CRUISE REPORT

R/V Aranda

Cruise 03/2022

Combine spring

21.4.2022 – 30.4.2022

This report is based on preliminary data and is subject to changes.

Objectives of the cruise

The objectives of the cruise were:

1) Monitoring of the Northern Baltic Proper, Åland sea and the Southern part of the Bothnian Sea. Measured parameters were inorganic nutrients, pH, hydrography, phytoplankton community and chlorophyll a…

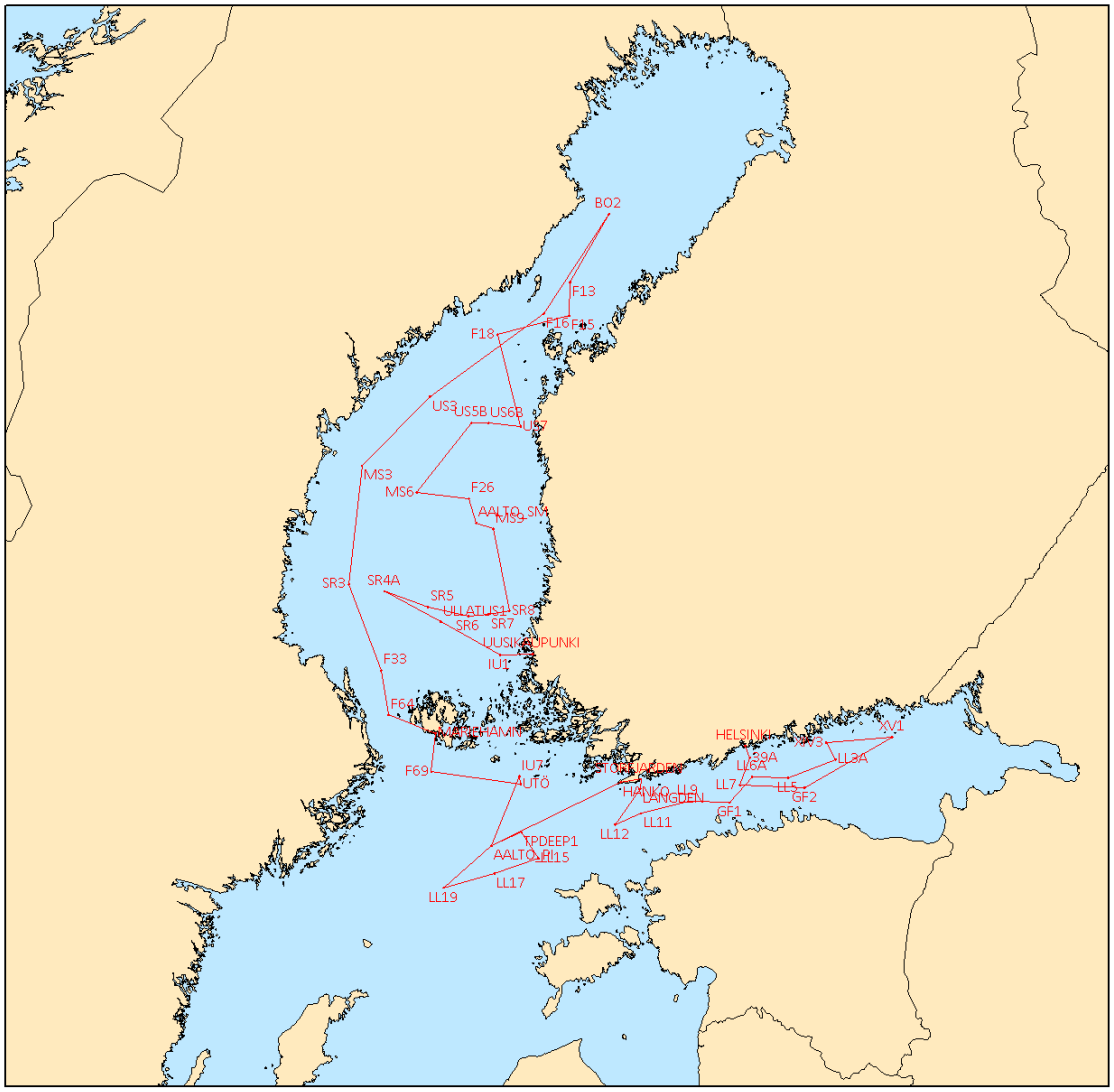
Table 1 The scientific crew

Name	On board	Organization
Kristian Spilling	21-30 April	SYKE
Tanja Kinnunen	21-30 April	SYKE
Haavisto Noora	21-30 April	SYKE
Varmanen Piia	21-30 April	SYKE
Hyvärinen Susanna	21-30 April	SYKE
Olga Kovru	21-30 April	SYKE
Jere Riikonen	21-30 April	SYKE
Riikka Mattsson	21-30 April	SYKE
Elisa Lindgren	21-30 April	FMI
Sami Pusa	21-30 April	FMI
Tuomo Roine	21-25 April	FMI
Erkka Ilonen	23-25 April	FMI
Heini Jalli	23-25 April	FMI
Pertti Jämsén	23-25 April	FMI
Aleksi Arola	23-25 April	FMI

Cruise Route

We left the home harbor in Helsinki around 10.30 on 21 April 2022. We sampled in the Gulf of Finland before a short stopover in Hanko to pick up personnel on 23 April. We headed into the Northern Baltic Proper where FMI carried our CTD calibrations before sampling outside Utö. We then had a brief stopover in Mariehamn to let some personnel off the ship before we continued into the Åland Sea, the Bothnian Sea and the Bothnian Bay. More sampling points were made in the Bothnian Sea on the way south before a final sampling point in the Archipelago Sea before ending the cruise in Uusikaupunki. The following Maameri cruise is back-to-back and have their cruise from Uusikaupunki to Helsinki.

Most stations were regular monitoring stations, but there were two servicing of wave buoys in the Gulf of Finland and Bothnian Sea in addition to the CTD calibration. Two of the monitoring stations in Archipelago Sea was sampled in the following Maameri cruise.



Cruise route

Observations

Based on the nutrients and chlorophyll a concentration we were sampling close to the peak of the spring bloom in the Gulf of Finland (Fig 1). In the Bothnian Sea there were much less Chla but higher concentration on the western side (Fig 1). However, the nitrate concentration was very low (Fig 2), and we were likely sampling close to the spring bloom peak also there. In the Bothnian Bay there was still ice left and we had to shift one of the sampling points due to ice coverage. The spring bloom is of much less pronounced in this area, and we were sampling at the lowest Chla concentration but also with relatively little inorganic phosphorus available (Fig 2 and 3).

The pH, which increases during primary production due to the removal of CO2, was highest in the Gulf of Finland, and together with the Chla data suggested that the had been most production in the surface water in that sub-basin prior to our sampling.

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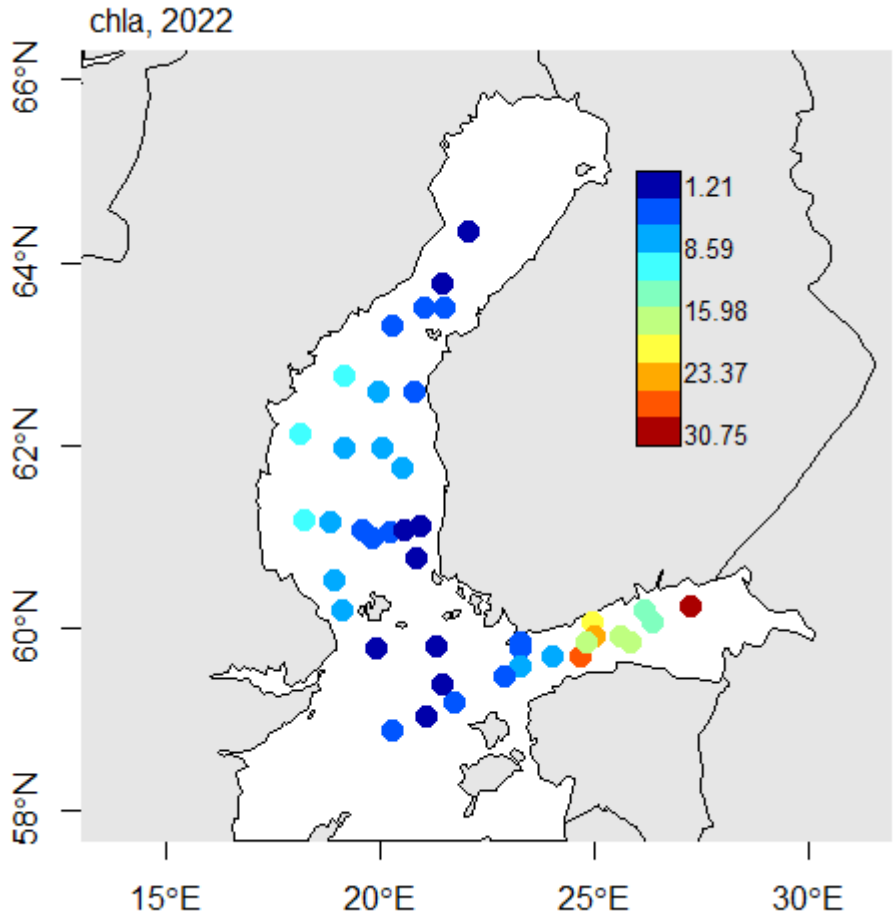

Fig 1. The chlorophyll a (Chla) concentration in µg L^{-1} measured at 5 m depth at the sampling stations.

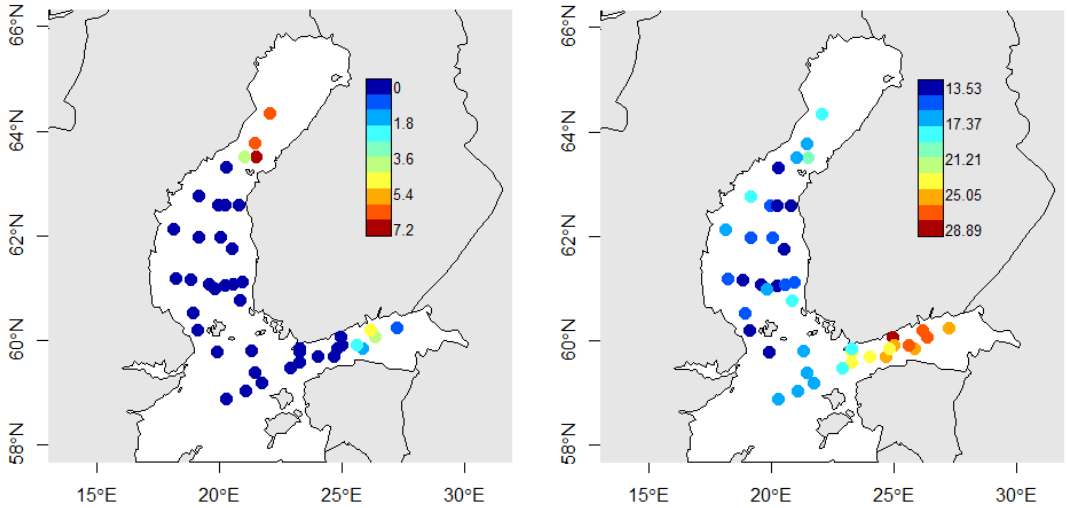

Fig 2. The nitrate (left) and total nitrogen (right) concentration in µmol L^{-1}, measured at 5 m depth at the sampling stations.

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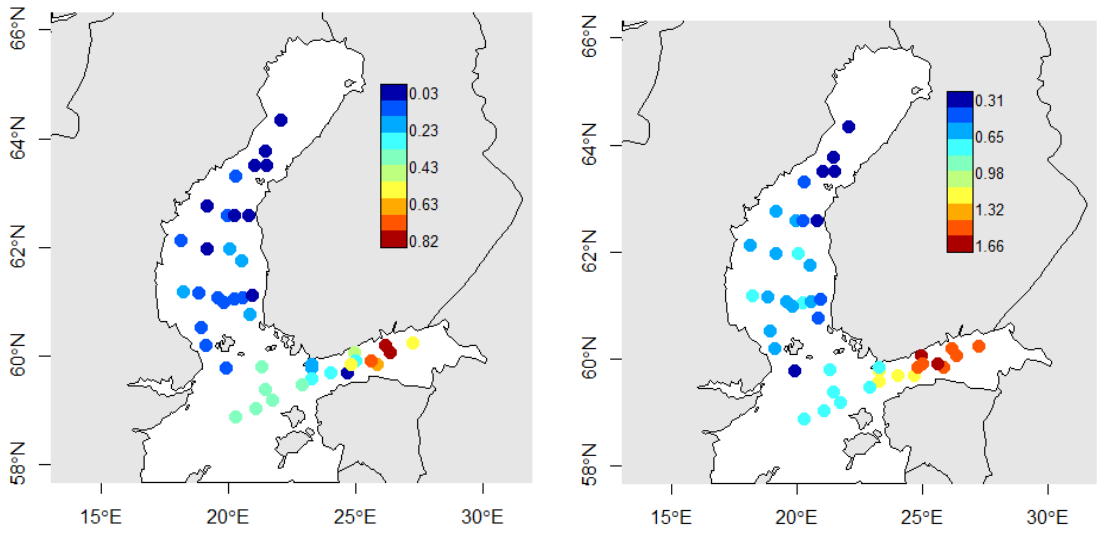

Fig 3. The phosphate (left) and total phosphorus (right) concentration in µmol L^{-1}, measured at 5 m depth at the sampling stations.

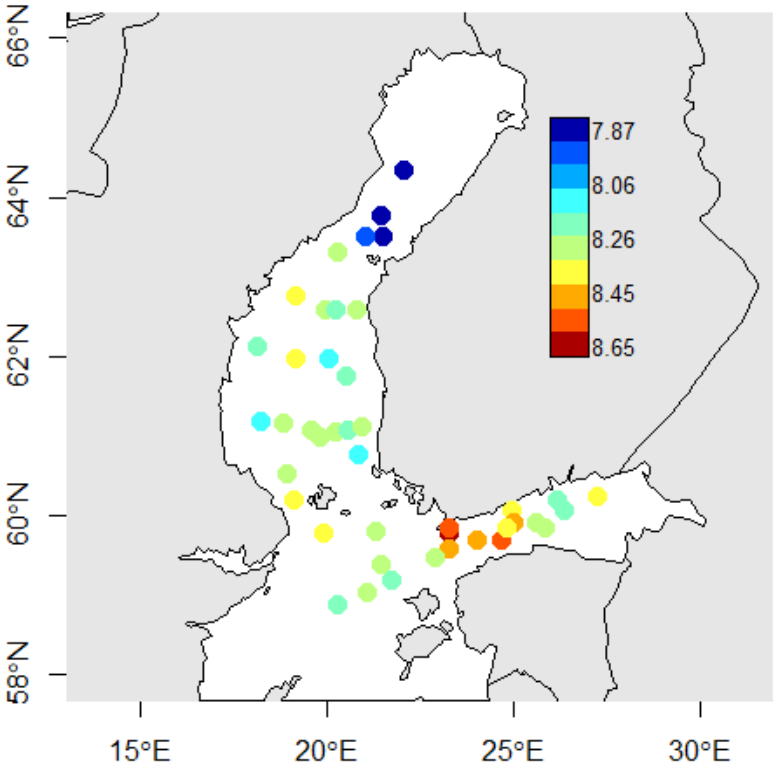

Fig 4. The pH measured at 5 m depth at the sampling stations.

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Conclusions

The phytoplankton spring bloom was well developed and at its peak in part of the Gulf of Finland, and also in the Bothnian Sea we were sampling during the peak or decline of the bloom as indicated by the low nitrate concentrations.

The sampling points in Bothnian Bay were clearly before any major growth event, but this sub-basin is also characterized by very low phytoplankton spring bloom peak compared with most other sub-basins in the Baltic Sea. There was still partly ice cover and these measurements could serve as a future reference.

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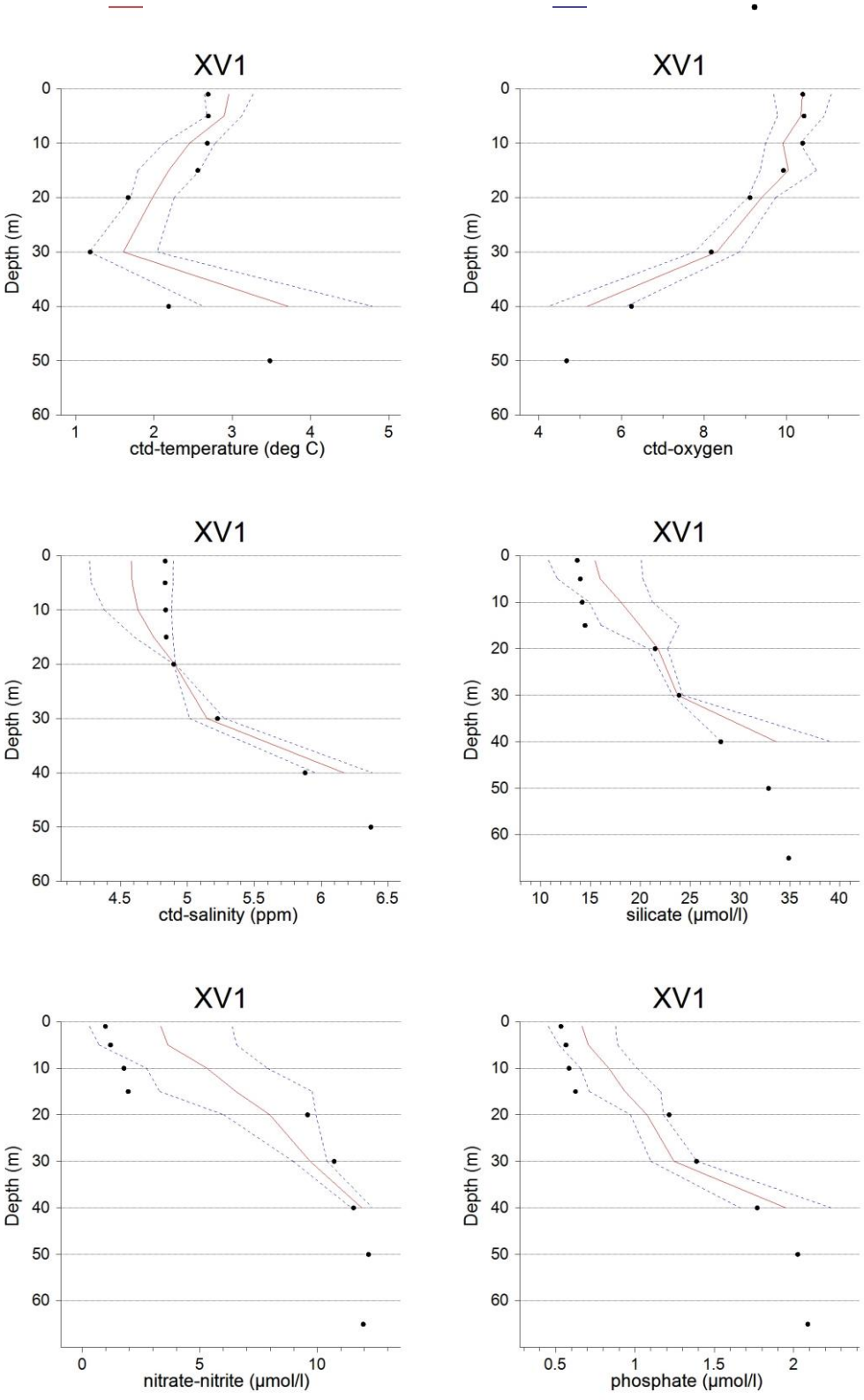
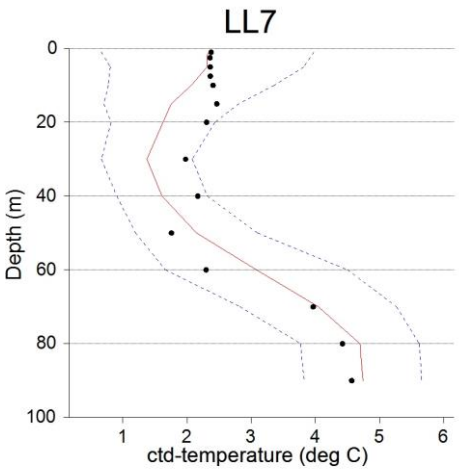
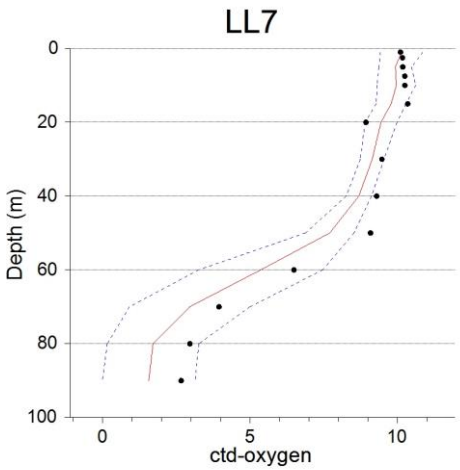
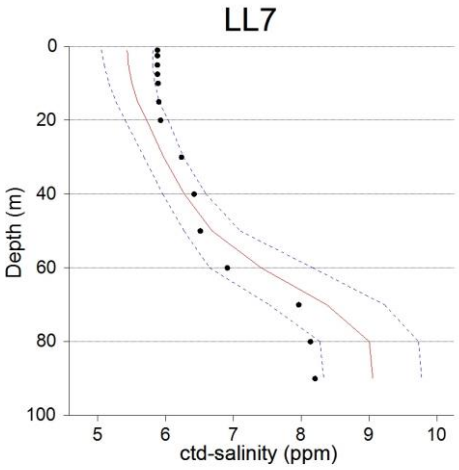
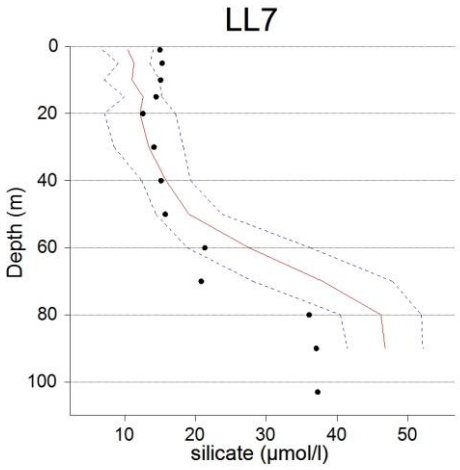
Annex 1. Selected variables at the stations XV1, LL7, LL12, LL17, F64, SR5, US5B, F18 and F13. Mean (red solid line) and standard deviation (blue dotted lines) represent the data collected at the same time of season since the year 2000.

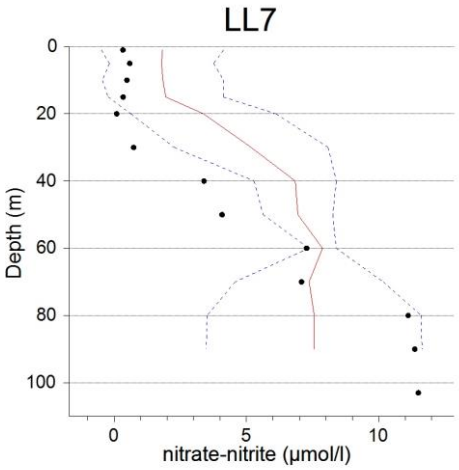


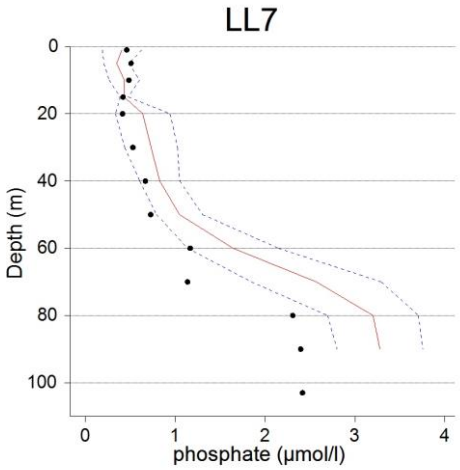

LL7
Depth (m)
0
20
40
60
80
100
1
2
3
4
5
6
ctd-temperature (deg C)

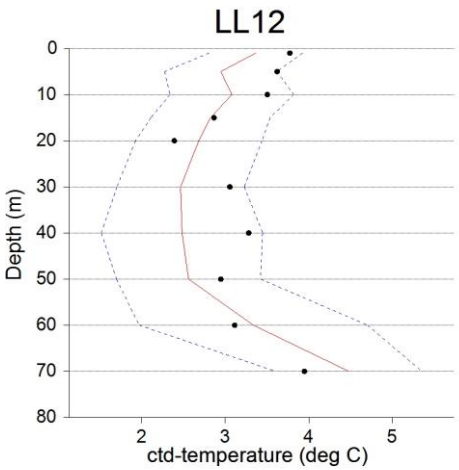

LL7
Depth (m)
0
20
40
60
80
100
0
5
10
ctd-oxygen

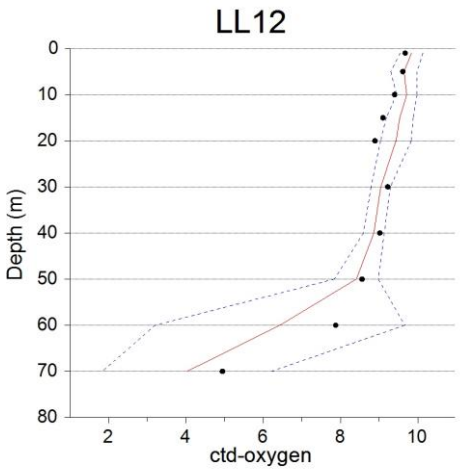

LL7
Depth (m)
0
20
40
60
80
100
5
6
7
8
9
10
ctd-salinity (ppm)

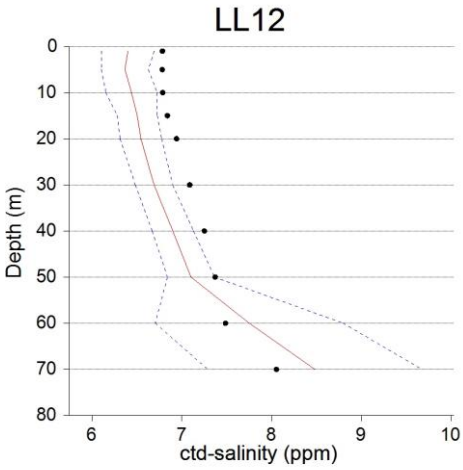

LL7
Depth (m)
0
20
40
60
80
100
10
20
30
40
50
silicate (µmol/l)

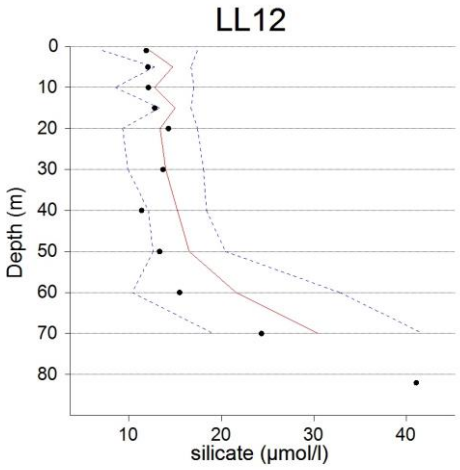

LL7
Depth (m)
0
20
40
60
80
100
0
5
10
nitrate-nitrite (µmol/l)

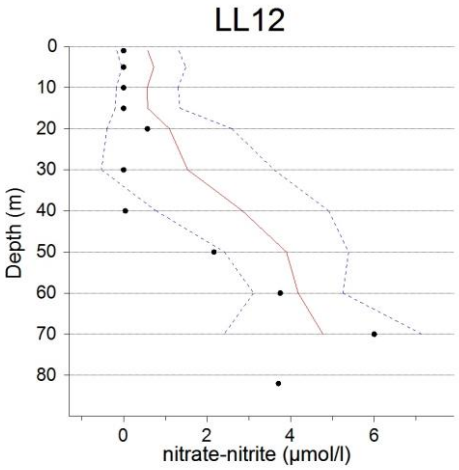

LL7
Depth (m)
0
20
40
60
80
100
0
1
2
3
4
phosphate (µmol/l)

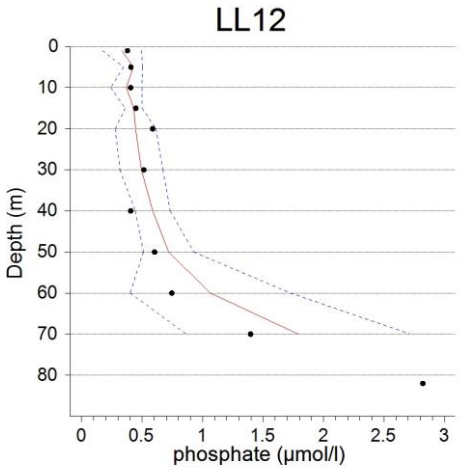

LL12
Depth (m)
0
10
20
30
40
50
60
70
80
2
3
4
5
ctd-temperature (deg C)

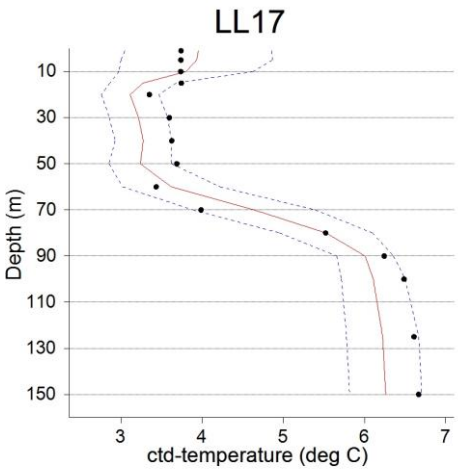

LL12
Depth (m)
0
10
20
30
40
50
60
70
80
2
4
6
8
10
ctd-oxygen

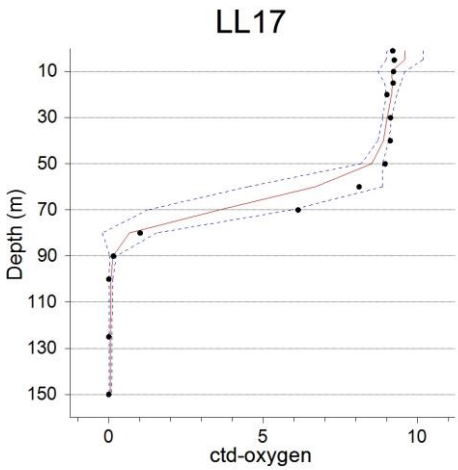

LL12
Depth (m)
0
10
20
30
40
50
60
70
80
6
7
8
9
10
ctd-salinity (ppm)

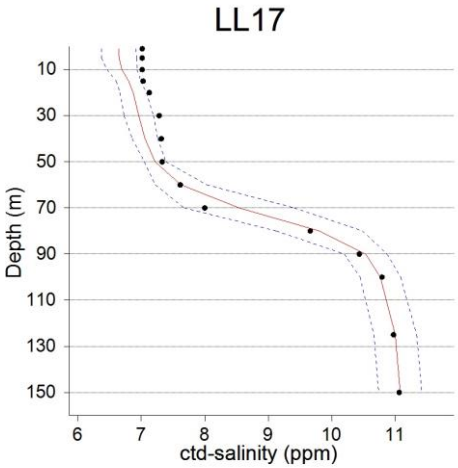

LL12
Depth (m)
0
10
20
30
40
50
60
70
80
10
20
30
40
silicate (µmol/l)

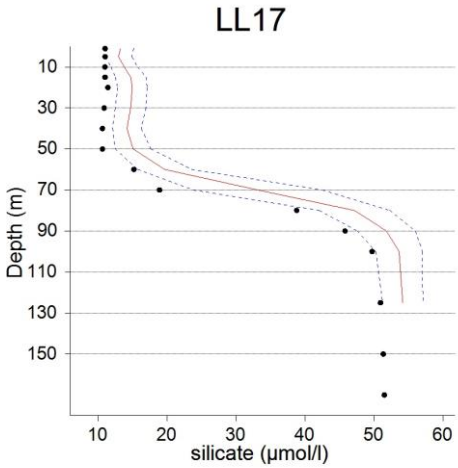

LL12
Depth (m)
0
10
20
30
40
50
60
70
80
0
2
4
6
nitrate-nitrite (µmol/l)

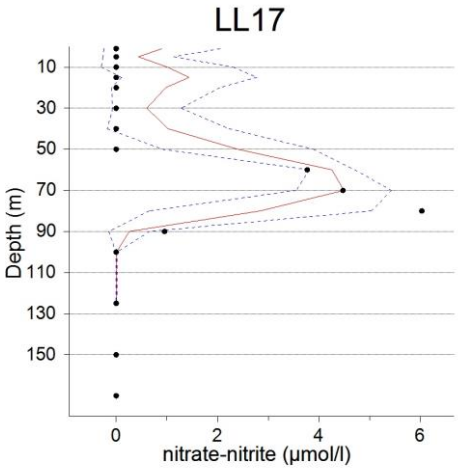

LL12
Depth (m)
0
10
20
30
40
50
60
70
80
0
0.5
1
1.5
2
2.5
3
phosphate (µmol/l)

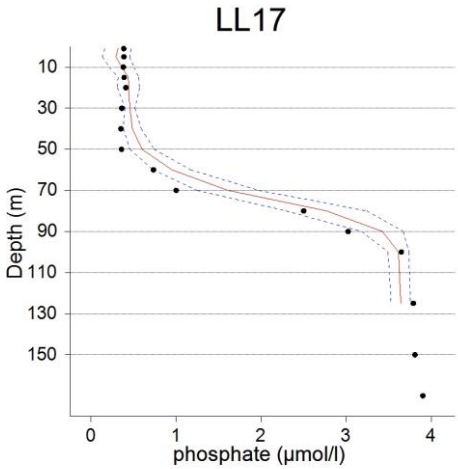

LL17
Depth (m)
10
30
50
70
90
110
130
150
3
4
5
6
7
ctd-temperature (deg C)

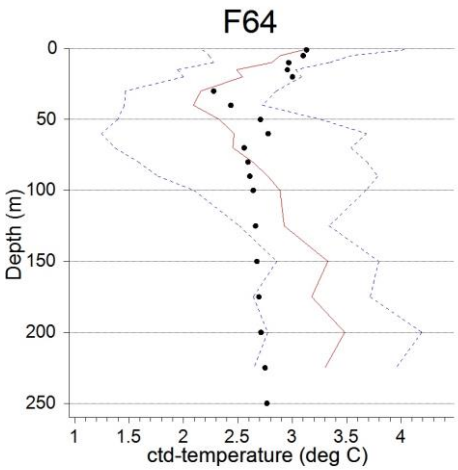

LL17
Depth (m)
10
30
50
70
90
110
130
150
0
5
10
ctd-oxygen

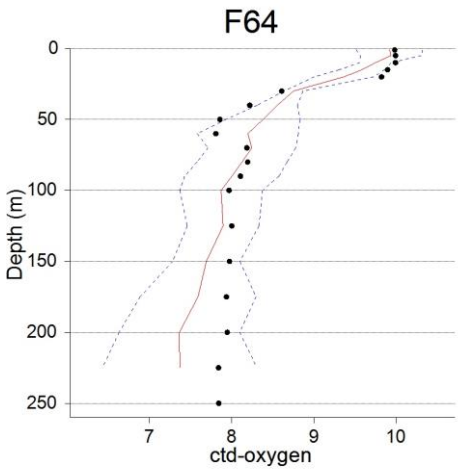

LL17
Depth (m)
10
30
50
70
90
110
130
150
6
7
8
9
10
11
ctd-salinity (ppm)

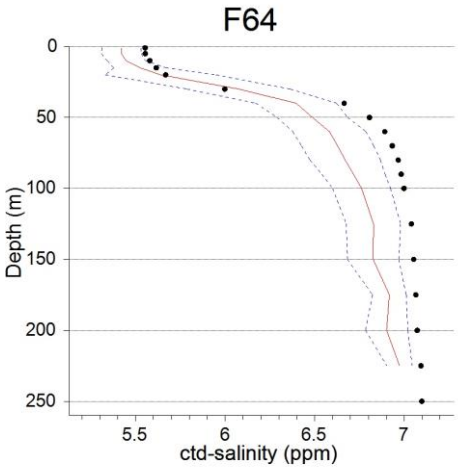

LL17
Depth (m)
10
30
50
70
90
110
130
150
10
20
30
40
50
60
silicate (µmol/l)

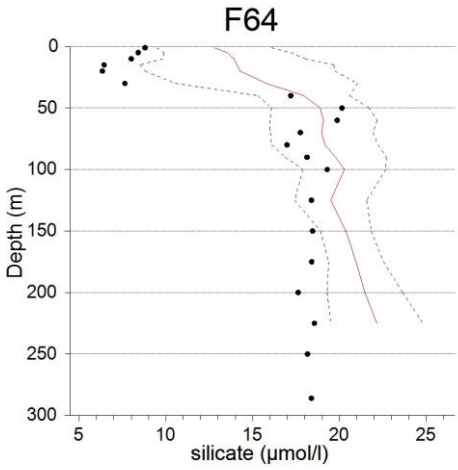

LL17
Depth (m)
10
30
50
70
90
110
130
150
0
2
4
6
nitrate-nitrite (µmol/l)

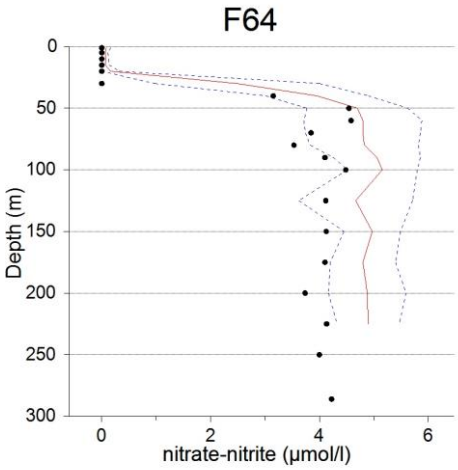

LL17
Depth (m)
10
30
50
70
90
110
130
150
0
1
2
3
4
phosphate (µmol/l)

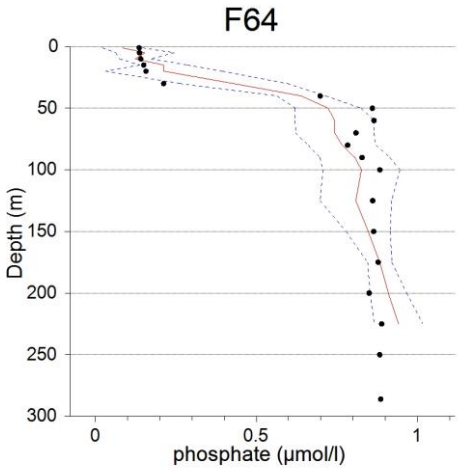

F64
Depth (m)
0
50
100
150
200
250
1
1.5
2
2.5
3
3.5
4
ctd-temperature (deg C)

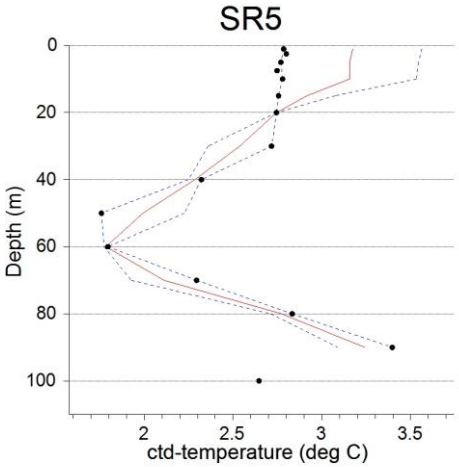

F64
Depth (m)
0
50
100
150
200
250
7
8
9
10
ctd-oxygen

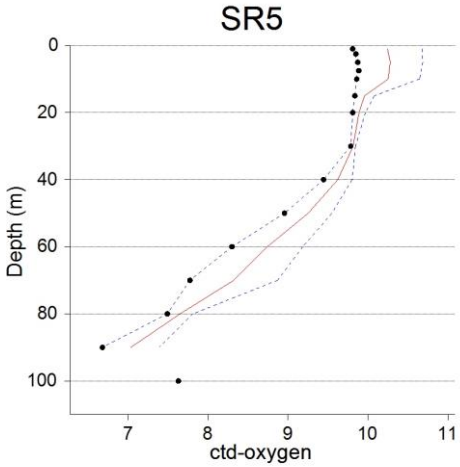

F64
Depth (m)
0
50
100
150
200
250
5.5
6
6.5
7
ctd-salinity (ppm)

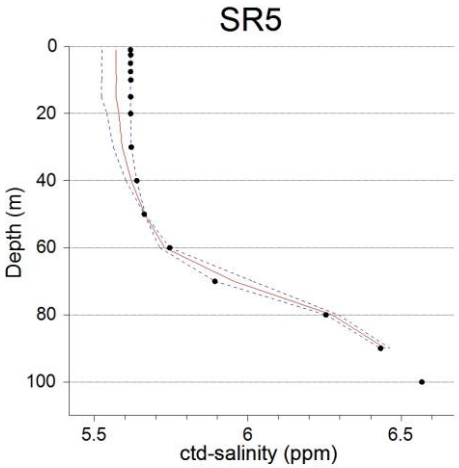

F64
Depth (m)
0
50
100
150
200
250
300
5
10
15
20
25
silicate (µmol/l)

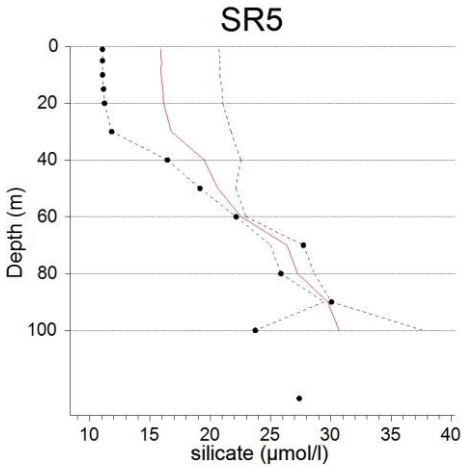

F64
Depth (m)
0
50
100
150
200
250
300
0
2
4
6
nitrate-nitrite (µmol/l)

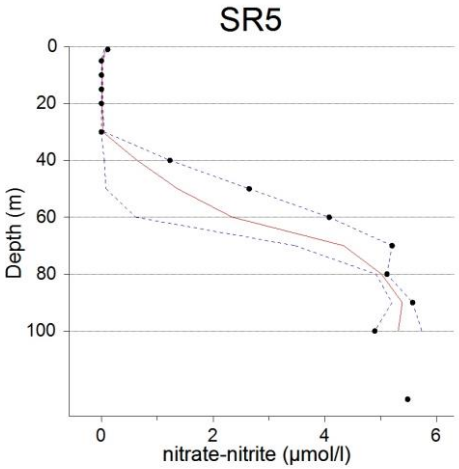

F64
Depth (m)
0
50
100
150
200
250
300
0
0.5
1
phosphate (µmol/l)

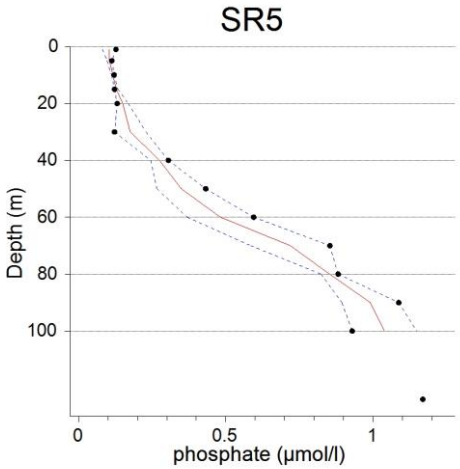

SR5
Depth (m)
0
20
40
60
80
100
2
2.5
3
3.5
ctd-temperature (deg C)

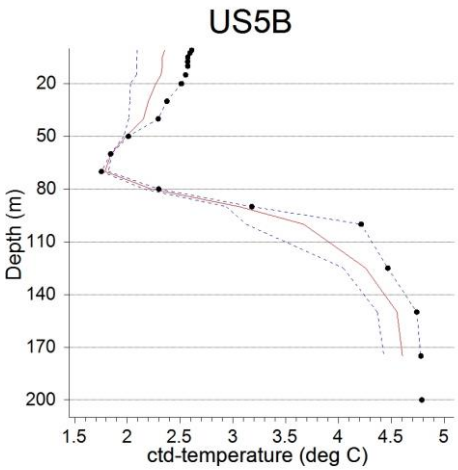

SR5
Depth (m)
0
20
40
60
80
100
7
8
9
10
11
ctd-oxygen

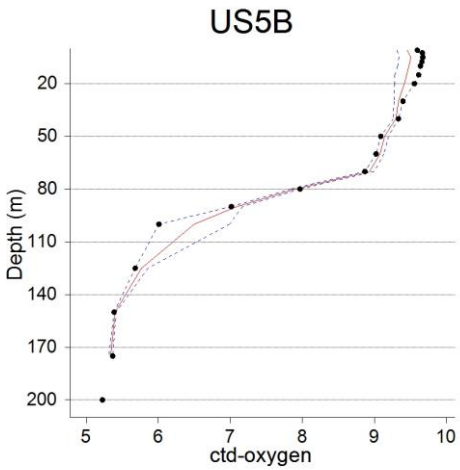

SR5
Depth (m)
0
20
40
60
80
100
5.5
6
6.5
ctd-salinity (ppm)

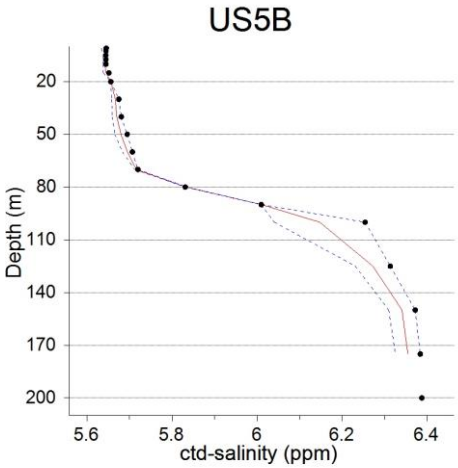

SR5
Depth (m)
0
20
40
60
80
100
10
15
20
25
30
35
40
silicate (µmol/l)

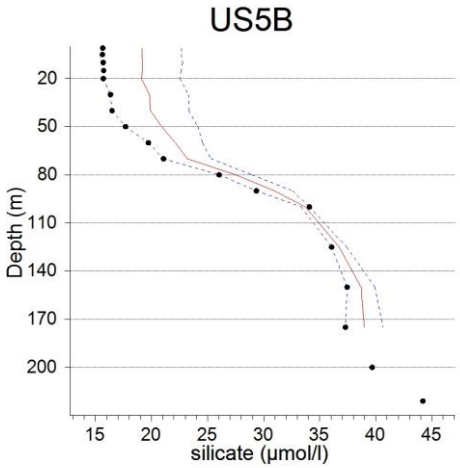

SR5
Depth (m)
0
20
40
60
80
100
0
2
4
6
nitrate-nitrite (µmol/l)

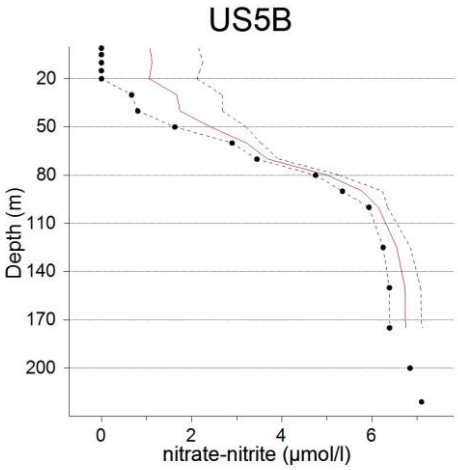

SR5
Depth (m)
0
20
40
60
80
100
0
0.5
1
phosphate (µmol/l)

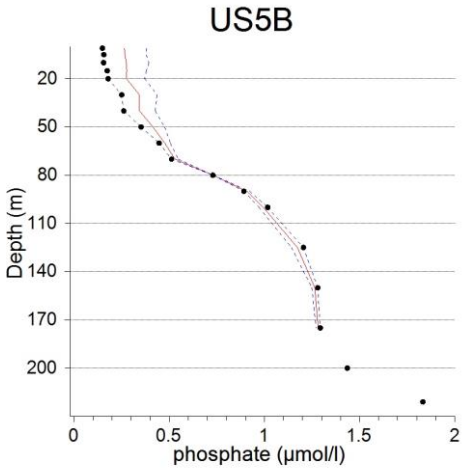

US5B
Depth (m)
20
50
80
110
140
170
200
1.5
2
2.5
3
3.5
4
4.5
5
ctd-temperature (deg C)

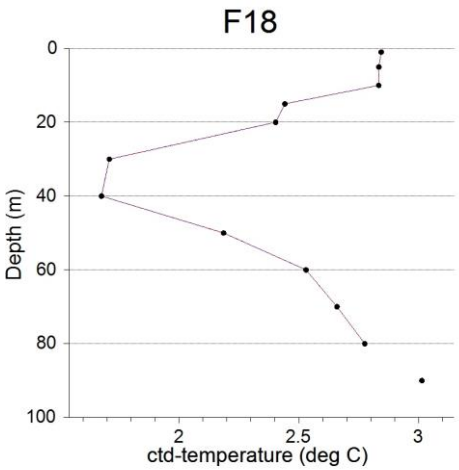

US5B
Depth (m)
20
50
80
110
140
170
200
5
6
7
8
9
10
ctd-oxygen

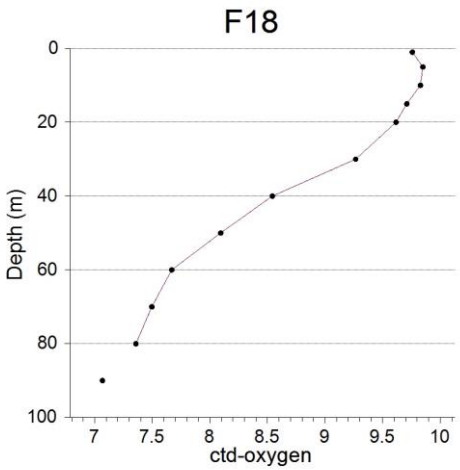

US5B
Depth (m)
20
50
80
110
140
170
200
5.6
5.8
6
6.2
6.4
ctd-salinity (ppm)

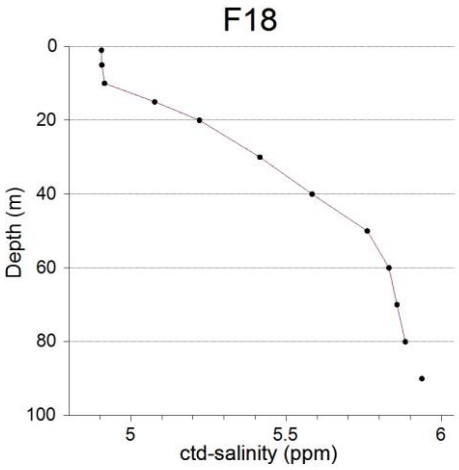

US5B
Depth (m)
20
50
80
110
140
170
200
15
20
25
30
35
40
45
silicate (µmol/l)

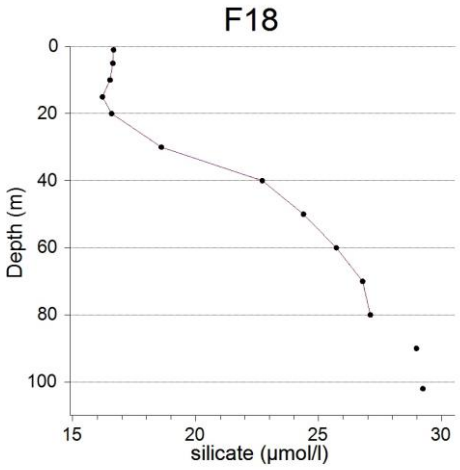

US5B
Depth (m)
20
50
80
110
140
170
200
0
2
4
6
nitrate-nitrite (µmol/l)

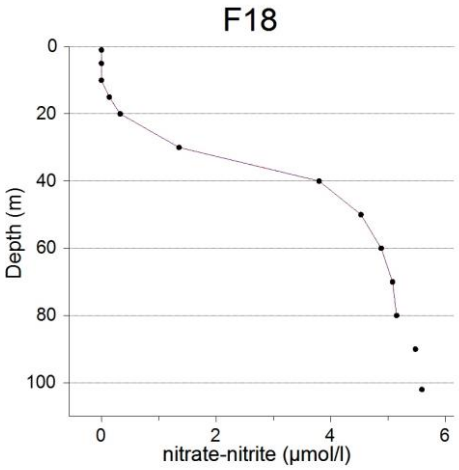

US5B
Depth (m)
20
50
80
110
140
170
200
0
0.5
1
1.5
2
phosphate (µmol/l)

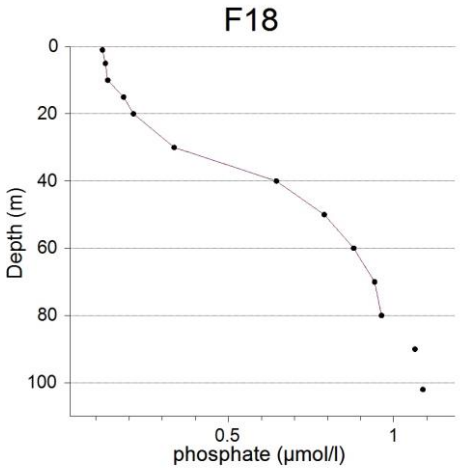

F18
Depth (m)
0
20
40
60
80
100
2
2.5
3
ctd-temperature (deg C)

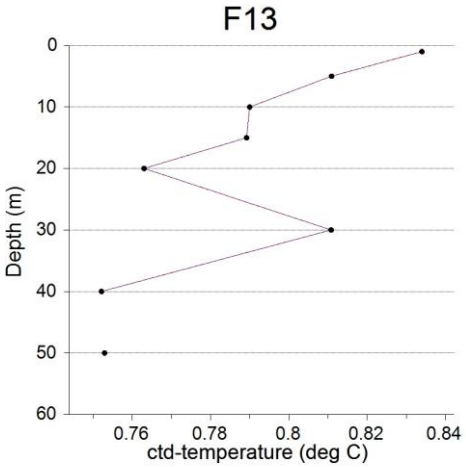

F18
Depth (m)
0
20
40
60
80
100
7
7.5
8
8.5
9
9.5
10
ctd-oxygen

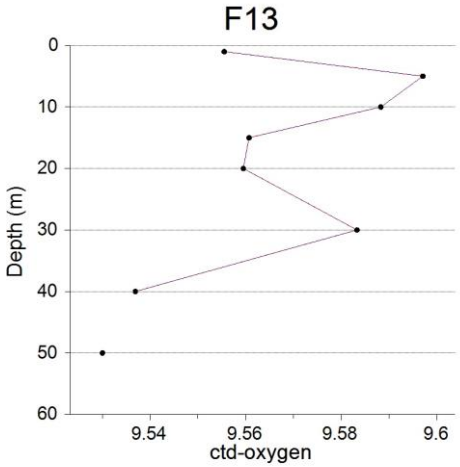

F18
Depth (m)
0
20
40
60
80
100
5
5.5
6
ctd-salinity (ppm)

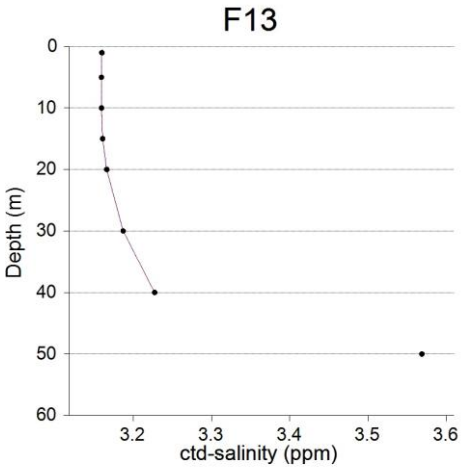

F18
Depth (m)
0
20
40
60
80
100
15
20
25
30
silicate (µmol/l)

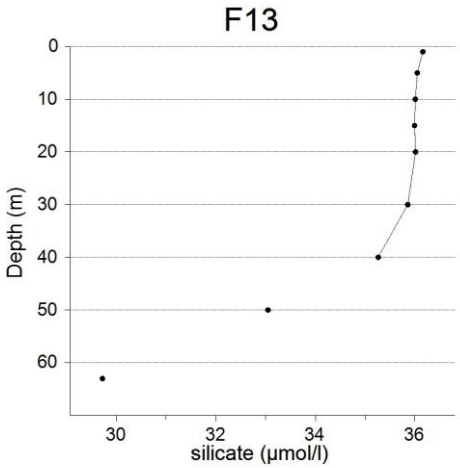

F18
Depth (m)
0
20
40
60
80
100
0
2
4
6
nitrate-nitrite (µmol/l)

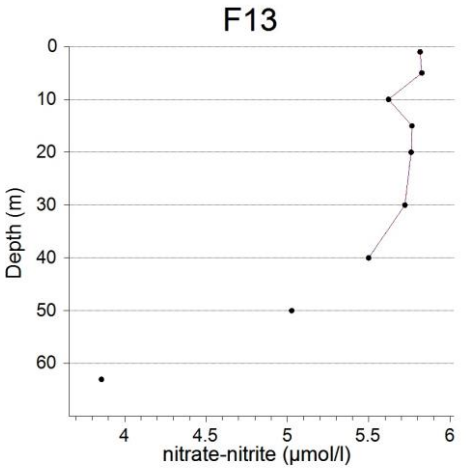

F18
Depth (m)
0
20
40
60
80
100
0.5
1
phosphate (µmol/l)

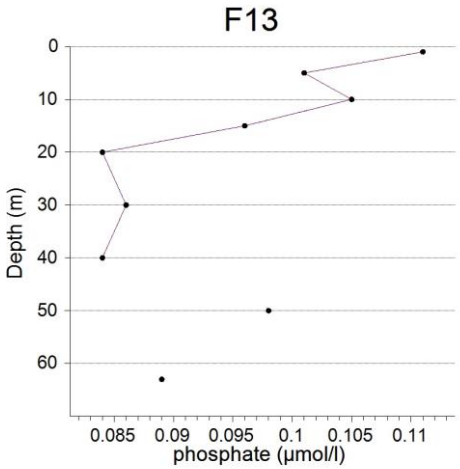

F13
Depth (m)
0
10
20
30
40
50
60
0.76
0.78
0.8
0.82
0.84
ctd-temperature (deg C)


F13
Depth (m)
0
10
20
30
40
50
60
9.54
9.56
9.58
9.6
ctd-oxygen


F13
Depth (m)
0
10
20
30
40
50
60
3.2
3.3
3.4
3.5
3.6
ctd-salinity (ppm)


F13
Depth (m)
0
10
20
30
40
50
60
30
32
34
36
silicate (µmol/l)


F13
Depth (m)
0
10
20
30
40
50
60
4
4.5
5
5.5
6
nitrate-nitrite (µmol/l)


F13
Depth (m)
0
10
20
30
40
50
60
0.085
0.09
0.095
0.1
0.105
0.11
phosphate (µmol/l)

Annex 2. List of sampled stations of the cruise

INDEX	STATION	latitude	longitude	depth	DATE	time	ctd	pH	ox	nu	ph	zo	be	chl	oil	tox	secchi
HELSINKI	HELSINKI	60.16180	24.90157		2022-04-21	06:31											
2022010098	39A	60.06688	24.98010	42	2022-04-21	08:40	x	x	x	x				x			x
2022010099	LL7	59.84653	24.83770	104	2022-04-21	11:15	x	x	x	x	x			x			x
2022010100	GF2	59.83852	25.85668	85	2022-04-21	15:43	x	x	x	x				x			x
2022010101	XV1	60.25005	27.24692	66	2022-04-21	21:55	x	x	x	x	x			x			
2022010102	XIV3	60.20315	26.19282	76	2022-04-22	02:36	x	x	x	x				x			
2022010103	LL3A	60.06732	26.34673	68	2022-04-22	04:38	x	x	x	x				x			x
2022010104	LL5	59.91683	25.59697	70	2022-04-22	08:17	x	x	x	x				x			x
2022010105	LL6A	59.91682	25.03020	73	2022-04-22	11:09	x	x	x	x				x			x
2022010106	GF1	59.70505	24.68205	84	2022-04-22	13:46	x	x	x	x	x			x			x
2022010107	LL9	59.70020	24.03032	67	2022-04-22	16:57	x	x	x	x	x			x			x
2022010108	LL11	59.58353	23.29683	67	2022-04-22	20:30	x	x	x	x				x			
2022010109	LL12	59.48352	22.89678	83	2022-04-22	23:12	x	x	x	x	x			x			
2022010110	LANGDEN	59.77683	23.26283	57	2022-04-23	02:45	x	x	x	x	x			x			
2022010111	STORFJARDEN	59.85598	23.26397	35	2022-04-23	04:41	x	x	x	x	x			x			x
HANKO	HANKO	59.82152	22.94805		2022-04-23	07:02											
2022010112	AALTO_PI	59.25093	20.99305	98	2022-04-23	14:54											
2022010113	LL19	58.88075	20.31078	164	2022-04-23	18:27	x	x	x	x				x			
2022010114	LL17	59.03337	21.07942	171	2022-04-23	22:51	x	x	x	x	x			x			
2022010115	LL15	59.18347	21.74608	131	2022-04-24	03:13	x	x	x	x				x			
2022010116	TPDEEP1	59.37832	21.44113	216	2022-04-24	06:40	x	x	x	x				x			x
2022010117	TPDEEP1	59.37830	21.44113	216	2022-04-24	09:04	x		x								x
2022010118	TPDEEP1	59.37830	21.44117	216	2022-04-24	11:38	x		x								x
2022010119	AALTO_PI	59.24927	20.99678	100	2022-04-24	15:12											
2022010120	IU7	59.81515	21.33660	92	2022-04-24	20:34	x										
2022010121	IU7	59.81515	21.33662	93	2022-04-24	21:42	x	x	x	x	x			x			
2022010122	UTÖ	59.75487	21.36457	70	2022-04-24	23:30											
2022010123	F69	59.78335	19.92990	190	2022-04-25	05:11	x	x	x	x				x			x
MARIEHAMN	MARIEHAMN	60.09093	19.92785		2022-04-25	08:48											
2022010124	F64	60.18900	19.14250	287	2022-04-25	12:12	x	x	x	x	x			x			x
2022010125	F33	60.53313	18.93765	136	2022-04-25	16:30	x	x	x	x				x			x
2022010126	SR3	61.18332	18.23002	73	2022-04-25	22:18	x	x	x	x				x			
2022010127	MS3	62.13450	18.16287	85	2022-04-26	05:13	x	x	x	x				x			x
2022010128	US3	62.75885	19.19570	177	2022-04-26	11:01	x	x	x	x				x			x
2022010129	F16	63.51673	21.06308	50	2022-04-26	18:59	x	x	x	x	x			x			
2022010130	BO2	64.35005	22.08450	107	2022-04-27	02:39	x	x	x	x	x			x			
2022010131	F13	63.78350	21.47958	64	2022-04-27	07:42	x	x	x	x				x			x
2022010132	F15	63.51690	21.51303	48	2022-04-27	10:19	x	x	x	x				x			x
2022010133	F18	63.31425	20.27257	103	2022-04-27	14:52	x	x	x	x				x			x
2022010134	US7	62.60023	20.82975	27	2022-04-27	20:49	x	x	x	x				x			
2022010135	US6B	62.60015	20.26308	81	2022-04-27	23:48	x	x	x	x				x			
2022010136	US5B	62.58622	19.96882	222	2022-04-28	03:27	x	x	x	x	x			x			
2022010137	MS6	61.98367	19.16355	72	2022-04-28	09:13	x	x	x	x				x			x
2022010138	F26	61.98352	20.06310	138	2022-04-28	12:40	x	x	x	x				x			x
2022010139	AALTO_SM	61.79818	20.23325	105	2022-04-28	14:48	x										x
2022010140	MS9	61.76682	20.53038	101	2022-04-28	17:59	x	x	x	x				x			
2022010141	SR8	61.12647	20.93005	47	2022-04-28	23:06	x	x	x	x				x			
2022010142	SR7	61.08350	20.59642	78	2022-04-29	01:25	x	x	x	x				x			
2022010143	SR6	61.05018	20.26348	102	2022-04-29	04:36	x	x	x	x				x			x
2022010144	SR5	61.08337	19.57958	125	2022-04-29	07:49	x	x	x	x	x			x			x
2022010145	SR4A	61.16663	18.82977	64	2022-04-29	11:35	x	x	x	x				x			x
2022010146	ULLATUS1	60.97958	19.81762	121	2022-04-29	15:25	x	x	x	x				x			x
2022010147	IU1	60.76678	20.84673	33	2022-04-29	19:53	x	x	x	x				x			
UUSIKAUPUNKI	UUSIKAUPUNKI	60.79672	21.37515		2022-04-29	22:55											

Parameters: ox = oxygen, nu = nutrients, ph = phytoplankton, zo = zooplankton, be = benthos, chl = chlorophyll a, oil = dissolved oil, tox = phytotoxins.