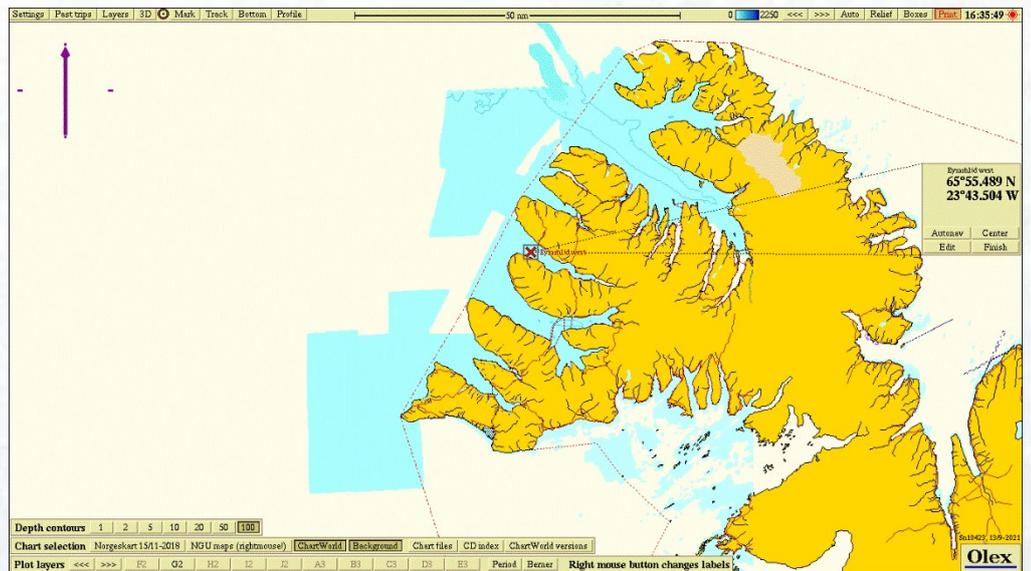


Eyrarhlíð 2, Arctic Sea Farm ehf.
B-bottom survey,
March 2022
(maximum biomass survey)



Information client			
Titel	Eyrarhlíð 2, Arctic Sea Farm ehf. B-bottom survey, March 2022 (maximum biomass survey)		
Report number	APN-63863.B01		
Site name	Eyrarhlíð 2	Coordinates site	65°55.489 N 23°43.504 V
County		Municipality	Ísafjarðarbær
MTB-or estimated max biomass	5069 ton	Site manager/contact	Steinunn G. Einarsdóttir
Client name	Arctic Sea Farm ehf.		

Biomass/production/status at date of survey			
Biomass at date of survey	3.576 ton	Feed use	4.479
Fish type	Salmon	Amount produced	3.214
Type/time of survey	Mark with X	Comments	
At maximal biomass see kap 7.9	<input checked="" type="checkbox"/>	Max biomass at the site was reached on the 26 th of January. Due to unfavourable circumstances at the site and also bad weather it was not possible to do the bottom survey until 3 rd of March. There was ongoing slaughter and mortalities at the site during the period from max biomass until sampling.	
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	0,00	Gr. II. pH/Eh	1
Gr. III. Sensory	0,12	Gr. III. Sensory	1
GR. II + III	0,06	GR. II+ III	1
Date field work	03.03 2022	Date report	20.04.2022
Site status (NS 9410:2016):			1

Report writing and project leader	Snorri Gunnarsson	Signature	
Quality control	Gyda W. Lorås	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 investigate state of health of seabed in local impact zone according to requirements defined in NS9410:2016. The max biomass for the current generation farmed salmon at the site Eyrarhlíð 2 was 5.069 MTB ton (26th of January). There is a requirement of at least 16 sampling stations within the mooring lines of the fish farm. The methods applied in this survey follow guidelines in chapter 5 (NS6410:216) and fulfil the requirements described in ISO 12878. 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).
Gyda W. Lorås	Akvaplan-niva AS	Quality assurance

The sampling at Arctic Sea Farm was done 03.03 2022.

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 Arctic Sea Farm ehf. and their personnel for the cooperation during the conductance of this site survey.

Kópavogi 20. april 2022



Snorri Gunnarsson
Project manager

1 Introduction

The sampling date for the present site survey was 03.03.2022 and done by Akvaplan-niva AS contracted by Arctic Sea Farm in relation to the company's fish farming activity at the site in Eyrarhlíð 2, Dýrafjörður.

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 of Vestfirðir where the site Eyrarhlíð 2 is located.

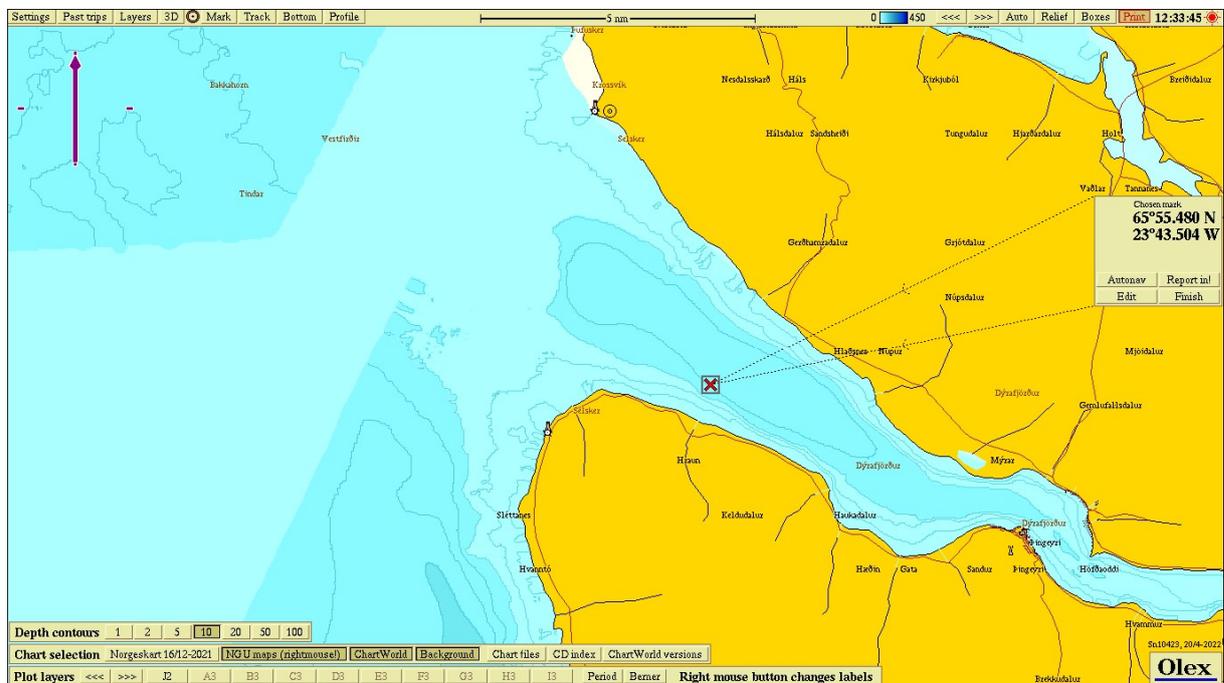


Figure 1. An overview map with the Eyrarhlíð 2 site marked with a red cross.

2 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 bobbles, 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, according to the scale of the impact on the benthic conditions from organic load, see criteria in table 1. 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 and it is the weighted average for all the sampling stations that gives the sites condition.

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

Olex mapping software

3 Site description and bottom topography

3.1 Info site operation

The Eyrarhlíð 2 site is located in Dýrafjörður about 11 km from Þingeyri. The cages are lined in a north-western direction from land (289 degrees). The depth under cages ranges from about 36 - 44 m.

The current generation of farmed Atlantic salmon is the first generations at the site. The fish farm at Eyrarhlíð 2 has a single frame 2x7 mooring system with a possibility total of 14 cages, each with 160 m circumference. The current generation was put into sea summer 2021 reared in 13 cages.

Fish mortalities were a problem at the Eyrarhlíð 2 site from around the year shift 2021/22 with subsequent emergency slaughter in the weeks leading up to the current bottom sampling. Max biomass was reached around 26th of January and due to mortalities and slaughter efforts the standing biomass at the day of sampling the bottom was around 3.576 ton. Bottom sampling was delayed both due to intense slaughter effort and collection of dead fish at the site and also due to bad weather in the period.

Table 2 shows the production and feed usage for the current generation.

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

Generation of fish (G)	Production (ton)		Feed usage (ton)
Summer 2021 - present	3.214		4.479

3.2 Present and past site surveys

There has previously been done one type B-surveys at the Eyrarhlíð 2 site (Table 3), pre survey in 2021 prior to putting out first smolts at the site. The results from the B pre survey in 2021 gave overall site condition 1 «very good».

Table 3. Past surveys in the local impact zone for Eyrarhlíð 2.

Date of sampling	Report number	Survey type	Overall site status
15.04 2021	APN-63091.B01 (Gunnarsson 2021)	Pre survey new site	1

3.3 Dispersing current

Measurement of dispersing current was done at the site in August – September 2019 measured 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 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. Eyrarhlíð 2 site is in Dýrafjörður. Depth at the site is in the range from about 36 to 44 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 previous production cycle. The sampling stations had a depth varying from 38 m to 44 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.

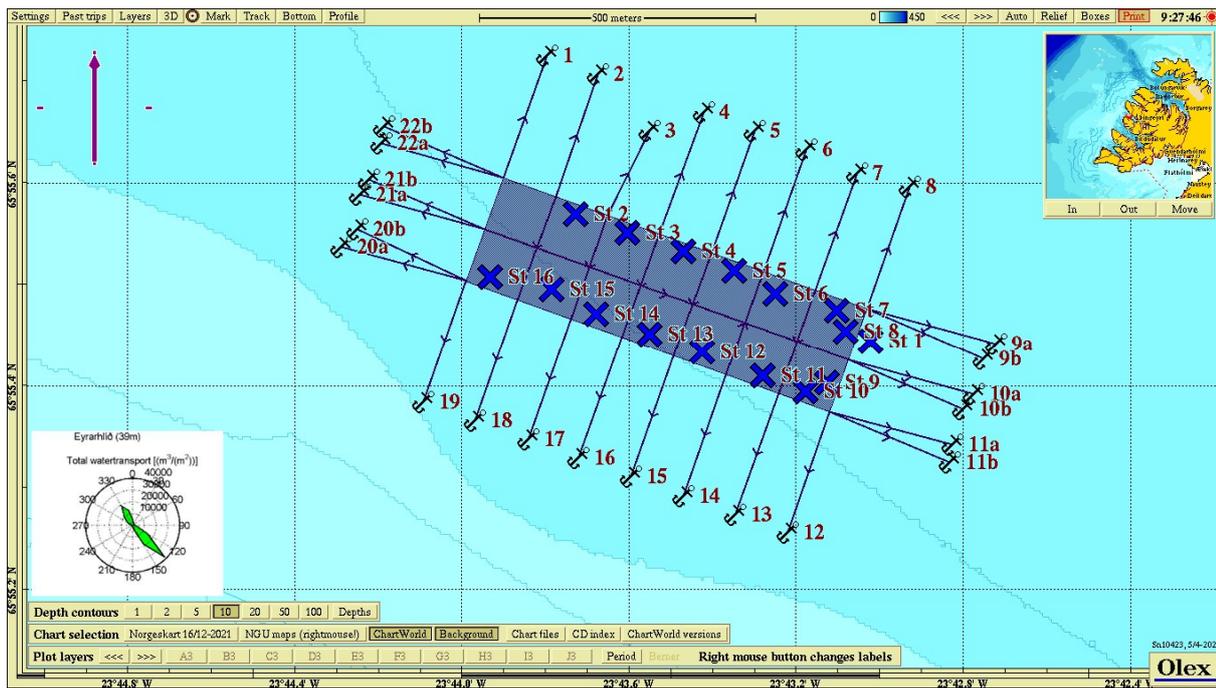


Figure 2. Chart showing depths at the site Eyrarhlíð 2. Sampling stations st. 1 – 16 are marked with color codes that describe the condition according to NS 9410:2016, chapter 7.11. Color codes: Blue = very good condition, green = good condition, yellow = bad condition, red = very bad condition. The spread current at 39 m depth is shown in lower left corner (Gustavsson, 2019).

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

Station number	North	Vest	Depth (m)
St 1	65°55.444	23°43.021	44
St 2	65°55.569	23°43.727	42
St 3	65°55.551	23°43.604	42
St 4	65°55.532	23°43.470	43
St 5	65°55.513	23°43.348	43
St 6	65°55.491	23°43.280	43
St 7	65°55.474	23°43.103	43
St 8	65°55.453	23°43.082	43
St 9	65°55.403	23°43.126	42
St 10	65°55.394	23°43.178	42
St 11	65°55.410	23°43.281	41
St 12	65°55.433	23°43.425	41
St 13	65°55.451	23°43.550	40
St 14	65°55.471	23°43.678	40
St 15	65°55.487	23°43.805	39
St 16	65°55.507	23°43.932	38

4 Results

Results for the different parameters are given in Table 5. A complete filled sampling sheet with calculations for each parameter is attached.

Table 5. Results from the classifications of the local impact zone of the fish farm Eyrarhlið 2 in March 2021.

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 the sixteen sampling but at one of the sampling stations (st. 12) group II parameters (pH/Eh) could not be measured due little sample in the grab but sensory analysis was possible. This indicates that most of the local impact zone is soft bottom. In general the sediment type consisted mainly of fine clay but clay with mixture of sand was more common in the western part of the local impact zone.

The results were homogenous for the whole farming area indication overall good condition in the whole local impact zone. The overall site condition was 1 «very good» and is the result of the weighted average for all sampling stations. The results were homogenous for the whole farming area indication overall good condition in the whole local impact zone. Overall, the condition for group II parameters (pH/Eh) was 1 «very good», the condition for group III parameters (sensory) was 1 «very good» and condition for combined group II + III parameters was also 1 «very good».

For the group II parameters (pH/redox), sensory parameters (group III) and the combined parameters II and III (pH/redox and sensory) all the sixteen stations had condition 1 «very good». Except station 12 where sample size did not allow measurement for group II parameters.

Animals where present in all soft bottom samples mainly in the form of polychaetes.

The overall site condition was 1 «very good» and is the result of the weighted average for all sampling stations.

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. For combined parameters II and III (pH/redox and sensory) all sixteen stations had condition 1 «very good».

The current generation of farmed Atlantic salmon is the first generations at the site Eyrarhlíð 2. Fish mortalities were a problem at the Eyrarhlíð 2 site from around the year shift 2021/22 with subsequent emergency slaughter in the weeks leading up to the current bottom sampling. Max biomass was reached around 26th of January and due to mortalities and slaughter efforts the standing biomass at the day of sampling the bottom was 3.576 ton. Bottom sampling was delayed both due to intense slaughter effort and collection of dead fish at the site combined with bad weather in the period.

This survey in the local impact zone at max biomass indicates little organic load in the local impact zone of the fish farming area. The previous B-survey (pre survey prior to putting out smolts at the site) resulted in overall condition 1 «very good» (Gunnarsson 2021).

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. 2021. Eyrarhlíð II. Arctic Sea Farm B-bottom survey, April 2021 (pre-survey). Akvaplan-niva AS project nr. 63091.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 akvakulturanlegg.

www.fiskeridir.no

7 Appendix:

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

Sample scheme B.1														
Company		Arctic Sea Farm						Date:		03.03 2022				
Site:		Eyrarhlíð 2						Site no.:						
Fieldworker:		Snorri Gunnarsson												
Gr	Parameter	Point	Sample number											
	Bottom type: S (soft) eller H (hard)		1	2	3	4	5	6	7	8	9	10		
			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	7,8	8,0	7,9	7,9	7,9	7,9	7,9	7,9	7,8	7,8		
	Eh (mV)	ORP	102	110	102	71	72	69	76	59	-45	34		
		plus ref. verdi	302	310	302	271	272	269	276	259	155	234		
	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			5,0 C			Sea temp			1,1 C		Sediment temp		1,1 C
	pH sea		8,01	ORP sea		186,5 mV	Eh sea		386,5 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	0	0	0	
			Brown/black (2)											
Smell		None (0)	0	0	0	0	0	0	0	0	0	0		
		Light (2)												
		Strong (4)												
Consistency		Solid (0)	0	0	0	0	0	0	0	0	0	0		
		Soft (2)												
		Aqueous (4)												
Grab volume (v)		v < 1/4 (0)		0	0	0								
	1/4 < v < 3/4 (1)					1	1	1	1	1	1	1		
	v > 3/4 (2)	2												
Thickness of sledge (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			2,0	0,0	0,0	0,0	1,0	1,0	1,0	1,0	1,0	1,0		
Corrected (**0,22)			0,4	0,0	0,0	0,0	0,2	0,2	0,2	0,2	0,2	0,2		
Status station			1	1	1	1	1	1	1	1	1	1		
Average group II & III			0,2	0,0	0,0	0,0	0,1	0,1	0,1	0,1	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													

Sample scheme B.1

Company:	Arctic Sea Farm
Site:	Eyrarhlíð 2
Fieldworker:	Snorri Gunnarsson

Date:	03.03 2022
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	S	S						94	6
I	Animals > 1mm	Yes (0) No (1)	0	0	0	0	0	0							
II	pH	value	7,9	ut	7,9	7,8	7,8	7,9							
	Eh (mV)	ORP	73	ut	84	88	86	87							
		plus ref. verdi	273		284	288	286	287							
	pH/Eh	from figure	0	ut	0	0	0	0							0,00
	Status station			1	ut	1	1	1	1						
	Status group II			1	Buffer temp	5,0 C	Sea temp	1,1 C	Sediment temp	1,1 C					
	pH sea	8,01	ORP sea	187	mV	Eh sea	387	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	0							
	1/4 < v < 3/4 (1)	1													
	v > 3/4 (2)														
Thickness of sludge (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	0,0	0,0	0,0	0,0							
Corrected (*0,22)			0,2	0,0	0,0	0,0	0,0	0,0						0,12	
Status station			1	1	1	1	1	1							
Status group III			1												
Average group II & III			0,1	0,0	0,0	0,0	0,0	0,0						0,06	
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															
2,1 - <3,1															
≥3,1															
Status site:			1												

Grab ID	K-22
pH / Eh ID	Ysi professional plus

Sample scheme B.2

Company:	Arctic Sea Farm	Date:	03.03 2022
Site:	Eyrarhlíð 2	Site no.:	0
Fieldworker:	Snorri Gunnarsson		

Sample number	1	2	3	4	5	6	7	8	9	10
Depth (m)	44	42	42	43	43	43	43	43	42	42
Number of trials	1	1	1	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
	Silt									
	Sand		X	X	X					
	Gravel									
	Shellsand									
Reef										
Rocky bottom (cobbles, boulders)										
Echinodermata, count										
Crustaceans, count										
Molluscs, count										
Polychaetes, count	>10	>10	14	>100	>200	>100	>100	>100	>100	>100
Other animals, count										
<i>Beggiatoa</i>										
Feed										
Faeces										
Comments										
Grab	Area [m ²]	0,025	Grab ID				K-22			

Sample scheme B.2

Company:	Arctic Sea Farm	Date:	03.03 2022
Site:	Eyrarhlíð 2	Site no.:	0
Fieldworker:	Snorri Gunnarsson		

Sample number	11	12	13	14	15	16	17	18	19	20
Depth (m)	41	41	40	40	39	38				
Number of trials	1	3	2	2	1	1				
Gas bubbles (in sample)	No	No	No	No	No	No				
Sediment type	Clay	X	X	X	X	X	X			
	Silt									
	Sand				X	X	X			
	Gravel									
	Shellsand									
Reef										
Rocky bottom (cobbles, boulders)										
Echinodermata, count										
Crustaceans, count										
Molluscs, count						1				
Polychaetes, count	>100	17	>50	>30	>20	>40				
Other animals, count										
<i>Beggiatoa</i>										
Feed										
Faeces										
Comments										
Grab	Area [m ²]	0,025	Grab ID	K-22						
Signature fieldworker:										

7.2 Pictures of samples at Eyrarhlíð 2

<i>St 1</i>	 <p>A white rectangular tray containing a dark, granular sediment sample. A small white label with the text 'C1-1' is placed on the right side of the tray.</p>	 <p>A circular sieve containing the sediment sample from St 1. A small white label with the text 'C1-1' is placed in the center of the sieve.</p>
<i>St 2</i>	 <p>A yellow rectangular tray containing a dark, clumpy sediment sample. A small white label with the text '2' is placed on the left side of the tray.</p>	 <p>A circular sieve containing the sediment sample from St 2. A small white label with the text '2' is placed in the center of the sieve.</p>
<i>St 3</i>	 <p>A yellow rectangular tray containing a dark, clumpy sediment sample. A small white label with the text '3' is placed in the center of the tray.</p>	 <p>A circular sieve containing the sediment sample from St 3. A small white label with the text '3' is placed in the center of the sieve.</p>
<i>St 4</i>	 <p>A yellow rectangular tray containing a dark, clumpy sediment sample submerged in water. A small white label with the text '4' is placed in the center of the tray.</p>	 <p>A circular sieve containing the sediment sample from St 4. A small white label with the text '4' is placed in the center of the sieve.</p>
<i>St 5</i>	 <p>A yellow rectangular tray containing a dark, clumpy sediment sample submerged in water. A small white label with the text '5' is placed in the center of the tray.</p>	 <p>A circular sieve containing the sediment sample from St 5. A small white label with the text '5' is placed in the center of the sieve.</p>

<p><i>St 6</i></p>		
<p><i>St 7</i></p>		
<p><i>St 8</i></p>	<p>NA</p>	
<p><i>St 9</i></p>		
<p><i>St 10</i></p>		

<p><i>St 11</i></p>		
<p><i>St 12</i></p>		
<p><i>St 13</i></p>		
<p><i>St 14</i></p>		
<p><i>St 15</i></p>		



7.3 Bottom topography and 3D view

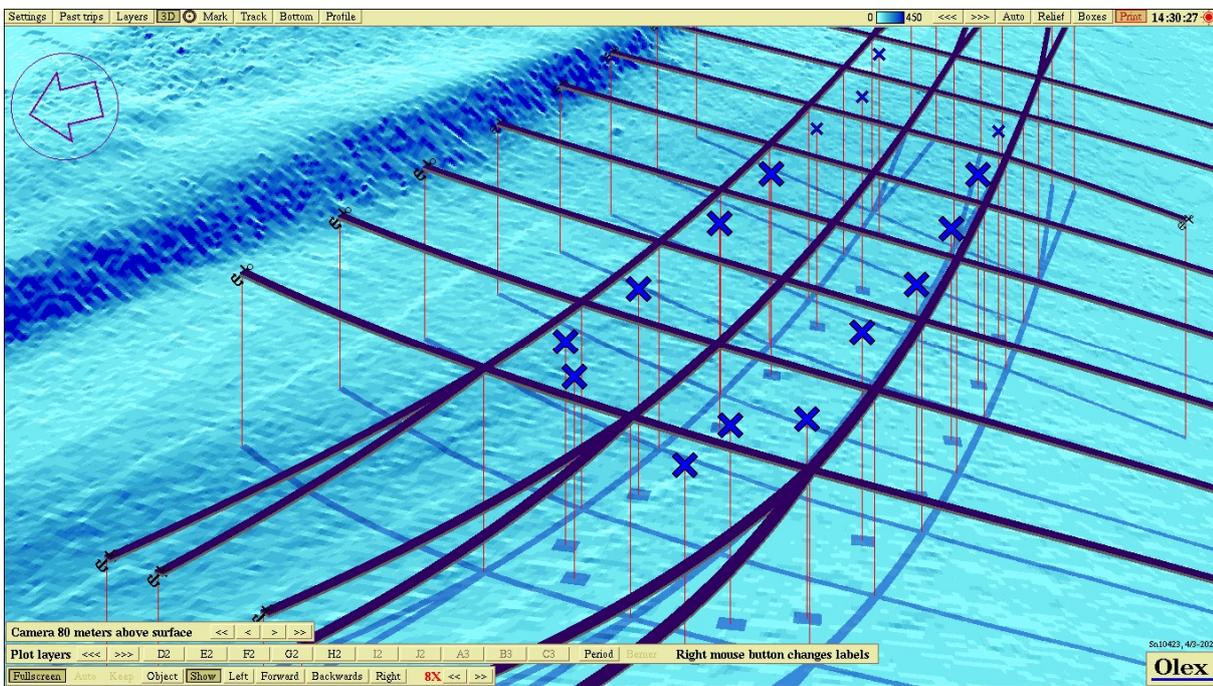


Figure 3. Showing bottom topography 3D at Eyrarhlíð 2 with each sampling station according to info in figure 2 and Table 3.