Hvestudalur, Arctic Sea Farm
B survey,
May 2022
(baseline – new site)

Akvaplan-niva AS: APN 64085.B01
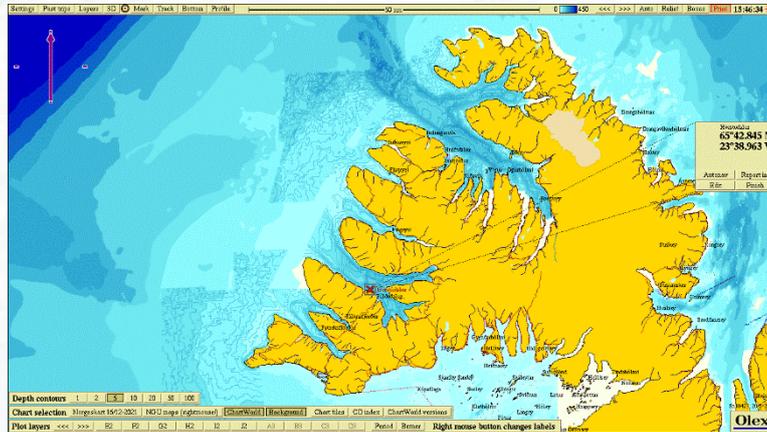
Information client

Title	Hvestudalur, Arctic Sea Farm. B survey (baseline – new site) , May 2022		
Report number	APN-64085.B01		
Site name	Hvestudalur	Coordinates site	65°42,845N 023°38,963V
County	Barðastrandarsýsla	Municipality	Vesturbyggð
MTB-or estimated max biomass	3.900 tonnes	Site manager/contact	Steinunn G Einarsdóttir
Client name	Arctic Sea Farm		

Biomass/production/status at date of survey

Biomass at date of survey		0 t	Feed use	0 t
Fish type		Salmon	Amount produced	-
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		☐		
Baseline survey - new site		☒		
Other		☐		
Last fallowing period:				

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	0,35	Gr. III. Sensory	1
GR. II + III	0,18	GR. II+ III	1
Date field work	11.05 2022	**Date report**	30.05.22
Site status (NS 9410:2016):			**1**

Report writing and project leader	Arnþór Gústavsson	Signature	*Arnþór Gústavsson*
Quality control	Astrid Harendza	Signature	

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Preface

The survey is carried out in accordance to 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 "akvakulturdriftsforskriften". 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 current survey is a baseline survey, i.e. it is undertaken before production starts at a new site. A total of 10 sampling stations were sampled within the near zone of the proposed farm location. The estimated max biomass for the first generation of farmed salmon at Hvestudalur is 3.900 ton.

The following have participated in the survey:

Arnþór Gústavsson	Akvaplan-niva AS	Prosjektleder.
Arnþór Gústavsson	Akvaplan-niva AS	Fieldwork and Report. Charts (Olex).
Astrid Harendza	Akvaplan-niva AS	Quality assurance

The sampling at Hvestudalur was done 11.05.2022.

Accredited survey:

The following parts of the survey are done following accredited 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.
NORSK AKKREDITERING 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.

Kópavogi, 30. May 2022

Arnþór Gústavsson
Project manager

1 Introduction

Sampling at was undertaken on 11.05 2022 by Akvaplan-niva AS, who has been contracted by Arctic Sea Farm following the company's fish farming activity at the site Hvestudalur in Arnarfjörður, Vesturbyggð municipality.

The objective of the B-survey is to document the environmental condition in the near zone 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 here presented survey is a baseline survey, i.e. it was taken prior the start of production at Hvestudalur. As part of the baseline survey a total of 10 sampling stations were sampled within the near zone of the proposed farm location.

Figure 1 shows a map of the southern part of Vestfirðir where Hvestudalur is located in the fjord Arnarfjörður.
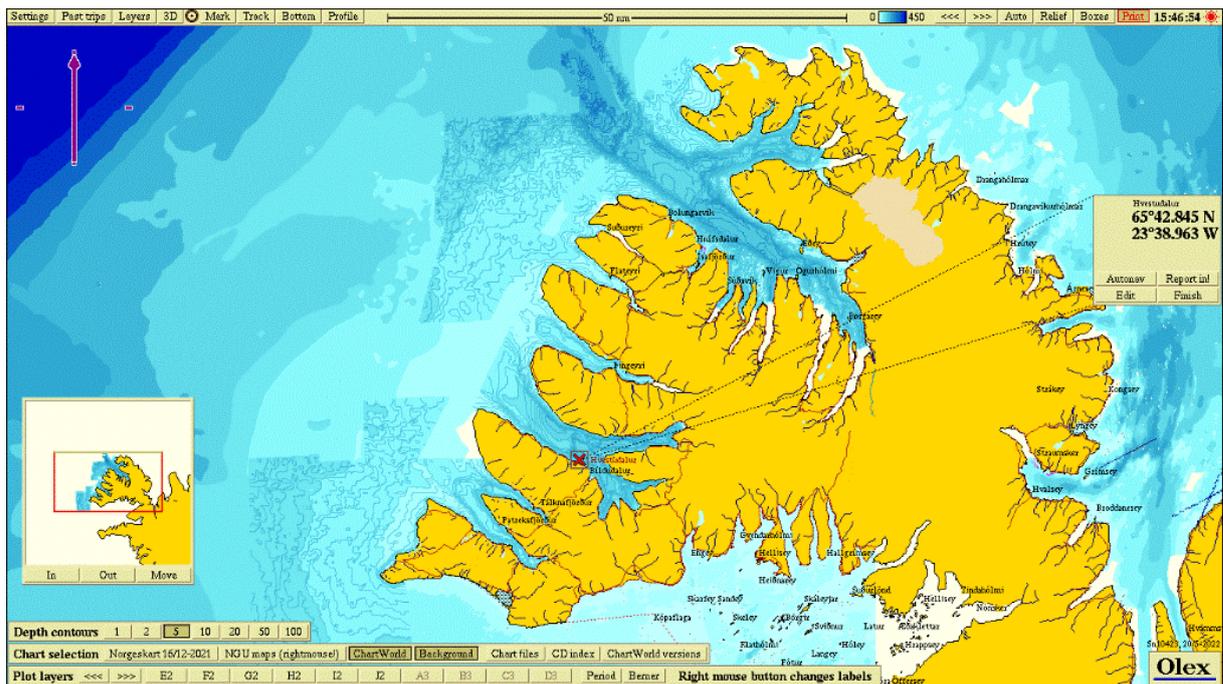

Figure 1. An overview map where Hvestudalur is marked with a red cross.

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. Environmental monitoring in Iceland is following 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^2). 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. Overview of classification of environmental site status and subsequent B survey sample frequency.

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 (0,1 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 Study site, production and survey design

3.1 Study site and production

Hvestudalur is located in the southern part of Arnarfjörður, approximately 2,5 nm northwest of the town of Bíldudalur. The proposed frame outline will host 11 cages (rows of 5 + 6) with a circumference of 160 - 200 m. At the date of sampling, only the frame in the westerly part of the farm was installed. The frame is positioned in north-northwesterly direction from land (350°) with depth below the cages ranging from ca. 45 - 78 m.

There has been no production at Hvestudalur prior to this survey. First smolt is planned to be set out at Hvestudalur in May 2022.

3.2 Hydrodynamics

Current measurements were undertaken in April-May 2022 at 51 m, which is the dispersing depth for Hvestudalur (Gustavsson, 2022). Main current flow at 51 m is in south-easterly direction (150 degrees) (Figure 2). Average current speed is 6,6 cm/s. Highest current speed is 20,6 cm/s and 5.3 % of the measurements are <1 cm/s.

3.3 Survey design

The placement of the 10 sampling stations is shown in Figure 2 with GPS positions listed in Table 2. Stations are distributed within the near zone of the new frame position following criteria outlined in NS 9410:2016. Depth beneath and in the close vicinity of the cages varies between 56– 88 m, with the deepest waters being located in northern part of the frame. 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 40 to 90 m. The placement of sampling stations is regarded to be in accordance with the requirements outlined in NS 9410:2016.
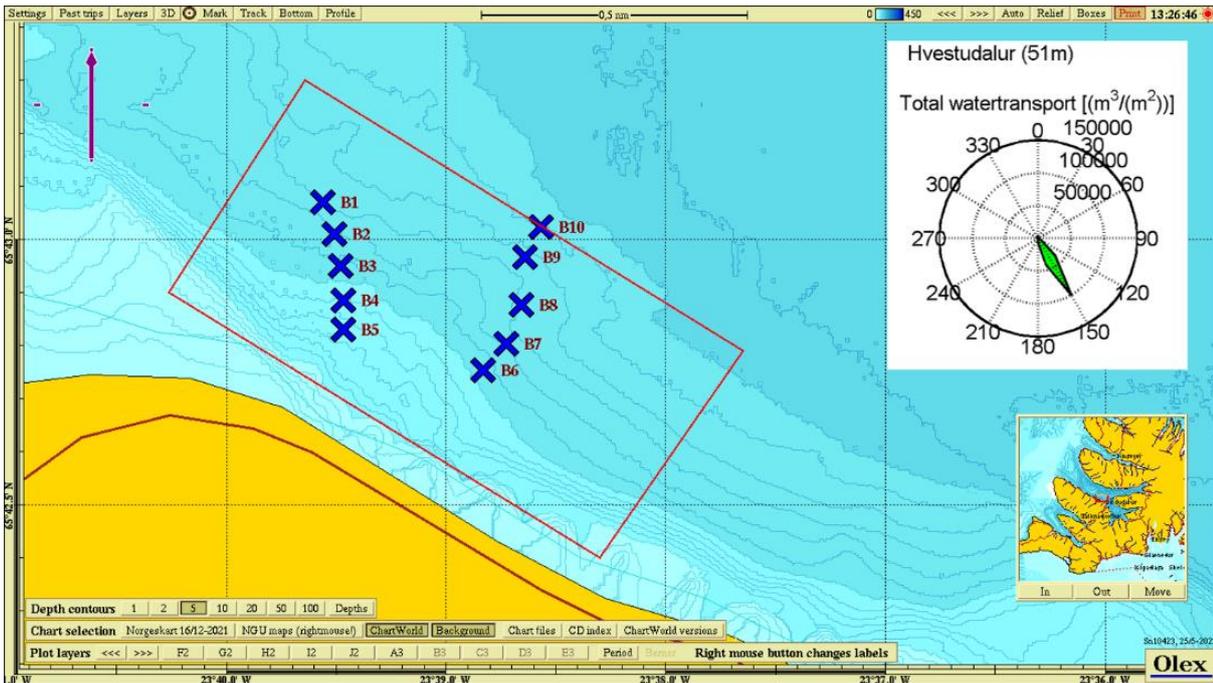
Figure 2. Site specific map of Hvestudalur showing the proposed farming area. Sampling stations B1 – 10 are marked with crosses. The color of each cross represents the environmental condition at the respective station following the classification as outlined in NS 9410:2016, chapter 7.11. Colour codes: blue = very good, green = good, yellow = bad, red = very bad. Current rose placed in the top right corner shows main current direction at 51 m (Gustavsson, 2022).

Table 2. Placement and depth of the sampling stations in the B survey.

Station number	North	West	Depth (m)
St 1	65°43°070	023°39,562	75
St 2	65°43,010	023°39,510	69
St 3	65°42,950	023°39,480	61
St 4	65°42,885	023°39,468	54
St 5	65°42,830	023°39,467	46
St 6	65°42,753	023°38°831	62
St 7	65°42,803	023°38,728	72
St 8	65°42,876	023°38,659	73
St 9	65°42,967	023°38,640	79
St 10	65°43,024	023°38,566	85

4 Results

Results for the different parameters are given in Table 3. The completed fieldwork sampling sheet with calculation for each parameter is attached in the appendix.

Table 3. Results from the parameter classifications of 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	**1**

Substrate was collected at all ten sampling stations (100% soft bottom). Sediment samples consisted mainly of silt, clay and sand. A thin layer of silt was commonly found at greater depths while sand and pebbles dominated in shallower waters closer to land. Fauna was recorded at all stations with polychaetes and molluscs being most prominent. The substrate was of light grey colour. Signs of out-gassing or smell of H_2S were not observed.

Based on the classification of sediment chemistry (pH/Eh - group II) and the sensory assessment (group III) all stations of this survey receive the status 1 – "very good". Consequently, the site also receives the environmental status 1 – "very good".

5 Conclusion

Applying the indicator thresholds and classification outlined in NS 9410:2016 it is shown that Hvestudalur receives site status 1 – "very good" at the time of this B survey. Samples were collected with a Van Veen grab (0,1 m^2) at 10 stations distributed within the near zone of the proposed farm location. Sediment was successfully collected at all stations and each station in this survey received status 1 – "very good". Sediment samples consisted mainly of silt, clay and sand.

The here presented survey constitutes a baseline survey, i.e. it documents the environmental status at the proposed farming location for Hverstudalur prior to the start of production at site. This survey did not detect signs of organic enrichment within the footprint of the new farm location.

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

6 References

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

Gustavsson, A., 2022. Hvestudalur – dispersing current, May 2022. Akvaplan-niva AS. Project nr. 63924. Report in progress.

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 Sample scheme (B.1 og B.2) NS 9410:2016

Sample scheme B.1

Company:	Arctic Sea Farm	Date:	11/05/2022
Site:	Hvestudalur	Site no.:	new
Fieldworker:	Arnþór Gústavsson		

Gr	Parameter	Point	1	2	3	4	5	6	7	8	9	10	S%	H%
	Bottom type: S (soft) or H (hard)		s	s	s	s	s	s	s	s	s	s	100	0
I	Animals > 1mm	Yes (0) No (1)	0	0	0	0	0	0	0	0	0	0		
II	pH	value	7.76	7.75	7.66	7.63	7.63	7.63	7.62	7.68	7.59	7.84		
	Eh (mV)	ORP	-20	-60	60	70	86	95	102	102	29	59		
		plus ref. value	180	140	260	270	286	295	302	302	229	259		
	pH/Eh	from figure	0	0	0	0	0	0	0	0	0	0	0.00	
	Status station		1	1	1	1	1	1	1	1	1	1		
	Status group II		1	Buffer temp	7.6 C		Sea temp	3.7 C		Sediment temp	3.7 C			
	pH sea	8.1	ORP sea	165 mV		Eh sea	365 mV		Reference electrode	200 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		
		Soft (2)		2										
		Aqueous (4)												
	Grab – volume (v)	v < 1/4 (0)								0	0			
		1/4 < v < 3/4 (1)					1	1						
		v > 3/4 (2)	2	2	2	2					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		2.0	4.0	2.0	2.0	1.0	1.0	0.0	0.0	2.0	2.0		
	Corrected (*0,22)		0.4	0.9	0.4	0.4	0.2	0.2	0.0	0.0	0.4	0.4	0.35	
	Status station		1	1	1	1	1	1	1	1	1	1		
	Status group III		1											
	Average group II & III		0.2	0.4	0.2	0.2	0.1	0.1	0.0	0.0	0.2	0.2	0.18	
	Status station		1	1	1	1	1	1	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

Grabb ID	K-3
pH / Eh ID	Ysi Professional plus

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Sample Scheme B.2

Company:	Arctic Sea Farm	Date:	11/05/2022
Site:	Hvestudalur	Site no.:	new
Fieldworker:	Arnþór Gústavsson		

Sample number		1	2	3	4	5	6	7	8	9	10
Depth (m)		75	69	61	54	46	62	72	73	79	85
Number of trials		1	1	1	1	1	1	1	1	1	1
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	X	X	X	X	X	X	X	X	X	X
	Gravel		X								
	Shellsand										
Reef											
Rocky bottom (cobbles, boulders)											
Echinodermata, count					2	1	1				
Crustaceans, count			1	2				1	1		
Molluscs, count		10+	10+	10+	3	10+	10+			10+	10+
Polychaetes, count		10+	10+	10+	10+	10+	10+	10+	10+	10+	10+
Other animals, count											
Beggiatoa											
Feed											
Faeces											
Comments											

Grab	Area [m²]	0.1	Grab ID	K-3
Signature fieldworker:		Arnþór Gústavsson		page 2 of 2 pages

7.2 Pictures of samples at Hvestudalur.

St 1		
St 2		
St 3		
St 4		
St 5		N/A

|		
St 6		
St 7		
St 8		
St 9		
St 10		

7.3 Bottom topography and 3D view
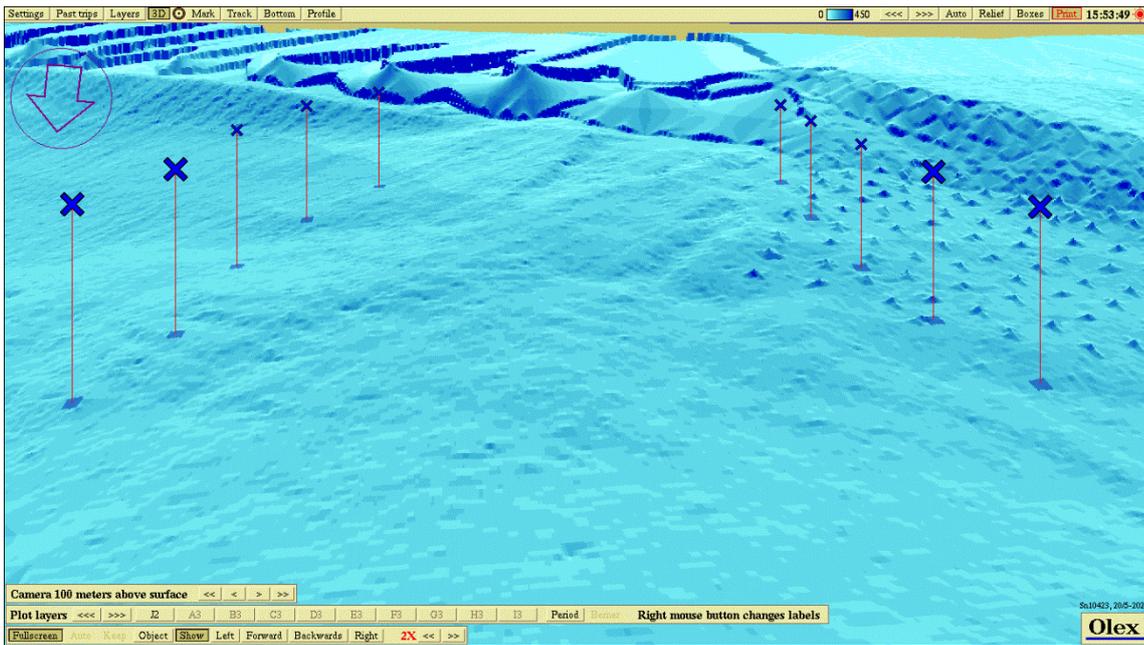
Figure 3. Bottom topography in 3D at Hvestudalur with each sampling station according to info in Figure 1 and Table 2.