

ASC Survey

Svarthamarsvík in Berufjörður

Peak biomass

Unnið af **Bláum Akri ehf. / DNV**

BA 2025-02

Eva Dögg Jóhannesdóttir / Þorleifur Ágústsson

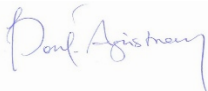

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S. 866 7780 / 858 7822

eva.johannesdottir@dnv.com / thorleifur.agustsson@dnv.com

Information			
Title	ASC during peak biomass at Svarthamarsvík, Berufjordur		
Date	14.04.2025		
No. Report	BA 2025-02		
Biological status	Peak biomass		
Location	Svarthmarsvik	Company	Kaldvík hf.
Biomass (ton)	2684	Type	Sea cages
Fish	Atlantic salmon	Size of station	10 x 160 m cages
Contact	Ólöf Stefánsdóttir	Head of station	Óskar Ragnarsson

Main findings according to ASC and NS 9410:2016	
Summary	<p>Results from chemical, show that situation of Svarthamarsvík during peak biomass is good with only one station exhibiting limited sign of organic load. All stations inside AZE were accepted on there being more than 1 species not indicating polluted conditions and occurring in higher numbers than 100 specimens/m².</p> <p>Stations located outside of AZE all had a Shannon Wiener faunal diversity index (H') higher than 3.0, indicating good conditions for the benthic fauna.</p>

Report			
Date	05.06.2025		
Author	Þorleifur Ágústsson	Signature	
QA	Eva Dögg Jóhannesdóttir	Signature	

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Foreword

Kaldvik hf. requested that Blár Akur carried out an environmental survey of the type ASC at Svarthamarsvik in Berufjordur. The survey was carried out during peak biomass according to ASC and NS 9410:2016 standards. The survey includes pH/redox measurements (Eh), hydrography, geochemical analyses and analyses of the bottom fauna by the fish farming site.

Accreditation information:

The survey is carried out by Blár Akur ehf. with Syni ehf. Laboratory, Reykjavík, as a sub-contractor.

1 Summary

1.1 Summary of the ASC results

All stations inside AZE were accepted on there being more than 1 species not indicating polluted conditions and occurring in higher numbers than 100 specimens/m².

Stations located outside of AZE all had a Shannon Wiener faunal diversity index (H') higher than 3.0, indicating good conditions for the benthic fauna.

Table 1 Summary overview of results. Colour of cells refers to sensitivity values based on Shannon Wiener Index (see further Appendix).

Indicator in ASC	ASC demand	Results									Remarks of the sampling
		Y1	Y2	Y3	A1	A2	A3	B1	B2	V1	
2.1.1	Redox >0 mV or sulphide level < 1500 microMol/L	146	130	178	109	280	-114	52	142	290	
2.1.2	«Faunal index score» outside AZE indicates good to very good ecological status – Shannon-Wiener > 3	3,90	4,18	3,46						3,74	
2.1.3	>= 2 macro faunal taxa within AZE which are not pollution indicators, with more than 100 ind/m ² present				10	8	3	9	8		
4.7.4	Copper level < 34 mg/kg DW	55,6	55,7	54,1	55,2	55,6	57	54,8	56,8	53,5	
2.1.4	Location specific AZE			See chapter 3.2.							

Table 2 Sensitivity values based on Shannon Wiener (H') (Molvær et al., 1997; Iversen and Sandøy, 2018)

	I Very good	II Good	III Fair	IV Bad
Shannon Wiener	>4	4-3	2-1	<1

1.2 Conclusions:

Overall results show that Svarthamarsvík has a low impact of organic material. Even though Redox is showing negative number, it is still low for a site that has reached a peak biomass. Copper levels are as expected and are similar at all stations. The level of copper varied from 53,3 to 57 mg/kg DW in the sediments, which is in category II (low values, with >75% of all samples measured in Iceland) according to the Icelandic regulation nr.796/1999. The redox potential (Eh) was positive in all sediments, except for station A3 (figure 1). This is further backed up by results presented when organic material is analysed.

The Shannon Wiener faunal diversity index (H') was higher than 3.0 for all stations outside of AZE.

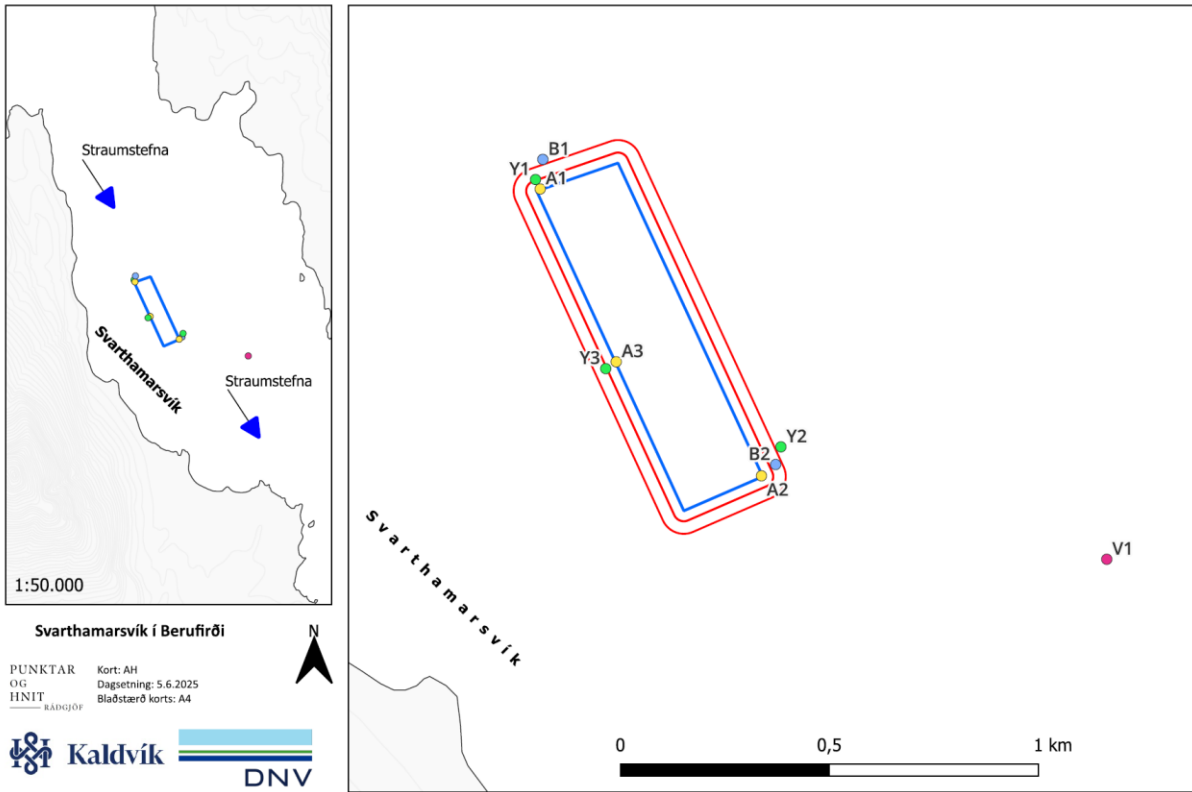


Figure 1 Map of Svarthamarsvík in Berufjörður showing stations for ASC survey, with in and outside the AZE. Straumstefna = current. Map done by Adam Hoffritz.

2 Introduction

2.1 Background

Blár Akur has on behalf of Kaldvík hf. done an ASC-survey for the site Svarthamarsvík in Berufjörður, Iceland.

The survey was conducted according by the Aquaculture Stewardship Council (ASC-standard) and NS 9410:2016.

This report is presented in manners to fulfil the demands from the Aquaculture Stewardship Council (ASC). The sampling stations were chosen based on results from earlier ocean current measurements (spread current) and bottom topography at the site (Olex).

A classification or threshold values for this type of survey have not been developed by Icelandic officials, so it is not possible to apply the classification based on Norwegian threshold values to Icelandic conditions. However, results are reported with reference to Norwegian threshold values, but it should be emphasized that some of these (such as NSI) are developed according to Norwegian conditions. For further descriptions of these indexes see details in Appendix 1 and Miljødirektoratets Veileder 02:2018.

2.2 Site operation and feed use

Svarthamarsvík had reached peak biomass, site is coming to an end of the second production cycle and the site is a frame mooring with a total of 10, 160 meters circumference cages in a 2 x 5 configuration. The current sampling took place coherent with period of peak biomass. The standing biomass the date of sampling was 2.684 ton. The current production Svarthamarsvík is shown in table 1.

Table 3 Production at Svarthamarsvík in Berufjörður

Time fish in sea (put in sea)	Production of salmon (ton, round weight).	Feed use (ton)
01.08.2023	2684	3221

2.3 Previous surveys

A previous environmental survey (ISO 12878) was conducted in may 2022, prior to start of the current production cycle (after fallowing).

2.4 ASC survey program

Choice of parameters, placement of sampling stations and other criteria for the survey was based on descriptions in the ASC and NS 9410:2016 standards (Table 2).

Table 4 The planned program for the ASC survey. TOC = total organic carbon. TOM = total organic material. TN = total nitrogen. Cu = Copper. pH/Eh = acidity and redox potential.

Station	Description of placement and measurements at each sampling point
B1 (edge of cages)	West-corner of cages / Cu, Sulfite, Sulfites, TN, TOC, DM, ORP, pH, °C
B2 (edge of cages)	East-corner of cages / Cu, Sulfite, Sulfites, TN, TOC, DM, ORP, pH, °C
A1 (transect zone, inside AZE)	25 m up-current from cages, NW direction / Cu, Sulfite, Sulfites, TN, TOC, DM, ORP, pH, °C
A2 (transect zone, inside AZE)	25 m down-current from cages, SE direction / Cu, Sulfite, Sulfites, TN, TOC, DM, ORP, pH, °C
A3 (transect zone, inside AZE)	25 m cross-current, S direction / Cu, Sulfite, Sulfites, TN, TOC, DM, ORP, pH, °C
Y1 (outside AZE)	55 m up-current, NW direction / Cu, Sulfite, Sulfites, TN, TOC, DM, ORP, pH, °C
Y2 (outside AZE)	55 m down-current, SA direction / Cu, Sulfite, Sulfites, TN, TOC, DM, ORP, pH, °C
Y3 (outside AZE)	55 m cross-current, S direction / Cu, Sulfite, Sulfites, TN, TOC, DM, ORP, pH, °C
V1 (reference station)	850 m down-current from cages / Cu, Sulfite, Sulfites, TN, TOC, DM, ORP, pH, °C

Fieldwork was carried out on April 14th 2025.

2.5 Placement of ASC-stations and AZE

ASC-standard allows that a site specific AZE zone can be defined (site-specific AZE, see pkt. 2.1.4. in «audit manual»). Based on measured current at the site (Fiskeldi Austfjarða, 2017), an AZE zone has been calculated according to

AZE = $(\pi \times r^2) \times K_s \times K_d \times K_b$, where

r = radius (25 m within AZE and 55 m outside AZE)

K_s = Correction coefficient for current (1,0 -1,5)

K_d = correction coefficient for depth (0,8 – 1,2)

K_b = Correction coefficient for topography (0,9 – 1,1)

With background in sampling system described in point 2.1 in ASC «Audit manual» («Request to allow for sampling at different locations and/or changes in total number of samples»), samples from nine biological stations were collected. The placement of the stations is based on results from measured oceanic current measured at 5 and 15 m depth (distribution current) at the site (Fiskeldi Austfjarða, 2017).

Coordinates, depth and distance of stations from frame of fish farm is given in **Error! Reference source not found.3**

Table 5 Distance between the nearest frame of the fish farm and sampling stations. Coordinates for stations, depth, at Svarthamarsvík.

Station	Depth, m	Distance from frame, m	Position	
			N	E
B1	41,6	0 m West-corner of cages	64° 42.891'	014° 22.883'
B2	40,9	0 m East-corner of cages	64° 42.477'	014° 22.251'
A1	42,1	25 m up-current from cages, NW direction	64° 42.853'	014° 22.897'
A2	41,2	25 m down-current from cages, SE direction	64° 42.464'	014° 22.246'
A3	40,8	25 m cross-current, S direction	64° 42.624'	014° 22.707'
Y1	43	55 m up-current, NW direction	64° 42.866	014° 22.909'
Y2	42	55 m down-current, SA direction	64° 42.499'	014° 22.231'
Y3	40,8	55 m cross-current, S direction	64° 42.616'	014° 22.740'
V1	42,6	850 m up-current from cages	64° 42.324'	014° 21.278'

3 ASC-survey Svarthamarsvík

3.1 Results

3.1.1 Bottom sediment and redox measurements (Eh)

Error! Reference source not found.4 shows the description of bottom sediment and results from redox measurements at the sampling stations. Eh had positive values in all but one sampling stations.

Table 6 Description of bottom sediment and redox measurements (Eh). ASC-stations Svarthamarsvík 2025.

Station	Description of bottom sediment	Eh (ORP)
B1	Gray brown mud, no odour, no bacteria, no feed	52
B2	Gray brown mud, no odour, no bacteria, no feed	142
A1	Gray brown mud, no odour, no bacteria, no feed	109
A2	Gray brown mud, no odour, no bacteria, no feed	280
A3	Dark gray mud, slight odour, no bacteria, no feed	-114
Y1	Gray brown mud, no odour, no bacteria, no feed	146
Y2	Gray brown mud, no odour, no bacteria, no feed	130
Y3	Dark gray mud, no odour, no bacteria, no feed	178
V1	Gray brown mud, no odour, no bacteria, no feed	290

3.1.2 Copper in sediments

The level of copper varied from 53,3 to 57 mg/kg DW in the sediments, which is in category II (low values, with >75% of all samples measured in Iceland) according to the Icelandic regulation nr.796/1999. Table 5. Copper (Cu), mg/kg DW.

Table 7 Levels of copper at Svarthamarsvik 2025.

Station	Copper (Cu) Mg/kg DW
B1	54,8
B2	56,8
A1	55,2
A2	55,6
A3	57
Y1	55,6
Y2	55,7
Y3	54,1
V1	53,5

3.1.3 TN, TOC, Sulfite and Sulfites levels in sediment

Table All stations showed similar low levels of TN, TOC Sulfite and Sulfites, except station A3 where highest levels of TN and Sulfites were observed.

Table 8 Levels of TN, TOC, Sulfite and Sulfites, in Svarthamarsvik 2025.

Station	TN mg/L	TOC %DW	Sulfite mg/L	Sulfites mg/kg DW
B1	7,57	1,32	<0,85	<500
B2	7,26	1,36	<0,85	<500
A1	11	1,43	<0,85	<500
A2	9,23	2,69	<0,85	<500
A3	12,8	1,53	<0,85	2900
Y1	8,22	1,32	<0,85	<500
Y2	10,1	1,43	<0,85	<500
Y3	12,8	1,38	<0,85	<500
V1	4,24	1,17	<0,85	<500

3.2 Number of species, Shannon Wiener Index diversity index (H').

The Shannon Wiener Index diversity index (H') for benthic fauna communities is presented in **Error! Reference source not found.**. Here are also presented number of species and individuals for each of the sampling stations.

The number of specimens was low to moderate, while the number of species ranged from 23 (A3) to 47 (A1). The diversity index H' varied from 3.4 to 4.3 and was thus higher than 3 for all stations both inside and outside AZE.

Table 9 Number of species and individuals pr. 0,1 m². H' = Shannon Wiener Index diversity index. ASC-stations at Svarthamarsvik in 2025.

Station	Number individuals	Number of species	Shannon Wiener H'
A1 (inside AZE)	537	47	4,279
A2 (inside AZE)	419	41	4,120
A3 (inside AZE)	144	23	3,596
B1 (inside AZE)	537	38	3,987
B2 (inside AZE)	379	37	4,172
V1 (outside AZE)	611	46	3,741
Y1 (outside AZE)	523	41	3,901
Y2 (outside AZE)	320	36	4,184
Y3 (outside AZE)	328	28	3,460

3.2.1 ASC evaluation of the benthic fauna communities

In Rygg and Norling (2013) the species are categorized into ecological group's based on the values of the sensitivity indexes. The pollution indicators (pollution indicator species) are categorized into ecological group V. Results are presented in Table 8.

Table 10 The dominating taxa with number of individuals per m² at Svarthamarsvik 2025.

Station	Dominating taxa	Number per 0,1 m ²	Number per m ²	NSI Ecological group *
A1 (inside AZE)	Ennucula tenuis	81	810	III
A2 (inside AZE)	Prionospio steenstrupi	77	770	IV
A3 (inside AZE)	Eteone flava/longa	45	450	IV
B1 (inside AZE)	Euchone papillosa	112	1120	IV
B2 (inside AZE)	Prionospio steenstrupi	60	600	IV
V1 (outside AZE)	Owenia borealis	194	1940	III
Y1 (outside AZE)	Euchone papillosa	135	1350	IV
Y2 (outside AZE)	Leitoscoloplos sp.	50	500	Ik
Y3 (outside AZE)	Chaetozone setosa (aggregate)	105	1050	IV

*Ecological group: I = sensitive species. II = neutral species. III = tolerant species. IV = opportunistic species. V = Pollution indicator species. From Rygg and Norling, 2013. Ik = no ecological group.

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- Reglugerð um varnir gegn mengun vatns. 796/1999

5 Appendix I

Statistical results at Svarthamarsvik 2025.

Total number of species and specimens per station

	Total number	A1	A2	A3	B1	B2	V1	Y1	Y2	Y3
# Specimens	3798	537	419	144	537	379	611	523	320	328
# Species	79	47	41	23	38	37	46	41	36	28

Benthic animal indexes, average per station

	A1	A2	A3	B1	B2	V1	Y1	Y2	Y3
Shannon Wiener	4.279	4.120	3.596	3.987	4.172	3.741	3.901	4.184	3.460
Pielou	0.770	0.769	0.795	0,760	0,801	0.677	0.728	0.809	0.752

Sensitivity values based on Shannon Wiener (H') (Molvær et al., 1997; Iversen and Sandøy, 2018)

	I Very good	II Good	III Fair	IV Bad
Shannon Wiener	>4	4-3	2-1	<1

6 Appendix II

Taxonomy at Svarthamarsvik 2025.

Taxonomy	A 1	A 2	A 3	B 1	B 2	V 1	Y 1	Y 2	Y 3
Animalia									
Annelida									
Polychaeta									
Eunicida									
Lumbrineridae									
Lumbrineris mixochaeta	19	4		8	3	5	5	6	1
Goniadidae									
Goniada maculata	1								
Nephtyidae									
Nephtys ciliata	7	4	4	6	5	4	2	3	2
Nephtys paradoxa	1							1	1
Pholoidae									
Pholoe inornata	4	36	4	6	19	1	9	1	27
Phyllodoce									
Eteone flava/longa	7	11	45	5	14	7	8	1	38
Phyllodoce groenlandica							1		
Phyllodoce maculata	2		1				2		1
Polynoidea									
Gattyana amondseni	2	2			1				
Harmothoe imbricata	1								1
Syllidae									
Syllidae				1					
Sabellida									
Sabellidae									
Chone sp.							3		
Euchone incolor						1			
Euchone papillosa	76	4		11	6	31	13	1	0
Spionida									
Spionidae									
Dipolydora coeca						1			
Prionospio steenstrupi	48	77	11	40	60	51	47	4	27
Pseudopolydora sp.					1				
Spio limicola	9	2	3	3	4	2	4	4	7
Terebellida									
Ampharetidae									
Ampharete acutifrons	1							1	
Ampharete petersenae	3	1		6	4	1	7	1	1
Cirratulidae									

				Chaetozone setosa (aggregate)	13	40	17	17	36	21	8	2	10
				Pectinariidae									
				Lagis koreni					1				
				Sternaspidae									
				Sternaspis sp.	22	23	11	21	13	8	18	8	18
				Terebellidae									
				Lanassa venusta	1	1							
				Laphania boeckii	2					2	1		
				Neoamphitrite affinis							1		
				Nicolea zostericola	1								
				Polycirrus sp.					1				
				Trichobranchi dae									
				Terebellides sp.				1	1	2			
				Unassigned									
				Capitellidae									
				Capitella capitata	1	1		1	1			2	1
				Mediomastus fragilis		2		1				1	
				Cossuridae									
				Cossura longocirrata			1			1			1
				Maldanidae									
				Maldane sarsi	12	3		11	2	50	4		
				Praxillella gracilis	2	3		1	2	10	4	1	1
				Praxillella praetermissa		2			1	2	2	1	
				Rhodine gracilior						2			
				Orbiniidae									
				Leitoscoloplos sp.	13	33	5	7	26	11	4	5	19
				Scoloplos armiger	3	13	2	2	2	1	7	6	4
				Oweniidae									
				Galathowenia oculata	50	14	2	59	41	87	35	2	8
				Myriochele olgae	39	8		42	23	32	38		4
				Owenia borealis	40	29		28	12	19	4	3	7
				Paraonidae									
				Levinsenia gracilis	1	1	1	2	1	7		2	
				Scalibregmati dae									
				Scalibregma inflatum						1			1
				Arthropoda									
				Malacostr aca									
				Amphipoda									
				Caprellidae									
				Caprellidae	2			3			1		
				Dulichidae									
				Dulichidae				1		5			
				Ischyrocerida e									
				Jassa sp.	1			3	3				
				Maeridae									

			Littorinimorpha																	
				Naticidae																
					Euspira pallida		1						1					1		
				Neogastropoda																
				Mangeliidae																
					Curtitoma sp.	1	1												2	
				Nematoda																
					Nematoda	4				1								2		
				Nemertea																
					Nemertea	5	2	2	4				2	1						5
				Animalia																
					Animalia (Eggs)		2	5		X	4	X	5	6						
				Chromista																
				Cercozoa																
					Cercozoa														3	
				Foraminifera																
					Foraminifera	3	50		3	15	20	25	30							