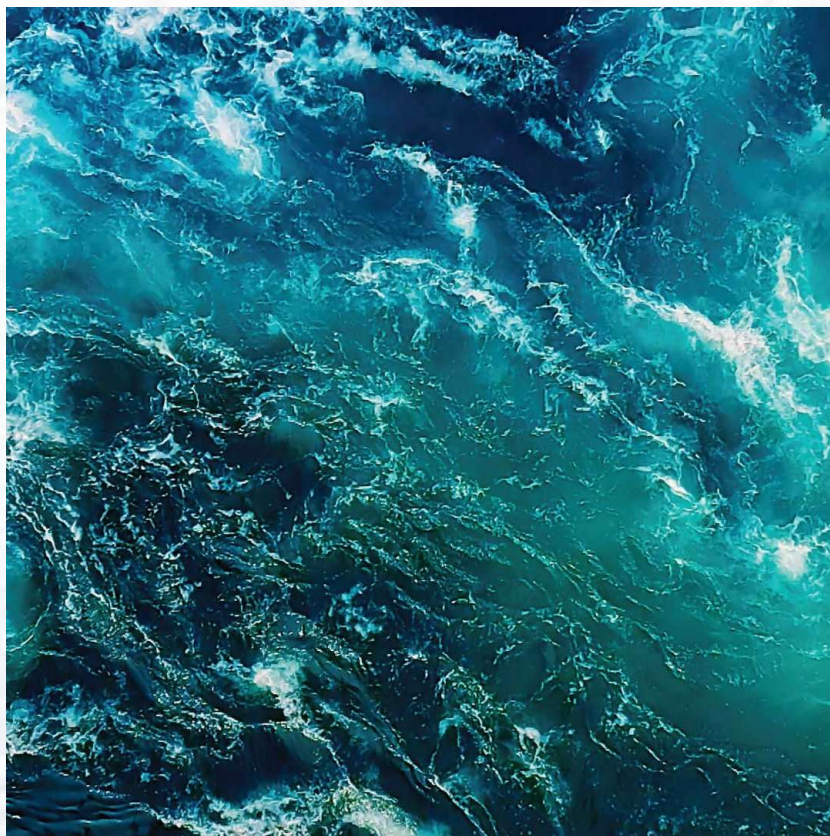



Eyrarhlíð 2, Arctic Sea Farm  
B survey,  
August 2023  
(fallow period)



Information client			
Title	Eyrarhlíð 2, Arctic Sea Farm B survey (fallow period), August 2023		
Report number	APN-65177.B01		
Site name	Eyrarhlíð 2	Coordinates site	65°55,489N 23°43,504V
County	Ísafjarðarbær	Municipality	Ísafjarðabær
MTB-or estimated max biomass	7.250 tonnes	Site manager/contact	Maria E. Chiarandini
Client name	Arctic Sea Farm ehf		

Biomass/production/status at date of survey			
Biomass at date of survey	-	Feed use	-
Fish type	Salmon	Amount produced	-
<b>Type/time of survey</b>		Comments:	
At maximal biomass see kap 7.9	<input type="checkbox"/>		
A follow up survey	<input type="checkbox"/>		
Half maximal biomass	<input type="checkbox"/>		
Survey prior to putting out smolt	<input checked="" type="checkbox"/>		
A pre-survey new site	<input type="checkbox"/>		
Other	<input type="checkbox"/>		
Last fallowing period:	August 2022- date of survey		

Results from B-survey according to 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 fieldwork	29.08 2023	Date report	06.09 2023
<b>Site status (NS 9410:2016):</b>			<b>1</b>

Report writing and project leader	Snorri Gunnarsson	Signature	
Quality control	Gyda W. Lorås	Signature	

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# Preface

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The B-survey is carried out in accordance with the Norwegian standard NS 9410:2016 - "Environmental monitoring of benthic impact from marine fish farms". Impact assessment is based on sediment condition (chemistry, sensory & presence/absence of fauna). The environmental survey is regulated by § 35 in the Norwegian "akvakulturdriftsforakrften". The survey also fulfills the requirements regarding seabed surveys outlined in the standard ISO 12878.

The primary objective of a B-survey is to assess the benthic impact beneath and in the close vicinity (near zone) of a marine fish farm by applying methods, thresholds and classifications as defined in NS9410:2016.

The following have participated in the survey:

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

The sampling at Eyrarhlíð 2 was done 29.08.2023.

## Accredited survey:

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

Sampling and treatment of sediment samples, analysis of samples and evaluations of the results. Thresholds and classifications of assessment criteria applied in this report are based on Norwegian environmental conditions as Iceland specific criteria have yet not been developed. This should be taken into consideration when reviewing site status.



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.

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

Kópavogur 06.09 2023

Snorri Gunnarsson  
Project manager

# 1 Introduction

Sampling was undertaken on 29.08.2023 by Akvaplan-niva AS, who has been contracted by Arctic Sea Farm in relation to the company's fish farming activity at the site Eyrarhlíð 2 in Dýrafjörður, Ísafjarðabær municipality.

The objective of the B-survey is to document the environmental condition in the near zone (beneath and in the close vicinity) of a fish farm by evaluating sediment condition (chemistry, sensory & presence/absence of fauna) as defined in NS 9410:2016 (and ISO 12878). The B-survey is a tool for trend monitoring and allows to assess the status of organic enrichment beneath the net pens at various stages of the production cycle.

The survey was undertaken at the time of fallow period prior to putting out next generation farmed fish at the site. Fallow period started on the 13<sup>th</sup> of August 2022 until day of sampling or just over 1 year. Previously there has been farmed one generation salmon at the Eyrarhlíð 2 site.

Sampling stations in this survey are placed within the near zone of the new farm location. Eyrarhlíð 2 has an estimated max. biomass of 7.250 t for planned next generation farmed fish (Fredrik Hansen Mosti, personal reference) and thus a total of 20 stations were sampled.

Figure 1 shows a map of the Dýrafjörður in Vestfirðir where Eyrarhlíð 2 is located.

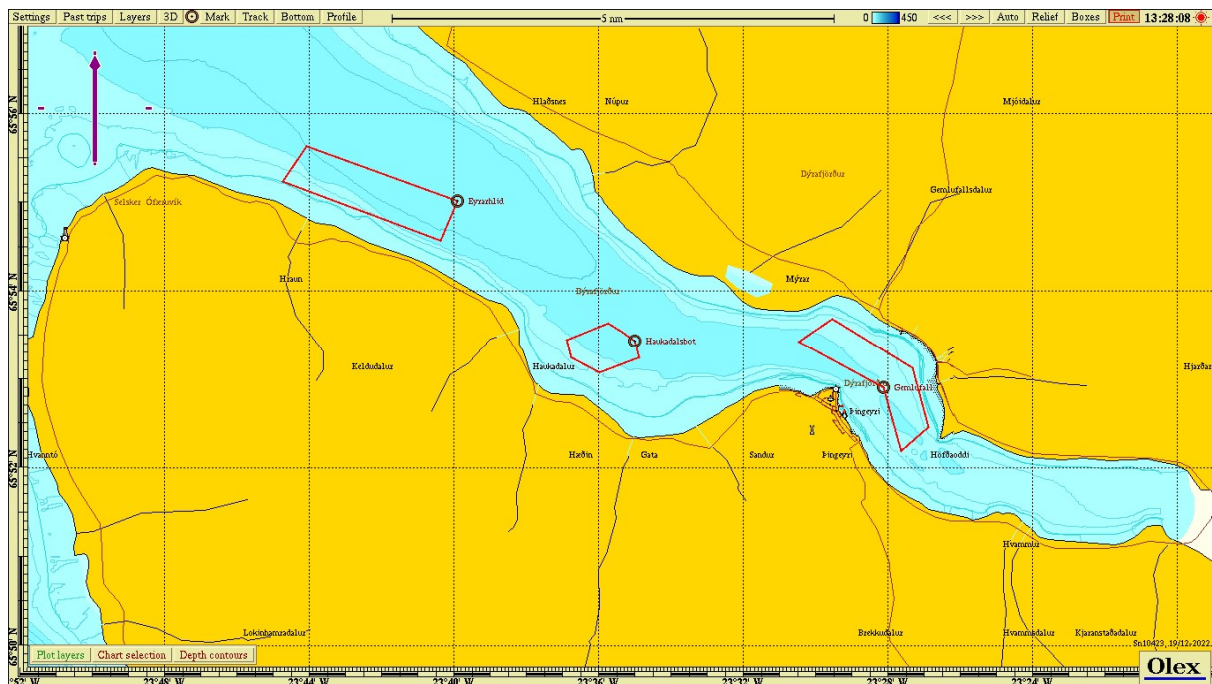


Figure 1. An overview map where Eyrarhlíð 2 (western part of Eyrarhlíð fish farming area) is marked. Other fish farming areas in the nearest vicinity (Dýrafjörður) are also shown.

## 2 Methods

---

Monitoring of the environmental impact of fish farming activities on the seabed is standardised and regulated. All fish farming sites in the sea are to be regularly assessed. This B-survey follows guidelines and methods outlined in NS 9410:2016 and ISO 12878. The Icelandic Environmental agency (Umhverfisstofnun) can also set specific requirements regarding frequency of surveys for different fish farming sites, which can overrule the above-mentioned standards.

The B-survey is a trend monitoring tool with the focus on sediment condition (benthic impact) beneath and in the close vicinity of the fish cages (near zone). Sediment is collected using a grab (min 250 cm<sup>2</sup>). Sediment condition for each sample is assessed using three indicators: sediment chemistry (pH and redox potential), sensory evaluation (gas bubbles, smell, texture, colour and thickness of sludge) and the presence or absence of fauna. The performance of these indicators against predefined thresholds categorizes the farming locations into four different site conditions (see Table 1), which are used to determine the sampling frequency.

*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"><li>- Condition 1 – next site survey at next max biomass</li><li>- Condition 2 – next site survey at next 50% max biomass and at max biomass</li><li>- 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</li></ul> 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:

Grab: Van Veen grab 0,025 (used for sampling stations 1 – 10) and 0,1 m<sup>2</sup> (used for sampling stations 11 – 20)

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 Study site, production, and survey design

---

### 3.1 Study site and production

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.

Previously there has been farmed one generation salmon 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 site has been in fallow state for over 12 months (started 13<sup>th</sup> of August 2022) and the plan is to put out next generation salmon in October 2023.

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

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

Generation of fish (G)	Production (tonnes)	Feed usage (tonnes)
Generation 2017-2019	5.389	7.257

### 3.2 Present and past site surveys

There have previously been done two type B-surveys at the Eyrarhlíð 2 site Table 3.

Table 3 provides an overview of sampling dates and results of current and historic B-surveys undertaken at the site following NS 9410:2016.

*Table 3. Current and historic B surveys taken at Eyrarhlíð 2.*

Date of sampling	Report number	Survey type	Overall site status
03.03.2022	APN 63863.B01 (Gunnarson, 2022)	Max biomass	1
15.04 2021	APN-63091.B01 (Gunnarsson, 2021)	Pre survey new site	1

### 3.3 Hydrodynamic conditions

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 Survey design

The placement of the 20 sampling stations is shown in Figure 2 with positions listed in Table 4. The number of sampling stations is based on the estimated max. biomass of 7.250 t for next generation farmed fish. Stations are distributed within the near zone of the new frame position following criteria outlined in NS 9410:2016. The typical depth in the local impact zone is in the range from 36 – 44 m. Sampling stations were placed to represent the varied environmental conditions within the near zone and cover thus both the deeper and shallower areas. The sampling stations had a depth varying from 38 to 43 m. The placement of sampling stations is regarded to be in accordance with the requirements outlined in NS 9410:2016.

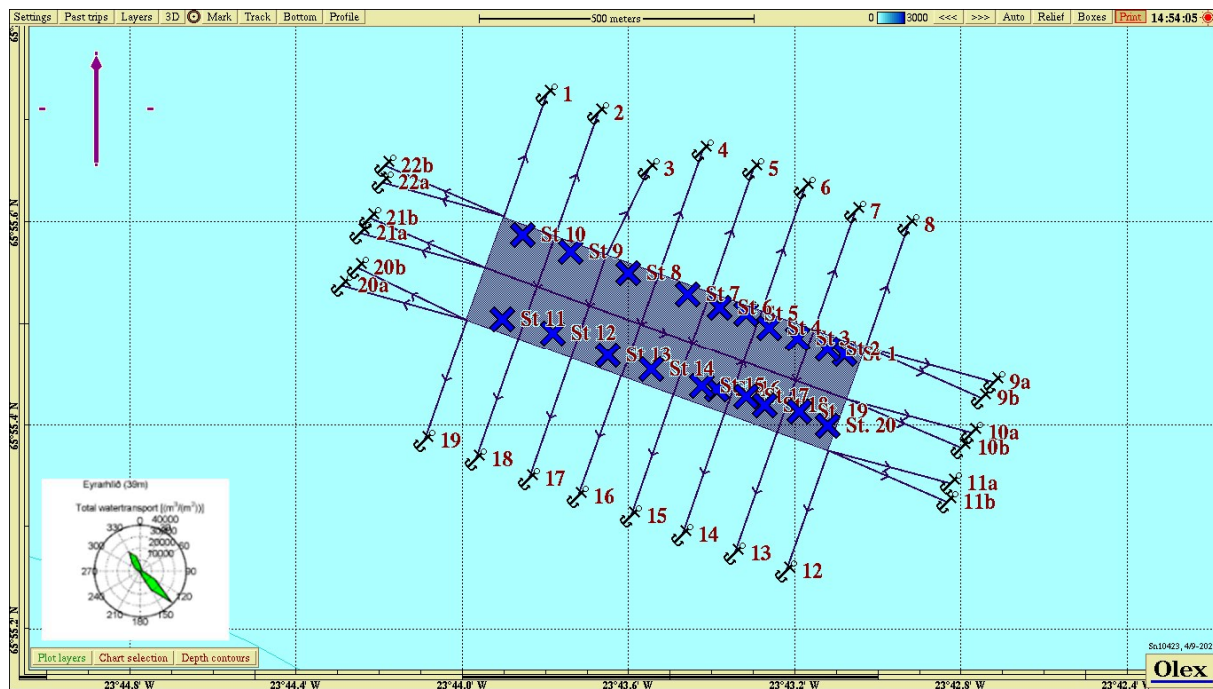


Figure 2. Site specific map of Eyrarhlíð 2 showing frame, mooring lines and farming area. Sampling stations st. 1 – 20 are marked with crosses. The color of each cross represents the environmental condition at the respective station following the classification as outlined in NS 9410:2016, chapter 7.11. Color codes: Blue = very good, green = good, yellow = bad, red = very bad. Current rose placed in the lower left corner shows main current direction at 39 m (Gustavsson, 2019).



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

Station number	North	West	Depth (m)
St 1	65°55,469	23°43,081	43
St 2	65°55,474	23°43,122	43
St 3	65°55,485	23°43,194	43
St 4	65°55,495	23°43,261	43
St 5	65°55,509	23°43,317	43
St 6	65°55,515	23°43,381	43
St 7	65°55,528	23°43,549	43
St 8	65°55,570	23°43,601	42
St 9	65°55,570	23°43,739	42
St 10	65°55,587	23°43,855	41
St 11	65°55,504	23°43,904	38
St 12	65°55,490	23°43,782	39
St 13	65°55,468	23°43,650	40
St 14	65°55,454	23°43,540	40
St 15	65°55,438	23°43,424	41
St 16	65°55,434	23°43,387	41
St 17	65°55,417	23°43,355	41
St 18	65°55,418	23°43,271	42
St 19	65°55,413	23°43,189	42
St 20	65°55,399	23°43,120	42

## 4 Results

---

Results for the different parameters are given in Table 5. The completed fieldwork sampling sheet with calculations for each parameter is attached in appendix.

*Table 5. Results from the parameter classifications in the near 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	<b>1</b>

Substrate was collected at 19 out of the total 20 sampling stations. At one station no substrate was collected (nr. 11 in the shallowest part of the local impact zone) despite three attempts and that station is defined as hardbottom, total 95% soft bottom at the fish farm. Overall, in the shallower parts of the local impact zone the bottom sediment consisted more of silt and sand but mud and silt in the deeper areas. Fauna was recorded at all the soft bottom stations with polychaetes being most prominent but overall, rather few individuals in each grab sample. The substrate was of light grey/olive green colour, no smell or H<sub>2</sub>S gas in all the 19 soft bottom stations.

Based on the classification of sediment chemistry (pH/Eh) and the sensory assessments at the nineteen soft bottom stations received status 1 – "very good" (Figure 2).

Taken together the site receives the overall environmental status 1 – "good" (average group II-III index =0.06).

## 5 Conclusion

---

Applying the indicator thresholds and classification outlined in NS 9410:2016 it is shown that the local impact zone at Eyrarhlíð 2 receives site status 1 – "very good" at the time of this B survey. Samples were collected with a Van Veen grab (0,025 m<sup>2</sup> at stations 1 – 10 and 0,1 m<sup>2</sup> at stations 11 - 20) at 20 stations distributed around the 14 cages which are placed in the mooring frame. One station was defined as hard bottom and neither parameter II (pH/redox) or parameter III (sensory) could be measured/assessed due to lack of sediment so defined as hard bottom. Out of the total 19 station were both parameters II and III could be assigned all sampling stations received status 1 – "very good" (Figure 2).

The here presented survey was undertaken during the time of fallowing period that started in August 2022 (over 12 months period). The results indicate overall very little organic load in the whole local impact zone.

Compared to previous B survey at max biomass in March 2021 (Gunnarsson, 2021) the results from the present survey are very similar indicating overall very little organic load in the local impact zone at the site Eyrarhlíð 2. The index score for both parameters II and III is same between the two surveys, i.e. 0,00 for parameter II pH/Eh and 0,12 for parameter III sensory.

**Following the criteria outlined in NS 9410:2016 the site receives the status 1 - "very good".**

## 6 References

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

Gunnarsson, S. 2021. Eyrarhlíð II. Arctic Sea Farm B-bottom survey, April 2021 (pre-survey). APN nr. 63091.B01.

Gunnarsson, S. 2022. Eyrarhlíð 2. Arctic Sea Farm ehf. B-bottom survey, March 2022 (maximum biomass survey). APN nr. 63863.B01.

Gustavsson, A. 2019. Arctic Sea Farm hf, measurement of spread current at Eyrarhlíð, fall 2019. APN 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.

Personal reference. Frederik Hansen Mosti, Biological controlle Arctic Sea Farm ehf.

[www.fiskeridir.no](http://www.fiskeridir.no)

# 7 Appendix

## 7.1 Survey data sheet (B.1 & B.2), NS 9410:2016.

Sample scheme B.1																
Company		Arctic Sea Farm														
Site:		Eyrarhlíð 2 (fallow period)														
Fieldworker:		Snorri Gunnarsson														
Date:		29.08 2023														
Site no.:																
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	7.51	7.52	7.45	7.60	7.52	7.74	7.66	7.54	7.60	7.61				
	Eh (mV)	ORP	48	-49	56	63	72	41	71	62	81	47				
		plus ref. verdi	248	151	256	263	272	241	271	262	281	247				
	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			10.0 C			Sea temp			11.3 C		Sediment temp		10.5 C		
	pH sea		8.16	ORP sea			118.0 mV			Eh sea		318.0 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	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	0			
	1/4 < v < 3/4 (1)	1	1	1	1	1	1	1								
	v > 3/4 (2)															
Thickness of sidge (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			1.0	1.0	1.0	1.0	1.0	1.0	0.0	0.0	0.0	0.0				
Corrected (**0,22)			0.2	0.2	0.2	0.2	0.2	0.2	0.0	0.0	0.0	0.0				
Status station			1	1	1	1	1	1	1	1	1	1				
Average group II & III			0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0				
Status station			1	1	1	1	1	1	1	1	1	1				
Grab ID	K22 st 1-10/K3 st 11-20															
pH/ Eh ID	Ysi prof. Plus															

## Sample scheme B.1

Company:	Arctic Sea Farm
Site:	Eyrarhlíð 2 (fallow period)
Fieldworker:	Snorri Gunnarsson

Date:	29.08 2023
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)		H	S	S	S	S	S	S	S	S	S	95	5
I	Animals > 1mm	Yes (0) No (1)	1	0	0	0	0	0	0	0	0	0		
II	pH	value	Ut	7.51	7.81	7.90	7.51	7.51	7.55	7.72	7.4	7.6		
	Eh (mV)	ORP	Ut	36	44	81	-18	45	33	48	60	53		
		plus ref. verdi		236	244	281	182	245	233	248	260	253		
	pH.Eh	from figure	ut	0	0	0	0	0	0	0	0	0	0.00	
	Status station		ut	1	1	1	1	1	1	1	1	1		
	Status group II		1	Buffer temp	10.0 C	Sea temp	11.3 C	Sediment temp	10.5 C					
	pH <sub>sea</sub>	8.16	ORP <sub>sea</sub>	118 mV	Eh <sub>sea</sub>	318 mV	Reference electrode	200 mV						
II	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	0	0		
		1/4 < v < 3/4 (1)		1	1	1	1	1						
		v > 3/4 (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		0.0	1.0	1.0	1.0	1.0	1.0	0.0	0.0	0.0	0.0		
	Corrected (°0.22)		0.0	0.2	0.2	0.2	0.2	0.2	0.0	0.0	0.0	0.0	0.12	
	Status station		1	1	1	1	1	1	1	1	1	1		
	Status group III		1											
	Average group II & III		0.0	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.06	
	Status station		1	1	1	1	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	K22 st 1-10/K3 st 11-20
pH / Eh ID	Ysi prof Plus

## Sample scheme B.2


Company:	Arctic Sea Farm
Site:	Eyrarhlíð 2 (fallow period)
Fieldworker:	Snorri Gunnarsson

Date:	29.08 2023
Site no.:	0

Sample number	1	2	3	4	5	6	7	8	9	10
Depth (m)	43	43	43	43	43	43	43	42	42	41
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									
	Gravel									
	Shellsand									
Reef										
Rocky bottom (cobbles, boulders)										
Echinodermata, count										
Crustaceans, count										
Molluscs, count										
Polychaetes, count	4	5	4	4	3	5	4	>10	>20	7
Other animals, count										
Beggiatoa										
Feed										
Faeces										
Comments	St. 10. Lite sediment men mulig at m�le/vurdere parameter II og III									
Grab	Area [m <sup>2</sup> ]	0.025/0.1		Grab ID	K22 st 1-10/K3 st 11-20					
page 3 of 4 pages										


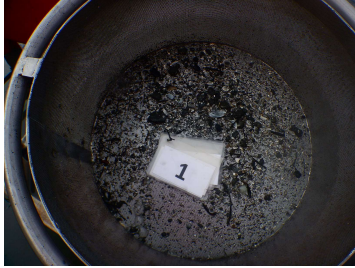



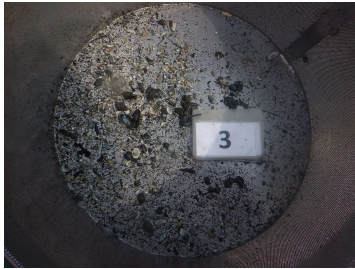

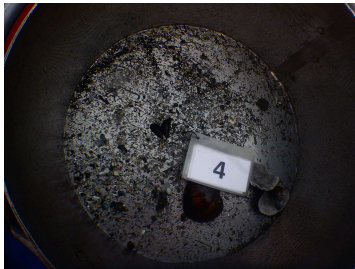


## Sample scheme B.2

Company:	Arctic Sea Farm	Date:	29.08 2023
Site:	Eyrarhlíð 2 (fallow period)	Site no.:	0
Fieldworker:	Snorri Gunnarsson		







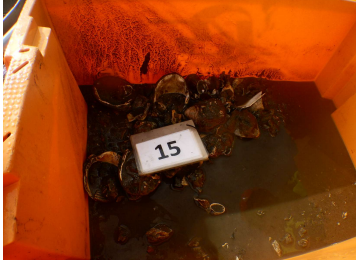

Sample number	11	12	13	14	15	16	17	18	19	20
Depth (m)	38	39	40	40	41	41	41	42	42	42
Number of trials	3	1	1	1	1	2	1	1	1	1
Gas bubbles (in sample)	No	No	No	No	No	No	No	No	No	No
Sediment type	Clay								X	X
	Silt	X	X	X	X	X	X	X	X	X
	Sand		X	X	X	X	X	X		
	Gravel									
	Shellsand									
Reef										
Rocky bottom (cobbles, boulders)										
Echinodermata, count			1	1		1			1	2
Crustaceans, count							1			
Molluscs, count										
Polychaetes, count		4	7	2	4	3	>10	3	2	7
Other animals, count										
Beggiatoa										
Feed										
Faeces										
Comments	St 11. 3 forsök men tom grabb. St. 13. 1 x sjøpølse. St. 14. 1 x sjøpølse (lite sediment). St. 16. 1 x sjøpølse. St. 17. 1 x liten krabbe. St. 19. 1 x sjøpølse. St. 20. 1 x sjøpølse.									
Grab	Area [m <sup>2</sup> ]	0.025/0.1		Grab ID	K22 st 1-10/K3 st 11-20					
Signature fieldworker:										page 4 of 4 pages



## 7.2 Pictures of samples at Eyrahlíð 2.

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

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

<i>St 11</i>	NA (hard bottom)	NA (hard bottom)
<i>St 12</i>		
<i>St 13</i>		
<i>St 14</i>		
<i>St 15</i>		

<p><i>St 16</i></p>		
<p><i>St 17</i></p>		<p>NA (no picture human failure).</p>
<p><i>St 18</i></p>		
<p><i>St 19</i></p>		
<p><i>St 20</i></p>		

### 7.3 Bottom topography and 3D view.

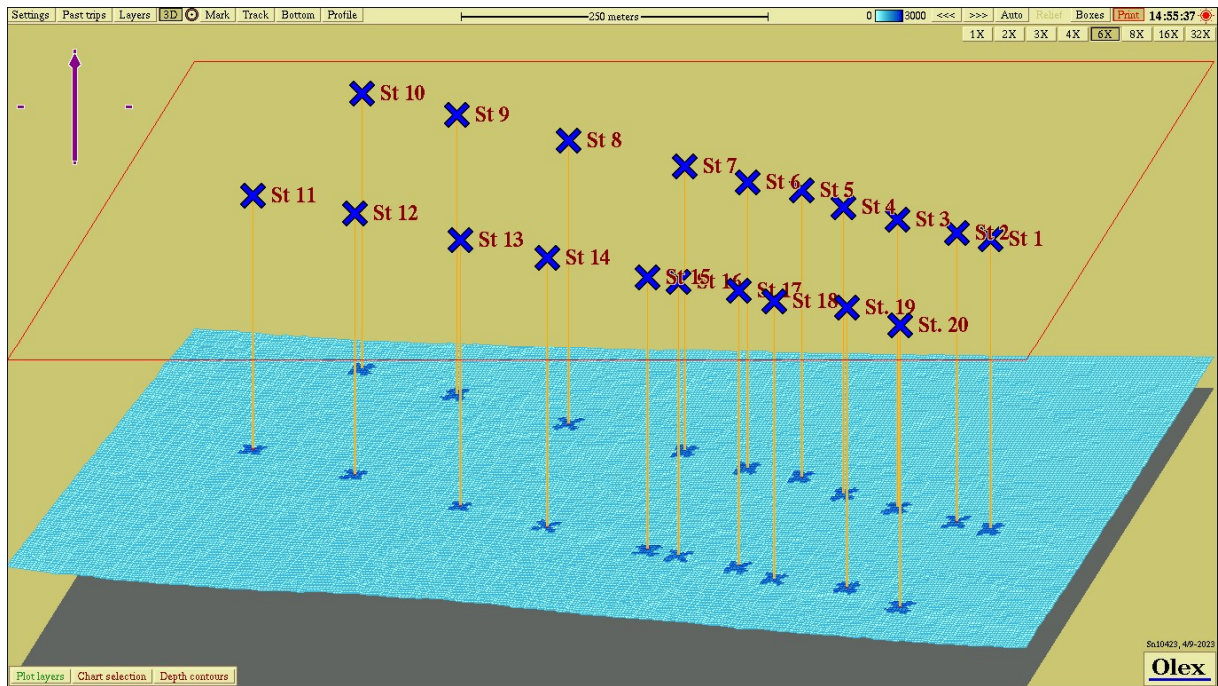


Figure 3. Bottom topography in 3D at Eyrarhlíð 2 with each sampling station according to info in Figure 2 and Table 4.