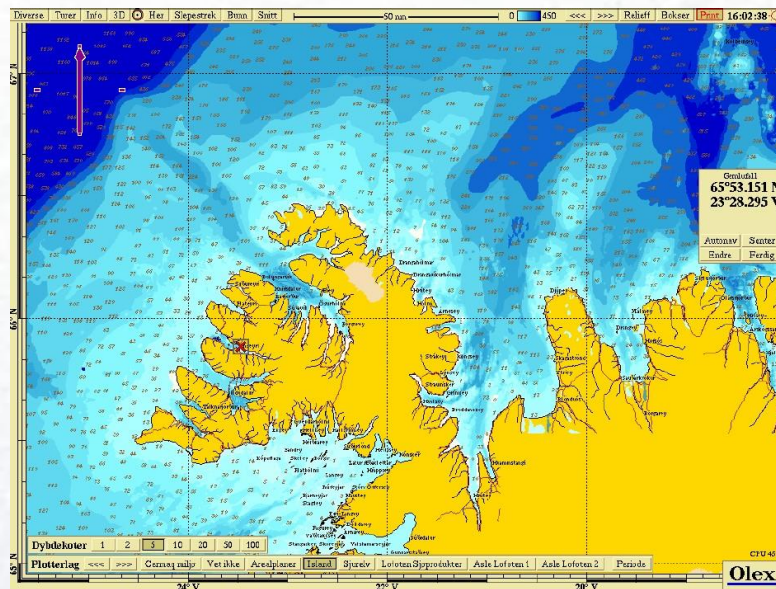




Gemlufall, Arctic Sea Farm hf.  
B-bottom survey,  
May 2020  
(Post fallow period)



Information client			
Title	Gemlufall, Arctic Sea Farm hf. B-bottom, May 2020		
Report number	APN-62175.B01		
Site name	Gemlufall	Coordinates site	65°53.151 N 023°28.295 V
County	Ísafjarðarsýsla	Municipality	Ísafjarðarbær
MTB-or estimated max biomass	3500 tonn	Site manager/contact	Steinunn G. Einarsdóttir
Client name	Arctic Sea Farm hf.		

Biomass/production/status at date of survey			
Biomass at date of survey	0 ton	Feed use	N/A
Fish type	Salmon	Amount produced	N/A
<b>Type/time of survey</b>	<b>Mark with X</b>	Comments Planned to put out smolts late July 2020	
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 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	0,39	Gr. III. Sensory	1
GR. II + III	0,20	GR. II+ III	1
Date field work	20.05 2020	Date report	27.08.20
<b>Site status (NS 9410:2016):</b>			<b>1</b>

Report writing and project leader	Arnbór Gústavsson	Signature	
Quality control	Snorri Gunnarsson	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 trend-monitoring as they are defined in NS9410:2016. Current survey is carried out to estimate status of the farm site post fallow period. 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 Gemlufall is 3.500 MTB ton. The methods applied in this pre-survey follow guidelines in chapter 5 (NS6410:2016) 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:


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

The sampling at Gemlufall was done 20.05 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.
---	--

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

Kópavogi 27. august 2020

*Arnþór Gústavsson*  
Arnþór Gústavsson  
Project manager

# 1 Introduction

---

The sampling date for the present site survey was 20.05 2020 and done by Akvaplan-niva AS contracted by Arctic Sea Farm hf. in relation to the company's fish farming activity at the site Gemlufall in Dýrafjörður, 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 central part of Vestfirðir where the site Gemlufall is located.

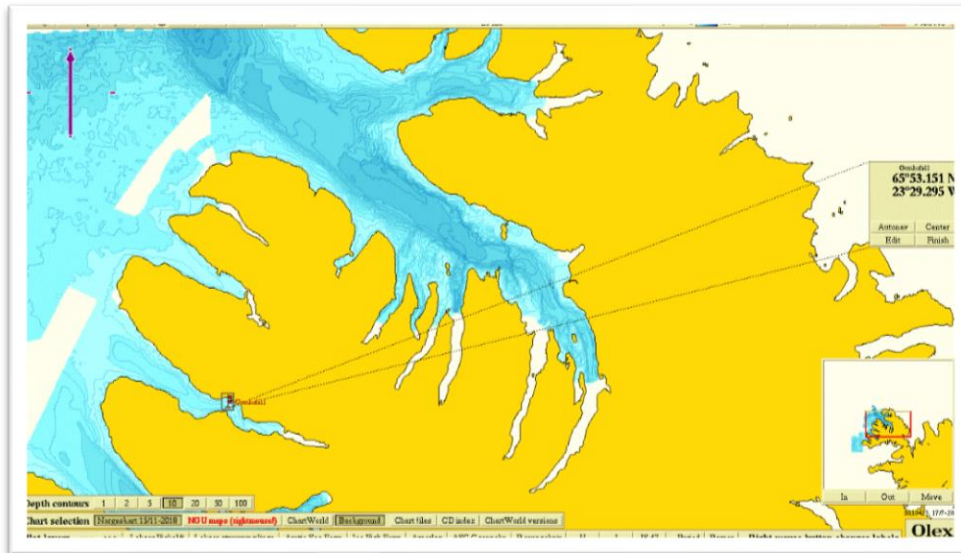


Figure 1. An overview map with the Gemlufall site marked by its name.

## 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<sup>2</sup>). 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	<p>Prior to putting next generation into sea. Based on the site condition prior to putting next generation into sea:</p> <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> <p>If any of the samples result in character 4 it is a sign of overload.</p>
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<sup>2</sup>)

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

Gemlufall site is coming to an end of a fallow-period starting at 23.10.2019 after 1 production cycle with current setup and position of farm. Previous production cycle was started in June 2017. The fish farm at the site has a single frame 2x5 mooring system, a total of 10 cages, each with 160 m circumference.

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

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

Generation of fish (G)	Production (ton)	Feed usage (ton)
Present generation	N/a	N/a
Previous generation	2.914	3.954

### 3.2 Present and past site surveys

*Table 3. Past site studies for Gemlufall site*

Date of sampling	Report number	Survey type	Overall site status
1.02.2018	NV nr. 1-18	Fallow	"good"
1.04.2019	NV nr. 9-19	Maximum biomass	"good"

### 3.3 Dispersing current

Current at 5 and 15 meter depth at Gemlufall is towards north-by-northwest (345-360°) (Eriksen, 2016). Dispersing current, measured at 29 m for Gemlufall site, was used as a basis for sampling stations. Dominating current (29 m) is in direction south-east (120 degrees) with little counter current. Average current speed is measured to be 5.9 cm/s. Highest current speed is measured to be 25.6 cm/s and 4.0 % of the measurements are < 1 cm/s (Gustavsson, 2019).

### 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. Gemlufall site is close to the center of Dýrafjörður fjord and the site is well sheltered. Depth at the site is mostly around 30 meters with very little slope and slightly less depth further north. The placement of sampling stations was 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 (St 1) to 31 m (St 7 & 8). 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.

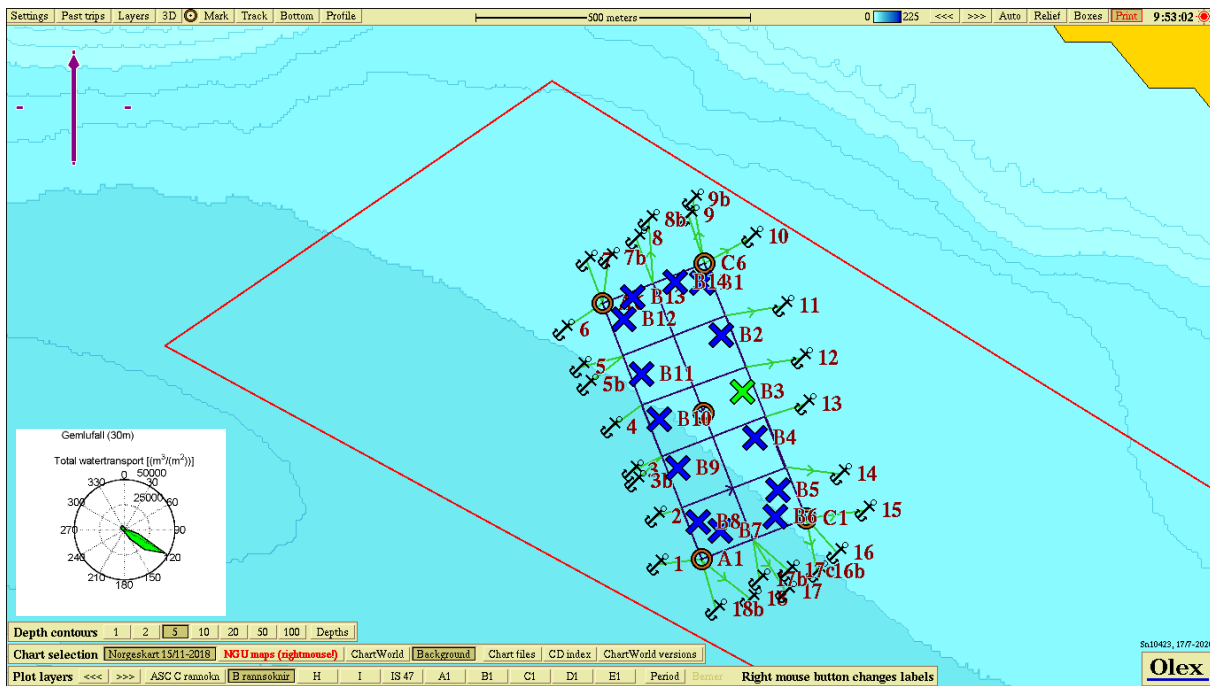


Figure 2. Chart showing depths at the site Gemlufall. Sampling stations st. 1 – 14 are marked with color codes that describe the condition according to NS 9410:2016, chapter 7.11. Color codes: Blue = very good condition, green = good condition, yellow = bad condition, red = very bad condition.

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

Station number	North	Vest	Depth (m)
St 1	65°53.482	023°29.180	28
St 2	65°53.430	023°29.132	29
St 3	65°53.375	023°29.082	29
St 4	65°53.330	023°29.051	29
St 5	65°53.278	023°28.996	30
St 6	65°53.251	023°29.002	30
St 7	65°53.238	023°29.135	31
St 8	65°53.247	023°29.188	31
St 9	65°53.300	023°29.236	30
St 10	65°53.348	023°29.282	30
St 11	65°53.392	023°29.323	30
St 12	65°53.446	023°29.366	29
St 13	65°53.468	023°29.346	29
St 14	65°53.483	023°29.244	29



## 4 Results

---

Results for the different parameters are given in Table 5. 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 stations in the first grab taken. This indicates that in general there is soft bottom in the whole local impact zone. The sediment type consisted mainly of clay, silt and occasionally a little sand. For the group II parameters, all fourteen station had conditions 1 «very good». For sensory parameters (group III) 13 out of fourteen stations had condition 1 «very good» and one station had condition 2 «good». For combined parameters II and III (animals, pH/redox and sensory) all fourteen stations had condition 1 «very good». Animals were present in all samples.

## 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 14 samples were taken with Van Veen grab (0,025 m<sup>2</sup>), divided on 14 stations placed around the ten cages that are operated at Gemlufall site. For sensory parameters (group III) 13 out of fourteen stations had condition 1 «very good» and one station (St 3) had condition 2 «good». Station 3 is located on the eastern part of the farm site where organic load would be expected to be highest, based on disperse current.

Results are partly in line with what can be expected in terms of dispersing current. Sampling station with lower assigned condition factor is concurrent with current measurements. Dominant dispersing current (at 29 meters) was measured 120° (Southeast) with average current speed of 5.9 cm/sec. Sampling station assigned condition factor 2 is located central to east part of the site. It could be expected, based on disperse current, that highest organic load would be on the southeast corner of the site. Dominating current at 15 m is in direction south-east (135°) while current at 5 meters is in direction north (355°). Different current directions at different depths could explain why organic load is evaluated higher on the far east side rather than. It is likely that organic matter travels north before travelling southeast in the water column on the way to the seafloor.

**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

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

Erikssen, S.E. 2016. Arctic Fish hf, lokalitetsrapport Gemlufall. Akvaplan-niva AS rapport nr. 8704.01.

Gallo, C. 2018. Hvítarskýrsla, Gemlufall 2017. Náttúrustofa Vestfjarða. Skýrsla nr: NV nr. 1-18.

Gallo, C. 2019. Environmental impact assessment at peak biomass for Gemlufall salmon farming site 2018. Náttúrustofa Vestfjarða. Skýrsla nr: NV nr. 9-19.

Gústavsson, A. 2019. Arctic Sea Farm hf., málning av spredningsstrøm ASC lokaliteter. Akvaplan-niva AS prosjekt no. 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](http://www.fiskeridir.no)

# 7 Appendix:

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

Sample scheme B.1																		
Company		Arctic Sea Farm hf.					Date:		20.5.2020									
Site:		Gemefall					Site no.:											
Fieldworker:		Araþór Gústavsson																
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	1	0	0	0	0	0	0	0	0						
II	pH	value	7,6	7,7	7,6	7,7	7,6	7,5	7,7	7,7	7,7	7,7						
	Eh (mV)	ORP	-22	-26	-55	51	30	-67	-5	-28	38	13						
		plus ref. verdi	178	174	145	251	230	133	195	172	238	213						
	pH/Eh	from figure	0	0	0	0	0	0	0	0	0	0						
	States station			1	1	1	1	1	1	1	1	1	1					
	Buffer temp			7,3 C				Sea temp			5,3 C		Sediment temp		5,5 C			
	pH ref		8,23	ORP ref				172,0 mV			Eh ref		372,0 mV		Reference electrode		200,0 mV	
	III	bubbles	Yes (4) No (0)	0	0	0	0	0	0	0	0	0	0					
		Colour	Light/grey (0)	0	0	2	0	0	0	0	0	0	0					
			Brown/black (2)															
Smell		None (0)		0		0			0	0	0	0						
		Light (2)	2		2		2	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)																
	1/4 < v < 3/4 (1)	1	1	1	1	1	1	1	1		1							
	v > 3/4 (2)									2								
Thickness of sludge (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			3,0	1,0	5,0	1,0	3,0	3,0	1,0	1,0	2,0	1,0						
Corrected (**0,22)			0,7	0,2	1,1	0,2	0,7	0,7	0,2	0,2	0,4	0,2						
States station			1	1	2	1	1	1	1	1	1	1						
Average group II & III			0,3	0,1	0,6	0,1	0,3	0,3	0,1	0,1	0,2	0,1						
States station			1	1	1	1	1	1	1	1	1	1						
Grab ID	K-22																	
pH / Eh ID	Yci Professional plus																	

### Sample scheme B.1

<b>Company:</b>	Arctic Sea Farm hf.	<b>Date:</b>	20.5.2020
<b>Site:</b>	Gemlufall	<b>Site no.:</b>	0
<b>Fieldworker:</b>	Arapór Gústavsson		

Gr	r	Point	Sample number																	Index	
			11	12	13	14	15	16	17	18	19	20	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	7,7	7,7	7,6	7,6														
		Eh (mV)	ORP	39	-2	42	47														
			plus ref. verdi	239	198	242	247														
		pH/Eh	from figure	0	0	0	0													0,00	
		States station		1	1	1	1														
	States group II		1																		
		pH <i>ave</i>	8,23	ORP <i>ave</i>	172 mV	Eh <i>ave</i>	372 mV	Buffer temp	7,3 C	Sea temp	5,3 C	Sediment temp	5,5 C	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)																			
		1/4 < v < 3/4 (1)	1	1	1	1															
		v > 3/4 (2)																			
	Thickness of sidge (t)	t < 2 cm (0)	0	0	0	0															
2 < t < 8 cm (1)																					
t > 8 cm (2)																					
	Sum		1,0	1,0	1,0	1,0															
	Corrected (*0,22)		0,2	0,2	0,2	0,2													0,39		
	States station		1	1	1	1															
	States group III		1																		
	Average group II & III		0,1	0,1	0,1	0,1													0,20		
	States station		1	1	1	1															
	States group II & III		1																		
	pH/Eh Corr.sum Index Average	States																			
		<1,1	1																		
		1,1 - <2,1	2																		
		2,1 - <3,1	3																		
		≥3,1	4																		
	States site:		1																		

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

## Sample scheme B.2

<b>Company:</b>	<b>Arctic Sea Farm hf.</b>
<b>Site:</b>	<b>Gemlufall</b>
<b>Fieldworker:</b>	<b>Arnpór Gústavsson</b>



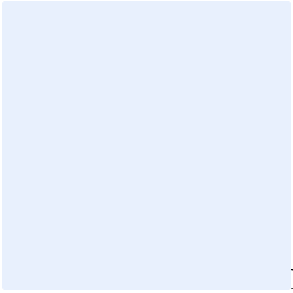







<b>Date:</b>	<b>20.5.2020</b>
<b>Site no.:</b>	<b>0</b>

Sample number	1	2	3	4	5	6	7	8	9	10
<b>Depth (m)</b>	30	30	30	30	30	30	30	30	30	30
<b>Number of trials</b>	1	1	1	1	1	1	1	1	1	1
<b>Gas bubbles (in sample)</b>										
<b>Sediment type</b>	<b>Clay</b>	X	X	X	X	X	X	X	X	X
	<b>Silt</b>	X	X	X	X	X	X	X	X	X
	<b>Sand</b>									
	<b>Gravel</b>									
	<b>Shellsand</b>									
<b>Reef</b>										
<b>Rocky bottom (cobble, boulders)</b>										
<b>Echinodermata, count</b>						2				
<b>Crustaceans, count</b>	1									
<b>Molluscs, count</b>				2				5+	20+	10+
<b>Polychaetes, count</b>	1		4	10+	6	4	10+	5+	3	2
<b>Other animals, count</b>										
<b>Beggiatoa</b>										
<b>Feed</b>										
<b>Faeces</b>										
<b>Comments</b>										
<b>Grab</b>	<b>Area [m<sup>2</sup>]</b>					<b>Grab ID</b>				K-22











## Sample scheme B.2









<b>Company:</b>	Arctic Sea Farm hf.				<b>Date:</b>		20.5.2020				
<b>Site:</b>	Gemlufall				<b>Site no.:</b>		0				
<b>Fieldworker:</b>	Arnpór Gústavsson										
<b>Sample number</b>	11	12	13	14	15	16	17	18	19	20	
<b>Depth (m)</b>	30	30	30	30							
<b>Number of trials</b>	1	1	1	1							
<b>Gas bubbles (in sample)</b>											
<b>Sediment type</b>	<b>Clay</b>	X	X	X	X						
	<b>Silt</b>	X	X	X	X						
	<b>Sand</b>										
	<b>Gravel</b>										
	<b>Shellsand</b>										
<b>Reef</b>											
<b>Rocky bottom (cobbles, boulders)</b>											
<b>Echinodermata, count</b>				3							
<b>Crustaceans, count</b>											
<b>Molluscs, count</b>				5							
<b>Polychaetes, count</b>	5+	10+	2	1							
<b>Other animals, count</b>											
<i>Beggiatca</i>											
<b>Feed</b>											
<b>Faeces</b>											
<b>Comments</b>											
<b>Grab</b>	<b>Area [m<sup>2</sup>]</b>	0		<b>Grab ID</b>	K-22						
<b>Signature fieldworker:</b>	Arnpór Gústavsson										

## 7.2 Pictures of samples at Gemlufall

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



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

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

### 7.3 Bottom topography and 3D view

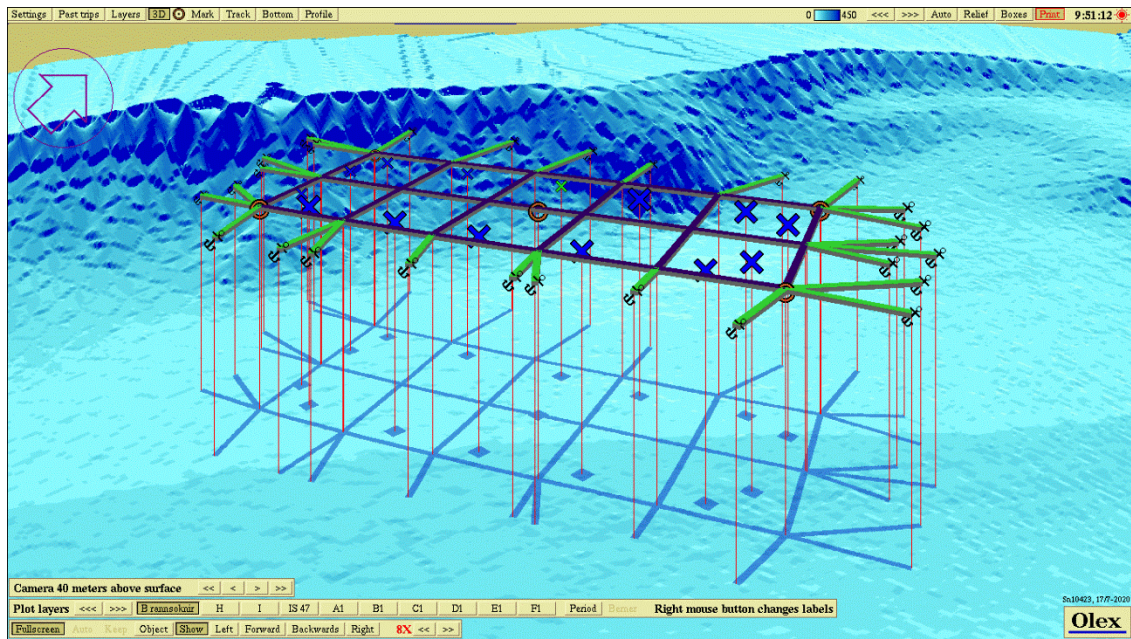


Figure 3. Showing bottom topography 3D at Gemlufall with each sampling station according to info in figure 2 and Table 3.