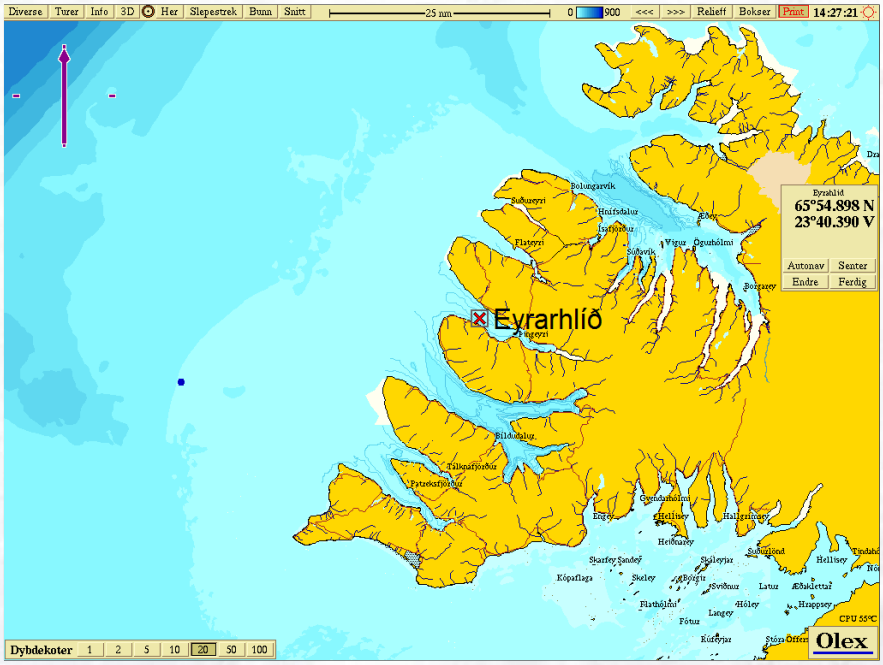
Akvaplan niva

Rapport Report

Eyrarhlíð, Arctic Sea Farm
B-bottom survey,
March 2020
(maximum biomass survey)



NORSK
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Akvaplan-niva AS: APN 62008.B01

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Information client			
Title	Eyrarhlíð, Arctic Sea Farm. B-bottom survey, March 2020		
Report number	APN-62008.B01		
Site name	Eyrarhlíð	Coordinates site	65°54.898 N 023°40.390 V
County	Ísafjarðarbær	Municipality	Ísafjarðarbær
MTB-or estimated max biomass	4.000 ton	Site manager/contact	Steinunn Guðný Einarsdóttir
Client name	Arctic Sea Farm		

Biomass/production/status at date of survey			
Biomass at date of survey	3.384 ton	Feed use	7.288
Fish type	Salmon	Amount produced	5.886
Type/time of survey	**Mark with X**	Comments	
At maximal biomass see kap 7.9	☒		
A follow up survey	☐		
Half maximal biomass	☐		
Survey prior to putting out smolt	☐		
A pre-survey new site	☐		
Other	☐		
Last fallowing period:			

Results from B-survey iht. NS 9410:2016 (main results)			
Parameters and indexes		**Parameters and site status**	
Gr. II. pH/Eh	0,00	Gr. II. pH/Eh	1
Gr. III. Sensory	0,68	Gr. III. Sensory	1
GR. II + III	0,34	GR. II+ III	1
Date field work	25.03 2020	**Date report**	16.04.20
Site status (NS 9410:2016):			**1**

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

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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 Eyrarhlíð is 4.000 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).
Arnþór Gústavsson	Akvaplan-niva AS	Quality assurance

The sampling at Eyrarhlíð was done 25.03 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.

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Akvaplan-niva AS thanks Arctic Sea Farm and their personnel for the cooperation during the conductance of this site survey.

Kópavogi 16. april 2020

Snorri Gunnarsson
Project manager

1 Introduction

The sampling date for the present site survey was 25.03 2020 and done by Akvaplan-niva AS contracted by Arctic Sea Farm in relation to the company's fish farming activity at the site in Dýrafjörður, Eyrarhlíð Ísafjarðarbær 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 Eyrarhlíð is located.

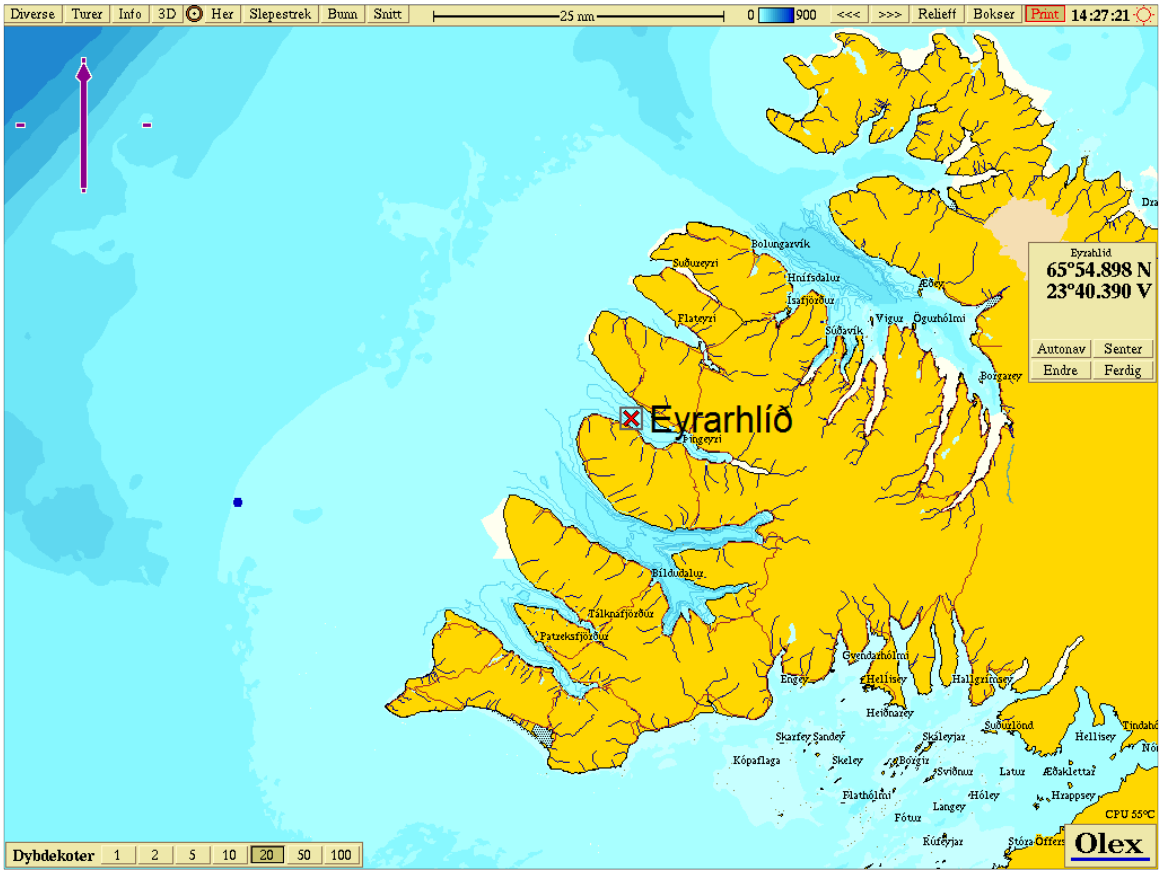

Figure 1. An overview map with the Eyrarhlíð site market by its name with a red cross.

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 cm^2). 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: - 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 m^2)
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

Eyrarhlíð site is coming to an end of the first production cycle that was started with putting out smolts in the period from June to September 2018. The fish farm at the site is a two-frame mooring system, each frame having 6 cages total 12 cages each with 160 m circumference. During the present production cycle all 12 cages of have been used but at the sampling date for the present survey 4 cages were empty.

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

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

Generation of fish (G)	Production (ton)	Feed usage (ton)
Present generation	5.886	7.288

3.2 Present and past site surveys

There was done a base line study (C-survey) at the site prior to putting fish into sea (Gallo, 2019) with sampling date 5.06 2018. Bottom was described as muddy and visual and chemical parameters did not show any signs of organic load at the site. Redox potential was positive at all eight sampling stations.

There was done a B-survey at the time of a half-max biomass, done upon the initiative from Arctic Sea Farm. The date for the sampling was somewhat delayed due to unusual and prolonged bad weather conditions in December 2019 through January 2020 so the timing of the survey was somewhat overdue and was done on the 30th January 2020.

Table 3. Past site studies for Eyrarhlíð site

Date of sampling	Report number	Survey type	Overall site status
30.01.2020	APN-61859.B01	B survey halv max biomass	1

3.3 Dispersing current

Measurement of dispersing current was done at the site in August – September 2019 measurements at 39 m depth (Gustavsson, 2019). Dominating current (39 m) is in direction south-east (130 degrees) with a smaller counter current in north-west direction. Average current speed is measured to be 5.9 cm/s. Highest current speed is measured to be 26.7 cm/s and 3.4 % of the measurements are < 1 cm/s.

3.4 Position of sampling stations

Description of the stations in the survey is given in figure 2 and table 3. Positioning of the stations was chosen based on guidance and perimeters described in NS 9410:2016 and spread around the periphery of the cages. At the site the typical depth in the local impact zone is in the range from 40 – 42 m, with a slightly deeper area into the fjord (NNV). The placement of

sampling stations was chosen to give a good picture of the condition of the whole local impact zone. It is important to evaluate the status in both the deeper and shallower parts of the local impact zone of the fish farm. The sampling stations had a depth varying from 40 to 41 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.

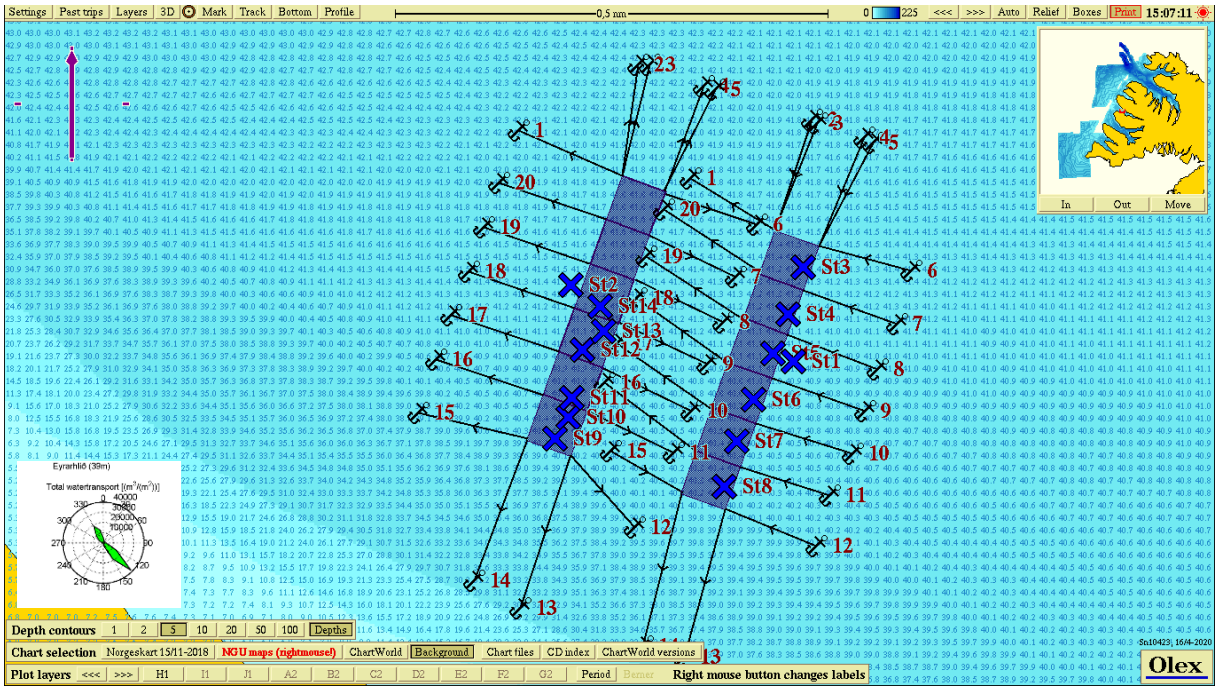

Figure 2. Chart showing depths at the site Eyrarhlíð. Sampling stations st. 1 – 14 are marked with color codes that describe the condition according to NS 9410:2016, chapter 7.11. Color codes: Blue =very good condition, green = good condition, yellow = bad condition, red = very bad condition.

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

Station number	North	Vest	Depth (m)
St 1	65°54.876	23°40.052	41
St 2	65°54.964	23°40.681	41
St 3	65°54.984	23°40.023	41
St 4	65°54.930	23°40.067	41
St 5	65°54.885	23°40.109	41
St 6	65°54.832	23°40.164	41
St 7	65°54.783	23°40.211	41
St 8	65°54.731	23°40.246	40
St 9	65°54.786	23°40.725	40
St 10	65°54.811	23°40.689	41
St 11	65°54.834	23°40.679	41
St 12	65°54.889	23°40.647	41
St 13	65°54.910	23°40.587	41
St 14	65°54.939	23°40.598	41

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 all fourteen sampling stations. This indicates that in general there is soft bottom in the whole local impact zone. The sediment type consisted mainly of clay and silt. For the group II parameters (pH/Eh), all fourteen stations had conditions 1 «very good». For sensory parameters (group III) eleven out of fourteen stations had condition 1 «very good» and three stations had condition 2 «good» (stations 5, 11 and 14). For combined parameters II and III (pH/redox and sensory) all fourteen stations had status 1 «very good». Animals where present in all 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 16 graps were taken with Van Veen grab (0,025 m^2), divided on 14 stations placed around the cages that are operated at the Eyrarhlíð site during the present production cycle. All fourteen stations were assigned condition 1 «very good» for combined parameters II and III (pH/redox and sensory). Animals were present in all samples. This indicates small organic load at the Eyrarhlíð site during the current production cycle. The results from this B-survey are in line with previous B-survey for the site done at halv-max biomass also reporting overall site condition 1 "very good".

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 (se chapter 7 Appendix).

6 References

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

Gunnarsson, S. 2020. Arctic Sea Farm, B-survey local impact zone, Eyrarhlíð, January 2020. Akvaplan-niva AS report nr. 61859.B01.

Gustavsson, A. 2019. Arctic Sea Farm hf, measurement of spread current at Eyrarhlíð, fall 2019. Akvaplan-niva AS project nr. 61426.

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 akvakultur-anlegg.

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7 Appendix:

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

Sample scheme B.1

Company	**Arctic Sea Farm PS 62008**	**Date:**	**25.03 2020**
Site:	**Eyrarhlíð, Dýrafjörður**	**Site no.:**	
Fieldworker:	**Snorri Gunnarsson (SGU)**		

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	S	S	S
I	Animals > 1mm	Yes (0) No (1)	0	0	0	0	0	0	0	0	0	0
II	pH	value	7,5	7,9	7,7	7,5	7,7	7,7	7,6	7,6	7,7	7,6
	Eh (mV)	ORP	-10	95	82	76	58	69	-12	46	56	54
		plus ref. verdi	190	295	282	276	258	269	188	246	256	254
	pH/Eh	from figure	0	0	0	0	0	0	0	0	0	0
	Status station		1	1	1	1	1	1	1	1	1	1
			Buffer-temp	3,1 C		**Sea temp**	2,0 C		**Sediment temp**		C	
	pH sea	7,96	**ORP sea**	140,0 mV		**Eh sea**	340,0 mV		**Reference electrode**		200,0 mV	
III	Gas bubbles	Yes (4) No (0)	0	0	0	0	0	0	0	0	0	0
	Colour	Light/grey (0)	0	0	0		0			0	0	0
		Brown/black (2)				2		2	2			
	Smell	None (0)		0		0		0	0	0	0	0
		Light (2)	2		2		2					
		Strong (4)										
	Consistency	Solid (0)	0	0	0	0		0	0		0	0
		Soft (2)					2			2		
		Aqueous (4)										
	Grab volume (v)	v < 1/4 (0)		0								
		1/4 < v < 3/4 (1)			1	1	1	1	1	1	1	1
		v > 3/4 (2)	2									
	Thickness of slidge (t)	t < 2 cm (0)	0	0	0	0	0	0	0	0	0	0
		2 < t < 8 cm (1)										
		t > 8 cm (2)										
		Sum	4,0	0,0	3,0	3,0	5,0	3,0	3,0	3,0	1,0	1,0
		Corrected (*0,22)	0,9	0,0	0,7	0,7	1,1	0,7	0,7	0,7	0,2	0,2
		Status station	1	1	1	1	2	1	1	1	1	1
		Average group II & III	0,4	0,0	0,3	0,3	0,6	0,3	0,3	0,3	0,1	0,1
		Status station	1	1	1	1	1	1	1	1	1	1

Grab ID	k-22
pH / Eh ID	YSI-professional plus

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Sample scheme B.1

Company:	**Arctic Sea Farm PS 62008**	**Date:**	**25.03 2020**
Site:	**Eyrarhlíð, Dýrafjörður**	**Site no.:**	**0**
Fieldworker:	**Snorri Gunnarsson (SGU)**		

Gr	Parameter	Point	Sample number 11	12	13	14	15	16	17	18	19	20	Index S%	H%
	Bottom type: S (soft) or H (hard)		S	S	S	S							100	0
I	Animals > 1mm	Yes (0) No (1)	0	0	0	0								
II	pH	value	7,6	7,4	7,8	7,4								
	Eh (mV)	ORP	62	15	41	15								
		plus ref. verdi	262	215	241	215								
	pH/Eh	from figure	0	0	0	0								0,00
		Status station	1	1	1	1								
		Status group II	1	**Buffer temp**	3,1 C		**Sea temp**	2,0 C		**Sediment temp**	0,0 C			
		pH sea 7,96	**ORP sea**	140 mV		**Eh sea**	340 mV		**Reference electrode**		200 mV			
III	Gas bubbles	Yes (4) No (0)	0	0	0	0								
	Colour	Light/grey (0)			0									
		Brown/black (2)	2	2		2								
	Smell	None (0)		0	0									
		Light (2)	2			2								
		Strong (4)												
	Consistency	Solid (0)	0	0	0	0								
		Soft (2)												
		Aqueous (4)												
	Grab volume (v)	v < 1/4 (0)			0									
		1/4 < v < 3/4 (1)	1	1		1								
		v > 3/4 (2)												
	Thickness of slidge (t)	t < 2 cm (0)	1	1	1	1								
		2 < t < 8 cm (1)												
		t > 8 cm (2)												
		Sum	6,0	4,0	1,0	6,0								
		Corrected (*0,22)	1,3	0,9	0,2	1,3								0,68
		Status station	2	1	1	2								
		Status group III	1											
		Average group II & III	0,7	0,4	0,1	0,7								0,34
		Status station	1	1	1	1								
		Status group II & III	1											

pH/Eh Corr.sum Index Average	**Status**
< 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

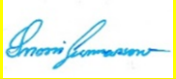
Sample scheme B.2

Company:	**Arctic Sea Farm PS 62008**	**Date:**	**25.03 2020**
Site:	**Eyrarhlíð, Dýrafjörður**	**Site no.:**	**0**
Fieldworker:	**Snorri Gunnarsson (SGU)**		

Sample number		1	2	3	4	5	6	7	8	9	10
Depth (m)		41	41	41	41	41	41	41	40	40	41
Number of trials		1	1	2	1	1	1	1	1	1	1
Gas bubbles (in sample)		No	No	No	No	No	No	No	No	No	No
Sediment type	**Clay**	X	X	X	X	X	X	X	X	X	X
	Silt	X	X	X	X	X	X	X	X	X	X
	Sand										
	Gravel										
	Shellsand										
Reef											
Rocky bottom (cobbles, boulders)											
Echinodermata, count											
Crustaceans, count											
Molluscs, count											
Polychaetes, count		>50	>50	>50	>100	>100	>100	>100	>100	>100	>50
Other animals, count											
Beggiatoa											
Feed											
Faeces											
Comments											
Grab	**Area [m^2]**					**Grab ID**			k-22		

Sample scheme B.2

Company:	**Arctic Sea Farm PS 62008**	**Date:**	**25.03 2020**
Site:	**Eyrarhlíð, Dýrafjörður**	**Site no.:**	**0**
Fieldworker:	**Snorri Gunnarsson (SGU)**		

Sample number		11	12	13	14	15	16	17	18	19	20
Depth (m)		41	41	41	41						
Number of trials		1	1	2	1						
Gas bubbles (in sample)		No	No	No	No						
Sediment type	**Clay**	X	X	X	X						
	Silt	X	X	X	X						
	Sand										
	Gravel										
	Shellsand										
Reef											
Rocky bottom (cobbles, boulders)											
Echinodermata, count											
Crustaceans, count											
Molluscs, count											
Polychaetes, count		>10	>10	>10	>10						
Other animals, count											
Beggiatoa											
Feed											
Faeces											
Comments											
Grab		**Area [m^2]**		0		**Grab ID**		k-22			
Signature fieldworker:										page 4 of 4 pages	

7.2 Pictures of samples at Eyrarhlíð

St 1		
St 2		
St 3		
St 4		
St 5		

St 6		
St 7		
St 8		
St 9		
St 10		

St 11		
St 12		
St 13		
St 14		

7.3 Bottom topography and 3D view

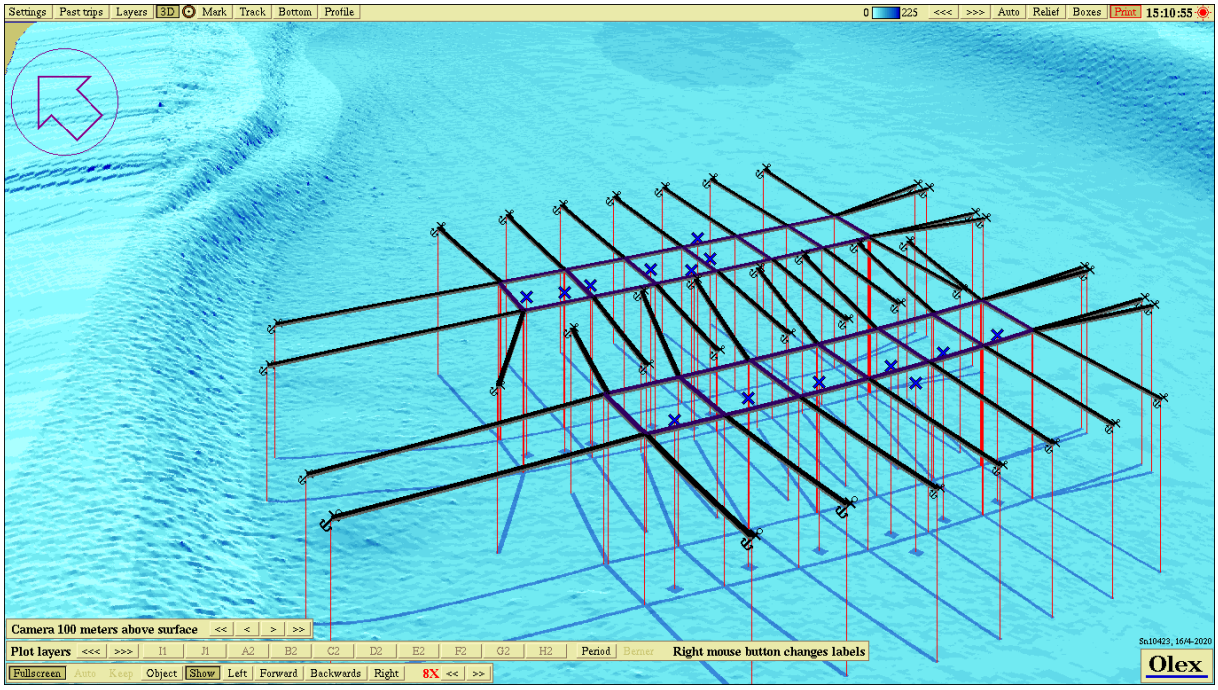


Figure 3. Showing bottom topography 3D at Eyrarhlíð with each sampling station according to info in figure 2 and Table 3.