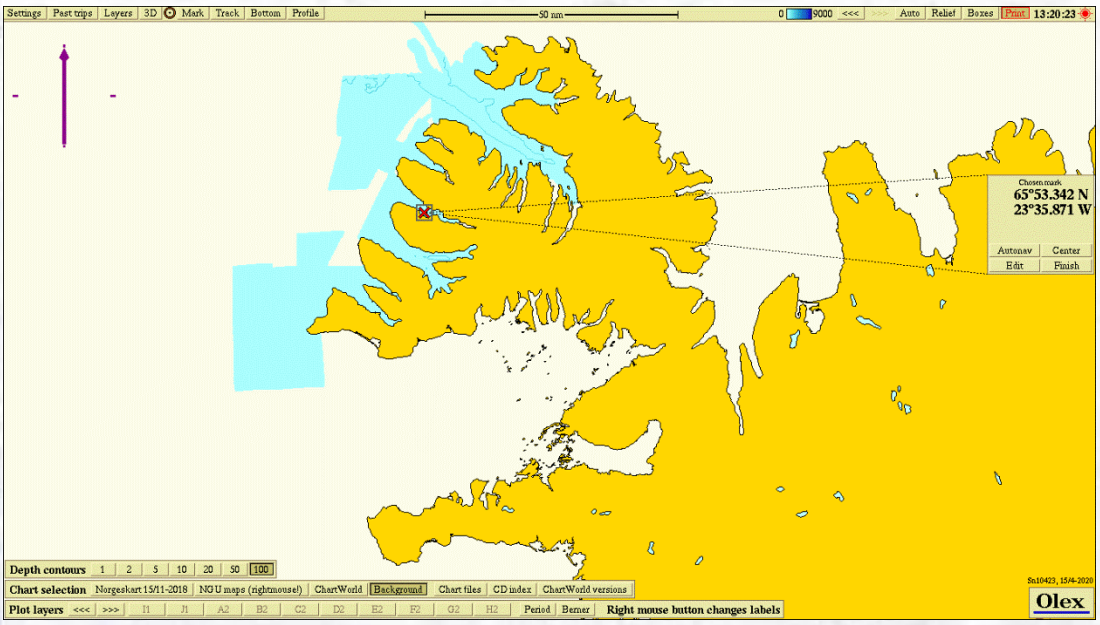
Akvaplan niva

Rapport Report

Haukadalsbót, Arctic Sea Farm
B-bottom survey fallow period,
March 2020



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Akvaplan-niva AS: APN 62024.B01

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Information client			
Title	Haukadalsbót, Arctic Sea Farm. B-bottom survey fallow period, March 2020		
Report number	APN-62024.B01		
Site name	Haukadalsbót	Coordinates site	65°53.342 N 23°35.871 V
County	Ísafjarðabær	Municipality	Þingeyri
Estimated max biomass	4000 ton	Site manager/contact	Steinunn Guðný Einarsdóttir
Client name	Arctic Sea Farm		

Biomass/production/status at date of survey			
Biomass at date of survey	0 ton	Feed use	0 ton
Fish type	Salmon	Amount produced	0 ton

Type/time of survey	Mark with X	Comments
At maximal biomass see kap 7.9	☐	Two previous generations farmed at the site. Fallow period since last generation since November 2016.
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	0,25	Gr. III. Sensory	1
GR. II + III	0,13	GR. II+ III	1
Date field work	25.03 2020	**Date report**	15.04.20
Site status (NS 9410:2016):			**1**

Report writing and project leader	Snorri Gunnarsson	Signature	
Quality control	Arnþór 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 fullfills the requirements regarding bottom surveys in the standard ISO 12878.

The primary objective of a B-survey is to fulfil the requirements regarding bottom surveys they are defined in NS9410:2016. There is a requirement of at least 14 sampling stations within the mooring lines of the fish farm. The estimated max biomass for next generation farmed salmon at the site Haukadalsbót is 4.000 MTB ton (Eva Dögg Jóhannesdóttir, personal comm. 2020).

The following have participated in the survey:

Snorri Gunnarsson	Akvaplan-niva AS	Project manager, field work (Olex mapping) and report.
Snorri Gunnarsson	Akvaplan-niva AS	Quality assurance

The date for sampling at the Haukadalsbót site 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 their personnel for the cooperation during the conductance of this site survey.

Kópavogi 15. april 2020

Snorri Gunnarsson
Project manager

1 Introduction

The sampling date for the present site survey was the 25.03 2020 and done by Akvaplan-niva AS contracted by Arctic Sea Farm in relation to the companies fish farming activity at the site Haukadalsbót in 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 with regard to organic load and suitability assessment of the site for fish farming activity.

Figure 1 shows map of the fjord system Vestfirðir where the site Haukadalsbót is placed.

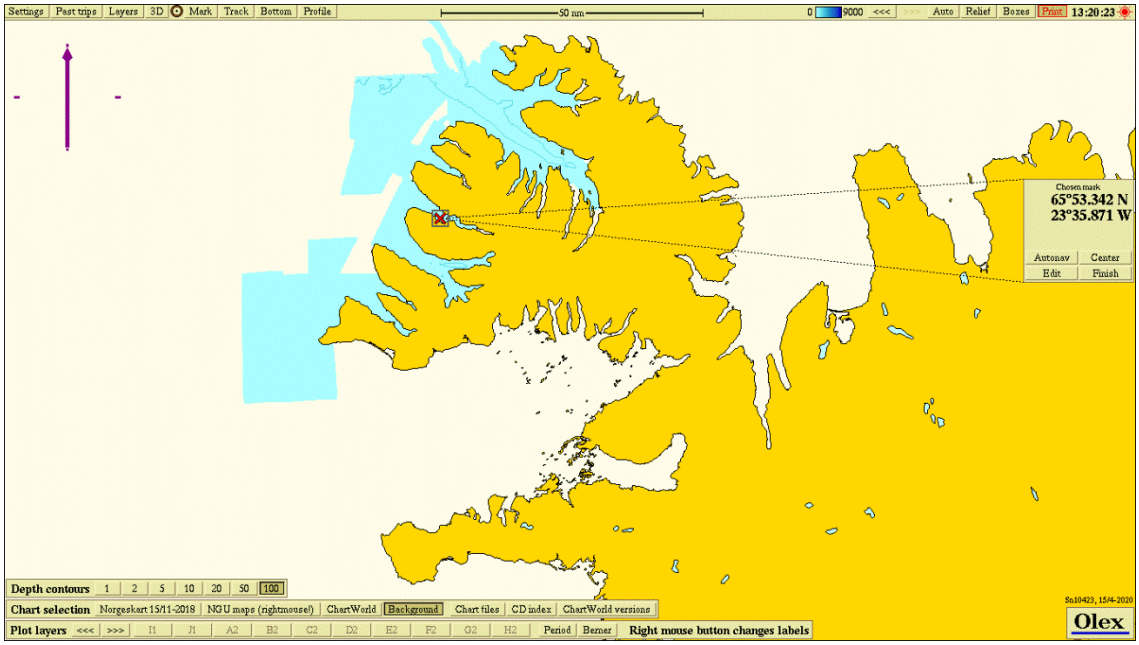

Figure 1. An overview map with the Haukadalsbót site market with a red cross.

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 is in Iceland based on description in the ISO 12878 standard and we also follow the methodology described in the NS 9410:2016. The Icelandic 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 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 according to NS 9410:2016
1-very good	At next max biomass
2-good	Prior to putting nex generation into sea and again at next max biomass.
3-bad	Prior to putting next generataion 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 halv max biomass and at max biomass - Condition 3 – next site survey at next halv 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:
Grab: Van Veen grab (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

The Haukadalsbót site is has been in fallow state for over two years. Previously there have been farmed two generations of fish at the site. The planned fish farm at the site will be a two frame mooring system, each frame having 6 cages total 12 cages each with 160 m circumference. The planned timing for putting smolts into sea is May/June 2020. The first generation at Haukadalsbót was salmon farmed from August 2012 to late fall 2014. The second generation was farmed rainbow trout from spring 2015 until late 2016 early year 2017.

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

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

Generation of fish (G)	Production (ton)	Feed usage (ton)
Generation 2012-2014 A. salmon	1.000 ton (approx.)	1.000 ton (approx.)
Generation 2015-2017 rainbow trout	1.900 ton (approx.)	-

3.2 Present and past site surveys

There have not been done any previous B-surveys at the site Haukadalsbót. There have been three C-surveys at the site. In 2009 there was done a background study at the site prior to any farming activity and describing the bottom type as soft muddy bottom with no smell. Second C-survey was done at the end of farming the first generation salmon at the site. Bottom at stations closest to the farm were described at black, muddy with small smell. The third C-survey was done in November 2016 at the end of the farming of second generation (trout) at the site. The two stations closest to the cages were described having soft bottom, black in color and some smell. Redox values were positive for all stations.

3.3 Dispersing current

Measurement of dispersing current has been done at the site at 28 m deep in October and November 2019 (Gustavsson, 2019). Dominating current (28 m) is in direction South East (160-170 degrees). Average current speed is measured to be 6.0 cm/s. Highest current speed is measured to be 21 cm/s and 3.6 % 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 guidance and perimeters described in NS 9410:2016 and the bottom typography and planned configuration of the farm. The planned fish farming site is to be placed in the fjord were the bottom depth is the range from 25 – 36 m, with the shallowest parts in the South part (closest to land) and more depth in direction into the middle of the fjord. The placement of sampling stations were chosen to give a good picture 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 28 m to 35 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.

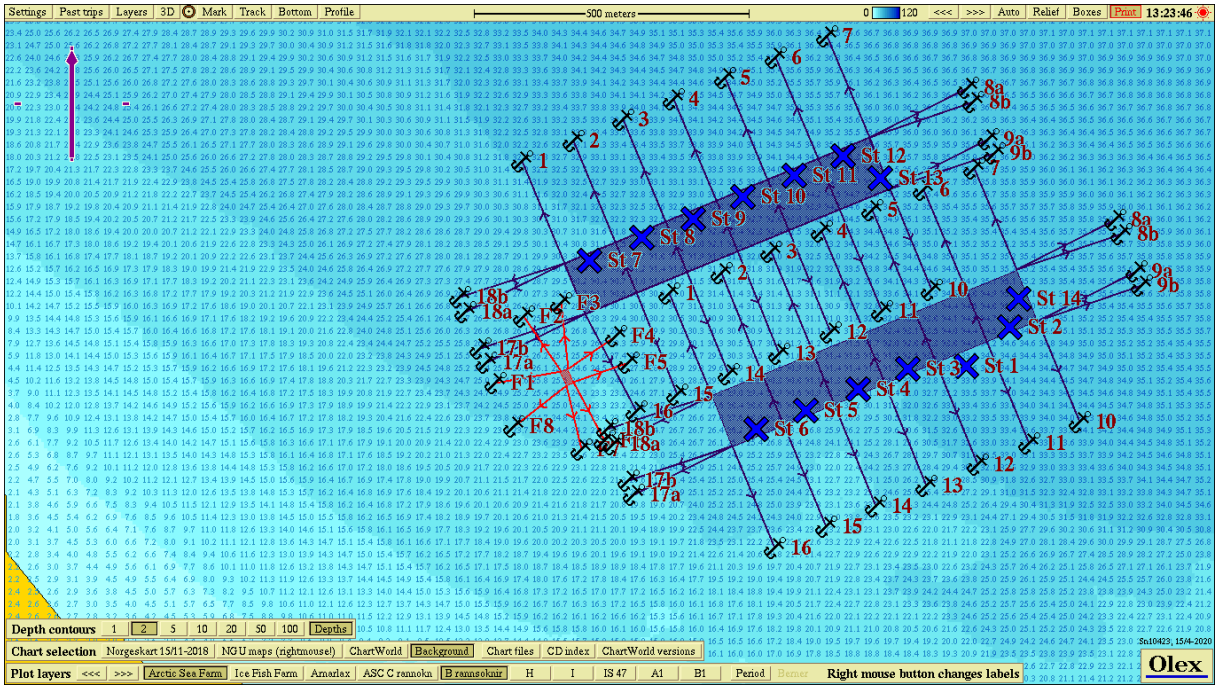

Figure 2. Chart showing depths at the site Haukadalsbót. Sampling stations st. 1 – 14 are marked with color codes that describe the condition according to NS 9410:2016, chapter 7.11. Color codes: Blue =very good condition, green = good condition, yellow = bad condition, red = very bad condition. (Current rose from Gustavsson, 2019)

Table 3. Placement and depth of the sampling stations in the B-survey.

Station number	North	Vest	Depth (m)
St 1	65°53,279	23°35,446	34
St 2	65°53,317	23°35,343	35
St 3	65°53,276	23°35,588	32
St 4	65°53,256	23°35,707	32
St 5	65°53,235	23°35,833	31
St 6	65°53,217	23°35,952	28
St 7	65°53,382	23°36,353	31
St 8	65°53,404	23°36,227	32
St 9	65°53,423	23°36,103	33
St 10	65°53,444	23°35,984	33
St 11	65°53,466	23°35,861	34
St 12	65°53,485	23°35,743	35
St 13	65°53,463	23°35,654	35
St 14	65°53,345	23°35,322	35

4 Results

Results for the different parameters are given in Table 4. A complete filled sampling sheet with calculations for each parameter is attached in appendix.

Table 4. 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 ten out of the fourteen stations in the first grab taken and station at one station 2 grabs were needed. In the case of three stations (station 7, 10 and 12) only a small bottom sediment could be collected and pH/Eh parameters could be measured but sensory analysis was not possible. This indicates that in general there is soft bottom in the whole local impact zone these three exceptions for stations 7, 10 and 12 which are all located in the northern part of the local impact zone. The sediment type consisted mainly of clay and silt. For the group II parameters, all ten station had conditions 1 «very good». For sensory parameters (group III) all stations had condition 1 «very good». For combined parameters II and III (animals, pH/redox and sensory) had all stations had condition 1 «very good». Animals where present in all soft bottom samples. Overall the condition for Haukadalsbót is 1 «very good».

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 21 bottom sediment samples were taken with Van Veen grab (0,025 m^2), divided on 14 stations placed around the local impact zone in the area where the planned 12 cages are to be place for farming of next generation at the site. All fourteen stations were assigned condition 1 «very good» for combined parameters II and III (pH/Eh and sensory parameters). The results from the study indicate that in general there is soft bottom in the whole local impact zone.

Measurement of dispersing current has been done at the site at 28 m deep in October and November 2019. Dominating current (28 m) is in direction South East (160-170 degrees). Average current speed is measured to be 6.0 cm/s. Highest current speed is measured to be 21 cm/s and 3.6 % of the measurements are < 1 cm/s.

The results from the current B-survey indicate a general little or no organic load in the area. There are no previous B-studies that these results can be compared to. Haukadalsbót has been standing empty with no fish for over 2 years (about 27 months) so the area has been given good time to recover from any organic load during farming of the previous generation at the site. The planned timing for putting the next smolts into sea at Haukadalsbót is May/June 2020.

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.

Gallo, C 2015. Botndýra athugun við Haukadalsbót í Dýrafirði 2014, unnið fyrir Dýrfisk ehf. NV nr. 23-15.

Gallo, C 2017. Lokaskýrsla Haukadalsbót Dýrafirði 2016, unnið fyrir Arctic Sea FArm. NV nr. 16-17

Gukstavsson, A. 2019. Arctic Sea Farm hf, measurement of spread current at Haudadalsbót 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.

Þorisson, B, Gallo, C and Eirikson, Þ. 2010. Athugun á botndýrum utarlega í Dýrafirði 2009, unnið fyrir Dýrfisk ehf. NV nr. 7-10.

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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 62024**	**Date:**	**25.03 2020**
Site:	**Haukadalsbót, 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	H	S	S	H
I	Animals > 1mm	Yes (0) No (1)	0	0	0	0	0	0		0	0	
II	pH	value	7,9	7,6	7,6	7,7	7,7	7,6	7,7	7,6	7,6	7,7
	Eh (mV)	ORP	109	94	99	107	109	116	85	89	96	58
		plus ref. verdi	309	294	299	307	309	316	285	289	296	258
	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	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
		1/4 < v < 3/4 (1)		1	1	1	1	1		1		
		v > 3/4 (2)	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	2,0	1,0	1,0	1,0	1,0	1,0	0,0	1,0	2,0	0,0
		Corrected (*0,22)	0,4	0,2	0,2	0,2	0,2	0,2	0,0	0,2	0,4	0,0
	Status station		1	1	1	1	1	1	1	1	1	1
	Average group II & III		0,2	0,1	0,1	0,1	0,1	0,1	0,0	0,1	0,2	0,0
	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 62024**	**Date:**	**25.03 2020**
Site:	**Haukadalsbót, 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	H	S	S							79	21
I	Animals > 1mm	Yes (0) No (1)	0		0	0								
II	pH	value	7,6	7,7	7,6	7,6								
	Eh (mV)	ORP	77	51	61	51								
		plus ref. verdi	277	251	261	251								
	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	0	0	0								
		Brown/black (2)												
	Smell	None (0)	0	0	0	0								
		Light (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)												
		v > 3/4 (2)	2		2	2								
	Thickness of slidge (t)	t < 2 cm (0)	0	0	0	0								
		2 < t < 8 cm (1)												
		t > 8 cm (2)												
		Sum	2,0	0,0	2,0	2,0								
		Corrected (*0,22)	0,4	0,0	0,4	0,4							0,25	
		Status station	1	1	1	1								
		Status group III	1											
		Average group II & III	0,2	0,0	0,2	0,2							0,13	
		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 62024**	**Date:**	**25.03 2020**
Site:	**Haukadalsbót, Dýrafjörður**	**Site no.:**	**0**
Fieldworker:	**Snorri Gunnarsson (SGU)**		

Sample number		1	2	3	4	5	6	7	8	9	10
Depth (m)		34	35	32	32	31	28	31	32	33	33
Number of trials		1	2	1	1	1	1	3	1	1	3
Gas bubbles (in sample)											
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						1					
Crustaceans, count											
Molluscs, count			2	2	5	3	4		>10	>10	
Polychaetes, count		>50	>5	>5	3	4	3		2	2	
Other animals, count											
Beggiatoa											
Feed											
Faeces											
Comments		Stations 7 and 10 small samples sediment, possible to measure parameter II but not I and III.									
Grab		**Area [m^2]**				**Grab ID**			K-22		

Sample scheme B.2

Company:	**Arctic Sea Farm PS 62024**	**Date:**	**25.03 2020**
Site:	**Haukadalsbót, Dýrafjörður**	**Site no.:**	**0**
Fieldworker:	**Snorri Gunnarsson (SGU)**		

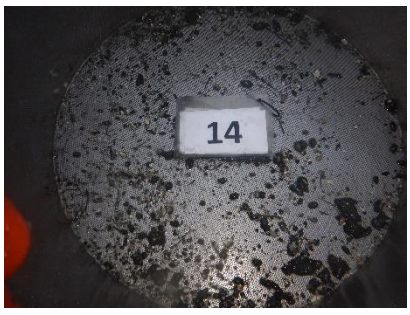
Sample number		11	12	13	14	15	16	17	18	19	20
Depth (m)		34	35	35	35						
Number of trials		1	3	1	1						
Gas bubbles (in sample)		No		No	No						
Sediment type	**Clay**	X		X	X						
	Silt	X		X	X						
	Sand										
	Gravel										
	Shellsand										
Reef											
Rocky bottom (cobbles, boulders)											
Echinodermata, count											
Crustaceans, count											
Molluscs, count											
Polychaetes, count		>10		>10	>10						
Other animals, count				3	2						
Beggiatoa											
Feed											
Faeces											
Comments		Stations 12 small sample sediment, possible to measure parameter II but not I and III.									

Grab	**Area [m^2]**	0	**Grab ID**	K-22
Signature fieldworker:				

7.2 Pictures of samples at Haukadalsbót

St 1		
St 2		
St 3		
St 4		
St 5		

St 6		
St 7	n.a.	n.a.
St 8		
St 9		
St 10	n.a.	n.a.

St 11		
St 12	n.a.	n.a.
St 13		
St 14		

7.3 Bottom topography and 3D view

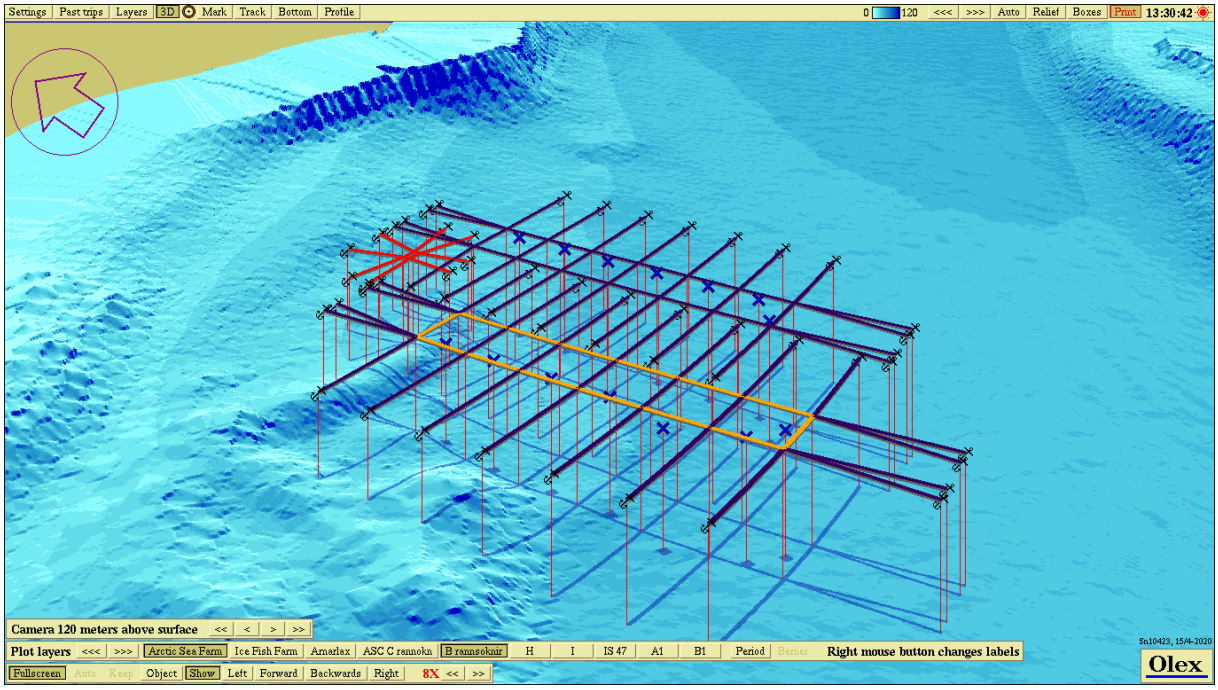


Figure 3. Showing bottom topography 3D at Haukadalsbót with each station marked by cross and color code according to info in figure 2.