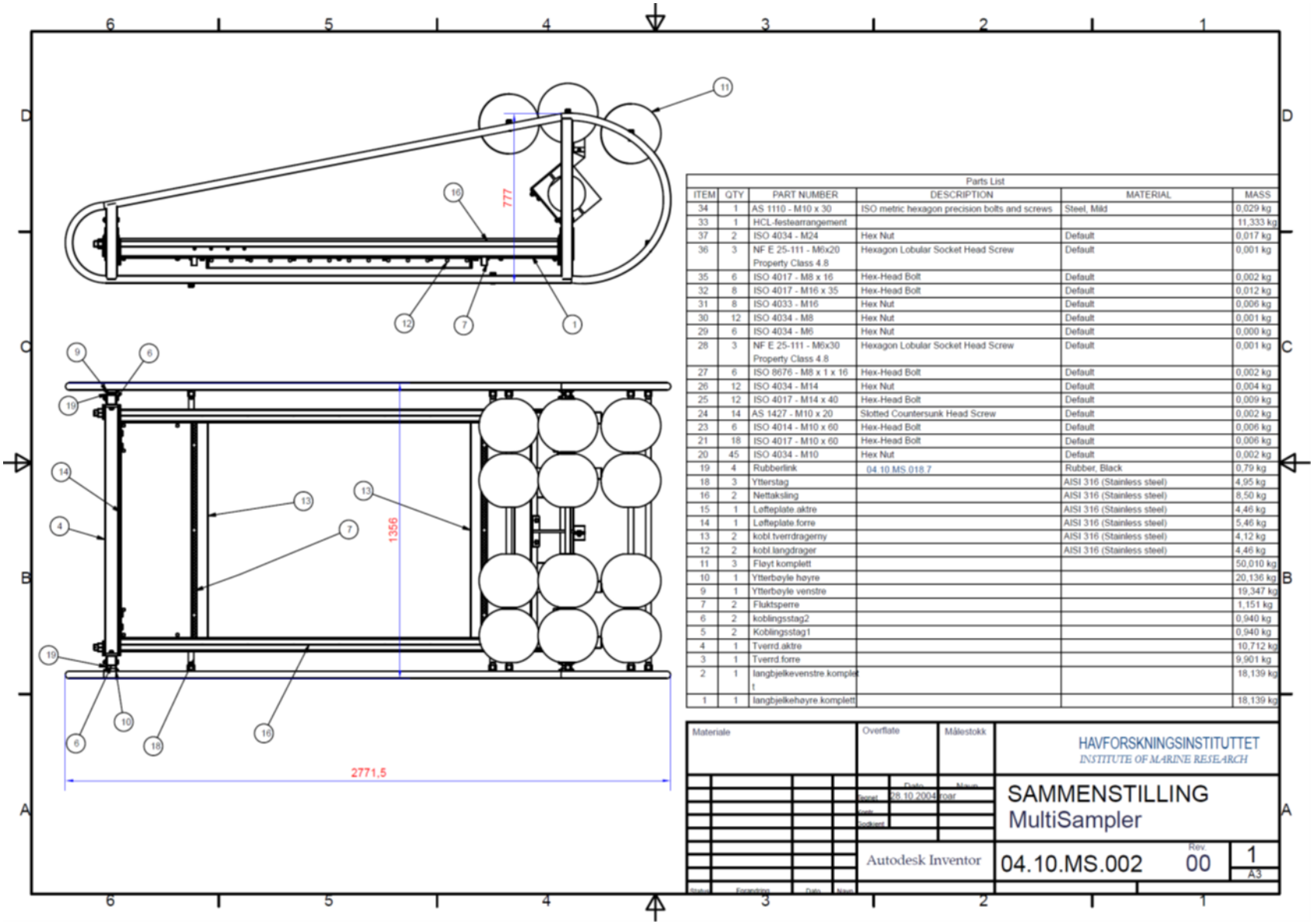
Концевая часть трала черт. 2492-00-020 изм. «3»



Pelagic trawl

Annex 11: Multi-sampler used by Germany and Iceland





Parts List

ITEM	QTY	PART NUMBER	DESCRIPTION	MATERIAL	MASS
34	1	AS 1110 - M10 x 30	ISO metric hexagon precision bolts and screws	Steel, Mild	0,029 kg
33	1	HCL-festearrangement			11,333 kg
37	2	ISO 4034 - M24	Hex Nut	Default	0,017 kg
36	3	NF E 25-111 - M6x20 Property Class 4.8	Hexagon Lobular Socket Head Screw	Default	0,001 kg
35	6	ISO 4017 - M8 x 16	Hex-Head Bolt	Default	0,002 kg
32	8	ISO 4017 - M16 x 35	Hex-Head Bolt	Default	0,012 kg
31	8	ISO 4033 - M16	Hex Nut	Default	0,006 kg
30	12	ISO 4034 - M8	Hex Nut	Default	0,001 kg
29	6	ISO 4034 - M6	Hex Nut	Default	0,000 kg
28	3	NF E 25-111 - M6x30 Property Class 4.8	Hexagon Lobular Socket Head Screw	Default	0,001 kg
27	6	ISO 8676 - M8 x 1 x 16	Hex-Head Bolt	Default	0,002 kg
26	12	ISO 4034 - M14	Hex Nut	Default	0,004 kg
25	12	ISO 4017 - M14 x 40	Hex-Head Bolt	Default	0,009 kg
24	14	AS 1427 - M10 x 20	Slotted Countersunk Head Screw	Default	0,002 kg
23	6	ISO 4014 - M10 x 60	Hex-Head Bolt	Default	0,006 kg
21	18	ISO 4017 - M10 x 60	Hex-Head Bolt	Default	0,006 kg
20	45	ISO 4034 - M10	Hex Nut	Default	0,002 kg
19	4	Rubberlink	04.10.MS.018.7	Rubber, Black	0,79 kg
18	3	Ytterstag		AISI 316 (Stainless steel)	4,95 kg
16	2	Nettaksling		AISI 316 (Stainless steel)	8,50 kg
15	1	Løfteplate aktre		AISI 316 (Stainless steel)	4,46 kg
14	1	Løfteplate forre		AISI 316 (Stainless steel)	5,46 kg
13	2	kobl.tverrdragerny		AISI 316 (Stainless steel)	4,12 kg
12	2	kobl.langdrager		AISI 316 (Stainless steel)	4,46 kg
11	3	Fløyt komplett			50,010 kg
10	1	Ytterbøyle høyre			20,136 kg
9	1	Ytterbøyle venstre			19,347 kg
7	2	Fluktsperre			1,151 kg
6	2	koblingsstag2			0,940 kg
5	2	Koblingsstag1			0,940 kg
4	1	Tverrd.aktre			10,712 kg
3	1	Tverrd.forre			9,901 kg
2	1	langbjelkevenstre komplett			18,139 kg
1	1	langbjelkehøyre komplett			18,139 kg

Materiale	Overflate	Målestokk	HAVFORSKNINGSINSTITUTTET *INSTITUTE OF MARINE RESEARCH*
	Dato	Navn	
	Tegnet 28.10.2004 roar		SAMMENSTILLING MultiSampler
	Sjekk		
	Godkjent		
Autodesk Inventor			04.10.MS.002 Rev. 00 — 1 / A3

Annex 12: Russian 3K Hydrographical Section

Station no.	Latitude	Longitude
1	62°15'N	33°30'W
2	62°00'N	33°00'W
3	61°40'N	32°10'W
4	61°18'N	31°15'W
5	61°00'N	30°20'W
6	60°40'N	29°30'W
7	60°25'N	28°40'W
8	60°10'N	27°55'W
9	59°55'N	27°05'W

Annex 13: DATRAS – Haul Information

Order	Field Name	Width	Value	Mandatory	Data Type
1	RecordType	2	HH	yes	char
2	Quarter	1	1–4	yes	int
3	Country	3	GFR, IS, NOR, RUS	yes	char
4	Ship	4	46AS, 46BS, WAH3, ATL, RU9H, 90VY, 909H	yes	char
5	Gear	6	PG1, PRT	yes	char
6	SweepLngt	3	-9	n/a	int
7	GearExp	2	MN, MY		char
8	DoorType	2	-9		char
9	StNo	6	National number	yes	char
10	HaulNo	6		yes	int
11	Year	4	yyyy	yes	char
12	Month	2	1–12	yes	int
13	Day	2	dd	yes	int
14	TimeShot	4	GMT, hhmm	yes	char
15	Stratum	4	-9	n/a	char
16	HaulDur	3	15–600	yes	int
17	DayNight	2	D, N	yes	char
18	ShootLat	8	Range: 50–66	yes	decimal4
19	ShootLong	9	Range: -58 to -20	yes	decimal4
20	HaulLat	8	Range: 50–66	yes	decimal4
21	HaulLong	9	Range: -58 to -20	yes	decimal4
22	StatRec	4	ICES stat rect NAFO = -9		char
23	Depth	4	Range: 5–6000	yes	int
24	HaulVal	1	I, P, V	yes	char
25	HydroStNo	8	-9	yes	char
26	StdSpecRecCode	1	1	yes	char
27	BycSpecRecCode	1	1	yes	char
28	DataType	2	R	x	char
29	Netopening	4	Range: 30–200		decimal1
30	Rigging	2	-9	n/a	char
31	Tickler	2	-9	n/a	int
32	Distance	5	Range: 1000–20000		int
33	WarpIngt	4	-9		int
34	Warpdia	2	-9		int
35	WarpDen	2	-9		int
36	DoorSurface	4	-9		decimal1
37	DoorWgt	4	-9		int
38	DoorSpread	5	-9		decimal1
39	WingSpread	4	-9		decimal1
40	Buoyancy	4	-9	n/a	int
41	KiteDim	3	-9	n/a	decimal1
42	WgtGroundRope	4	-9	n/a	int
43	TowDir	3	1–360		int
44	GroundSpeed	3	2.5–4.5		decimal1
45	SpeedWater	3	-9	n/a	decimal1
46	SurCurDir	3	-9	n/a	int
47	SurCurSpeed	4	-9	n/a	decimal1
48	BotCurDir	3	-9	n/a	int

Order	Field Name	Width	Value	Mandatory	Data Type
49	BotCurSpeed	4	-9	n/a	decimal1
50	WindDir	3	Value or -9		int
51	WindSpeed	3	Value or -9		int
52	SwellDir	3	Value or -9		int
53	SwellHeight	4	Value or -9		decimal1
54	SurTemp	4	Value or -9		decimal1
55	BotTemp	4	Range: -2 – 20		decimal1
56	SurSal	5	-9	n/a	decimal2
57	BotSal	5	-9	n/a	decimal2
58	ThermoCline	2	-9	n/a	char
59	ThClineDepth	4	-9	n/a	int
60	CodendMesh	4			int
61	PelSampType	2	-9, 1, 2, 3		char
62	MinTrawlDepth	4	1–1200		int
63	MaxTrawlDepth	4	1–1200		int

https://datras.ices.dk/Data_products/ReportingFormat.aspx

http://dome.ices.dk/datsu/selRep.aspx

Select Irminger Sea International Deep Pelagic Survey and HH – Haul Information for detailed description of fields.

Annex 14: DATRAS – Length Frequency Information

Order	Field Name	Width	Value	Mandatory	Data Type
1	RecordType	2	HH	yes	char
2	Quarter	1	1–4	yes	int
3	Country	3	GFR, IS, NOR, RUS	yes	char
4	Ship	4	46AS, 46BS, WAH3, ATL, RU9H, 90VY, 909H	yes	char
5	Gear	6	PG1, PRT	yes	char
6	SweepLngt	3	-9	n/a	int
7	GearExp	2	MN, MY		char
8	DoorType	2	-9		char
9	StNo	6	National number	yes	char
10	HaulNo	6		yes	int
11	Year	4	yyyy	yes	char
12	SpecCodeType	1	W	yes	char
13	SpecCode	10	WoRMS AphiaID code	yes	char
14	SpecVal	2	0, 1, 4, 6, 7, 8, 9	yes	char
15	Sex	2	F, M, U, -9		char
16	TotalNo	10			decimal2
17	CatIdentifier	2	1	yes	int
18	NoMeas	4		yes	int
19	SubFactor	9		yes	decimal4
20	SubWgt	5			int
21	CatCatchWgy	8		yes	int
22	LngtCode	2		yes	char
23	LngtClass	4		yes	int
24	HLNoAtLngt	10		yes	decimal2
25	LenMeasType	2	-9, 1, 2, 3, 4		char

https://datras.ices.dk/Data_products/ReportingFormat.aspx

http://dome.ices.dk/datsu/selRep.aspx

Select Irminger Sea International Deep Pelagic Survey and HL – Length Frequency Distribution for detailed description of fields.

Annex 15: DATRAS – SMALK

Order	Field Name	Width	Value	Mandatory	Data Type
1	RecordType	2	CA	yes	char
2	Quarter	1	1–4	yes	int
3	Country	3	GFR, IS, NOR, RUS	yes	char
4	Ship	4	46AS, 46BS, WAH3, ATL, RU9H, 90VY, 909H	yes	char
5	Gear	6	PG1, PRT	yes	char
6	SweepLngt	3	-9	n/a	int
7	GearExp	2	MN, MY		char
8	DoorType	2	-9		char
9	StNo	6	National number	yes	char
10	HaulNo	6		yes	int
11	Year	4	yyyy	yes	char
12	SpecCodeType	1	W	yes	char
13	SpecCode	10	WoRMS AphiaID code	yes	char
14	AreaType	10	23	yes	char
15	AreaCode	4	A, B, C, D, E, F	yes	char
16	LngtCode	2		yes	char
17	LngtClas	4		yes	int
18	Sex	2	-9, F, M, U	yes	char
19	Maturity	4		yes	char
20	PlusGr	2		yes	char
21	AgeRings	3		yes	int
22	CANoAtLngt	3		yes	int
23	IndWgt	5			decimal1
24	FishID	6			int
25	GenSamp	2	-9, N, Y		char
26	StomSamp	2	-9, N, Y		char
27	ParSamp	2	-9, N, Y		char

https://datras.ices.dk/Data_products/ReportingFormat.aspx

http://dome.ices.dk/datsu/selRep.aspx

Select Irminger Sea International Deep Pelagic Survey and CA – SMALK for detailed description of fields.