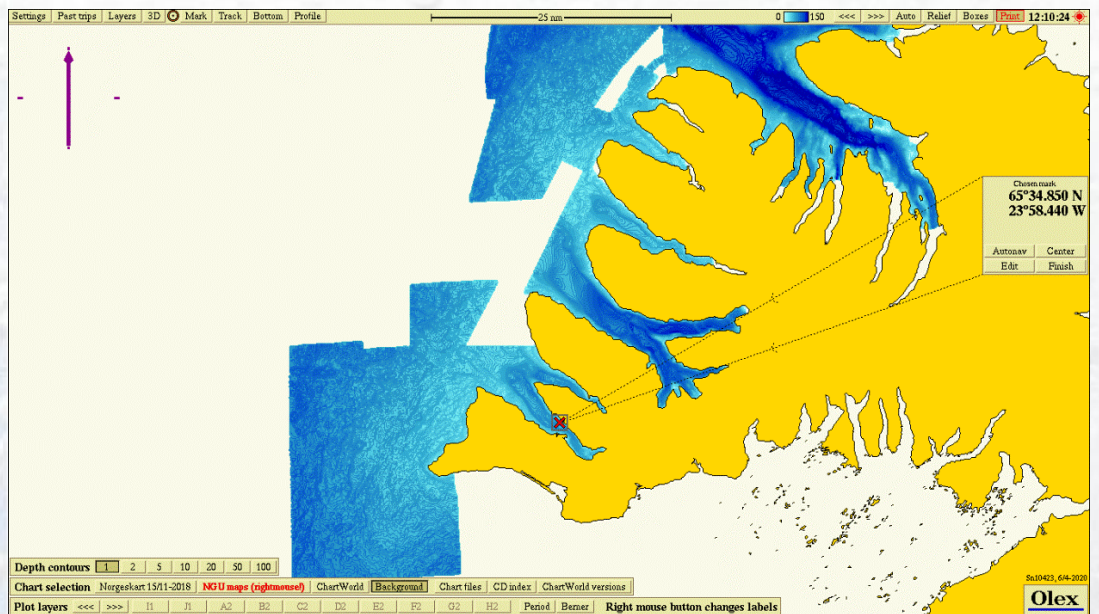




Eyri, Arnarlax hf.
B-bottom survey,
March 2019
(maximum biomass survey)



Information client			
Titel	Eyri, Arnarlax hf. B-bottom survey, March 2020		
Report number	APN-61958.B01		
Site name	Eyri	Coordinates site	65°34.850 N 023°58.440 V
County	Vestur Barðastrandasýsla	Municipality	Vesturbyggð
MTB-or estimated max biomass	5000 tonn	Site manager/contact	Silja Baldvinsdóttir
Client name	Arnarlax hf.		

Biomass/production/status at date of survey			
Biomass at date of survey	4.856 ton	Feed use	6.258
Fish type	Salmon	Amount produced	
Type/time of survey	Mark with X	Comments	
At maximal biomass see kap 7.9	<input checked="" type="checkbox"/>		
A follow up survey	<input type="checkbox"/>		
Half maximal biomass	<input type="checkbox"/>		
Survey prior to putting out smolt	<input type="checkbox"/>		
A pre-survey new site	<input type="checkbox"/>		
Other	<input type="checkbox"/>		
Last following period:			

Results from B-survey iht. NS 9410:2016 (main results)			
Parameters and indexes		Parameters and site status	
Gr. II. pH/Eh	0,19	Gr. II. pH/Eh	1
Gr. III. Sensory	0,63	Gr. III. Sensory	1
GR. II + III	0,41	GR. II+ III	1
Date field work	05.03 2020	Date report	26.05.20
Site status (NS 9410:2016):			1

Report writing and project leader	Snorri Gunnarsson	Signature	
Quality control	Arnbór Gústavsson	Signature	

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Preface

The survey is carried out according to guidelines in NS 9410:2016 which includes evaluation of sediment, faunal investigation and bottom topography. The environmental survey is regulated by § 35 in the Norwegian «akvakulturdriftsforskriften. The survey also fulfills the requirements regarding bottom surveys in the standard ISO 12878.

The primary objective of a B-survey is to fulfil the requirements regarding maximum biomass survey (MTB) as they are defined in NS9410:2016. There is a requirement of at least 16 sampling stations within the mooring lines of the fish farm. The estimated max biomass for the current generation farmed salmon at the site Eyri is 5.000 MTB ton. The methods applied in this pre-survey follow guidelines in chapter 5 (NS6410:216) and fulfil the requirements described in ISO 12878. The survey deviates though from chapter 7.6 in NS9410:2016 regarding sampling. Requirements that samplings stations should be placed just beside the cages or under cages that have been used is fulfilled.

The following have participated in the survey:


Snorri Gunnarsson	Akvaplan-niva AS	Prosjektleder.
Snorri Gunnarsson	Akvaplan-niva AS	Fieldwork and Report. Charts (Olex).

The sampling at Eyri was done 05.03 2020.

Accredited survey:


The following parts of the survey are done in accordance to accreditation methods:

Sampling and treatment of sediment samples, analysis of samples and evaluations of the results. It should be pointed out that as Icelandic officials have not set standards regarding different parameters based on samplings at Icelandic conditions so the site characters in this report should be interpreted with that disclaimer in mind.

	Akvaplan-niva AS er akkreditert av Norsk Akkreditering for prøvetaking og faglig vurderinger og fortolkninger, akkrediteringsnummer TEST 079. Akkrediteringen er iht. NS-EN ISO/IEC 17025 Akkrediteringen omfatter bla. NS 9410, NS-EN ISO 5667-19 og NS-EN ISO 16665.
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Akvaplan-niva AS thanks Arnarlax hf. and their personnel for the cooperation during the conductance of this site survey.

Kópavogi 26. mai 2020


Snorri Gunnarsson
Project manager

1 Introduction

The sampling date for the present site survey was 05.03 2020 and done by Akvaplan-niva AS contracted by Arnarlax hf. in relation to the company's fish farming activity at the site in Patreksfjörður, Eyri Vesturbyggð municipality.

The objective of the B-survey is to document the environmental condition of the local impact zone of the fish farm according to NS 9410:2016 (and ISO 12878) which includes condition of the seabed, faunal evaluation and bottom topography registration.

The survey gives an estimate and evaluation of the site condition regarding organic load and feasibility assessment of the site for fish farming activity.

Figure 1 shows map of the fjord system southern part of Vestfirðir where the site Eyri is located.

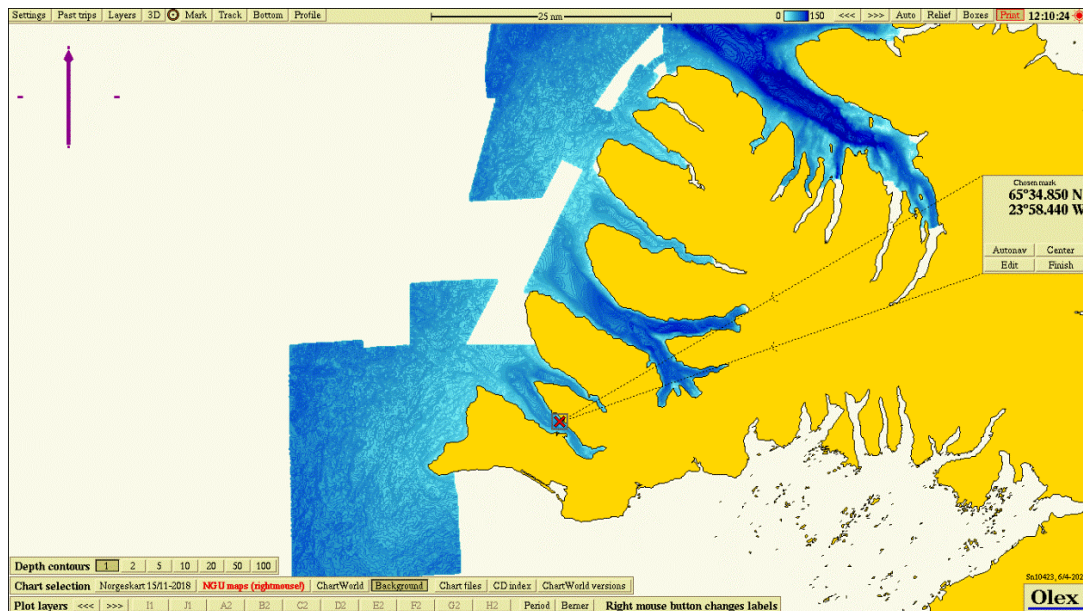


Figure 1. An overview map with the Eyri site marked by its name with a red cross.

2 Professional program and methods

Environmental monitoring of the impact from the fish farming activities on the seabed is a standardised system. All fish farming sites in the sea are to be regularly assessed. The methods for monitoring in Iceland, are based on description in the ISO 12878 standard and methodology described in the NS 9410:2016 is followed. The Icelandic Environmental agency (Umhverfisstofnun) can also set forward specific requirements regarding frequency of samplings for different fish farming sites that can overrule the requirements in the above mentioned standards.

The B-survey is a trend study of the benthic conditions at, or in close proximity, to the fish farming site (local impact zone). Sediment is collected by use of grab (min 250 cm²). Each grab sample is investigated with regard to three observation types of benthic characters; faunal parameters, chemical parameters (pH and redox potential) and a sensory evaluation (gas bubbles, smell, texture, colour and the thickness of the precipitated slam layer in the sediment). The different benthic parameters are given a character on the scale from 1 to 4 (see Table 1), according to the scale of the impact on the benthic conditions from organic load, see criteria in table 1 and it is the weighted average for all the sampling stations that gives the sites condition. The number of sampling stations are decided based on the estimated max standing biomass for the given year class for farmed fish at the site.

Table 1. Frequency of category B-research for the location of the farm based on state of the defined farming area.

Site condition at the time of sampling	Sampling frequency for B-surveys (NS 9410:2016)
1-very good	At next max biomass
2-good	Prior to putting next generation into sea and again at next max biomass.
3-bad	Prior to putting next generation into sea. Based on the site condition prior to putting next generation into sea: <ul style="list-style-type: none">- Condition 1 – next site survey at next max biomass- Condition 2 – next site survey at next 50% max biomass and at max biomass- Condition 3 – next site survey at next 50% max biomass and at max biomass. Some conditions should apply for farming of next generation at the site If any of the samples result in character 4 it is a sign of overload.
4-very bad	Overload

2.1 Field equipment

The following field equipment was used during the site survey:

Grabb: Van Veen grabb (0,025 m²)

Sieve 1 mm: Akvaplan-niva

pH meter: Electrode, YSI Professional Plus

Redox-meter: Electrode, YSI Professional Plus

Position determination– Garmin GPS mapping tool.

Digital camera

3 Site description and bottom topography

3.1 Info site operation

Eyri site is coming to an end of the first production cycle that was started with putting out smolts in June 2018. The fish farm at the site has a single frame 2x7 mooring system with a possibility total of 14 cages, each with 160 m circumference. During the present production cycle 7 cages of have been used.

Table 2 shows the production and feed usage for the present and past generations.

Table 2. Production and feed usage at the site Eyri, data is based on info given from the fish farmer.

Generation of fish (G)	Production (ton)	Feed usage (ton)
Present generation	5.123	6.258

3.2 Present and past site surveys

Table 3. Past site studies for Eyri site

Date of sampling	Report number	Survey type	Overall site status
17.05.2018	APN-60033.01	Pre survey new site	1

3.3 Dispersing current

Dispersing current has not been measured for Eyri site so measurements at 15 m (Heggem, 2017) were used as basis for estimate of dispersing current. Dominating current (15 m) is in direction north-northwest (330 - 345 degrees) with slight counter current from south-east (150 degrees). Average current speed is measured to be 5,2 cm/s. Highest current speed is measured to be 32,6 cm/s and 4.6 % of the measurements are < 1 cm/s (Heggem, 2017).

3.4 Position of sampling stations

Description of the stations in the survey is given in Figure 2 and Table 4. Positioning of the stations was chosen based guidance and perimeters described in NS 9410:2016 and the bottom topography and planned configuration of the farm. Eyri site is on the Patreksfjörður. Depth at the site is in the range from 51 to 55 meters. The placement of sampling stations were chosen to give a good picture of the whole local impact zone in the area with cages that were used during current production cycle (7 cages). The sampling stations had a depth varying from 52 m to 54 m. The placement of the sampling stations is regarded to be in accordance with the descriptions for survey of local impact zone given in NS 9410:2016.

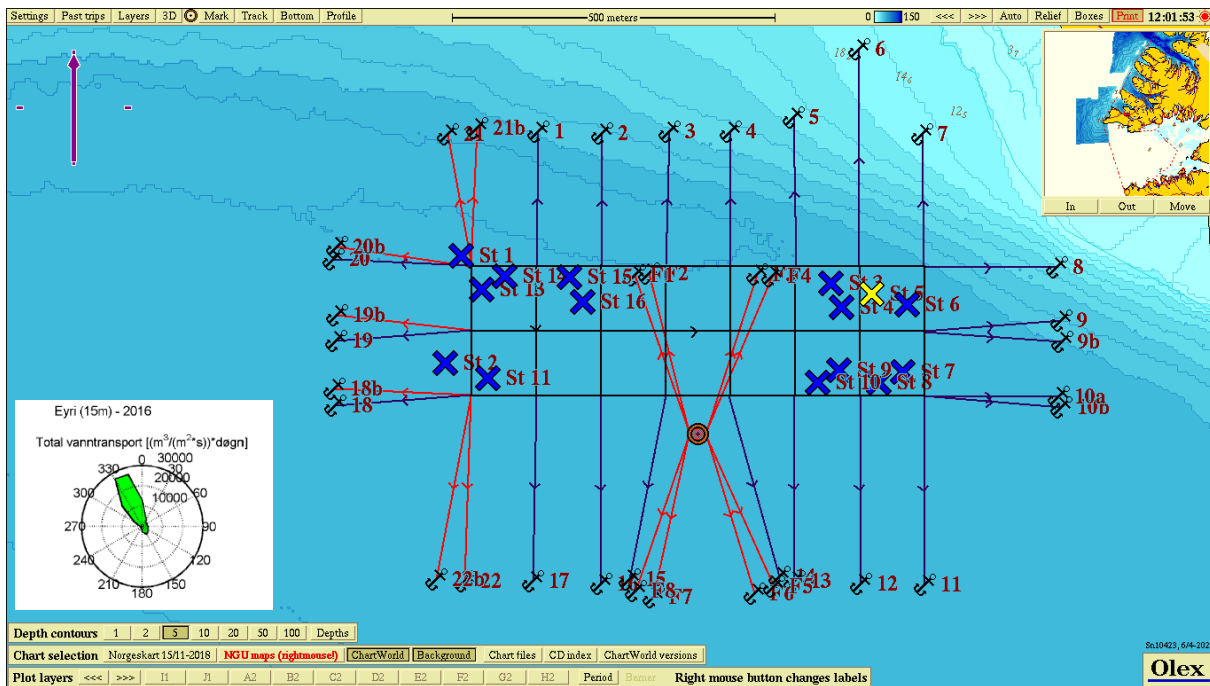


Figure 2. Chart showing depths at the site Eyri. Sampling stations st. 1 – 16 are marked with color codes that describe the condition according to NS 9410:2016, chapter 7.11. Color codes: Blue = very good condition, green = good condition, yellow = bad condition, red = very bad condition.

Table 4. Placement and depth of the sampling stations in the B-survey.

Station number	North	Vest	Depth (m)
St 1	65°34.786	23°59.156	54
St 2	65°34.696	23°58.189	52
St 3	65°34.763	23°58.411	54
St 4	65°34.743	23°58.389	54
St 5	65°34.754	23°58.329	54
St 6	65°34.745	23°58.256	54
St 7	65°34.689	23°58.266	53
St 8	65°34.680	23°58.313	53
St 9	65°34.690	23°58.394	53
St 10	65°34.680	23°58.438	53
St 11	65°34.684	23°59.102	52
St 12	65°34.705	23°59.119	53
St 13	65°34.758	23°59.116	53
St 14	65°34.769	23°59.069	53
St 15	65°34.768	23°58.938	54
St 16	65°34.747	23°58.912	53

4 Results

Results for the different parameters are given in Table 5. Overall the condition for group II (pH/Eh), group III (sensory) and group II + III parameters (mean value) and condition 1. The overall site condition is 1 «very good». A complete filled sampling sheet with calculations for each parameter is attached in appendix.

Table 5. Results from the classifications of the local impact zone of the fish farm.

Parameter	Condition
Group II - parameters (pH/Eh)	1
Group III – parameters, (sensory)	1
Group II + III – parameters (mean value)	1
Site condition	1

There were collected valid sediment samples at eleven stations out of the sixteen. This indicates that in general there is soft bottom in the whole local impact zone but the five stations defined as hard bottom were found at both ends of the array of cages (St. 8, 10, 12, 15 and 16). The sediment type consisted mainly of clay and silt. For the group II parameters, fifteen out of sixteen stations had conditions 1 «very good» and one station (St. 5) had conditions 3 «bad». For sensory parameters (group III) ten out of sixteen stations had condition 1 «very good», five stations had condition 2 «good» and one station had condition 3 «bad». For combined parameters II and III (pH/redox and sensory) fifteen out of sixteen stations had condition 1 «very good». Animals were present in all soft bottom samples mainly in the form of polychaetes

5 Conclusion

Based on the criteria given in NS 9410:2016 the fish farming site has been assigned a site condition 1 «Very Good» at the date of sampling. A total of 27 grabs were taken with Van Veen grab (0,025 m²), divided on 16 stations placed around the seven cages that are operated at the Eyri site during the present production cycle. Fifteen out of sixteen stations were assigned condition 1 «very good» for combined parameters II and III (pH/redox and sensory) while one station (St. 5) was assigned condition 3 «bad».

This indicates small organic load at the Eyri site during the current production cycle. The only sampling station with condition 3 «bad» (St. 5) is placed on the eastern side of the array of cages in the concurrent with the dominant dispersing current. Dominating current (15 m) is in direction north-northwest (330 - 345 degrees) with slight counter current from south-east (150 degrees). Average current speed is measured to be 5,2 cm/s.

The site is assigned a condition factor 1 "Very good" according to calculations based on methodology described in NS 9410:2016 and sample sheet Table B.1 and B.2 (see chapter 7 Appendix).

6 References

Forskrift om drift av akvakulturanlegg (akvakulturdriftsforskriften) §§ 35 og 36.

Gunnarsson, S. 2018. Eyri, Arnarlax hf, Forundersøkelse (B-undersøkelse), mai 2018. Akvaplan-niva AS rapport nr. 60033.01.

Heggem, T. 2017. Arnarlax hf, lokalitetsrapport, Eyri. Akvaplan-niva AS rapport nr. 8999.01.

ISO 5667-19:2004. Guidance on sampling of marine sediments.

ISO 12878:2012. Environmental monitoring of the impacts from marine finfish farms on soft bottom.

Norsk Standard NS 9410:2016. Miljøovervåking av bunnpåvirkning fra marine akvakulturanlegg.

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7 Appendix:

7.1 Sheet (B.1 og B.2) NS 9410:2016

Sample scheme B.1												
Company		Arnariax										
Site:		Eyri										
Fieldworker:		Snorri Gunnarsson (SGU)										
Date:		05.03 2020										
Site no.:												
Gr	Parameter	Point	Sample number									
			1	2	3	4	5	6	7	8	9	10
	Bottom type: S (soft) eller H (hard)		S	S	S	S	S	S	S	H	S	H
I	Animals > 1mm	Yes (0) No (1)	0	0	0	0	0	0	0		0	
II	pH	value	7,8	7,8	7,7	7,8	7,0	7,8	7,7		7,6	
	Eh (mV)	ORP	109	-10	-61	-5	-188	-13	9		45	
		plus ref. verdi	309	190	139	195	12	187	209		245	
	pH/Eh	from figure	0	0	0	0	3	0	0	0	0	0
	Status station			1	1	1	1	3	1	1	1	1
	Buffer-temp			C			Sea temp			C		
	Sediment temp									C		
	pH sea			ORP sea			mV			Eh sea		
	Reference electrode									200,0 mV		
	III	Gas bubbles	Yes (4) No (0)	0	0	0	0	0	0	0	0	0
Colour		Light/grey (0)	0					0	0	0		0
		Brown/black (2)		2	2	2	2				2	
Smell		None (0)	0		0	0			0	0		0
		Light (2)		2				2			2	
		Strong (4)					4					
Consistency		Solid (0)	0	0					0	0		0
		Soft (2)			2	2	2	2			2	
		Aqueous (4)										
Grab volume (v)		v < 1/4 (0)									0	0
		1/4 < v < 3/4 (1)			1	1		1	1		1	
		v > 3/4 (2)	2	2			2					
Thickness of sludge (t)		t < 2 cm (0)	0	0	0	0		0	0	0	0	0
		2 < t < 8 cm (1)					2					
		t > 8 cm (2)										
Sum			2,0	6,0	5,0	5,0	12,0	5,0	1,0	0,0	7,0	0,0
Corrected (**0,22)			0,4	1,3	1,1	1,1	2,6	1,1	0,2	0,0	1,5	0,0
Status station			1	2	2	2	3	2	1	1	2	1
Average group II & III			0,2	0,7	0,6	0,6	2,8	0,6	0,1	0,0	0,8	0,0
Status station			1	1	1	1	3	1	1	1	1	1
Grab ID	K-22											
pH / Eh ID	Ysi professional plus											

Sample scheme B.1

Company:	Arnarlax
Site:	Eyri
Fieldworker:	Snorri Gunnarsson (SGU)

Date:	05.03 2020
Site no.:	0


Gr	Parameter	Point	Sample number								Index			
			11	12	13	14	15	16	17	18	19	20	S%	H%
	Bottom type: S (soft) or H (hard)		S	H	S	S	H	H					69	31
I	Animals > 1mm	Yes (0) No (1)	0		0	0								
II	pH	value	7,7		7,8	7,8								
	Eh (mV)	ORP	64		64	67								
		plus ref. verdi	264		264	267								
	pH/Eh	from figure	0	0	0	0	0	0					0,19	
	Status station			1	1	1	1	1	1					
	Status group II			1	Buffer temp	0,0 C	Sea temp	0,0 C	Sediment temp	0,0 C				
	pH sea	0	ORP sea	0	mV	Eh sea	mV	Reference electrode	200 mV					
	III	Gas bubbles	Yes (4) No (0)	0	0	0	0	0	0					
		Colour	Light/grey (0)	0	0	0	0	0	0					
			Brown/black (2)											
Smell		None (0)	0	0	0	0	0	0						
		Light (2)												
		Strong (4)												
Consistency		Solid (0)	0	0	0	0	0	0						
		Soft (2)												
		Aqueous (4)												
Grab volume (v)		v < 1/4 (0)		0		0	0	0						
	1/4 < v < 3/4 (1)	1												
	v > 3/4 (2)			2										
Thickness of sledge (t)	t < 2 cm (0)	0	0	0	0	0	0							
	2 < t < 8 cm (1)													
	t > 8 cm (2)													
Sum			1,0	0,0	2,0	0,0	0,0	0,0						
Corrected (*0,22)			0,2	0,0	0,4	0,0	0,0	0,0				0,63		
Status station			1	1	1	1	1	1						
Status group III			1											
Average group II & III			0,1	0,0	0,2	0,0	0,0	0,0				0,41		
Status station			1	1	1	1	1	1						
Status group II & III			1											
pH/Eh														
Corr.sum														
Index														
Average														
< 1,1			1											
1,1 - <2,1			2											
2,1 - <3,1			3											
≥3,1			4											
Status site:			1											
Grab ID	K-22													
pH / Eh ID	Ysi professional plus													

Sample scheme B.2











Company:	Arnarlax	Date:	05.03 2020
Site:	Eyri	Site no.:	0
Fieldworker:	Snorri Gunnarsson (SGU)		






Sample number	1	2	3	4	5	6	7	8	9	10
Depth (m)	54	52	54	54	54	54	53	53	53	53
Number of trials	1	1	1	2	1	1	1	3	1	3
Gas bubbles (in sample)	No	No	No	No	No	No	No		No	
Sediment type	Clay	X	X	X	X	X	X	X		X
	Silt			X	X					
	Sand									
	Gravel									
	Shellsand									
Reef										
Rocky bottom (cobbles, boulders)										
Echinodermata, count							1			
Crustaceans, count										
Molluscs, count										
Polychaetes, count	>100	>20	>100	>100	>5	>100	>100		>100	
Other animals, count										
<i>Beggiatoa</i>										
Feed										
Faeces										
Comments	Stations 8 and 10, three trials but grab came up empty, defined hard-bottom.									
Grab	Area [m ²]	0,025		Grab ID			K-22			
	page 3 of 4 pages									







Sample scheme B.2

Company:		Arnarlax								
Site:		Eyri								
Fieldworker:		Snorri Gunnarsson (SGU)								
Date:		05.03 2020								
Site no.:		0								
Sample number	11	12	13	14	15	16	17	18	19	20
Depth (m)	52	53	53	53	54	53				
Number of trials	1	3	1	1	3	3				
Gas bubbles (in sample)	No		No	No						
Sediment type	Clay	X		X	X					
	Silt	X		X	X					
	Sand									
	Gravel									
	Shellsand									
Reef										
Rocky bottom (cobble, boulders)										
Echinodermata, count										
Crustaceans, count										
Molluscs, count										
Polychaetes, count	>100		>100	>100						
Other animals, count										
<i>Beggiatoa</i>										
Feed										
Faeces										
Comments	Stations 12, 15 and 16, three trials but grab came up empty, defined as hard bottom.									
Grab	Area [m ²]	0,025				Grab ID	K-22			
Signature fieldworker:										page 4 of 4 pages

7.2 Pictures of samples at Eyri

<p><i>St 1</i></p>		
<p><i>St 2</i></p>		
<p><i>St 3</i></p>		
<p><i>St 4</i></p>		
<p><i>St 5</i></p>		

<i>St 6</i>	n.a.	
<i>St 7</i>		
<i>St 8</i>	n.a.	n.a.
<i>St 9</i>		
<i>St 10</i>	n.a.	n.a.

<p><i>St 11</i></p>		
<p><i>St 12</i></p>	<p>n.a.</p>	<p>n.a.</p>
<p><i>St 13</i></p>		
<p><i>St 14</i></p>		
<p><i>St 15</i></p>	<p>n.a.</p>	<p>n.a.</p>

<i>St 16</i>	n.a.	n.a.
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7.3 Bottom topography and 3D view

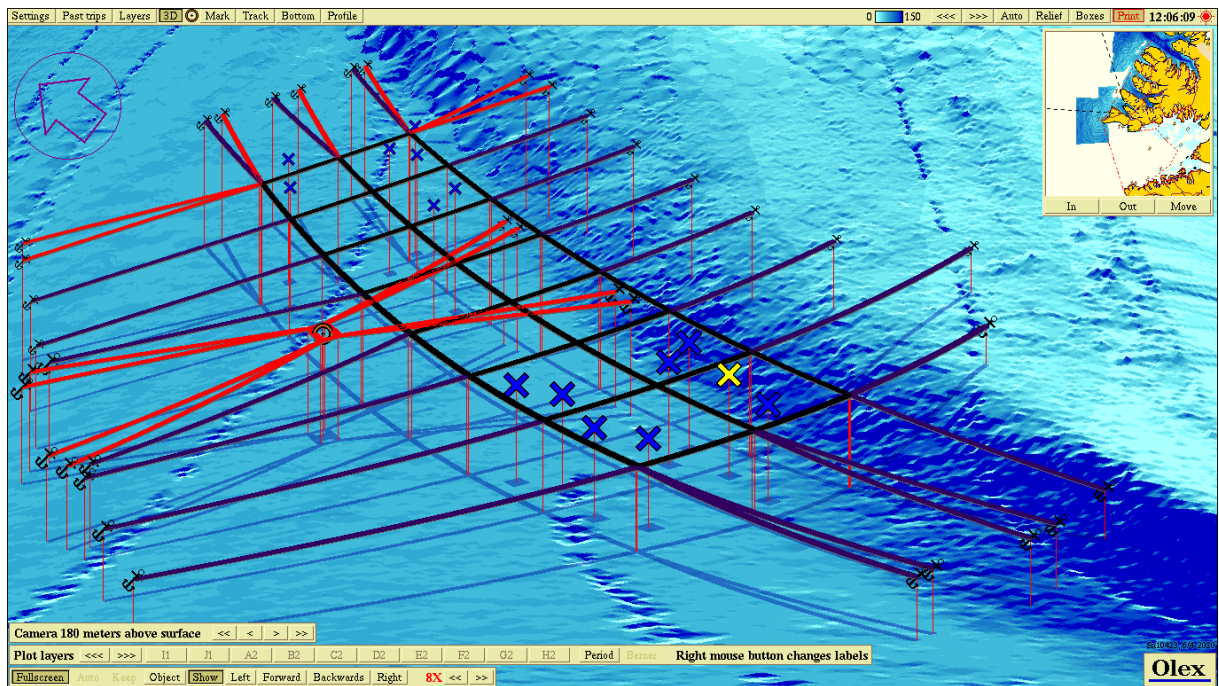


Figure 3. Showing bottom topography 3D at Eyri with each sampling station according to info in figure 2 and Table 3.