C-survey at Eyrarhlíð II (pre-survey), April 2021

Arctic Sea Farm hf

Akvaplan-niva AS Report: 2021 63091.01

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Summary

The results from the monitoring at the farming site Eyrarhlíð II in April 2021 showed that the sediment was somewhat loaded with organic carbon and the copper concentrations were within reported natural levels for bottom sediment around Iceland (Egilsson *et al.*, 1999). No load effect was recorded in the fauna and faunal index nEQR showed good conditions and no impact at all stations (> 0.6). The diversity index H ' was above 3 at all the stations. NS 9410:2016-assessment of the community in the local impact zone (C1) showed environmental condition 1 (Very good). No pollution indicators were recorded among the top-10 species at any of the stations. The redox measurements (pH/Eh) gave point 0 acc. Appendix D in NS 9410:2016 for all the sampling stations. The oxygen saturation in April was good in the whole water column with 92 % in the bottom water.

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Preface

Akvaplan-niva carried out an environmental survey of type C (NS 9410:2016) at the Eyrarhlíð II site. It includes pH/redox measurements (Eh), hydrography, geochemical analyses and analyses of the bottom fauna from five stations at the fish farming site. The following personnel have contributed in this work:

Snorri Gunnarsson	Akvaplan-niva	Field work, report, project leader.
Kamila Sztybor	Akvaplan-niva	Report, professional assessments and interpretations.
Hans-Petter Mannvik	Akvaplan-niva	Identification of bottom fauna (Echinodermata). QA report, professional assessments and interpretations.
Rune Palerud	Akvaplan-niva	Identification of bottom fauna (Crustaceans). Statistics.
Thomas Hansen	Akvaplan-niva	Identification of bottom fauna (Mollusca and Varia).
Charlotte Pedersen Ugelstad	Akvaplan-niva	Identification of bottom fauna (Polychaeta).
Stine Hermansen	Akvaplan-niva	Hydrographical vertical profiles
Kristine H Sperre	Akvaplan-niva	Coordination of sorting of bottom fauna.
Ingar H. Wasbotten	Akvaplan-niva	Coordination of geo-chemical analyses.

Akvaplan-niva would like to thank Arctic Sea Farm hf. and Steinunn G. Einarsdóttir for good cooperation.

Accreditation information:

The survey was done by Akvaplan-niva AS with ALS Laboratory Group (Czech Republic) as a sub-contractor.

NORSK AKKREDITERING TEST 079

Akvaplan-niva AS is accredited under NS-EN ISO/IEC 17025 by Norwegian Accreditation for field sampling of sediments and fauna, analyses of TOC, TOM, TN, particle size and macrofauna, and for professional evaluations and interpretations. Our Accreditation number is TEST 079.

Czech Accreditation Institute (Lab nr 1163)

ALS Laboratory Group is accredited by the Czech Accreditation Institute (Lab nr 1163) for copper analyses.

Non-accredited services: Hydrographical measurements and mapping of bottom topography (Olex).

Tromsø, 22.09 2021

Snorri Gunnarsson (Project Manager)

1 Data Summary

Client information			
Report title:	C-Survey at Eyrarhlíð II (pre-survey), April 2021.		
Report nr.	2021 63091.01	Site:	Eyrarhlíð II
Municipality:		Map Coordinates (construction):	65°55,488 N 23°43,509 W
MTB permitted:	Site MTB	Operations manager:	Egill Ólafsson
Client:	Arctic Sea Farm hf		

Biomass/production status at time of survey (15.04 2021)			
Fish group:	Salmon	Biomass on examination:	0
Feed input:	0	Produced amount of fish:	0
Type/time of survey			
Maximum biomass:	4.805	Follow up study:	
Fallow (resting period):		New location:	X

Results from the C study /NS 9410 (2016) – Main results from soft bottom fauna			
Faunal index nEQR (Veileder 02:2018)		**Diversity index H' (Shannon-Wiener)**	
Fauna C1 (impact zone)	0,703	Fauna C1 (impact zone)	3,66
Fauna C2	0,687	Fauna C2	3,63
Fauna C3	0,708	Fauna C3	3,79
Fauna C4 (deep area)	0,689	Fauna C4 (deep area)	3,75
Fauna Cref	0,697	Fauna Cref	3,53
Date fieldwork:	15.04 2021	**Date of report:**	15.09 2021
Notes to other results (sediment, pH/Eh, oxygen)			nTOC from 26,4 to 28,2 mg/g TS. Copper from 13,7 to 40,3 mg/kg. Eh positive at all stations. O_2-conditions were good throughout the water column.
Responsible for field work: Snorri Gunnarsson	Signature: 	Project manager Snorri Gunnarsson	Signature: 

2 Introduction

2.1 Background and aim of the study

On behalf of Arctic Sea Farm hf, Akvaplan-niva completed a pre-survey (type C) for a new fish farming site at Eyrarhlíð II (Figure 1). The survey fulfils the requirements from the Icelandic authorities for bottom surveys according to ISO 12878 and the requirements for environmental bottom surveys (according to Vöktunaráætlun). An environmental study was simultaneously undertaken, with reference to chapter 5.0 in NS 9410:2016 which follows the methodology for C-study. A pre-survey (type C) is aimed at studying the environmental conditions of the bottom sediments along a transect sector from the fish farm that extends from the local, to the intermediate and to the regional impact zones. The main emphasis is on the study of the soft bottom fauna which is conducted according to standards ISO 5567-19:2004 and ISO 16665:2014. The obligatory parameters that are included in the survey are described in NS 9410:2016.

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. We do however report the results with these same indexes 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.

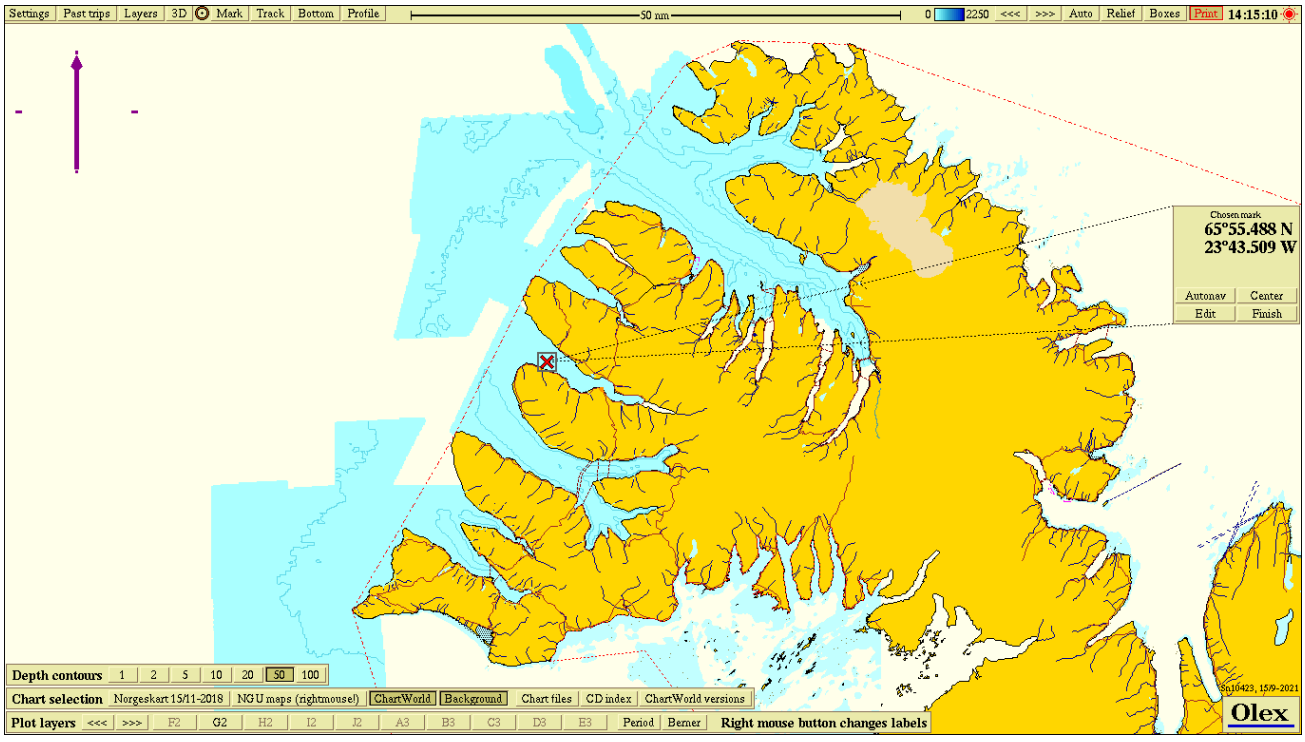

Figure 1 Overview of Dýrafjörður with the farming site Eyrarhlíð II (red cross). The map coordinates for the midpoint of the farming site are given to the right.

2.2 Site operation and feed use

The plant has a total of fourteen 160 meters circumference cages in a one frame configuration, 2 x 7 cage configuration. The Eyrarhlíð II is a new fish farming site but at the same farming licence there is another fish farming site about 2 km eastwards (by the name Eyrarhlíð) where farming activity has been going on since 2018. The planned time for setting out next generation at the site is summer 2021.

In Iceland, the MTB (maximum allowed biomass) limit is not given a site level as in Norway. The MTB limit determines how much live fish the holder of the permit can have standing in the sea at any time. In Iceland the allowed production is regulated at two levels, site level and company level. For this site the estimated maximal standing biomass for the next generation is 4.805 tonnes, used as MTB here (Einarsdóttir, pers reference).

2.3 Previous surveys

Akvaplan-niva AS has not done any previous environmental surveys of the type B/C (NS 9410) at the site and this C-survey is a pre-survey for the area.

3 Materials and methods

3.1 Survey program

The choice of study parameters, placement of sampling stations and other criteria for the study is based on descriptions in NS 9410 (C-surveys). An overview of the planned professional program is given in Table 1.

Akvaplan-niva is accredited for field work, analyses of samples and professional evaluation of results in accordance with applicable standards and guidelines ("Veiledere"). For implementation and follow through, the following standards and quality assurance systems were used:

- ISO 5667-19:2004: *Guidance on sampling of marine sediments.*
- ISO 16665:2014. *Water quality – Guidelines for quantitative sampling and sample processing of marine soft-bottom macro fauna.*
- NS 9410:2016. *Miljøovervåking av bunnpåvirkning fra marine oppdrettsanlegg.*
- Internal procedures. *Quality Manual for Akvaplan-niva.*
- Veileder 02:2018. *Klassifisering av miljøtilstand i vann*. Norsk klassifiseringssystem for vann i henhold til Vannforskriften. Veileder fra Direktoratgruppen.

Table 1. Survey program for the C-survey at Eyrarhlíð II, 2021. TOC = total organic carbon. Korn = grain size in sediment. TOM = total organic material. TN = total nitrogen. Cu = Copper. pH/Eh = acidity and redox potential.

Station	Type analyses/parameters
C1 (local impact zone)	Quantitative analyses of bottom fauna. TOC. Korn. TOM. TN. Cu. pH/Eh.
C2 (transect zone outer)	Quantitative analyses of bottom fauna. TOC. Korn. TOM. TN. 2 x Cu. pH/Eh.
C3 (transect zone)	Quantitative analyses of bottom fauna. TOC. Korn. TOM. TN. pH/Eh.
C4 (transect zone, deep area)	Quantitative analyses of bottom fauna. TOC. Korn. TOM. TN. Hydrography/O_2. pH/Eh.
Cref (outside transect zone, future reference station)	Quantitative analyses of bottom fauna. TOC. Korn. TOM. TN. 2 x Cu pH/Eh.

Field work was completed on 15.04 2021.

3.2 Placement of stations and local conditions

The number of stations was calculated with reference to the sites estimated maximal standing biomass for the first planned generation which is 4.805 tones (used as MTB here). According to the standard four sampling stations should be examined and the fifth stations is added about 1000 m from the planned farming site as a future reference station (Cref). Depth and position of the stations are given in Table 2 and shown in Figure 2. The stations were placed in accordance to the direction of the main oceanic current direction at 39 m depth (APN unpublished data) showing the main direction of oceanic flow in SE direction (125 degrees).

Table 2. Depth, distance between the nearest frame of the fish farm and sampling stations and coordinates for C-stations at Eyrarhlíð II, 2021.

Station	Depth, m	Distance from frame, m	Position N	W
C1	44	25	65°55.444	23°43.021
C2	43	500	65°55.276	23°42.546
C3	44	68	65°55.437	23°42.967
C4	44	125	65°55.429	23°42.864
C5	43	1024	65°55.182	23°41.855

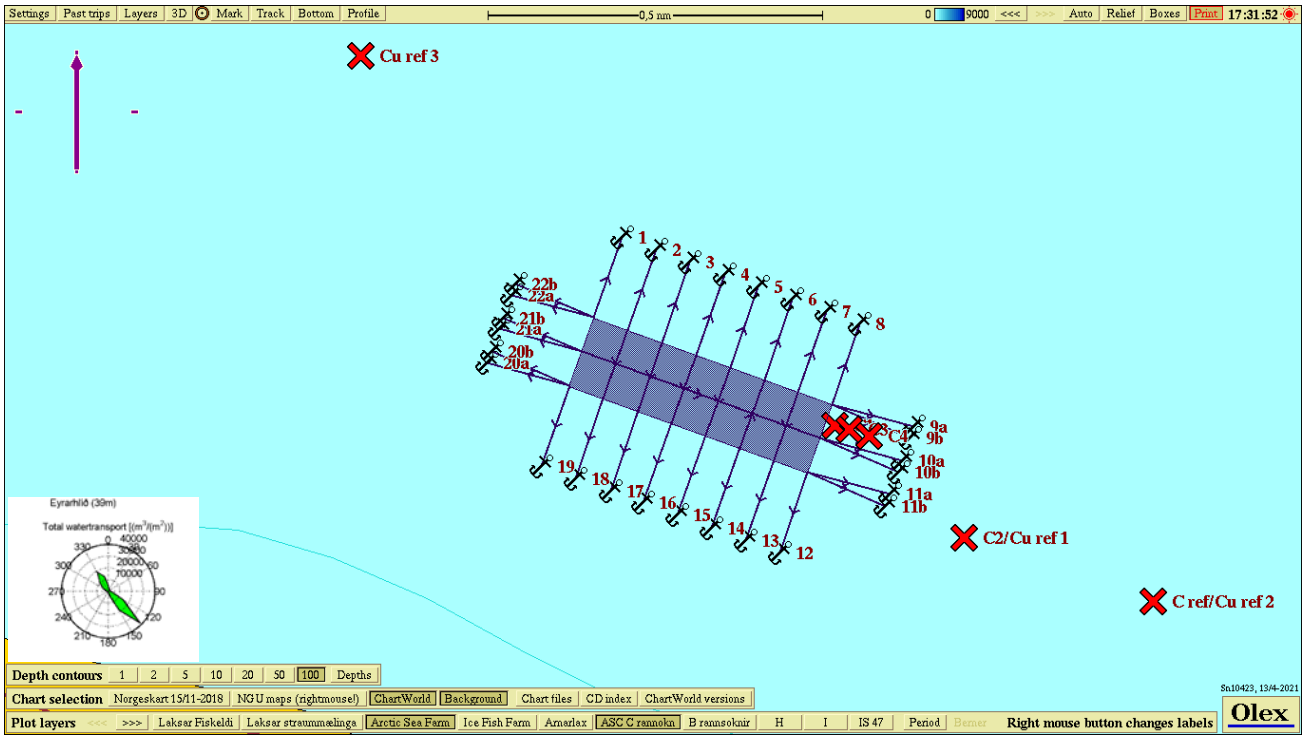

Figure 2. Map showing the sampling stations for the C-survey at Eyrarhlíð II, 2021. Current measurements used were from 39 m depth (APN unpublished data).

3.3 Hydrography and oxygen

At station C4, hydrographic measurements, salinity, temperature, density and oxygen saturation were carried out for vertical surface to bottom profiles using a Sensordata CTDO 204 probe.

3.4 Soft bottom sampling and analyses

3.4.1 Fieldwork

Sediment samples were collected with a 0.1 m^2 bottom grab (van Veen). The sample material was collected through inspection openings. Samples for TOC, TN and Cu were taken from the top 1 cm layer of the sediment and for TOM and grain size analyses from the top 5 cm using a hollow pipe. Only samples with an undisturbed surface were used. The samples were frozen for further processing in the laboratory.

3.4.2 Total organic material (TOM)

The amount of TOM in sediment was determined by weight loss after combustion at 495 °C. The percent weight loss was calculated. The reproducibility of the TOM analyses is checked during the analyses by using a standard household sediment that contains TOM with a known level. Standard calcium carbonate was burned together with the samples as a control of the amount of carbonate that was not burned in the analyses process.

3.4.3 Total nitrogen (TN)

After drying the samples at 40°C, the amount of total nitrogen (TN) was quantified by electrochemical determination using an internal method that is based on NS-EN 12260:2003 (Vannundersøkelse – Bestemmelse av bundet nitrogen (TNb) etter oksidasjon til nitrogenoksider).

3.4.4 Total organic carbon (TOC) and grain size

The proportion of fine material, the fraction less than 63 μm, was determined gravimetrically after wet-sieving of the samples. The results are presented as proportion of fine material on a dry weight basis.

After drying the samples at 40 °C, the content of total organic carbon (TOC) was determined by NDIR-detection in accordance with DIN19539:2016 (Investigation of solids – Temperature-dependent differentiation of total carbon (TOC_{400}, ROC, TIC_{900})). In order to classify the environmental conditions based on the content of TOC, the measured concentrations are normalized for proportion of fine substance (nTOC) using the equation: nTOC = TOC + 18 (1 – F), where TOC and F represent a measured TOC value and the proportion of fine substance (%) in the sample (Aure *et al.,* 1993).

3.4.5 Metal analysis - copper (Cu)

The samples for metal analysis were freeze-dried before being placed in a microwave oven in a sealed Teflon container with concentrated ultrapure nitric acid and hydrogen peroxide. The concentration of copper (Cu) was determined by means of ICP-SFMS.

3.4.6 Redox- and pH measurements

At all the stations, a quantitative chemical examination of the sediment was carried out. Acidity (pH) and redox potential (Eh) were measured using electrodes and the YSI Professional Plus instrument. In accordance to the manual of the instrument, 200 mV was added to the measured ORP (the Oxidation Reduction Potential) value.

3.5 Soft bottom fauna investigation

3.5.1 About effect of organic material on bottom fauna

The emission of organic material from fish farms can contribute to the deterioration of conditions for many of the organisms living in the bottom sediment. Negative effects in the bottom fauna can best be assessed through quantitative bottom fauna analyses. Many soft bottom species have low mobility, the fauna composition will largely reflect the local environmental conditions. Changes in the bottom fauna communities are a good indication of unwanted organic loads. Under natural conditions, the communities typically consist of many species. High number of species (diversity) is, amongst other things, dependent on favorable conditions for the fauna. However, moderate increases in organic load can stimulate the fauna and result in an increased number of species found. Larger organic loads can result in less favorable conditions where opportunistic species increase their individual numbers, while the species not suited are knocked out resulting in a reduced diversity of species. Changes in species diversity near emission points of feed and fecal

matter can, to a large degree, be attributed to changes in organic content (from the feed and fecal matter) in the sediment.

3.5.2 Sampling and fixation

All the bottom fauna samples were taken with a 0.1 m^2 van Veen grab. Only grab samples where the grab was completely closed and the surface undisturbed were approved. After approval, the contents were washed through a 1 mm sieve and the remaining material fixed with 4 % formalin with Bengal Rose dye added and neutralized with borax. In the laboratory, the animals were sorted from the remaining sediment.

3.5.3 Quantitative bottom fauna analysis

At all stations, two samples (replicates) were collected in accordance with guidelines in NS 9410 (2016). After sorting the sample material was processed quantitatively. The bottom fauna was identified to the lowest level possible and quantified by specialists (taxonomists). The quantitative lists of species were analyzed statistically. See Appendix 1 for description of analysis methods. The following statistical methods were used to describe community structure and to assess the similarity between different communities:

- Shannon-Wiener diversity index (H')
- Hurlberts diversity index (ES_{100}) – expected number of species pr. 100 individuals
- Pielou's evenness index (J)
- Sensitivities index (Ømfintlighet) (ISI_{2012}), unsuitable at low individual/species number
- Sensitivity index (NSI)
- Composite index for diversity of species and sensitivity (NQI1)
- Sensitivities index which is included in NQI1 (AMBI)
- Normalized EQR (nEQR)
- Number of species plotted against the number of individuals in geometric arts classes
- Cluster analyses
- The ten most dominant taxa per station (top-ten)

4 Results

4.1 Hydrography and oxygen

The hydrographical profile for the deep station C4 in April 2021 is presented in Figure 3.

Temperature was around 2 ^{0}C from the surface to the bottom, and oxygen saturation 100 % in the upper layer and 92 % in the bottom layer.

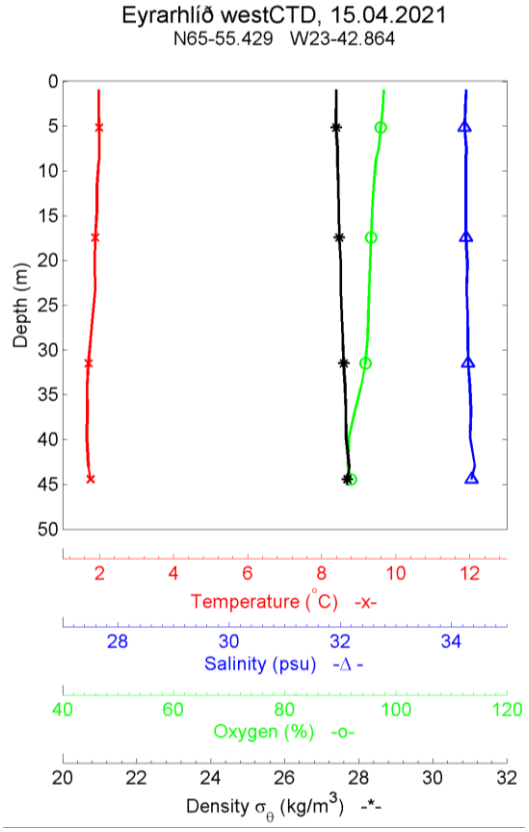

Figure 3. Vertical profiles. Temperature, salinity, density and oxygen at C4 at Eyrarhlíð II, 2021.

4.2 Sediment

4.2.1 TOC, TOM, TN, C/N, grain size and pH/Eh

Levels of total organic material (TOM), total organic carbon (TN), C/N-relationship, grain size distribution in sediment (Pelitt) and pH/Eh in the sediment are presented in Table 3.

TOM-levels varied from 7,6 to 10,1 %. TN-levels were low (2,1 – 2,9 mg/g) as was the C/N-ratio. TOC was rather high at all stations and nTOC varied from 26,4 to 28,2 mg/g TS. The bottom sediments grain size was fine with a pelite ratio ranging from 72,4 to 78,8 %.

Redox measurements (pH/Eh) gave a point of 0 for all the sampling stations according to Appendix D in NS 9410:2016.

Table 3. Sediment description, TOM (%), TOC (mg/g), TN (mg/g), C/N, grain size distribution (pelitt ratio % <0,063 mm) and pH/Eh. Eyrarhlíð II, 2021.

St.	Sediment description	TOM	TOC	nTOC*	TN	C/N	Pelitt	pH/Eh
C1	Muddy with some crushed shells. Grab full of sediment.	7,6	21,7	26,7	2,9	7,6	72,4	7.69/ 185
C2	Muddy with some crushed shells. Grab full of sediment.	7,9	23,2	28,0	2,1	11,3	73,5	7.65/ 268
C3	Muddy with some crushed shells. Grab full of sediment.	7,8	21,8	26,4	2,1	10,3	74,4	7.78/ 247
C4	Muddy with some crushed shells. Grab full of sediment.	8,5	23,8	28,2	2,8	8,6	75,4	7.78/ 306
Cref	Muddy with some crushed shells. Grab full of sediment.	10,1	24,3	28,1	2,6	9,3	78,8	7.81/ 356

4.2.2 Copper

Levels of copper in bottom sediments are shown in Table 4. The level of copper varied from 13,7 to 40,3 mg/kg.

Table 4. Copper (Cu), mg/kg TS. Eyrarhlíð II, 2021.

St.	Cu repl. 1	Cu repl. 2
C1	39,1	-
C2 / Cu ref1	39,1	38,5
Cref / Cu ref2	39,1	40,3
Cu ref3	13,7	14,7

4.3 Soft-bottom fauna

4.3.1 Faunal indices

Results from the quantitative soft bottom faunal analyses at the C-stations are presented in Table 5. Faunal index nEQR is presented without the density index (DI) in accordance with recommendations from the Norwegian Environment Agency (Miljødirektoratet).

The number of individuals varied between 764 (Cref) and 1348 (C1) and number of species between 36 (C2) and 53 (C3). The diversity H' varied between 3,53 and 3,79. At all stations, the overall index of nEQR was higher than 0.6. The nEQR values indicate good conditions and no disturbance of the communities.

J (Pielous evenness index) is a measure of how equally individuals are divided between species, and will vary between 0 and 1. A station with low-value has a "crooked" individual distribution between the species, indicating a disturbed bottom fauna community. The index was above 0,6 at all stations indicating even distribution.

Table 5. Number of species and individuals pr. 0,2 m2. H´ = Shannon-Wieners diversity index. ES100 = Hurlberts diversity index. NQI1 = overall index (diversity and sensitivity). ISI2012 = sensitivity index. NSI = sensitivity index. J = Pielous evenness index. AMBI = AZTI marine biotic index (part of NQI1). nEQR = normalized EQR (excl. DI). C-stations at Eyrarhlíð II, 2021.

St.	Numb. ind.	Numb. species	H´	ES_{100}	NQI1	ISI_{2012}	NSI	nEQR	AMBI	J
C1	1348	51	3,66	20,34	0,715	9,47	23,12	0,703	2,08	0,69
C2	799	36	3,63	19,66	0,699	8,98	22,99	0,687	2,09	0,74
C3	1115	53	3,79	21,55	0,719	9,32	23,23	0,708	2,10	0,71
C4	1048	48	3,75	20,63	0,710	8,68	23,14	0,689	2,14	0,72
Cref	764	43	3,53	20,74	0,721	9,32	22,86	0,697	1,91	0,70

4.3.2 NS 9410 Evaluation of the bottom fauna at station C1 (local impact zone).

According to NS 9410 the classification of the environmental status in the local impact zone can also be evaluated based on the number of species and their dominance in the bottom faunal community (see chapter 8.6.2 in NS 9410:2016).

The soft bottom communities were classified to environmental condition 1 "Very good". The criteria for condition 1 are that there are at least 20 species/0,2 m^2 and that none of these are in numbers exceeding 65 % of the individuals (Table 6). The data for number of species and dominating taxa at station C1 is given in Table 5 and Table 7.

Table 6. Classification of the environmental status of the soft bottom fauna at station C1 at the Eyrarhlíð II site 2021.

Station	Site name	Num. species	Dominating taxa	Environmental condition-NS 9410
C1	Eyrarhlíð II	51	Ennucula tenuis – 28 %	1 – Very good

Geometric classes

Figure 4 shows the number of species plotted against the number of individuals, where the number of individuals is divided into geometric classes. For an explanation of the concept of geometric classes is given in Appendix 1.

The curves started highest at C3 and relatively low (≤ 15 species) at the other stations and stretched out in varying degrees towards higher classes. These did not give any clear indications of fauna condition.

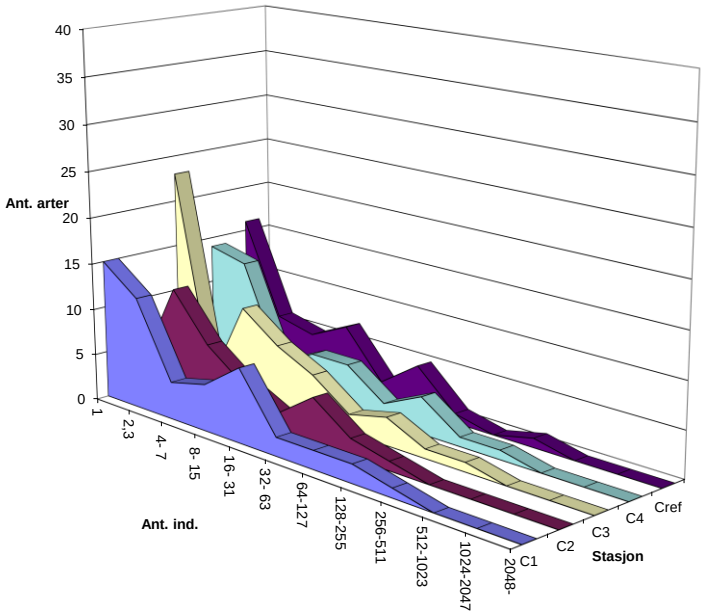

Figure 4. The soft bottom fauna shown as number of species against number of individuals pr. species in geometric classes. Eyrarhlíð II, 2021.

4.3.3 Cluster analyses

To investigate the similarity of the faunal composition between the sampling stations, the multivariate technique cluster analysis was used. The results of this are presented in dendrogram in Figure 5.

The fauna composition was more than 70 % similar between all stations in the survey.

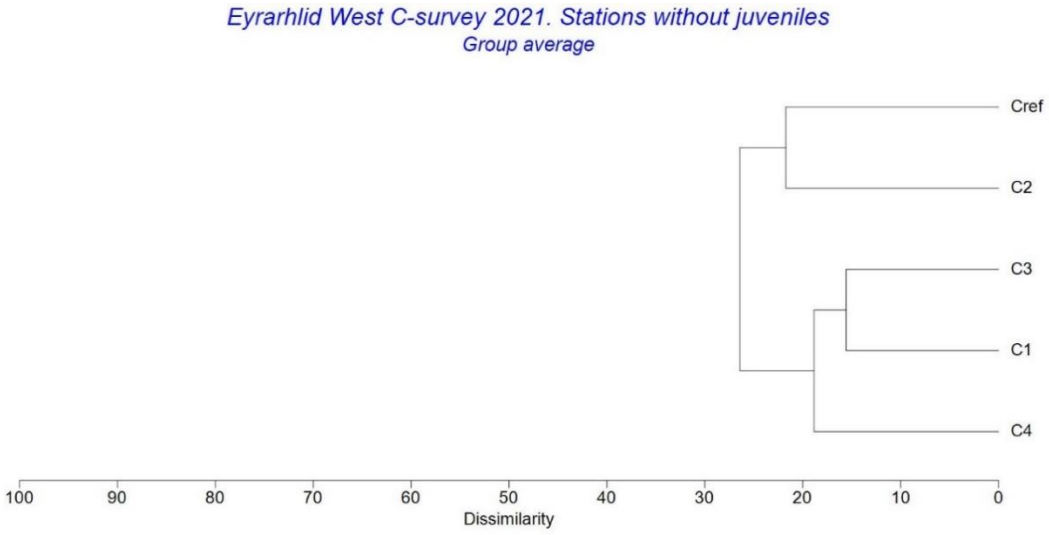

Figure 5. Cluster diagram for the soft bottom fauna at the C- sampling stations at Eyrarhlíð II, 2021.

4.3.4 Species composition

The main features of the species composition are shown in the form of a top ten species list from each station in Table 7.

In Rygg and Norling (2013) the species are divided into five ecological groups (EG) based on the value of the sensitivity index. These groups run from sensitive species (group I) to pollution indicators (group V).

All stations were dominated by the neutral bivalve *Ennucula tenuis* with between 24 and 37 % of the individuals. The other most dominant species at the stations were a mixture of neutral, tolerant, and opportunistic species.

No pollution indicators were recorded among the top-10 at any of the stations.

Table 7. Number of individuals, cumulative percentage, and ecological group for the ten most dominant species on the C stations. Eyrarhlíð II, 2021.*

C1	EG	Numb.	Cum.	C2	EG	Numb.	Cum.
Ennucula tenuis	II	383	28 %	Ennucula tenuis	II	236	29 %
Owenia sp.	II	204	43 %	Galathowenia oculata	III	102	41 %
Levinsenia gracilis	II	129	52 %	Owenia sp.	II	87	52 %
Galathowenia oculata	III	123	61 %	Sternaspis scutata		53	59 %
Sternaspis scutata		109	69 %	Nuculana pernula	II	49	65 %
Nuculana pernula	II	56	74 %	Levinsenia gracilis	II	48	71 %
Myriochele malmgreni/olgae		54	78 %	Myriochele malmgreni/olgae		37	75 %
Leucon sp.		30	80 %	Leucon sp.		36	80 %
Abra nitida	III	28	82 %	Abra nitida	III	26	83 %
Lagis koreni	IV	28	84 %	Prionospio steenstrupi	II	16	85 %
C3	**EG**	**Numb.**	**Cum.**	**C4**	**EG**	**Numb.**	**Cum.**
Ennucula tenuis	II	274	24 %	Ennucula tenuis	II	268	25 %
Owenia sp.	II	168	39 %	Owenia sp.	II	133	38 %
Levinsenia gracilis	II	119	50 %	Levinsenia gracilis	II	114	48 %
Galathowenia oculata	III	101	59 %	Galathowenia oculata	III	95	57 %
Sternaspis scutata		82	66 %	Sternaspis scutata		82	65 %
Nuculana pernula	II	56	71 %	Myriochele malmgreni/olgae		65	71 %
Myriochele malmgreni/olgae		46	75 %	Nuculana pernula	II	47	76 %
Abra nitida	III	31	78 %	Leucon sp.		33	79 %
Leucon sp.		31	81 %	Abra nitida	III	26	81 %
Maldane sarsi	IV	23	83 %	Axinopsida orbiculata		21	83 %

Cref	EG	Numb.	Cum.
Ennucula tenuis	II	285	37 %
Galathowenia oculata	III	65	45 %
Sternaspis scutata		52	52 %
Levinsenia gracilis	II	51	59 %
Nuculana pernula	II	50	65 %
Abra nitida	III	42	70 %
Myriochele malmgreni/olgae		35	75 %
Maldane sarsi	IV	31	79 %
Owenia sp.	II	16	81 %
Leucon sp.		14	83 %

*Ecological groups: EG I = sensitive species. EG II = neutral species. EG III = tolerant species. EG IV = opportunistic species. EG V = pollution indicator species. From Rygg and Norling, 2013. Ik = unidentified group.

5 Summary and Conclusions

5.1 Summary

The results from the environmental monitoring (type C) at Eyrarhlíð II, 2021, can be summarized as follows:

- The hydrography measurements showed good oxygen conditions throughout the water column with 92 % saturation in the bottom layer in April 2021.
- TOC was rather high at all stations and nTOC varied from 26,4 to 28,2 mg/g TS. TOM-levels varied from 7,6 to 10,1 %. TN-levels were low (2,1 – 2,9 mg/g) as was the C/N-ratio. The copper concentrations in the sediments varied between 13,7 and 40,3 mg/kg and are within natural level (~ 55 mg/kg) in Icelandic coastal areas (Egilsson *et al.* 1999). The sediment was fine grained with a pelite share between 72,4 and 78,8 %. The redox measurements (pH/Eh) gave point 0 acc. Appendix D in NS 9410:2016 for all the stations.
- The number of individuals varied between 764 (Cref) and 1348 (C1) and number of species between 36 (C2) and 53 (C3). The diversity H' varied between 3,53 and 3,79. At all stations, the overall index of nEQR was higher than 0.6. The nEQR values indicate good conditions and no disturbance of the communities.

5.2 Conclusions

The results from the monitoring at the farming site Eyrarhlíð II in April 2021 showed that the sediment was somewhat loaded with organic carbon and the copper concentrations were within reported natural levels for bottom sediment around Iceland (Egilsson *et al.*, 1999). No load effect was recorded in the fauna and faunal index nEQR showed good conditions and no impact at all stations (> 0.6). The diversity index H ' was above 3 at all the stations. NS 9410:2016-assessment of the community in the local impact zone (C1) showed environmental condition 1 (Very good). No pollution indicators were recorded among the top-10 species at any of the stations. The redox measurements (pH/Eh) gave point 0 acc. Appendix D in NS 9410:2016 for all the sampling stations. The oxygen saturation in April was good in the whole water column with 92 % in the bottom water.

6 References

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7 Appendix (In Norwegian)

7.1 Statistical methods

7.1.1 Diversity

Diversitet er et begrep som uttrykker mangfoldet i dyre- og plantesamfunnet på en lokalitet. Det finnes en rekke ulike mål for diversitet. Noen tar mest hensyn til artsrikheten (mål for artsrikheten), andre legger mer vekt på individfordelingen mellom artene (mål for jevnhet og dominans). Ulike mål uttrykker derved forskjellige sider ved dyresamfunnet. Diversitetsmål er "klassiske" i forurensningsundersøkelser fordi miljøforstyrrelser typisk påvirker samfunnets sammensetning. Svakheten ved diversitetsmålene er at de ikke alltid fanger opp endringer i samfunnsstrukturen. Dersom en art blir erstattet med like mange individer av en ny art, vil ikke det gjøre noe utslag på diversitetsindeksene.

Shannon-Wieners indeks (Shannon & Weaver, 1949) er gitt ved formelen:

$$H' = -\sum_{i=1}^{s} \frac{n_i}{N} \log_2 \left(\frac{n_i}{N} \right)$$

der n_i = antall individer av art i i prøven
N = total antall individer
s = antall arter

Indeksen tar hensyn både til antall arter og mengdefordelingen mellom artene, men det synes som indeksen er mest følsom for individfordelingen. En lav verdi indikerer et artsfattig samfunn og/eller et samfunn som er dominert av en eller få arter. En høy verdi indikerer et artsrikt samfunn.

7.1.2 Pielous mål for jevnhet (Pielou, 1966)

har følgende formel, der symbolene er som i Shannon-Wieners indeks

$$J = \frac{H'}{\log_2 s}$$

7.1.3 Hurlberts diversitetskurver

Grafisk kan diversiteten uttrykkes i form av antall arter som funksjon av antall individer. Med utgangspunkt i total antall arter og individer i en prøve søker man å beregne hvor mange arter man ville vente å finne i delprøver med færre individer. Diversitetsmålet blir derved uavhengig av prøvestørrelsen og gjør at lokaliteter med ulik individtetthet kan sammenlignes direkte. Hurlbert (1971) har gitt en metode for å beregne slike diversitetskurver basert på sannsynlighetsberegning.

ES_n er forventet antall arter i en delprøve på n tilfeldig valgte individer fra en prøve som inneholder total N individer og s arter og har følgende formel:

$$ES_n = \sum_{i=1}^{s} \left[1 - \frac{\binom{N-N_i}{n}}{\binom{N}{n}} \right]$$

der N = total antall individ i prøven
N_i = antall individ av art i
n = antall individ i en gitt delprøve (av de N)
s = total antall arter i prøven

7.1.4 Plott av antall arter i forhold til antall individer

Artene deles inn i grupper/klasser etter hvor mange individer som er registrert i en prøve. Det vanlige er å sette klasse I = 1 individ pr. art, klasse II = 2-3 individer, klasse III = 4-7 individer, klasse IV = 8-15 individer, osv., slik at de nedre klassegrensene danner en følge av ledd på formen 2^x, x=0,1,2, ... En slik følge kalles en geometrisk følge, derfor kalles klassene for geometriske klasser. Hvis antall arter innenfor hver klasse plottes mot klasseverdien på en lineær skala, vil det fremkomme en kurve som uttrykker individfordelingen mellom artene i samfunnet. Det har vist seg at i prøver fra upåvirkede samfunn vil det være mange arter med lavt individantall og få arter med høyt individantall, slik at vi får en entoppet, asymmetrisk kurve med lang "hale" mot høye klasseverdier. Denne kurven vil være godt tilpasset en log-normal fordelingskurve.

Ved moderat forurensing forsvinner en del av de individfattige artene, mens noen som blir begunstiget, øker i antall. Slik flater kurven ut, og strekker seg mot høyere klasser eller den får ekstra topper. Under slike forhold mister kurven enhver likhet med den statistiske log-normalfordelingen. Derfor kan avvik fra log-normalfordelingen tolkes som et resultat av en påvirkning/forurensing. Det har vist seg at denne metoden tidlig gir utslag ved miljøforstyrrelse. Ved sterk forurensning blir det bare noen få, men ofte svært tallrike arter tilbake. Log-normalfordelingskurven vil da ofte gjenoppstå, men med en lavere topp og spredt over flere klasser enn for uforstyrrede samfunn.

7.1.5 Faunaens fordelingsmønster

Variasjoner i faunaens fordelingsmønster over området beskrives ved å sammenligne tettheten av artene på hver stasjon. Til dette brukes multivariate klassifikasjons- og ordinasjons-analyser (Cluster og MDS).

Analysene i denne undersøkelsen ble utført ved hjelp av programpakken PRIMER v5. Inngangsdata er individantall pr. art, pr. prøve. Prøvene kan være replikater eller stasjoner. Det tas ikke hensyn til hvilke arter som opptrer. Forut for klassifikasjons- og ordinasjonsanalysene ble artslistene dobbelt kvadratrot-transformert. Dette ble gjort for å redusere avviket mellom høye og lave tetthetsverdier og dermed redusere eventuelle effekter av tallmessig dominans hos noen få arter i datasettet.

7.1.6 Clusteranalyse

Analysen undersøker faunalikheten mellom prøver. For å sammenligne to prøver ble Bray-Curtis ulikhetsindeks benyttet (Bray & Curtis, 1957):

$$d_{ij} = \frac{\sum_{k=1}^{n} \left| X_{ki} - X_{kj} \right|}{\sum_{k=1}^{n} (X_{ki} + X_{kj})}$$

der n = antall arter sammenlignet
X_{ki} = antall individ av art k i prøve nr. i
X_{kj} = antall individ av art k i prøve nr. j

Indeksen avtar med økende likhet. Vi får verdien 1 hvis prøvene er helt ulike, dvs. ikke har noen felles arter. Identiske arts- og individtall vil gi verdien 0. Prøver blir gruppert sammen etter graden av likhet ved å bruke

”group-average linkage”. Forholdsvis like prøver danner en gruppe (cluster). Resultatet presenteres i et trediagram (dendrogram).

7.1.7 Ømfintlighet (AMBI, ISI og NSI)

Ømfintligheten bestemmes ved indeksene ISI og AMBI. Beregning av ISI er beskrevet av Rygg (2002). Sensitivitetsindeksen AMBI (Azti Marin Biotic Index) tilordner en ømfintlighetsklasse (økologisk gruppe, EG): EG-1: sensitive arter, EG-II: indifferente arter, EG-III: tolerante arter, EG-IV: opportunistiske arter, EG-V: forurensningsindikerende arter. Sammensetningen av makroevertebratsamfunnet i form av andelen av økologiske grupper indikerer omfanget av en forurensningspåvirkning.

NSI er en sensitivitetsindeks som ligner AMBI, men er utviklet med basis i norske faunadata og ved bruk av en objektiv statistisk metode. En prøves NSI verdi beregnes ved gjennomsnittet av sensitivitetsverdiene av alle individene i prøven.

7.1.8 Sammensatte indekser (NQI1 og NQI2)

Sammensatte indekser NQI1 og NQI2 bestemmes både ut fra artsmangfold og ømfintlighet. NQI1 er brukt i NEAGIG (den nordøst-atlantiske interkalibreringen). De fleste land bruker nå sammensatte indekser av samme type som NQI1 og NQI2.

NQI1 indeksen er beskrevet ved hjelp av formelen:

7.1.9 NQI1 (Norwegian quality status, version 1) = [0.5* (1-AMBI/7) + 0.5*(SN/2.7)* (N/(N+5)]

Diversitetsindeksen SN = lnS/ln(lnN), hvor S er antall arter og N er antall individer i prøven

7.1.10 References

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7.2 Statistical results Eyrarhlíð II, 2021

7.2.1 Number of species and individuals per station

st.nr.	tot.	C1	C2	C3	C4	Cref
no. ind.	5074	1348	799	1115	1048	764
no. spe.	79	51	36	53	48	43

7.2.2 Benthos indices per replicate

st.nr.	tot.	C1_01	C1_02	C2_01	C2_02	C3_01	C3_02	C4_01	C4_02	Cref_01	Cref_02
no. ind.	5074	764	584	316	483	501	614	468	580	412	352
no. spe.	79	38	43	29	31	37	45	39	36	31	34
Shannon-Wiener:		3,48	3,85	3,76	3,50	3,80	3,79	3,82	3,68	3,38	3,68
Pielou		0,66	0,71	0,77	0,71	0,73	0,69	0,72	0,71	0,68	0,72
ES100		19	22	20	19	21	22	21	20	19	22
SN		1,92	2,03	1,92	1,89	1,98	2,05	2,02	1,94	1,91	1,99
ISI-2012		9,83	9,12	8,82	9,14	9,16	9,48	8,86	8,50	9,39	9,26
AMBI		2,03	2,14	2,20	1,99	2,19	2,02	2,19	2,09	1,92	1,89
NQI1		0,71	0,72	0,69	0,70	0,71	0,73	0,71	0,71	0,71	0,73
NSI		23,34	22,90	22,95	23,03	23,18	23,28	23,06	23,22	23,08	22,64
DI		0,83	0,72	0,45	0,63	0,65	0,74	0,62	0,71	0,56	0,50

7.2.3 Benthos indices, averages per station

st.nr.	C1	C2	C3	C4	Cref
Shannon-Wiener:	3,66	3,63	3,79	3,75	3,53
Pielou	0,69	0,74	0,71	0,72	0,70
ES100	20,34	19,66	21,55	20,63	20,74
SN	1,98	1,90	2,01	1,98	1,95
ISI-2012	9,47	8,98	9,32	8,68	9,32
AMBI	2,083	2,093	2,104	2,142	1,908
NQI1	0,71	0,70	0,72	0,71	0,72
NSI	23,12	22,99	23,23	23,14	22,86
Tilstandsklasse nEQR	0,703	0,687	0,708	0,689	0,697

7.2.4 Geometric classes

int.	C1	C2	C3	C4	Cref
1	15	3	23	14	16
2,3	12	12	1	13	6
4- 7	4	7	10	3	5
8- 15	5	4	7	5	7
16- 31	8	2	5	5	2
32- 63	2	5	2	2	5
64-127	2	2	3	4	1
128-255	2	1	1	1	0
256-511	1	0	1	1	1
512-1023	0	0	0	0	0
1024-2047	0	0	0	0	0
2048-	0	0	0	0	0

7.3 Species lists

Artsliste — *Eyrarhlíð II C-survey 2021*

Rekke	*Klasse*	*Art/Taxa*	*01*	*02*	*Sum*
Stasjonsnr.: C1					
NEMERTINI					
		Nemertea indet.	1	1	2
ANNELIDA					
	Polychaeta				
		Aricidea sp.		1	1
		Bradabyssa villosa		1	1
		Chaetozone setosa		1	1
		Chaetozone sp.	1		1
		Diplocirrus longisetosus	6	11	17
		Dipolydora coeca		1	1
		Euchone sp.		1	1
		Galathowenia oculata	62	61	123
		Lagis koreni	9	19	28
		Laphania boecki	1	2	3
		Leitoscoloplos mammosus	1		1
		Levinsenia gracilis	76	53	129
		Lumbrineris mixochaeta	1	2	3
		Maldane sarsi	16	3	19
		Maldanidae indet. juv.	1		1
		Melinna cristata		3	3
		Myriochele malmgreni/olgae	41	13	54
		Nephtys ciliata	14	5	19
		Nothria conchylega	1		1
		Owenia sp.	128	76	204
		Pholoe baltica		1	1
		Praxillella gracilis	7	4	11
		Praxillella praetermissa	5	8	13
		Prionospio steenstrupi	5	3	8
		Rhodine gracilior	4	1	5
		Spio limicola		4	4
		Sternaspis scutata	53	56	109
		Syllis cornuta		1	1
CRUSTACEA					
	Ostracoda				
		Ostracoda indet.	1	1	2
	Malacostraca				
		Bathymedon obtusifrons	3	3	6
		Campylaspis sp.	1		1
		Eudorella sp.	3	6	9
		Leptostylis sp.	2	1	3
		Leucon sp.	15	15	30
		Lysianassidae indet.	1		1
		Oedicerotidae indet.		2	2
		Pleurogonium spinosissimum		1	1
MOLLUSCA					
	Caudofoveata				
		Caudofoveata indet.		2	2
	Prosobranchia				
		Euspira pallida	2		2
	Bivalvia				
		Abra nitida	16	12	28

Rekke	Klasse	Art/Taxa	01	02	Sum
		Arctica islandica	3	2	5
		Astarte sp. juv.		1	1
		Axinopsida orbiculata	7	2	9
		Ennucula tenuis	238	145	383
		Macoma calcarea	1	1	2
		Musculus niger	1	2	3
		Nuculana pernula	25	31	56
		Thyasira gouldi	6	11	17
		Thyasira sarsii	4	14	18
		Thyasiridae indet.		1	1
		Yoldia hyperborea	1		1
ECHINODERMATA					
	Ophiuroidea				
		Ophiocten affinis	2		2
		Ophiuroidea indet. juv.	8	7	15
		Maks:	238	145	383
		Antall:	40	45	54
		Sum:			1365

Stasjonsnr.: C2

NEMERTINI					
		Nemertea indet.	2		2
ANNELIDA					
	Polychaeta				
		Diplocirrus longisetosus	2	3	5
		Galathowenia oculata	44	58	102
		Lagis koreni	2	10	12
		Laphania boecki		2	2
		Levinsenia gracilis	24	24	48
		Maldane sarsi	1	1	2
		Melinna cristata		3	3
		Myriochele malmgreni/olgae	15	22	37
		Nephtys ciliata	3	5	8
		Owenia sp.	33	54	87
		Parougia eliasoni		1	1
		Praxillella gracilis	3	10	13
		Praxillella praetermissa	2	7	9
		Prionospio steenstrupi	11	5	16
		Scoloplos armiger	2		2
		Spio limicola	2		2
		Sternaspis scutata	22	31	53
CRUSTACEA					
	Malacostraca				
		Byblis sp.	1	1	2
		Campylaspis sp.		2	2
		Dulichiidae indet.		1	1
		Eudorella sp.	3	2	5
		Leucon sp.	17	19	36
		Oedicerotidae indet.	3	2	5
		Paguridae indet.	1		1
MOLLUSCA					
	Caudofoveata				
		Caudofoveata indet.		2	2
	Bivalvia				
		Abra nitida	13	13	26

Rekke	Klasse	Art/Taxa	01	02	Sum
		Arctica islandica	1	1	2
		Astarte sp. juv.	1		1
		Axinopsida orbiculata	4	2	6
		Ennucula tenuis	77	159	236
		Mya sp. juv.		1	1
		Nuculana pernula	16	33	49
		Thyasira gouldi	2	4	6
		Thyasira sarsii	5		5
		Yoldia hyperborea		2	2
ECHINODERMATA					
	Ophiuroidea				
		Ophiocten affinis	4	3	7
		Ophiura albida	1	1	2
		Ophiuroidea indet. juv.	3	11	14
		Maks:	77	159	236
		Antall:	31	33	39
		Sum:			815

Stasjonsnr.: C3

NEMERTINI					
		Nemertea indet.		1	1
SIPUNCULIDA					
		Phascolion strombus		1	1
ANNELIDA					
	Polychaeta				
		Chaetozone setosa	1		1
		Chaetozone sp.	1		1
		Cistenides hyperborea	1		1
		Diplocirrus longisetosus	4	7	11
		Dipolydora coeca	1	1	2
		Euchone sp.	1		1
		Galathowenia oculata	51	50	101
		Lagis koreni	4	14	18
		Laphania boecki		1	1
		Leitoscoloplos mammosus		1	1
		Levinsenia gracilis	66	53	119
		Lumbrineris mixochaeta	1		1
		Maldane sarsi	13	10	23
		Melinna cristata		1	1
		Myriochele malmgreni/olgae	31	15	46
		Nephtys ciliata	3	7	10
		Nothria conchylega		1	1
		Owenia sp.	91	77	168
		Paramphinome jeffreysii		1	1
		Pholoe assimilis		1	1
		Praxillella gracilis	6	7	13
		Praxillella praetermissa	5	15	20
		Prionospio steenstrupi	5	2	7
		Scoloplos armiger	4	1	5
		Spio limicola	4		4
		Sternaspis scutata	39	43	82
		Syllis cornuta		1	1
CRUSTACEA					
	Malacostraca				

Rekke	Klasse	Art/Taxa	01	02	Sum
		Argissa hamatipes	1		1
		Bathymedon obtusifrons	3	2	5
		Brachydiastylis resima		1	1
		Byblis sp.	2	6	8
		Eudorella sp.	4	5	9
		Leptostylis sp.	1	3	4
		Leucon sp.	10	21	31
		Lysianassidae indet.		1	1
		Oedicerotidae indet.	1	4	5
MOLLUSCA					
	Caudofoveata				
		Caudofoveata indet.		1	1
	Prosobranchia				
		Neogastropoda indet.		1	1
	Bivalvia				
		Abra nitida	13	18	31
		Arctica islandica	1	5	6
		Astarte sp. juv.		1	1
		Axinopsida orbiculata	2	4	6
		Ennucula tenuis	91	183	274
		Macoma calcarea	1		1
		Musculus niger		1	1
		Nuculana pernula	22	34	56
		Thyasira gouldi	6	4	10
		Thyasira sarsii	5	3	8
		Thyasiridae indet.		1	1
		Yoldia hyperborea		1	1
ECHINODERMATA					
	Ophiuroidea				
		Ophiocten affinis	3	1	4
		Ophiura albida	3	3	6
		Ophiuroidea indet. juv.	5	4	9
		Maks:	91	183	274
		Antall:	38	47	55
		Sum:			1125

Stasjonsnr.: C4

NEMERTINI					
		Nemertea indet.	2	1	3
ANNELIDA					
	Polychaeta				
		Ampharete petersenae	1		1
		Bradabyssa villosa	1		1
		Chaetozone setosa	1	1	2
		Chaetozone sp.	1		1
		Diplocirrus longisetosus	2	6	8
		Galathowenia oculata	47	48	95
		Heteromastus filiformis		2	2
		Lagis koreni	5	13	18
		Laphania boecki		2	2
		Levinsenia gracilis	57	57	114
		Maldane sarsi	6	4	10
		Melinna cristata	1		1
		Myriochele malmgreni/olgae	26	39	65
		Nephtys ciliata	7	3	10

Rekke	Klasse	Art/Taxa	01	02	Sum
		Owenia sp.	43	90	133
		Phyllodoce groenlandica		1	1
		Polynoidae indet.	1		1
		Praxillella gracilis	7	12	19
		Praxillella praetermissa	6	11	17
		Prionospio steenstrupi	5	1	6
		Rhodine gracilior		2	2
		Scoloplos armiger	1		1
		Sphaerodorum gracilis	1		1
		Spio limicola	1	2	3
		Sternaspis scutata	55	27	82
		Syllis cornuta		1	1
CRUSTACEA					
	Malacostraca				
		Bathymedon obtusifrons		1	1
		Byblis sp.	1		1
		Eudorella sp.	2	4	6
		Leptostylis sp.	1	1	2
		Leucon sp.	17	16	33
		Oedicerotidae indet.	1	1	2
		Stenothoidae indet.	1		1
MOLLUSCA					
	Caudofoveata				
		Caudofoveata indet.		2	2
	Bivalvia				
		Abra nitida	10	16	26
		Arctica islandica	3		3
		Axinopsida orbiculata	5	16	21
		Ennucula tenuis	112	156	268
		Musculus niger	2		2
		Mya sp. juv.	1	1	2
		Nuculana pernula	18	29	47
		Thracia myopsis	1	1	2
		Thyasira gouldi	7	2	9
		Thyasira sarsii	6	6	12
		Thyasiridae indet.	1		1
		Yoldia hyperborea		1	1
ECHINODERMATA					
	Ophiuroidea				
		Ophiocten affinis	3	2	5
		Ophiura albida		3	3
		Ophiuroidea indet. juv.	5	8	13
		Maks:	112	156	268
		Antall:	41	38	50
		Sum:			1063

Stasjonsnr.: Cref

ANNELIDA					
	Polychaeta				
		Cistenides hyperborea		1	1
		Diplocirrus longisetosus	1	2	3
		Galathowenia oculata	32	33	65
		Lagis koreni		5	5
		Levinsenia gracilis	34	17	51
		Maldane sarsi	9	22	31
		Melinna cristata		1	1

Rekke	Klasse	Art/Taxa	01	02	Sum
		Myriochele malmgreni/olgae	22	13	35
		Nephtys ciliata	5	7	12
		Owenia sp.	8	8	16
		Polycirrus sp.	1		1
		Polynoidae indet.	1		1
		Potamilla neglecta		1	1
		Praxillella gracilis	6		6
		Praxillella praetermissa		10	10
		Prionospio steenstrupi	4	2	6
		Rhodine gracilior		1	1
		Scoloplos armiger	1		1
		Sternaspis scutata	34	18	52
		Terebellides sp.		1	1
CRUSTACEA					
	Ostracoda				
		Ostracoda indet.	1		1
	Malacostraca				
		Bathymedon obtusifrons	3		3
		Campylaspis sp.	1	1	2
		Dulichiidae indet.		2	2
		Eudorella sp.	4	2	6
		Leucon sp.	7	7	14
		Oedicerotidae indet.	1	2	3
MOLLUSCA					
	Caudofoveata				
		Caudofoveata indet.	1		1
	Bivalvia				
		Abra nitida	24	18	42
		Arctica islandica	1	2	3
		Axinopsida orbiculata	5	6	11
		Crenella decussata	4	6	10
		Ennucula tenuis	159	126	285
		Kurtiella bidentata	1		1
		Mya arenaria		1	1
		Mya sp. juv.	1		1
		Nuculana pernula	30	20	50
		Thyasira gouldi	4	5	9
		Thyasira sarsii	4	6	10
		Yoldia hyperborea		1	1
ECHINODERMATA					
	Asteroidea				
		Ctenodiscus crispatus	1		1
		Leptasterias muelleri		1	1
	Ophiuroidea				
		Ophiocten affinis	3	3	6
		Ophiura albida		1	1
		Ophiuroidea indet. juv.	5	4	9
		Maks:	159	126	285
		Antall:	33	35	45
		Sum:			774
				TOTAL:	***Maks:*** 383
					Sum: 5142

7.4 Analytical report

Akvaplan niva

NORSK AKKREDITERING TEST 079

ANALYSERAPPORT

Kunde:	Arctic Sea Farm / Arctic Fish	**Rapport nr.:**	P2100013
Kundemerking:	Eyrarhlid		
Kontaktperson kunde:		**Rapportdato**	**2021-05-21**
		Ankomst dato	2021-04-23

Lab-id. P2100013-01

Objekt	Kundens ID	Beskrivelse	Notering	Mottatt lab
Sediment	C1	63091 Eyrarhlid		2021-04-23

Analyseresultat

Parameter	Resultat	Enhet	Analysedato start	Analysedato slutt	Standard	Måleusikkerhet
TOC	22	mg/g TS	2021-04-27	2021-04-29	DIN 19539:2016	±2.2
TNb	2.9	mg/g TS	2021-04-27	2021-04-29	NS-EN 16168:2012	±0.4
N TOC	26.7	mg/g TS	2021-05-10	2021-05-10	Veileder 02:2018	
C/N - forhold	7.6		2021-05-10	2021-05-10		
TOM	7.6	% TS	2021-04-26	2021-04-29	Intern metode	±0.0
Vekt% pelitt (<0,063 mm)	72.4	% TS	2021-04-26	2021-04-29	Intern metode (Bale/Kenny 2005)	±3.6
Vekt% > 0.063 mm	27.6	% TS	2021-04-26	2021-04-29	Intern metode (Bale/Kenny 2005)	±1.4
Cu (kobber) [a]	39.1	mg/kg TS	2021-05-05	2021-05-07	Intern metode	

[a] Prøvingen er utført av eksternt laboratorium, ALS Laboratory Group

Lab-id. P2100013-02

Objekt	Kundens ID	Beskrivelse	Notering	Mottatt lab
Sediment	C2/Curef1	63091 Eyrarhlid		2021-04-23

Analyseresultat

Parameter	Resultat	Enhet	Analysedato start	Analysedato slutt	Standard	Måleusikkerhet
TOC	23	mg/g TS	2021-04-27	2021-04-29	DIN 19539:2016	±2.3
TNb	2.1	mg/g TS	2021-04-27	2021-04-29	NS-EN 16168:2012	±0.3
N TOC	28.0	mg/g TS	2021-05-10	2021-05-10	Veileder 02:2018	
C/N - forhold	11.3		2021-05-10	2021-05-10		
TOM	7.9	% TS	2021-04-26	2021-04-29	Intern metode	±0.0
Vekt% pelitt (<0,063 mm)	73.5	% TS	2021-04-26	2021-04-29	Intern metode (Bale/Kenny 2005)	±3.7
Vekt% > 0.063 mm	26.5	% TS	2021-04-26	2021-04-29	Intern metode (Bale/Kenny 2005)	±1.3
Cu (kobber) [a]	39.1 38.5	mg/kg TS	2021-05-05	2021-05-07	Intern metode	

[a] Prøvingen er utført av eksternt laboratorium, ALS Laboratory Group

* – Ikke akkreditert resultat

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ANALYSERAPPORT

Kunde:	Arctic Sea Farm / Arctic Fish	**Rapport nr.:**	P2100013
Kundemerking:	Eyrarhlid		
Kontaktperson kunde:		**Rapportdato**	**2021-05-21**
		Ankomst dato	2021-04-23

Lab-id. P2100013-03

Objekt	Kundens ID	Beskrivelse	Notering	Mottatt lab
Sediment	C3	63091 Eyrarhlid		2021-04-23

Analyseresultat

Parameter	Resultat	Enhet	Analysedato start	Analysedato slutt	Standard	Måleusikkerhet
TOC	22	mg/g TS	2021-04-27	2021-04-29	DIN 19539:2016	±2.2
TNb	2.1	mg/g TS	2021-04-27	2021-04-29	NS-EN 16168:2012	±0.3
N TOC	26.4	mg/g TS	2021-05-10	2021-05-10	Veileder 02:2018	
C/N - forhold	10.3		2021-05-10	2021-05-10		
TOM	7.8	% TS	2021-04-26	2021-04-29	Intern metode	±0.0
Vekt% pelitt (<0,063 mm)	74.4	% TS	2021-04-26	2021-04-29	Intern metode (Bale/Kenny 2005)	±3.7
Vekt% > 0.063 mm	25.6	% TS	2021-04-26	2021-04-29	Intern metode (Bale/Kenny 2005)	±1.3

Lab-id. P2100013-04

Objekt	Kundens ID	Beskrivelse	Notering	Mottatt lab
Sediment	C4	63091 Eyrarhlid		2021-04-23

Analyseresultat

Parameter	Resultat	Enhet	Analysedato start	Analysedato slutt	Standard	Måleusikkerhet
TOC	24	mg/g TS	2021-04-27	2021-04-29	DIN 19539:2016	±2.4
TNb	2.8	mg/g TS	2021-04-27	2021-04-29	NS-EN 16168:2012	±0.4
N TOC	28.2	mg/g TS	2021-05-10	2021-05-10	Veileder 02:2018	
C/N - forhold	8.6		2021-05-10	2021-05-10		
TOM	8.5	% TS	2021-04-26	2021-04-29	Intern metode	±0.0
Vekt% pelitt (<0,063 mm)	75.4	% TS	2021-04-26	2021-04-29	Intern metode (Bale/Kenny 2005)	±3.8
Vekt% > 0.063 mm	24.6	% TS	2021-04-26	2021-04-29	Intern metode (Bale/Kenny 2005)	±1.2

* = Ikke akkreditert resultat

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ANALYSERAPPORT

Kunde:	Arctic Sea Farm / Arctic Fish	**Rapport nr.:**	P2100013
Kundemerking:	Eyrarhlid		
Kontaktperson kunde:		**Rapportdato**	2021-05-21
		Ankomst dato	2021-04-23

Lab-id. P2100013-05

Objekt	Kundens ID	Beskrivelse	Notering	Mottatt lab
Sediment	Cref/Cu ref2	63091 Eyrarhlid		2021-04-23

Analyseresultat

Parameter	Resultat	Enhet	Analysedato start	Analysedato slutt	Standard	Måleusikkerhet
TOC	24	mg/g TS	2021-04-27	2021-04-29	DIN 19539:2016	±2.4
TNb	2.6	mg/g TS	2021-04-27	2021-04-29	NS-EN 16168:2012	±0.4
N TOC	28.1	mg/g TS	2021-05-10	2021-05-10	Veileder 02:2018	
C/N - forhold	9.3		2021-05-10	2021-05-10		
TOM	10.1	% TS	2021-04-26	2021-04-29	Intern metode	±0.0
Vekt% pelitt (<0,063 mm)	78.8	% TS	2021-04-26	2021-04-29	Intern metode (Bale/Kenny 2005)	±3.9
Vekt% > 0.063 mm	21.2	% TS	2021-04-26	2021-04-29	Intern metode (Bale/Kenny 2005)	±1.1
Cu (kobber) [a]	39.1 40.3	mg/kg TS	2021-05-05	2021-05-07	Intern metode	

[a] Prøvingen er utført av eksternt laboratorium, ALS Laboratory Group

Lab-id. P2100013-06

Objekt	Kundens ID	Beskrivelse	Notering	Mottatt lab
Sediment	Cu ref3	63091 Eyrarhlid		2021-04-23

Analyseresultat

Parameter	Resultat	Enhet	Analysedato start	Analysedato slutt	Standard	Måleusikkerhet
Cu (kobber) [a]	13.7 14.7	mg/kg TS	2021-05-05	2021-05-07	Intern metode	

[a] Prøvingen er utført av eksternt laboratorium, ALS Laboratory Group

* = Ikke akkreditert resultat

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ANALYSERAPPORT

Kunde:	Arctic Sea Farm / Arctic Fish	**Rapport nr.:**	P2100013
Kundemerking:	Eyrarhlid		
Kontaktperson kunde:		**Rapportdato**	2021-05-21
		Ankomst dato	2021-04-23

Analyseansvarlig: Ingar H. Wasbotten

Signatur: Ingar H. Wasbotten

Underskriftsberettiget: Ingar H. Wasbotten

Signatur: Ingar H. Wasbotten

Analysene gjelder bare for de prøver som er testet. De oppgitte analyseresultat omfatter ikke feil som måtte følge av prøvetagningen, inhomogenitet eller andre forhold som kan ha påvirket prøven før den ble mottatt av laboratoriet. Rapporten får kun kopieres i sin helhet og uten noen form for endringer. En eventuell klage skal leveres laboratoriet senest en måned etter mottak av analyseresultat. Nærmere informasjon om analysemetodene (måleusikkerhet, metodeprinsipp etc.) fås ved henvendelse til Akvaplan-Niva AS

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