Hafrannsóknir nr. 156

Manuals for the Icelandic bottom trawl surveys in spring and autumn

Reykjavík 2010

CONTENTS

ÁGRIP

Enskar útgáfur handbóka stofnmælinga með botnvörpu að vori og hausti. Hafrannsóknir nr. 156.

Handbækur eru gefnar út hvert ár af Hafrannsóknastofnuninni í tengslum við framkvæmd stofnmælinga með botnvörpu á Íslandsmiðum. Í þeim er nákvæmlega lýst framkvæmd verkefnanna, m.a. umfangi gagnasöfnunar úr aflanum, hvernig safna eigi líffræðilegum upplýsingum, skráningu mælinga, veiðarfæri og veiðiaðferðum. Einnig eru fyrirmæli um það hvernig aðferðum skuli beitt við tog og gefnar nákvæmar staðsetningar og aðrar upplýsingar um togstöðvar. Þá eru í handbókunum viðaukar sem greina frá sérstökum verkefnum eða aðferðum.

Handbækur stofnmælinganna eru skrifaðar á íslensku, enda verkefnið nær eingöngu unnið af Íslendingum. Vegna aukins samstarfs við erlenda vísindamenn, t.d. innan Alþjóðahafrannsóknaráðsins (ICES), hefur þörfin á því að þýða handbækur stofnmælinganna yfir á ensku farið vaxandi. Sú þörf hefur einnig aukist vegna vaxandi notkunar gagna úr stofnmælingunum í ýmsum rannsóknum sem gerð eru skil í erlendum tímaritum.

Hér hafa handbækur verkefnanna ”Stofnmæling botnfiska á Íslandsmiðum 2009” og ”Stofnmæling botnfiska að haustlagi 2009” verið þýddar á ensku. Framkvæmd þessara verkefna undanfarin ár hefur í meginatriðum verið eins og þar er lýst.

ABSTRACT

Manuals for the Icelandic bottom trawl surveys in spring and autumn. Marine Research in Iceland 156.

Manuals describing the methodology of bottom trawl surveys in Icelandic waters are published annually by the Marine Research Institute. The manuals describe the extent of data collection, provide instructions on sampling of biological variables, registration of information, the survey fishing gear and fishing methods. They provide instructions on towing methods and exact data on locations and other information on the tows. Furthermore, the manuals include appendices describing certain side projects or methods.

The manuals are written in Icelandic, since the projects are almost exclusively carried out by Icelandic fishermen and scientists. Due to increased collaboration with foreign scientists, e.g. within ICES, the need for English versions of the manuals has increased. English versions are also needed because of the increased usage of survey data in various research published in international scientific journals.

Here, the manuals of the two projects; “The Icelandic Groundfish Survey in spring 2009” and “The Icelandic Autumn Groundfish Survey 2009” have been translated to English. The methodology of these projects in the preceding years has been more or less similar to what is described here for the year 2009.

MARINE RESEARCH INSTITUTE

Manual for

THE ICELANDIC GROUNDFISH SURVEY IN SPRING 2009

PROJECT COMMITTEE:

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February 2009

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1 PREFACE

In the spring of 1985, the Icelandic Groundfish Survey (IGS) was initiated by the Marine Research Institute (MRI), and the survey has been carried out annually since then. The main aim is to "improve the precision of stock assessments of demersal fish in Icelandic waters, with particular emphasis on cod" (Pálsson et al. 1989). Today, the survey is a significant part of the stock assessment and fishery advice for cod, haddock, redfish, tusk, ling, monkfish and several species of flatfish. Moreover, the survey provides information on the distribution and condition of many other fish species, as well as ocean temperatures.

Another original aim was to improve relations with fishermen and people in other sectors of the fishing industry. Fishermen were involved in planning the project, especially on aspects such as gear selection and standardization, stratification of the survey area with respect to fish abundance and allocation of stations. The survey gear and methods have been more or less unchanged over the study period.

The month of March was considered the most suitable time for the survey, since the availability of spawning cod was believed to be greater at this time of year than in other seasons. Furthermore, diurnal vertical migrations are less pronounced in spring than in autumn (Pálsson et al. 1989), an important factor since samples are collected using bottom trawls. Finally, earlier groundfish surveys were carried out at this time of year and these studies could therefore be used for comparison.

The IGS covers the continental shelf of Iceland to depths of 500 m. Allocation of stations and data collection is based on a division into Northern and Southern areas (Fig. 1). The Northern area is the colder part of Icelandic waters where the main nursery grounds of cod are located, whereas the main spawning grounds are found in the warmer Southern area.

Stratification in the survey and the allocation of stations was based on pre-estimated cod density patterns in different "statistical squares" (Pálsson et al. 1989). The statistical squares were grouped into 10 strata depending on cod density. The number of stations allocated to each stratum was in proportion to the relative size of the area of the stratum and cod density. Finally, stations within each stratum were allocated to several statistical squares in proportion to the size of the area studied within each square. Fishery scientists at the MRI selected random positions for their stations, whereas the fishermen selected their stations from their fishing experience. These two groups allocated equal number of stations within the squares. In the list of stations and maps in this manual, the tows selected by fishermen are identified by tow-numbers 1-9, but those set out randomly by scientists have tow-numbers 11-19.

The number of stations has varied over the survey period. In the first two years, about 590 tows were taken but in 1990-1992, the number of stations had dropped to about 570, mainly due to difficulties in towing in certain areas. In 1993, a total of 30 tows were added in shallow waters, as a response to critics claiming that the survey did not effectively cover important shallow fishing grounds. These tows were selected by local fishermen in each area and are distinguished from other tows with tow-numbers 31-39.

The number of stations was reduced in 1996 due to financial reasons. This included a cutback of all 24 stations on the Iceland-Faroe Ridge, 17 shallow water stations in the Northern area as well as other stations in the Northern area that had not been taken in all the preceding years. However, a total of 11 deep-water stations NW of Iceland that had been omitted once due to a drift-ice cover, were still included. In the Southern area, all original stations that had been omitted twice or more often were excluded from the survey. The shallow-water stations added in the Southern area in 1993 continued to be part of the survey.

In 2004, as a response to information on a growing abundance of cod on the Iceland-Faroe Ridge in the early 2000s, a part of the stations that had been cut out in 1996 were taken, and since 2005 the Iceland-Faroe Ridge has been surveyed in the same way as in 1985-1995.

In 1985-1995 the MRI rented five Japan-built trawlers for the project, in 1996-2006 four trawlers were rented. Since 2007, only three trawlers have been used, together with r/v Bjarni Sæmundsson (Table 1). R/v Árni Friðriksson has been used in the survey as well, but mainly for side projects. The data sampling in 2009 is carried out onboard three trawlers and the r/v Bjarni Sæmundsson and r/v Árni Friðriksson.

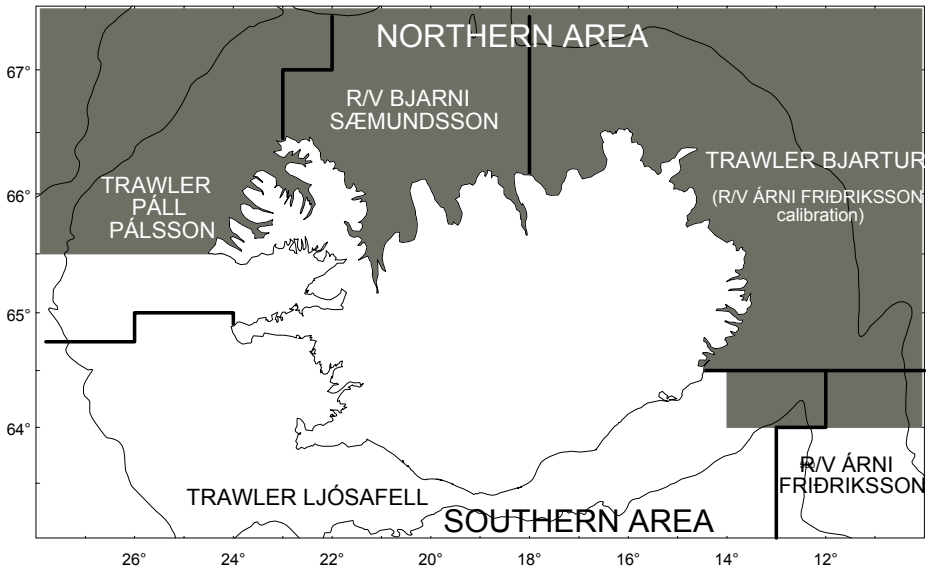


Figure 1. The study areas of survey vessels in IGS 2009 (lines) and the division into Northern (grey) and Southern area (white).

Table 1. Vessels (13 trawlers and 2 research vessels) used in the IGS 1985-2009 and their survey areas.

Vessel / Registration number	Arnar HU-1 1307	Bjartur NK-121 1278	Breki VE-61 1459	Brettingur NS-50 1279	Drangey SK-1 1276	Hoffell SU-70 1325	Jón Vídalín ÁR-1 1325	Ljósafell SU-70 1277	Ólafur Bekkur ÓF-2	Múlaberg ÓF-32 1281	Páll Pálsson ÍS-102 1274	Rauðinúpur ÞH-160 1280	Vestmannaey VE-54 1273	r/v Bjarni Sæmundsson 1131	r/v Árni Friðriksson 2350
1985	NW				E	S, E					NW		S		
1986	NW			E				E			NW		S		
1987	NW			E				E				NW	S		
1988	NW	E						E	S			NW			
1989	NW	E				E						NW	S		
1990	NW	E						E				NW	S		
1991	NW	E				E						NW	SW		
1992	NW	E						E				NW	SW		
1993		NE		SW		SE				W		NW			
1994		NE		SE						W		NW	SW		
1995		NE		SE						W		NW	SW		
1996				S				E		W		N			
1997		E		S						W		N			
1998		E		N			S			W					
1999		E		N							W		S		
2000		N					S	E			W				
2001			S	N			W[1)]	E							W[1)]
2002		N		E				S			W[1)]				W[1)]
2003		N	W[2)]	E				S			W[2)]				
2004		N		E				S			W				
2005		N[3)]		E				S			W			N[3)]	
2006		N[3)]		E				S			W			N[3)]	
2007		N, E						S[4)]			W			N	S[4)], E
2008		N, E						S			W			N	W[5)]
2009		N, E[6)]						S			W			N	E[6)]

[1)] In 2001 and 2002 a comparison was made between r/v Árni Friðriksson and trawlers in the W-area.
[2)] In 2003, a comparison was made between two similar trawlers in the W-area.
[3)] In 2005 and 2006 r/v Bjarni Sæmundsson was compared to trawler Bjartur in the N-area.
[4)] In 2007 r/v Árni Friðriksson was compared to trawler Ljósafell in the W-area.
[5)] In 2008 r/v Árni Friðriksson took part in side projects in the W-area.
[6)] In 2009, r/v Árni Friðriksson will be compared to trawler Bjartur in the E-area.

2 PREPARING THE CRUISE

Before leaving harbour, it is necessary to check whether all instruments are onboard and in working condition. The working area must be prefixed, and scales, computers and headsets must be connected and checked. It must be checked carefully if there is a danger of losing small fish, e.g. through interstices in processing lines or conveyor belts. The cruise leader, together with vessel members, checks whether the trawls conform to standardized specifications and if instruments used for measuring gear geometry and environmental parameters are onboard and working.

3 DATA COLLECTION

3.1 Measurements of length and numbers

Length of all fish species is measured (a sample or the whole catch). For the majority of species, total length is measured (from the tip of the snout to the tip of the longer lobe of the caudal fin). For grenadier species, the pre anal-fin length is measured (from the tip of the snout to the base of the first anal-fin ray). The length of the squid *Todarodes sagittatus* is measured as mantle length.

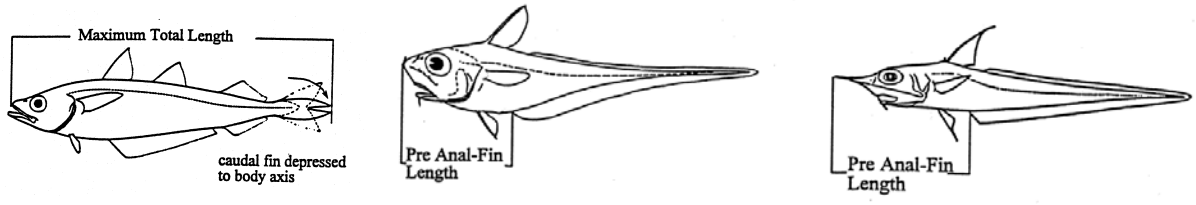


Figure 2. Common length measurements ---------- Length measurements of grenadiers ----------

Number of individuals measured: For each station, the general rule is to **measure at least 4 times the length interval of the given species.** This rule applies to 24 of the 28 species that have been measured since the beginning of the survey. For **long-rough dab, starry ray, Norway haddock and whiting** the rule is to measure at least 2 times the length interval (Table 2). For other species, it is sufficient to measure 20 individuals at each station (Table 3). If the number of individuals exceeds these limits, the rest must be counted. The quantity of northern shrimp is estimated and recorded as kg, whereas Norway lobster is recorded in numbers.

Example: Length measurements using the rule of "4 times the length interval": If the continuous length distribution of cod is between 20 and 100 cm, the length interval is 80 cm and the number of measurements needed is 320. If the catch of cod at this station exceeds 320 individuals, the rest must be counted.

If, for some valid reasons, it is not possible to apply the above rules in a given station, **IT IS, HOWEVER, ABSOLUTELY NECESSARY TO MEASURE THE LENGTH OF AT LEAST A PART OF THE INDIVIDUALS OF EACH AND EVERY SPECIES**

Samples for length measurements must be **randomly collected** so that the fish measured for length will reflect the length distribution of the total catch. If the length distribution is highly skewed, e.g. a relatively high abundance of small individuals, researchers must be especially careful in order to get a representative sample from the catch. There is a considerable risk that larger fish will be measured in higher proportions than smaller fish. An example: A great number (hundreds) of juvenile haddock (11-20 cm) in the catch but only 20 haddock larger than 30 cm. **A decision is made to measure about 10% of the juveniles and therefore only 10% of the larger haddock should be measured, or 2 individuals.**

EXCEPTION: If the length distribution of a species is highly skewed and it is almost impossible to get a representative sample using the methods described above, it is possible to use the option "lengdarbilsháð talning" (length-based counting) in the *SeaScale* data collection program. This option should only be used as an exception. Using the haddock example above, it would be possible to measure about 4 times the length distribution of the haddock fry and all the larger haddock. The

whole of the counted fish is then assigned to haddock at the length interval of 11-20 cm. This method is described in details in the manual for the *SeaScale* Program.

3.2 Sex- and maturity identification during length measurements

For the following species, the sex of individuals measured for length is also recorded:

Halibut, Greenland halibut, roundnose grenadier, roughhead grenadier, starry ray, lumpsucker.

For the following species, the sex and sexual maturity of the first 5 length measured individuals is also recorded: **Whiting, Norway haddock, deepwater redfish.** The rest is only measured for length.

3.3 Otolith sampling and weighing

Otoliths are sampled from a total of 18 species (Table 2). **Otoliths must be sampled randomly.** For cod, otolith sampling differs between the Northern and the Southern area.

Otoliths are taken from a minimum of 5 fish per station for the following species: cod, haddock, golden redfish, plaice, lemon sole, witch, megrim and dab, given that 5 fish are caught at the station. The minimum number of **long-rough dab** sampled for otoliths is **3 fish** per station and for **halibut** the number is **25** (in fact meaning that otoliths are sampled from all halibut caught).

The maximum number of fish collected for otolith sampling is usually 25 fish per station for each species. This applies for all species **except golden redfish, most flatfishes and lumpsucker** (Table 2).

An extra otolith sampling from a total of 100 plaice is carried out in square 618, tow-number 12.

To secure that otoliths collected and their accompanying computerized data can be traced together, the following information must be written on each otolith envelope: **species – fish number - cruise number – station number – length – sex – maturity stage.**

A RANDOM SAMPLING of fish collected for otolith extraction is important! All researchers should use the following method: The computer is programmed to send a sound signal for every *n* length measured fish, where *n* depends on the otolith sampling ratio. The fish is either taken for otolith extraction immediately, or put aside for later inspection. Fish collected for otolith sampling are not measured for length until the otolith extraction takes place.

During otolith collection the following must in all cases be recorded: length – sex – maturity stage. Furthermore, the following measurements are made (depending on species, see Table 2).

- Weight of ungutted fish (g)
- Weight of gutted fish (g)
- Liver weight (g)
- Weight of roe and milt (if maturity stage = 2) (g)

Cod smaller than 16 cm and haddock smaller than 18 cm (1 yr) that enter otolith sampling only need to be length measured and weighed ungutted.

Otoliths are collected from wolffish smaller than 15 cm, but these fish are only weighed ungutted.

3.3.1 Otolith sampling – the whole catch measured for length

The first fish of each species is taken for otolith extraction and every *n* fish thereafter, e.g. every 3rd saithe, every 20th haddock etc. (Table 3). Since a minimum of 5 fish/station is the rule for cod, haddock and golden redfish, it is necessary to estimate whether the minimum number will be obtained by collecting every *n* fish. If this does not appear to be the case, 5 fish need to be taken randomly aside for otolith sampling before finishing the length measurements. In cases where individuals of the above species are 5 or less, all fish are taken for otolith extraction.

An example for cod in Southern area: The length interval turns out to be 100 cm, the total number of individuals is 60, and therefore all are measured for length. Every 3rd fish (33%) is taken aside for otolith sampling 0.33×60 = 20 fish. The minimum of 5 fish is therefore obtained during the length measurement session.

Another example, for haddock: The length interval is 50 cm and the number of fish to be measured for length is therefore 4×50 = 200 fish according to the rule, but the haddock catch is only

80 individuals. Every 20th haddock (5%) is sampled for otoliths 0.05×80 = 4 fish. The minimum of 5 fish is not obtained and therefore 1 haddock needs to be taken additionally.

3.3.2 Otolith sampling – a part of the catch measured for length

When the catch is large and not all the fish are measured for length, sampling for length and otoliths typically happens in the following way (an example for cod in the Northern area):

1. The length interval is 70 cm and the number of fish measured for length is therefore 4×70 = 280 fish.
2. Every 20th fish (5%) is taken for otolith sampling from the length measured fish, a total of 0.05×280 = 14 fish
3. During counting of the rest of the cod, every 20th fish also need to be taken aside. A total of 300 cod were counted and from this group 0.05×300 = 15 fish are taken aside.
4. A total of 29 fish were therefore taken for otolith sampling, but since the maximum is 25 fish, the rest of 4 fish is registered as counted.

Table 2. Overview of data sampling of species where 4 (or 2) times the length interval is measured per station.

		Length measurements			Otolith extraction (length, sex and maturity always reported)								
No	Species	Length interval	Sex determination	Maturity determination	Max/min number	n^{th}. fish	Frequency (%)	Ungutted weight	Gutted weight	Liver weight	Ovaries/testes weigh	Stomach analysis	Note
1	Cod N	4			25/5	20	5	x	x	x	x[1)]	x	Max 15 cod for stomach analysis
1	Cod S	4			25/5	3	33	x	x	x	x[1)]	x	Max 15 cod for stomach analysis
2	Haddock	4			25/5	20	5	x	x	x		x	Max 5 haddock for stomach analysis
3	Saithe	4			25/1	3	33	x	x	x			
4	Whiting	2	x[2)]	x[2)]									Max 5 fish for sex determination
5	Golden redfish	4			10/5	20	5	x					
6	Ling	4			25/1	4	25						
7	Blue ling	4			25/1	4	25						
8	Tusk	4			25/1	4	25						
9	Atlantic wolffish	4			25/1	20	5	x	x	x			
10	Roundnose grenadie	4	x										
12	Starry ray	2	x										
13	Spotted wolffish	4			25/1	5	20	x	x	x			
14	Monkfish	4											
19	Greater argentine	4			25/1	30	3						
21	Halibut	4	x		25/25	1	100	x	x				
22	Greenland halibut	4	x										
23	Plaice	4			25/5	5	20	x					Extra 100 plaice for otolith
24	Lemon sole	4			15/5	20	5	x					extr. in tow 618-12
25	Witch flounder	4			15/5	15	7	x					
26	Megrim	4			15/5	15	7	x					
27	Dab	4			15/5	15	7	x					
28	Long rough dab	2			10/3	25	4	x					
33	Norway pout	4											
47	Arctic wolffish	4	x	x									
48	Lumpsucker	4	x		1/1			x	x		x[1)]		
60	Norway haddock	2	x[2)]	x[2)]									Max 5 fish for sex determination
61	Deepwater redfish	4	x[2)]	x[2)]									Max 5 fish for sex determination
62	Roughead grenadier	4	x										

Table 3. Species for which 20 fish are measured for length per station (the list is not exhaustive).

ID	Species	ID	Species
56	Atlantic poacher	79	Vahl's eelpout
639	Squid	125	Lantern shark
57	Four-bearded rockling	31	Capelin
58	North Atlantic codling	80	Bull-rout
249	Checkered wolf eel	81	Arctic sculpin
59	Arctic eelpout	82	Spinytail skate
63	Esmark's eelpout	83	Lesser sandeel
64	Greater lantern shark	84	Lumpeniids - unid
65	Spotted snake blenny	85	Eelpout sp. – unid
66	Twohorn sculpin	87	Round ray
113	Pale eelpout	88	Arctic rockling
39	Rat-tail	35	Small sandeel
68	Yellow brandeel	89	Poacher
16	Dogfish	30	Herring
69	Longear eelpout	15	Common skate
70	Sea tadpole	90	Arctic skate
71	Polar cod	92	Sea snails - unid
72	Yarrel's blenny	94	Snake blenny
34	Blue whiting	97	Greater sandeel
74	Atlantic hookear sculpin	98	Doubleline eelpout
75	Lanternfishes	99	Grey gurnard
76	Forkbeard	53	Moustace sculpin

Table 4. Maturity stages for gadoids and flatfish species.

Code	Maturity stage	Ovaries description – Females	Testes description – Males
1	Immature (juvenile)	Ovaries small and translucent. Eggs not visible with the naked eye.	Testes (lobules) tiny, thin and translucent.
2	Maturing/ mature (ripening to ripe)	Ovaries increased considerable in size. Colour red to orange and opaque. Individual eggs visible with the naked eye when close to stage 22. With prominent blood vessels when close to stage 22.	Testes getting bigger, opaque, whitish in colour. When close to stage 3, lobules are distended and brittle. Sperm in spermaducts. Not running under moderate pressure.
22	Mature females (ripe, only used for cod, haddock and saithe).	Ovaries occupy most of the body cavity. Distended and soft. Prominent blood vessels. Colour yellow to orange. Eggs visible with the naked eye, few or many eggs hydrated (eyes). Not yet running under moderate pressure.	
3	Spawning (running)	Ovaries occupy most of the body cavity. Very distended and soft. Hydrated eggs can be extruded on slight pressure.	Testes (lobules) plump but soft. Big and white and occupy most of the body cavity. Testes run on slight pressure.
4	Post-spawning (spent)	In recently spent females ovaries are reduced in size, flaccid and bloodshot. Some opaque eggs may occur. Sometimes greyish in colour. Ovary wall thicker than within immature fish. Later, this stage may be difficult to distinguish from immature fish (stage 1).	In recently spent males, testes are thin, flabby, and bloodshot. Some sperm may remain in spermaducts. Later, this stage is difficult to distinguish from immature fish (stage 1).
5	Uncertain maturity identification	Maturity identification not determined. Difficult to distinguish between stage 1 and 4.	Maturity identification not determined. Difficult to distinguish between stage 1 and 4.

Table 5. Maturity stages for redfish species.

Code	Maturity stage	Ovaries description – Females	Test description – Males
1	Immature (juvenile)	Ovaries tubular, thin and small. Ovarian wall whitish and delicate. Without conspicuous blood vessels.	Testes are translucent, threadlike and very thin (width less than 1 mm). Sometimes difficult to detect, because it is confused with mesentery. The penis is difficult to distinguish and easy to confuse with female genital papilla.
2	Maturing/ mature	The ovaries have 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 to red and opaque.	The testes are more easily distinguishable because of increasing size. They are white. Penis is visible, and it is easy to identify sex externally. Late on this stage the testes are white or with a cream colour. There is no running sperm when the testes are cut. Penis is thick, but no sperm is observed on it.
3	Parturition		Testes are big and with cream colour. The sperm run out of the fish on slight pressure on the belly or if testes are cut and sperm runs out. Penis is very conspicuous, with a purple tip and there are remains of sperm on it.
31	Parturition (A)	Ovaries occupy most of the body cavity, it is delicate and the wall transparent and thin. The colour of eggs yellow to green-yellowish due to larval developing.	
32	Parturition (B)	Eyes are evident as black points and there is little yolk.	
33	Parturition (C)	Larvae are easily released from the ovary when it is manipulated, i.e. on slight pressure on the belly. The tails of the larvae are clearly visible.	
4	Post-spawning	Ovaries are flaccid and bloodshot, but still big. Ovary wall is thicker than among immature fish. No visible larvae inside or just a remainder of them. The colour is dark-purple or blackish, sometimes confused with the body cavity wall (peritoneum).	In post-spawning state, the testes are flaccid. The colour is still cream but with obvious dark (brown) patches. Practically no sperm inside the testes.
5	Uncertain maturity identification	Maturity identification not determined. Difficult to distinguish between stage 1 and 4.	Maturity identification not determined. Difficult to distinguish between stage 1 and 4.

Maturity stages of Atlantic wolffish and spotted wolffish

Females

Stage 1. Ovaries translucent. Eggs not visble.

Stage 2. Eggs are clearly visible with the naked eye and are 0.5-1.2 mm in dimension. Eggs are yellowish.

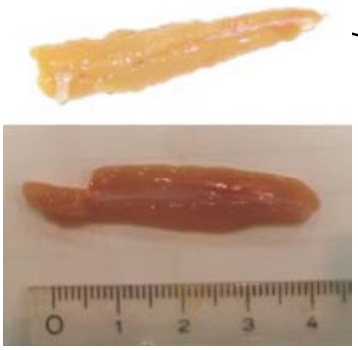
Stage 3. Ovaries are considerable bigger than in stage 2. Eggs are 2-6 mm in dimension.

Stage 33. Running state. Hydrated eggs can be extruded on slight pressure.

Stage 4. Spent. Ovaries are reduced in size and are matte, flaccid and opaque. Some opaque eggs may occur.

Males

Stage 1. Testes are translucent and maximum length is about 4 cm.



Stage 6. Testes are opaque and matte and between 4-10 cm long. The colour withish to brownish.

Stage 5. Maturity identification can not be determined.

3.4 Species identification and sampling of rare species

The following literature can be used for species identification: "Icelandic fishes" (Gunnar Jónsson 1992), "Icelandic fishes" (Gunnar Jónsson & Jónbjörn Pálsson 2006), "Fishes of the North Atlantic" (E. Bertelsen et al: translated by Gunnar Jónsson).

Putatively rare species, and fish that cannot definitely be identified to species, are to be frozen and brought to a laboratory for further examination.

Skates and rays. An identification sheet has been prepared for enabling species identification of skates and rays. This sheet should be used, but if in doubt, freeze the fish and bring it to the laboratory at the end of the cruise.

Redfish species. Figure 3 can be used for species identification of redfish.

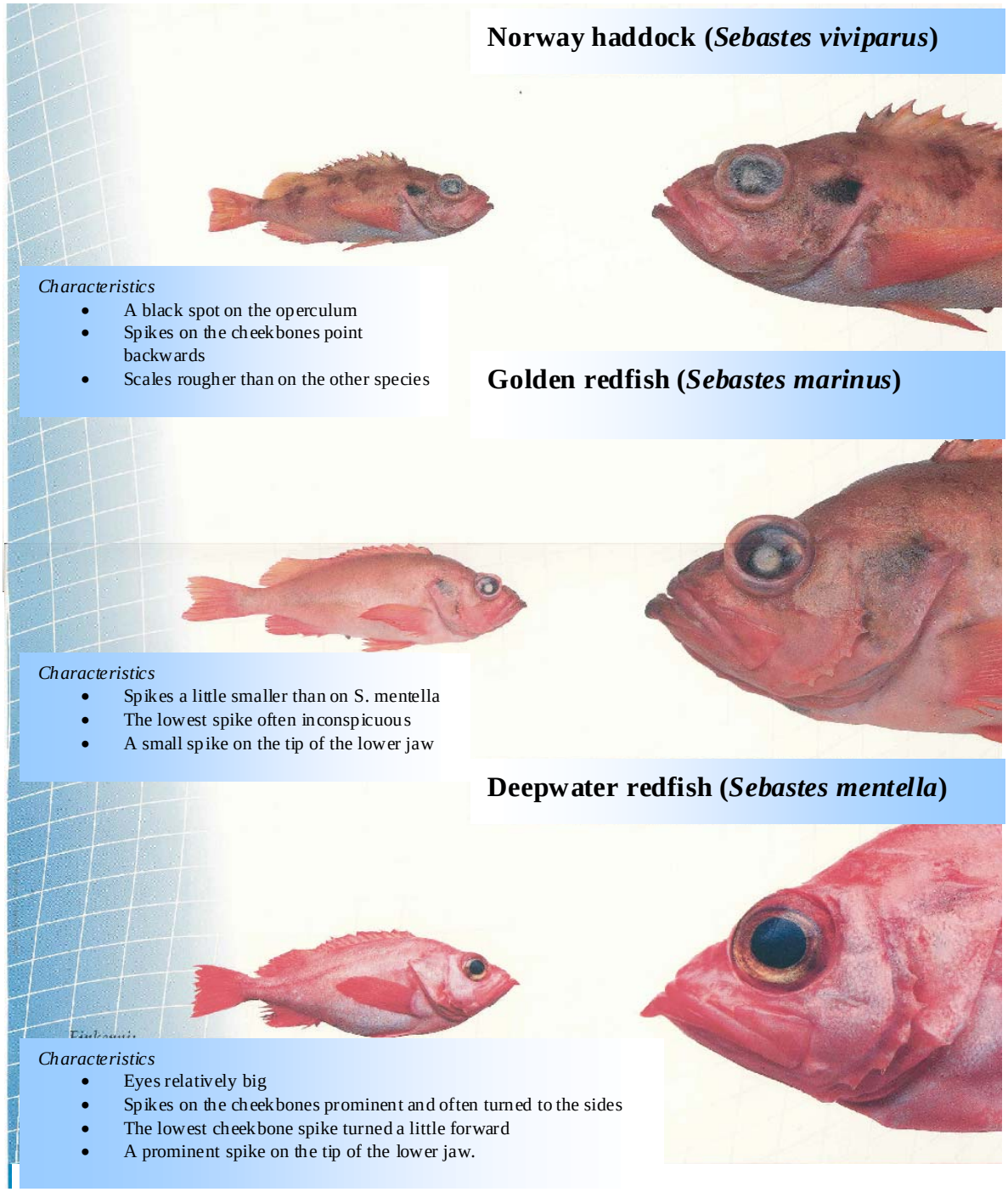
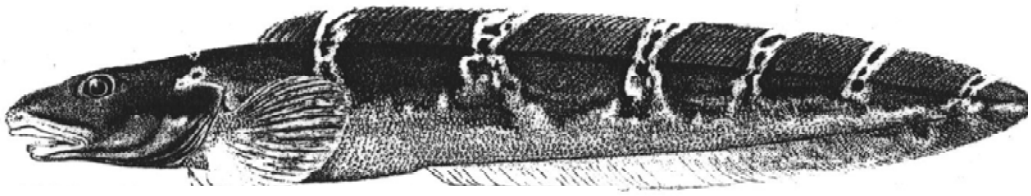
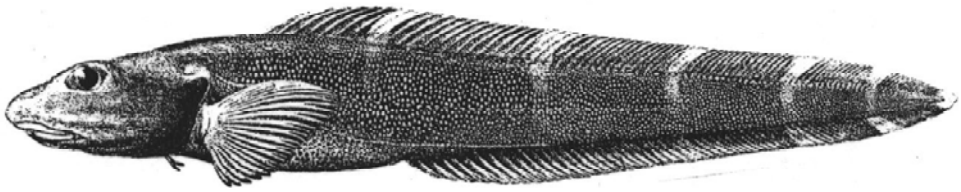


Figure 3. Species identification of redfish: Norway haddock, golden redfish and deepwater redfish.

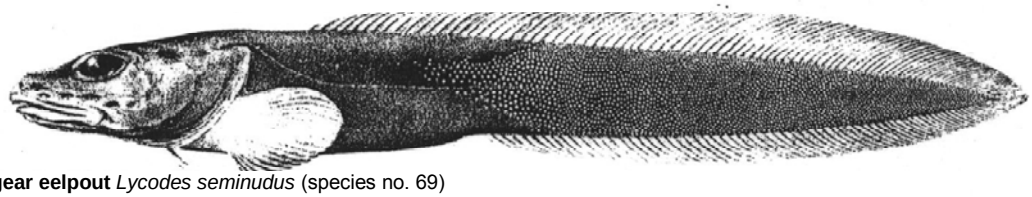
Eelpout species. The following overview is used for species identification of eelpouts (Figure 4). If in doubt, register the fish as unidentified eelpout, freeze it and bring to the laboratory at the end of the cruise. This overview is not exhaustive since other rare eelpout species may be caught, e.g. scale-belly eelpout, Adolf's eelpout and glacial eelpout.



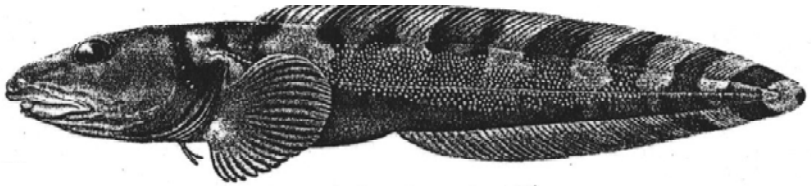
Esmark's eelpout – *Lycodes esmarki* (species no. 63)
A chain-like pattern on dorsal fin and sides. Scales on abdomen



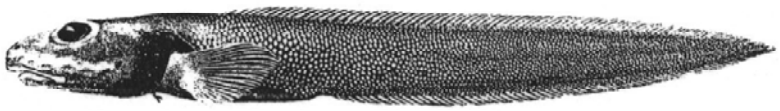
Doubleline eelpout – *Lycodes eudipleurostictus* (species no. 98)
About 6-8 transverse stripes, scales on abdomen. Rather common.



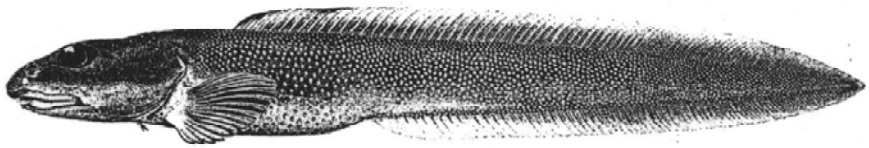
Longear eelpout *Lycodes seminudus* (species no. 69)
Scales on the posterior part - extending towards the anus. Lateral line central. Color variable – light brown to dark blue



Arctic eelpout *Lycodes reticulatus* (species no. 59)
Dark and light transverse bands, in older fish disband into a net-like pattern. A light spot often found at the top of the head.



Pale eelpout *Lycodes pallidus* (species no. 113)
No bands, pattern or spots on adult fish. No scales on abdomen. Two lateral lines. Common, especially in colder water.



Vahl's eelpout *Lycodes vahli* (species no. 79)
Scales on abdomen. Adults usually have 1- 4 spots at the anterior part of the dorsal fin. A ventral lateral line. Common, especially in shallow water.

Figure 4. Species identification of eelpout species commonly caught in the IGS.

3.5 Other data sampling

3.5.1 The food of cod and haddock

Stomach content is to be analysed in the first 15 cod and the first 5 haddock taken for otolith extraction (see Appendix 3).

3.5.2 Sampling of dab for sandeel monitoring

Dab are sampled in specific areas south and west of Iceland according to Appendix 5.

3.5.3 Sampling of cephalopods

The mantle length of the squid *Todarodes sagittatus* is measured and entered for species **no. 639**. Other cephalopods are counted and the number entered under **no. 44** and the sample collected and frozen for further species identification (see Appendix 6).

3.5.4 Samples for the monitoring of contaminants in the marine environment

Samples collected for Matís (Icelandic food research); see Appendices 7, 8 and 9.

3.5.5 Sampling of herring for studying *Ichthyophonus* infection

Samples of herring are collected and frozen at stations where more than 20 herring are caught (see Appendix 10).

3.6 Deviations from the sampling protocol due to vessel calibration experiments

This years calibration experiments aim at comparing r/v Árni Friðriksson and the trawler Bjartur. These experiments take place off the east coast. See Appendix 4 for data collection.

3.7 Data entry

All data on species, length, numbers counted, sex, maturity and weight are entered directly into a computer that is connected to Marel weighing machine (using *SeaScale* data collection program). This also accounts for the stomach-analysis data.

A copy of all data is transferred to the cruise leader's computer, which adds information on the station (environmental observations, trawl geometry etc.). For each station, the cruise leader furthermore checks carefully if everything regarding data sampling is normal.

It is important that the cruise leader examines carefully the overview of data sampling in each station and enquires the researchers on dubious data as soon as possible. Incorrect data must be corrected and missing data added before the final copy is made. If not possible, a separate list must be made including all corrections and data entries that are yet to be made. At the end of the cruise, this list must be sent to the MRI Data manager, along with other data and source material.

4 STATION INFORMATION

The upper part of the "Station information form", i.e. information on the tow and environmental factors, are to be filled out by the captain and the first officer in co-operation with the cruise leader. All remarks and comments regarding the station are written on the "Station information form" and later entered in a specific "comments" field in the *SeaScale* Program. Comments on the data sampling, e.g. if corrections are yet to be made or if some extra sampling has been carried out, are furthermore entered in the comments field in *SeaScale*.

The upper part of “Station information form”:

Cruise ID	*Year Station*	*Vessel registry no.*	Wind direction		Air temp °C	
Day./month			Wind speed		Bottom temp °C	
Stat. square	*Sub-square*	*Tow number*	Sea surface		Surface temp °C	
			Weather		Tow.d. temp °C	
Gear type no.	*Mesh size*	*Sweeps length (m)*	Cloud cover		Secchi d. (m)	
Gear ID			Air pressure		Drift ice	
Start of haul	*Pos. N*	*Pos. W*	End of haul	*Pos. N*	*Pos. W*	
	Time (hour:min)	*Tow direction°*		*Time (hour:min)*	*Warp length (fm)*	
	Bottom depth (m)	*Towing depth (m)*		*Bottom depth (m)*	*Towing depth (m)*	
	Vert. opening (m)	*Horiz. opening (m)*		*Tow length (naut. miles)*	*Tow time (min) Tow speed (knots)*	

4.1 Tow information

A “Station information form” must be filled for each tow (station). Information that must be registered include **cruise ID (**e.g. TP1 for trawler Páll Pálsson, the first cruise in the given year), **year**, **station** i.e. a running number starting with 1, **vessel registry no.** of the given vessel and **date**. Furthermore, **ID number of the statistical square** within which the tow is located, the **ID number of sub-square**, and **tow number** which is a fixed number for the tow, must be filled out (see List of stations and Maps). Note that the Sub-square for each tow has been fixed and is registered according to the List of stations. The ID number of the **gear type** (73), **mesh size** (40 mm), **sweeps length** (35 or 45 fm) and the **gear ID** are also entered.

The **geographical location** of the stations is registered as latitudinal and longitudinal coordinates (in degrees, minutes and seconds converted to decimal minutes) according to GPS calculations, **depth** in meters and **time** in hours and minutes (clock, four number digits) at the **beginning** and **end** of each trawl haul. The tow starts when the trawl touches the bottom and ends when the hauling of the trawl starts. **Trawling direction** in degrees is registered as well as **warp length** used. **Trawling speed** and **trawling distance** is calculated with GPS. **Vertical** and **horizontal** opening of the trawl is registered in meters (mean values for the whole haul) if relevant net sensors are available (i.e. Scanmar or Furuno).

If it is not possible to finish a full tow, e.g. because of snagging of the trawl or other malfunction, it is necessary to register the reasons and the location of the snag. Recommendation of another position of the station, for example because of rough bottom, or of new trawling direction is also reported.

4.2 Environmental information

Information on weather and other environmental factors is registered as follows:

1. **Wind speed** is registered in **knots**. If an anemometer is onboard it is necessary to observe it for few minutes as wind speed is never stable, but fluctuates around some mean value, both wind direction and speed. If an anemometer is not onboard, wind speed is estimated by the following table:

Beaufort number	Wind speed		Description	Sea conditions	Wave height (m)
	knots	m/sec			
0	**00**	0 - 0.2	Calm	Sea like a mirror.	
1	**02**	0.3 - 1.5	Light air	Ripples without crests.	0.1
2	**05**	1.6 - 3.3	Light breeze	Small wavelets. Crests of glassy appearance, not breaking.	0.2
3	**09**	3.4 – 5.4	Gentle breeze	Large wavelets. Crests begin to break; scattered whitecaps.	0.6
4	**13**	5.5 – 7.9	Moderate breeze	Small waves - becoming longer; fairly frequent white horses.	1
5	**18**	8.0 – 10.7	Fresh breeze	Moderate waves, taking a more pronounced long form; many white horses are formed - a chance of some spray.	2
6	**24**	10.8 – 13.8	Strong breeze	Large waves begin to form; the white foam crests are more extensive with probably some spray.	3
7	**30**	13.9 – 17.1	Near gale	Sea heaps up and white foam from breaking waves begins to be blown in streaks along direction of wind.	4
8	**37**	17.2 – 20.7	Gale	Moderately high waves of greater length; edges of crests begin to break into spindrift; foam is blown in well-marked streaks along the direction of the wind.	5.5
9	**44**	20.8 – 24.4	Strong gale	High waves; dense streaks of foam; crests of waves begin to topple, tumble and roll over; spray may affect visibility.	7
10	**52**	24.5 – 28.4	Storm	Very high waves with long overhanging crests; the resulting foam in great patches is blown in dense white streaks; the surface of the sea takes on a white appearance; the tumbling of the sea becomes heavy with visibility affected.	9
11	**60**	28.5 – 32.6	Violent storm	Exceptionally high waves; small and medium sized ships occasionally lost from view behind waves; the sea is completely covered with long white patches of foam; the edges of wave crests are blown into froth.	11.5
12	**68**	≥32.7	Hurricane-force	Huge waves. The air is filled with foam and spray. Sea completely white with driving spray; visibility very seriously affected.	≥14

2. **Wind direction**. Main wind directions are registered according to following table.

Calm	00	SE	14	W	27
NNE	02	SSE	16	WNW	29
NE	05	S	18	NW	32
ENE	07	SSW	20	NNW	34
E	09	SW	23	N	36
ESE	11	WSW	25	Not defined	99

3.-5. **Weather, clouds and sea state.**

3. Weather	4. Cloud cover	5. Sea	Wave height
0 No clouds, clear	0 No clouds, clear	0 Calm (glassy)	0
1 Cloudy	1 1/8 or less but not 0	1 Calm (rippled)	0-0.1
2 Overcast	2 2/8	2 Smooth (wavelets)	0.1-0.5
3 Sandwind, soilwind	3 3/8	3 Slight	0.5-1.25
4 Fog or mist	4 4/8	4 Moderate	1.25-2.5
5 Drizzle	5 5/8	5 Rough	2.5-4
6 Rain	6 6/8	6 Very rough	4-6
7 Snow or sleet	7 7/8 or more but not 8/8	7 High	6-9
8 Shower	8 8/8	8 Very high	9-14
9 Not recorded	9 Not recorded	9 Not recorded	

6. **Sea Ice**

0	No ice
1	Ice is close, directly visible or in radar, but the type is unknown
2	Few icebergs (10 or less)
3	Many icebergs (more than 10)
4	Very thin or thin cover of drift ice, 6/10 or less in density, in more than 1 nautical miles from station
5	Dense or very dense cover of drift ice, more than 6/10 in density, in more than 1 nautical miles from station
6	Very thin or thin cover of drift ice, 6/10 or less in density, in less than 1 nautical miles from station
7	Dense or very dense cover of drift ice, more than 6/10 in density, in less than 1 nautical miles from station
8	Station within a dense drift ice etc.
9	No observation because of low visibility etc.

7. **Air temperature** is measured in °C.
8. **Surface temperature** is measured in °C.
9. **Bottom temperature** is measured in °C, with Scanmar thermometer or similar instrument. The thermometer must be calibrated before the cruise. Bottom temperature is also measured with Starmon mini temperature recorders from Star-Oddi, placed on the upper belly or headline of the trawl.
10. **Air pressure.** Air pressure is recorded on each station.

4.3 Other information

The cruise leader updates information on each station from the "Station information form" into the station information form in *SeaScale* and prints out the form. *SeaScale* automatically produces an overview over measurements made for each species on a given station. All numbers in the columns of that overview refer to the number of individuals processed, except for northern shrimp where total catch is given in kg.

5 THE SAMPLING GEAR

5.1 Description of the sampling gear

The trawl used for sampling is of the Granton type (Figures 5-12). The trawl was originally standardized in cooperation with the captains of the survey trawlers. Each trawl has a unique ID number identified by a plate that is fastened on the headline of the trawl.

The headline is 32.0 m long. The bobbin footrope is 18.30 m long, weighing about 3250 kg in air and 1270 kg submerged. Total weight of footrope (Danleno-Danleno) is about 4200 kg in air and 1900 kg submerged.

The meshes of the trawl net are smaller than in an ordinary commercial bottom trawl, since the aim is to catch both small and large fish. The front section of the trawl has a mesh size of 135 mm, the middle section (belly) 80 mm and the codend is covered inside with a 40 mm net.

The lower part (lower wings and first panel of lower belly) of the net have a double netting. This is not considered to significantly affect the fishing efficiency of the trawl compared to using a single netting, but is likely to reduce damages of the trawl due to a rough bottom. Moreover, the rearmost 1.8 m of the flying line (lower lines of the top wings) are made of wire (18 mm in diameter).

The ratio between the 135 mm mesh and the 80 mm mesh is 132 meshes vs. 230, set up in the following way from lastridge to lastridge (see Figure 6):

5 × 1/1 then 5/9 then 5 × 1/1

The ratio between the 80 mm middle part and the 135 mm codend middle part is:

5 × 1/1 then 9/5 then 5 × 1/1

The sweeps are 64 m (35 fathoms) long when towing at depths of less than 183 m (100 fathoms), but when towing at depths greater than 183 m an extension chain of 18.3 m (10 fathoms) is added (sweeps 45 fathoms or 82 m). This does not apply for the SW-area where sweeps of 64 m (35 fathoms are used in all stations.

The otter boards are of the "Poly-Ice" type no. 7, weighing about 1950 kg each.

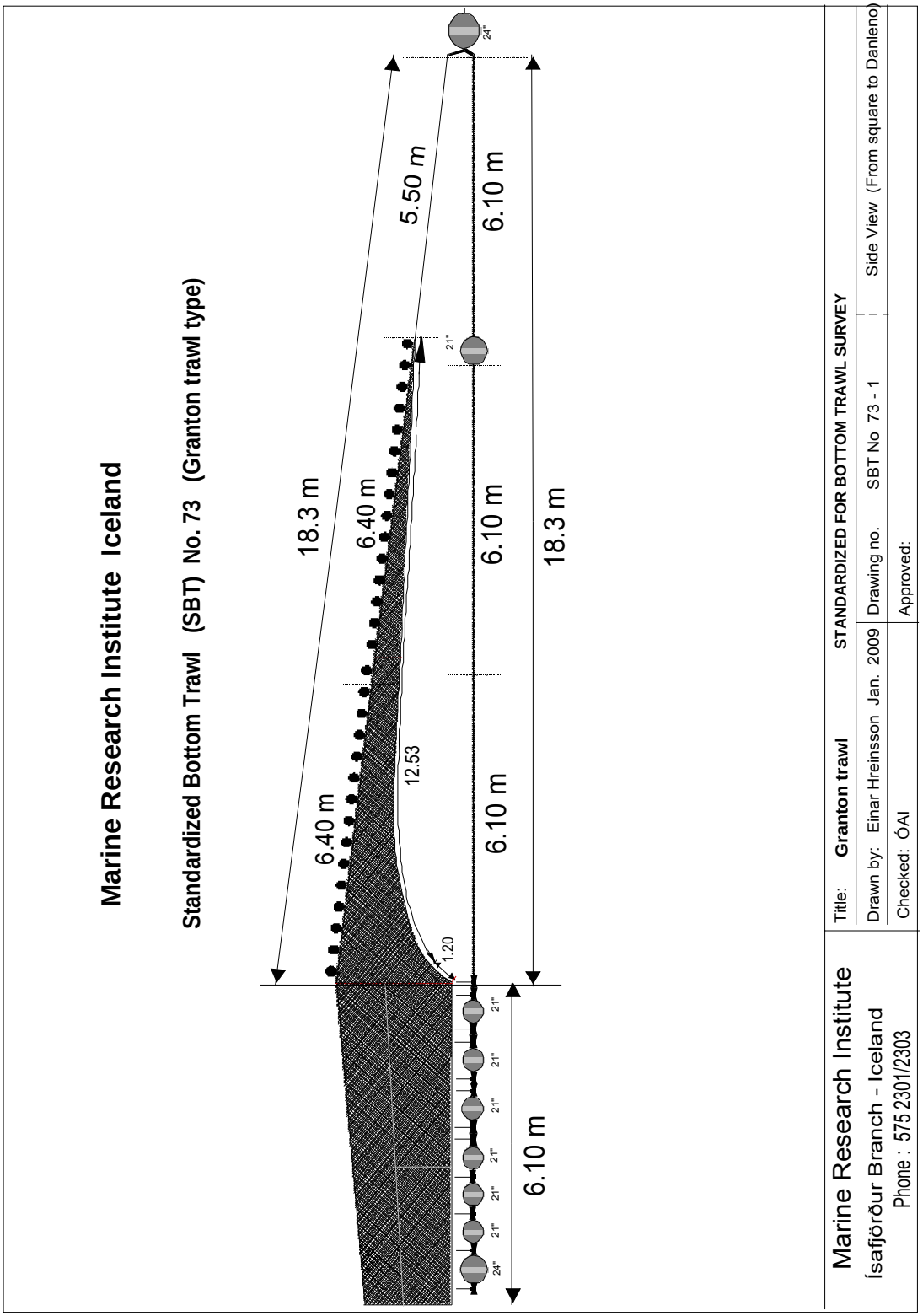


Figure 5. Standardized bottom trawl no. 73 used in the Icelandic Groundfish Survey in spring. Side view from square to Danleno.

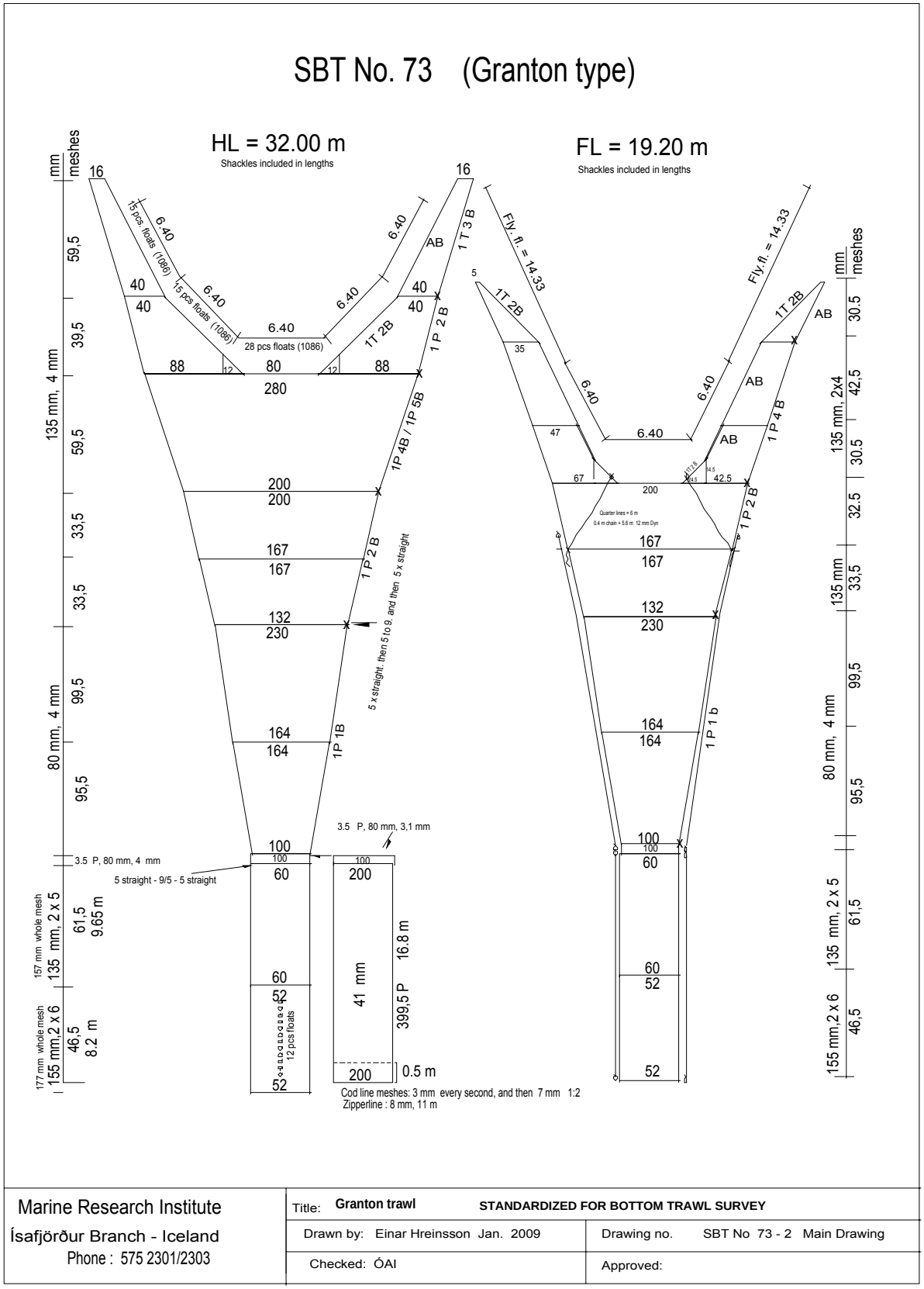


Figure 6. Standardized bottom trawl no. 73 used in the Icelandic Groundfish Survey in spring. Main drawing.

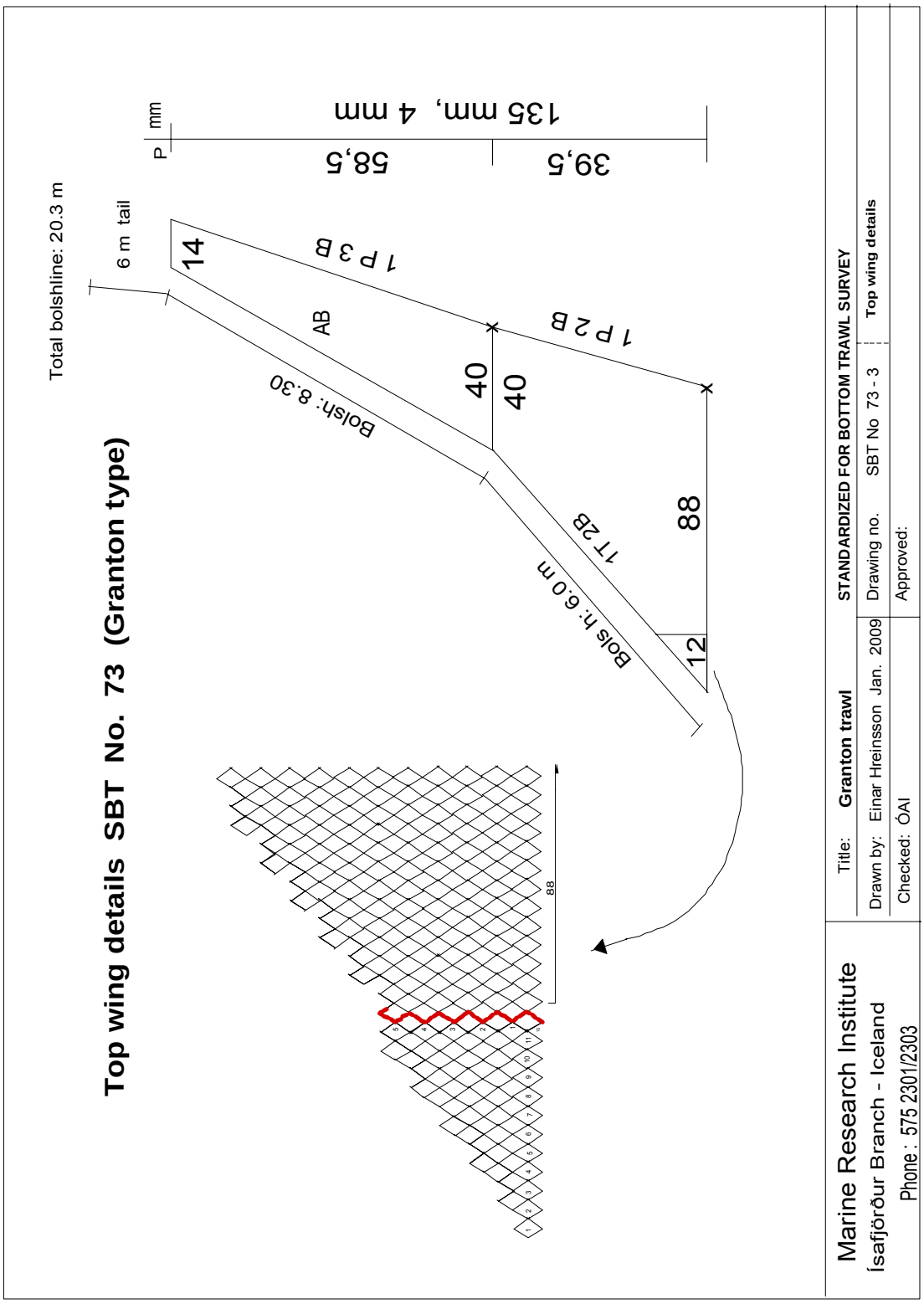


Figure 7. Standardized bottom trawl no. 73 used in the Icelandic Groundfish Survey in spring. Top wing details.

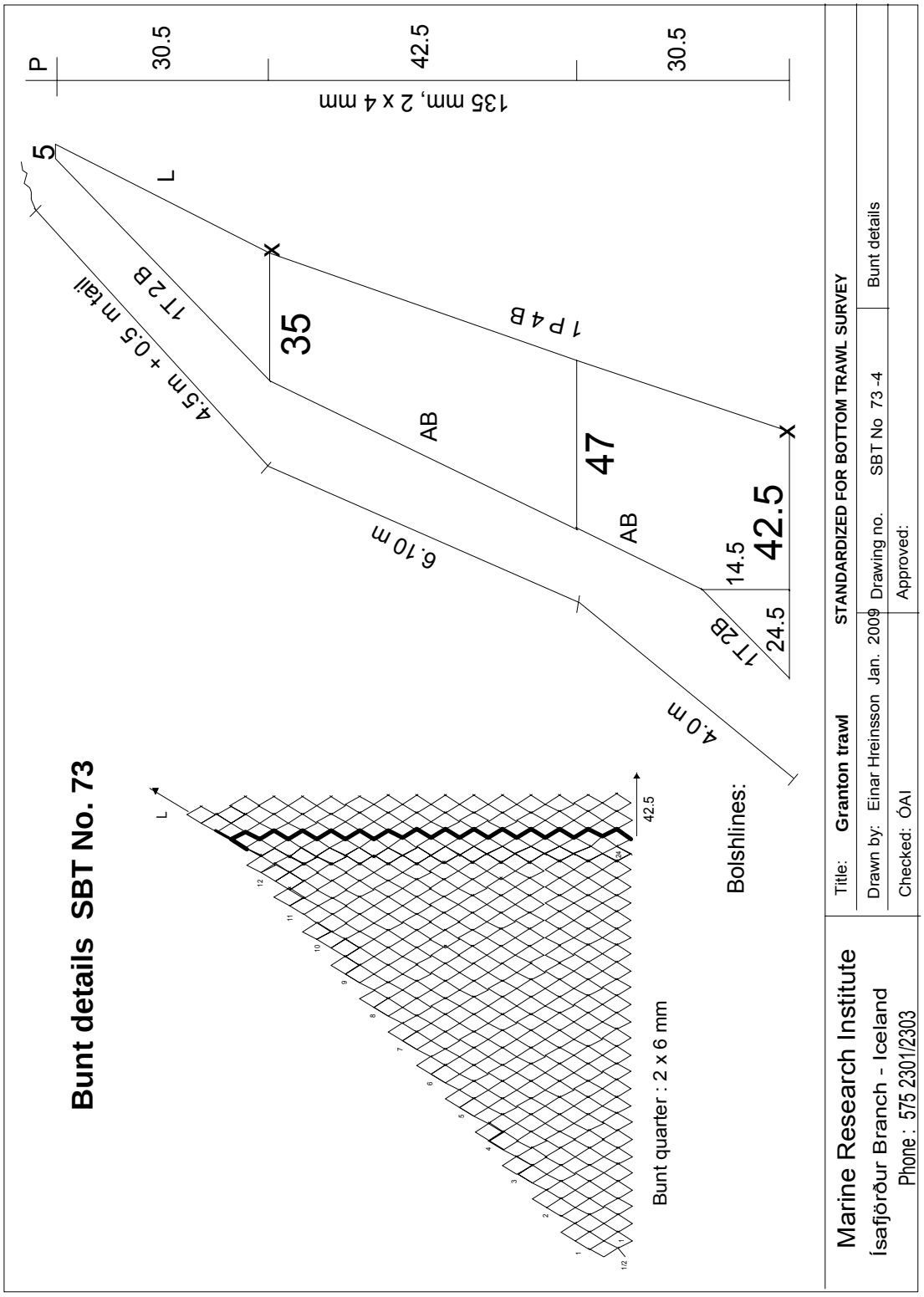


Figure 8. Standardized bottom trawl no. 73 used in the Icelandic Groundfish Survey in spring. Bunt details.

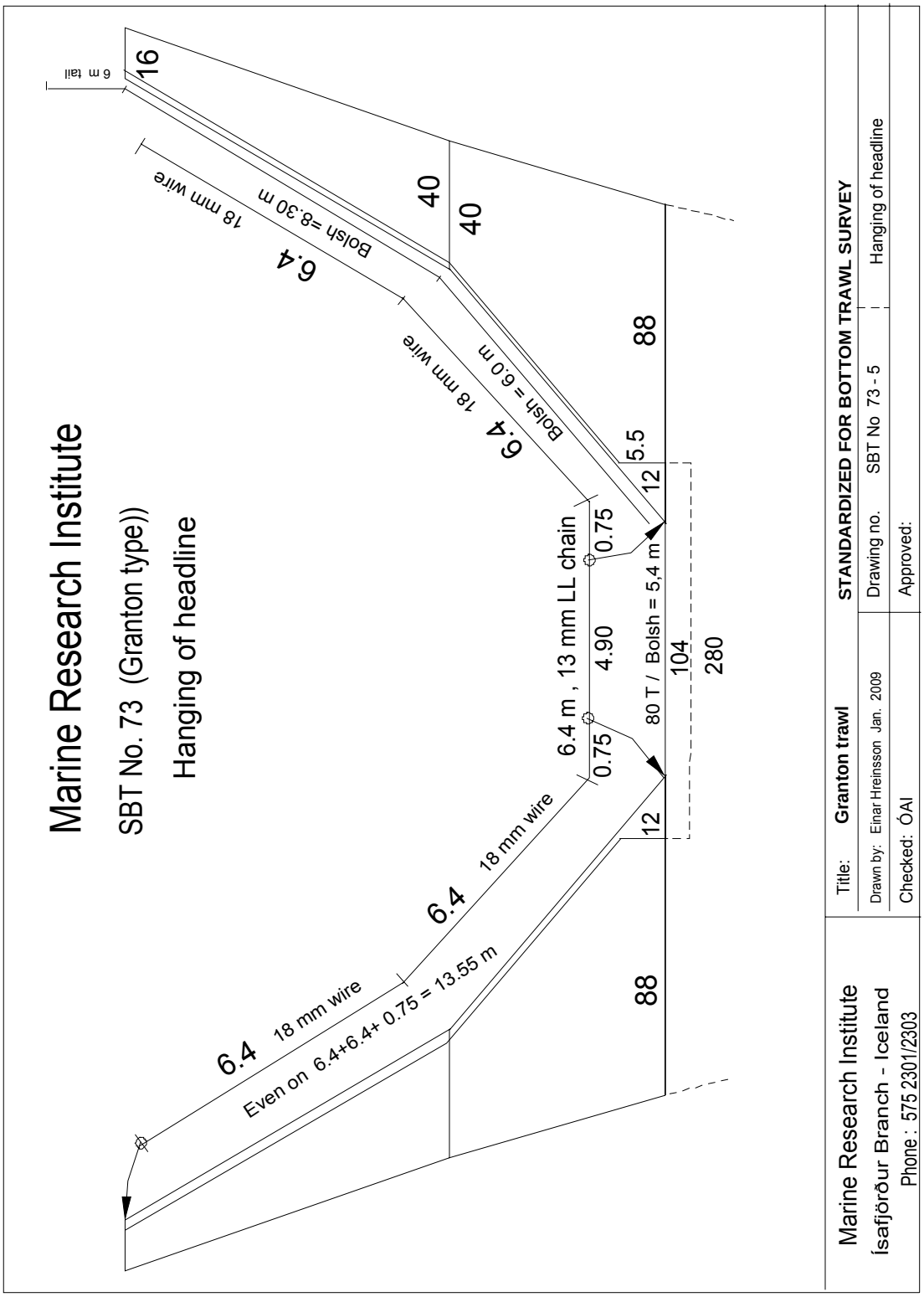


Figure 9. Standardized bottom trawl no. 73 used in the Icelandic Groundfish Survey in spring. Hanging of headline.

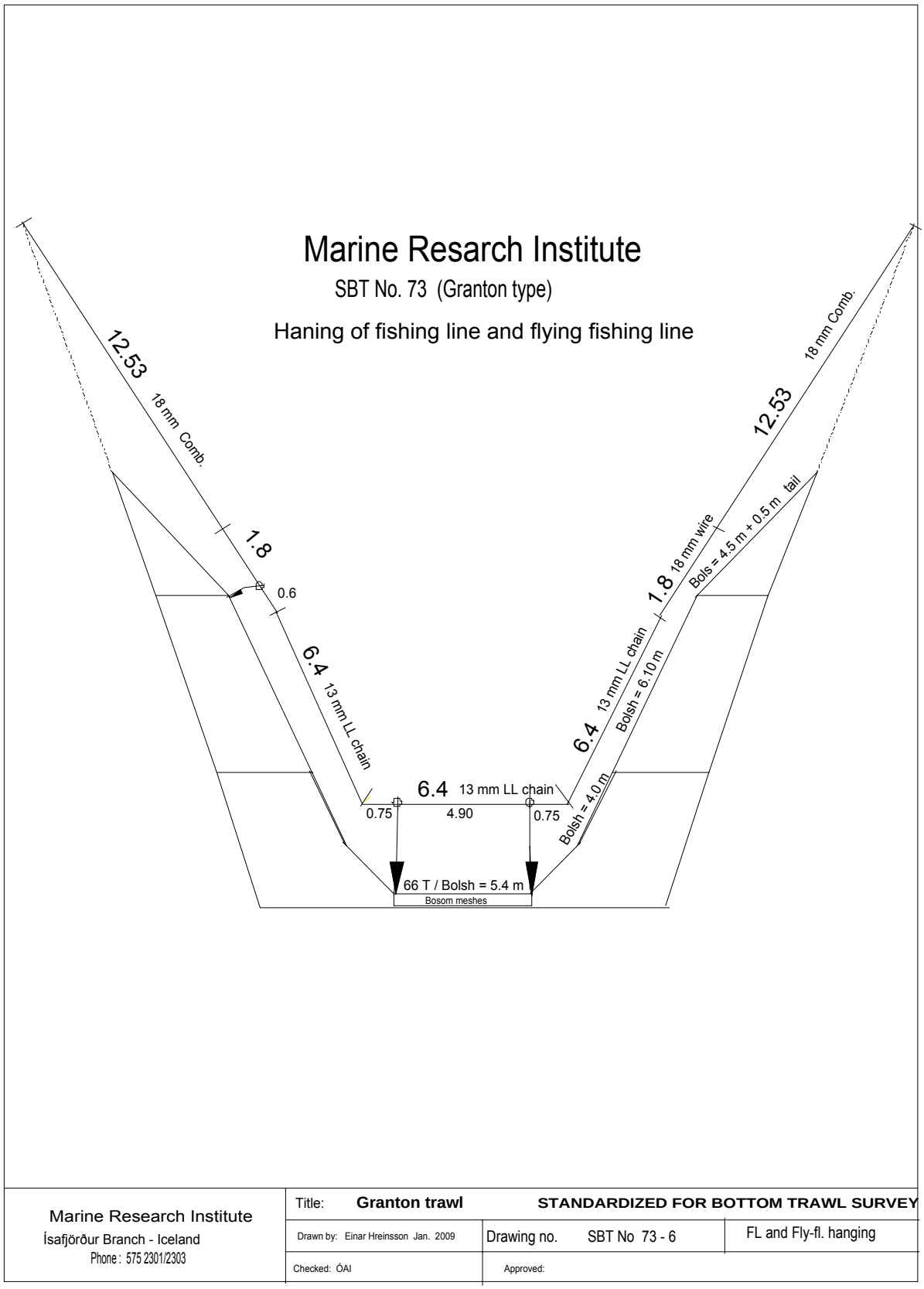


Figure 10. Standardized bottom trawl no. 73 used in the Icelandic Groundfish Survey in spring. Hanging of fishing line and flying fishing line.

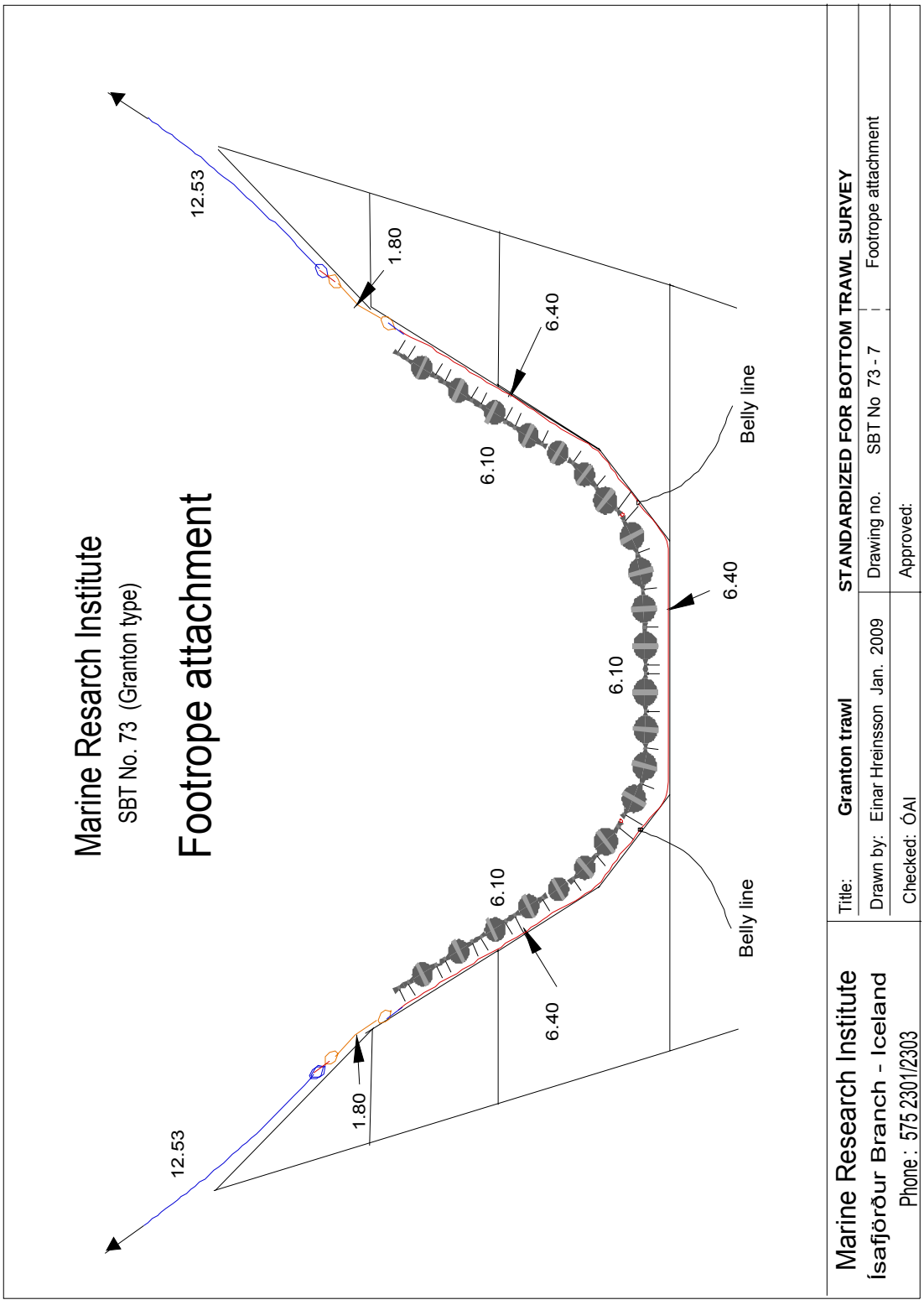
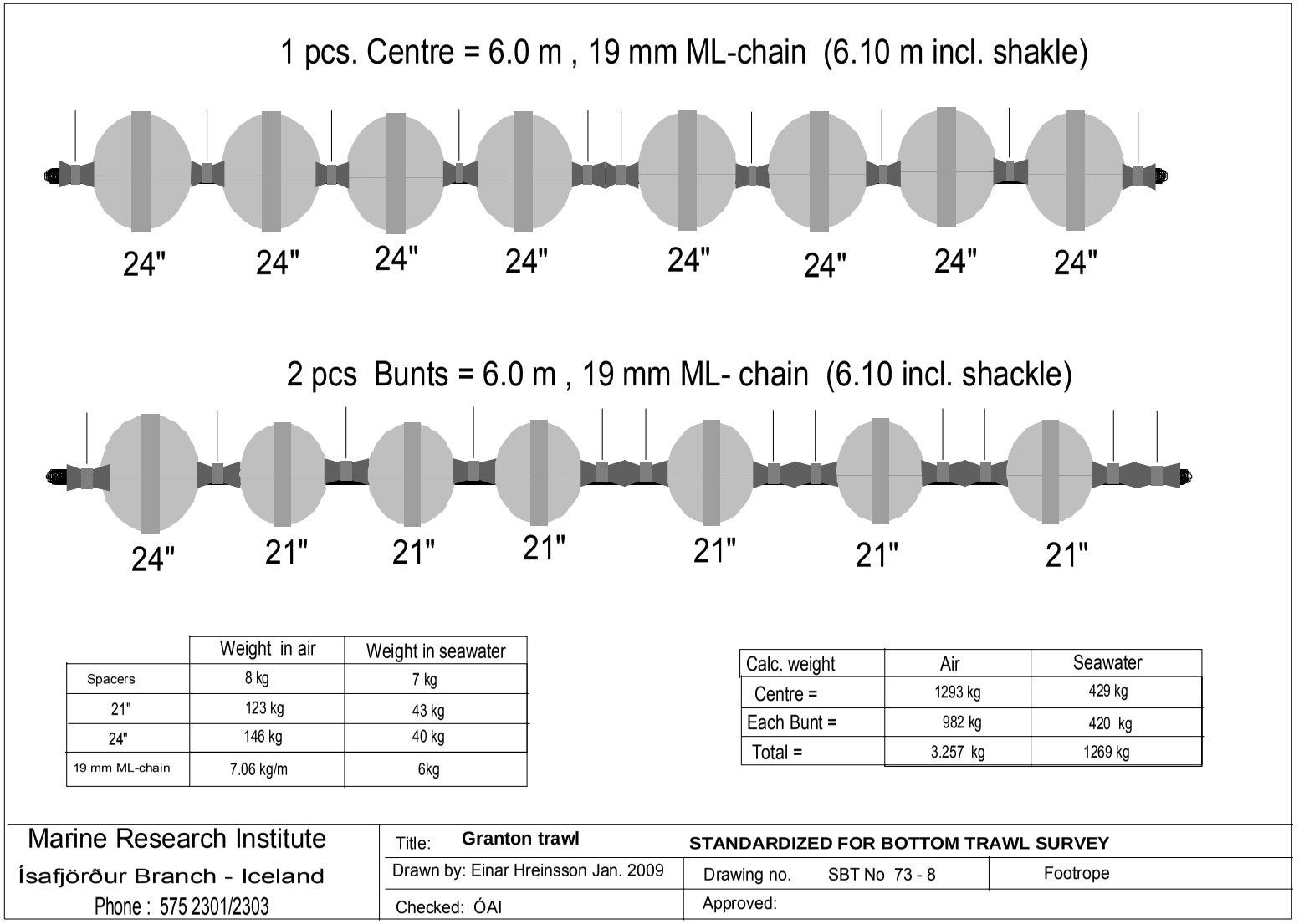


Figure 11. Standardized bottom trawl no. 73 used in the Icelandic Groundfish Survey in spring. Footrope attachment.



	Weight in air	Weight in seawater
Spacers	8 kg	7 kg
21"	123 kg	43 kg
24"	146 kg	40 kg
19 mm ML-chain	7.06 kg/m	6kg

Calc. weight	Air	Seawater
Centre =	1293 kg	429 kg
Each Bunt =	982 kg	420 kg
Total =	3.257 kg	1269 kg

Marine Research Institute Ísafjörður Branch - Iceland Phone : 575 2301/2303	Title: **Granton trawl**	**STANDARDIZED FOR BOTTOM TRAWL SURVEY**	
	Drawn by: Einar Hreinsson Jan. 2009	Drawing no. SBT No 73 - 8	Footrope
	Checked: ÓAI	Approved:	

Figure 12. Standardized bottom trawl no. 73 used in the Icelandic Groundfish Survey in spring. Footrope.

5.2 Standardisation of the sampling gear

It is critically important that the sampling gear is set up according to the approved standardized gear diagram no. 73 (Figs. 5-12). It is therefore necessary to check if all measurements of all gears are in accordance to the diagram. This check is to be done by the relevant gear workshops responsible for the maintenance of the trawls before they are shipped on board the survey vessels. Before the vessels leave harbour, cruise leaders carefully examine whether the sampling gear is set up according to the diagram.

The following specifications (lengths and weights) are checked:

Trawl part	**Standard**	**Check - Trawl 1**	**Check - Trawl 2**
Headline – length	31.0 m		
Headline – diameter	18 mm		
Floats (4 L) – on headline	88 floats		
Floats (4 L) – on codend	12 floats		
Flying wing wire rope – length	14.33 m		
Flying wing – diameter	18 mm		
Headline bridles wire – length	5.5 m		
Headline bridles – diameter	16 mm		
Belly line legs – length	6.0 m		
Belly line legs – diameter	12 mm Dyn		
Fishing line chain – length	9.20 m		
Fishing line – diameter	13 mm LL		
Bobbin footrope chain – length	18.30 m		
Bobbin footrope chain – diameter	19 mm ML		
Sweeps – length	64 m		
Sweeps wire – diameter	28 mm		
Sweeps extension chain – length	18.3 m		
Codend cover and middle section	41 mm		
Bobbin footrope - weight:	3260 kg		
Total flying footrope chain - length	36.6 m		
Total flying footrope chain - weight	260 kg		
Total weight 21” bobbins on flying footrope	246 kg		
Total weight Danleno bobbins and bracket	360 kg		
Shackles	50 kg		
Total weight of footrope (Danleno-Danleno)	4200 kg		
Otter boards: Poly-Ice no 7 - weight	ca 1950 kg		
Length	3.4 m		
Width	2.25 m		
Back strops – double + single	6.1 + 3.05 m		

6 FISHING METHOD AND INFORMATION ON EACH STATION

Towing speed and distance: The towing speed is 3.8 knots over the bottom. The trawling distance is **4.0 nautical miles** calculated with GPS when the trawl has set on the bottom until the hauling begins (i.e. excluding setting and hauling of the trawl).

Towing warp: The length of the towing warp of each tow is not fixed, but should be similar to earlier years. The length of the towing warp may also be decided in relation to position and status of the trawl according to measurements from trawl sensors.

Towing direction: The towing direction is the one given in the station list or the opposite direction. The trajectory of each tow from previous surveys should be used when towing.

Invalid tows – snags, malfunctions etc.

- A tow is considered valid if the towing distance is at least **2 nautical miles**. If there is a hang up or net damage before a towing distance of 2 nautical miles is reached, the tow is invalid and has to be repeated. When repeating the tow it may be better to tow in the opposite direction.
- If something is wrong in relation to the trawl, such as if the codend is stuck to the headline, the wings are wound or something is wrong with the otter boards, the tow is invalid and has to be repeated.
- If parts of the headline, the footrope or the bridles are broken the tow is only valid if it is known precisely when the rope broke down (for example, if it broke down due to snagging of the trawl) and the tow has reached at least 2 nautical miles. Normally, the trawl is hauled immediately if snagging is believed to be the cause of the breakdown. If the trawl is in order it is allowed to set the trawl out again and finish the tow. If the trawl is not in order but it is thought that the breakdown occurred during the snag, the tow is only valid if it has reached 2 nautical miles.
- If the codend has a hole or is ragged the tow is invalid and must be repeated. If the net in the upper or lower belly, wings and the square have holes or is ragged the tow is only valid if it is believed to have had no effect on the sampling efficiency of the trawl.

Number of repetitions: When invalid tows are repeated, a towing distance of 2 nautical miles is sufficient, especially in areas where the bottom is rough. If a repeated tow is also invalid, the cruise leader must decide whether a third attempt shall be made, e.g. by shifting the tow track or changing the tow direction.

Weather: Trawling is stopped when the wind force exceeds 8 on the Beaufort scale (17.2-20.7 m/sec) with corresponding sea condition.

Auto-trawling: Auto-trawling system is allowed.

Following issues are important during towing and documentation of information on each station:

- Towing procedure has to be in accordance to the station list and in other sections of this protocol.
- The towing direction is **not fixed**, that is, start and end of the tow given in the station list is not decided beforehand. This means that it does not matter at which end point the tow starts.
- **Sub-square within each statistical square is as given in the station list** and hence, not calculated after each tow.
- If a stationary fishing gear, such as longline or gillnets, are within the towing direction of a given station, it is allowed to relocate the tow by a maximum of one nautical mile from the standard tow. Otherwise, the tow is omitted.
- All deviations from the standard tow need to be documented on the station list form.

Copy of tow trajectories: Cruise leaders shall save a digital copy of the trajectories of all towing stations.

7 ADDITIONAL STATIONS

7.1 Captain-selected stations at the slopes of the continental shelf – outside fixed stations

The IGS has been criticized for incompletely covering the distribution of cod at the slopes of the continental shelf areas. Cod is known to accumulate at thermal fronts in slope areas and variable positioning of the fronts may affect the results obtained using fixed stations. It has also been pointed out, that the location of the fronts has changed in recent years.

It is therefore important to define the outer boundaries of cod and thermal fronts at the slope areas, e.g. to:

- Improve data sampling in areas with high environmental variability.
- Reduce the uncertainty in how well the distribution area of cod is encompassed by the survey.
- Collect more biological data on cod at slope areas (age, condition, feeding habits).

Additional stations will be set out in areas outside fixed stations where cod is believed to accumulate.

- The NW slope (Víkuráll - Þverálshorn) by trawler Páll Pálsson – a total of 8 stations.
- The NE slope (Axarfjarðardjúp - Héraðsdjúp) by trawler Bjartur – a total of 10 stations.
- The SW slope (Háfadjúp – Skerjadjúp) by trawler Ljósafell – a total of 5 stations.

The stations will be set out by captains, in a way that they are fairly evenly distributed over the areas.

To distinguish these stations from the fixed stations given in the station list, they shall be given **tow number 41-49** within each statistical square.

The instructions for additional tows if a high catch is taken at the outermost stations, as described in the next section, are still valid.

7.2 Additional stations at the slopes of the continental shelf

According to distribution maps from earlier surveys, there is some variability in the abundance of cod at the slopes of the continental shelf. When high catches are taken at the outermost stations, additional tows should be taken further off in order to define the outer boundaries of cod.

Following points should be had in mind when additional stations are taken:

- The main objective of additional stations is to define geographical boundaries of cod, so that the abundance of cod is low at the outermost stations.
- Additional stations should be taken adjacent to outermost fixed stations containing a relatively great quantity of cod or a certain size group of cod.
- To distinguish additional stations from the fixed stations given in the station list, they shall be given **tow number 21-29** within the given statistical square.

7.3 Additional stations in shallow waters

Eight near-shore stations will be taken by trawler Páll Pálsson in the north of Breiðafjörður and off Vestfirðir. The stations will be selected from a list of stations taken by r/v Árni Friðriksson in 2008.

Five near-shore stations will be taken by r/v Bjarni Sæmundsson north of Iceland. The stations are shown in the station list and maps (Figure 7).

8 OVERALL SAMPLING PLAN

The total number of fixed stations is 562. A total of 23 additional stations will be taken at slope areas and 13 additional stations in shallow waters. In addition, about 40 calibration tows will be made in the E-area (comparison between r/v Árni Friðriksson and trawler Bjartur, a total of 40 tows). The study area is divided into 5 subareas according to the following table:

Area	Vessel	Number of fixed stations	Number of add. slope stations	Number of add. shallow-water stations	Number of stations for calibration
S-area	Ljósafell	158	5		
NW-area	Páll Pálsson	142	8	8	
E-area	Bjartur	141	10		
N-area	r/v Bjarni Sæmundsson	98		5	
Iceland-Faeroe Ridge	r/v Árni Friðriksson	23			ca 40
Total		562	23	13	ca 40

9 MALFUNCTIONS OF RESEARCH EQUIPMENT

It is not self-evident to resume sampling if important research equipment, such as temperature sensors or weighing scales, break down during the cruise. In such occasions the possibility must be considered to sail to the next harbour and get the equipment repaired. If this solution is not applicable the cruise leader must consult the coordinator of the project for the next steps.

10 STATION LIST

The station list includes locations and other information on the tows. See also station maps for all subareas (Figures 13-17).

Information on warp lengths has been updated according to the registered warp length in 2002-2006. The new values show the median, min and max warp length in this period.

Tows with tow number 1-9 were originally selected by captains, tows with tow number 11-19 were set out randomly but adjusted by captains, and tow numbers 31-39 indicate shallow-water tows added in 1993 and tows that have been added since then.

CRUISE LEADERS! All notes and comments on tows must be delivered to the coordinator of the project after the cruise. See Chapter 12 “Remarks and notes on tows”. **Remember to document the comments in the station list form in *SeaScale*.**

Stat sq.	Tow-no.	Sub-sq.	Pos. A N	Pos. A W	Pos. B N	Pos. B W	Depth m	Depth m	Sweeps fm	Warp Med	Warp Min	Warp Max	Tow direction	Tow length	Notes
310	1	1	632300	103900	632160	104750	430	438	45	525	460	590	250	4	
310	11	3	631500	104950	631700	104100	399	412	45	470	450	490	40	4	note
311	1	2	632907	110122	633307	105986	333	344	45	435	420	450	20	4	
311	2	1	632530	114370	632900	114070	392	408	45	545	540	550	20	4	note
311	11	3	631300	114200	631500	113400	421	428	45	515	510	520	60	4	note
311	12	4	630500	112000	630700	111300	447	454	45	520	510	530	70	4	
311	31	2	632511	111405	632540	112300	333	345	45	430	430	430	275	4	note
312	1	4	631420	121390	631240	122160	414	435	45	515	500	530	227	4	note
315	1	1	632750	154700	632900	153900	192	228	35	275	250	275	60	4	
316	1	2	632300	161500	632300	160700	251	284	45	400	400	400	90	4	
316	11	2	632500	161000	632500	161900	128	156	35	250	200	250	270	4	
317	1	2	631470	173200	631590	172350	183	183	45	300	300	300	75	4	
317	11	1	632800	175300	632500	174700	125	180	35	250	230	250	140	4	
317	12	2	631500	172100	631700	171300	167	214	45	325	300	325	65	4	
318	2	2	632500	182000	632400	182900	20	35	35	100	100	100	255	4	
318	11	1	632058	185921	632098	185067	73	57	35	150	120	150	75	4	note
319	**1**	**2**	**632170**	**192660**	**631970**	**191880**	**95**	**125**	**35**	**190**	**170**	**200**	**115**	**4**	
319	**11**	**2**	**632070**	**191350**	**631990**	**190420**	**40**	**100**	**35**	**125**	**125**	**150**	**100**	**4**	**note**
319	**12**	**1**	**632008**	**195094**	**632285**	**194451**	**136**	**210**	**35**	**290**	**240**	**300**	**45**	**4**	
319	31	2	632400	191750	632550	192575	37	53	35	100	100	100	110	4	note
319	32	1	632925	194500	632925	195350	46	81	35	90	90	100	270	4	
320	**1**	**1**	**632467**	**204566**	**632694**	**203811**	**90**	**100**	**35**	**200**	**200**	**200**	**45**	**4**	**note**
320	3	3	630762	203933	630799	203109	311	322	35	450	380	450	80	4	note
320	4	3	630732	205365	630766	204462	284	293	35	425	380	425	80	4	
320	11	3	631413	205242	631516	210096	149	162	35	275	250	275	290	4	note
320	**12**	**1**	**632063**	**205908**	**631661**	**205919**	**131**	**161**	**35**	**250**	**200**	**250**	**180**	**4**	
320	13	2	631800	202463	631485	203007	130	149	35	220	220	250	207	4	note
321	1	4	630956	211369	630888	210515	274	296	35	425	375	425	100	4	note
321	**2**	**4**	**630770**	**210888**	**630627**	**210063**	**411**	**430**	**35**	**500**	**450**	**500**	**100**	**4**	
321	3	2	632196	211013	631796	211005	142	168	35	250	200	275	180	4	
321	4	2	632264	212917	632643	212623	128	146	35	275	190	275	25	4	
321	**11**	**2**	**631495**	**211010**	**631537**	**211874**	**167**	**200**	**35**	**280**	**255**	**300**	**270**	**4**	
321	13	1	631499	215180	631488	214361	195	229	35	275	275	300	90	4	
321	31	2	632825	213050	632825	212050	104	123	35	180	180	250	270	4	
322	1	2	632576	220148	632974	220069	155	179	35	250	190	275	360	4	note
322	2	2	632900	221700	632902	220826	200	218	35	300	300	300	90	4	
322	3	4	630807	221457	631103	220847	238	256	35	360	340	362	20	4	
322	11	4	630403	221841	630590	221059	333	379	35	500	450	500	60	4	
322	12	3	631486	224807	631151	224323	268	286	35	425	355	425	150	4	
322	13	1	632188	224486	631869	223948	240	272	35	350	340	350	145	4	
323	1	2	632001	232567	632001	231654	333	384	35	512	500	515	90	4	
323	2	2	632007	230811	632404	230797	246	281	35	400	400	400	360	4	
323	11	3	630801	235595	631103	235006	381	398	35	550	550	550	45	4	
323	12	1	631402	240393	631603	235620	240	257	35	375	310	375	65	4	
323	13	3	631407	234703	631617	233942	296	325	35	425	400	425	60	4	
324	1	1	632690	243994	632295	243963	243	265	35	400	400	400	160	4	
324	2	4	630079	242759	630271	241987	393	439	35	525	400	550	60	4	
324	3	4	631089	241641	631400	241074	125	222	35	275	250	275	40	4	note
324	11	1	632300	243998	631960	244290	242	265	35	400	310	400	180	4	note
324	12	3	630975	245925	630873	245070	304	311	35	425	345	425	100	4	
324	13	4	630698	241854	630970	241336	283	311	35	425	365	425	10	4	note
360	1	1	635200	105500	635600	105200	403	443	45	505	480	530	30	4	note
361	1	2	635541	112034	635883	111581	371	367	45	470	440	500	40	4	note
361	2	1	635905	113516	635492	113498	324	364	45	460	450	470	180	4	
361	11	3	634290	113880	634500	113200	362	384	45	480	440	520	60	4	

Stat sq.	Tow-no.	Sub-sq.	Pos. A N	Pos. A W	Pos. B N	Pos. B W	Depth m	Depth m	Sweeps fm	Warp Med	Warp Min	Warp Max	Tow direction	Tow length	Notes
361	12	1	635160	115200	635500	115100	366	383	45	450	420	500	20	4	
362	11	2	635000	121050	634600	121280	403	421	45	505	480	530	190	4	
363	11	1	635500	134400	635700	133700	175	217	45	320	275	350	50	4	
364	1	2	634560	141600	634700	140700	218	292	45	350	300	350	50	4	
364	2	3	634438	144304	634060	143983	201	223	35	275	275	280	170	4	note
364	11	1	635500	145100	635100	145000	132	192	35	250	190	250	180	4	note
364	12	2	635900	140300	635600	135900	183	228	45	300	240	300	150	4	
365	1	4	633400	151700	633400	150800	132	179	35	270	230	275	80	4	
365	2	4	633700	153000	633400	152500	149	176	35	250	190	250	140	4	
365	11	4	634000	151700	633980	150800	110	125	35	200	175	200	70	4	
366	1	2	634900	162500	634500	162200	59	84	35	135	125	150	170	4	
366	2	1	634500	162800	634600	163500	66	73	35	135	125	150	290	4	
366	11	3	633298	165893	633174	165044	167	218	35	275	275	300	300	4	
366	12	4	633000	161500	633000	160600	113	121	35	190	180	200	90	4	
367	1	3	634100	174000	633800	174600	26	53	35	100	100	100	220	4	
367	11	4	633200	171100	633000	171700	110	179	35	250	200	250	230	4	note
367	12	4	633400	170800	633700	171300	167	179	35	275	250	275	320	4	
367	31	3	633163	174098	633550	174307	122	110	35	225	220	225	350	4	note
370	1	4	633445	202271	633209	201589	18	27	35	150	110	150	115	4	
370	**11**	**3**	**633292**	**203884**	**633092**	**203099**	**74**	**79**	**35**	**175**	**150**	**175**	**120**	**4**	
370	**31**	**3**	**634160**	**203990**	**633860**	**203266**	**30**	**32**	**35**	**100**	**100**	**100**	**130**	**4**	
371	**1**	**2**	**634900**	**211174**	**634725**	**210367**	**64**	**66**	**35**	**150**	**100**	**175**	**100**	**4**	
371	**2**	**2**	**634740**	**212927**	**634790**	**212034**	**73**	**88**	**35**	**200**	**130**	**200**	**75**	**4**	
371	11	3	633009	214056	633010	214944	128	140	35	250	200	250	270	4	
371	**12**	**3**	**633016**	**212988**	**633018**	**213869**	**110**	**128**	**35**	**234**	**190**	**250**	**270**	**4**	
371	**31**	**4**	**634150**	**213317**	**634161**	**212460**	**114**	**89**	**35**	**175**	**175**	**190**	**85**	**4**	
371	32	3	633755	215288	633982	214498	140	128	35	225	200	225	60	4	note
372	**1**	**4**	**633714**	**222100**	**633438**	**221439**	**201**	**223**	**35**	**325**	**260**	**325**	**125**	**4**	
372	**2**	**1**	**635337**	**225498**	**635739**	**225531**	**95**	**109**	**35**	**250**	**150**	**250**	**360**	**4**	
372	**11**	**3**	**633402**	**224356**	**633494**	**223520**	**177**	**219**	**35**	**325**	**230**	**325**	**80**	**4**	**note**
372	**31**	**1**	**635370**	**224720**	**635000**	**224550**	**47**	**79**	**35**	**135**	**110**	**135**	**165**	**4**	
373	1	2	635710	232382	635388	232913	128	141	35	250	190	250	215	4	
373	3	2	635943	231885	635734	232601	121	133	35	180	170	250	270	4	note
373	11	3	634486	234079	634401	233215	137	168	35	287	190	287	90	4	note
373	12	1	635026	234326	634744	233678	150	152	35	300	200	300	140	4	
373	13	3	633480	235990	633884	240007	155	168	35	280	190	360	360	4	
374	1	2	634796	242247	634507	242871	322	344	35	429	370	450	225	4	
374	2	2	635305	241450	634961	241863	260	271	35	400	330	400	205	4	
374	3	2	635781	241078	635432	241515	296	325	35	425	350	425	200	4	note
374	11	2	634522	241187	634922	241249	150	174	35	275	220	275	360	4	note
374	12	4	634309	242428	634484	241618	164	216	35	300	260	300	60	4	
374	13	3	634501	245697	634202	245097	429	444	35	550	300	550	140	4	
375	1	2	635521	251656	635912	251337	232	241	35	300	300	300	30	4	
375	11	1	634989	254574	635123	253716	201	241	35	300	285	400	80	4	
376	1	2	635383	262092	635215	262870	292	325	35	400	400	400	260	4	note
410	11	3	640600	103800	641000	103300	439	458	45	525	500	550	30	4	
411	1	4	641080	112300	640960	113260	314	330	45	460	380	470	240	4	
411	2	2	641900	111200	641500	111400	320	329	45	460	420	500	190	4	
411	3	2	641800	110800	642100	110200	333	351	45	500	430	500	20	4	
411	4	2	641500	110200	641800	110900	329	359	45	460	430	490	315	4	
411	11	1	641500	114200	641870	113800	348	366	45	490	450	500	20	4	
411	12	2	641980	112980	642100	112100	375	384	45	500	480	530	70	4	
411	13	3	641000	114500	641000	115400	348	392	45	450	400	500	260	4	
411	14	4	640400	112300	640000	111700	344	357	45	460	420	500	210	4	
412	1	3	640900	125420	640600	130100	264	302	45	425	420	430	214	4	
412	2	1	642390	125550	642100	124900	157	166	35	230	190	260	130	4	

Stat sq.	Tow-no.	Sub-sq.	Pos. A N	Pos. A W	Pos. B N	Pos. B W	Depth m	Depth m	Sweeps fm	Warp Med	Warp Min	Warp Max	Tow direction	Tow length	Notes
412	3	3	640820	125440	641100	124800	340	384	45	525	500	550	55	4	note
412	4	1	642120	123890	641800	124400	172	183	35	280	200	300	214	4	
412	5	1	641800	123700	642000	122800	232	335	45	370	320	400	80	4	note
412	6	2	642400	122000	642600	121100	302	330	45	400	340	450	70	4	
412	11	1	641500	124150	641800	123500	245	267	45	370	340	400	60	4	
412	12	2	642100	122800	642500	122400	218	247	45	325	320	360	30	4	
412	13	3	641390	125090	641000	125380	183	218	45	320	290	325	200	4	
412	16	2	642600	120600	643000	120300	361	384	45	500	460	500	25	4	
413	1	4	640200	131100	640500	130400	274	320	45	440	420	450	35	4	
413	2	4	640100	132400	640100	131500	292	383	45	525	370	550	80	4	
413	3	4	640700	131400	640300	131300	159	204	35	250	220	250	180	4	
413	4	4	640701	132407	641101	132718	150	174	35	250	220	250	330	4	
413	5	1	641800	133400	642100	134100	128	150	35	210	200	225	300	4	note
413	6	2	641900	132100	642200	132700	124	143	35	220	200	240	310	4	
413	7	1	642200	133400	642600	133500	125	150	35	200	190	200	350	4	
413	11	4	640510	131830	640310	132685	165	220	35	275	270	310	245	4	note
413	12	2	642300	131600	642500	130800	146	165	35	250	200	250	60	4	
413	13	2	642000	132400	641800	133300	161	203	35	300	200	300	245	4	note
413	14	1	642500	134600	642400	135400	101	128	35	190	160	250	250	3.8	note
413	15	1	642000	134600	641600	134800	128	150	35	200	180	225	180	4	
413	16	4	641400	130300	641000	130400	139	156	35	225	200	250	180	4	
413	17	3	640000	133500	640200	132700	156	183	35	250	210	260	55	4	
413	18	3	640400	133300	640800	133000	132	156	35	230	190	250	20	4	
414	1	4	641100	142800	641000	142300	113	174	35	190	170	200	250	4	note
414	3	3	641600	143200	641200	143200	106	134	35	175	160	176	180	4	note
414	11	3	640500	144200	640300	145100	104	119	35	160	140	175	240	4	note
414	31	3	641600	144830	641190	145360	47	38	35	120	120	125	205	4	note
415	1	4	641100	150800	640800	151600	40	64	35	75	75	75	230	4	
415	31	3	635900	160700	640200	160500	126	79	35	175	155	175	20	4	note
422	1	1	642148	224781	642095	223840	51	69	35	130	97	130	135	4	
422	11	1	642490	224795	642093	224807	64	88	35	150	106	150	170	4	
422	12	3	640288	225955	640686	225898	79	91	35	175	140	175	10	4	
422	**31**	**3**	**640600**	**223250**	**640680**	**222400**	**35**	**35**	**35**	**80**	**80**	**80**	**255**	**4**	
422	32	4	641120	221000	640940	221800	28	33	35	80	80	80	245	4	
423	1	3	640880	233120	640480	233000	107	126	35	225	136	225	170	3	note
423	2	3	641310	233398	641599	232812	110	125	35	205	180	225	45	4	note
423	3	2	642696	230230	642751	231126	110	142	35	225	167	225	270	4	
423	11	3	640000	233321	635910	234194	138	151	35	250	166	287	260	4	note
423	12	3	640991	234196	641400	233803	113	128	35	225	180	225	30	4	note
423	13	3	640937	235862	641277	235369	279	320	35	425	366	425	45	4	note
424	1	1	641484	245312	641650	244501	161	193	35	275	250	275	65	4	note
424	2	2	641750	243299	641944	242549	175	185	35	275	216	275	60	4	note
424	3	3	640788	244121	640616	244911	209	222	35	300	250	300	245	4	note
424	11	3	641010	245703	640658	245846	186	205	35	275	260	300	180	4	note
424	12	3	640714	244616	641012	245161	191	207	35	300	280	300	320	4	note
424	13	3	641528	242666	641361	243473	212	231	35	295	226	300	245	4	
425	1	2	642502	250101	642106	250131	204	227	35	300	265	300	180	4	
425	2	2	641839	252247	642221	252511	226	256	35	300	280	300	340	4	note
425	11	4	641155	251707	641544	251440	256	271	35	375	300	375	20	4	
425	12	3	640009	253510	640182	252767	183	220	35	255	255	275	90	4	note
426	1	3	640381	264574	640002	264120	410	434	35	500	435	500	155	4	note
426	2	1	641957	265878	641598	265378	402	430	35	512	435	512	150	4	note
426	11	2	642705	261068	642538	261929	280	302	35	410	350	412	250	4	
426	12	2	642548	262560	642204	262088	302	314	35	415	375	438	145	4	
460	1	3	644300	105000	644800	104600	432	434	45	520	520	520	10	4	
461	1	1	645102	113900	644702	114319	246	300	45	400	400	425	205	4	

Stat sq.	Tow-no.	Sub-sq.	Pos. A N	Pos. A W	Pos. B N	Pos. B W	Depth m	Depth m	Sweeps fm	Warp Med	Warp Min	Warp Max	Tow direction	Tow length	Notes
461	2	1	645100	113400	644908	113688	338	360	45	480	470	500	205	4	
461	11	4	643410	113047	643526	112135	436	452	45	550	500	570	70	4	note
461	12	2	644978	112067	644742	111286	468	495	45	575	550	580	135	4	note
461	15	1	645884	115825	645500	120200	178	190	35	260	250	300	210	4	
462	1	4	643690	115970	643350	120480	229	256	45	330	320	350	205	4	
462	2	4	643200	121680	643400	122480	210	234	45	270	250	325	305	4	note
462	3	3	643150	123436	643548	123510	152	178	35	250	230	300	350	4	
462	4	3	643600	123500	643533	124437	139	192	35	250	220	300	260	4	
462	5	3	643600	124300	643430	125250	154	192	35	250	220	250	260	4	
462	6	3	644333	124031	644704	123625	137	174	35	230	200	250	30	4	
462	7	3	643934	123013	644337	123007	146	156	35	220	200	250	360	4	
462	8	4	643570	121475	643934	121110	161	168	35	240	230	275	20	4	
462	13	4	643971	121523	643835	122411	161	168	35	270	230	275	250	4	
462	17	3	643340	125530	643020	124870	142	162	35	240	210	250	135	4	
462	18	2	645860	122630	645450	122750	157	180	35	260	230	275	180	4	
463	1	4	643200	130800	643300	125900	117	135	35	200	200	240	60	4	
472	11	3	643892	224436	643528	224436	45	59	35	100	100	110	207	4	note
473	1	4	643459	230230	643092	230587	67	99	35	150	150	150	208	4	note
473	2	1	645832	235780	650031	235005	222	226	35	250	230	275	50	4	note
473	**11**	**3**	**643509**	**234405**	**643657**	**233584**	**127**	**137**	**35**	**225**	**225**	**225**	**65**	**4**	
474	1	4	642905	243151	643103	242286	138	204	35	250	235	250	75	4	
474	**2**	**1**	**645625**	**244750**	**645490**	**245650**	**136**	**163**	**35**	**250**	**230**	**250**	**250**	**4**	
474	**4**	**4**	**643971**	**241252**	**644322**	**241617**	**110**	**150**	**35**	**264**	**190**	**264**	**320**	**4**	**note**
474	11	3	643547	244187	643700	243287	240	280	35	425	330	425	60	4	
474	12	2	645244	240970	644936	241488	162	182	35	300	300	300	215	4	note
474	13	3	643330	243364	643490	243975	215	245	35	350	305	350	233	4	note
474	31	2	644897	240260	645289	240558	69	95	35	100	100	110	340	4	note
475	1	3	644052	255560	644204	254676	210	232	35	300	266	300	70	4	
475	2	3	644578	252816	644444	253604	175	200	35	260	226	275	240	4	
475	3	1	645536	252950	645602	254021	161	179	35	275	206	275	290	4	
475	11	1	644638	254510	645040	254810	186	201	35	300	236	300	340	4	
475	12	3	643213	255996	643615	255998	200	228	35	325	275	325	360	4	note
475	13	4	644117	250515	643973	251339	200	206	35	310	290	325	250	4	
476	1	2	644777	263080	644422	262656	203	191	35	250	250	300	145	4	note
476	2	2	645664	262152	650050	262330	154	188	35	250	250	250	345	4	note
476	3	2	645884	261270	645661	262073	164	178	35	250	250	250	248	4	note
476	11	2	645153	261491	645522	261483	171	186	35	300	250	300	355	4	note
476	12	1	645872	263848	645719	264667	197	216	35	300	300	300	245	4	
477	11	2	645549	271470	645138	271269	380	408	35	500	450	500	170	4	note
511	1	1	652710	114897	653020	114313	190	203	45	300	260	300	45	4	
511	2	1	651704	114415	651437	113665	223	244	45	310	300	330	130	4	
511	11	1	651766	115732	651616	115095	216	197	45	290	250	350	130	4	
511	12	3	650990	113090	650586	113178	252	271	45	330	330	375	190	4	
511	13	3	650516	114816	650100	114796	207	239	45	310	300	375	180	4	
512	1	2	652511	120183	652521	121168	190	223	45	320	300	325	270	4	
512	2	4	651319	122570	650949	122989	160	216	45	300	280	300	205	4	
512	3	3	650295	123958	650399	124916	144	158	35	240	200	250	290	4	
512	5	1	652335	125801	652331	124809	180	210	45	270	250	300	90	4	note
512	6	1	652327	124300	652309	123406	245	282	45	280	260	325	90	4	
512	7	1	651715	125090	651708	130000	153	193	35	240	220	280	270	4	
512	11	1	651500	125100	651500	124400	148	160	35	250	200	290	270	4	
512	12	2	651944	122966	651730	122478	175	205	45	280	250	325	145	4	
512	13	3	650987	125394	651220	124649	149	165	45	210	210	250	50	4	
512	14	4	650504	121186	650386	122120	185	205	45	350	280	350	250	4	
512	15	4	651505	120307	651306	121215	138	147	35	250	250	280	255	4	
512	16	2	653021	120314	652911	121309	165	175	35	260	250	275	270	4	

Stat sq.	Tow-no.	Sub-sq.	Pos. A N	Pos. A W	Pos. B N	Pos. B W	Depth m	Depth m	Sweeps fm	Warp Med	Warp Min	Warp Max	Tow direction	Tow length	Notes
513	2	4	650675	130274	650313	130305	136	162	35	235	210	250	180	4	
513	11	2	652054	130809	652077	131529	203	180	45	260	240	375	275	4	note
523	1	3	650330	233031	650235	234000	100	260	35	200	190	225	260	4	
523	12	3	650050	234250	650000	235250	148	241	35	250	200	280	260	4	note
523	31	4	651093	232431	651245	231553	121	135	35	140	120	160	73	3.9	note
524	1	3	651580	244184	651187	244282	89	96	35	135	95	150	190	4	
524	2	4	650135	242525	650238	243600	103	117	35	155	110	240	275	4	
524	11	3	651435	245116	651000	245268	96	107	35	150	105	150	205	4	
524	12	3	651008	250000	650600	250000	119	126	35	140	120	175	180	4	
525	1	3	650228	255190	650310	260100	170	174	35	190	185	250	280	4	
525	3	3	650050	253780	650050	254800	163	176	35	186	180	200	270	4	note
525	11	1	651950	254900	651710	255650	139	148	35	160	140	200	250	4	
525	12	2	652592	252147	652327	251445	96	104	35	120	95	150	140	4	note
525	13	3	651489	255240	651250	260100	148	157	35	170	160	200	250	4	note
526	1	1	652349	264216	652621	263243	182	200	35	275	200	300	67	4	note
526	2	4	650110	261480	650100	262416	159	174	35	190	180	225	270	4	
526	3	2	652108	262626	652550	262606	154	160	35	230	160	250	360	4	note
526	11	4	650967	262508	650840	263420	164	183	35	200	170	250	250	4	note
526	12	3	651026	270180	651400	270100	238	250	35	270	245	300	10	4	note
526	13	4	650952	260930	650670	261535	161	170	35	185	165	220	220	4	note
527	1	2	652175	270030	652530	270002	265	302	35	280	270	350	360	4	note
527	11	4	650257	270389	650062	271108	232	333	35	290	260	350	255	4	note
561	1	3	653580	113626	653907	113136	235	284	45	370	320	375	25	4	
561	2	3	653508	115003	653906	115030	200	203	45	280	260	325	360	4	
561	11	3	654410	114640	654011	114663	212	240	45	290	260	350	180	4	
561	12	1	654520	115400	654998	115406	174	252	45	300	240	350	350	4	note
562	1	2	655011	120415	654750	115634	185	196	45	250	230	300	125	4	
562	2	1	654611	122514	654550	123535	180	212	45	300	240	300	270	4	
562	3	1	654900	123004	654794	123959	129	166	35	250	220	300	254	4	note
562	4	3	653069	124395	653116	125388	122	139	35	220	200	250	270	4	
562	5	4	653195	123403	653220	122400	156	167	35	255	250	275	92	4	
562	6	4	653402	121231	653129	120472	187	190	45	270	250	325	120	4	
562	11	4	653508	122103	653507	123080	214	226	45	300	260	330	270	4	
562	12	2	655500	120864	655498	115872	252	285	45	350	330	375	80	4	
562	13	2	655000	122476	654996	121421	172	190	45	250	230	300	90	4	
562	15	1	655013	124491	654788	125320	190	216	45	310	280	350	240	4	
562	16	4	654523	120501	654358	121432	222	236	45	320	260	350	260	4	
563	1	1	655806	134728	655621	133790	175	186	45	250	240	325	110	4	
563	2	4	653799	133486	653650	132400	118	122	35	175	160	250	115	4	
563	11	4	654004	130900	653705	130257	180	206	45	275	270	300	130	4	note
563	12	2	654995	131965	654832	132895	223	252	45	320	310	375	250	4	note
563	13	1	654901	134765	654536	134420	194	240	45	260	260	350	160	4	note
564	1	2	655100	141598	655000	140669	120	150	35	250	200	250	110	4	
568	1	2	655800	181600	660200	182100	90	113	35	160	150	175	330	4	
569	11	1	655600	194700	660000	195000	81	117	35	150	110	165	343	4	
570	1	1	654428	203091	654824	203346	76	95	35	150	110	190	343	4	
570	2	1	655500	203200	655910	203610	117	138	35	200	155	225	334	4	
570	11	1	655900	204500	655500	204800	126	153	35	180	135	200	200	4	note
571	1	2	655730	205897	655436	210782	162	234	35	280	260	315	230	4	note
571	11	4	653757	210340	653360	210460	120	128	35	160	150	190	188	4	note
573	11	1	654915	235449	655242	240026	52	63	35	70	50	100	340	4	
574	2	1	654934	245945	655310	245870	72	91	35	120	90	125	10	4	
574	3	1	655675	250020	655910	245175	102	117	35	145	120	175	40	4	
574	4	1	655770	242955	660110	243390	70	83	35	105	95	125	340	3.9	note
574	5	3	654264	245962	654703	245962	69	83	35	100	80	125	360	4	note
574	13	1	654770	245800	655130	245400			35					4	note

Stat sq.	Tow-no.	Sub-sq.	Pos. A N	Pos. A W	Pos. B N	Pos. B W	Depth m	Depth m	Sweeps fm	Warp Med	Warp Min	Warp Max	Tow direction	Tow length	Notes
574	14	1	654760	244550	655050	243850	65	80	35	100	85	125	45	4	note
574	15	4	653905	241100	654212	240717	51	23	35	55	45	65	30	4	note
575	1	1	655072	254665	654700	254939	195	207	45	235	225	300	220	4	
575	2	1	654799	254007	654500	254687	222	250	45	240	200	300	230	4	note
575	3	4	654394	251856	654270	252910	154	204	35	205	165	210	260	4	
575	4	2	654634	251746	655013	251470	102	120	35	130	120	160	30	4	note
575	5	4	654691	250630	654300	250909	74	83	35	100	80	110	210	4	
575	6	1	655876	254431	655885	255425	176	194	35	250	175	275	270	4	
575	7	2	655324	250704	655732	250297	119	146	35	135	125	200	30	4	note
575	11	1	655502	253290	655100	253297	137	157	35	170	160	220	180	4	
575	12	1	655555	254623	655640	255716	189	207	45	230	190	260	105	4	
575	13	3	652892	254275	653297	254320	107	120	35	135	120	175	360	4	
575	14	1	653000	251300	653410	251300			35					4	note
575	16	3	653460	254786	653779	255387	120	129	35	145	130	175	330	4	
576	2	3	654248	263157	653887	263600	182	172	45	200	185	300	209	4	
576	3	2	654990	260931	654850	255950	222	259	45	275	270	300	105	4	
576	4	2	655662	260207	660062	260255	182	232	45	260	225	280	3	4	note
576	5	2	660027	261681	655860	260750	223	230	45	285	272	300	116	4	
576	6	4	653128	261250	653538	261360	157	167	35	195	160	250	360	4	
576	12	1	654520	264280	654936	264120	254	309	45	330	275	375	15	3.9	note
576	13	3	653460	264400	653900	263961	195	217	45	230	195	300	20	4	
576	14	1	655120	264426	655560	264414	250	320	45	300	240	350	25	4	
576	15	1	655510	263260	655878	262787	287	300	45	310	270	350	30	4	
576	16	4	654000	260970	653919	261895	178	189	35	195	190	265	255	4	note
611	1	3	660497	115107	660143	115594	259	285	45	340	330	375	200	4	note
611	11	3	660999	115338	660695	114646	262	264	45	340	330	375	130	4	note
612	1	4	661556	121693	661498	120677	266	302	45	330	330	380	90	4	
612	2	1	661888	122897	662233	123350	295	425	45	450	420	450	335	4	
612	3	1	662395	124180	662284	125199	154	185	45	270	250	320	265	4	
612	4	1	662105	124886	661713	125225	129	145	45	250	200	275	200	4	
612	11	3	661000	122706	661299	123295	183	185	35	270	250	300	310	4	
612	13	4	655984	120904	660385	120551	271	273	45	330	300	375	25	4	
613	1	4	660999	132178	661013	133200	128	158	35	225	200	275	260	4	
613	2	3	660991	133693	661387	133899	140	190	45	230	225	275	355	4	note
613	3	2	662097	131633	662316	130774	212	219	45	325	240	350	40	4	
613	11	4	660499	132126	660097	132577	86	95	35	200	150	250	200	4	note
613	12	2	661489	132703	661623	131702	155	165	35	210	200	300	80	4	
613	13	1	662000	134140	661960	135085	240	263	45	350	350	375	75	4	note
613	14	1	662498	134500	662889	134209	198	205	45	320	300	350	15	4	
614	1	2	662296	140907	662694	141083	90	95	35	175	150	180	340	4	
614	2	1	662790	143584	662901	142608	89	102	35	150	150	150	73	4	note
614	4	3	660711	145112	660600	144200	93	114	35	175	170	175	115	4	
614	11	4	661002	142696	661431	142588	216	223	45	375	260	375	0	4	
614	12	4	660503	142677	660177	141991	111	165	35	275	250	275	135	4	
614	13	2	661897	141922	662000	140914	112	137	35	200	200	200	75	4	
615	1	2	662417	152486	662810	152914	86	153	35	190	170	225	335	4	
615	2	1	662217	153371	661817	153584	100	144	35	220	190	250	195	4	
615	11	2	662600	150758	662889	150050	90	120	35	220	200	230	50	4	
615	12	2	662026	152385	661811	153202	80	100	35	170	170	225	230	4	
616	1	1	662193	164190	662625	164294	113	136	35	160	130	190	345	4	
616	11	1	661576	164822	661861	164092	196	202	35	260	225	275	65	4	
617	1	3	660800	173200	661150	172600	170	180	45	225	210	300	35	4	
617	2	1	662000	174200	662400	174700	158	198	45	220	210	220	0	4	
617	3	1	662700	173600	662700	172600	216	324	45	340	280	380	90	4	
617	11	3	661400	174500	661000	174300	162	216	45	240	230	275	175	4	
617	12	2	661500	173000	661900	173000	216	234	45	250	230	275	360	4	

Stat sq.	Tow-no.	Sub-sq.	Pos. A N	Pos. A W	Pos. B N	Pos. B W	Depth m	Depth m	Sweeps fm	Warp Med	Warp Min	Warp Max	Tow direction	Tow length	Notes
617	13	4	661500	171900	661100	172200	126	171	45	230	200	275	200	4	note
618	2	2	661500	181800	661800	182300	171	180	35	250	220	300	333	4	
618	3	2	662600	182200	663000	182200	99	162	35	180	150	200	360	4	
618	11	2	662000	182700	662400	182700	135	189	45	225	220	240	355	4	
618	12	2	662700	180700	662400	181400	63	76	35	130	120	150	225	4	note
618	13	4	660500	182100	660900	182500	72	131	35	150	140	175	335	4	
618	14	1	662200	184800	662540	185420	400	431	45	480	435	550	310	4	note
619	1	1	661900	194700	662315	194625	180	200	35	225	220	250	360	4	
619	2	1	662150	193747	661750	193620	160	225	45	240	220	250	170	4	
619	3	3	661500	193600	661350	194612	180	225	45	240	210	250	260	4	
619	4	2	662000	190300	662400	190500	189	225	45	270	250	300	350	4	
619	11	3	660500	194700	660737	193860	117	171	35	190	160	210	55	4	
619	12	4	661100	191000	661500	190900	81	126	35	150	140	200	0	4	
619	13	3	660000	195400	660310	194776	82	146	35	150	110	200	38	4	
619	14	2	662000	192400	662000	191400	117	198	35	220	175	250	90	4	
619	15	3	660500	195400	660900	195100	150	153	35	210	200	250	17	4	
620	1	3	661100	203800	661500	203900	171	207	45	250	230	300	350	4	
620	2	1	662345	204716	662744	204811	180	184	35	250	210	275	351	4	
620	11	3	661300	200000	661700	200000	135	153	35	200	180	225	182	4	
620	12	2	662000	201800	662400	202000	90	162	35	190	150	225	350	4	
621	1	2	663040	210120	662688	210613	185	165	45	240	210	250	210	4	
621	2	2	662450	211560	662834	211986	160	180	35	225	200	260	325	4	
621	3	1	663000	213620	663012	214711	81	133	35	140	110	150	270	4	
621	4	2	662400	212500	662004	212004	108	133	35	150	140	180	325	4	
621	11	2	662000	210300	661600	210300	135	153	35	200	180	230	180	4	
621	12	2	661700	211700	661400	210900	100	145	35	180	150	200	145	4	note
621	13	4	660900	211500	660488	211421	90	112	35	150	120	160	175	4	
622	1	3	660800	225304	661003	230274	130	139	35	150	120	170	300	4	
622	11	3	660444	224350	660662	224987	126	133	35	150	120	155	310	4	
623	1	1	661691	235890	661950	235101	70	82	35	115	100	135	50	4	
623	2	1	662660	233100	663100	233436	111	148	35	175	160	188	350	4	
623	3	1	662469	234948	662841	234581	152	182	35	220	175	225	360	4	note
623	4	1	661986	235528	662340	234780	107	130	35	145	120	165	40	4	
623	5	2	662812	232694	662422	233186	74	157	35	180	150	200	205	4	
623	12	4	661526	230600	661175	231317	109	124	35	140	105	150	210	4	note
623	13	1	662046	233771	662358	234450	111	167	35	200	180	250	320	4	
623	14	2	661580	230879	661787	231806	65	111	35	105	90	125	310	4	
624	1	1	663200	245168	662841	245680	159	166	35	180	160	250	210	4	
624	2	1	662602	244828	662850	244166	107	119	35	140	125	145	45	4	
624	3	2	662573	240270	662212	241044	120	129	35	135	130	145	225	4	note
624	4	2	662011	241020	662315	240350	117	120	35	135	130	160	45	4	
624	5	4	660424	241464	660780	241280	54	65	35	85	75	100	10	4	
624	6	3	660420	250030	660825	250033	102	128	35	175	130	180	0	4	
624	11	3	660007	243937	660312	243245	89	102	35	105	90	125	35	4	
624	12	1	662104	244691	662430	244438	95	106	35	135	130	175	10	4	note
624	13	3	660948	243296	660870	244318	89	111	35	140	130	200	255	4	note
624	14	3	660986	242988	660631	243628	98	126	35	145	135	150	205	4	
624	15	1	661995	250031	662437	245711	120	139	35	170	147	200	10	4	
624	16	1	661475	244094	661592	243100	83	94	35	100	85	125	85	4	
624	17	3	660497	244540	660400	245520	131	136	35	200	165	200	250	4	
625	1	2	662157	251117	662002	252024	161	173	35	180	170	275	250	4	
625	2	3	660491	254260	660085	254680	181	200	45	260	170	275	190	4	
625	3	2	662723	252254	662972	251437	256	296	45	335	320	360	45	4	
625	4	2	662400	252197	662082	252877	167	185	35	210	177	300	225	4	
625	5	3	660742	254409	660440	255320	175	182	35	190	185	275	240	4	
625	6	2	662709	250297	662815	251225	175	185	35	220	180	240	280	4	

Stat sq.	Tow-no.	Sub-sq.	Pos. A N	Pos. A W	Pos. B N	Pos. B W	Depth m	Depth m	Sweeps fm	Warp Med	Warp Min	Warp Max	Tow direction	Tow length	Notes
625	7	1	662060	253667	662405	253117	278	333	45	350	330	390	30	4	
625	11	3	660999	255710	661303	254955	222	263	45	301	255	330	45	4	
625	12	4	661015	250590	660697	251452	102	109	35	125	120	150	230	4	
625	13	1	661520	255476	661812	254850	380	393	45	400	375	430	35	4	
625	14	1	661500	255047	661786	254349	296	314	45	360	320	400	45	4	note
625	15	4	661561	252720	661294	253361	150	176	35	175	155	250	220	4	
625	16	2	661535	250800	661911	250693	126	148	35	175	160	200	15	4	
625	17	4	660980	251200	661097	252227	126	148	35	160	135	175	290	4	
626	1	4	660210	260240	660001	261009	191	213	45	230	205	300	225	4	
626	11	4	660037	261840	660340	261040	219	257	45	265	230	300	50	4	
626	12	4	660560	260833	660895	260024	265	287	45	320	280	340	45	4	
662	1	3	663889	125608	664308	125664	228	310	45	370	300	400	360	4	
663	1	2	663686	130611	664077	130498	194	262	45	320	290	350	5	4	
663	2	3	663801	133899	663400	134086	163	180	45	300	250	300	190	4	
663	3	4	663700	132716	663800	131737	198	218	45	300	240	325	75	4	note
663	4	4	663300	131846	663543	131050	266	271	45	340	310	375	45	4	
663	11	1	665792	134716	665461	134186	301	294	45	400	370	400	150	4	
663	12	1	665252	133411	664953	132657	223	332	45	440	400	450	135	4	
663	13	2	664497	131520	664534	130488	208	228	45	350	300	350	85	4	
663	14	1	664929	134888	664618	134288	180	247	45	350	240	350	160	4	note
664	1	3	663816	144498	663902	143609	193	202	35	260	250	300	75	4	
664	2	3	663288	145000	663296	144002	147	160	35	240	220	250	90	4	
664	3	4	663415	141468	663794	141377	151	182	35	250	250	250	4	4	
664	4	2	665008	141581	665393	141297	216	223	45	330	270	375	10	4	
664	11	1	664998	145014	665201	150009	109	131	35	200	170	200	300	4	
664	12	3	664100	145185	664491	144805	136	164	35	270	240	275	210	4	
664	13	1	665494	144846	665488	143870	162	187	45	300	260	300	85	4	
665	1	2	664391	151112	664809	151072	151	156	35	270	240	275	360	4	
665	2	2	665591	151184	665823	150288	132	150	35	250	225	275	55	4	
665	3	3	664388	155011	664400	154015	151	190	35	240	205	275	90	4	
665	4	3	664102	153900	663785	153366	208	212	45	230	220	235	156	4	
665	5	1	664799	155531	665207	155331	257	284	45	370	350	375	10	4	note
665	11	4	663505	150609	663390	151608	150	162	35	275	190	275	265	4	
665	12	4	663518	152701	663826	152100	199	210	35	290	230	300	30	4	
665	13	4	664478	152398	664319	153338	220	243	45	325	290	350	260	4	note
665	14	4	663025	152414	663206	153303	137	154	35	200	180	235	300	4	
665	15	1	665510	152777	665636	153728	176	182	45	275	230	300	290	4	note
666	1	1	664537	164730	664971	164585	110	126	35	225	180	250	5	4	note
666	2	1	665507	165030	665519	163919	180	190	45	265	250	300	90	4	note
666	3	4	664509	163012	664517	161977	160	178	35	250	220	275	90	4	
666	4	2	665017	161512	664766	160685	252	273	45	330	300	350	130	4	
666	5	1	670001	165002	670004	163940	256	270	45	345	300	350	90	4	
666	11	3	664422	165013	664012	164749	130	135	35	230	200	250	175	4	note
666	12	4	664084	160241	664520	160185	180	207	35	240	230	275	360	4	
666	13	3	664001	165693	663695	165044	182	265	35	320	300	330	145	4	
666	14	1	664541	163970	664962	163592	145	186	35	245	200	260	20	4	note
666	15	4	663942	162558	664005	161461	120	123	35	175	150	180	70	4	
667	1	4	664100	171700	663700	171800	158	229	35	240	210	250	360	4	note
667	11	1	665500	180000	665100	180000	351	423	45	450	450	450	180	4	note
667	12	2	665000	171800	665400	171800	216	243	45	300	275	325	360	4	
667	13	2	664500	172277	664500	171254	260	245	45	310	285	320	90	4	
667	14	2	664500	170300	664819	170936	198	252	45	300	270	350	330	4	
668	1	2	664900	182900	665000	181900	230	242	45	300	290	330	80	4	
668	2	2	665900	182800	665500	182800	180	225	45	260	235	300	180	4	
668	3	4	663800	180000	663900	180900	153	189	45	210	200	230	275	4	note
668	4	4	664200	183100	664500	182400	230	252	45	320	300	350	35	4	

Stat sq.	Tow-no.	Sub-sq.	Pos. A N	Pos. A W	Pos. B N	Pos. B W	Depth m	Depth m	Sweeps fm	Warp Med	Warp Min	Warp Max	Tow direction	Tow length	Notes
668	5	4	663500	182400	663900	182500	180	180	45	230	220	300	352	4	
668	11	3	663000	183600	663400	183300	216	216	45	290	250	300	17	4	
668	12	4	664200	182100	664500	181500	198	306	45	255	200	350	35	4	note
668	13	1	664659	183408	665065	183358	374	385	45	400	400	450	360	4	
668	14	4	663500	180600	663700	181500	81	108	35	150	100	160	300	4	
668	15	1	665700	185000	670000	185100	225	252	45	290	280	320	0	4	note
669	1	1	664400	193100	664700	193800	216	243	45	275	260	300	318	4	
669	2	3	663500	194000	663900	193500	225	243	45	285	250	300	20	4	
669	3	3	663900	194800	664200	194400	144	160	45	185	175	220	30	4	
669	4	4	664100	191300	663700	191700	288	320	45	350	300	350	200	4	
669	11	4	663000	192400	663400	192200	306	306	45	355	340	370	15	4	
669	12	2	664500	192100	664900	192200	297	315	45	350	345	400	350	4	
669	13	1	664500	195700	664700	194800	216	266	45	300	270	325	65	4	
670	1	4	663400	201300	663645	200564	78	113	35	150	140	160	53	4	
670	2	4	663900	200000	664300	200000	124	162	45	200	200	250	360	4	
670	3	1	664800	204800	665100	204000	279	297	45	340	340	350	46	4	
670	4	1	665900	205268	665900	204255	177	226	45	250	225	275	90	4	note
670	5	2	665585	203056	665800	202200	261	288	45	325	300	340	57	4	
670	11	1	665500	205500	665800	210000	135	171	45	220	190	225	329	4	
670	12	4	663500	202700	663700	201700	272	282	45	300	250	320	55	4	
670	14	4	664000	201800	664200	200900	252	250	45	310	270	350	53	4	
670	15	3	663000	204200	663400	204300	207	315	35	375	330	380	355	4	note
671	1	4	664000	212700	664000	211700	90	126	45	160	150	200	81	4	
671	2	2	665300	211000	665400	205800	117	171	45	190	165	200	260	4	
671	3	2	664400	211300	664800	210800	99	108	45	150	140	160	26	4	
671	4	2	664800	212700	664900	211600	81	81	45	120	100	130	75	4	
671	5	3	663600	215500	663700	214500	72	108	35	140	125	150	75	4	note
671	11	4	663540	213300	663900	212700	108	117	45	160	140	175	30	4	
671	12	1	665500	213900	665600	212900	162	162	45	225	200	230	80	4	
671	13	1	664500	214200	664700	215100	117	153	45	225	210	230	295	4	
671	14	1	665300	215500	665500	214600	171	180	45	230	220	250	65	4	
671	15	4	664000	210600	664300	210000	189	225	45	275	250	300	46	4	
672	1	2	665300	220700	665600	221300	144	171	45	235	225	250	330	4	
672	2	2	665900	221500	665900	222600	189	198	45	250	230	275	270	4	
672	3	2	665700	222600	665400	223400	162	189	45	235	210	250	220	4	
672	4	1	665700	224900	665400	225800	220	225	45	270	250	300	225	4	
672	5	1	665600	224100	665900	223500	180	198	45	250	220	300	45	4	
672	6	2	665200	222500	665100	221500	126	126	45	200	185	200	100	4	
672	11	1	664500	223600	664800	224300	81	108	35	140	130	170	313	4	
672	12	1	665000	224200	665300	223500	126	144	45	225	200	230	43	4	
672	14	4	663500	222300	663900	222400	58	68	35	100	100	125	350	4	note
672	15	4	664400	220800	664000	220600	90	90	35	150	120	150	170	4	note
672	16	1	664500	225700	664900	225300	90	126	45	150	140	170	20	4	
673	1	1	665697	235990	665994	235191	222	241	45	280	240	300	50	4	
673	2	1	665800	233000	665800	234000	207	216	45	280	220	325	270	4	
673	3	2	665400	232600	665800	233100	216	225	45	250	240	300	330	4	
673	4	2	665600	230000	665400	231000	225	225	45	285	250	325	245	4	
673	5	2	665200	230900	665100	232000	216	243	45	275	215	300	250	4	
673	6	1	665300	240030	664857	235850	159	185	45	200	170	250	175	4	
673	7	2	665100	230300	665500	230000	180	216	45	260	225	325	10	4	
673	11	1	665000	234211	665355	234905	176	196	45	210	180	275	325	4	
673	12	1	665191	232990	665028	234075	185	196	45	220	180	250	260	4	
673	13	4	664500	231200	664400	232200	117	139	45	185	145	258	250	4	
673	14	1	665003	235157	665338	235760	168	185	45	200	180	250	322	4	note
673	15	3	663500	234482	663211	233621	126	157	35	180	160	200	130	4	
673	16	3	663460	240110	663158	235429	157	204	35	220	190	275	130	4	note

Stat sq.	Tow-no.	Sub-sq.	Pos. A N	Pos. A W	Pos. B N	Pos. B W	Depth m	Depth m	Sweeps fm	Warp Med	Warp Min	Warp Max	Tow direction	Tow length	Notes
673	17	1	665508	235820	665775	234933	189	200	45	240	225	300	45	4	
673	31	3	664003	235498	664005	234462	96	105	35	125	115	125	93	4	note
674	1	1	664742	244269	665064	243670	246	201	45	290	280	325	30	4	note
674	2	3	664242	244294	663853	244581	152	188	45	220	190	300	205	4	
674	3	2	664912	242338	665162	241540	188	204	45	240	210	300	80	4	
674	4	2	664900	241431	664571	242005	176	213	45	225	210	300	210	4	
674	5	1	664433	243980	664785	243667	154	175	45	200	180	275	20	4	
674	11	3	663544	245758	663836	245131	241	270	45	300	260	350	35	4	note
674	13	3	663509	243040	663585	244005	104	120	35	130	130	150	280	4	note
674	14	4	663312	243316	662995	242342	102	111	35	120	115	130	140	4	
674	15	1	665130	243735	665360	242770	210	270	45	265	250	300	55	4	
674	16	4	664067	242150	663990	241120	161	263	45	225	140	250	100	4	
675	1	4	663301	251432	663496	250695	426	383	45	420	415	450	50	4	
675	2	4	662991	250978	663307	250164	182	200	45	250	230	280	50	4	
714	1	3	670180	142699	670389	143666	225	237	45	350	310	350	295	4	
714	11	3	670508	145721	670172	145172	207	230	45	350	320	350	145	4	
715	1	3	670804	154491	670810	153517	189	234	45	300	300	300	90	4	
715	2	4	670000	151209	670416	151229	162	176	35	300	300	300	360	4	
715	11	3	665974	154490	670391	154503	158	162	35	275	270	275	360	4	
716	11	3	670600	165440	670600	164410	350	370	45	450	450	500	90	4	note
717	1	4	670000	172600	670400	172300	234	261	45	325	290	350	15	4	
718	1	4	670410	183020	670040	183240	163	123	45	200	180	250	210	4	note
718	2	3	670000	184800	670400	184670	162	207	45	230	220	270	15	4	note
718	11	2	671100	182900	671400	182200	416	531	45	520	450	550	40	4	
718	12	4	670400	182200	670000	182100	162	207	45	250	240	300	360	4	note
719	1	1	671900	194400	671600	194900	288	342	45	360	350	450	215	4	
719	2	3	670900	194900	670600	195600	279	297	45	340	310	360	220	4	
719	11	4	671000	192400	670700	193200	369	468	45	530	425	540	215	4	
720	1	1	671800	204600	671400	204000	252	315	45	340	320	410	147	4	
720	2	3	671000	204600	670700	205400	216	239	45	270	230	300	234	4	note
720	3	3	670600	204000	670300	204900	189	205	45	250	220	250	232	4	
720	11	1	672000	203300	671800	204300	329	351	45	440	400	450	235	4	
720	12	4	670500	200900	670200	201700	270	279	45	340	300	350	220	4	
720	13	4	670900	202800	671000	201800	234	252	45	300	260	325	70	4	
720	14	3	670200	203400	670500	202700	230	252	45	280	280	320	50	4	
721	1	3	670500	212700	670200	213600	207	216	45	250	220	270	233	4	
721	11	4	670200	211300	670600	211000	171	202	45	220	195	240	15	4	
721	12	3	670600	214300	671000	213900	207	216	45	250	225	250	30	4	
722	1	3	670000	230000	670000	224900	234	252	45	300	285	325	90	4	
722	2	3	670600	230000	670200	230000	243	252	45	300	270	300	180	4	
722	3	3	670300	225000	670700	225000	243	261	45	300	265	300	360	4	
722	4	4	670600	220200	671000	220200	216	247	45	270	260	300	360	4	
722	5	4	670600	222000	670800	221100	234	234	45	290	270	325	60	4	
722	12	3	670000	223800	670100	222800	180	198	45	250	210	255	80	4	
722	13	4	670400	222800	670000	222400	198	216	45	240	220	260	135	4	
722	14	2	671500	220600	671500	221600	342	378	45	405	390	430	270	4	
722	16	3	671100	224700	671200	225700	252	275	45	300	275	325	287	4	
723	1	4	670600	231400	670400	232300	252	261	45	290	270	300	240	4	
723	2	4	670100	232700	670400	233200	234	243	45	270	255	325	330	4	
723	3	3	670000	234100	670000	233000	216	234	45	260	220	300	90	4	
723	4	3	670355	234231	665982	234631	217	232	45	260	260	290	23	4	
723	11	3	665992	235901	670308	235100	250	265	45	300	260	310	35	4	
723	12	4	670000	231400	670000	230300	252	257	45	300	285	350	90	4	
723	13	3	670600	233200	670900	233900	243	252	45	275	240	295	300	4	

11 STATION MAPS

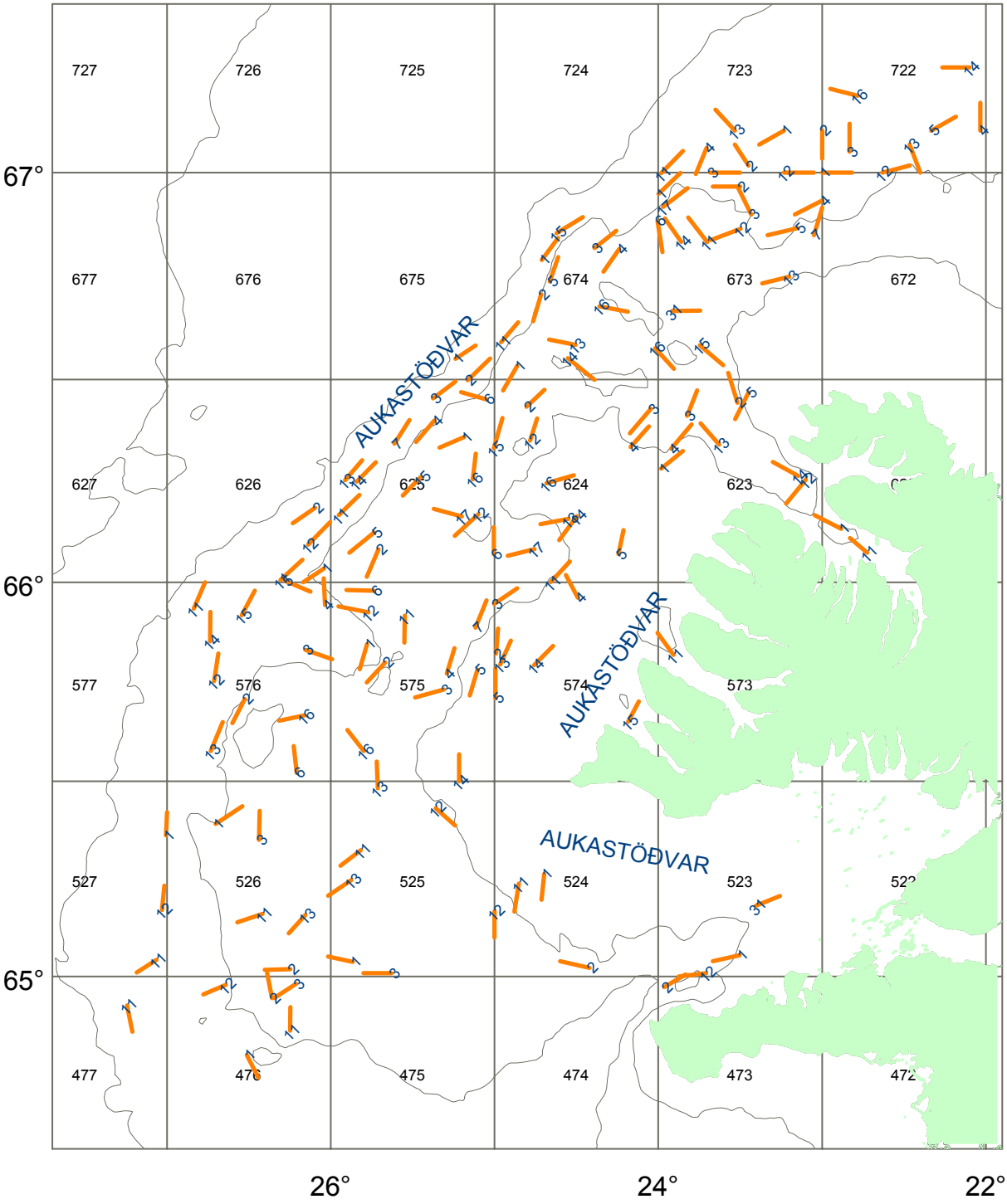


Figure 13. Stations in the survey area of the trawler Páll Pálsson. “AUKASTÖÐVAR” indicate areas where additional stations will be taken.

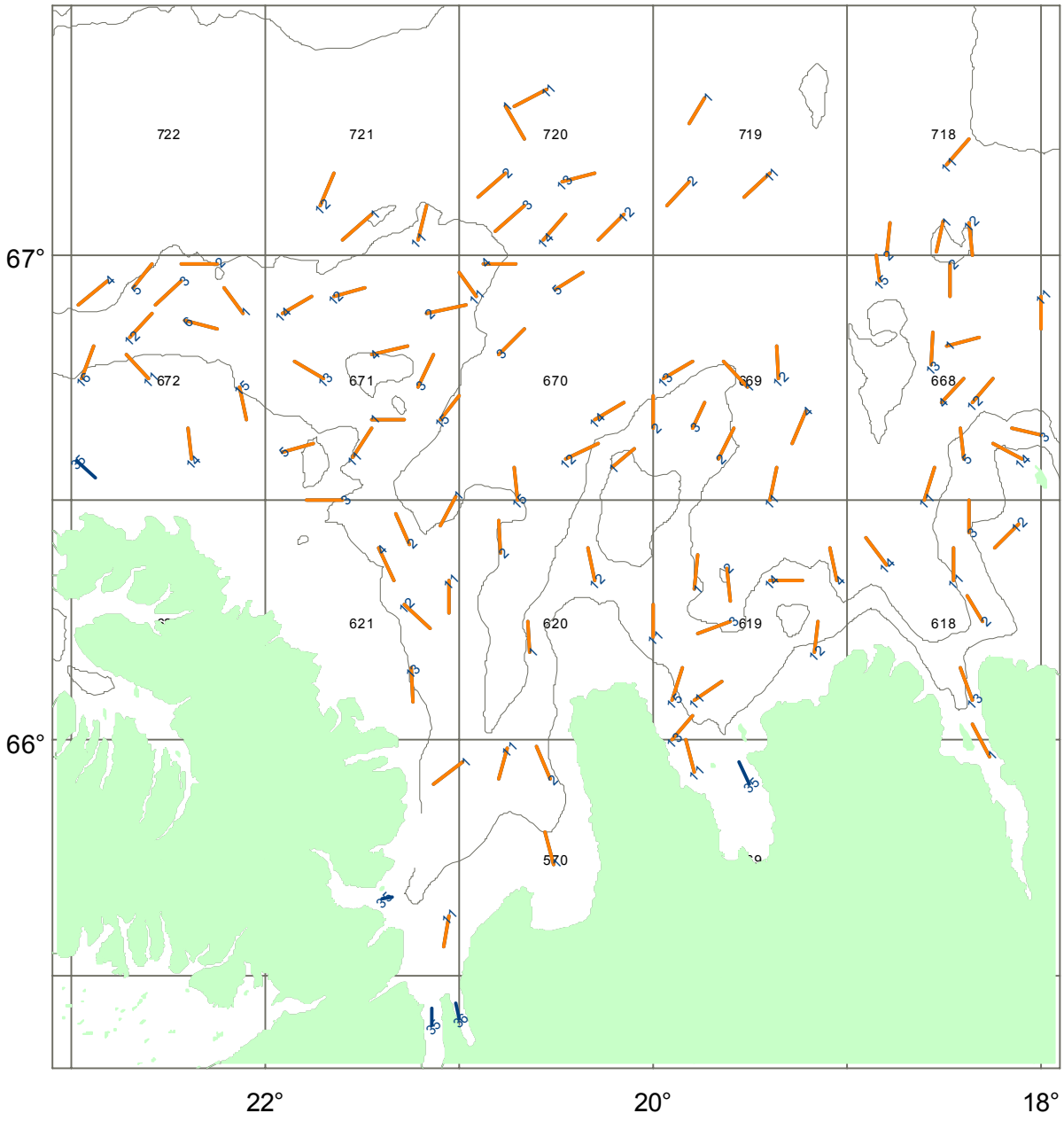


Figure 14. Stations in the survey area of the r/v Bjarni Sæmundsson. Additional stations in shallow waters are shown in blue.

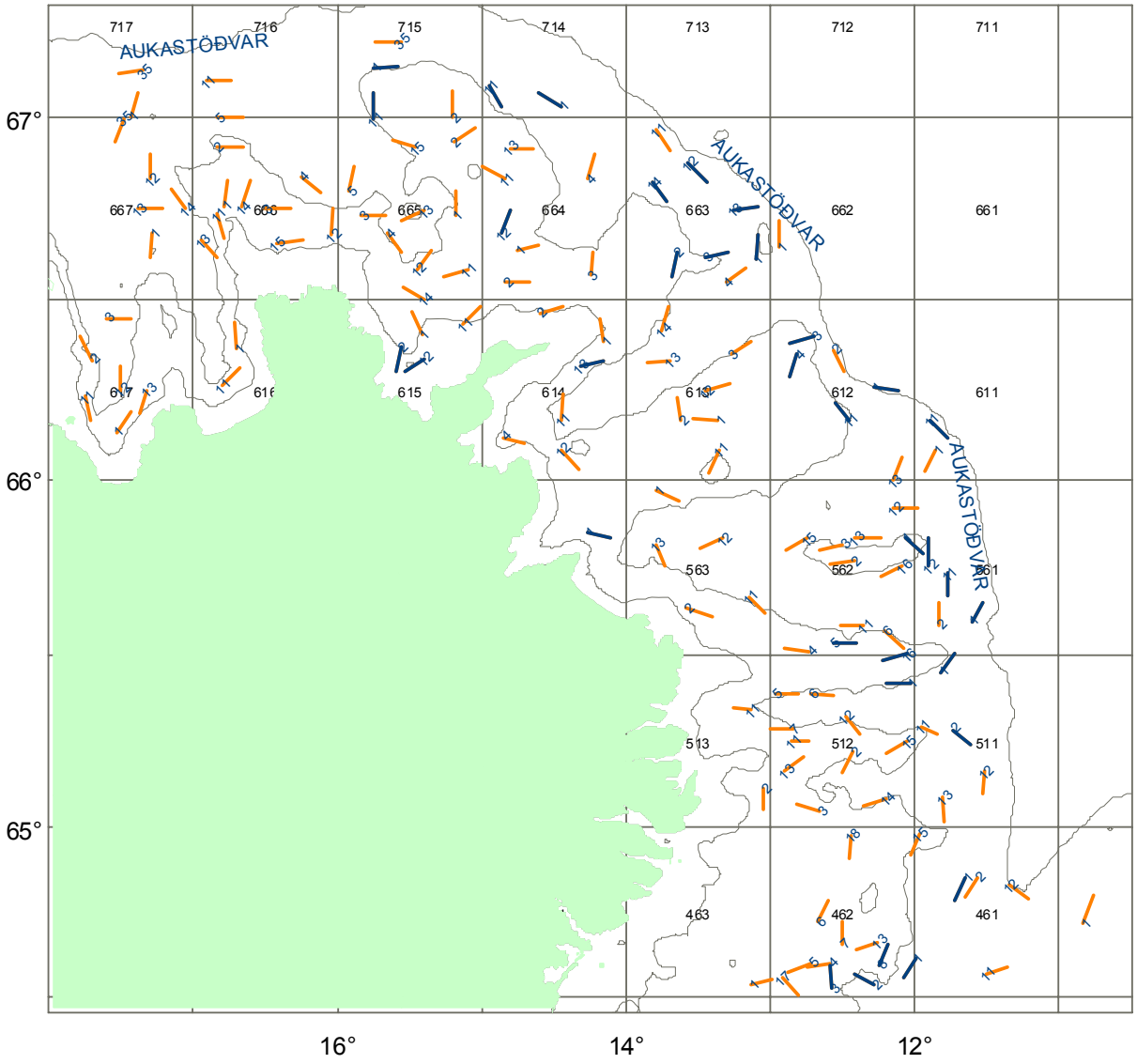


Figure 15. Stations in the survey area of the trawler Bjartur. Stations preferred for calibration are shown in blue. “AUKASTÖÐVAR” indicate areas where additional stations will be taken.

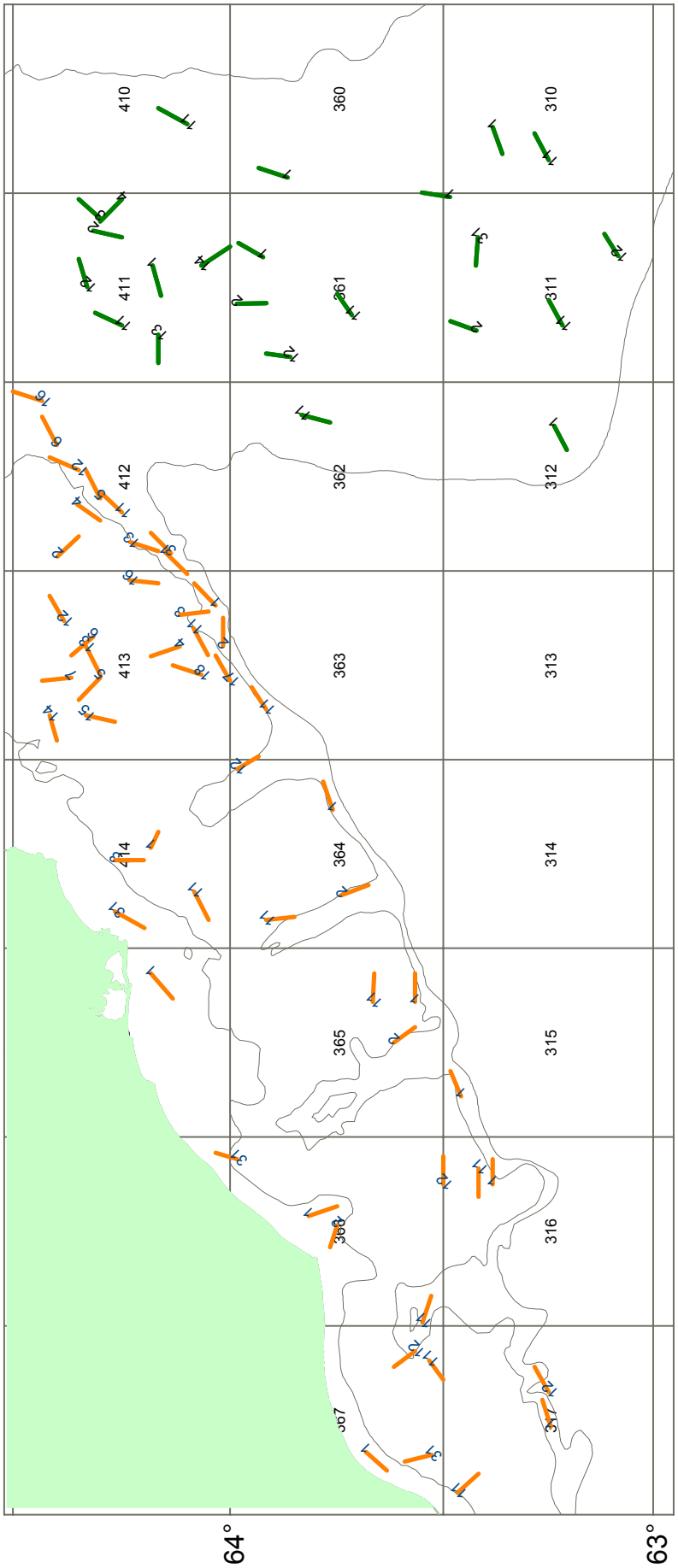


Figure 16. Stations in the eastern part of the survey area of the trawler Ljósafell and stations in the survey area of r/v Árni Friðriksson (shown in green).

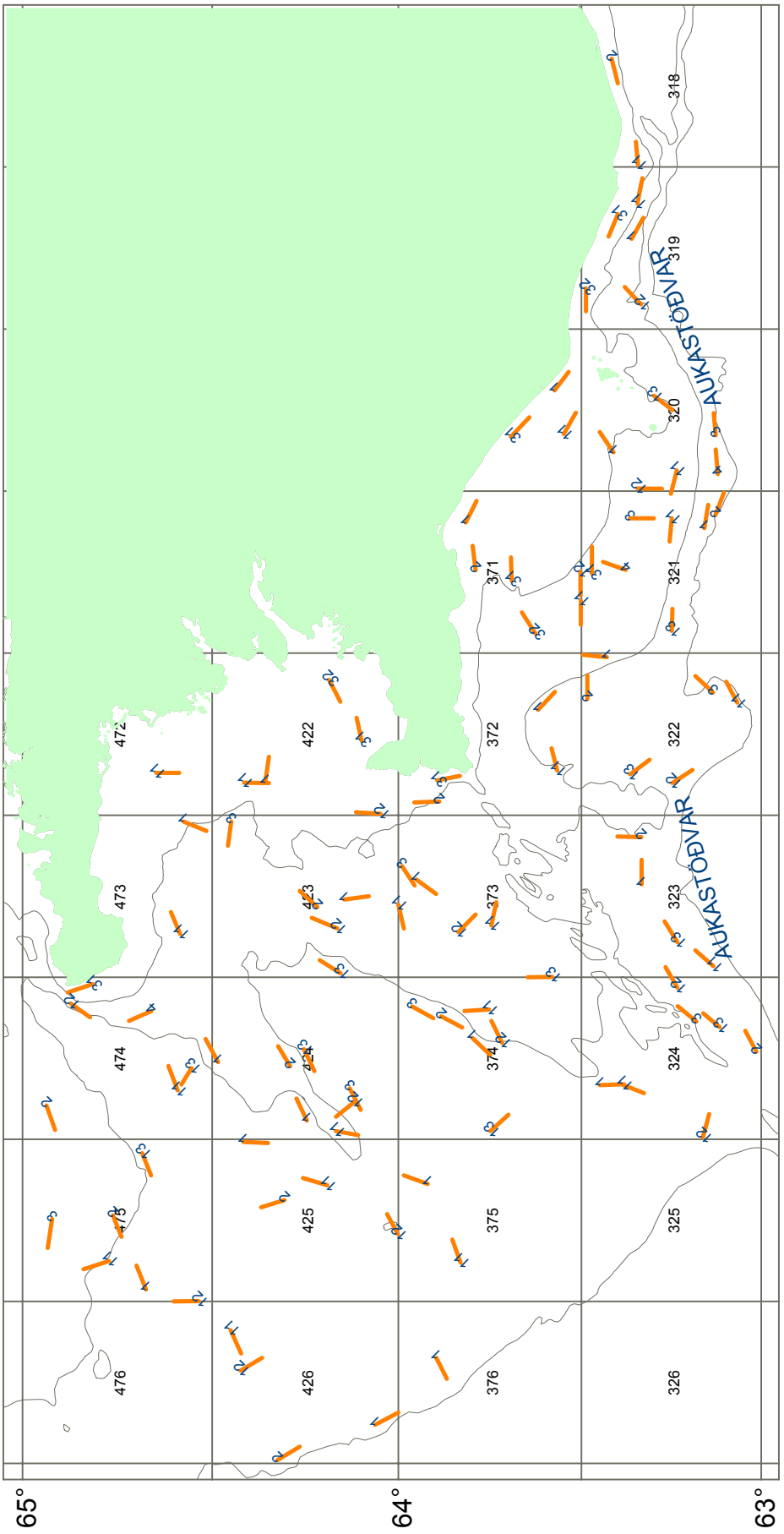


Figure 17. Stations in the western part of the survey area of the trawler Ljósafell. "AUKASTÖÐVAR" indicate areas where additional stations will be taken.

12 REMARKS AND NOTES ON TOWS

Below are listed remarks on "deviations from standard procedures" such as snags and rough bottom which have been recorded during the execution of the trawl survey as well as other useful information (e.g. change of towing-course) which have to be taken into account during a haul. The identification and/or location of each haul is indicated by statistical square number and tow number.

Note: position such as 65°55´75 N - 22°50´70 W are expesssed as 655575-225070.

Square	Haul	Year	Remarks
310	11	2005	The south end of haul relocated to a position north of seabed telephone-cable.
311	2	2005	Iron debris in belly and codend 2005; hauls 2006 and 2007 OK.
311	11	2006	Trawl snagged and stuck after towing 2,1 nm in position 633970-113844, towing-course 242°.
311	31	2005	A new haul added this year to the survey-series on Workingmans bank.
312	1	1988	Trawl snagged and got stuck after towing 3.0 nm in position 630924-121536, towing-course 180°.
	1	2005	Haul relocated due to new telephone-cable, slight snag, no gear damage.
	1	2007	Haul still relocated (north of cable), see new positions in haul station list.
313	2	2005	Trawl snagged, codend torn open, rest of the gear also damaged.
319	11	1989	Haul relocated due to sunken vessel (NANNA) position 631946-190148. Another shipwreck (?)
	11		in the vicinity, position 632075-190468.
	11	1993	Trawl snagged and got stuck in position 632013-190788.
		2001	Gear lifted due to rough bottom (ugly pinacles) after towing 2.8 nm, position 632009-190719.
319	31	1997	Trawl snagged and got stuck, gear lifted in position 632400-192000, towing course 108°.
	31	2003	Trawl snagged and stuck in position 622534-192493, not a valid haul. New positions (better bottom) recommended south off this location.
320	1	Gen.	Sunken vessel; position 8-8.4 nm from the island of Álsey, 3.0 nm from the rock Einidrangur.
320	11	Gen.	Sunken vessel (m/b BRYNJÓLFUR ?) in the vicinity, position 631382-205435.
320	13	1988	Trawl snagged and got stuck after towing 2.8 nm in position 631606-202928.
	13	1989	Trawl snagged and got stuck after towing. 2.3 nm in position 631579-203018.
	13	1993	Trawl snagged & stuck on pinacles in pos. 634552-203188. Haul relocated 1.0 nm toward NE.
	13	1998	Trawl snagged & got stuck after towing 1.8 nm in pos. 631614-203059, towing course. 27°.
	13	2001	Haul relocated, pos. 631414-203265/631799-202835, change tow. course in pos. 631593-202951.
320	3	1985	Trawl snagged and got stuck after towing 3.0 nm, position 630802-203264.
	3	2003	Trawl snagged & got stuck after towing 1.25 nm, position 630798-203387; towing course 264°.
321	1	2001	Haul relocated 0.1 nm toward E: The new positions (630954-211349/630874-210456).
	1	2006	Snag, gear lifted, codend torn open (boulders) haul repeated p. 630960-211350/630900-210471.
324	11	Gen	Change towing course 240° at position 632075-244002. (If towing toward N then change towing course after 2.44 nm to 190° and after towing 1.56 nm change the course to 230°).
324	13	Gen.	Do not tow beyond position 630985-241437 due to rough bottom (patches of corals).
324	3	1988	Gear lost in pos. 631182-241624. Be aware; the edge of lava field is close, very rough bottom.
	3	1994	Trawl snagged and got stuck after towing 3.7 nm, position 631107-241602; towing course 220°.
	3	2002	Gear lifted after towing 3.3 nm, position 631250-241675; very rough bottom ahead.
	3	2008	Trawl snagged and got stuck after towing 2.4 nm, position 631344-241512; towing course 35°.
360	1	2005	Slight snag, gear lifted, an opening torn on the lower belly net.
361	1	2005	Trawl snagged and the whole gear badly damaged, haul relocated toward W.
	1	2007	Boulders in codend; positions of haul 635560-112030/635890-111550, towing course 37°.
362	11	1994	Trawl snagged and got stuck after towing 3.5 nm, position 634650-121250; towing course 190°.
	11	2005	Trawl slightly snagged, net in lower wing torn and damaged.
364	2	1985	Trawl snagged and got stuck after towing 2.7 nm, position 634100-144100.
	2	1989	Trawl snagged and got stuck after towing 2.3 nm, position 634210-144126; towing course 175°.
366	12	2003	Trawl snagged and got stuck after towing 3.7 nm, position 633000-161420.
367	11	1993	Trawl snagged and got stuck after towing 3.5 nm, position 632980-171680; towing course 240°.
	11	1994	Trawl snagged and got stuck after towing 3.4 nm, position 633071-171394; towing course 240°.
367	31	1997	Trawl snagged & got stuck aft towing 3.3 nm, pos. 633060-173800. Haul relocated toward W.
371	32	Gen.	Be aware of sunken vessel (SKULD), position 633911-215165.
372	11	Gen.	Change towing course to 60° at position 633376-224026.
373	11	Gen.	Change towing course from 110° to 130° at position 634500-233600.
	11	2004	Trawl sank into muddy bottom and got stuck, after towing 2.6 nm, position 634460-233800.
	11	2005	Towing course eastbound, hazardous rock-step after 3.55 nm, gear lifted in pos. 634400-233279.
373	3	Gen.	Change towing course from 270° to 220° at position 6358-2325, due to hazardous bottom ahead.
374	11	1988	Trawl snagged and got stuck after towing 3.5 nm in position 634636-241214.
	11	1990	Trawl snagged & got stuck after towing 2.7 nm, in position 644838-241186; towing course 360°.
374	3	Gen.	Be aware of sunken vessel in position 635800-241214 at 188-190 m depth.
376	1	1994	Trawl snagged & got stuck after towing 2.5 nm in position 635301-262514; towing course 280°.
	1	2007	Ca 20 tons of redfish, codend and belly net busted.
411	11	1988	Trawl snagged and got stuck after towing 3 nm in position 641622-114069; towing course 200°.
	11	1991	Trawl badly snagged, gear lifted in position 641611-114199; towing course 200°.
412	3	2001	Trawl snagged & stuck aft. towing 3.3 nm, gear lifted, pos. 646792-125493; towing course 226°.
412	5	1996	Trawl snagged and stuck, gear retrieved in position 641980/123060, towing course 260°.
	5	2002	Trawl snagged and got stuck after towing 3.6 nm; position 641993-122903; towing course 60°.
413	5	2005	Trawl snagged and got stuck half way through the haul.
	7	2008	Trawl snagged and got stuck after towing 3.6 nm, position 642588-133770; towing course 35°.
413	11	2006	An opening torn on the codend net; invalid haul, repeated.
413	13	2001	Trawl snagged and got stuck after towing 2.5 nm, position 641908-1327712; towing course 63°.
	13	2002	Trawl snagged and got stuck after towing 1.0 nm, towing course 240°.

Square	Haul	Year	Remarks
413	14	2006	Snag; gear lifted and an opening torn on the codend net, not a valid haul, repeated.
	14	2007	Trawl snagged after towing 2.3 nm, gear lifted in position 642470-134927, towing course 70°, the net in the lower belly damaged.
414	1	Gen.	Note: The towing course is curved.
	1	2006	Slight snag, gear lifted, an opening torn on the condend net, haul repeated.
414	3	1989	Hazardous bottom, snags and the trawl got stuck; net of the whole gear badly torn.
	3	1990	Snag, net damages, northward towing course recommended.
414	11	2006	Snag; gear liften and an opening torn on the codend net, not a valid haul-length , repeated.
414	31	1997	Trawl snagged and got stuck after towing 2.3 nm, pos. 641396-145044; towing course 205°.
	31	2001	Trawl snagged and got stuck after towing 3.8 nm, position 641512-144905; towing course 25°.
	31	2002	Trawl snagged and got stuck after towing 2.4 nm, position 641416-145091; towing course 25°.
415	31	1996	Trawl snagged and got stuck after towing 2.0 nm, position 640760-154789; hazardous bottom.
	31	1997	Haul relocated due to very hazardous bottom; lava field. Note this new location is in fact outside statistical square 415 but due to coherency the number tag of the haul (415-31) is not changed.
423	1	1988	Trawl snagged and got stuck in position 640385-233163.
	1	1989	Trawl snagged and got stuck in position 640392-233166.
	1	1990	Trawl snagged and got stuck in position 640683-233149.
	1	1993	Trawl snagged and got stuck, gear door got lost. Sunken vessel in position 6404500-2331741.
	1	1995	Haul relocated to NW, po. 640522-233310, tow.course 360°; snag, stuck, net damaged, not valid.
	1	1997	Relocated 0.3 nm toward E; sunken vessel at S end of the haul, snag, got stuck close to the N end.
	1	2001	Trawl snagged and got stuck aft., towing 0.7 nm, position 640469-233198; towing course 35°.
	1	2005	Trawl snagged & got stuck aft. towing 0.5 nm, pos. 640479-232977, t.course 170°, net damaged.
423	2	1988	Trawl snagged and got stuck after towing 2.1 nm in position 641400-233260.
	2	1991	Trawl snagged and got stuck after towing 2.1 nm in position 641420-233190; tow. course 180°.
	2	1995	Trawl snagged and got stuck after towing 2.6 nm in position 641515-232970; tow. course 45°.
	2	2005	Trawl snagged and got stuck aft. towing 0.5 nm, tow. course 225°, opening torn on codend net.
423	11	Gen.	Change towing course to 260° at position 640000-233700.
	11	2001	Hazardous bottom, frequent snags, and gear damage. A valid haul-length was not achieved until in third attempt; a 2.3 nm long haul with positions (635998-232730/640000-233796).
423	12	?	Trawl snagged and got stuck after towing 3.7 nm, position 641350-233832; towing course 30°.
	12	2001	Trawl snagged and got stuck after towing 1.3 nm in position 641081-234136.
423	13	1993	Trawl snagged and got stuck after towing 2.0 nm in position 641137-235587.
	13	1996	Trawl snagged and got stuck in position 641166-235501.
	13	2001	Trawl snagged and got stuck in position 641169-255528.
424	1	1991	Trawl snagged and got stuck after towing 2.4 nm, position 641574-244910; towing course 245°.
	1	1998	Trawl snagged and got stuck after towing 0.8 nm, position 641516-245140; towing course 64°.
	1	2005	Trawl snagged and got stuck after towing 1.2 nm, position 641993-244805; towing course 75°. Another attempt yielded valid haul, positions 641564-245095/641655-244193; towing course 65°
	1	2009	Two unsuccessful attempts - snags & wrecked gear, not valid towing-length, haul-station abandoned.
424	2	1988	Trawl snagged and got stuck after towing 2.5 nm in position 641816-243066.
	2	1989	Trawl snagged and got stuck after towing 3.1 nm in position 641875-242839.
	2	1990	Trawl snagged and got stuck after towing 2.7 nm in position 641894-242795; towing course 60°.
	2	1991	Trawl snagged and got stuck after towing 2.4 nm, position 641850-243049; towing course 240°.
	2	2001	Trawl snagged and got stuck after towing 2.2 nm, position 641862-242864; towing course 60°.
	2	2005	Trawl snagged and got stuck haul repeated, positions 641914-242820/641733-243636; towing course 236°.
424	3	1993	Trawl snagged and got stuck after towing 2.2 nm, position 640704-244489; towing course 65°.
	3	1997	Trawl snagged and got stuck after towing 2.8 nm, in position 640750-244390.
	3	1998	Trawl snagged and got stuck in position 640674-244560; towing course 40°.
	3	2002	Trawl snagged and got stuck after towing 3.3 nm, position 641931-242768; towing course 60°.
	3	2008	Trawl snagged and got stuck after towing 2.1 nm, position 640707-244499; towing course 245°.
424	11	Gen.	Change towing course from 240° to 180° in position 641000-245900. (If towing northbound then change course after 2.6 nm to 360° and after 1.4 nm to course; 60°).
424	12	1986	Trawl snagged and got stuck in position 640740-244696.
	12	1989	Trawl snagged and got stuck in position 640962-245016.
	12	2002	Trawl snagged and got stuck in position 640950-245086; towing course 320°.
425	2	1989	Trawl snagged and got stuck after towing 2.3 nm, pos. 641945-252320; mud & silicon-sponges.
	2	1990	Trawl snagged and got stuck after towing 3.4 nm, position 642156 252443; towing course 340°.
	2	1991	Trawl snagged and almost got stuck after towing 2.3 nm, p. 242093-252470; towing course 340°.
	2	2003	Trawl snagged and got stuck after towing 2.4 nm, position 641890-243040; towing course 240°.
425	12	1991	Trawl snagged and got stuck after towing 2.1 nm, position 640107-253151; towing course 90°.
	12	1994	Trawl snagged, gear lifted after towing 3.2 nm, position 635996-253402; towing course 260°.
	12	2002	Trawl snagged and got stuck after towing 1.3 nm, position 640071-253284; towing course 64°.
426	1	1985	Trawl snagged and got stuck after towing 3.5 nm, position 640048-264142.
	1	2003	Trawl snagged and got stuck after towing 2.4 nm, position 640134-264062; towing course 162°.
426	2	2003	Trawl snagged and got stuck after towing 2.8 nm, position 641692-265465; towing course 160°.
461	12	1990	Trawl snagged and got stuck after towing 3.3 nm in position 644975-111748; towing course 315°, debris of silicon-sponges and bottom mud in the codend.
462	2	1990	Trawl snagged and got stuck after towing 3.5 nm, position 643455-122187; towing course 305°.
472	11	2004	Snags, hazardous bottom. Recommended to relocate the haul slightly eastward?
	11	2005	Valid hauls in length 2005 & 2006, positions 643938-224386/643570-224782; tow.course 305°.
	11	2008	Valid hauls in length 2007 and 2008. Position-haul-list as haul 2007.
473	1	1988	Trawl snagged and got stuck after towing 1.7 nm in position 643055-230370.
	1	1990	Trawl snagged and got stuck after towing 2.3. Position 643417-230451; towing course 20°.

Square	Haul	Year	Remarks
473	2	1987	Haul relocated more to the S due to hazardous bottom.
	2	Gen.	Very seldom a full 4.0 nm standard towing length due to hazardous bottom.
474	4	Gen.	Sunken vessel (BERGUR) in the vicinity, position 644283-241573.
	4	2007	Trawl snagged and got stuck after towing 3.8 nm, pos. 644160-241550; towing course 320°.
474	12	2001	Hazardous bottom between pos. 645217-241031 to 645184-241090 (the trawl lifted slightly ”over”
	12		these snags), latter positions 645245-240974/644917-241529. Total towing-length 3.3 nm.
	12	2008	Trawl snagged and got stuck after towing 3.4 nm, pos. 645188-241050; towing course 35°.
474	13	Gen.	Change towing course to 240° at position 643565-243694.
474	31	Gen.	Locate this haul 1.0 nm off the beach-cliffs, hazardous bottom more to the S.
475	12	1990	Trawl snagged and got stuck after towing 2.2 nm, position 643351-255974; towing course 180°.
	12	1995	Trawl snagged and got stuck after towing 2.2 nm, position 643390-255980; towing course 180°.
476	1	1988	Lost gear, (due to misreading of Loran C positioning system?). Wreck (airplane?) in the vicinity,
	1		position 644503-262505.
		Gen.	This haul was consequently dropped out of the haul-station list of the Bottom trawl survey
			Catalogue in 1989 but “revived” with new positions in 1990, see haul-station position list.
476	2	1996	Trawl snagged and got stuck in position 645718-262166; towing course 345°.
	2	1998	Trawl snagged & got stuck; repeated in 2 nm long haul, pos. 645670-262220/645870-262244.
	2	2007	Trawl snagged and got stuck after towing 1.5 nm in position 645809-262250.
476	3	1990	Trawl snagged and got stuck after towing 3.7 nm, pos. 645695-262220; towing course 248°.
	3	1997	Trawl snagged and nearly got stuck in position 645610-262236.
476	11	1991	Trawl snagged and got stuck after towing 3.7 nm, pos. 645629-261490; towing course 355°.
	11	1995	Trawl snagged and got stuck after towing 3.5 nm, pos. 645650-261512; towing course 355°.
477	11	1986	Trawl snagged and got stuck after towing 3.6 nm in position 645165-271293.
	11	1993	Trawl snagged and got stuck after towing 2.9 nm, pos. 645254-271282; towing course 165°.
	11	2002	Trawl snagged & got suck after towing 0.2 nm, position 645512-271438; towing course
			170°; haul repeated but got stuck again in position 645135-271247.
	11	2004	Trawl snagged & got stuck after tow. 2.0 nm, pos. 645249-271313, t.course 170°, net badly torn.
511	11	2003	Haul relocated due to new seabed telephone cable, see new positions in haul-station list.
512	5	2002	Trawl snagged and got stuck after towing 2.3 nm 652339-125264, towing course 90°.
	5	2003	Hazardous bottom, snag, net damaged, repeated in a 2.0 nm long haul.
512	12	2008	Steep hill-step at N-end of haul. Trawl shot at the step-bottom & standard 4.0 nm haul achieved.
513	11	2003	Haul relocated slightly due to new seabed telephone cable, see new positions in haul-station list.
521	35	2009	New haul added this year to the series. Initially added to the Autumn-bottom-trawl-survey 2008.
521	36	2009	New haul added this year to the series. Initially added to the Autumn-bottom-trawl-survey 2008.
523	12	2002	Hazardous bottom due to mud, trawl full of mud in first attempt, repeated.
523	31	Gen.	Hazardous bottom and very muddy toward SW; haul only 3.4 nm for many years. Haul slightly
			relocated in 2004 and a full towing length of 4.0 nm was possible.
525	1	2008	Trawl snagged and got stuck after towing 3.4 nm, pos. 650313-260077, t. course 293°; net torn.
525	2	Gen.	Very hazardous bottom, frequent snags and gear damage, haul expended from the series list in 1999.
525	3	1999	Trawl snagged and got stuck after towing 2.6 nm in position 650057-254262.
	3	2003	Trawl snagged and got stuck after towing 2.1 nm 650060-254280; towing course 266°.
525	12	Alm.	Hazardous rocky bottom, frequent snags with boulders in codend and consequent gear damage.
526	1	2002	Trawl snagged and got stuck in position 652500-263660; towing course 235°.
526	3	2006	Trawl snagged, net of bottom belly torn.
526	11	1992	Trawl snagged and got stuck after towing 3.4 nm in position 650903-263105.
527	11	Gen.	Hazardous bottom, frequent snags and consequent gear damage.
	11	1990	Trawl snagged and got stuck after towing 3.2 nm, position 650062-270900; towing course 255°.
	11	1992	Trawl snagged and got stuck after towing 2.4 nm, position 650121-270815; towing course 230°.
561	12	1994	Trawl snagged & almost got stuck after towing 3.5 nm pos. 654850-115400; towing course 360°.
562	3	1992	Trawl snagged and got stuck after towing 3.2 nm, pos. 654819-123744; towing course 254°.
562	15	2008	Trawl snagged and got stuck after towing 2.4 nm, position 654825-124982; towing course 240°.
563	11	1986	Trawl snagged and got stuck 2.4 nm in position 653828-130528.
	11	1989	Trawl snagged and got stuck, pos. 653811-130462; a NW-bound towing course recommended.
563	12	Gen.	A W-bound towing course recommended due to steep hill-steps at the West-most end of haul.
	12	2001	OK to tow E-bound course but the trawl should not touch the bottom W of longitude 132850.
563	13	2006	Hazardous bottom ”ugly pinacles”. Trawl snagged and got stuck at the southern-most end of the haul.
569	35	2009	A new haul added to the survey series in 2009.
569	35	2009	A new haul added to the survey series in 2009. Origin. a haul from Autumn-bottom-trawl survey.
570	11	2002	Trawl snagged and got stuck after towing 3.1 nm, position 655604-204722; towing course 200°.
571	1	2001	Hazardous bottom, haul terminated after towing 3.6 nm in position 655699-210001. A
			Southwest bound towing course recommended.
	1	?	Trawl snagged and almost got stuck in position 655460-210701. Some very heavy object entangled
			to the trawl which in the process of lifting eventually tore off the whole net from the gear.
571	11	2000	Trawl snagged and got stuck after towing 3.4 nm, pos. 653427-210478; towing course 200°.
	11	2003	Trawl snagged and got stuck in pos. 653442-210320. North-bound towing course recommended.
	11	2004	Haul slightly relocated due to muddy bottom, see positions in haul station list.
	11	2005	Trawl lifted after 3.4 nm, towing course 10° - the trawl doors were not spreading the net open
			enough due to mud.
571	35	2009	A new haul added to the survey series in 2009. Originally a haul from the Autumn-bottom-trawl survey.
			Note: A U-shaped haul.
574	4	Gen.	Hazardous bottom at N end of haul.

Square	Haul	Year	Remarks
574	5	Gen.	Hazardous bottom.
	5	1987	Trawl snagged and got stuck in position 654573-245919.
	5	1991	Trawl snagged and got stuck after towing 3.5 nm, pos. 654776-254141; towing course 43°.
574	13	Gen.	Hazardous bottom, snags and consequent gear damage, haul relocated in 2008.
574	14	Gen.	Hazardous bottom, frequent snags and consequent gear damage.
	14	1986	Hazardous bottom, haul relocated toward NW but hardly better bottom there.
	14	1990	Trawl snagged (and got stuck?) after towing 2.2 nm, position. 659774-244573.
	14	2001	Haul relocated to better bottom, see new positions in haul station list.
574	15	Gen.	Hazardous rocky bottom - haul located on a well known-lava field called ”Múlahraun” . Frequent snags with consequent gear damage & standard towing length of 4.0 nm seldom achieved.
574	15	2002	Haul relocated more to the E where bottom conditions were thought to be better.
	15	2008	Trawl snagged & got stuck after towing 2.9 nm, p. 654135-240826; t.course 26°, net damaged.
575	4	1992	Trawl snagged and got stuck after towing 3.5 nm in position 654973-251532.
575	7	Gen.	Hazardous bottom; snags, gear damage and standard towing length of 4.0 nm seldom achieved.
575	13	1999	Trawl snagged and got stuck after towing 3.2 nm in position 653008-254262.
575	14	2005	Hazardous bottom snags and gear damages, net of under belly damaged in two attempts.
	14	2007	Trawl snagged and got stuck after towing 3.5 nm, in position 653393-250006.
	14	2008	Haul relocated toward W on better bottom condition.
576	4	1989	Trawl snagged and got stuck after towing 2.0 nm; towing course 03°.
	4	1990	Trawl snagged and got stuck in position 655832-200275; towing course 03°.
576	12	Gen.	Frequent snags and consequent net damage, rarely standard towing length of 4.0 nm. A S-bound towing course towards shallower waters recommended.
611	11	1992	Trawl snagged & almost got stuck after towing 2.9 nm, p. 660788-114880; towing course 35°.
613	11	2002	Trawl snagged & almost got stuck after towing 2.3 nm, p. 660318-132346; towing course 205°. A N-bound towing course recommended.
613	13	1987	Haul relocated toward E due to steep bottom-ridge.
	13	1996	Trawl snagged and got stuck in position 662150-133350; towing course 75°.
614	2	1985	Trawl snagged and got stuck in position 2.2 nm in position 662900-142636.
	2	1986	Haul relocated due to hazardous bottom, see positions in haul station list.
617	13	1990	Trawl snagged and got stuck after towing 3.0 nm, pos. 661219-172108; towing course 300°.
618	12	2002	Trawl snagged and got stuck after towing 3.3 nm, pos. 662640-180843; towing course 45°.
618	14	2003	Muddy bottom; trawl snagged and got stuck after towing 3.2 nm, pos. 662272-184924; towing course 145°, sweeps broken.
	14	2005	Muddy bottom; the trawl doors did not spread the trawl open enough. Gear lifted after towing 2.8 nm; towing course 145°.
619	3	2008	Trawl snagged and got stuck after towing 2.3 nm, pos. 661423-194120; towing course 250°.
621	12	2002	Trawl snagged and got stuck after towing 2.3 nm, pos. 661556-211364; towing course 310°.
621	13	2008	A magnetic mine in the codend!!!!!
623	12	2005	Trawl stuck in mud after towing 2.0 nm, in position 661360-230490.
624	11	2004	Trawl snagged and got stuck after towing 2.1 nm, position 660162-243633, depth 95 m; gear badly damaged. Recommended to relocated the haul toward E.
624	13	1992	Trawl snagged and got stuck, haul slightly relocated towards WSW in positions 660930-243514/660861-244500.
625	14	1987	Trawl snagged and got stuck after towing 3.0 nm in position 661805-254375.
	14	1989	Trawl snagged and got stuck after towing 1.4 nm, towing course 45°.
665	5	1999	Trawl snagged and got stuck after towing 2.5 nm in position 664984-155435.
665	13	2002	Trawl snagged and got stuck after towing 3.3 nm, pos. 664457-152560; towing course 65°.
665	15	2001	Trawl snagged and got stuck after towing 2.0 nm in 665555-153054, towing course 110°.
666	11	1989	Trawl snagged and got stuck after towing 3.2 nm, pos. 664106-164816; towing course 167°.
	11	2001	Trawl snagged and got stuck after towing 2.3 nm in position 664293-164919.
666	2	2002	Trawl snagged and got stuck after towing 3.1 nm, position 665510-164200; towing course 90°.
666	14	1999	Trawl snagged and got stuck after towing 3.9 nm in position 664536-163888.
666	14	2002	Trawl snagged and got stuck after towing 2.3 nm, position 664770-163770; towing course 20°.
667	11	2001	Trawl snagged and almost got stuck after towing 3.2 nm, position 665109-175995; t.course 180°.
	11	2002	Recommended that the haul should be relocated 1.0 nm to the N.
667	35	2009	A new haul added to the survey series this year. Had been added as an ”extra haul” in 2008.
668	3	2001	Trawl snagged and got stuck after towing 2.9 nm, pos. 663803-180121; towing course 105°.
	3	2007	Trawl snagged and got stuck, pos. 663896-180703; towing course 110°, not valid haul-length.
668	12	2003	Trawl snagged and got stuck, position 664355-181781; towing course 220°.
668	15	Gen.	Haul has a curved shape, towing course toward west and then north.
670	4	2002	Trawl slightly snagged twice and got half stuck after towing 1.0 and 3.8 nm, towing course 270°.
	4	2003	Slightly relocated toward W, see new positions in station list.
670	15	Gen.	Muddy bottom; sweeps shortened to 35 fm.
671	5	2001	W-bound towing course, net torn in belly and wings; E-bound towing course recommended.
671	13	2008	Trawl snagged and got stuck after towing 3.1 nm, pos. 664575-214570; towing course 250°.
672	11	2007	Trawl snagged and got stuck after towing 2.6 nm, pos. 664672-224106; towing course 318°.
	11	2008	Trawl snagged and got stuck after towing. 2.1 nm, pos. 664670-224010; towing course 135°.
672	14	2002	Trawl snagged and got stuck after towing 2.6 nm, pos. 663636-222350; towing course 170°.
672	15	2000	Trawl snagged and got stuck after towing 3.0 nm, pos. 664098-220646; towing course 170°.
672	35	2009	A new (old) haul added to the survey series this year. Originally set up for this survey but had been ”abandoned” but later added to the Autumn-bottom trawl-survey series.
673	16	1992	Trawl snagged and got stuck in position 663200-225688.
673	21	Gen..	A ”new” haul added to the survey series in 2005.

Square	Haul	Year	Remarks
674	1	2004	Trawl snagged and got stuck after towing ca 2.5 nm; boulders in the codend. Explanation: In autumn 2003 an iceberg stranded at this very location and this happening seems to have created a boulder snag which did not exist there prior to that. Haul relocated to positions 664742-244269/665064-243670, depth 246 m and 201 m.
715	35	2009	A new haul added to the survey series this year. Had been added as an ”extra haul” in 2008.
716	11	2002	Steep hill-step at E-end of haul, trawl snagged and got stuck at the very beginning of towing. Haul relocated toward W in positions 670600-164410/670600-165440.
717	35	2009	A new haul added to the survey series this year. Had been added as an ”extra haul” in 2008.
718	1	Gen.	Haul curve shaped around a hill.
718	2	1987	Trawl snagged and got stuck after towing 3.6 nm.
	2	1997	Trawl snagged & got stuck at the very beginning of towing, pos. 670398-184527, net badly torn.
	2	2000	Trawl snagged and got stuck after towing 3.4 nm, pos. 670340-184576; towing course 200°.
	2	2001	Hazardous rocky bottom; N-end of haul relocated W of lava-field-edge.
718	12	Gen.	A curved haul on the 100 fm depth-edge, towing course A- and then S-bound
720	2	2003	Trawl snagged and got stuck after towing 3.5 nm, pos. 670755-205242; towing course 235°.
720	3	2008	Trawl snagged and got stuck after towing 2.3 nm, pos. 6704278-2044710; towing course 51°.

APPENDICES

APPENDIX 1: CALIBRATION OF TRAWL TEMPERATURE SENSOR AND USE OF PRE-CALIBRATED TEMPERATURE RECORDERS

There appears to be a strong relationship between bottom temperature and fish abundance in the IGS. It is important to strengthen these findings by calibrating the trawl temperature sensors of the survey vessels. This calibration is based on a comparison between temperature measurements made by Scanmar (or Furuno) trawl sensors and pre-calibrated temperature recorders from Star-Oddi (Starmon or DST milli).

The comparison is made according to following procedure:

1. Put the temperature recorder in measurement mode (see instructions in *SeaStar* program).
2. Fasten the trawl sensor and the temperature recorder at the end of a rope/trawl twine and sink to a sufficient depth.
3. Let the trawl sensor and temperature recorder adjust to the seawater temperature for at least 15 min so that reliable measurements are obtained. The measurement frequency of the temperature recorders needs to be adjusted so that several measurements are made.
4. Use the *SeaStar* program to retrieve data from the temperature recorder (see instructions below). After data retrieval, put the recorder in measurement mode.
5. Measurements from the temperature recorder are compared to measurements taken by the trawl sensor and a correction factor is calculated.
6. Preferably, the comparison needs to be made at 3 different temperatures (e.g. in the range of 0-6°C).

After the pre-calibrated temperature recorder has been used to calibrate temperature measurements from trawl sensors, it is put in measurement mode with a measurement frequency of 2 min. The temperature recorder is then fastened to the trawl to be used. Whenever the crew switches between trawls, the temperature recorder has to follow.

Instructions: The *SeaStar* program for Star-Oddi temperature recorders

See further information on *star-oddi.com* and in the Icelandic version of this manual.

APPENDIX 2: COLLECTING DATA FROM SCANMAR TRAWL SENSONS

Instructions on how to connect a PC to trawl sensor instruments in the wheelhouse, and how to use *Hyper Terminal* to collect and save text strings of data from the sensors. The text strings include informatioin on e.g. time, position, temperature, vertical opening of the trawl and distance between otter boards.

See further information in the Icelandic version of this manual.

APPENDIX 3: THE FOOD OF COD AND HADDOCK

1 Collection and registration of data

Stomach content is collected from cod and haddock, food items are identified aboard the research vessel. The data collected are based on single stomachs; one fish, one sample. Stomach content is analysed from the first 15 cod and 5 first haddock selected for otolith collection on each station. A care must be taken to ensure that these fish are representative of the otolith fish sample. Preferably the stomach content should be analysed concurrent to the otolith removal and weighing process and registered in *SeaScale* as described in chapter 2.

If it is impossible to analyse the stomach content along with the otolith removal and weighing, it can be postponed (see chapter 3). If this road is chosen, it is important that the connection between the individual fish in the otolith sample and the stomach sample is not lost. The connection is first of all the **station ID number**, then **species** and at last the **individual otolith ID number**, which is a running number for each species on each station. This care must also be taken if the analysis is registered on paper, using special form for stomach content analysis. If analysis of the stomach content is postponed, it must be labelled with the above information to ensure registration to the right individual fish.

2 Analysis of stomach content and registration in *SeaScale* during otolith removal and weighing process

After registering the gutted weight in the otolith removal and weighing process, the program asks for "Condition of stomach". Condition of stomach is graded into five categories:

1. Containing food
2. Empty
3. Regurgitated
4. Undigested remains
5. Everted

If condition of stomach is graded 2, 3 or 5 and has been registered as such, the data collection of that individual fish is finished and the program asks for the length of the next fish to be processed.

If condition of stomach is graded 1 or 4 the food items must be identified. That follows directly after registration of stomach condition.

1. Condition of stomach registered (1 or 4) and **ENT**-button pushed.
2. Food item is selected by using arrow buttons (up/down) or by punching the identification number of the food item (see list of food items) and accept by ENT-button. **If prey is to be measured it is done at this stage.**
3. **If food item (prey) is to be measured** select **F5** next as the food item has been selected and the program enters length measurements of prey. When all individuals of this particular prey have been measured, **F8** is used to go back one step in the prey.
4. Total number of that particular prey (measured and unmeasured) is registered and accepted by **ENT**-button. For food items where number of individuals cannot be estimated **F7** is used to skip that entry and continue to the next one (weight).
5. That particular prey group is put on the scale and the total weight accepted by **ENT**-button. The program now asks for the next prey group. When all prey has been identified, **F8** is used to enter next fish in the otolith removal and weighing process.

During analysis of stomach content the following should be kept in mind:

- All food items that **obviously** have been eaten in the trawl must be rejected, for example prey that is still alive. Fresh prey (but dead) could have been eaten just before the predator was caught by the trawl and must be accepted as valid.
- Fish prey should be identified to species level if possible, or else as far in the classification system as possible considering the conditions at hand. For each group of

prey, the total number must be counted or estimated and the group weighed. Those prey fish that have been identified to species and the total length is measurable, must be measured for length. It is especially important to measure the length of capelin, sand eels and cod-like fishes that are found in stomach samples.

- ◊ It is important to measure length, identify sex and sexual maturity of capelin that has not lost any length due to digestion. If sex or sexual maturity cannot be identified **F7** should be used to omit those registrations. For measurements of capelin in **F5** the following information should be registered:
  - Length
  - Sex
  - Sexual maturity
    - 1: immature
    - 2: mature (not spawned)
    - 3: spawning (running)
    - 4: spawned
    - 5: Uncertain stage
- ◊ When possible, 4x length distribution in cm should be measured, at a maximum of 50 individuals per station. It is important to measure capelin even if only one capelin is in the sample.
- ◊ Example of work arrangement when measuring length of capelin from stomach samples: Select **F5** after the food group capelin has been selected and the program enters measurements of prey. When all measurable capelin have been measured, use **F8** to get one step back into the food group. **Total number of capelin** (number measured and not measured) is registered and accepted by **ENT**-button. All the capelin is put on the scale and total weight accepted. When analysis of stomach content is finished **F8** is used to enter the next fish to be processed (the program asks for the length of next fish), and so on until the last fish of that species on that station has been processed.

- The shrimps *Pandalus borealis* and *Pandalus montaqui* should be identified to species when possible, **carapace length measured**, total number counted and the food group weighed.
  - ◊ It is important to measure the shrimps whenever a measurable shrimp is in the stomach content. In samples containing many shrimps it is important to randomise the measurements, don't choose only the big ones. On stations with many measurable shrimps in stomach contents it is sufficient to measure 20 individuals per station for each species.
- Other invertebrates shall be identified in accordance to the classification system to the extent of the knowledge of the researcher. The list of food groups that are recognised by the program should be kept in mind.
- The list of food groups is based on species or group identity number in the database of the Marine Research Institute. Most researcher know these numbers for common fish species (1 = cod, 2 = haddock, 28 = long rough dab, 31 = capelin, 301 = sand eels and so on), but rarely for invertebrates. As previously stated, the arrow buttons can be used to find the food group in the program if one does not know its identity number. To ease the search the historically most common food groups in stomach content of cod have been put at the top of the list.
- **All measurements of prey are registered in mm**. For measuring length of fish prey special measuring boards have been made with a 5 mm grid. Shrimps are measured using a caliper.

3. Analysis of stomach content and registration in *SeaScale* aside from otolith removal and weighing process

If analysis of stomach content is to be postponed, the **F8**-button is used after the condition of stomach has been registered during otolith removal and weighing process, by which the program asks for the length of the next fish. That is if condition of stomach has been registered as "containing food" or "undigested remains", but for other conditions the data sampling is now finished.

Starting the food analysis, the proper station is opened in the program and **Food analysis** chosen from the main menu. The fish species and the individual number of the fish (otolith number) are chosen and the analysis of stomach content continued as described above.

Species identity number (ID) of most common food groups. This list, showing the most common food groups, as well as a list containing more food groups, should be at hand during stomach content analysis.

Group	Array	ID nr.	Food group	Engl. name	Scientific name
	1	**31**	mall vil	**Capelin**	*Mallotus villosus*
	2	**301**	ammodytx	**Sand eels**	Ammodytidae
	3	**302**	pisces	**Fish unid.**	Pisces
	22	**28**	hipp pla	**Long rough dab**	*Hippoglossoides platessoides*
	23	**29**	heteroso	**Flatfishes**	Heterosomata
	24	**85**	lycodesz	**Eelpout**	*Lycodes* sp.
	25	**30**	clup har	**Herring**	*Clupea harengus*
	26	**75**	myctophx	**Lantern fishes**	Myctophydae
	27	**65**	lept mac	**Spotted snake blenny**	*Leptoclinus maculatus*
	28	**34**	micr pou	**Blue whiting**	*Micromesistius poutassou*
	29	**53**	trig mur	**Moustace sculpin**	*Triglops murray*
	30	**84**	lumpenix	**Blenny fishes**	Lumpenix
	31	**94**	lump lam	**Snake blenny**	*Lumpenus lampretaeformis*
Fish	32	**1**	gadu mor	**Cod**	*Gadus morhua*
	33	**2**	mela aeg	**Haddock**	*Melanogrammus aeglefinus*
	34	**300**	gadidaex	**Cod-like fishes**	Gadidae
	35	**5**	seba mar	**Redfish**	*Sebastes marinus*
	36	**60**	seba viv	**Norway haddock**	*Sebastes viviparus*
	37	**9**	anar lup	**Wolffish**	*Anarhichas lupus*
	38	**74**	arte atl	**Atlantic hookear sculpin**	*Artediellus atlanticus*
	39	**57**	rhin cim	**Fourbeard rockling**	*Rhinonemus cimbrius*
	40	**27**	lima lim	**Dab**	*Limanda limanda*
	41	**33**	tris esm	**Norway pout**	*Trisopterus esmarki*
	42	**88**	onog arg	**Silver rockling**	*Onogadus argentatus*
	43	**56**	lept dec	**Atlantic poacher**	*Leptagonus decagonus*
	44	**330**	arge sil	**Greater argentine**	*Argentina silus*
	4	**41**	pand bor	**Northern red shrimp**	*Pandalus borealis*
	5	**51**	pand mon	**Pink shrimp**	*Pandalus montaqui*
	6	**186**	euphausi	**Krill**	Euphausiacea
	7	**307**	hyperiid	**Hyperiids**	Hyperiidae
	8	**52**	hyme gla	**Northern ambereye**	*Hymenodora glacialis*
	9	**303**	natantia	**Shrimps unid.**	Natantia
Crustaceans	10	**271**	mysidace	**Opossum shrimps**	Mysidacea
	11	**306**	gammarid	**Gammariids**	Gammaridea
	15	**304**	hyas coa	**Arctic lyre crab**	*Hyas coarctatus*
	16	**182**	pagurusz	**Hermit crab**	Pagurus
	17	**190**	copepoda	**Copepods**	Copepoda
	18	**308**	crustace	**Crustaceans**	Crustacea
	19	**305**	decapoda	**Decapods**	Decapoda
	20	**40**	neph nor	**Norway lobster**	*Nephrops norvegicus*
	21	**403**	munidaz	**Galatheid crab**	*Munida* sp.
	12	**312**	ophiuroi	**Brittle stars**	Ophiuroidea
	13	**314**	polychae	**Bristle worms**	Polychaeta
	14	**313**	ctenopho	**Comb jellies**	Ctenophora
	45	**160**	cephalop	**Cephalopods**	Cephalopoda
	46	**311**	benthos	**Benthos unid.**	Benthos unid.
	47	**310**	gastropo	**Gastropods**	Gastropoda
	48	**309**	bivalvia	**Bivalves**	Bivalvia
	49	**199**	holothur	**Sea cucumbers**	Holothurioidea
Other	50	**180**	scyphozo	**Jellyfish**	Scyphozoa
	51	**444**	plathyhe	**Flatworms**	Plathyhelminthes
	52	**193**	chaetogn	**Arrow worms**	Chaetognata
	53	**457**	raja ova	**Ray egg cases**	*Raja radiata* ova
	54	**456**	pycnogon	**Pycnogonids**	Pycnogonidae
	55	**999**	unid	**Unidentifiable**	Unid.

APPENDIX 4: VESSEL CALIBRATION EXPERIMENTS: COMPARING R/V ÁRNI FRIÐIRIKSSON TO TRAWLER BJARTUR

In the E-area r/v Árni Friðriksson will be compared to the trawler Bjartur, as part of extensive vessel calibration studies that have taken place since 2001. R/v Árni Friðriksson will follow the track of trawler Bjartur and the aim is to sample a total of 40 station pairs. Preferred tows are those that have already been repeated by the same trawler (see Figure 8).

Objective

The aim is to estimate the catch efficiency of r/v Árni Friðriksson in comparison to a Japan built trawler, in order to evaluate whether it is acceptable to use r/v Árni Friðriksson as survey vessel in the IGS.

Methods

The main setup of the calibration experiments will be as follows: Trawler Bjartur will conduct survey tows in a conventional manner and r/v Árni Friðriksson will tow the same track about 2 hours later. In each tow pair, it is important that the vessels use exactly the same methods, e.g. regarding the track covered, towing speed and warp length. It is important that the distance between otter boards and vertical opening of the trawl is constantly recorded for both vessels.

Registration on the ”Station information form”

The tow number of the tows of r/v Árni Friðriksson is registered as 50+ the tow number of trawler Bjartur. E.g. if tow number of trawler Bjartur is 13, the tow number of r/v Árni Friðriksson is 63. Furthermore, prominently label the Station information form with "*Calibration tow*".

Data sampling

Before leaving harbour, it is necessary to check carefully if there is a danger of losing small fish, e.g. through interstices in processing lines and conveyor belts. Cruise leaders exchange data regularly and compare length distributions of main species, so that it is possible to react in time if there are some differences in methods used by researchers of the two vessels.

On trawler **Bjartur** all stations are conventional survey stations and data sampling is therefore according to the plan presented in this manual, with the exception that on calibration stations it is necessary to measure up to 8 times the length interval for cod, haddock and saithe. The research team of trawler Bjartur therefore has to know in advance whether r/v Árni Friðriksson will tow the same track. On r/v **Árni Friðriksson** the rule for the number of fish measured for length is the same as for trawler Bjartur. On the other hand, extraction of otoliths, estimation of sex and maturity and stomach analysis will not be conducted in calibration tows onboard r/v Árni Friðriksson.

- Tow speed should be about 3.8 knots.
- R/v Árni Friðriksson tows the same towing track as trawler Bjartur.
- Warp length is to be the same for both tows of each calibration tow pair.
- The distance between otter boards (horizontal opening) and height of headline (vertical opening) shall be constantly recorded.

APPENDIX 5: SAMPLING OF DAB FOR THE MONITORING OF SAND EEL

This project aims at using food of dab as an index on stock size and recruitment of sand eel (a part of a more extensive research on sand eel).

For this purpose, 20 dab are collected within each of the following statistical squares: 366, 318, 319, 370, 422, 523 og 524 or a total of 140 dab. **The dab are whole frozen**. The dab can be collected from the counted fish and/or the fish measured for length, but avoid rupturing the stomach when analysing sex and sexual maturity if samples are collected from the fish measured for length.

The 20 dab taken from each square do not need to be taken from the same station. All dab from the same station are put in plastic bags, labelled with the **Cruise ID and Station number** and frozen as soon as possible. Dab from each square are put in a separate box and labelled with **Cruise ID and "DAB project 27.30".**

Area	**Square**	**Vessel**	**No. of dab**
S-area	366	Trawler Ljósafell	20
	318	-	20
	319	-	20
	370	-	20
	422	-	20
Total			**100**
W-area	523	Trawler Páll Pálsson	20
	524	-	20
Total			**40**

APPENDIX 6: SAMPLING OF CEPHALOPODS

Registration and sampling of cephalopods has been inadequate during most of the history of the bottom trawl survey. For many years this class of the animal kingdom was paid little systematic attention to in the bottom trawl survey. Now, for several years the European flying squid (*Todarodes sagittatus*) has been recorded under the species number **639.** All other cephalopods have not been identified to species but recorded (counted and sometimes length measured) under one common species number, namely **44**. This situation is mainly due to rather poor and scattered knowledge of cephalopods in Icelandic waters and a lack of "handy" field guide for species identification. A decision has now been taken to compile such a field guide which not only shall contain keys for identification of species but also information about their distribution in Icelandic waters.

The basis for such a work is the collection of further information about the cephalopod fauna in Icelandic waters. The available data is mainly single recordings of rare species but systematic recordings of the distribution of even common species has been lacking. Therefore a plan of systematic sampling has been set up for both the spring- and the autumn bottom trawl surveys. The plan is to sample and preserve by freezing all cephalopods caught in the surveys. The samples will then be processed further ashore, i.e. species identification, photographs taken for possible use in a field guide to point out key-marks and drawing of distribution lines as it is clear that in Icelandic waters there are both warm- and coldwater species and also quite cosmopolitan species.

Sampling plan and instructions

All cephalopods caught shall be collected (except European flying squid which is already registered and length measured within the frame of these projects; species nr. **639**). The specimens shall be put into plastic bags (which contain information tag, i.e. station number etc.) and preserved by freezing. Note that if many specimens obviously of the same species are caught at the same station, only one should be collected but the number of specimens recorded on the tag in the sample bag. Different species at one station shall preferably be put into separate sampling bags. An electronic book-keeping should be kept over sampled and counted cephalopod specimens (except *Todarodes*) under the species number **44** where total number (collected and counted) of cephalopod samples at each station should be registered. Note that some of the bobtail squids (Sepiolids) such as the, Atlantic bobtail (*Sepiola atlantica*) found here off the South-coast are very small, sometimes only 2-3 cm in total length.

APPENDIX 7: SAMPLING OF COD FOR MONITORING OF MARINE ENVORONMENT (AMSUM PROJECT)

The Marine Research Institute takes part in an international monitoring of the state of the fishing grounds in the Northeast Atlantic, with respect to polluting substances and other trace substances. Pollutants measured include heavy metals (e.g. mercury, lead, cadmium, zink, copper, selen and arsene) and persistent organic pollutants (e.g. PCB and DDT).

Sampling plan in 2009:

	S-area Trawler Ljósafell	W-area Trawler Páll Pálsson	N-area RV Bjarni Sæmundsson	E-area Trawler Bjartur
Cod	25	25	25	25

Size:
Cod 30-45 cm.

Sampling area:
Samples can be collected anywhere within the given areas (see Maps). Samples can be collected at several stations.

Handling of samples, packing and labelling:
It is important that the fish and equipments are kept clean of oils or any other smutch and dirt.

- The length and ungutted weight of the fish are measured and the sex recorded (male/ female). This information is registered on a form that is included in the sampling kit.
- The liver is extracted from the fish, put in a glass jar and closed tightly. Note that the jars are cleaned thoroughly and should not be kept open for a longer time than necessary. When the livers are in the jars, the jars should be kept in an upright position so that the livers will not touch the lid. Note also that labels are not to be put into the jars. The lids of the jars are labelled by running numbers according to the number of the fish in the form, using permanent markers.
- Other viscera are extracted from the fish and thrown away. The fish is put in a plastic bag, labelled with the number of the jar [the number of the sample].
- On the forms the following information is to be registered: Cruise and station number – number of sample – ungutted weight – gender of the fish.
- The samples are put in the freezer immediately after data collection at the station is finished – both the fish and the jars containing livers.

Fish from the same station can be put together in a separate plastic bag – identified by the cruise and station number. The fish are to be frozen in a straight position.

APPENDIX 8: SAMPLING FOR MATÍS: PROJECT „Grandskoðum þann gula“

This project involves cooperation between Icelandic Food Research (Matís), Marine Research Institute, The Directorate of Fisheries and HB Grandi. The project is supported by the AVS R&D Fund of Ministry of Fisheries in Iceland.

Objectives

- To gather information on the following properties of cod throughout the process from fishing to the dish.
  - Chemical substances in the flesh, i.e. nutritive elements and undiserable substances.
  - Flesh processing quality and utilisation.
  - Liver condition in respect to utilisation and fish (stock) condition.
- The relationships of the above properties will be studied, with respect to time of year, fishing areas, sex, maturity, age, fishing conditions, processing and storage. The aim is to maximise the profit of the cod catch.

Vessel	Area	Livers (no.)	Intestines (no.)	Whole cod for processing analyses (no.)	Whole cod for chemical analyses (no.)
Trawler Ljósafell	S	50	50		5 (frozen)
Trawler Páll Pálsson	W	50	50	30 (on ice)	
Trawler Bjartur	NE	50	50		5 (frozen)
R/v Árni Friðriksson	SE	50	50		5 (frozen)

Methods at sea

Sampling: Randomly select 50 cod from the catch (all sizes).

1. Attach a plastic tag to fish to be iced or frozen (not needed if only livers and intestines are sampled).
2. Measure the total length of the fish.
3. Measure the ungutted and gutted weight.
4. Estimate sex and sexual maturity stage (1-4)
5. Measure liver weight and put livers in jars labelled with sample id number – put in freezer.
6. Other viscera/intestines are put in a plastic bag, labelled and frozen.
7. Gutted cod.
   a. **Cod for chemical analyses:** The tagged fish is put in a plastic bag and frozen.
   b. **Cod for processing analyses:** The tagged fish are put in a fish tub and landed. Contact the nearest employee of Icelandic Food Research.
8. Information needed
   a. Fishing area (position N and W, start and end of the haul)
   b. Towing depth (start and end)
   c. Bottom temperature
   d. Time of day and duration of the haul
   e. Total catch of the haul

APPENDIX 9: SAMPLING FOR MATÍS: PROJECT "UNDESIRABLE SUBSTANCES IN ICELANDIC MARINE CATCHES

This project was started in 2003 at the request of the Icelandic Ministry of Fisheries. Until then, monitoring of undesirable substances in the edible portion of marine catches had been rather limited in Iceland. The purpose of the project is to gather information and evaluate the status of Icelandic seafood products in terms of undesirable substances. Substances measured include: heavy metals, dioxins and dioxin like PCB, marker PCBs, brominated flame redurdants (PBDE), Polyaromatic hydrocarbons (PAH) and pesticides. Below are instructions on how samples shall be collected.

The substances are found in low concentrations in the flesh and it is important to avoid any external contamination. Take care that the fish do not come into contact with any source of contamination.

All samples except cod:

1. The fish is bled when applicable.
2. Each fish is put in a plastic bag.
3. A label containing the following information is put in a small plastic envelope, and the envelope put in the plastic bag for each fish.
   a. species
   b. station number
   c. size class
   d. date
4. Each sample is put into a separate box (or bag) and carefully labelled.
5. Finally the whole sample is frozen.

Samples of cod

1. Ovaries and livers are removed in the following way:
   a. The knife is washed with Aceton, milliQ-water, Citrat/EDTA solution, milliQ water in this order. Note: End with washing several times with milliQ water.
   b. Ovaries and liver are carefully cut from the fish and put in separate jars labelled with station, size class and date. Avoid contact of ovaries and livers with other surfaces that have not been washed with the solutions.
   c. The gutted fish is labelled and frozen whole as other fish (see 2-5 above)

Sample	Species (size class)	Area	Number	Size class	Vessel
1	Herring	N- and S-areas	30-40	20-30	R/v Árni F. and r/v Bjarni S.
2	Herring	N- and S-areas	30	31-40	R/v Árni F. and r/v Bjarni S.
3	Haddock	NW-area	10	30-39	R/v Bjarni Sæmundsson
4	Haddock	NW-area	10	50-59	-
5	Cod	NW-area	10	45-59	-
6	Cod	NW-area	10	75-89	-
7	Cod ovaries	NW-area	10	45-59	-
8	Cod ovaries	NW-area	10	75-89	-
9	Cod livers	NW-area	10	45-59	-
10	Cod livers	NW-area	10	75-89	-
11	Cod	E-area	10	45-59	R/v Árni Friðriksson
12	Cod	E-area	10	75-89	-
13	Cod ovaries	E-area	10	45-59	-
14	Cod ovaries	E-area	10	75-89	-
15	Cod livers	E-area	10	45-59	-
16	Cod livers	E-area	10	75-89	-

APPENDIX 10: COLLECTION OF HERRING FOR STUDYING ICHTYOPHONUS-INFECTION

In autumn 2008, a severe infection by the parasite *Ichthyophonus hoferi* was observed in the stock of the Icelandic summer spawning herring. An extensive sampling program was initiated in order to estimate the dispersion and frequency of the infection in areas where herring is abundant. Since sampling stations in the IGS are distributed all over the Icelandic continental shelf, the survey could be used to get a more comprehensive knowledge of the infection. Therefore, herring will be collected in 2009 according to the following sampling plan.

For all stations where **more than 20 herring** are caught, a maximum of **50 herring** are collected and frozen. At each station, the sampled herring are put in a plastic bag and labelled (paper sheet in plastic envelope) with cruise ID and station number. The cruise leader prepares an overview of the sampling, to be returned to the project coordinator at the end of the cruise.

If facilities for freezing the samples are limited, they can be put on ice and frozen immediatly after the cruise or during landing break.

In the 2005-2008 surveys, the number of stations where more than 20 herring were caught were

Year	W-area	S-area	E-area	N-area	Total
2008	2	8	13	1	24
2007	15	4	4	9	28
2006	9	20	1	0	30
2005	12	3	0	0	15

APPENDIX 11: LIST OF TRAWL SPARE PARTS

The following table shows the number of spare parts onboard each vessel. The crew and cruise leader pay attention to the spare parts supplies as the cruise progresses and take necessary action if some parts are about to be finished. At the end of the cruise a list should be made showing the number of spare parts used.

Ready-made spare parts (in Icelandic)	No.
Yfirvængir	4
Miðnet	2
Undirvængir	4
Yfirbyrði 1. og 2. sp. samansaumaðar	2
Undirbyrði 1 - 4 sp. samansaumaðar	1
Undirbyrði 1. og 2. sp. samansaumaðar	3
Undirbyrði 1. spóla	1
Undir / yfirbyrði 2. spóla	1
Undirb/Yfirb: 3. og 4 sp. samansaumaðar	1
Undirb/Yfirb: 3. spóla	2
Undirb/Yfirb: 4. spóla	2
Codend inside cover 41 mm	1

Mending net pieces	No.
Mending net piece 4 mm single 135 100x58,5	1
Mending net piece 4 mm single 135 100x 33	1
Mending net piece 4 mm double 135 100 x 32	1
Mending net piece 4 mm, 80 mm 250 x99,5	1
Mending net piece 2.2 mm, 41 mm 200 x 100	1
Mending net piece 2 x 6 mm, 135 mm 61x29,5	1
Mending net piece 2 x 6 mm, 155 mm 54 x 46,5	1

Lines and legs	No.
Belly lines: 6 m, (0.4 chain + 5.6 m ,12 mm dyn)	1
Fishing line legs 1.8 m, 18 mm wire	2
Headline legs: 6.40, 18 mm wire labelled	2
Klafaleggir: 5,5.m 16 mm vír.	4
Flying wing wire rope : 12.53 m, 18 mm Manilla	2

Other	No.
Spacers	5
Codend mats	2
Floats 1086	10

MARINE RESEARCH INSTITUTE

Manual for

THE ICELANDIC AUTUMN GROUNDFISH SURVEY IN 2009

PROJECT COMMITTEE:

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CONTENTS

1 PREFACE

The Icelandic Autumn Groundfish Survey (AGS) has been conducted annually since 1996 by the Marine Research Institute (MRI). The objective is to gather fishery independent information on biology, distribution and biomass of demersal fish species in Icelandic waters, with particular emphasis on Greenland halibut (*Reinhardtius hippoglossoides*) and deepwater redfish (*Sebastes mentella*). This is because the Icelandic Groundfish Survey (IGS) conducted annually in March does not cover the distribution of these deep-water species. Another aim of the survey is to obtain a second valuation on biomass and biology of demersal species, such as cod (*Gadus morhua*), haddock (*Melanogrammus aeglefinus*) and golden redfish (*Sebastes marinus*), in order to improve the precision of stock assessments.

AGS is conducted in October, which is a suitable month in relation to diurnal vertical migration, distribution and availability of Greenland halibut and deep-sea redfish. The research area is the Icelandic continental shelf and slopes within the Icelandic Exclusive Economic Zone to depths down to 1500 m. The research area is divided into a shallow-water area (0-400 m) and a deep-water area (400-1500 m). The shallow-water area is the same area as covered by IGS. The deep-water area is directed at the distribution of Greenland halibut, mainly found at depths from 800-1400 m west, north and east of Iceland, and deep-sea redfish, mainly found at 500-1200 m depths southeast, south and southwest of Iceland and on the Reykjanes Ridge.

Initially, 430 stations were divided between the two areas. Of them, 150 stations were allocated to the shallow-water area and randomly selected from the IGS station list. In the deep-water area, half the 280 stations were randomly positioned in the area. The other half were randomly chosen from log-books of the commercial bottom trawl fleet fishing for Greenland halibut and deep-sea redfish in 1991-1995. The locations of those stations were, therefore, based on distribution and pre-estimated density of the species.

MRI was not able to finance a project in order of this magnitude and it was decided to focus the survey in the deep-water area on Greenland halibut. For this reason, important deep-sea redfish areas south and west of Iceland were omitted. The number of stations and the location in the shallow-water area were kept unchanged.

Thus, the number of stations in the deep-water area was reduced to 150. A total of 100 stations were randomly positioned in the area. The remaining stations were located on important Greenland halibut fishing grounds west, north and east of Iceland and randomly selected from a log-book data base of the bottom trawl fleet fishing for Greenland halibut 1991-1995. The number of stations in each area was partly based on the total commercial catch.

With the arrival of a new research vessel in 2000, MRI was able finance the project according to the initial plan. Stations were added to cover the distribution of deep-sea redfish and the location of the stations was selected in a similar manner as for Greenland halibut. A total of 30 stations were randomly assigned to the distribution area of deep-sea redfish and 30 stations were randomly assigned to the main deep-sea redfish fishing grounds based on log-books of the bottom trawl fleet in 1996-1999.

In addition, 14 stations were randomly added in deep-water areas where great variations had been observed in 1996-1999. However, because of rough bottom which made it impossible to tow, five stations had to be omitted. Finally, 12 stations were added in 1999 in the shallow-water area, making total stations in the shallow-water area 162. Total number of stations taken since 2000 has been around 381 (Table 1).

The R/V “Bjarni Sæmundsson” has been used in the shallow-water area from the beginning of the survey. In the deep-water area MRI rented one commercial trawler in 1996-1999, but in 2000 the commercial trawler was replaced by the R/V “Árni Friðriksson” (Table 1).

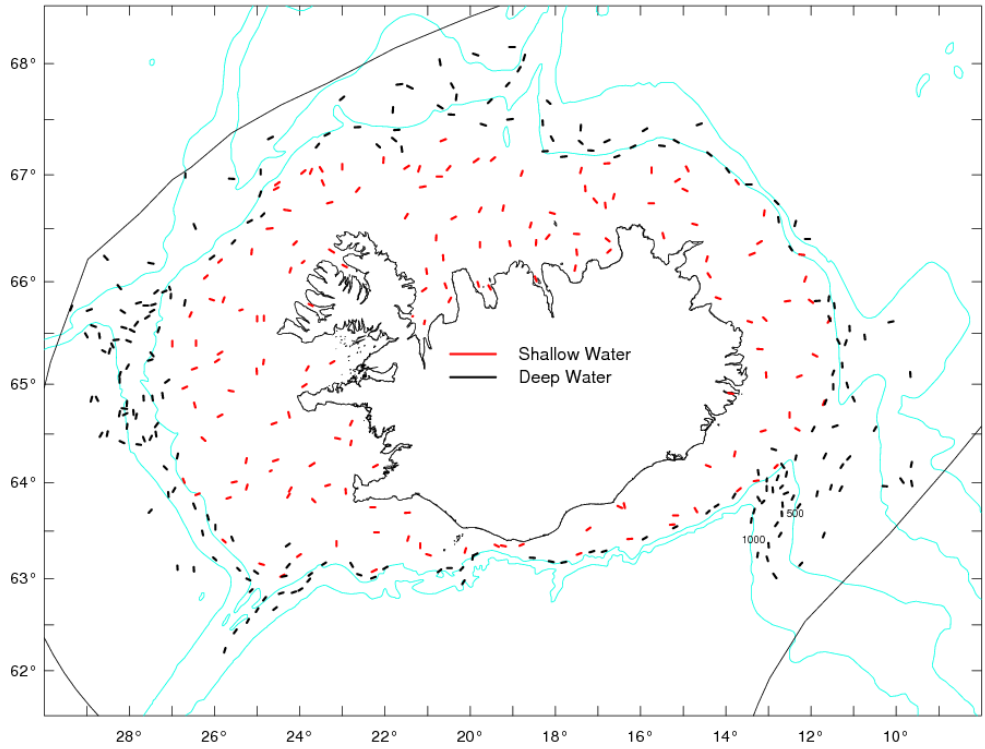


Figure 1. Stations in the Autumn Groundfish Survey (AGS). R/v "Bjarni Sæmundsson" takes stations in the shallow-water area (red lines) and r/v "Árni Friðriksson" takes stations in the deep-water areas (black lines).

Table 1. Vessels used in the Autumn Groundfish Survey 1996-2009, their survey areas, and the number of stations taken.

	Shallow-water		Deep-water		
Year	Vessel name	No. of stations	Vessel name	No. of stations	Total stations
1996	r/v Bjarni Sæmundsson	146	Múlaberg ÓF 32	144	290
1997	r/v Bjarni Sæmundsson	150	Brettingur NS 50	149	299
1998	r/v Bjarni Sæmundsson	153	Brettingur NS 50	144	297
1999	r/v Bjarni Sæmundsson	166	Brettingur NS 50	149	315
2000	r/v Bjarni Sæmundsson	163	r/v Árni Friðriksson	219	382
2001	r/v Bjarni Sæmundsson	161	r/v Árni Friðriksson	219	380
2002	r/v Bjarni Sæmundsson	162	r/v Árni Friðriksson	221	383
2003	r/v Bjarni Sæmundsson	162	r/v Árni Friðriksson	220	382
2004	r/v Bjarni Sæmundsson	162	r/v Árni Friðriksson	220	382
2005	r/v Bjarni Sæmundsson	162	r/v Árni Friðriksson	219	381
2006	r/v Bjarni Sæmundsson	162	r/v Árni Friðriksson	219	381
2007	r/v Bjarni Sæmundsson	162	r/v Árni Friðriksson	219	381
2008	r/v Bjarni Sæmundsson	186[1)]	r/v Árni Friðriksson	219	405
2009	r/v Bjarni Sæmundsson	178[1)]	r/v Árni Friðriksson	219	397

[1)] Extra stations were added in the shallow water area, see Section 8.1.2.

2 PREPERATION OF THE CRUISE

Before leaving harbour, it is necessary to check whether all instruments are onboard and in working condition. The working area must be prefixed and scales, computers and headsets must be connected and checked. It must be checked carefully if there is a danger of losing small fish, e.g. through interstices in the processing lines or conveyor belts. The cruise leader, together with vessel members, checks whether the trawls conforms to standardized specifications and if instruments used for measuring gear geometry and environmental parameters are onboard and working.

3 DATA COLLECTION (BIOLOGICAL SAMPLING)

3.1 Length measurement, counting (sub-sampling)

Length of all fish species is measured (a sample or the whole catch). For the majority of species, total length is measured to nearest cm from the tip of the snout to the tip of the longer lobe of the caudal fin (Figure 2). For grenadier species, the pre anal-fin length is measured to the nearest cm from the tip of the snout to the base of the first anal-fin ray (Figure 2, see also species list in Appendix 10.4). The length of the squid *Todarodes sagittatus* is measured as mantle length.

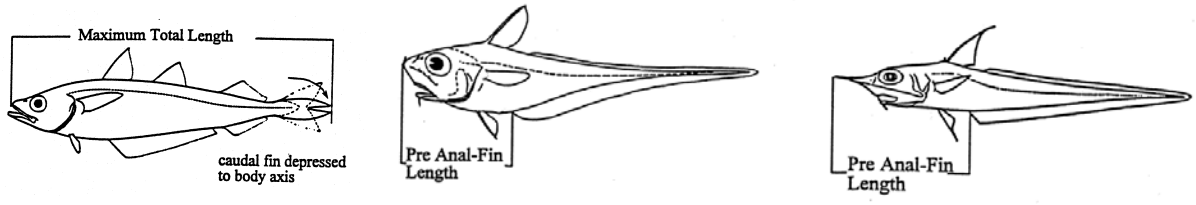


Figure 2. Common length measurements ---------- Length measurements of grenadiers ----------

Number of individuals measured: For each station, the general rule is to **measure at least 4 times the length interval of a given species.** For **Greenland halibut, deep-sea redfish, and golden redfish** the rule is to measure at least 5 times the length interval, whereas at least 2 times the interval for **long-rough dab and thorny skate** (Table 2). For other species, it is sufficient to measure 20 individuals at each station (Table 3). If the number of individuals exceeds these limits, the rest must be counted. The quantity of northern shrimp is estimated and recorded as kg, whereas Norway lobster is recorded in numbers.

Example of length measurements using the rule of “4 times the length interval”: If the continuous length distribution of cod is between 20 and 100 cm, the length interval is 80 cm and the number of measurements needed is 320. If the catch of cod at this station exceeds 320 individuals, the rest must be counted.

If, for some valid reasons it is not possible to apply the above rules for a given species, **IT IS ABSOLUTELY NECESSARY TO MEASURE THE LENGTH OF AT LEAST A PART OF THE INDIVIDUALS.** Overview of the magnitude of the length measurements and species list are found in Tables 2 and 3.

Samples for length measurements must be **randomly collected** so that the fish measured will reflect the length distribution of the total catch. If the length distribution is highly skewed, e.g. a relatively high abundance of small individuals, researchers must be especially careful in order to get a representative sample from the catch. There is a considerable risk that larger fish will be measured in higher proportions than the smaller fish. An example: A great number (hundreds) of haddock juvenile (11-20 cm) is in the catch but only 20 haddocks larger than 30 cm. **A decision is made to measure about 10% of the juvenile and therefore only 10% of the larger haddock should be measured, or 2 individuals.**

EXCEPTION: If the length distribution of a species is highly skewed and it is almost impossible to get a representative sample using the methods described above, it is possible to use the option “lengdarbilsháð talning” (length-based counting) in the *SeaScale* data collection program. This option should only be used as an exception. Using the haddock example above, it would be possible to measure about 4 times the length distribution of the haddock fry and all the larger haddock. The

counting is then assigned to haddock at the length interval of 11-20 cm. This method is described in details in the manual for the *SeaScale* Program.

3.2 Sex and maturity identification

For the following species, the sex and stage of maturity of individuals measured for length is also recorded (Table 2): **Blue ling, Atlantic wolffish, spotted wolffish, arctic wolfish, Atlantic halibut, Greenland halibut, and deep-sea redfish.**

For **thorny skate and lumpsucker,** sex is recorded for all individuals measured for length (Table 2).

Maturity scales of **gadoids** are shown in Table 4, of **flatfishes** in Table 5 and for **redfishes** in Table 6. Identification of maturity stages for Atlantic wolffish and spotted wolffish is shown on page 15.

3.3 Otolith sampling and weighing

Otoliths are sampled from the following species: **cod, haddock, saithe, golden redfish, ling, blueling, tusk, Atlantic wolffish, spotted wolffish, greater silver smelt, Atlantic halibut, Greenland halibut, plaice, lemon sole, witch, megrim, dab, long-rough dab, lumpsucker and deep-sea redfish** (Table 2).

Otoliths must be sampled randomly. The frequency of otolith sampling is as shown in Table 2. **Note that the minimum and maximum number of otoliths sampled per station differs between species.** For example, the minimum and maximum number of **cod** sampled for otoliths per station is 25 and 50 fish respectively. For **golden redfish**, the minimum number fish sampled for otoliths is 5 per station and the maximum number is 15 fish. For **Atlantic halibut** the minimum number is **25** meaning that otoliths are sampled from all halibut caught.

To make sure that otoliths collected and their accompanying computerized data can be traced together, the following information must be written on each otolith envelope: **species – fish number - cruise number – station number – length – sex – maturity stage.** If a special designed box is used for otolith storage it is important to label the box clearly with station number and the number of the fish. Furthermore, information must be registered on a paper that is attached to the otolith box.

RANDOM SAMPLING of fish collected for otolith extraction is **IMPORTANT!** All researchers should use the following method: The computer is programmed to send a sound signal for every *n* length measured fish, where *n* depends on the otolith sampling ratio. The fish is either taken for otolith extraction immediately, or put aside for later inspection. Fish collected for otolith sampling are not measured for length until the otolith extraction takes place.

During otolith collection the following must be recorded: length, sex, and maturity stage. Furthermore, the following measurements are made (depending on species, see Table 2).

- Weight of ungutted fish (g).
- Weight of gutted fish (g).
- Liver weight (g).
- Weight of roe (ovaries) and milt (testes) if maturity stage = 2 (g).

Fish smaller than 20 cm that enter otolith sampling is length measured, weighted ungutted, and the otolith removed.

3.3.1 Otolith sampling – the whole catch measured for length

The first fish of each species is taken for otolith extraction and every *n* fish thereafter, e.g. every 10^{th} cod, every 3^{rd} saithe, every 50^{th} haddock etc. (Table 2). Since a minimum of 25 fish/station taken for otolith sampling is the rule for cod, 10 per station for Greenland halibut, and 5 fish per station of haddock, saithe, golden redfish and most flatfish species, it is necessary to estimate whether the minimum number will be obtained by collecting every *n* fish. For example, to fulfil this minimum for cod, 250 fish (25/0.1) are needed. If this does not appear to be the case, 25 fish need to be taken randomly aside for otolith sampling before finishing the length measurements. In cases where individuals of cod are 25 or less in a tow, all fish are taken for otolith extraction.

An example for saithe: The length interval is 100 cm, but the total number of individuals is 60. Therefore, all are measured for length (maximum number of fish measured = 400 fish). Every 3rd fish (33%) is taken aside for otolith sampling or 0.33×60 = 20 fish. The minimum of 5 fish required is therefore obtained during the length measurement session.

Another example, for haddock: The length interval is 50 cm and the number of fish measured for length is therefore 4×50 = 200 fish according to the rule, but the haddock catch is only 180 individuals. Every 20th haddock (2%) is sampled for otoliths 0.02×180 = 4 fish. The minimum of 5 fish is not obtained and therefore **one haddock needs to be taken additionally**.

3.3.2 Otolith sampling – part of the catch measured for length

When the catch is large and not all the fish of a given species is measured for length, sampling for length and otoliths typically happens in the following way:

1. The length interval is 70 cm and the number of fish measured for length is therefore 4×70 = 280 fish.
2. Every 10th fish (10%) is taken for otolith sampling from the length measured fish, a total of 0.1×280 = 28 fish
3. During counting of the rest of the cod, every 10th fish also need to be taken aside. A total of 200 cod were counted and from this group 0.1×200 = 20 fish are taken aside.
4. A total of 48 fish were therefore taken for otolith sampling.

Table 2. Overview of data sampling of commercial fish species in the Autumn Groundfish Survey.

		Length measurements			Otolith extraction (length, sex and maturity always reported)							
Nr	Species	Length interval	Sex	Maturity	Max./min.	*n*. fish	Frequency (%)	Ungutted	Gutted	Liver	Ovaries/testes (stage 2)	Stomach analysis
1	Cod	4			50/25	10	10	x	x	x	x	x[2)]
2	Haddock	4			25/5	50	2	x	x	x		x
3	Saithe	4			25/5	3	33	x	x	x		x
4	Whiting	4										
5	Golden redfish	5			15/5	10	10	x				x
6	Ling	4			25/1	4	25	x			x	x
7	Blue ling	4	x	x	25/1	4	25	x			x	x
8	Tusk	4			25/1	4	25	x			x	x
9	Atlantic wolffish	4	x	x	25/1	5	20	x	x	x	x[1)]	
10	Roundnose grenadier	4										
12	Starry ray	2	x									
13	Spotted wolffish	4	x	x	25/1	3	33	x	x	x	x[1)]	
14	Monkfish	4										
19	Greater silver smelt	4			25/1	30	3					
21	Atlantic halibut	4	x	x	25/25	1	100	x	x			
22	Greenland halibut	5	x	x	50/10	3	33	x	x	x	x	x
23	Plaice	4			25/5	5	20	x				
24	Lemon sole	4			15/5	20	5	x				
25	Witch flounder	4			15/5	15	7	x				
26	Megrim	4			15/5	15	7	x				
27	Dab	4			15/5	15	7	x				
28	Long rough dab	2			10/3	25	4	x				
33	Norway pout	4										
47	Arctic wolffish	4	x	x								
48	Lumpsucker	4	x		1/1			x			x	
60	Norway haddock	4										
61	Deepwater redfish	5	x	x	25/1	10	10	x				x
62	Roughhead grenadier	4										

1) Ovaries weighted.
2) In addition, minimum 15 one year old cod (16-26 cm) and 15 two years old cod (17-38 cm) on each station is taken for stomach analysis.

Table 3. List of species for which at least 20 fish are measured for length per station. The list is not exhaustive.

Nr	Species	Nr	Species	Nr	Species
106	Antarctic snaggletooth	76	Forkbeard	89	Poacher
59	Arctic eelpout	57	Four-bearded rockling	71	Polar cod
88	Arctic rockling	86	Fuller's ray	174	Portuguese dogfish[1)]
81	Arctic sculpin	110	Gelatinous seasnail	67	Ratfish[1)]
90	Arctic skate[1)]	214	Glacial eelpout	171	Rough-nosed grenadier
74	Atlantic hookear sculpin	64	Greater lantern shark	87	Round ray[1)]
56	Atlantic poacher	97	Greater sandeel	35	Sandeel
161	Baird's smooth-head[1)]	99	Gray gurnard	216	Scalebelly eelpout
154	Bean's sawtoothed eel	30	Herring	133	Schnakenbeck's searsid
168	Birdbeak dogfish[1)]	141	Lancet fish	92	Sea snail - unid
96	Black dogfish[1)]	125	Lantern shark[1)]	70	Sea tadpole
173	Black scabbard-fish[1)]	75	Lanternfishes	94	Snake blenny
230	Black seasnail	163	Leafscale gulper shark[1)]	105	Spiny-eel[1)]
34	Blue whiting	83	Lesser sandeel	82	Spinytail skate
80	Bull-rout	69	Longear eelpout	65	Spotted snake blenny
31	Capelin	164	Longnose velvet dogfish[1)]	639	Squid
249	Checkered wolf eel	120	Loosejaw	44	Squid sp.
15	Common skate	84	Lumpeniids - unid	91	Threespot eelpout
241	Crested bigscale	134	Morid cod	66	Twohorn sculpin
16	Dogfish	118	Mouse catshark[1)]	79	Vahl's eelpout
98	Doubleline eelpout	53	Moustace sculpin	123	White barracudina
85	Eelpout sp. - unid	58	North-Atlantic codling[1)]	93	White hake
63	Esmark's eelpout	113	Pale eelpout	72	Yarrel's blenny
73	Five-bearded rockling	153	Pallid sculpin	68	Yellow brandeel

1) See also Appendix 10.4 in relation to sampling of deep-water fish species.

Table 4. Maturity scales for gadoids (cod, haddock, saithe, ling, blue ling and tusk).

Code	Maturity stage	Ovaries description – Females	Testes description – Males
1	Immature (juvenile)	Ovaries small and translucent. Eggs not visible with the naked eye.	Testes (lobules) tiny, thin and translucent.
2	Maturing/ mature (ripening to ripe)	Ovaries increased considerable in size. Colour red to orange and opaque. Individual eggs visible with the naked eye when close to stage 22. With prominent blood vessels when close to stage 22.	Testes getting bigger, opaque, whitish in colour. When close to stage 3, lobules are distended and brittle. Sperm in spermaducts. Not running under moderate pressure.
22	Mature females (ripe, only used for cod, haddock and saithe).	Ovaries occupy most of the body cavity. Distended and soft. Prominent blood vessels. Colour yellow to orange. Eggs visible with the naked eye, few or many eggs hydrated (eyes). Not yet running under moderate pressure.	
3	Spawning (running)	Ovaries occupy most of the body cavity. Very distended and soft. Hydrated eggs can be extruded on slight pressure.	Testes (lobules) plump but soft. Big and white and occupy most of the body cavity. Testes run on slight pressure.
4	Post-spawning (spent)	In recently spent females ovaries are reduced in size, flaccid and bloodshot. Some opaque eggs may occur. Sometimes greyish in colour. Ovary wall thicker than within immature fish. Later, this stage may be difficult to distinguish from immature fish (stage 1).	In recently spent males, testes are thin, flabby, and bloodshot. Some sperm may remain in spermaducts. Later, this stage is difficult to distinguish from immature fish (stage 1).
5	Uncertain maturity identification	Maturity identification not determined. Difficult to distinguish between stage 1 and 4.	Maturity identification not determined. Difficult to distinguish between stage 1 and 4.

Table 5. Maturity scales of flatfish species (Atlantic halibut, Greenland halibut, plaice, lemon sole, witch, megrim, dab and long-rough dab).

Code	Maturity stage	Ovaries description – Females	Testes description – Males
1	Immature (juvenile)	Ovaries small and translucent and lie mostly behind the body cavity. Sometimes silvery or dark in colour.	Testes very small and translucent and up to 1 cm long.
2	Maturing/ Mature (ripening to ripe)	Ovaries are up to half the length of a full ovary and are now found in the body cavity. Pinkish in colour in the beginning of this stage but later yellow to orange. In the beginning of this stage the eggs are opaque and walls thin, but later individual oocytes can be seen with the naked eye. When close to stage 3 ovaries contain few or many hydrated eggs, but will not run under moderate pressure	Testes getting bigger and are about half size of full testes. Are now within the body cavity. Opaque, grey to white in colour.
3	Spawning (running)	Hydrated eggs can be extruded on slight pressure.	Testes run on slight pressure.
4	Post-spawning (spent)	In recently spent females ovaries are reduced in size, flaccid and blood-shot. Some opaque eggs may occur. Much slime in ovaries. Ovary wall thicker than within immature fish. Later, this stage may be difficult to distinguish from immature fish (stage 1).	In recently spent males, testes are thin and flabby. Little sperm may remain in spermaducts. Later, this stage is difficult to distinguish from immature fish (stage 1), but walls of the testes are thicker than in immature fish (stage 1).
5	Uncertain maturity identification	Maturity identification not determined. Difficult to distinguish between stage 1 and 4.	Maturity identification not determined. Difficult to distinguish between stage 1 and 4.

Table 6. Maturity scales for redfish species (golden redfish, deep-sea redfish and Norway haddock).

Code	Maturity stage	Ovaries description – Females	Test description – Males
1	Immature (juvenile)	Ovaries tubular, thin and small. Ovarian wall whitish and delicate. Without conspicuous blood vessels.	Testes are translucent, threadlike and very thin (width less than 1 mm). Sometimes difficult to detect, because it is confused with mesentery. The penis is difficult to distinguish and easy to confuse with female genital papilla.
2	Maturing/ mature	The ovaries have 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 to red and opaque.	The testes are more easily distinguishable because of increasing size. They are white. Penis is visible, and it is easy to identify sex externally. Late on this stage the testes are white or with a cream colour. There is no running sperm when the testes are cut. Penis is thick, but no sperm is observed on it.
3	Parturition		Testes are big and with cream colour. The sperm run out of the fish on slight pressure on the belly or if testes are cut and sperm runs out. Penis is very conspicuous, with a purple tip and there are remains of sperm on it.
31	Parturition (A)	Ovaries occupy most of the body cavity, it is delicate and the wall transparent and thin. The colour of eggs yellow to green-yellowish due to larval developing.	
32	Parturition (B)	Eyes are evident as black points and there is little yolk.	
33	Parturition (C)	Larvae are easily released from the ovary when it is manipulated, i.e. on slight pressure on the belly. The tails of the larvae are clearly visible.	
4	Post-spawning	Ovaries are flaccid and bloodshot, but still big. Ovary wall is thicker than among immature fish. No visible larvae inside or just a remainder of them. The colour is dark-purple or blackish, sometimes confused with the body cavity wall (peritoneum).	In post-spawning state, the testes are flaccid. The colour is still cream but with obvious dark (brown) patches. Practically no sperm inside the testes.
5	Uncertain maturity identification	Maturity identification not determined. Difficult to distinguish between stage 1 and 4.	Maturity identification not determined. Difficult to distinguish between stage 1 and 4.

Maturity stages of Atlantic wolffish and spotted wolffish

Females

Stage 1. Ovaries translucent. Eggs not visble.

Stage 2. Eggs are clearly visible with the naked eye and are 0.5-1.2 mm in dimension. Eggs are yellowish.

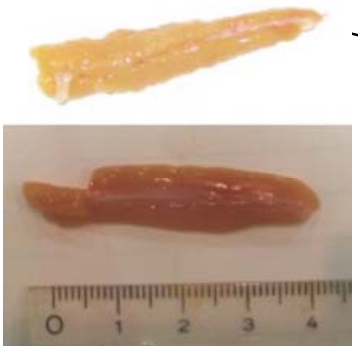
Stage 3. Ovaries are considerable bigger than in stage 2. Eggs are 2-6 mm in dimension.

Stage 33. Running state. Hydrated eggs can be extruded on slight pressure.

Stage 4. Spent. Ovaries are reduced in size and are matte, flaccid and opaque. Some opaque eggs may occur.

Males

Stage 1. Testes are translucent and maximum length is about 4 cm.



Stage 6. Testes are opaque and matte and between 4-10 cm long. The colour withish to brownish.

Stage 5. Maturity identification can not be determined.

3.4 Species identification and sampling of rare species

The following literature can be used for species identification: "Icelandic fishes" (Gunnar Jónsson 1992), "Icelandic fishes" (Gunnar Jónsson & Jónbjörn Pálsson 2006), "Fishes of the North Atlantic" (E. Bertelsen et al: translated by Gunnar Jónsson).

Putatively rare species, and fish that cannot definitely be identified to species, are to be frozen and brought to a laboratory for further examination.

Skates and rays. An identification sheet has been prepared for enabling species identification of skates and rays. This sheet should be used, but if in doubt, freeze the fish and bring it to the laboratory at the end of the cruise.

Redfish species. Figure 3 can be used for species identification of redfish.

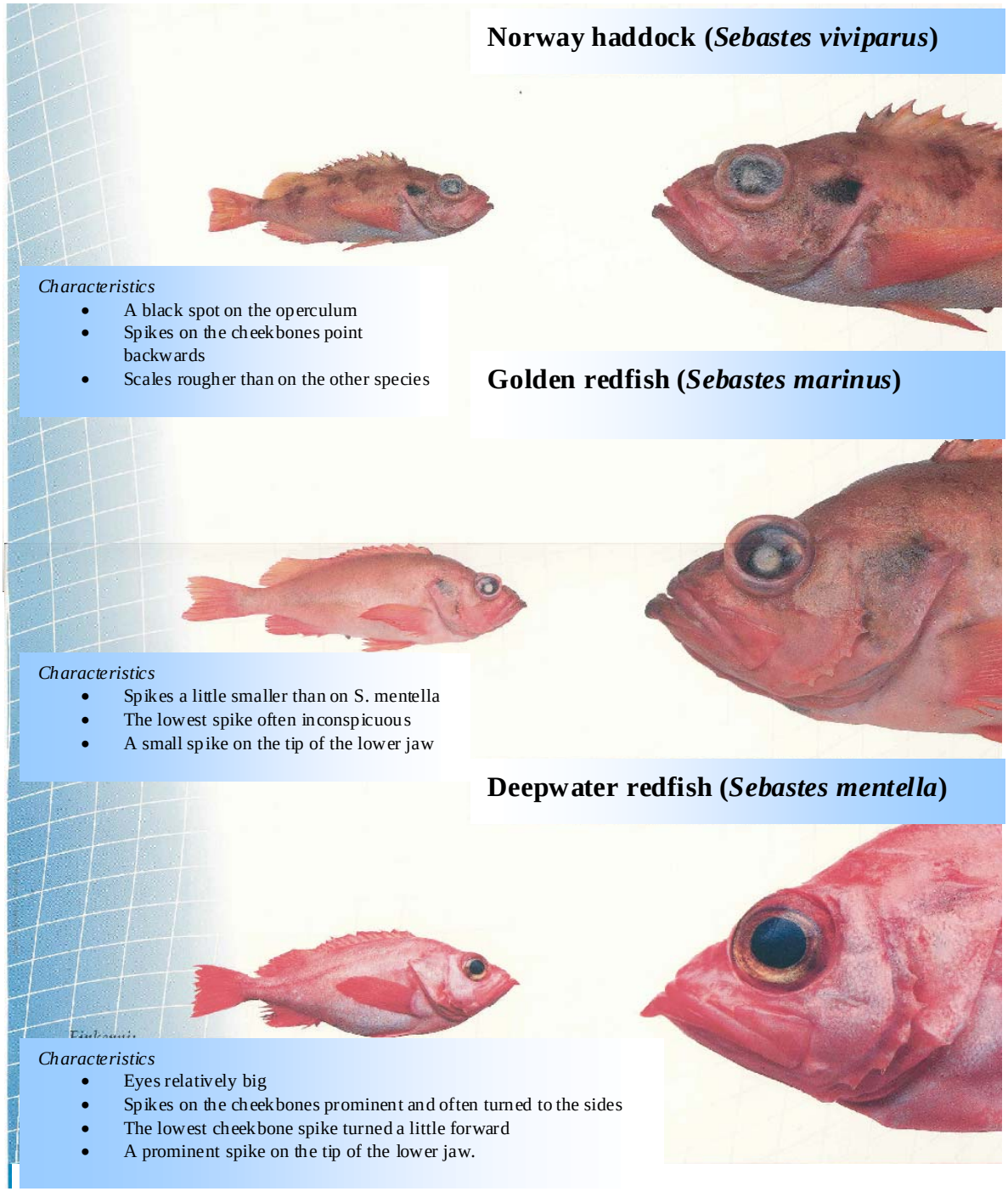
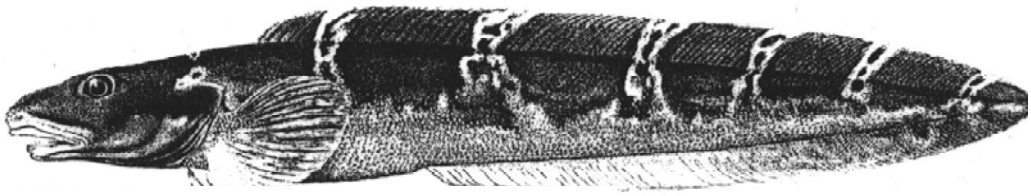
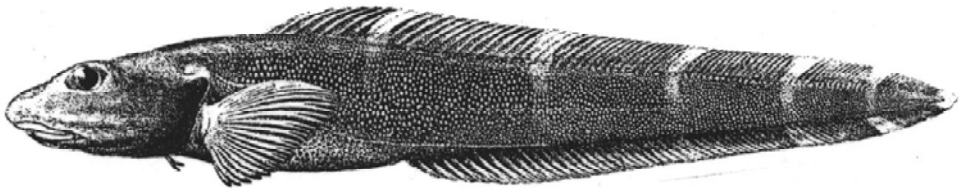


Figure 3. Species identification of redfish: Norway haddock, golden redfish and deepwater redfish.

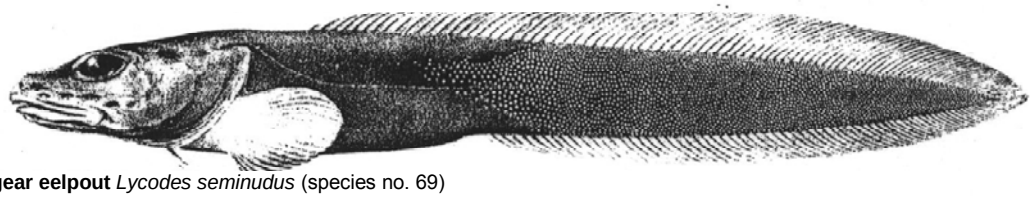
Eelpout species. The following overview is used for species identification of eelpouts (Figure 4). If in doubt, register the fish as unidentified eelpout, freeze it and bring to the laboratory at the end of the cruise. This overview is not exhaustive since other rare eelpout species may be caught, e.g. scale-belly eelpout, Adolf's eelpout and glacial eelpout.



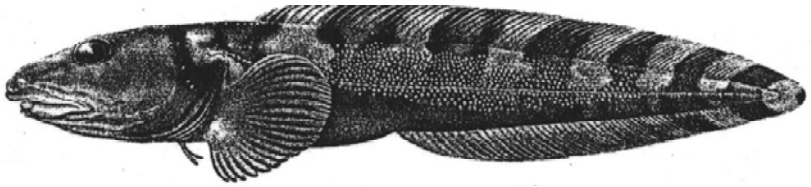
Esmark's eelpout – *Lycodes esmarki* (species no. 63)
A chain-like pattern on dorsal fin and sides. Scales on abdomen



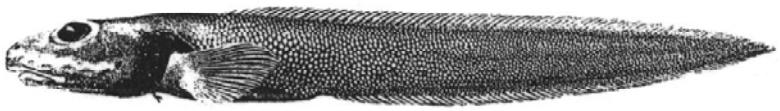
Doubleline eelpout – *Lycodes eudipleurostictus* (species no. 98)
About 6-8 transverse stripes, scales on abdomen. Rather common.



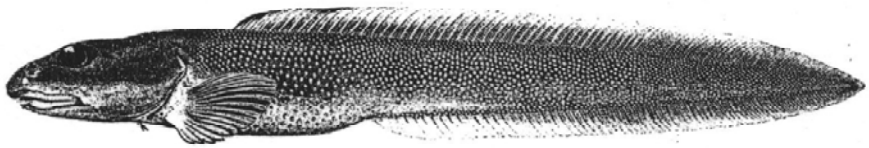
Longear eelpout *Lycodes seminudus* (species no. 69)
Scales on the posterior part - extending towards the anus. Lateral line central. Color variable – light brown to dark blue



Arctic eelpout *Lycodes reticulatus* (species no. 59)
Dark and light transverse bands, in older fish disband into a net-like pattern. A light spot often found at the top of the head.



Pale eelpout *Lycodes pallidus* (species no. 113)
No bands, pattern or spots on adult fish. No scales on abdomen. Two lateral lines. Common, especially in colder water.



Vahl's eelpout *Lycodes vahli* (species no. 79)
Scales on abdomen. Adults usually have 1- 4 spots at the anterior part of the dorsal fin. A ventral lateral line. Common, especially in shallow water.

Figure 4. Species identification of eelpout species commonly caught in the AGS.

3.5 Other data sampling

3.5.1 Stomach content sampling and analysis

The stomach content must be analysed for following fish species that are sampled for otoliths extraction: **cod, haddock, saithe, golden redfish, ling, blue ling, tusk, Greenland halibut and deep-sea redfish**. Analysis and other processing of the food are given in Appendix 3. **In addition, minimum 15 one year old cod and 15 two year old cod shall be analysed on each station.** They will get the species numbers 901 (one year old, 16-26 cm) and 902 (two years old, 27-38 cm) in *SeaScale*, the data processing program. These fishes are outside the traditional stomach content sampling and are therefore double length measured. In all cases these fish must first go through traditional sampling, i.e. length measurement, otolith extraction or counting

The stomach content for all species must be analysed in the same manner. If it is foreseeable that food content for all species at a station cannot be analysed, the fish pray must at least be identified, weighed and length measured if possible. Other pray shall be weighed and classified into food groups like decapoda, echinodermata and so forth. It is, however, an unbreakable rule to analyse stomach content in the same way as usual.

3.5 2 Deep-sea fish sampling

Sampling of deep-sea fishes, see Appendix 4.

3.5.3 Sampling of cephalopods

The mantle length of the squid *Todarodes sagittatus* is measured and entered for species **no. 639**. Other cephalopods are counted and the number entered under **no. 44** and the sample collected and frozen for further species identification (see Appendix 5).

3.5.4 Sampling of ovaries from female spotted wolffish

See Appendix 6 for the protocol of sampling.

3.5.5 Eyrall - Educational cruise with students of Natural Resource Science of University of Akureyri

See Appendix 7.

3.5.6 Sampling for Icelandic food research: Project ”Undesirable substances in Icelandic marine catches”

See Appendix 8 for the protocol of sampling.

3.6 Data entry

All data on species, length, numbers counted, sex, maturity and weight are entered directly in a computer that is connected to Marel weighing machine (using *SeaScale* data collection program). This also accounts for the stomach-analysis data.

A copy of all data of each station is transferred to the cruise leader’s computer, which adds information on the station (environmental observations, trawl geometry etc.). For each station, the cruise leader furthermore checks carefully if everything regarding data sampling is normal.

It is important that the cruise leader examines carefully the overview of data sampling on each station and enquires the researchers on dubious data as soon as possible. Incorrect data must be corrected and missing data added before the final copy is made. If not possible, a separate list must be made including all corrections and data entries that are yet to be made. At the end of the cruise, this list must be sent to the MRI Data manager, along with other data and source material.

4 STATION INFORMATION

The upper part of the "Station information form", i.e. information on the tow and environmental factors, are to be filled out by the captain and the first officer in co-operation with the cruise leader. All remarks and comments regarding the tow are written on the "Station information form" and later entered in a specific "comments" field in the *SeaScale* program. Comments on the data sampling, e.g. if corrections are yet to be made or if some extra sampling has been carried out, are furthermore entered in the comments field in *SeaScale*. *The lower part of the form is an overview of the data sampling and is not of concern since it is computerized during data processing.*

The upper part of "Station information form":

Cruise ID	*Year Station*	*Vessel registry no.*	Wind direction		Air temp °C	
Day./month			Wind speed		Bottom temp °C	
Stat. square	*Sub-square*	*Tow number*	Sea surface		Surface temp °C	
			Weather		Tow.d. temp °C	
Gear type no.	*Mesh size*	*Sweeps length (m)*	Cloud cover		Secchi d. (m)	
Gear ID			Air pressure		Drift ice	
Start of haul	*Pos. N*	*Pos. W*	End of haul	*Pos. N*	*Pos. W*	
	Time (hour:min)	*Tow direction°*		*Time (hour:min)*	*Warp length (fm)*	
	Bottom depth (m)	*Towing depth (m)*		*Bottom depth (m)*	*Towing depth (m)*	
	Vert. opening (m)	*Horiz. opening (m)*		*Tow length (naut. miles)*	*Tow time (min) Tow speed (knots)*	

4.1 Tow information

A "Station information form" must be filled for each tow (Figure 5). Information that must be registered include **cruise ID (**e.g. A1 for R/V Árni Friðriksson, the first cruise in the given year), **year**, **station number** i.e. a running number starting with 1 as the first tow of the year of a given vessel, **vessel registry no.** of the given vessel and **date**. Furthermore, **statistical square number** within which the tow is located, the **number of sub-square**, and **tow number,** which is a fixed number for the tow, must be filled out (see List of stations and Maps in Sections 8 and 9 respectively). Note that the sub-square for each tow has been fixed and is registered according to the list of stations (see Chapter 8). The ID number of the **gear type** (77 for the gear on R/V Bjarni Sæmundsson and 78 for the gear on R/V Árni Friðriksson), **mesh size** (40 mm), **sweeps length** (35 fm for R/V Bjarni Sæmundsson and 120 fm for R/V Árni Friðriksson), and **gear ID** must are also entered.

The **geographical location** of the stations is registered in latitudinal and longitudinal (in degrees, minutes and seconds converted to decimal minutes) according to GPS calculations, **depth** in meters and **time** in hours and minutes (clock, four number digits) at the **beginning** and **end** of each trawl haul, excluding the setting and hauling of the net. The tow starts when the trawl touches the bottom and ends when the hauling of the trawl starts. **Trawling direction** is registered in degrees as well as **warp length** used. **Trawling speed** and **trawling distance** is calculated with GPS. **Vertical** and **horizontal** opening of the trawl is registered in meters (mean values for the whole haul) if relevant instruments are available (i.e. Scanmar or Furuno).

If it is not possible to finish the tow, for example because of snagging of the trawl or other malfunction, it is necessary to register the reasons and the location of the snag. Recommendation of another position of the station, for example because of rough bottom or of new trawling direction, is also reported.

Detailed information on trawling is given in Chapter 6.

4.2 Environmental information

Information on weather and other environmental factors is registered as follows:

1. **Wind speed** is registered in **knots**. If an anemometer is onboard it is necessary to observe it for few minutes as wind speed is never stable, but fluctuates around some mean value, both wind direction and speed. If an anemometer is not onboard, wind speed is estimated by the following table:

Beaufort number	Wind speed		Description	Sea conditions	Wave height (m)
	knots	m/sec			
0	**00**	0 - 0.2	Calm	Sea like a mirror.	
1	**02**	0.3 - 1.5	Light air	Ripples without crests.	0.1
2	**05**	1.6 - 3.3	Light breeze	Small wavelets. Crests of glassy appearance, not breaking.	0.2
3	**09**	3.4 – 5.4	Gentle breeze	Large wavelets. Crests begin to break; scattered whitecaps.	0.6
4	**13**	5.5 – 7.9	Moderate breeze	Small waves - becoming longer; fairly frequent white horses.	1
5	**18**	8.0 – 10.7	Fresh breeze	Moderate waves, taking a more pronounced long form; many white horses are formed - a chance of some spray.	2
6	**24**	10.8 – 13.8	Strong breeze	Large waves begin to form; the white foam crests are more extensive with probably some spray.	3
7	**30**	13.9 – 17.1	Near gale	Sea heaps up and white foam from breaking waves begins to be blown in streaks along direction of wind.	4
8	**37**	17.2 – 20.7	Gale	Moderately high waves of greater length; edges of crests begin to break into spindrift; foam is blown in well-marked streaks along the direction of the wind.	5.5
9	**44**	20.8 – 24.4	Strong gale	High waves; dense streaks of foam; crests of waves begin to topple, tumble and roll over; spray may affect visibility.	7
10	**52**	24.5 – 28.4	Storm	Very high waves with long overhanging crests; the resulting foam in great patches is blown in dense white streaks; the surface of the sea takes on a white appearance; the tumbling of the sea becomes heavy with visibility affected.	9
11	**60**	28.5 – 32.6	Violent storm	Exceptionally high waves; small and medium sized ships occasionally lost from view behind waves; the sea is completely covered with long white patches of foam; the edges of wave crests are blown into froth.	11.5
12	**68**	≥32.7	Hurricane-force	Huge waves. The air is filled with foam and spray. Sea completely white with driving spray; visibility very seriously affected.	≥14

2. **Wind direction**. Main wind directions are registered according to following table.

Calm	00	SE	14	W	27
NNE	02	SSE	16	WNW	29
NE	05	S	18	NW	32
ENE	07	SSW	20	NNW	34
E	09	SW	23	N	36
ESE	11	WSW	25	Not defined	99

3.-5. **Weather, clouds and sea state.**

3. Weather	4. Cloud cover	5. Sea	Wave height
0 No clouds, clear	0 No clouds, clear	0 Calm (glassy)	0
1 Cloudy	1 1/8 or less but not 0	1 Calm (rippled)	0-0.1
2 Overcast	2 2/8	2 Smooth (wavelets)	0.1-0.5
3 Sandwind, soilwind	3 3/8	3 Slight	0.5-1.25
4 Fog or mist	4 4/8	4 Moderate	1.25-2.5
5 Drizzle	5 5/8	5 Rough	2.5-4
6 Rain	6 6/8	6 Very rough	4-6
7 Snow or sleet	7 7/8 or more but not 8/8	7 High	6-9
8 Shower	8 8/8	8 Very high	9-14
9 Not recorded	9 Not recorded	9 Not recorded	

6. **Sea Ice**

0	No ice
1	Ice is close, directly visible or in radar, but the type is unknown
2	Few icebergs (10 or less)
3	Many icebergs (more than 10)
4	Very thin or thin cover of drift ice, 6/10 or less in density, in more than 1 nautical miles from station
5	Dense or very dense cover of drift ice, more than 6/10 in density, in more than 1 nautical miles from station
6	Very thin or thin cover of drift ice, 6/10 or less in density, in less than 1 nautical miles from station
7	Dense or very dense cover of drift ice, more than 6/10 in density, in less than 1 nautical miles from station
8	Station within a dense drift ice etc.
9	No observation because of low visibility etc.

7. **Air temperature** is measured in °C.
8. **Surface temperature** is measured in °C.
9. **Bottom temperature** is measured in °C, with Scanmar thermometer or similar instrument. The thermometer must be calibrated before the cruise. Bottom temperature is also measured with Starmon mini temperature recorders from Star-Oddi, placed on the upper belly or headline of the trawl.
10. **Air pressure.** Air pressure is recorded on each station.

4.3 Other information

The cruise leader updates information on each station from the "Station information form" into the station information form in *SeaScale* and prints out the form. *SeaScale* automatically produces an overview over measurements made for each species on a given station. All numbers in the columns of that overview refer to the number of individuals processed, except for northern shrimp where total catch is given in kg.

5 THE SAMPLING GEAR

Two types of the bottom survey trawl "Golden Top" are used for sampling: "Golden Top" is used in the shallow water and "Golden Top 66.6m" is used in deep waters. The trawls were common among the Icelandic bottom trawl fleet in the mid 1990's and are well suited for fisheries on cod, Greenland halibut and redfish.

Each trawl has an unique ID number identified by a plate. Cruise leaders must put the identification plate on each trawl on the headline of the trawl.

5.1 Bottom trawl in shallow water (gear nr. 77)

The bottom trawl used for sampling on the r/v Bjarni Sæmundsson is called "Golden Top" nr. 77. The headline is 31.0 m, the fishing line is 19.6 m according to Figures 6 and 7. The rock hoppers used are 3 x 6.1 m, weighing 2,200 kg. The otter boards are PolyIce nr. 7 and weigh 1950 kg. It is important that the standardization of the trawl must be exactly as given in the table in Section 5.3.1 and in Figures 6-13.

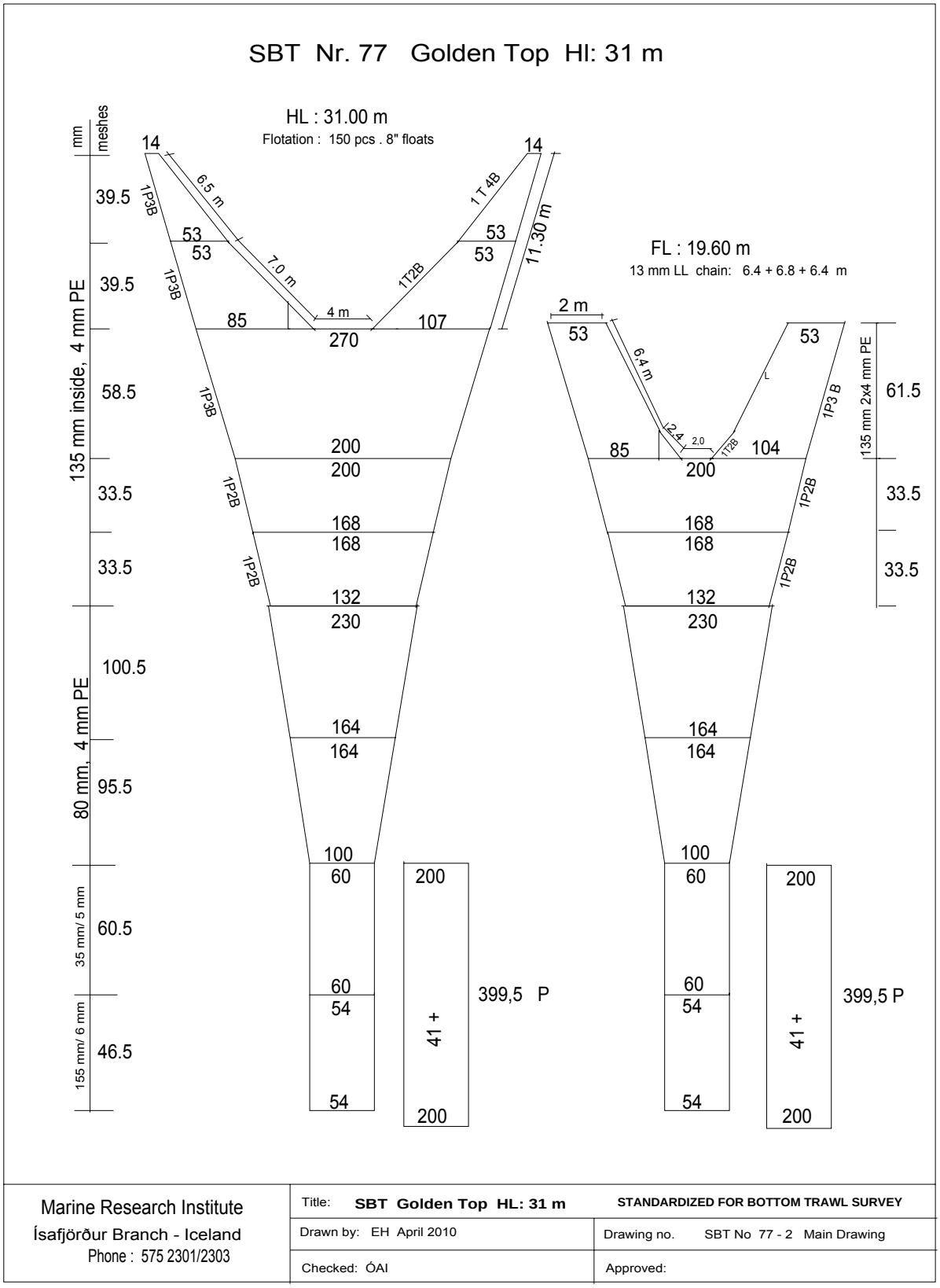


Figure 6. Standardised bottom trawl no. 77 used in the shallow water in the Autumn Groundfish Survey. Main drawing.

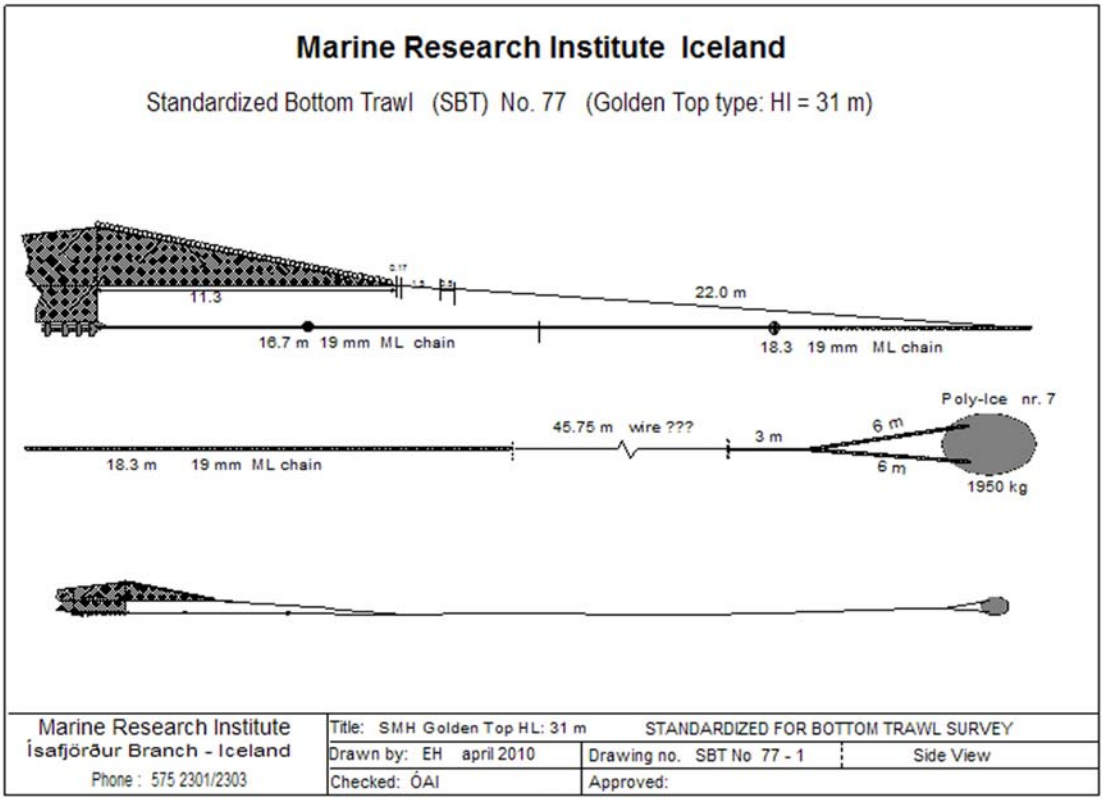


Figure 7. Standardised bottom trawl no. 77 used in the shallow water in the Autumn Groundfish Survey. Side view.

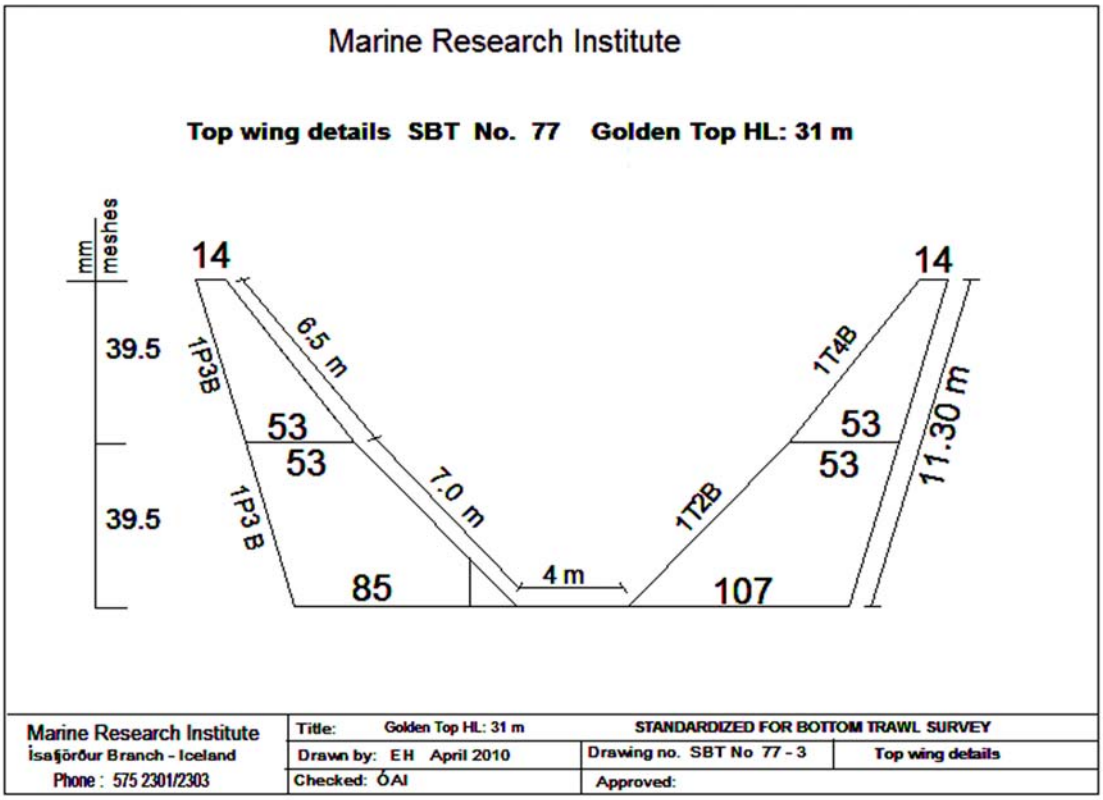


Figure 8. Standardised bottom trawl no. 77 used in the shallow water in the Autumn Groundfish Survey. Top wing details.

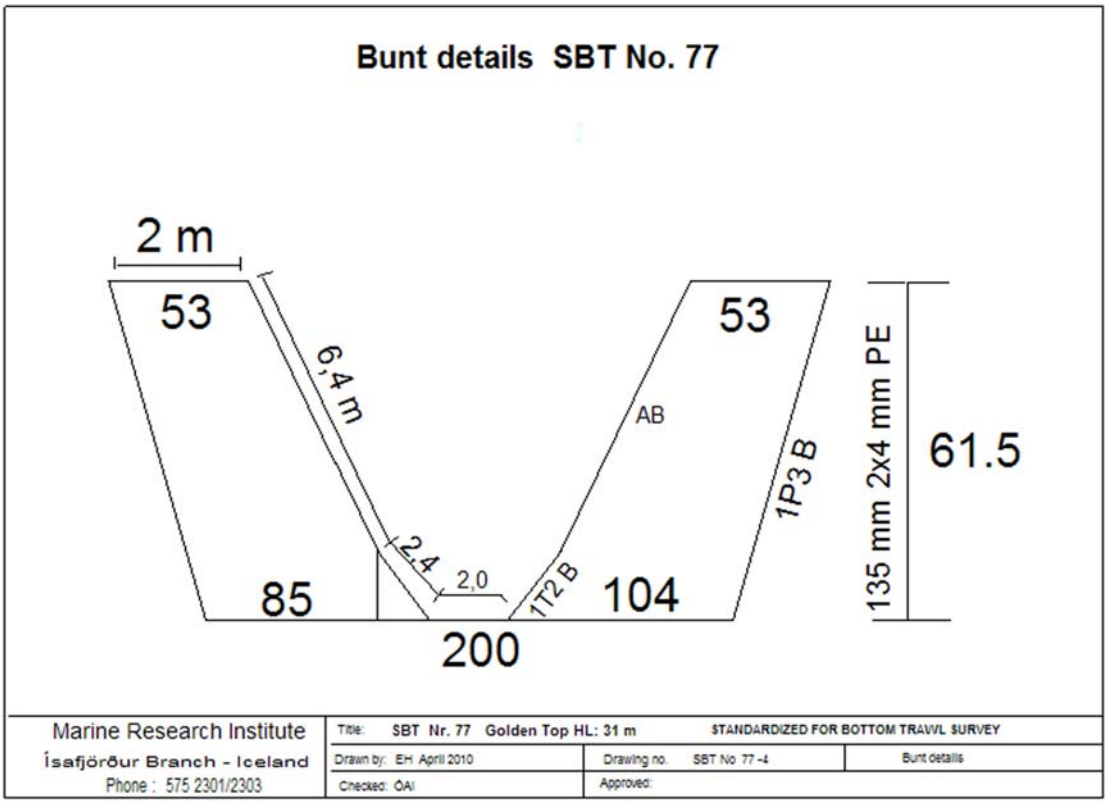


Figure 9. Standardised bottom trawl no. 77 used in the shallow water in the Autumn Groundfish Survey. Bunt details.

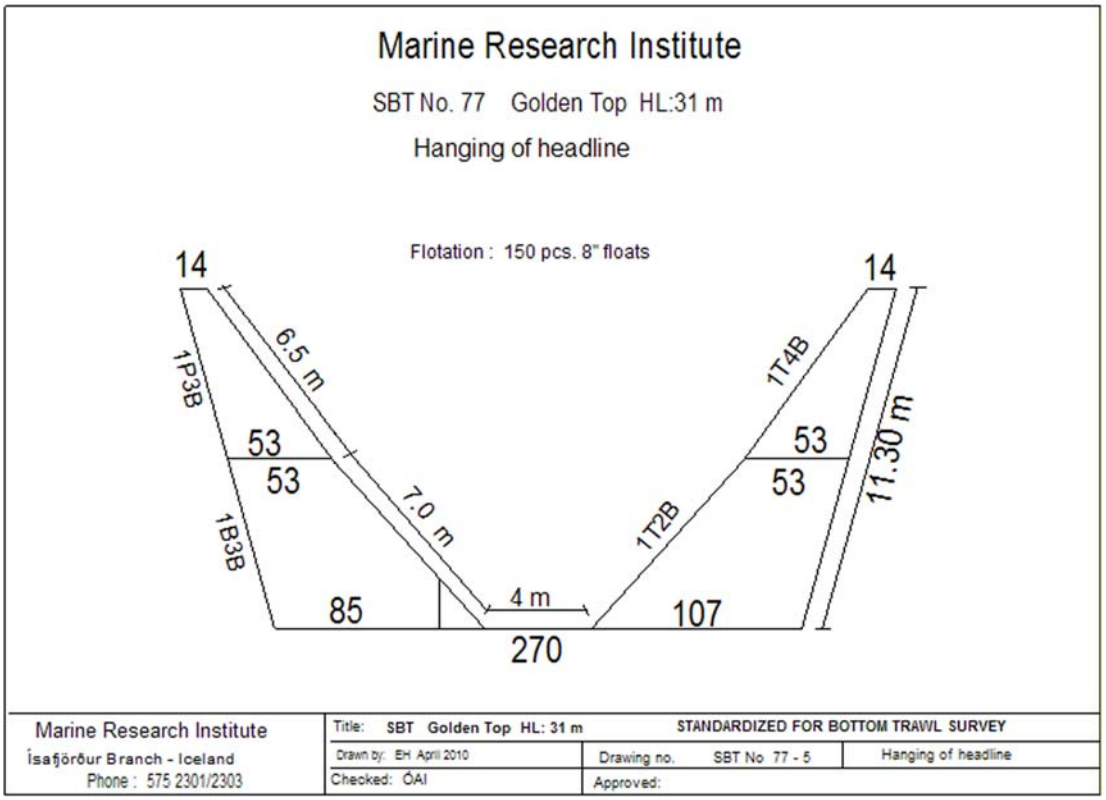


Figure 10. tandardised bottom trawl no. 77 used in the shallow water in the Autumn Groundfish Survey. Hanging of headline.

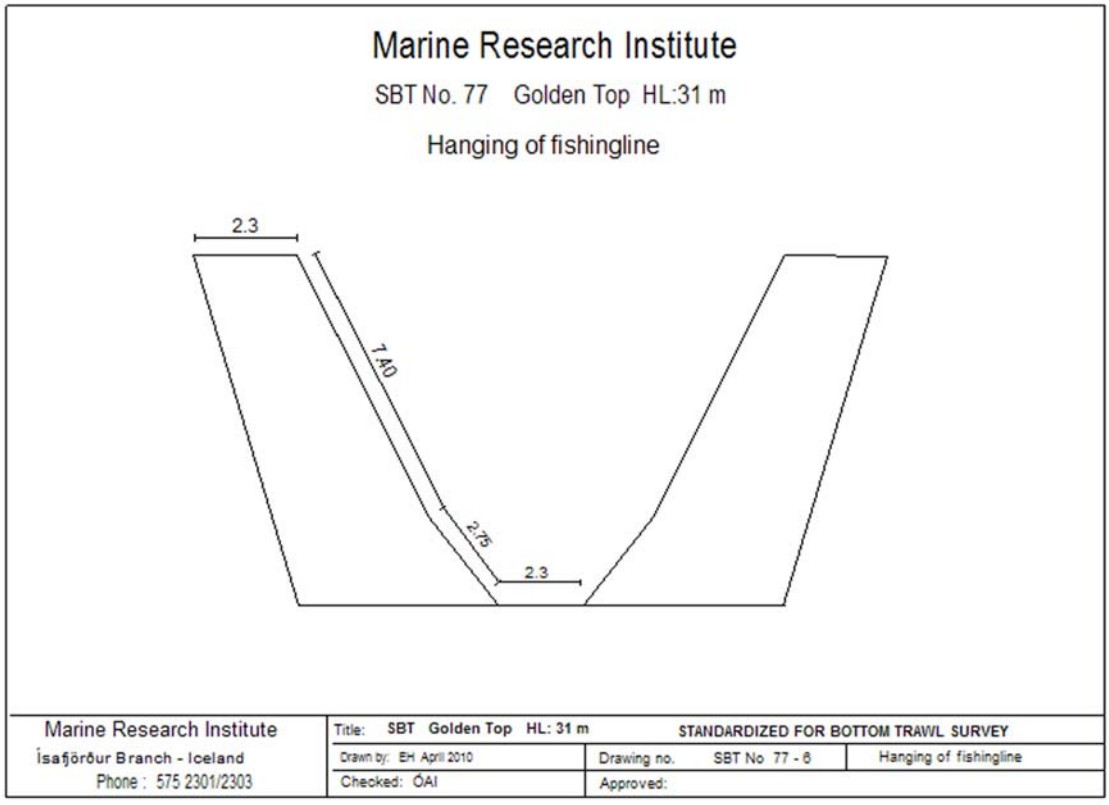


Figure 11. Standardised bottom trawl no. 77 used in the shallow water in the Autumn Groundfish Survey. Hanging of fishingline.

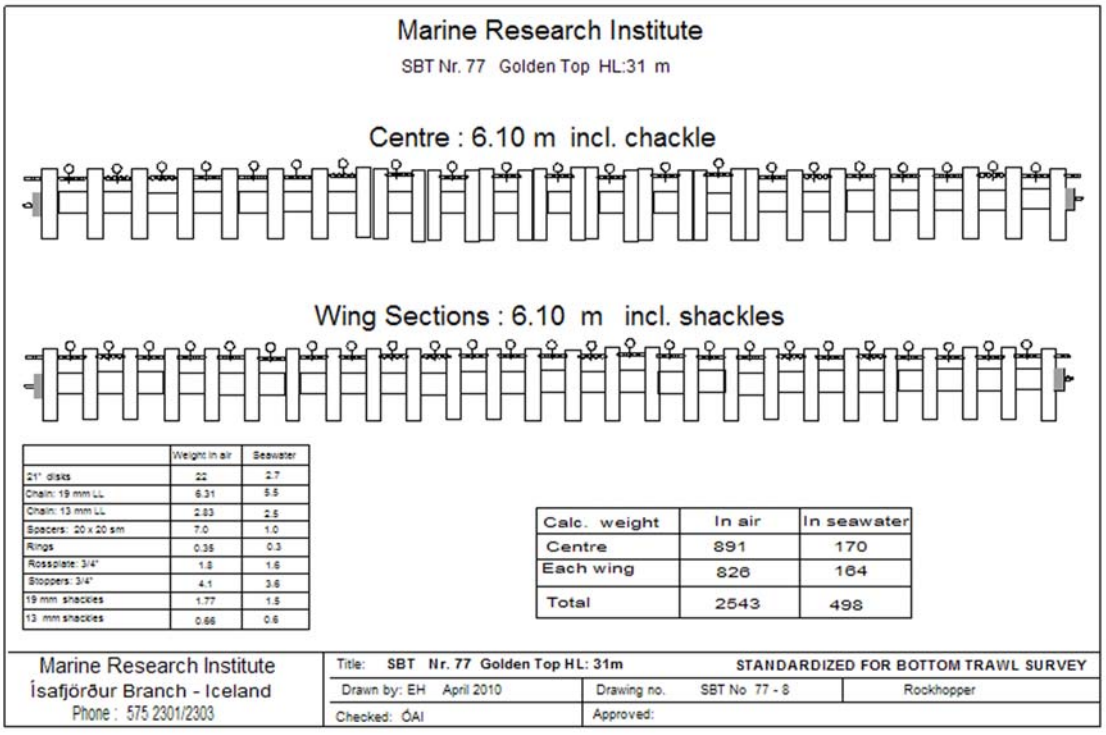


Figure 12. Standardised bottom trawl no. 77 used in the shallow water in the Autumn Groundfish Survey. Rockhopper.

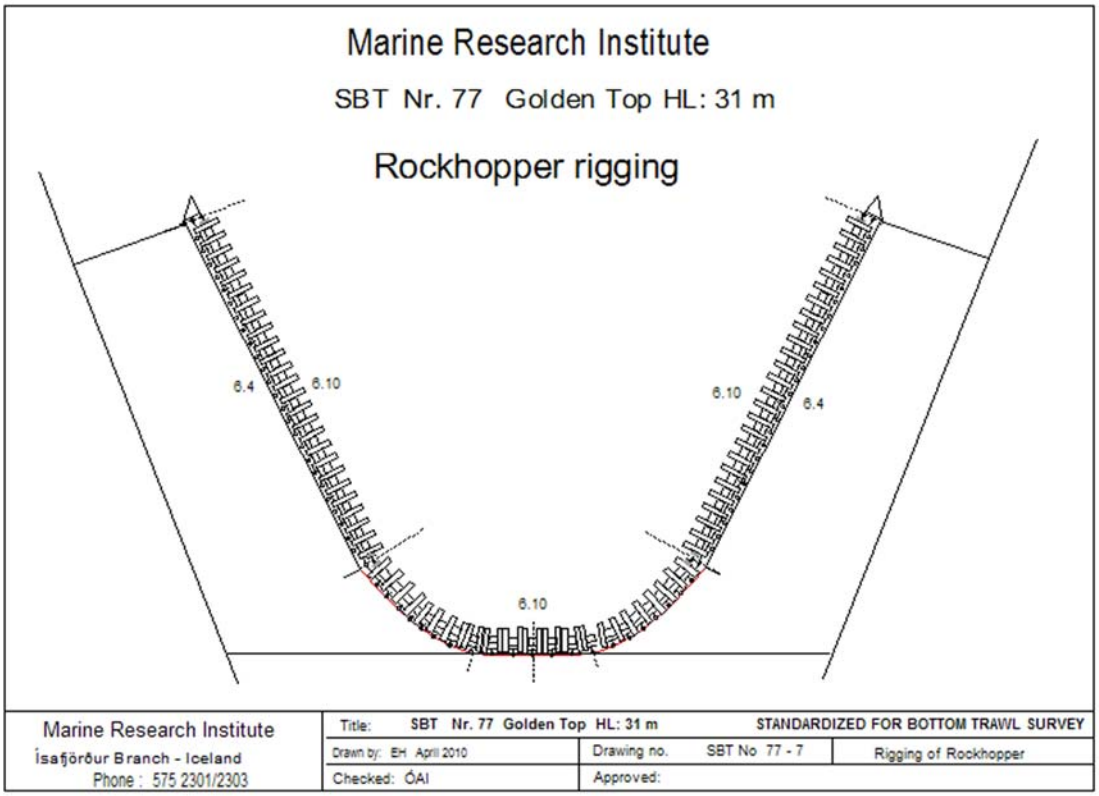


Figure 13. Standardised bottom trawl no. 77 used in the shallow water in the Autumn Groundfish Survey. Rigging of rockhopper.

5.2 Bottom trawl in deep water (gear nr. 78)

The bottom trawl used for sampling on the r/v Árni Friðriksson is "Golden Top" nr. 78 (Figures 14-21). The headline is 35.6 m, the fishing line is 22.6 m. The rock hoppers used are 3 x 7.33 m, weighing 2,200 kg. The otter boards are PolyIce nr. 8 and weigh 2700 kg. It is important that the standardization of the trawl must be exactly as given in the table in section 5.3.2 and in Figures 14-21.

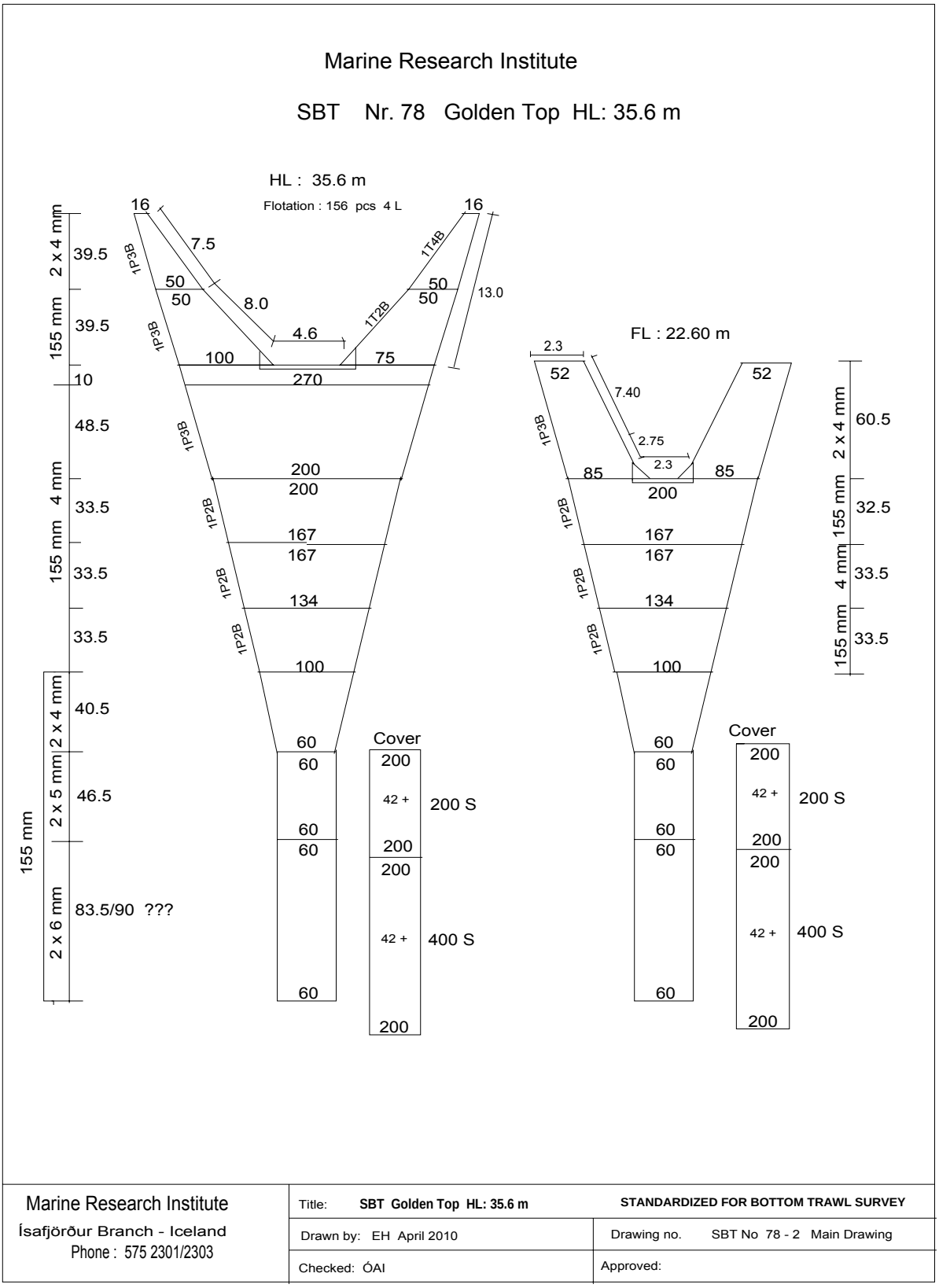


Figure 14. Standardised bottom trawl no. 78 used in the deep water in the Autumn Groundfish Survey. Main drawing.

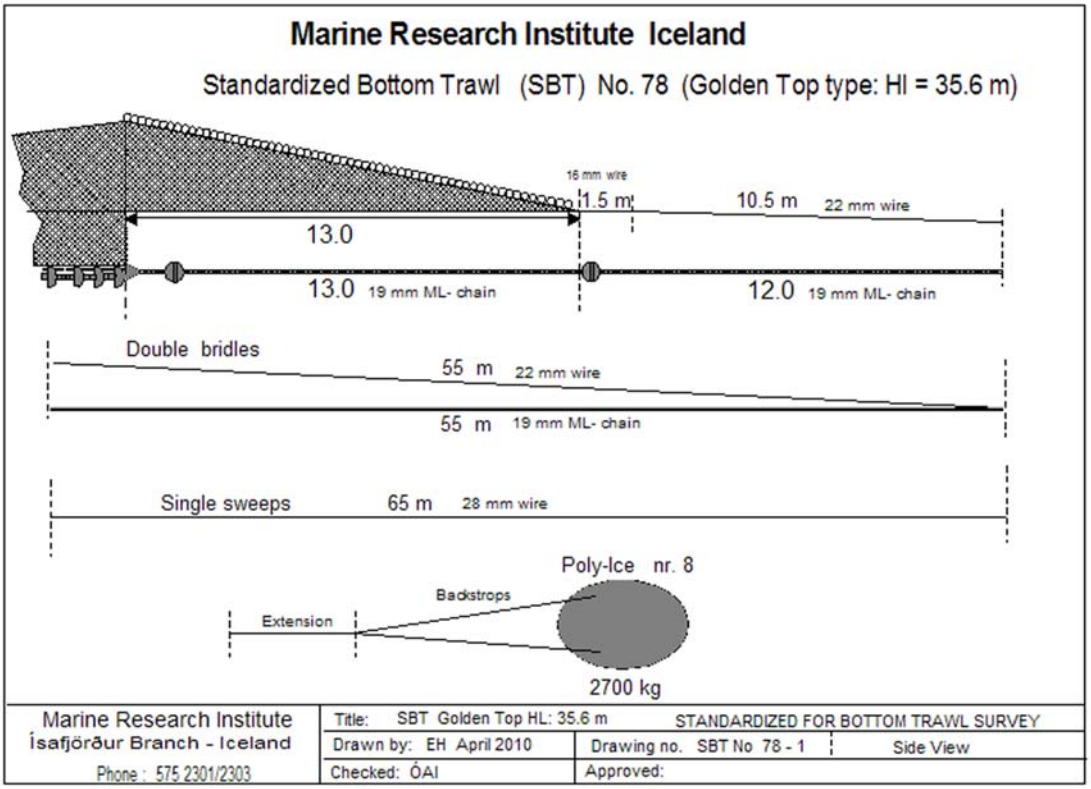


Figure 15. Standardised bottom trawl no. 78 used in the deep water in the Autumn Groundfish Survey. Side view.

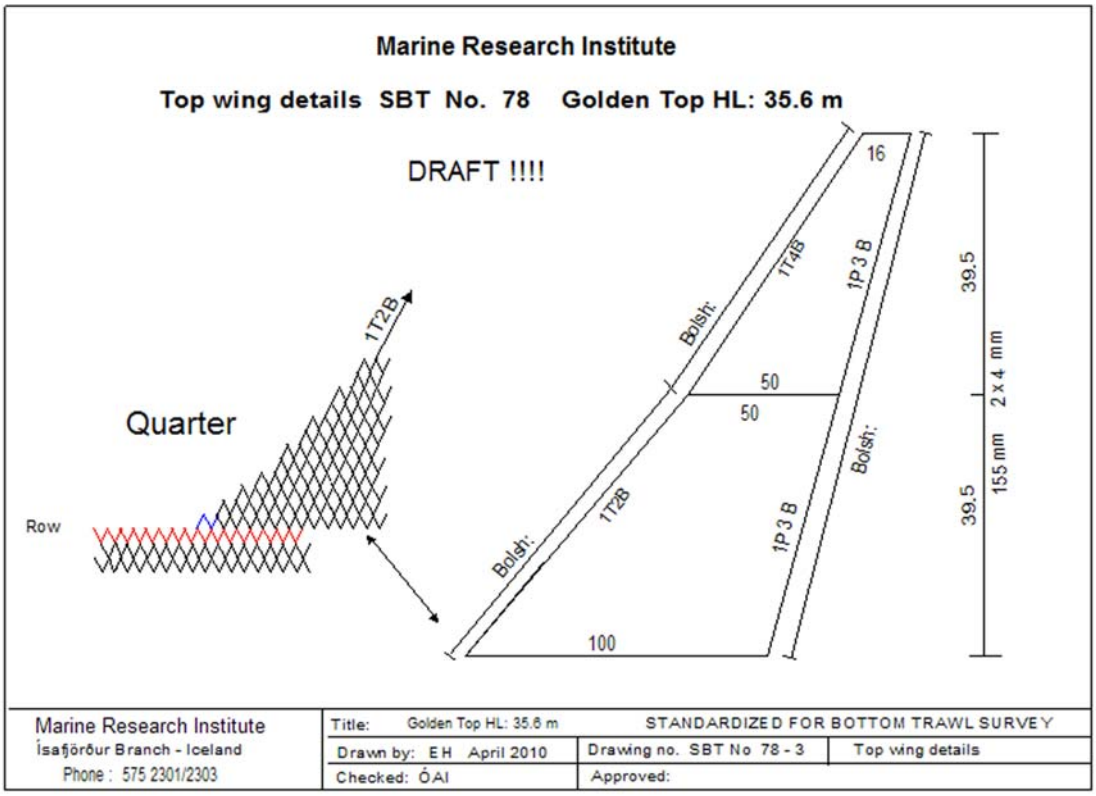


Figure 16. Standardised bottom trawl no. 78 used in the deep water in the Autumn Groundfish Survey. Top wing details.

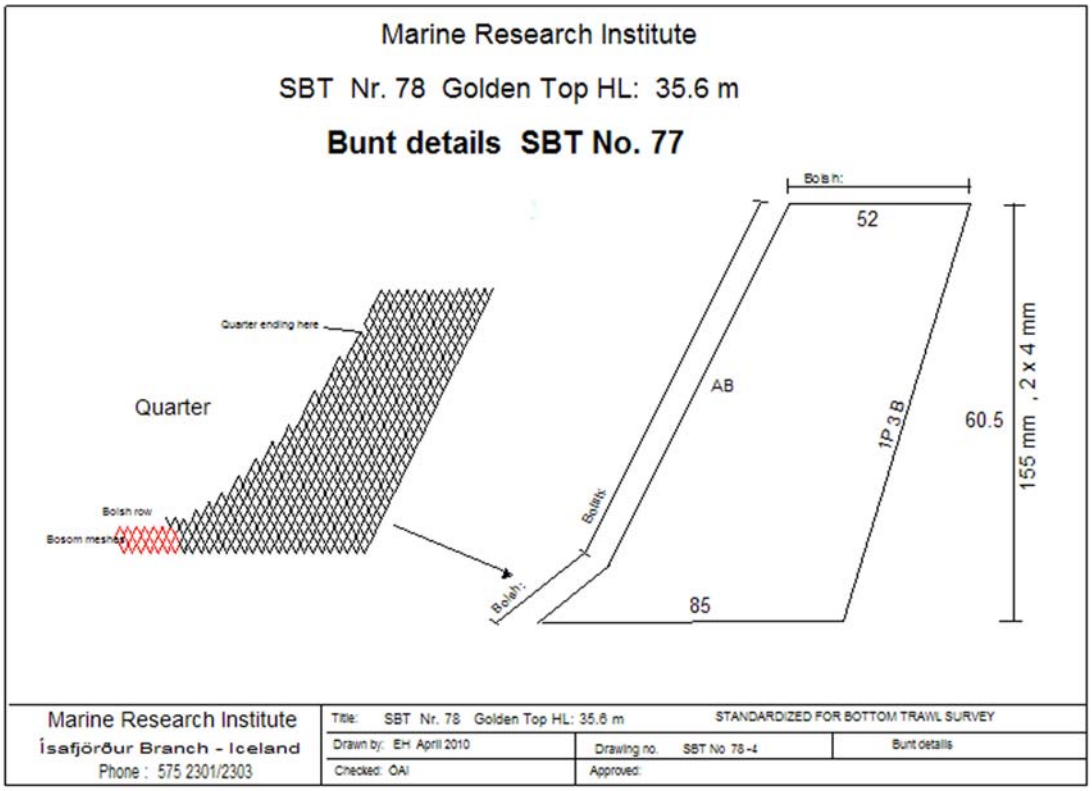


Figure 17. Standardised bottom trawl no. 78 used in the deep water in the Autumn Groundfish Survey. Bunt details.

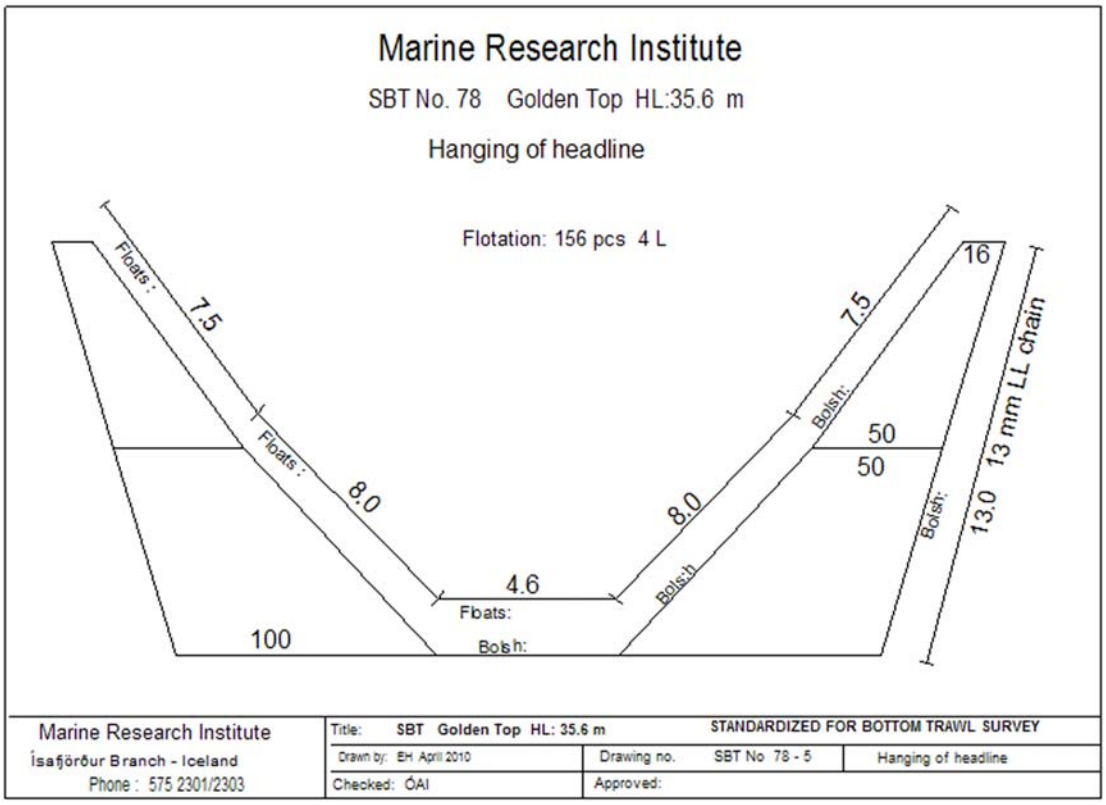


Figure 18. Standardised bottom trawl no. 78 used in the deep water in the Autumn Groundfish Survey. Hanging of headline.

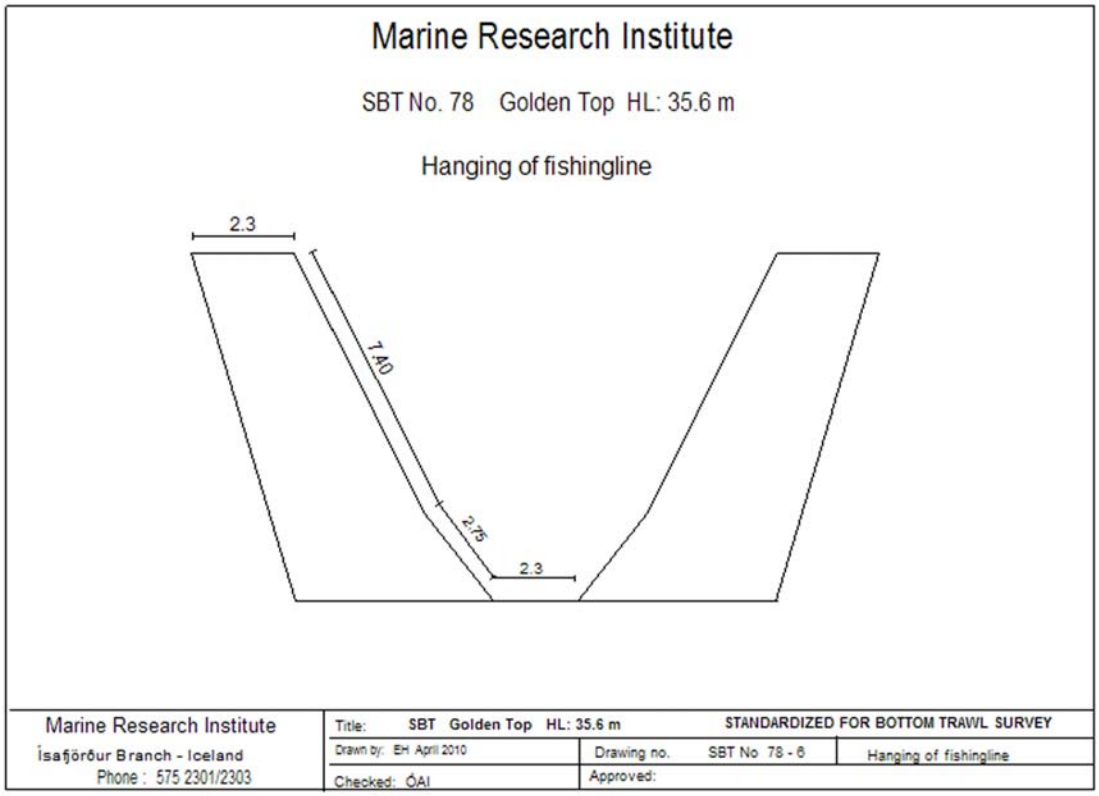


Figure 19. Standardised bottom trawl no. 78 used in the deep water in the Autumn Groundfish Survey. Hanging of fishingline.

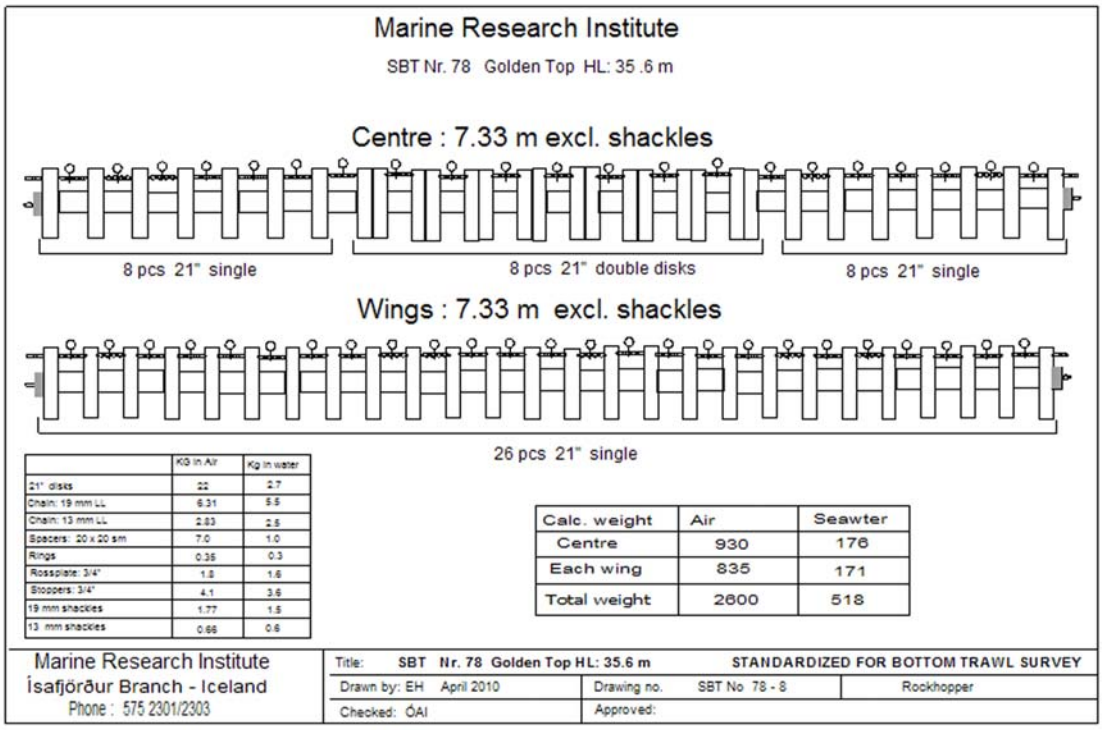


Figure 20. Standardised bottom trawl no. 78 used in the deep water in the Autumn Groundfish Survey. Rockhopper.

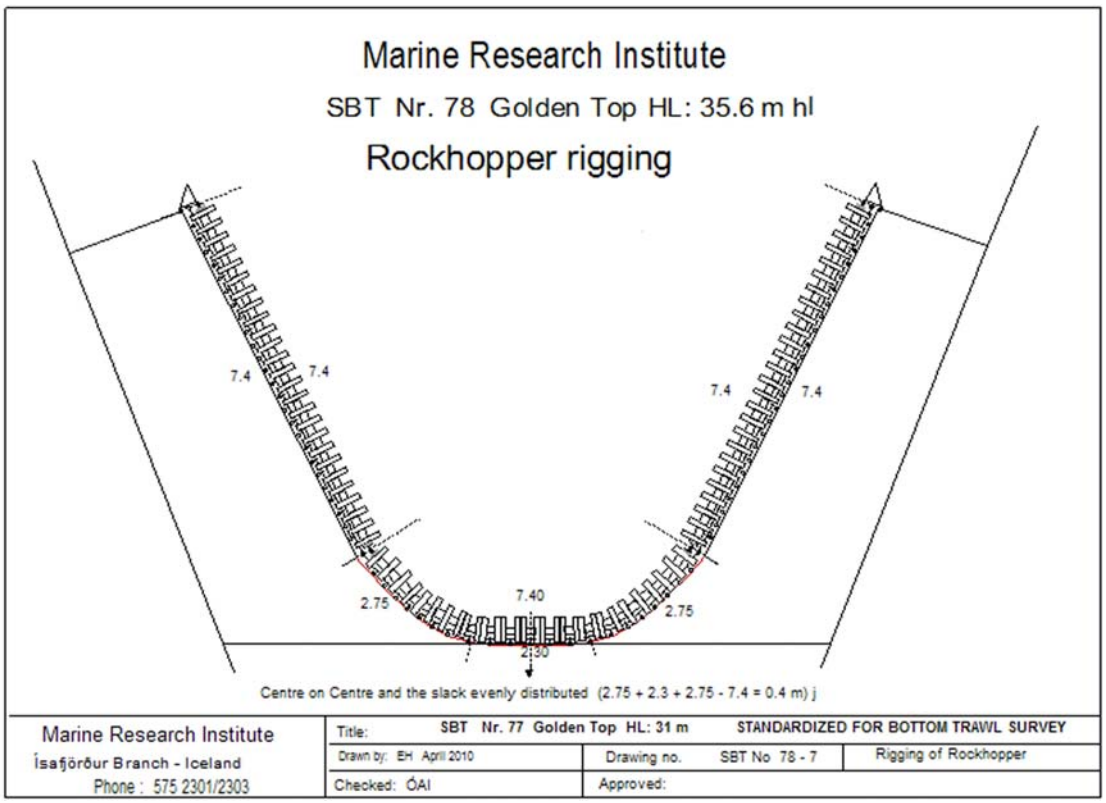


Figure 21. Standardised bottom trawl no. 78 used in the deep water in the Autumn Groundfish Survey. Rigging of rockhopper.

5.3 Standardisation of the sampling gear

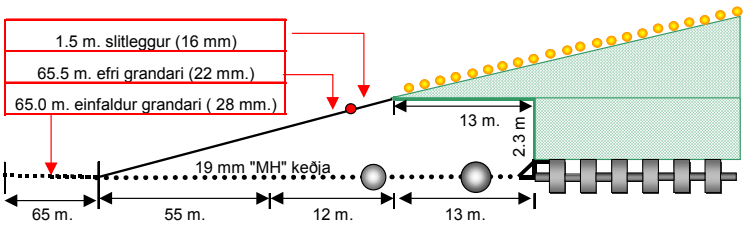
It is critically important that the sampling gear is set up according to the approved standardized gear diagram no. 77 and no. 78 (Figures 6-21). It is therefore necessary to check if all measurements of all gears are in accordance to the diagram. This check is to be done by the relevant gear workshops responsible for the maintenance of the trawls before they are shipped on board the survey vessels. Before the vessels leave harbour, cruise leaders carefully examine wheter the sampling gear is set up according to the diagram.

5.3.1 Gear type 77 – shallow water

The following specifications (lengths and weights) are checked:

Name	Measurement	Standard	Trawl 1	Trawl 2
Headline Headline	Length (m) Diameter (mm)	6.5+7+4+7+6.5 = **31 m** 18 mm		
Floats (4 L) on headline	Number	156 floats		
Wing line	Length (m)	11.3 m		
Headline legs	Length (m)	1.5 m		
Upper leg	Length (m)	24.57-1.5 = 23.07 m		
Lower leg	Length (m)	16.8 m		
Belly line legs Belly line legs	Length (feet) Diameter (inch)	17 feet 2 1/4' ?		
Fishing line, chain Fishing line, chain	Length (m) Diameter (m)	6.4+6.8+6.4 = **19.6 m** 13 mm		
Rock hopper footrope	Length (m)	3x6.1 = 18.3 m		
Bridles, wire Bridles, wire Bridles, chain	Length (m) Diameter (mm) Length (m)	25 fm ? 10 fm		
Back straps – double + single	Length (feet)	20 + 10 feet		
Codend cover – mesh size	Width (mm)	40 mm		
Total weight of rock hoppers	Kg	2150-2350 kg		
Otter boards: Poly-Ice nr.7:				
Weight (w. back straps)	Kg	1950 kg		
Length	M	3.4 m		
Width	M	2.25 m		

5.3.2 Gear type 78 – deep water (in Icelandic)



Gulltoppur 66.6m Teikning 78		Staðall	Mæling troll 1	Mæling troll 2
Höfuðlína	Lengd	35.6 m.		
	þvermál	18 mm.		
Kúlur (4L)	á höfuðlínu	156 stk.		
	á poka			
Fljúgandi VÍRMANILLA	lengd	13 m.		
	þvermál	18 mm.		
Slitleggur	lengd	1.5 m.		
	þvermál	16 mm.		
Fiskilína keðja	lengd	22.6 m		
	þvermál	13 mm.		
Belglínur	lengd	5.12 m		
	þvermál	16 mm.		
Grandarar, fótreipi og lengja.				
Efri grandarar vír	lengd	65.5 m.		
	þvermál	22 mm.		
Grandarakeðjur MH keðja	lengd	55 m.		
	þvermál	19 mm.		
Einfaldur grandari VÍR	lengd	65 m./(35 fm.)		
	þvermál	28 mm.		
Berafótreipi með lásum MH keðja	lengd	25 m (13+12)		
	þvermál	19 mm.		
Grjóthoppari (3 x 7.33 m.)	lengd	22 m.		
	þvermál	19 mm.		
Bakstroffur	Klof+skott	19 mm.		
Klæðning í poka og millistk.	Möskvastærð	42mm+		
Heildarþyngd grjóthoppara (ross í ross)		2.6-2.8 t.		
Hlerar Poly-Ice nr. 8 ($8m^2$) 2700 kg. Lengd 3.75m. Breidd 2.53 m.				

6 FISING MEHTOD AND INFORMATION ON EACH STATION

Towing speed and distance: The towing speed is 3.8 knots over the bottom. The trawling distance is **3.0 nautical miles** calculated with GPS when the trawl has set on the bottom until the hauling begins (i.e. excluding setting and hauling of the trawl).

Towing warp: The length of the towing warp of each tow is decided by the cruise leader and the captain and documented precisely. The length of the towing warp may also be decided in relation to position and status of the trawl according to measurements from trawl sensors.

Towing direction: The towing direction is the one given in the station list or in the opposite direction. The trajectory of each tow from previous surveys should be used when towing.

Invalid tows – snags, malfunctions etc.

- A tow is considered valid if the towing distance is at least **2 nautical miles**. If there is a snag or net damage before a towing distance of 2 nautical miles is reached, the tow is invalid and has to be repeated. When repeating the tow it may be better to tow in the opposite direction.
- If something is wrong in relation to the trawl, such as the codend is not properly closed, the wings are wound or something is wrong with the otter boards, the tow is invalid and has to be repeated.
- If parts of the headline, the footrope or the bridles are broken the tow is only valid if it is known precisely when the rope broke down (for example, if it broke down due to snagging) and the tow have reached at least 2 nautical miles. Normally, the trawl is hauled immediately if snagging is believed to be the cause of the breakdown. If the trawl is in order it is allowed to set the trawl out again and finish the tow. If the trawl is not in order but it is thought that the breakdown occurred during the snag, the tow is only valid if it has reached 2 nautical miles.
- If the codend has a hole or is ragged the tow is invalid and must be repeated. If the net in the upper or lower belly, wings and the square have holes or is ragged the tow is only valid if it is believed to have had no effect on the sampling efficiency of the trawl and the towing distance is at least 2 nautical miles. If the net is ragged without any snag, the tow is considered invalid and must be repeated, if the ragged net is considered to have effect on the sampling efficiency of the trawl.

Number of repetitions: When invalid tows are repeated, a towing distance of 2 nautical miles is sufficient, especially in areas where the bottom is rough. If a repeated tow is also invalid the cruise leader must decide whether that third attempt shall be made, e.g. by shifting the tow track or changing the tow direction.

Trawl measurements with Scanmar or Furuno: Trawl measurements are documented on the station information form.

Weather: Trawling is stopped when the wind force exceeds 8 on the Beaufort scale (17.2-20.7 m/sec) with corresponding sea condition.

Auto-trawling: Auto-trawling system is allowed.

Following issues are important during towing and documentation of information on each station:

- Towing procedure has to be in accordance to the station list and in other sections of this protocol. It is especially important that the **towing speed** is correct, and **the length of the warp and the bridles**.
- The towing direction is **not fixed**, that is, the start and the end of the tow given in the station list is not decided beforehand. This means that it does not matter at which end point of the tow starts.
- **Sub-square within each statistical square is as given in the station list** and hence, not calculated after each tow.
- If a stationary fishing gear, such as longline or gillnets, are within the towing direction of a given station, it is allowed to move the tow at a maximum of one nautical mile from the standard tow. Otherwise, the tow is omitted.

- All deviations from the standard tow have to be documented on the station list form.

Copy of tow trajectories: Cruise leaders shall save a digital copy the trajectories of all towing stations according to GPS locations.

Malfunctions of research equipment: If important research equipments, such as temperature sensors or weighing scales, break down during the cruise it is not self-evident to resume sampling. In such occasions the possibility must be considered to sail to the next harbour and get the equipment repaired. If this solution is not applicable the cruise leader must consult the coordinator of the project for the next steps

7 ADDITIONAL STATIONS

7.1 Additional stations at the slopes of the continental shelf

It is permitted to take additional stations at the slopes of the continental shelf in cooperation with the captain. In general, additional stations in interesting areas should be taken in relation to magnitude of fish in the area and in regard to the bottom type. If ice covers some of the fixed stations it may be necessary to take additional stations at the edge of the ice.

Following points should be had in mind when additional stations are taken:

- The main objective of additional stations is to define geographical boundaries of species, such as Greenland halibut and cod, so to secure low abundance at the outmost stations.
- Additional station should be taken adjacent to a fixed station if that haul contains relatively great quantity of cod or Greenland halibut.
- To distinguish additional stations from the fixed ones given on the station list, they shall be given a separate **tow number** within the statistical square the station in question (the first additional station within a given statistical square gets the tow number *statistical square-21*, for example 528-21).

7.2 Additional stations in shallow waters

The magnitude of cod in the shallowest waters (i.e. fjords) can be highly variable. Additional tows can therefore be taken in the shallowest waters (i.e. tows in fjords) to cover the distribution area of cod.

7.3 New stations in 2000

On the station list there are 63 stations that were added in 2000. The stations with the tow number 51-55 were randomly chosen within the distributional area of deepwater redfish. The stations with the tow number 61-65 are stations randomly chosen from a database of the fishing fleet fishing for deep water redfish. Station number 70 and 71 were old stations from IGS and were added to AGS because of a high variability within relevant areas.

7.4 New stations in shallow water in 2008

Information on the youngest year classes is one of the most important data collected in bottom trawl surveys. Concerns have been raised that the bottom trawl survey in the autumn does not cover the distribution of the youngest year classes of cod. This is because the youngest year classes may be in the shallowest areas and in fjords where stations are not located. To react to this, 19 stations were added in shallow water areas west, north and east of Iceland in 2008. When locations of the stations were decided the following criteria were used:

1. Shallow water stations omitted from the Icelandic groundfish survey in the spring 1985-1996 (8 tows).
2. Stations from the shrimp survey in which 0-group cod have been observed (6 tows).
3. Stations added in the Icelandic groundfish survey in the spring 2008 (4 tows).
4. Station taken in 1999 in the autumn groundfish survey.

The tows outside the fjords and in Breiðafjörður are **3 nautical miles** (except they are shorter on the station list). The fjord tows are at a maximum **2 nautical miles** and if they are longer on the station list it is recommended that the towing be taken in the shallower part of the tow. To distinguish these tows from other tows they will have the tow number **35-37** within the given statistical square.

8 STATION LIST

8.1 Station list in shallow water area

OBS! Sub-square is determined by the station list, not from the beginning of the tow.

CRUISE LEADERS! All notes and comments on tows must be delivered to the coordinator of the project after the cruise. See Chapter 8.1.1 “Comments and notes on tows”. **Remember to document the comments in the station list form in *SeaScale*.**

Square	Tow Nr.	Sub-square	Setting N	Setting W	Hauling N	Hauling W	Depth (m) setting	Depth (m) hauled	Warp (fm)	Notes
316	11	2	632504	161854	632503	161174	130	145	250	
317	1	2	631488	173056	631583	172410	180	177	300	
318	1	1	632078	185100	632190	184468	61	79	110	
319	1	2	632164	192630	632016	192036	105	119	180	
319	11	2	632026	190946	632105	191604	96	93	120	+
320	2	2	631622	200909	631899	200659	136	136	220	+
320	11	3	631538	210175	631453	205537	155	157	275	+
321	3	2	632222	211018	631924	211022	131	153	275	
321	4	2	632666	212664	632381	212837	127	142	275	
322	2	2	632910	220890	632898	221569	206	239	300	
322	11	4	630426	221759	630555	221153	369	333	500	
323	2	2	632048	230818	632354	230804	269	231	400	
323	12	1	631370	240450	631530	235890	237	239	375	
324	2	4	630230	242150	630090	242750	390	422	550	+
324	12	3	630975	245925	630873	245070	283	311	425	a)
325	11	1	632279	254391	632481	254900	360	356	500	a)+
363	11	1	635488	134467	635655	133891	177	238	275	
364	2	3	634435	144325	634166	144014	180	170	270	+
365	1	4	633400	151815	633403	151132	108	150	220	
365	11	4	633980	150781	633996	151456	111	107	180	
366	1	2	634470	162226	634767	162393	87	64	125	
366	2	1	634571	163242	634455	162630	73	80	120	
367	11	4	633022	171630	633208	171097	108	165	200	+
371	31	4	634150	213195	634161	212513	106	89	170	
372	2	1	635340	225520	635645	225512	103	93	200	+
372	12	4	634485	222076	634483	221390	106	109	170	
373	3	2	635900	231760	635890	232466	116	124	200	+
373	12	1	634800	233780	635003	234267	148	150	270	
374	2	2	635030	241800	635297	241468	270	268	400	
374	3	2	635440	241496	635713	241155	312	312	410	+
375	1	2	635890	251350	635605	251590	225	235	300	+
375	11	1	635119	253760	635020	254400	222	220	300	+
376	1	2	635370	262130	635240	262750	260	306	370	+
412	3	3	640898	125330	641107	124828	338	357	500	+
413	2	4	640132	132089	640138	131419	252	385	500	+
413	15	1	641968	134629	641675	134773	150	131	225	+
413	35	1	643130	133000	643500	132700	110	170		b)
414	1	4	641000	142192	641086	142796	156	167	250	
414	36	2	642070	141502	641672	141496	106	112		b)
422	11	1	642300	224880	642506	224756	80	82	140	
422	32	4	641120	220990	640980	221610	36	24	70	
423	3	2	642750	231040	642690	230370	137	121	225	
423	12	3	641230	233950	641050	234160	114	120	200	+
424	3	3	640780	244250	640620	244840	211	209	300	+
424	13	3	641450	243060	641340	243670	213	195	275	
425	11	4	641500	251470	641210	251670	252	255	370	
425	12	3	640100	252940	635996	253590	182	207	270	+

Square	Tow Nr.	Sub-square	Setting N	Setting W	Hauling N	Hauling W	Depth (m) setting	Depth (m) hauled	Warp (fm)	Notes
426	1	3	640020	264200	640300	264470	414	408	500	+
426	11	2	642550	261300	642770	261660	280	273	400	
461	1	1	645103	113892	644832	114216	316	259	420	
462	2	4	643343	122237	643203	121607	199	192	320	+
462	7	3	643988	122992	644289	122985	145	148	230	
463	1	4	643195	130782	643274	130107	125	128	190	+
463	32	1	645478	135665	645429	135103	83	94	140	
463	35	1	650028	135256	645886	134806	155	133		b)
472	11	3	643790	224620	643510	224900	51	63	115	+
473	2	1	645878	235575	650038	234960	214	217	275	+
474	4	4	644000	241320	644300	241590	105	146	260	+
474	11	3	643580	243970	643700	243310	266	275	425	
475	1	3	644060	255550	644170	254910	229	220	300	
475	3	1	645610	253970	645560	253260	173	160	270	
476	1	2	644590	262710	644856	262895	198	195	300	+
476	12	1	645740	264540	645860	263880	207	190	300	+
511	11	1	651766	115732	651616	115095	216	197	340	+
512	14	4	650393	122080	650476	121387	208	189	320	
513	2	4	650396	130273	650730	130314	156	145	230	
513	11	2	652054	130809	652077	131529	203	180	300	+
513	35	3	651205	134063	651204	134567	98	81		b)
521	35	2	652555	210821	652356	210850				b)
521	36	2	652430	210013	652620	210126				b)
523	11	3	651046	234789	650780	235122	62	107	140	+
523	31	4	651384	231100	651218	231686	101	146	130	+
523	35	1	651410	233750	651520	233070				b)
523	36	1	652070	233040	651930	233540				b)
524	11	3	651451	245090	651148	245214	90	102	150	+
524	12	3	650700	250010	650900	250120	116	119	200	
524	35	2	651860	241990	651590	242230				b)
525	11	1	651937	254924	651762	255512	131	137	210	
525	13	3	651475	255289	651306	255886	137	147	220	
526	3	2	652564	262598	652262	262617	155	152	240	
526	11	4	650963	262483	650874	263167	156	161	270	+
527	1	2	652498	265994	652198	270028	277	258	350	+
561	1	3	653600	113604	653859	113210	260	285	375	
562	1	2	654752	115666	654947	120233	194	178	300	
562	3	1	654900	122951	654838	123669	138	141	220	+
563	2	4	653652	132362	653745	133060	104	122	170	
563	11	4	653721	130258	653943	130744	183	202	280	
564	1	2	654988	140635	655080	141449	124	147	230	
564	35	3	654780	143220	654581	144190	102	95		b)
569	11	1	655979	194951	655686	194749	112	88	175	
569	33	1	655750	193370	655484	193000				
570	2	1	655899	203610	655621	203338	145	128	240	
570	33	1	654770	203043	655070	202720				
571	1	2	655457	210686	655660	210117	230	220	300	+
571	33	4	653880	210290	653590	210440				+
571	34	4	653950	212280	654040	212000				
571	35	3	654091	213603	654011	213242				b)
573	31	1	654589	234196	654716	234855	90	88	140	
574	1	3	653984	245961	653683	245990	76	73	125	+
574	31	3	654015	245074	653711	245078	58	62	100	+
574	35	2	655632	240225	655327	240090				b)
575	1	1	655068	254662	654777	254885	210	198	300	
575	3	4	654410	251810	654320	252510	136	167	225	

Square	Tow Nr.	Sub-square	Setting N	Setting W	Hauling N	Hauling W	Depth (m) setting	Depth (m) hauled	Warp (fm)	Notes
576	2	3	654216	263244	653945	263565	179	161	300	
576	3	2	654876	260050	654975	260738	216	250	325	
612	1	4	661553	121585	661500	120838	259	298	375	+
612	13	4	655977	120929	660261	120652	280	268	375	
613	3	2	662121	131562	662279	130905	208	196	350	
613	12	2	661500	132628	661594	131916	147	129	230	
614	11	4	661130	142720	661429	142597	221	230	370	
614	12	4	660223	142084	660454	142548	107	173	260	
615	1	2	662450	152699	662738	152892	106	150	220	
616	11	1	661813	164164	661611	164728	194	191	300	
616	33	1	662256	164304	662451	164862				
616	36	2	661529	163033	661910	163392	74	63		b)
617	3	1	662692	172688	662700	173441	222	315	380	
617	12	2	661515	172962	661814	173017	211	225	325	
617	33	3	660905	173160	660612	173279				
618	11	2	662338	182695	662029	182733	140	184	300	
617	35	4	660725	174748	660420	174018	132	140		b)
618	12	2	662633	180898	662402	181402	75	73	125	
618	31	2	660307	182893	660012	182652	99	58	120	
619	1	1	662261	194628	661957	194676	184	177	280	
619	4	2	662017	190294	662315	190442	221	190	320	
620	1	3	661495	203862	661192	203748	187	158	270	
620	2	1	662336	204788	662636	204794	172	180	300	
621	14	4	660791	210215	660495	210080	150	128	220	+
622	1	3	660808	225338	660953	230000	124	122	140	+
622	35	1	661650	224860	661650	224420				b)
622	36	3	660510	224160	660420	223870				b)
622	37	3	660210	223090	660410	223320	51	66		b)
623	14	2	661633	231138	661787	231778	62	71	125	
623	31	3	661210	235128	661011	235683	41	50	80	+
624	4	2	662294	240384	662071	240901	109	103	170	
624	5	4	660720	241270	660500	241453	56	49	90	
625	11	3	661278	254998	661063	255531	230	265	350	
625	16	2	661530	250830	661790	250730	127	132	250	
626	11	4	660350	261032	660142	261570	247	210	340	
663	1	4	663750	130621	664048	130510	256	200	350	+
663	11	1	665476	134205	665728	134631	292	299	400	
664	2	3	663200	144048	663283	144797	147	152	230	
664	11	1	665224	150044	665073	145372	107	120	200	
665	2	2	665785	150405	665624	151065	147	138	240	
665	3	3	664403	154070	664385	154834	175	140	275	+
666	11	3	664439	164975	664140	164879	140	172	270	+
666	14	1	664945	163600	664659	163868	179	148	270	+
667	12	2	665393	171825	665094	171796	231	235	350	+
667	14	2	664670	170704	664461	170141	213	251	350	
668	3	4	663821	180084	663907	180820	160	195	360	
668	11	3	663336	183380	663043	183584	223	220	325	
669	3	3	663907	194768	664178	194422	141	152	210	
669	4	4	663900	191424	664200	191323	310	312	430	
670	4	1	665901	204151	665900	204933	223	182	280	
670	12	4	663527	202622	663650	201935	281	224	380	
671	2	2	665306	211030	665357	210264	125	136	210	
671	11	4	663865	212733	663605	213132	117	117	150	
672	3	2	665410	223350	665620	222810	162	176	285	
672	12	1	665030	224100	665250	223640	126	143	250	+
672	35	3	663494	225838	663226	225140	65	78		b)

Square	Tow Nr.	Sub-square	Setting N	Setting W	Hauling N	Hauling W	Depth (m) setting	Depth (m) hauled	Warp (fm)	Notes
673	3	2	665400	232600	665680	232950	205	219	350	
673	13	4	664414	232135	664480	231393	143	114	225	
674	12	3	662974	244589	663020	243843	110	105	200	
674	15	1	665130	243735	665360	242770	210	270	350	a)
674	16	4	664055	242056	663993	241310	144	247	300	+
714	11	3	670471	145668	670217	145258	226	211	340	
715	11	3	670397	154518	670092	154503	165	166	260	
716	11	3	670623	164382	670604	165162	348	365	500	
717	1	4	670403	172263	670120	172522	235	240	350	+
718	2	3	670227	184645	665933	184857	188	170	260	+
719	2	3	670867	194892	670660	195453	296	274	425	
719	11	4	670728	193150	670933	192573	375	454	450	
720	11	1	671956	203478	671825	204187	346	325	450	
720	14	3	670457	202807	670232	203334	233	226	350	
721	1	3	670494	212635	670309	213248	213	219	290	
721	11	4	670204	211260	670496	211075	172	181	270	
722	2	3	670570	230000	670270	230000	261	240	350	
722	4	4	670620	220220	670920	220200	217	224	300	+
723	2	4	670140	232770	670400	233190	236	227	350	
723	4	3	670020	234580	670300	234290	209	224	375	
723	11	3	665992	235901	670308	235100	250	265	350	a)

1. Tows that were added in 1998.
2. Extra stations added in 2008, see chapter 8.1.2
3. +) Tows that have comments and remarks (not shown in this manual).

8.1.1 Comments and notes on tows in shallow waters

Comments and notes on deviation from standard tows, as described in the station list, must be documented. The comments are mainly on hang ups and rough bottom, but also information on changes of towing-course and other information that are considered important. Comments and notes must be delivered to the coordinator of the project after the cruise.

8.1.2 Additional stations in shallow water areas in 2008 and remarks on the tows

The table below shows the station list of the extra stations added in 2008 in the shallow water area.

Square	Tow nr.	Setting N	Setting W	Hauling N	Hauling W	Depth (m) setting	Depth (m) hauled	Tow length	Notes
413	35	643145	133004	643292	132873	135	130	1,6	+
414	36	641567	141594	641882	141506	105	88	3,0	
463	35	650048	135245	645888	134870	149	153	2,2	
513	35	651187	134565	651191	134413	88	91	0,6	+
521	35	652344	210869	652571	210833	50	72	2,3	
521	36	652438	210011	652635	210125	66	72	2,0	
523	35	651410	233786	651517	233068	48	56	3,0	
523	36	652065	233023	651929	233526	52	62	2,5	
524	35	651608	242250	651876	241986	90	140	2,9	
564	35	654612	144043	654703	143600	98	101	2,0	
571	35	654091	213560	654010	213291	107	116	1,4	+
574	35	655310	240091	655607	240200	45	39	3,0	
616	36	661592	163106	661789	163275	69	55	2,0	
617	35	660725	174702	660579	174374	140		2,0	
622	35	661650	224385	661657	224868	91	96	2,0	
622	36	660506	224235	660410	223838	103	107	2,0	
622	37	660430	223389	660258	223160	62	69	2,0	
665	35	663484	155368	663484	154703	90	116	2,6	+
672	35	663491	225857	663286	225287	63	75	3,0	

Below are listed remarks on "deviations from standard procedures" such as snags and rough bottom which have been recorded during the execution of the trawl survey as well as other useful information (e.g. change of towing-course) which have to be taken into account during a haul. The identification and/or location of each haul are indicated by statistical square number and haul number.

Square	Tow nr.	Year	Remarks
413	35	**2008**	Hauled because of hang up (*snagged*), rough bottom.
513	35	**2008**	Hauled because of .
571	35	**2008**	Very rough bottom.
665	35	**2008**	Very rough bottom, not taken in 2009.

8.2 Station list in deep water area

OBS! Sub-square is determined by the station list, not from the beginning of the tow.

CRUISE LEADERS! All notes and comments on tows must be delivered to the coordinator of the project after the cruise. See Chapter 8.1.2 on "Comments and notes on tows". **Remember to document the comments in the station list form in *SeaScale*.**

Square	Tow Nr.	Sub-square	Setting N	Setting W	Hauling N	Hauling W	Depth (m) setting	Depth (m) hauled	Warp (fm)	Notes
225	51	2	622400	252400	622700	252400				
225	61	3	621450	254480	621170	254690	790	739	750	+
270	61	2	625700	201090	625850	200810	774	843		+
272	51	2	630070	221490	630030	221400	707	740	800	+
273	51	1	625940	234540	625700	234970	620	620	680	+
274	51	2	625070	240980	624990	241380	678		760	+
274	52	2	625270	235830	625160	240450	634	644	720	
274	53	3	623980	243990	624050	243430	723	765	800	
274	61	1	624740	244860	624490	245220	464	515	520	
274	62	3	624100	245870	623850	250150	442	460	520	
274	63	2	625080	242440	624980	243140	664	628	720	
275	52	2	625140	251090	625330	250590	448	365	450	+
275	61	4	623390	251130	623130	251500	684	725	700	
311	71	1	633080	114440	632770	114310	388	395	475	
312	1	1	631954	125978	632253	130040	626	630	650	
312	51	3	630040	124870	630340	125290	561	570	650	
312	61	1	632650	124510	632400	124220	527	573	640	
312	71	4	631260	121180	630960	121430	406	418	475	
313	1	4	631070	130000	631356	130198	626	622	710	
313	21	4	631270	131530	631570	131511	767	760	810	+
315	51	1	632519	155110	632410	155600	276	300	340	+
316	61	1	631770	164770	631680	165350	538	314	650	
317	61	3	631050	174610	630980	175260	570	565	570	+
317	62	3	631730	170560	631640	172000	224	212	260	+
318	51	3	631330	183520	631300	182820	177		255	
318	61	4	631040	180240	631100	180880	558	558	625	
319	61	3	631340	195490	631060	195690	616	691	600	+
319	62	1	631580	195020	631440	195610	594	522	690	
320	51	3	630440	204400	630580	203940	428	437	550	+
320	61	4	630660	202610	630670	203270	420	497	550	
320	62	4	630730	200980	630500	201400	417	516	535	
321	51	3	630740	215640	630600	220230	516	517	600	
322	61	3	630750	224590	631010	224940	530	470	630	
322	62	4	630200	223370	630270	224020	601	647	650	

Square	Tow Nr.	Sub-square	Setting N	Setting W	Hauling N	Hauling W	Depth (m) setting	Depth (m) hauled	Warp (fm)	Notes
323	51	4	631000	232420	630800	232940	478	516	565	
323	61	3	630280	234480	630120	235020	552	546		
324	51	4	630700	241840	630920	241410	303	281	340	
324	52	2	632040	241920	632200	241400	196	182	265	
324	61	4	630120	242540	630160	241900	406	414		
325	51	1	632710	253670	632430	253430	313	297	400	
325	52	4	630470	250410	630310	245920	461	473	600	
325	53	4	625940	251080	630060	251610	644	675	640	+
325	54	4	630520	252500	630690	252860	821	878	780	
326	1	4	631330	260260	631140	255800	1020	1036	950	+
326	2	3	630571	265265	630871	265248	1354	1318	1200	
326	3	4	630711	262966	630413	262890	1281	1318	1200	+
326	51	2	632720	261640	632980	261750	837	793	800	
359	1	1	640070	93990	635790	93710	740	724	750	+
360	1	2	635780	101320	635788	102003	587	536	710	+
361	1	1	635650	113159	635921	112866	326	322	390	
361	71	2	635760	111990	635570	111990	348	319	375	+
361	72	1	635490	115190	635130	115200	366	0	400	
362	1	1	634862	124075	634565	123982	558	554	580	+
362	2	1	635952	123750	635713	124164	560	586	586	+
362	51	1	635230	122420	634950	122690	454	458	550	+
362	52	2	634720	121500	634460	121900	408	405	500	
362	61	3	633950	124090	634250	124140	523	539	600	
362	62	3	633260	125080	633510	124710	573	547	640	
362	63	1	635300	123800	635450	123200	530	509	600	+
363	1	4	634194	131927	634492	131857	875	884	950	
363	2	4	633523	132275	633823	132239	917	906	970	
363	3	2	634753	130806	635002	130426	747	741	800	
363	4	2	635460	130222	635760	130243	436	706	750	
363	51	2	634870	131110	635100	131500	780	827	850	
363	61	1	634500	135000	634800	135000				
363	62	2	635770	125450	635470	125300	655	643	650	+
364	51	4	634640	141100	634470	141670	365	326	420	+
364	52	4	634112	142600	634310	142180	420	415	500	+
365	51	4	633300	150840	633190	151450	271	295	340	+
375	1	3	633400	255888	633100	255896	370	193	420	+
376	2	4	634410	262762	634702	262914	714	550	700	
376	3	1	635427	265854	635702	265581	964	840	880	+
376	51	4	633960	260990	634140	261240	448	482	552	
377	2	2	635432	270511	635132	270518	1063	1113	1105	
377	41	3	634055	273482	634269	273008	1404	1473	1200	+
409	1	3	640131	95059	640321	95590	708	684	770	+
409	2	3	641270	93850	640976	93990	824	838	810	
411	1	2	641487	110779	641712	110323	337	348	410	
411	2	4	640906	111800	641174	111489	333	340	390	
411	71	1	641790	113930	641520	114260	354	0	400	
412	1	1	642038	124915	642097	125594	168	167	200	
412	2	4	641597	122148	641299	122221	472	481	540	+
412	3	3	640680	123377	640395	123588	536	554	540	+
412	51	3	640930	123750	641190	124120	514	455	600	+
412	61	3	640120	124890	640330	124680		592	675	+
413	1	4	640023	130203	640319	130087	670	604	700	+
413	51	4	640780	131430	640460	131360	139	172	200	
426	1	1	641443	265375	641736	265232	432	366	400	
427	1	1	642822	272874	642564	273228	776	833	835	
427	3	1	642388	275096	642311	274425	917	924	950	

Square	Tow Nr.	Sub-square	Setting N	Setting W	Hauling N	Hauling W	Depth (m) setting	Depth (m) hauled	Warp (fm)	Notes
427	41	2	642733	272185	643031	272265	721	712	700	
427	51	1	642570	273900	642850	274120	840	824	880	
427	52	4	640840	270720	641040	271210	753	771	750	
428	2	2	642434	280670	642545	281315	1189	1180	1220	
428	3	1	643070	283725	642817	284098	1299	1277	1235	
428	41	1	642871	283181	643166	283055	1244	1272	1200	
460	1	4	643163	103156	643417	102786	490	463	510	
461	1	2	645857	110810	650142	111030	602	584	680	+
461	2	2	644990	105864	645265	110148	479	445	500	+
461	3	1	645106	113719	644843	114057	293	344	370	
461	4	3	643430	115520	643168	115859	382	377	370	
461	5	1	650040	112834	645740	112848	415	381	440	
461	71	4	643530	112180	643440	112840	427	435	500	
477	1	3	643935	275038	644234	274985	942	897	920	+
477	21	1	645000	274000	645300	274000				
477	51	2	645350	272920	645060	272740	567	568	650	+
477	52	3	644410	275450	644100	275440	1029	1020	1150	
477	61	4	643670	271960	643430	272350	608	662	700	
477	71	2	645180	271280	645480	271390	386	357	450	
478	3	2	644517	280360	644570	281053	1050	1082	1070	
478	4	2	644950	280355	644650	280389	1091	1107	1070	
478	5	4	643633	280271	643334	280328	1014	1050	1050	+
478	6	4	644122	280949	644264	280330	1098	1078	1020	
478	7	4	644364	281330	644070	281467	1089	1089	1100	
478	41	1	644903	285464	645191	285267	1001	999	1050	
478	42	1	645143	283495	645391	283097	1276	1208	1100	+
478	44	1	645269	284742	645009	284391	1047	1116	1050	+
509	1	3	650671	94023	650371	93984	770	754	830	
510	1	1	652872	104381	652572	104393	824	873	900	+
511	2	2	652673	112311	652398	112021	459	476	530	
511	3	2	652411	111097	652703	110933	706	716	750	+
511	21	4	650836	112702	650559	112979	309	353	380	
511	41	4	651031	111556	651329	111646	576	60	660	
527	2	2	651673	272647	651910	273086	461	544	495	+
527	42	3	651384	273443	651462	272752	582	478	500	+
527	71	4	650070	271050	650250	270440	296	246	416	
528	1	4	650480	281343	650771	281168	1025	1032	1000	+
528	2	2	652007	282783	651746	283136	1155	1168	1200	+
528	3	2	652381	282458	652104	282180	1078	1113	1100	+
528	4	1	652776	284142	653071	284270	1199	1140	1250	
528	5	2	652624	281685	652591	282402	1038	1052	1100	+
528	6	4	650849	280503	651106	280135	952	922	970	+
528	7	2	652482	275712	652596	280379	884	937	1000	+
528	8	1	651917	283413	652062	284042	1248	1281	1280	
528	9	4	650050	281377	650350	281390	1047	1028	1000	+
529	21	2	653011	290247	652756	285865	1274	1173	1250	+
560	1	4	653638	100952	653717	100251	844	844	840	
561	1	1	654881	114843	654868	115574	329	379	270	
561	2	4	653500	110625	653204	110501	811	867	920	
561	3	1	655226	113413	654929	113520	362	381	420	
561	4	3	653979	113525	653703	113216	254	311	370	+
561	21	2	654774	112765	654479	112630	613	600	750	
576	71	1	654530	264270	654820	264260	303	279	360	+
577	1	4	653110	271957	653391	271701	503	487	500	+
577	2	2	655522	270275	655816	270417	673	542	530	
577	4	2	654631	273000	654712	272296	611	567	567	

Square	Tow Nr.	Sub-square	Setting N	Setting W	Hauling N	Hauling W	Depth (m) setting	Depth (m) hauled	Warp (fm)	Notes
577	5	4	654380	272402	654240	273047	582	690	600	+
577	6	2	655439	270944	655348	271644	522	578	550	+
577	7	3	654022	273141	653860	273754	640	701	620	+
577	8	2	654994	270169	655293	270125	456	468	440	+
577	9	2	655530	271910	655380	272510	622	688	700	+ e)
577	10	3	653650	274802	653427	275288	727	787	750	
577	11	3	653233	280006	653088	275373	834	818	850	+
577	12	1	654731	274937	654818	274237	747	727	770	
577	41	1	654624	273993	654624	273262	699	631	670	
577	42	3	654296	280019	654395	275330	816	765	805	
578	3	2	655770	281551	655512	281177	479	544	550	+
578	4	4	654320	281158	654166	280532	888	873	950	+
578	6	3	653356	284634	653477	285298	1145	1105	1225	+
578	7	4	653381	281228	653371	280503	884	919	920	
579	1	4	654298	292302	654589	292123	421	377	450	
612	1	1	662054	123128	661800	122731	421	489	550	
612	2	2	662419	120033	662424	120782	1162	1168	1070	+
625	71	1	662080	253650	662350	253170	318	333	380	
626	1	4	661236	260800	661400	260177	441	425	450	
627	1	3	661071	273168	661064	272425	496	498	550	
628	1	3	661220	283008	661415	283573	344	315	400	
662	2	3	663855	124568	663555	124582	320	311	375	
662	21	4	663138	122282	663432	122134	1180	1183	1070	+
662	41	3	664477	124865	664243	124389	981	906	1015	
663	21	2	665470	133038	665465	132273	554	609	660	+
674	1	1	664719	245715	665012	245555	640	692	700	+
674	71	3	663590	245650	663810	245130	272	265	350	
675	1	1	665797	253853	665755	253094	928	1003	940	+
675	71	4	663330	251380	663490	250700	422	396	440	
676	1	4	662884	262428	663159	262728	615	580	600	
676	2	1	665800	264104	670100	264123	520	487	510	
713	1	3	670315	135869	670092	135355	410	375	480	
714	1	1	672689	143864	672815	143154	964	996	1050	
714	21	4	671235	142635	671044	142038	465	461	550	
715	1	1	671602	153400	671562	152631	320	300	370	
715	2	2	671909	151405	671781	150702	452	423	470	
715	21	1	672376	155590	672532	154923	708	737	720	
716	1	2	671461	161460	671583	160751	373	403	390	
716	21	3	670945	163723	671033	162984	392	403	400	
716	22	1	671823	164844	671921	164109	717	697	820	
717	1	2	671630	171787	671760	172488	800	761	840	+
717	2	4	671325	171181	671345	170408	609	637	690	
717	3	2	672536	172410	672835	172364	963	939	970	
717	21	3	670975	175103	670974	174330	417	390	500	
718	2	4	671289	181800	671302	181026	490	478	500	+
718	21	2	672990	181815	672691	181761	554	622	700	
718	22	2	672026	180504	671755	180171	763	836	780	
719	1	1	672753	194509	672658	193767	348	255	425	
721	1	3	671219	213573	671511	213751	287	256	360	
721	2	1	671825	214465	672025	215045	393	379	470	+
721	3	1	672455	213687	672452	214468	500	505	530	
722	1	1	672611	223420	672591	224200	468	461	550	
722	71	2	671650	221140	671480	220540	362	376	420	
723	1	2	672277	231736	672141	232430	452	458	500	
723	2	1	671682	233245	671463	233774	395	401	450	
724	1	1	671932	244508	672078	243828	1266	1208	1250	

Square	Tow Nr.	Sub-square	Setting N	Setting W	Hauling N	Hauling W	Depth (m) setting	Depth (m) hauled	Warp (fm)	Notes
724	2	3	670050	245455	670318	245108	942	974	1000	
768	1	1	675770	184910	675530	185391	1003	1003	1130	
768	2	4	673809	180493	674008	181083	897	986	920	+
769	1	2	674954	190565	674723	191072	895	787	970	
769	2	3	674088	192998	673874	193552	443	428	480	
769	3	4	673007	190682	673048	185905	489	410	460	+
770	1	4	674073	201972	674372	201920	587	701	720	
770	2	2	674743	202420	675012	202771	816	884	930	
770	3	4	673297	202985	673261	202205	425	377	420	+
770	4	3	673743	204390	673559	203768	551	490	580	
771	2	1	674884	214245	674908	213453	774	729	850	
771	3	2	674760	212547	674602	211872	809	825	880	
771	21	3	673490	214795	673790	214785	620	644	700	
772	1	3	674110	230066	674314	225486	739	752	780	
818	1	3	680424	184201	680152	184540	996	1016	1070	
818	2	3	680868	190100	680849	185296	1155	1201	1100	+
819	1	1	680502	195480	680441	194684	1158	1096	1100	
820	1	1	675957	204144	680251	204301	970	980	1100	+

+) Tows that have comments and remarks (not shown in this manual).

8.2.1 Comments and notes on tows in deep waters

Comments and notes on deviation from standard tows, as described in the station list, must be documented. The comments are mainly on hang ups and rough bottom, but also information on changes of towing-course and other information that are considered important. Comments and notes must be delivered to the coordinator of the project after the cruise.

9 STATION MAPS

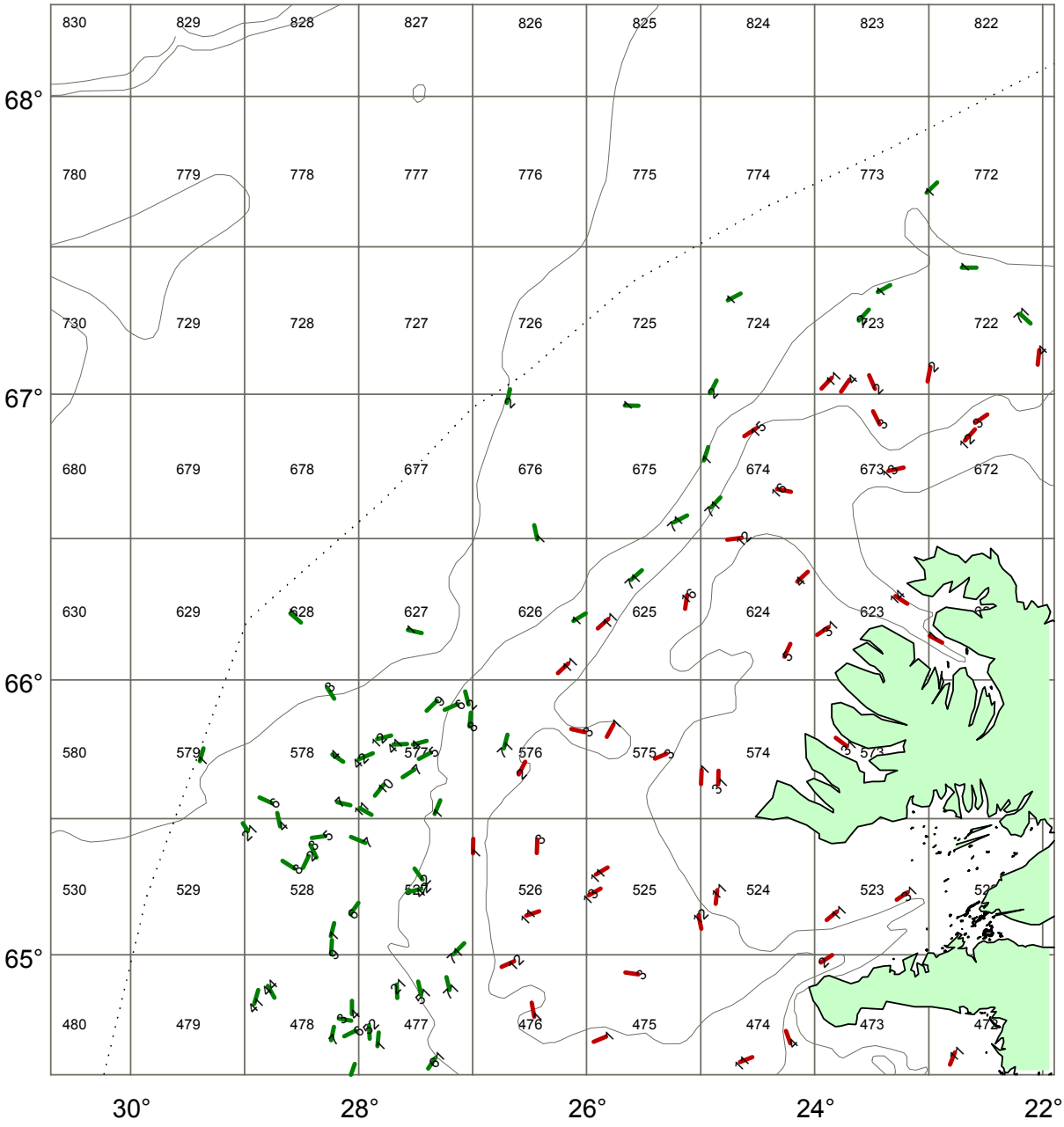


Figure 21. The stations in the Northwest area of the Autumn Groundfish Survey in Icelandic waters. The green lines show the stations taken by r/v Árni Friðriksson in the deep-water area and the red lines show the stations taken by r/v Bjarni Sæmundsson taken in the shallow-water area.

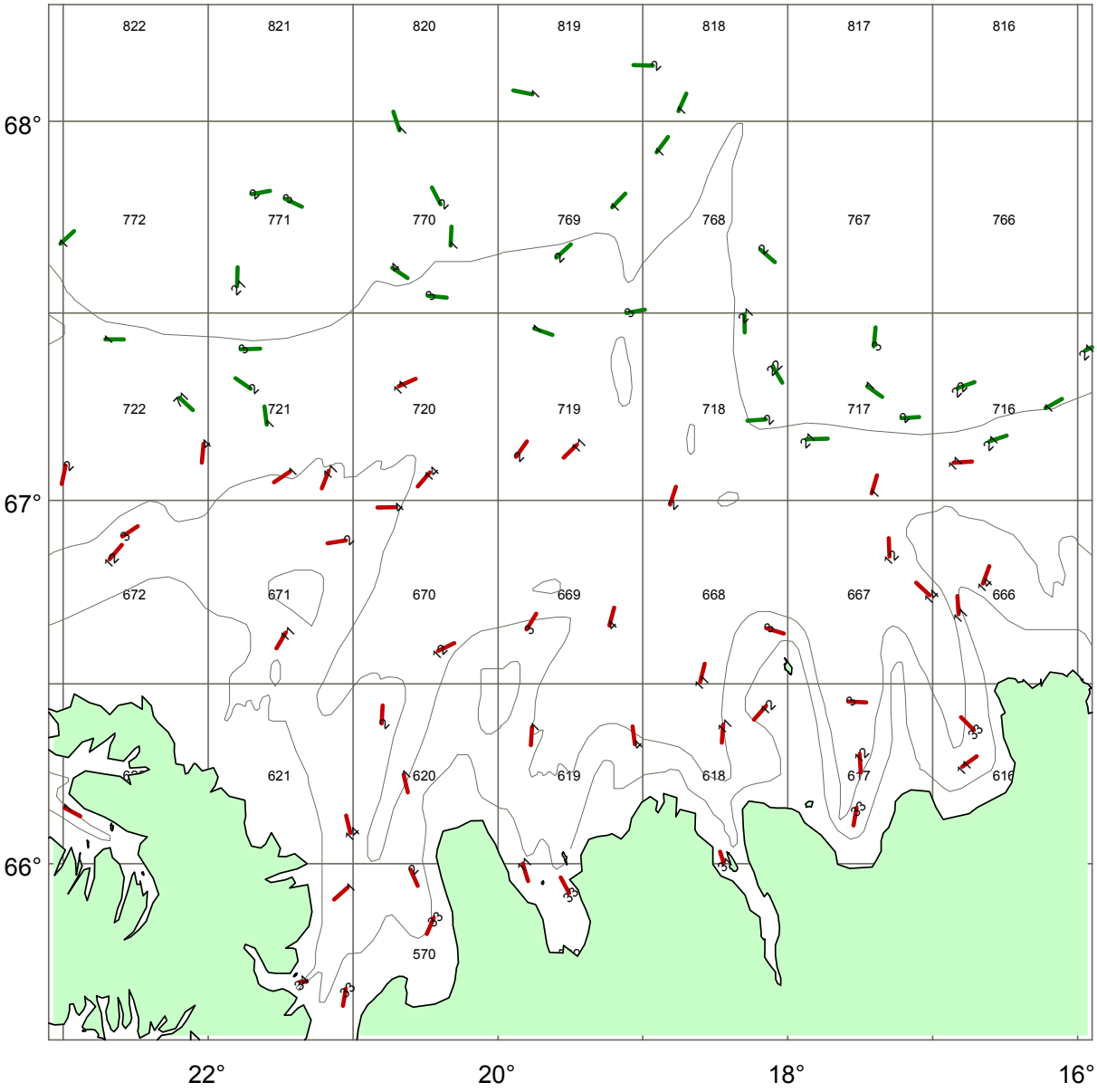


Figure 22. The stations in the North area of the Autumn Groundfish Survey in Icelandic waters. The green lines show the stations taken by r/v Árni Friðriksson in the deep-water area and the red lines show the stations taken by r/v Bjarni Sæmundsson taken in the shallow-water area.

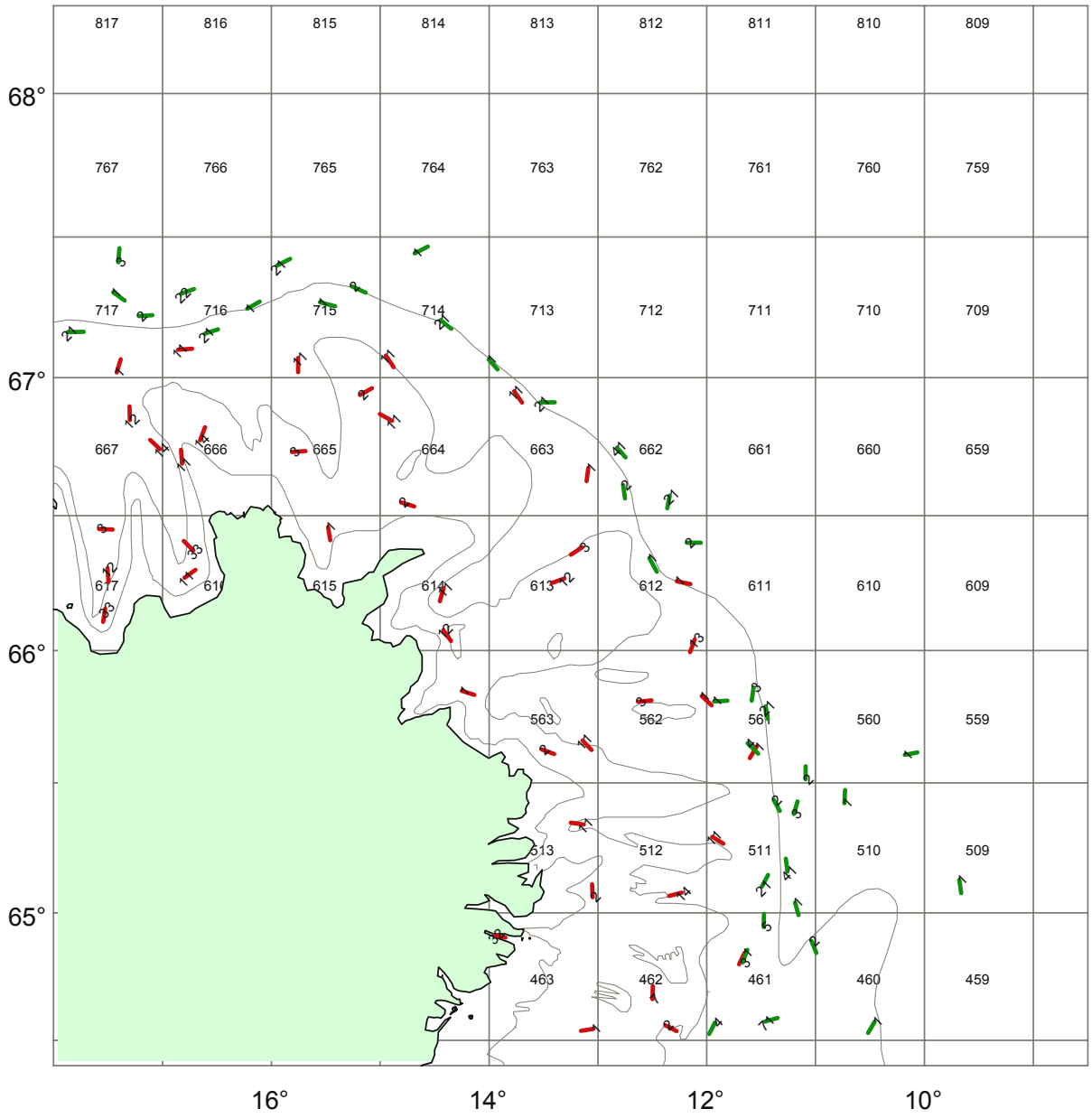


Figure 23. The stations in the Northeast area of the Autumn Groundfish Survey in Icelandic waters. The green lines show the stations taken by r/v Árni Friðriksson in the deep-water area and the red lines show the stations taken by r/v Bjarni Sæmundsson taken in the shallow-water area.

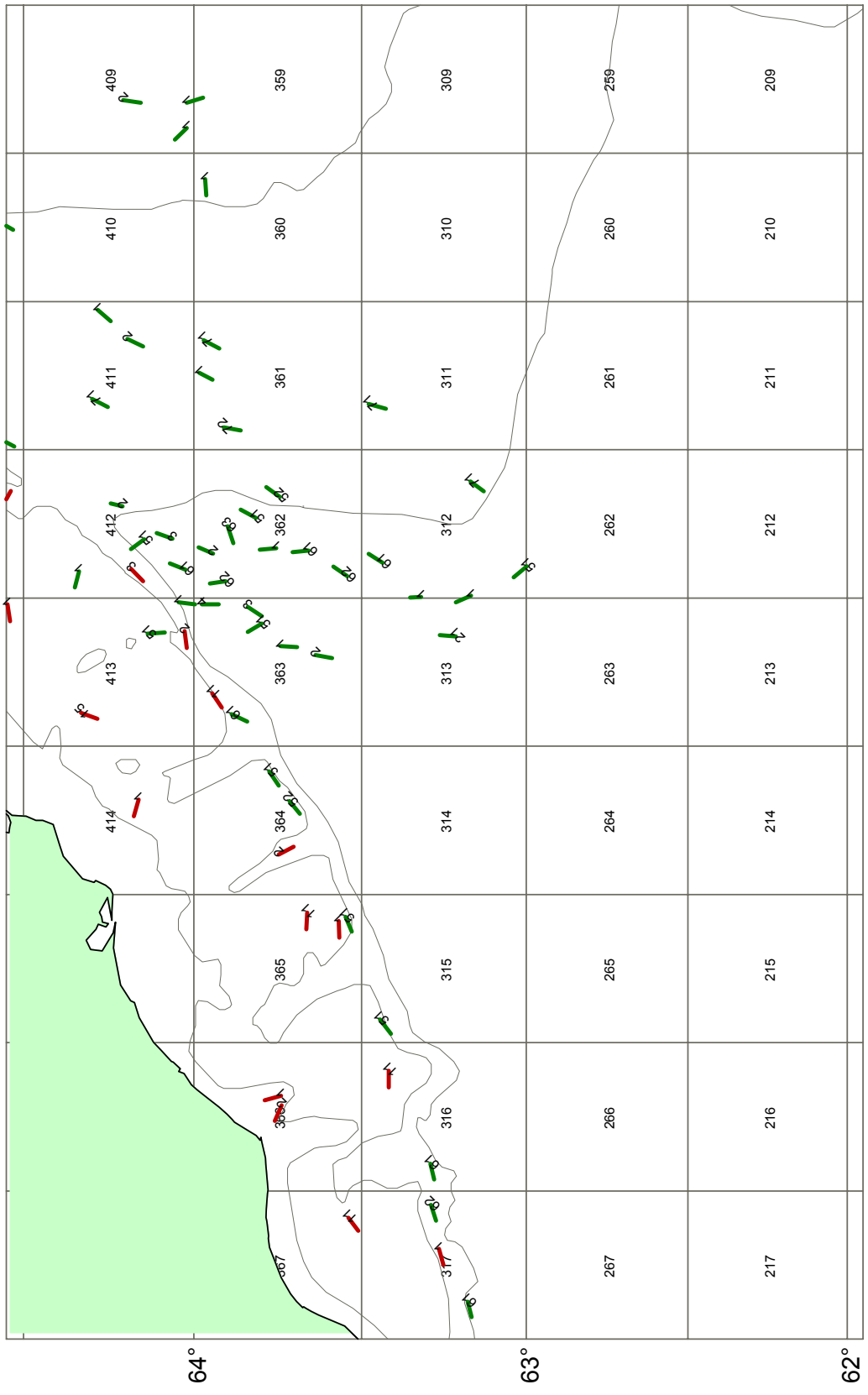


Figure 24. The stations in the Southeast area of the Autumn Groundfish Survey in Icelandic waters. The green lines show the stations taken by r/v Árni Friðriksson in the deep-water area and the red lines show the stations taken by r/v Bjarni Sæmundsson taken in the shallow-water area.

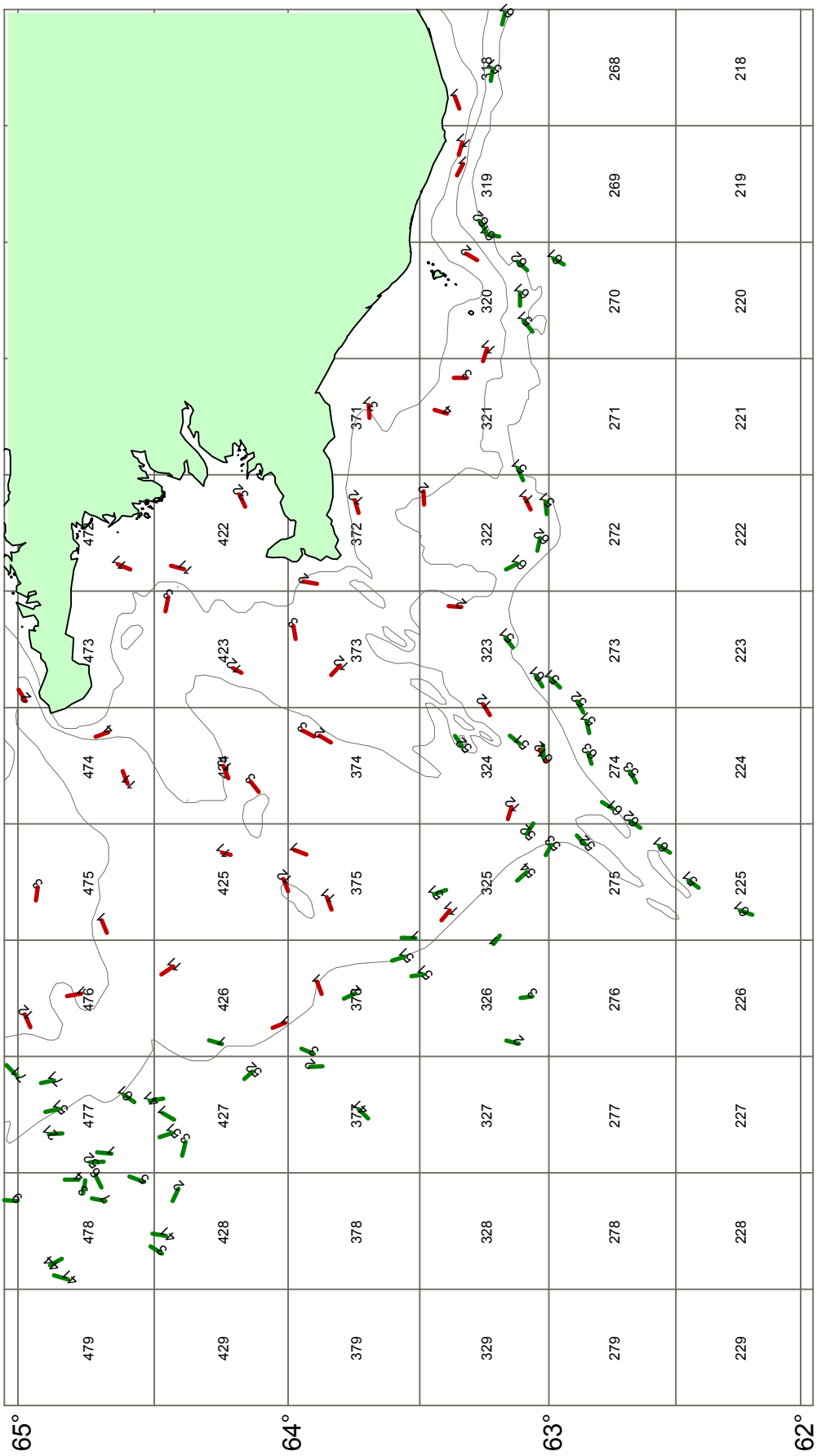


Figure 25. The stations in the Southwest area of the Autumn Groundfish Survey in Icelandic waters. The green lines show the stations taken by r/v Árni Friðriksson in the deep-water area and the red lines show the stations taken by r/v Bjarni Sæmundsson taken in the shallow-water area.

APPENDICES

APPENDIX 1: CALIBRATION OF TRAWL TEMPERATURE SENSOR AND USE OF PRE-CALIBRATED TEMPERATURE RECORDERS

There appears to be a strong relationship between bottom temperature and fish abundance in the AGS. It is important to strengthen these findings by calibrating the trawl temperature sensors of the survey vessels. This calibration is based on a comparison between temperature measurements made by Scanmar (or Furuno) trawl sensors and pre-calibrated temperature recorders from Star-Oddi (Starmon or DST milli).

The comparison is made according to following procedure:

1. Put the temperature recorder in measurement mode (see instructions in *SeaStar* program).
2. Fasten the trawl sensor and the temperature recorder at the end of a rope/trawl twine and sink to a sufficient depth.
3. Let the trawl sensor and temperature recorder adjust to the seawater temperature for at least 15 min so that reliable measurements are obtained. The measurement frequency of the temperature recorders needs to be adjusted so that several measurements are made.
4. Use the *SeaStar* program to retrieve data from the temperature recorder (see instructions below). After data retrieval, put the recorder in measurement mode.
5. Measurements from the temperature recorder are compared to measurements taken by the trawl sensor and a correction factor is calculated.
6. Preferably, the comparison needs to be made at 3 different temperatures (e.g. in the range of 0-6°C).

After the pre-calibrated temperature recorder has been used to calibrate temperature measurements from trawl sensors, it is put in measurement mode with a measurement frequency of 2 min. The temperature recorder is then fastened to the trawl to be used. Whenever the crew switches between trawls, the temperature recorder has to follow.

Instructions: The *SeaStar* program for Star-Oddi temperature recorders

See further information on *star-oddi.com* and in the Icelandic version of this manual.

APPENDIX 2: COLLECTING DATA FROM SCANMAR TRAWL SENSONS

Instructions on how to connect a PC to trawl sensor instruments in the wheelhouse, and how to use *Hyper Terminal* to collect and save text strings of data from the sensors. The text strings include informatioin on e.g. time, position, temperature, vertical opening of the trawl and distance between otter boards.

See further information in the Icelandic version of this manual.

APPENDIX 3: FOOD CONSUMPTION OF FISHES IN ICELANDIC WATERS

1 Sampling and documentation

Table 2 shows the list of species that are analysed for stomach content. The samples are analysed directly onboard the research vessels. The sampling is based on a "single stomach", that is each stomach is treated and analysed as one sample. The magnitude of the sampling is the same as the otolith sampling, meaning that stomach content is analysed from all fish sampled for otolith extraction of a given species (Table 2). Preferably the stomach content should be analysed concurrently with the otolith sampling and registered directly in *SeaScale* as described in Section 10.3.2

If it is not possible to analyse the stomach content along with the otolith removal, it can be postponed (see Section 10.3.3.) If this path is chosen it is important to make sure that the connection between the individual fish in the otolith sample and the stomach sample is correct. The connection is **station ID number**, then **the species** and finally the **individual otolith ID number**, which is a running number for each species on each station. If analysis of the stomach content is postponed, it must be labelled with the above mentioned information to ensure registration to the right individual fish.

2 Analysis of stomach content and registration in *SeaScale* during otolith removal and weighing process

Stomach analysis is a selection that is configured in the computer program. It is possible to either analyse the stomach sample right away or postpone the analysis.

When an otolith is sampled from a fish, the program asks for the "condition of the stomach" at the final stage of the operation. State of the stomach is entered by using the arrow keys (up/down) or the numbers 1-5 are chosen and then the **ENT**-key is pressed. The state of the stomach is categorised into five groups:

1. Containing food
2. Empty
3. Regurgitated
4. Undigested remains
5. Everted

If the condition of the stomach is 2, 3 or 5 and has been registered as such, the data collection of that individual fish is finished and the program asks for the length of the next fish in the otolith sampling.

If the condition of the stomach is graded 1 or 4 the food items are analysed. That follows directly after the entry of the stomach condition:

1. Condition of the stomach is entered by using the arrow keys (up/down) or either 1 or 4 is chosen and then press the **ENT**-key.
2. The foot item (the prey) is chosen by using the using the arrow keys (up/down) or the number of the prey is chosen (see Chapter 10.3.4.) and then confirmed with the **ENT**-key. **If the prey is measured it is done at this step.**
3. **If the prey is to be length measured** select **F5** when the prey has been selected and the program will enter into length measurement of the selected pray. When the length measurement is finished, **F8** is used to go back to previous step.
4. Total number of the particular prey (both measured and unmeasured) is registered and confirmed with the **ENT**-button. For food items where number of individuals cannot be estimated, **F7** is used to skip that entry and continue to the next step (registration of the weight of the prey).
5. The particular prey group (food item) is put on the scale and total weight is confirmed by the **ENT**-button. The program now asks for the next prey. When all food items have been analysed, **F8** is used to go to the next fish in the otolith extraction.

During analysis of stomach content the following should be kept in mind:

- All food items that **obviously** have been eaten in the trawl must be omitted, for example prey that is still alive. Fresh prey (but dead) could have been eaten just before the predator was caught by the trawl and must be accepted as valid.
- Fish prey should be identified to species level if possible, or else as far in the classification system as possible considering the conditions at hand. For each group of prey, the total number must be counted or estimated and the group weighed. Those prey fishes that have been identified to species and the total length is measurable must be measured for length. It is especially important to measure the length of capelin, sand eels and cod-like fishes that are found in stomach samples.
  - ◊ It is important to measure length, identify sex and sexual maturity of capelin that has not lost any length due to digestion. If sex or sexual maturity cannot be identified **F7** should be used to omit those registrations. For measurements of capelin in **F5** the following information should be registered:
    - Length
    - Sex
    - Sexual maturity
      - 1: immature
      - 2: mature (not spawned)
      - 3: spawning (running)
      - 4: spawned
      - 5: Uncertain stage
  - ◊ When possible, 4x length distribution in cm should be measured or at a maximum of **50 individuals per station**. It is important to measure capelin even if only one capelin is in the sample.
  - ◊ Example of work flow when measuring length of capelin from stomach samples: Press **F5**-key after the food group capelin has been selected and the program enters measurements of prey. When all measurable capelin have been measured use the **F8**-key to get one step back into the food group. **Total number of capelin** (number measured and not measured) is registered and confirmed by the **ENT**-button. All the capelin is finally put on the scale and total weight accepted. When analysis of stomach content is finished, the **F8**-key is used to enter the next fish in the otolith extraction (the program asks for the length of next fish), and so on until the last fish of that species on that station has been processed.
- The shrimps *Pandalus borealis* and *Pandalus montaqui* should be identified to species when possible, **carapace length measured**, total number counted and the food group weighed.
  - ◊ It is important to measure the shrimps whenever a measurable shrimp is in the stomach content. In samples containing many shrimps it is important to rand-omise the measurements, don't choose only the big ones. On stations with many measurable shrimps in stomach contents it is sufficient to measure **20 individuals** per station for each species.
- Other invertebrates shall be identified in accordance to the classification system to the extent of the knowledge of the researcher. The list of food groups that are recognised by the program should be kept in mind.
- The list of food groups is based on species or group identity number in the database of the Marine Research Institute. Most researcher know these numbers for common fish species (1 = cod, 2 = haddock, 28 = long rough dab, 31 = capelin, 301 = sand eels and so on), but rarely for invertebrates. As previously stated, the arrow buttons can be used to find the food group in the program if one does not know its identity number. To ease the search the historically most common food groups in stomach content of cod have been put at the top of the list (see Chapter 10.3.4).
- **All measurements of prey are registered in mm**. For measuring length of fish prey special measuring boards have been made with a 5 mm grid. Shrimps are measured using

a caliper.

- F-buttons in stomach analysis:
    - ◊ **F5** Length measurement of prey.
    - ◊ **F6** Extra measurement of capelin.
    - ◊ **F8** Go one step back from **F5** and **F6** in stomach analysis or go to next fish in otolith extraction.

3 Analysis of stomach content and registration in *SeaScale* aside from otolith removal and weighing process

If analysis of stomach content is to be postponed, the **F8**-button is used after the condition of stomach has been registered during otolith removal and weighing process, by which the program asks for the length of the next fish. That is if condition of stomach has been registered as "containing food" or "undigested remains", but for other conditions the data sampling is now finished.

Starting the food analysis, the proper station is opened in the program and **Food analysis** chosen from the main menu. The fish species and the individual number of the fish (otolith number) are chosen and the analysis of stomach content continued as described above.

4 Species identity number (ID of the most common food groups)

Species identity number (ID) of most common food groups. This list, showing the most common food groups, as well as a list containing more food groups, should be at hand during stomach content analysis.

Group	Array	ID nr.	Food group	Engl. name	Scientific name
	1	**31**	mall vil	**Capelin**	*Mallotus villosus*
	2	**301**	ammodytx	**Sand eels**	Ammodytidae
	3	**302**	pisces	**Fish unid.**	Pisces
	22	**28**	hipp pla	**Long rough dab**	*Hippoglossoides platessoides*
	23	**29**	heteroso	**Flatfishes**	Heterosomata
	24	**85**	lycodesz	**Eelpout**	*Lycodes* sp.
	25	**30**	clup har	**Herring**	*Clupea harengus*
	26	**75**	myctophx	**Lantern fishes**	Myctophydae
	27	**65**	lept mac	**Spotted snake blenny**	*Leptoclinus maculatus*
	28	**34**	micr pou	**Blue whiting**	*Micromesistius poutassou*
	29	**53**	trig mur	**Moustace sculpin**	*Triglops murray*
	30	**84**	lumpenix	**Blenny fishes**	Lumpenix
	31	**94**	lump lam	**Snake blenny**	*Lumpenus lampretaeformis*
Fish	32	**1**	gadu mor	**Cod**	*Gadus morhua*
	33	**2**	mela aeg	**Haddock**	*Melanogrammus aeglefinus*
	34	**300**	gadidaex	**Cod-like fishes**	Gadidae
	35	**5**	seba mar	**Redfish**	*Sebastes marinus*
	36	**60**	seba viv	**Norway haddock**	*Sebastes viviparus*
	37	**9**	anar lup	**Wolffish**	*Anarhichas lupus*
	38	**74**	arte atl	**Atlantic hookear sculpin**	*Artediellus atlanticus*
	39	**57**	rhin cim	**Fourbeard rockling**	*Rhinonemus cimbrius*
	40	**27**	lima lim	**Dab**	*Limanda limanda*
	41	**33**	tris esm	**Norway pout**	*Trisopterus esmarki*
	42	**88**	onog arg	**Silver rockling**	*Onogadus argentatus*
	43	**56**	lept dec	**Atlantic poacher**	*Leptagonus decagonus*
	44	**330**	arge sil	**Greater argentine**	*Argentina silus*
	4	**41**	pand bor	**Northern red shrimp**	*Pandalus borealis*
	5	**51**	pand mon	**Pink shrimp**	*Pandalus montaqui*
	6	**186**	euphausi	**Krill**	Euphausiacea
	7	**307**	hyperiid	**Hyperiids**	Hyperiidae
	8	**52**	hyme gla	**Northern ambereye**	*Hymenodora glacialis*
	9	**303**	natantia	**Shrimps unid.**	Natantia
Crustaceans	10	**271**	mysidace	**Opossum shrimps**	Mysidacea
	11	**306**	gammarid	**Gammariids**	Gammaridea
	15	**304**	hyas coa	**Arctic lyre crab**	*Hyas coarctatus*
	16	**182**	pagurusz	**Hermit crab**	Pagurus
	17	**190**	copepoda	**Copepods**	Copepoda
	18	**308**	crustace	**Crustaceans**	Crustacea
	19	**305**	decapoda	**Decapods**	Decapoda
	20	**40**	neph nor	**Norway lobster**	*Nephrops norvegicus*
	21	**403**	munidaz	**Galatheid crab**	*Munida* sp.
	12	**312**	ophiuroi	**Brittle stars**	Ophiuroidea
	13	**314**	polychae	**Bristle worms**	Polychaeta
	14	**313**	ctenopho	**Comb jellies**	Ctenophora
	45	**160**	cephalop	**Cephalopods**	Cephalopoda
	46	**311**	benthos	**Benthos unid.**	Benthos unid.
	47	**310**	gastropo	**Gastropods**	Gastropoda
	48	**309**	bivalvia	**Bivalves**	Bivalvia
	49	**199**	holothur	**Sea cucumbers**	Holothurioidea
Other	50	**180**	scyphozo	**Jellyfish**	Scyphozoa
	51	**444**	plathyhe	**Flatworms**	Plathyhelminthes
	52	**193**	chaetogn	**Arrow worms**	Chaetognata
	53	**457**	raja ova	**Ray egg cases**	*Raja radiata* ova
	54	**456**	pycnogon	**Pycnogonids**	Pycnogonidae
	55	**999**	unid	**Unidentifiable**	Unid.

APPENDIX 4: SAMPLING OF DEEP-WATER FISH SPECIES

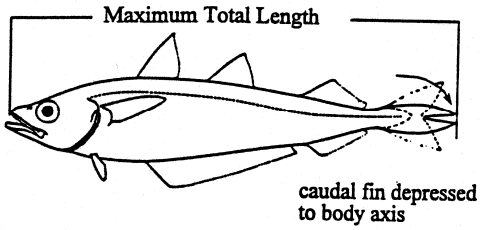
1 Sampling

It is important that all species of dogfishes, skates and ratfishes are registered. Sampling and procedure is the same as for other species. The table below shows the extent of sampling on deep-water fish species on each station.

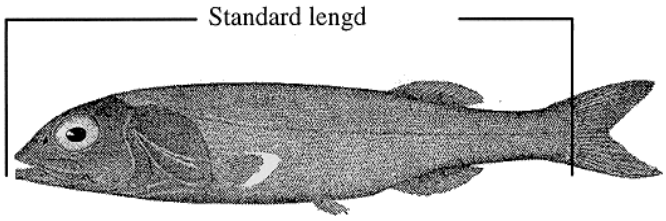
ID	Species	Sampling							Nr. per station	
		Length	Sex	Maturity	Ungutted	Gutted	Liver	Stomach	Min	Max
Dogfishes										
64	Greater lantern shark	x	x	x	x	x	x	x	10	20
96	Black dogfish	x	x	x	x	x	x	x	10	20
163	Leafscale gulper shark	x	x	x	x	x	x	x	5	10
164	Longnose velvet dogfish	x	x	x	x	x	x	x	5	10
168	Birdbeak dogfish	x	x	x	x	x	x	x	5	10
125	Lantern shark	x	x	x	x	x	x	x	5	10
174	Portuguese dogfish	x	x	x	x	x	x	x	5	10
114	Iceland catshark	x	x	x	x	x	x	x	5	10
118	Mouse catshark	x	x	x	x	x	x	x	5	10
Skates										
12	Starry ray	x	x	x	x				5	15
82	Spinytail skate	x	x	x	x			x	5	15
87	Round ray	x	x	x	x			x	5	15
90	Arctic skate	x	x	x	x			x	5	15
Ratfishes										
39	Rabbit-fish	x	x	x	x				5	10
145	Atlantic chimaera	x	x	x	x				5	10
167	Large-eyed rabbitfish	x	x	x	x				5	10
169	Bentnose rabbitfish	x	x	x	x				5	10
175	Knifenose chimaera	x	x	x	x				5	10
Bony fishes										
58	North Atlantic codling	x							20	20
49	Orange roughy	x	x	x	x	x	x		20	20
161	Baird's smooth-head	x							20	20
178	Agassiz' smooth-head	x							20	20
105	Largescale tapirfish	x							20	20

2 Length measurements

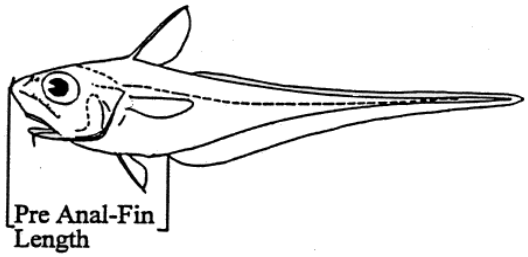
Most bony fishes, **dogfishes** and **skates** are measured in a traditional way, that is, the total length is measured (TL, cm, see figure below).

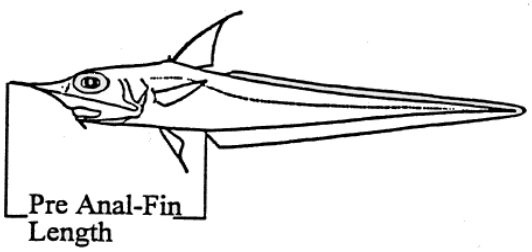


For some fishes (for example **Baird's smooth-head and Agassiz' smooth head** the caudal fin is often damaged. For those species, standard length (SL, cm) is measured, i.e. from the tip of the snout to the posterior end of the last vertebra or to the posterior end of the midlateral portion of the hypural plate. Simply put, this measurement excludes the length of the caudal fin (see picture below).



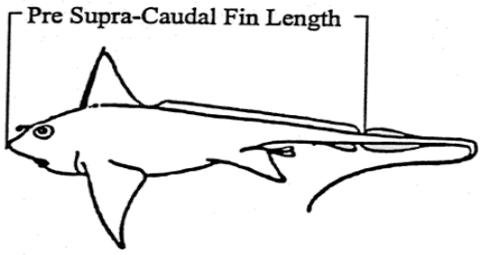
Grenadiers (Macrouridae), **ratfishes** (Chimaeridae), and **long-nosed chimaeras** (Rhinochimaeridae) are length measured as shown in the pictures below.

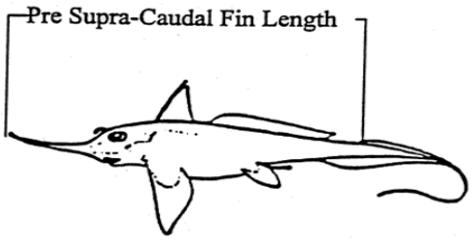




Grenadiers (rattails) are measured from the tip of the snout to the anal fin (PAFL, with 0.5 cm precision).

Ratfishes (for example **Rabbit-fish** and **Knifenose chimaera**) are measured from the tip of the snout to the beginning of the supra-caudal fin (see below).





3 Weighing

The fishes are only weighed ungutted, except for **dogfishes** and **orange roughy** which are also weighted gutted.

4 Sex- and maturity determination

For bony fishes, maturity determination is according to the four-stage system described in Table 2-4. For skates, dogfishes and ratfishes, the maturity determination is a four-stage system for males and 6-7 stage system for females (see Chapter 10.2.8 for further details).

5 Otolith sampling

There is no otolith extraction of deep-water fish.

6 Samples that are frozen

Fishes that cannot be identified to species must be taken aside and frozen. Each fish is put into a plastic bag and labelled with cruise ID, station number and date.

7 Measurments of cephalopods and decapods

Optional, but should be done if time allows. It is also preferable to freeze samples of cephalopods and decapods.

8 Maturity determination of cartilaginous fishes

Rays and skates (Rajiidae), ratfishes (Chimaeridae), catsharks (Scyliorhinidae) and other dogfishes and sharks that give birth to eggs (oviparous), for example Iceland shark and mouse catshark.

Males	
Stage	**Description**
1	**Immature, juvenile:** Claspers undeveloped as small, flexible sticks being shorter than extreme tips of posterior pelvic fin lobes. Gonads (testes) small, sperm ducts straight and threadlike.
2	**Maturing, adolescent, subadult:** Claspers becoming extended, longer than tips of posterior pelvic lobes, their tips (glans) becoming structured, but skeleton still soft and flexible. Gonads enlarged, sperm ducts beginning to meander (coil) posteriorly.
22	**Mature, adult:** Claspers full length, external and internal glans structures fully formed, skeleton hardened so that claspers stiff and free glans components sharp. Gonads greatly enlarged, sperm ducts meandering over their entire length and tightly filled with sperm.
3	**Active, copulating:** Glans claspers often dilated, its structure reddish and swollen. Sperm flowing on pressure from cloaca and/or present in clasper groove or glans. For **oviparous sharks and chimaeras**, this stage does not necessarily mean that the glans is spread open, but fleshy pads are obviously enlarged and sperm is present in clasper grooves.
7	Spawned.
Females – ovarian stages	
Stage	**Description**
1	**Immature, juvenile:** Ovaries small, their internal structure gelatinous or granulated. No oocytes differentiated or all uniformly small, granular. Oviducts (uteri) narrow, thread-like.
2	**Maturing, adolescent:** Ovaries somewhat enlarged, walls more transparent. Oocytes becoming differentiated to various small sizes. Uteri largely as stage 1 but may become widened posteriorly.
22	**Mature, adult:** Ovaries large and tight. Oocytes enlarged, with some being very large. Uteri enlarged and widening over nearly their entire length.
Females – uterine stages	
31	**Active:** A distinctly large yolk-egg present in one or both Fallopian tubes. No egg capsule yet visible in shell gland, or beginning formation of egg capsule at most.
32	**Advanced:** Large yolk-eggs in Fallopian tubes, or already passing through into egg capsules. Egg capsules about fully formed in one or both oviducts but still soft at upper end and located very close to Fallopian tubes.
6	**Extruding:** Completed, hardened egg capsules in one or both oviducts, more or less separated from Fallopian tubes. Capsule surface covered with dense silky fibres. Either no enlarged oocytes in fallopian tubes, or one or two in position. If oviducts empty but still much enlarged and wide, capsules have probably just been extruded – this corresponds with either stage 32 or 6.
7	Spawning finished.

Dogfishes and sharks (ovoviviparous and viviparous), for example black dogfish, greater lantern shark, and Portuguese dogfish.

Males	
Stage	**Description**
1	**Immature, juvenile:** Claspers undeveloped as small, flexible sticks being shorter than extreme tips of posterior pelvic fin lobes. Gonads (testes) small, whitish, sperm ducts straight and thread like.
2	**Maturing, adolescent, subadult:** Claspers becoming extended, longer than tips of posterior pelvic lobes, their tips (glans) becoming structured, but skeleton still soft and flexible. Gonads enlarged, sperm ducts beginning to meander (coil) posteriorly.
3	**Mature, adult:** Claspers fully formed and stiff, eventually present cartilaginous hooks, claws or spines of glans free and sharp. Gonads enlarged, well rounded, filled with flowing sperm and often reddish in colour. Sperm ducts tightly coiled and well filled with sperm.
4	**Active:** Glans claspers often dilated and swollen, with free cartilaginous spine mostly erect; sperm flowing from cloaca under pressure on seminal vesicle and/or present in clasper groove.
Females – ovarian stages	
Stage	**Description**
1	**Immature, juvenile:** Ovaries small, their internal structure gelatinous or granulated. No oocytes differentiated or all uniformly small, granular. Oviducts (uteri) narrow, thread-like.
2	**Maturing, adolescent:** Ovaries somewhat enlarged, walls more transparent. Oocytes becoming differentiated to various small sizes. Uteri largely as stage 1 but may become widened posteriorly. Ovaries at first maturity will not show *corpora lutea*, or a very few only, whereas ovaries of resting females prior to repeated reproduction will show *corpora lutea* in greater number.
22	**Mature, adult:** Ovaries large, well rounded. Oocytes obviously enlarged, all to about the same size, can easily be counted and measured.
Females – uterine stages	
31	**Developing:** Uteri well filled and rounded with seemingly un-segmented yolk content (“candle”).
32	**Differentiating:** Uteri well filled and rounded with segmented content of large yolk balls, can easily be counted and measured. Embryos variously small, atop their huge yolk balls, larger ones with external gills and un-pigmented (still “candle”).
33	**Expecting:** Embryos more or less fully formed, pigmented, external gills lost, yolk sacs obviously reduced. Can be counted, measured and sexed easily.
4	**Post-natal, spent:** Ovaries at resting stage, similar to stages 1 or 2. Uteri empty but still widened considerably over their full length in contrast to stages 1 or 2.

APPENDIX 5: SAMPLING OF CHEPHALOPODS

Registration and sampling of cephalopods has been inadequate during most of the history of the bottom trawl survey. For many years this class of the animal kingdom was paid little systematic attention to in the bottom trawl survey. Now, for several years the European flying squid (*Todarodes sagittatus*) has been recorded under the species number **639.** All other cephalopods have not been identified to species but recorded (counted and sometimes length measured) under one common species number, namely **44**. This situation is mainly due to rather poor and scattered knowledge of cephalopods in Icelandic waters and a lack of "handy" field guide for species identification. A decision has now been taken to compile such a field guide which not only shall contain keys for identification of species but also information about their distribution in Icelandic waters.

The basis for such a work is the collection of further information about the cephalopod fauna in Icelandic waters. The available data is mainly single recordings of rare species but systematic recordings of the distribution of even common species has been lacking. Therefore a plan of systematic sampling has been set up for both the spring- and the autumn bottom trawl surveys. The plan is to sample and preserve by freezing all cephalopods caught in the surveys. The samples will then be processed further ashore, i.e. species identification, photographs taken for possible use in a field guide to point out key-marks and drawing of distribution lines as it is clear that in Icelandic waters there are both warm- and coldwater species and also quite cosmopolitan species.

Sampling plan and instructions

All cephalopods caught shall be collected (except European flying squid which is already registered and length measured within the frame of these projects; species nr. **639**). The specimens shall be put into plastic bags (which contain information tag, i.e. station number etc.) and preserved by freezing. Note that if many specimens obviously of the same species are caught at the same station, only one should be collected but the number of specimens recorded on the tag in the sample bag. Different species at one station shall preferably be put into separate sampling bags. An electronic book-keeping should be kept over sampled and counted cephalopod specimens (except *Todarodes*) under the species number **44** where total number (collected and counted) of cephalopod samples at each station should be registered. Note that some of the bobtail squids (Sepiolids) such as the, Atlantic bobtail (*Sepiola atlantica*) found here off the South-coast are very small, sometimes only 2-3 cm in total length.

APPENDIX 6: SAMPLING OF OVARIES OF FEMALE SPOTTED WOLFFISH

Ovaries from all **female spotted wolffish** are sampled in the Autumn Groundfish Survey 2009 on both research vessels. Otoliths are extracted from each fish, the fish is weighted ungutted and gutted, and also the liver and the ovaries.

The females are sampled either within the regular otolith sampling scheme of spotted wolffish (species number 13) or are taken after they have been length measured. If the ovaries are taken from females in the length measurement scheme the fish will get the species number 909 (note that *SeaScale* shows "Atlantic wolffish within" when this species code is entered.

After weighing, the ovary is put in a plastic bag with a label containing following information: Cruise id, station number, species code (13 or 909) and the fish number. The plastic bag is then closed and put into a container containing 10% formaldehyde.

APPENDIX 7: EYRALL – EDUCATIONAL CRUISE WITH STUDENTS OF NATURAL RESOURCES OF THE UNIVERSITY OF AKUREYRI

Eyrall, the educational cruise in Eyjafjörður with students of Natural Resource Science of the University of Akureyri, started in 1992. Until 2003 the r/v Dröfn was used for the study but from 2005 the r/v Bjarni Sæmundsson has been used when the Autumn Groundfish Survey is halfway through. It is estimated that Eyrall will take about 12 hours starting at Dalvík and ending in Akureyri.

The crew and researchers on r/v Bjarni Sæmundsson participate in the cruise with two teachers from the MRI branch at Akureyri. The sampling and data entry is in the same manner as described in this manual for other areas. It is important that an experienced researcher be available to help the students with data entry into *SeaScale*.

The first station taken is a fixed Autumn Groundfish Survey station west of the island Hrísey in Eyjafjörður (station 618-31). In the meantime the students are divided into groups and the working schedule is introduced to the students. The students then take notice of sampling procedures of the station. After that the formal Eyrall starts with following working schedule (see table 10.5.1 and Figure 10.5.1):

1. The first station is station number 9 in Figure 1, north of the AGS fixed station.
2. The second station is station number 7 in Figure 1.
3. The third station is taken between stations 5 and 6 in Figure 1. After this station the vessel sails back to Dalvík to change students.
4. The new student group start on station number 4 in Figure 1.
5. The fifth station is the station number 3 in Figure 1.
6. The sixth and final station is close to Akureyri or station number 1 in Figure 1.

Tow length is **0.5 nautical miles**.

Table 1. Station list for Eyrall 2009.

Square	Sub-square	Tow nr.	Setting N	Setting V	Hauling N	Hauling V	Depth setting (m)	Depth haul. (m)	Notes
618	2	61	654107	180421	654136	180415	35	43	Pollurinn
618	2	63	654863	180826	654829	180731	38	66	Near Hörgá
618	2	64	655516	181441	655473	181397	91	91	Near Hauganes
618	2	65	655820	181862	655866	181905	98	98	North of Grenivík
618	2	67	660612	182153	660558	182124	86	87	East of Hrólfssker
618	2	69	660595	182869	660694	182872	131	168	West of Hrólfssker

Sampling

It is necessary to reduce sampling because the tows are close to each other and because of short towing length. The best way is to sample half of what is sampled in the Autumn Groundfish Survey.

The number of students varies from year to year and organization of the cruise must be in accordance. The researchers onboard the research vessel deal with the tows in the same manner as in the autumn survey and students observe and help.

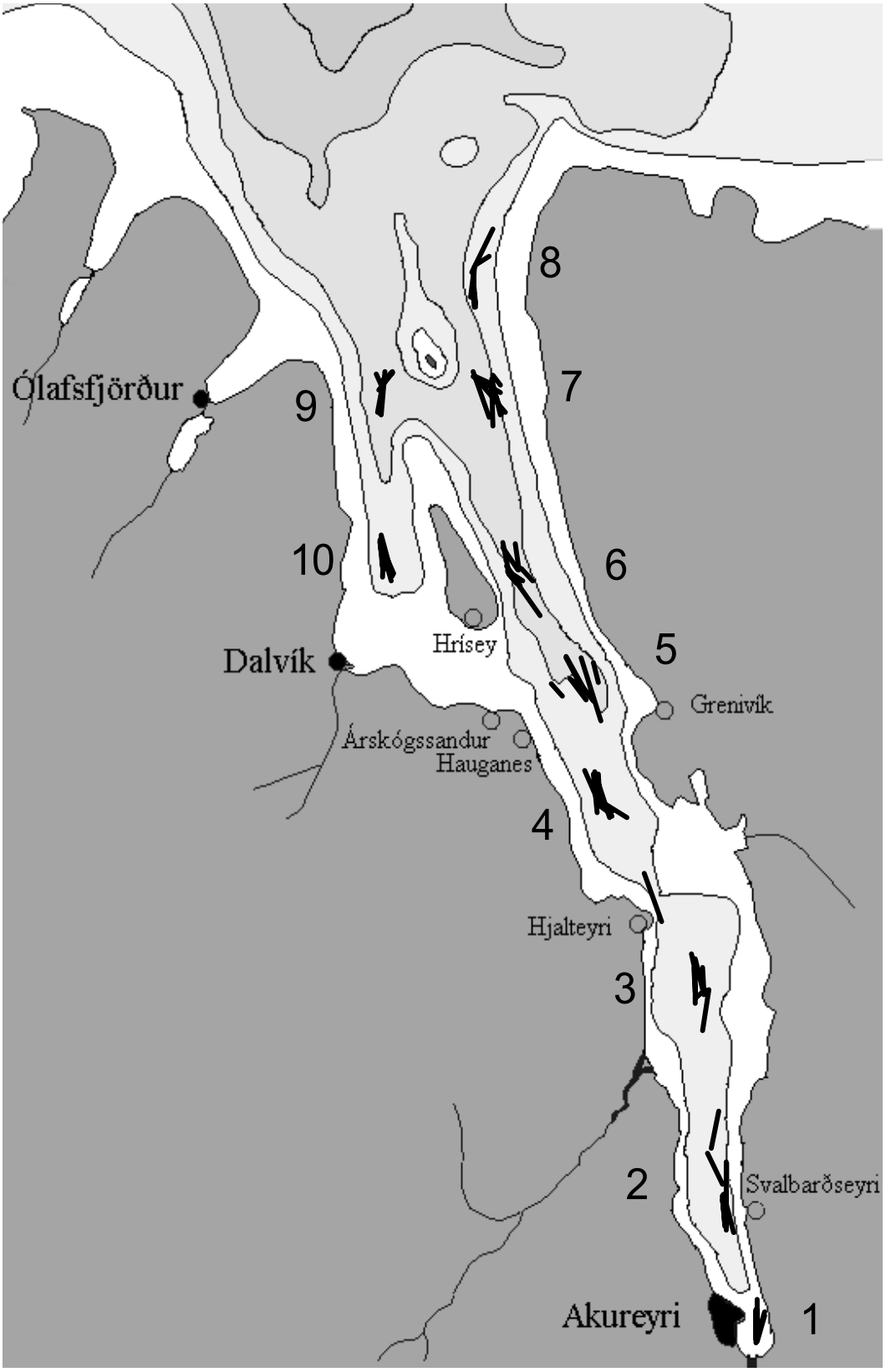


Figure 1. Station map for the Eyrall. The 50, 100 and 200 m depth contours are shown.

APPENDIX 8: SAMPLING FOR ICELANDIC FOOD RESEARCH: PROJECT "UNDESIRABLE SUBSTANCES IN ICELANDIC MARINE CATCHES

This project was started in 2003 at the request of the Icelandic Ministry of Fisheries. Until then, monitoring of undesirable substances in the edible portion of marine catches had been rather limited in Iceland. The purpose of the project is to gather information and evaluate the status of Icelandic seafood products in terms of undesirable substances. Substances measured include: heavy metals, dioxins and dioxin like PCB, marker PCBs, brominated flame redurdants (PBDE), Polyaromatic hydrocarbons (PAH) and pesticides. Below are instructions on how samples shall be collected.

The substances are found in low concentrations in the flesh and it is important to avoid any external contamination. Take care that the fish do not come into contact with any source of contamination.

Sampling:

1. The fish is bled when applicable.
2. Each fish is put in a plastic bag.
3. A label containing the following information is put in a small plastic envelope, and the envelope put in the plastic bag for each fish.
   a. species
   b. station number
   c. size class
   d. date
4. Each sample is put into a separate box (or bag) and carefully labelled.
5. Finally the whole sample is frozen.

The table below shows the species to be sampled in 2009 by area and size class.

Species	Area	Number	Size, cm	Vessel
Cod (*Gadus morhua*)	NW-area	10	45-59	Bjarni
Cod (*Gadus morhua*)	NW-area	10	75-89	Bjarni
Haddock (*Melanogrammus aeglefinus*)	NW-area	10	30-39	Bjarni
Haddock (*Melanogrammus aeglefinus*)	NW-area	10	50-59	Bjarni
Golden redfish (*Sebastes marinus*)	S-area	15	30-34	Bjarni
Golden redfish (*Sebastes marinus*)	S-area	10	40-44	Bjarni
Herring (*Clupea harengus*)	N or NW areas	15	20-29	Bjarni
Herring (*Clupea harengus*)	N or NW areas	15	30-39	Bjarni
Monkfish (*Lophius piscatorius*)	E, SE or SW areas	10		Bjarni
Atlantic wolffish (*Anarhichas lupus*)	E or SE areas	10	31-51	Bjarni
Lobster (*Nephrops norvegicus*)	S-areas	1 kg		Bjarni
Mackerel (*Scomber scombrus*)	Where found	15	20-29	Bjarni
Mackerel (*Scomber scombrus*)	Where found	15	30-39	Bjarni
Tusk (*Brosme brosme*)	E or SE areas	10	40-70	Árni
Saithe (*Pollachius virens*)	S or SW areas	10	50-59	Árni
Saithe (*Pollachius virens*)	S or SW areas	10	60-69	Árni
Greenland halibut (*Reinhardtius hippo-glossoides*)	E or SE areas	10	50-59	Árni
Greenland halibut (*Reinhardtius hippo-glossoides*)	E or SE areas	10	70-79	Árni
Orange roughy (*Hoplostethus atlanticus*)	Where found	10	40-60	Árni
Total		**205**		

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