Suomen ympäristökeskus
Finlands miljöcentral
Finnish Environment Institute

ILMATIETEEN LAITOS

CRUISE REPORT

R/V Aranda

Cruise 02/2024

Kevätseuranta 2024

13.4.2024 – 26.4.2024

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 temperature, salinity, inorganic nutrients, chlorophyll a, phytoplankton community composition, pH, H2S.
2) Investigation of the Gordyi shipwreck, and possible oil contamination.
3) We made several deployments, for example of wave buoys, and ARGO float, a deployment of passive collector of pharmaceutical products, and deployment a benthic lander plus sediment traps outside Utö.
4) We visited a sampling point further south (BY15) than our regular monitoring points to see if there any traces of a saltwater intrusion that took place in December.
5) An FMI team did calibration of CTDs belonging to different Finnish marine institutes.
6) We took eDNA samples for comparing with phytoplankton monitoring from one station in the Bothnian Sea.
7) A Syke team took samples for measuring the sinking speed and respiration of marine aggregates and collected samples for 16S bacterial sequencing of aggregates.
8) A US based team was on board and did vertical profile of imaging device recording holograms of plankton.
9) A Polish scientist determined the picoplankton community and grazing rates of these.

Table 1 The scientific crew

Name	On board	Organization
Kristian Spilling	13–26 April	Syke
Mira Granlund	13–26 April	Syke
Antti Räike	13–26 April	Syke
Riikka Mattsson	13–26 April	Syke
Jere Riikonen	13–26 April	Syke
Lastumäki Ilkka	13–26 April	Syke
Anne-Mari Lehto	13–26 April	Syke
Maria Immonen	13–26 April	Syke
Pia Varmanen	13–26 April	Syke
Sami Kielosto	13–22 April	Syke
Panu Hänninen	13–15 April	Syke
Kankaanpää Harri	13 April	Syke
Tommi Kontto	13 April	Syke
Henrik Hedberg	13–15 April	Syke
Josephin Lemke	13–26 April	Syke
Susanna Relander	13–15 April	Syke intern
Tuomo Roine	13–26 April	FMI
Heini Jalli	22–26 April	FMI

Meri Smedberg	13–26 April	FMI
Noora Haavisto	13–26 April	FMI
Joonas Virtasalo	15–22 April	GTK
Diego Lazaro	15–26 April	HY
Kasia Piwosz	16–26 Apil	Mar Inst, Poland
Aditya Nayak	16–26 April	Atalantic Univ, USA
Alexis Base	16–26 April	Atalantic Univ, USA
Olivia Ruchti	16–26 April	Atalantic Univ, USA

Cruise Route

We left Helsinki 13 April for the Goryij wreck, after which we returned to Helsinki shortly. Then we did the Eastern Gulf of Finland stations before returning to Helsinki again. The following morning, we sailed westwards, when north through the Archipelago Sea and along the Finnish coast northwards to the northernmost station BO3, before returning southwards closer to the Swedish coast. We had a stopover in Mariehamn, Åland, before the stations in Northern Baltic Proper and returned to Helsinki on 26 April. A map with the route is shown in Fig 1.

Sampling

A list of sampled stations and samples collected during the cruise is found in Annex 1. At each station a CTD profile was taken and when water samples were collected, the nutrient concentrations (NO2, NOX, NH3, PO4, SiO4, Total N, Total P), chlorophyll-a, O2 and pH were measured. If anoxic conditions were observed, also H2S was measured. The standard sampling depths were 1, 5, 10, 15, 20, 30, 40, 50, 60, 70, 80, 90, 100, 125, 150, 175, 200, 225 and 250 m, depending on the sampling station's depth. A water sample 1 m above the sea bottom was also taken. Chlorophyll-a were analyzed at 1, 5, 10, 15 and 20 m depth. Integrated samples from 0 - 10 m was taken for phytoplankton community composition at some sampling stations. These samples were fixed and will be analyzed later.

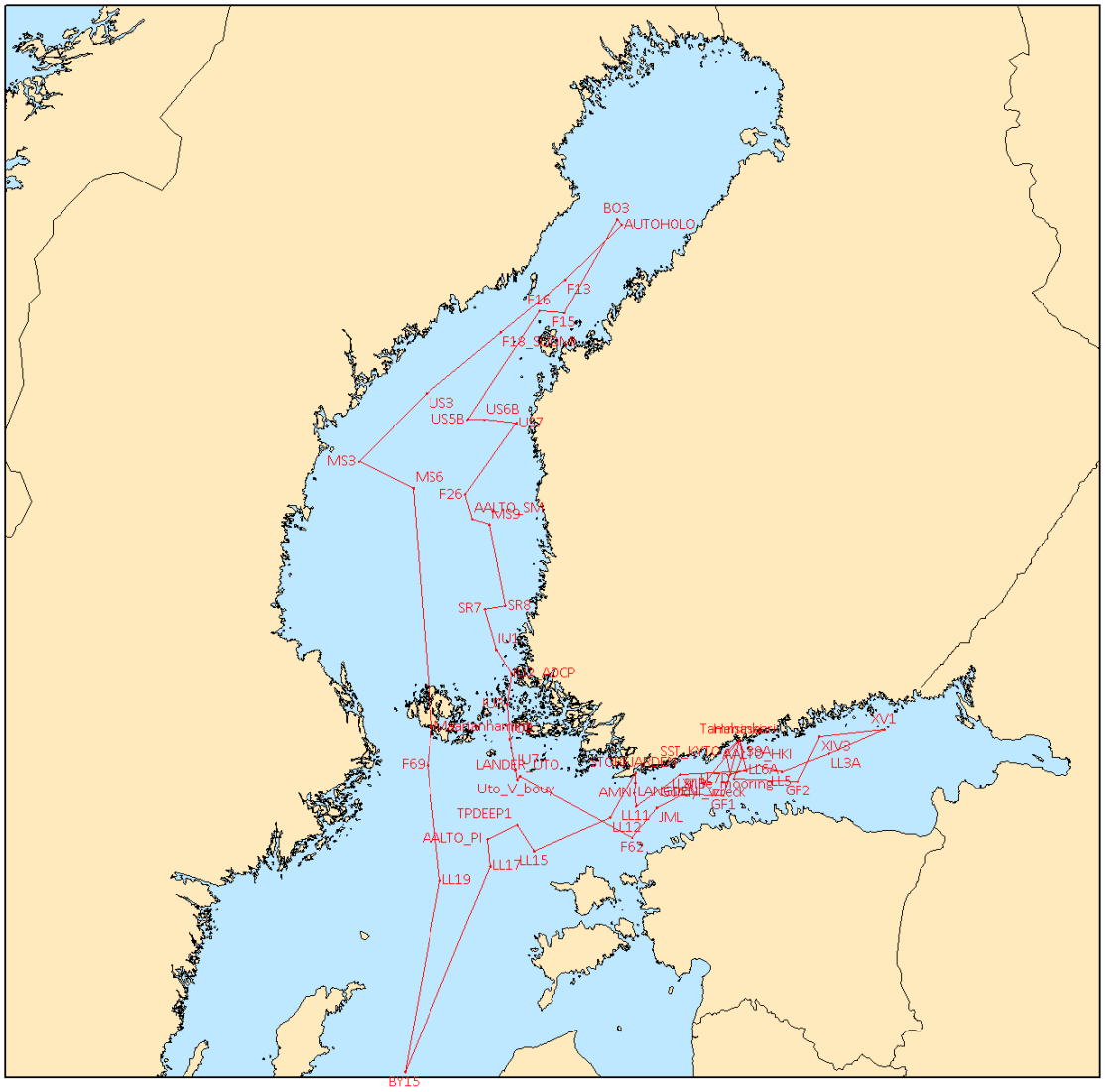


Fig 1. Cruise route

Observations

The temperature, salinity and oxygen profiles were as expected for the time of the year in the different sub-basins (Fig 2, Annex 1). We did not see any signs of the saltwater pulse that came during late December 2023.

Inorganic nutrients at the surface (Fig 3) were variable depending on the phase of the spring bloom and the sub-basin.

The spring bloom was at or close to its peak in Gulf of Finland, northern Baltic Proper and Archipelago Sea. In the Bothnian Sea it had started but not yet at its peak. In the Bothnian Bay it had not started at all and there was still an ice cover. In the southernmost point, outside Gotland, the spring bloom was clearly over and the place with the highest water transparency (Secchi depth of 11 m).

Finnish Environment Institute
Agnes Sjöbergin katu 2
FI-00790 Helsinki
Finland
http://www.syke.fi/en

Finnish Meteorological Institute
Erik Palménin aukio 1
P.O. Box 503
FI-00101 Helsinki
Finland
http://en.ilmatieteenlaitos.fi/

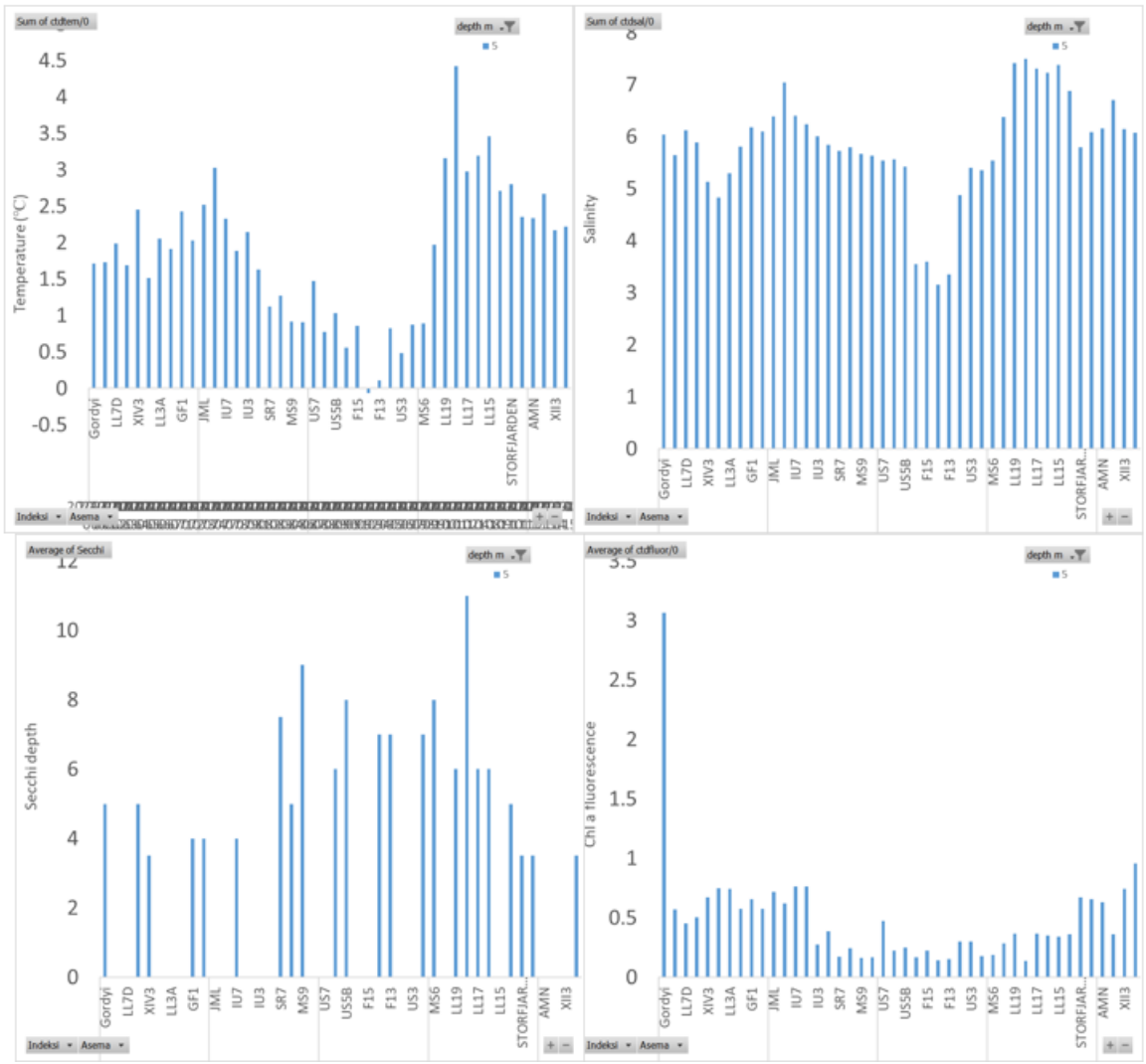


Fig 2. The temperature, salinity Secchi depth and Chla fluorescence at 5 m depth. Temperature, salinity and Chla fluorescence from the CTD, whereas Secchi depth was only taken during daytime, meaning not from all the stations.

Finnish Environment Institute
Agnes Sjöbergin katu 2
FI-00790 Helsinki
Finland
http://www.syke.fi/en

Finnish Meteorological Institute
Erik Palménin aukio 1
P.O. Box 503
FI-00101 Helsinki
Finland
http://en.ilmatieteenlaitos.fi/

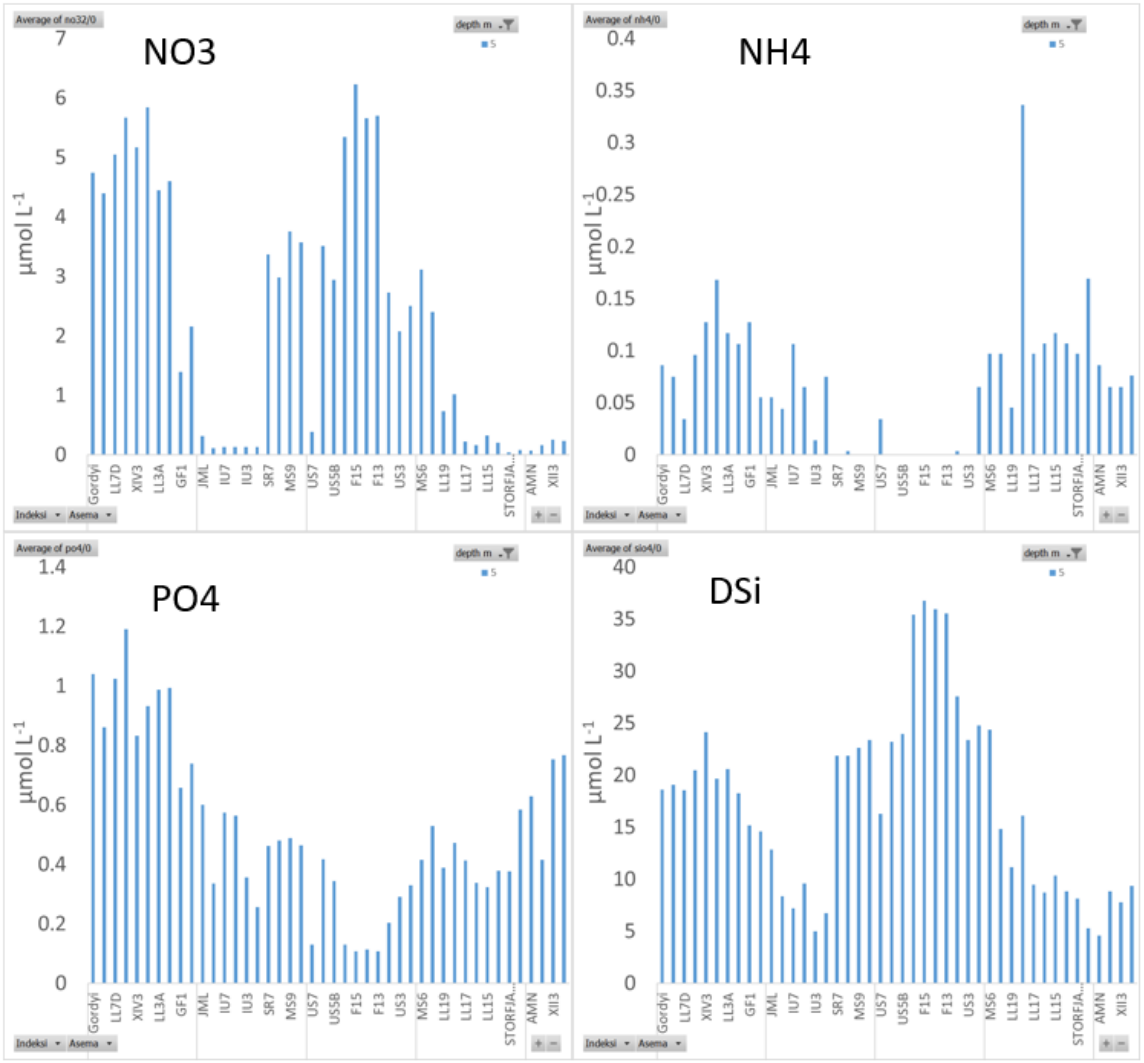


Fig 3 The concentration of nitrate (NO3), ammonium (NH4), phosphate (PO4) and dissolved silicate (DSi) 5 m depth, in the order of the stations (Annex 2).

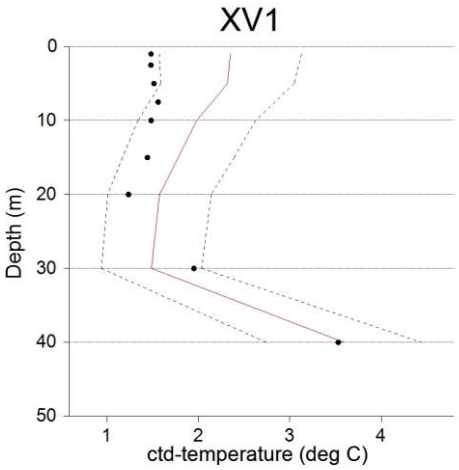
Conclusions

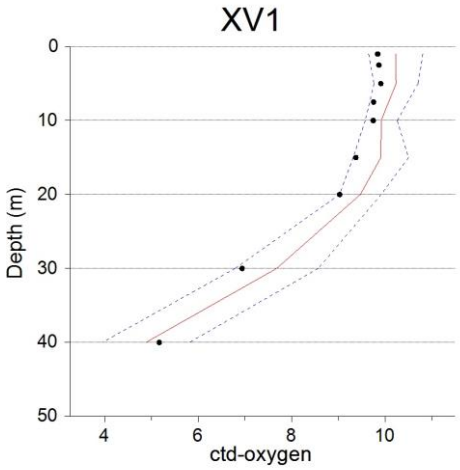
We were able to sample different phases of the spring bloom ranging from early, initiating bloom to peak biomass and one point that was clearly past the spring bloom. There was no sign of the saltwater intrusion that took place in December 2023 at the BY15 station east of Gotland.

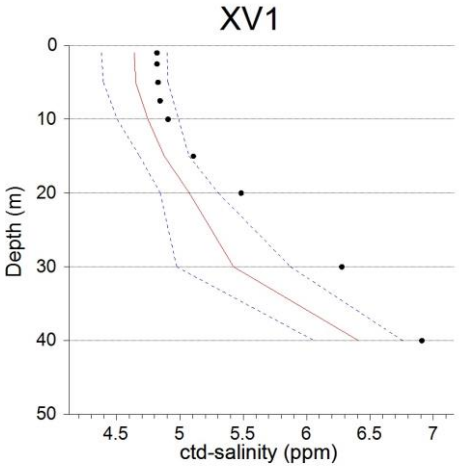
Finnish Environment Institute
Agnes Sjöbergin katu 2
FI-00790 Helsinki
Finland
http://www.syke.fi/en

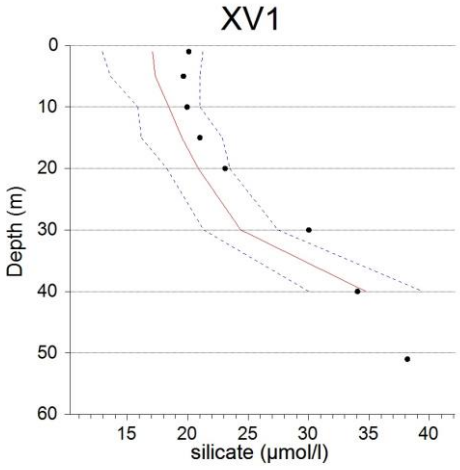
Finnish Meteorological Institute
Erik Palménin aukio 1
P.O. Box 503
FI-00101 Helsinki
Finland
http://en.ilmatieteenlaitos.fi/

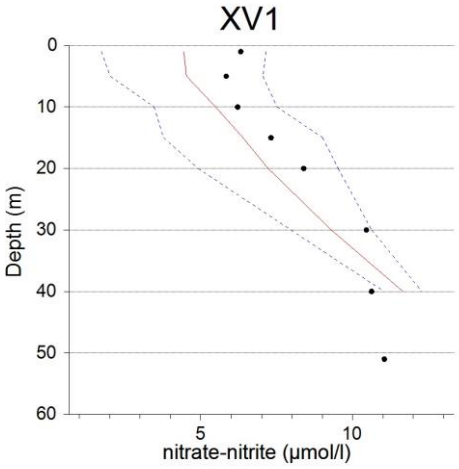
Annex 1. Selected variables at the stations XV1, LL12, LL17, US5B and BO3. Mean (red solid line) and standard deviation (blue dotted lines) represent the data collected at the same time of season since the year 2000.

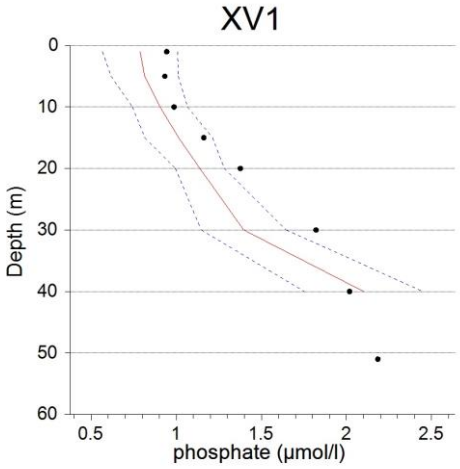


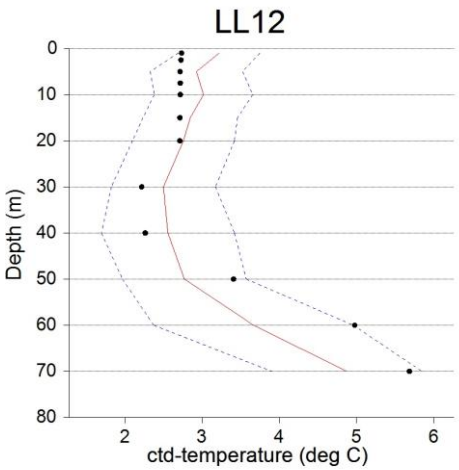


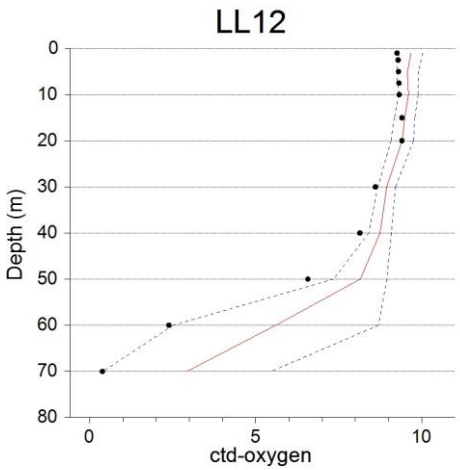


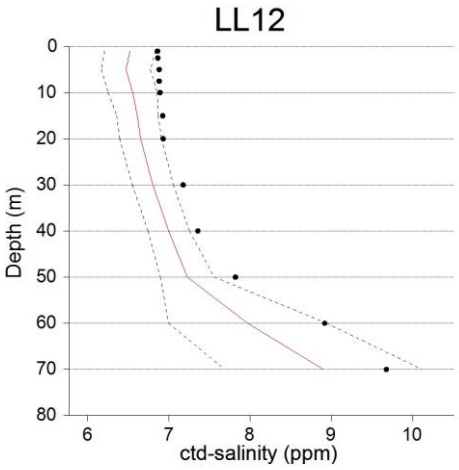


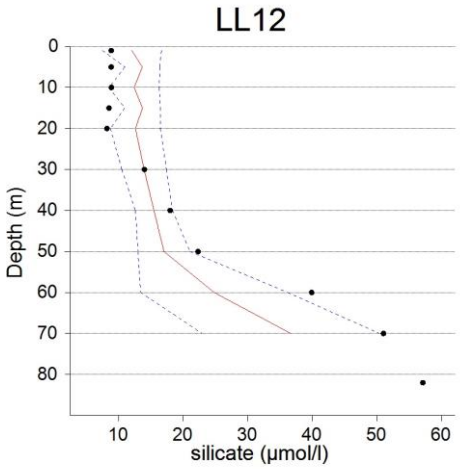


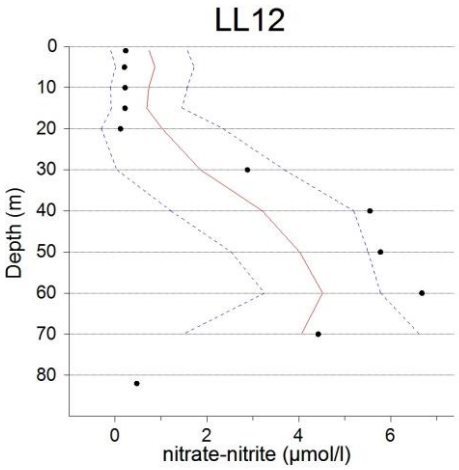


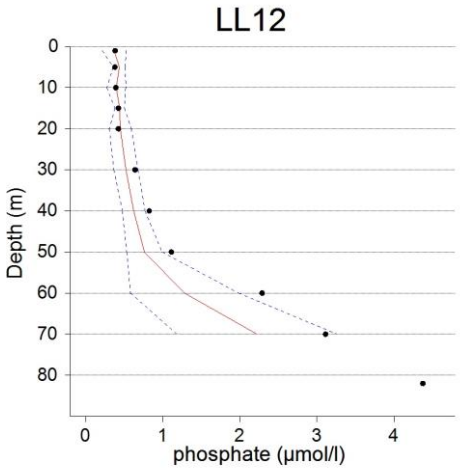

LL12
Depth (m)
0
10
20
30
40
50
60
70
80
2
3
4
5
6
ctd-temperature (deg C)

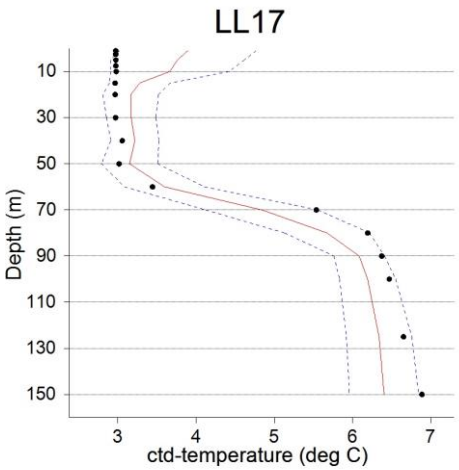

LL12
Depth (m)
0
10
20
30
40
50
60
70
80
0
5
10
ctd-oxygen

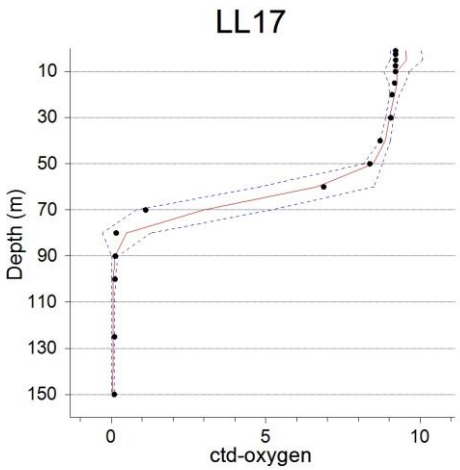

LL12
Depth (m)
0
10
20
30
40
50
60
70
80
6
7
8
9
10
ctd-salinity (ppm)

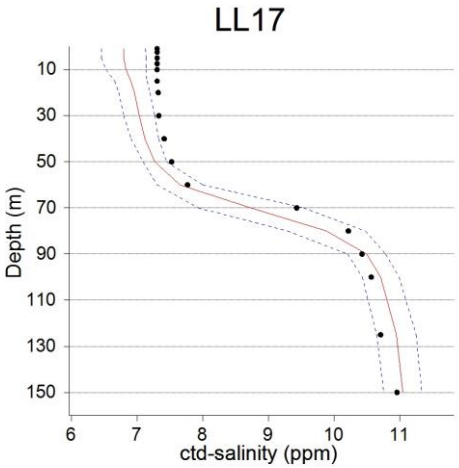

LL12
Depth (m)
0
10
20
30
40
50
60
70
80
10
20
30
40
50
60
silicate (µmol/l)

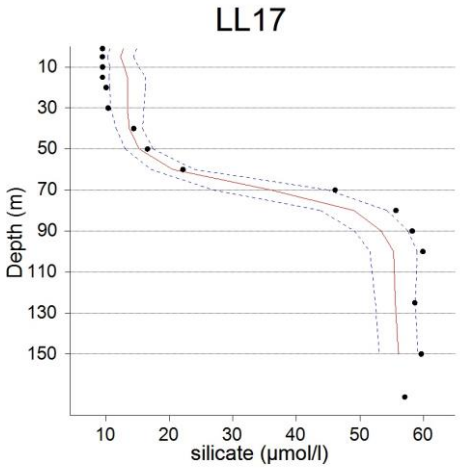

LL12
Depth (m)
0
10
20
30
40
50
60
70
80
0
2
4
6
nitrate-nitrite (µmol/l)

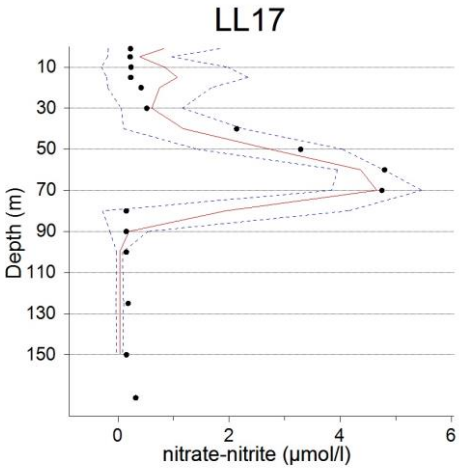

LL12
Depth (m)
0
10
20
30
40
50
60
70
80
0
1
2
3
4
phosphate (µmol/l)

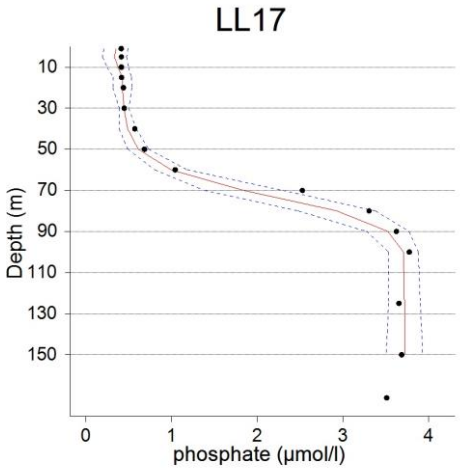

LL17
Depth (m)
10
30
50
70
90
110
130
150
3
4
5
6
7
ctd-temperature (deg C)

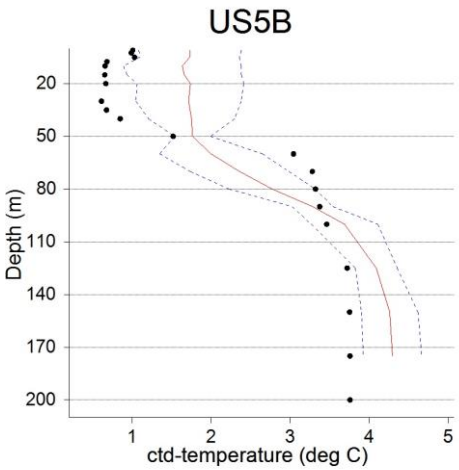

LL17
Depth (m)
10
30
50
70
90
110
130
150
0
5
10
ctd-oxygen

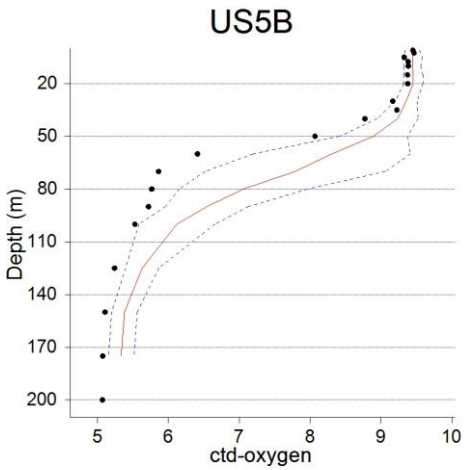

LL17
Depth (m)
10
30
50
70
90
110
130
150
6
7
8
9
10
11
ctd-salinity (ppm)

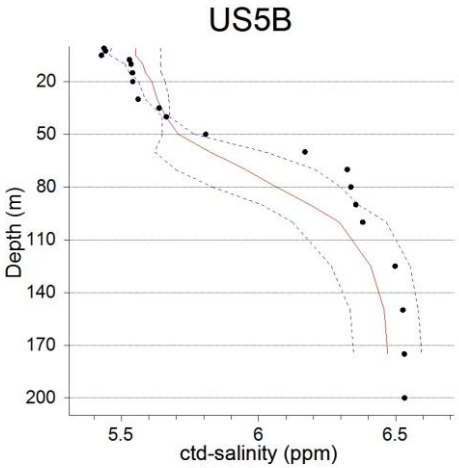

LL17
Depth (m)
10
30
50
70
90
110
130
150
10
20
30
40
50
60
silicate (µmol/l)

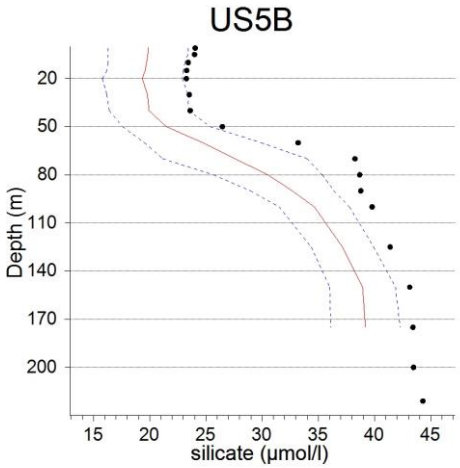

LL17
Depth (m)
10
30
50
70
90
110
130
150
0
2
4
6
nitrate-nitrite (µmol/l)

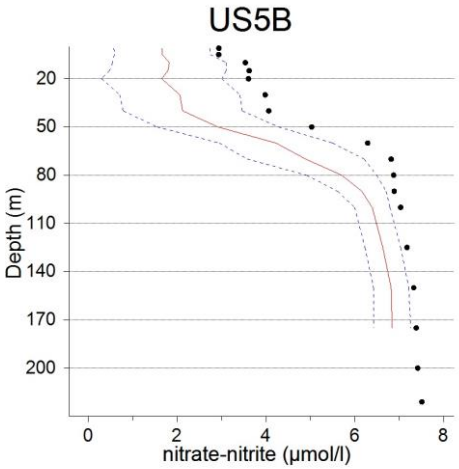

LL17
Depth (m)
10
30
50
70
90
110
130
150
0
1
2
3
4
phosphate (µmol/l)

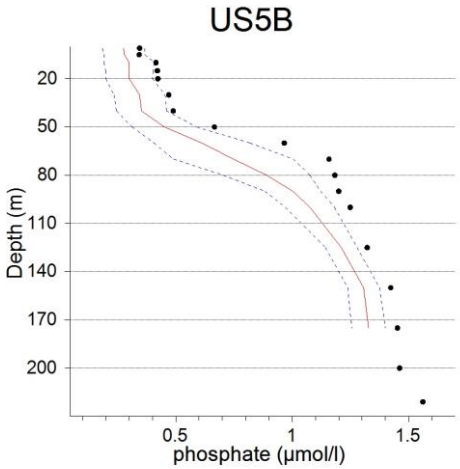

US5B
Depth (m)
20
50
80
110
140
170
200
1
2
3
4
5
ctd-temperature (deg C)

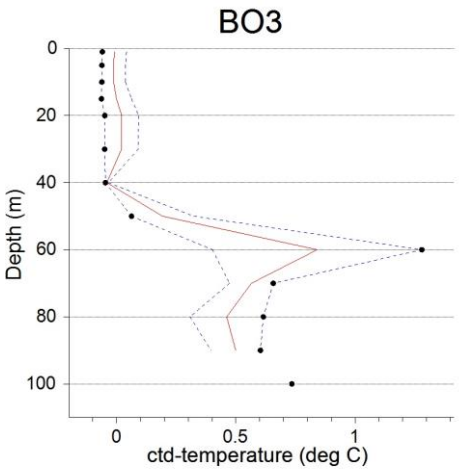

US5B
Depth (m)
20
50
80
110
140
170
200
5
6
7
8
9
10
ctd-oxygen

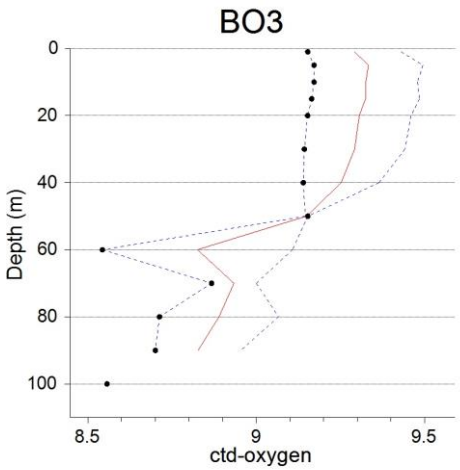

US5B
Depth (m)
20
50
80
110
140
170
200
5.5
6
6.5
ctd-salinity (ppm)

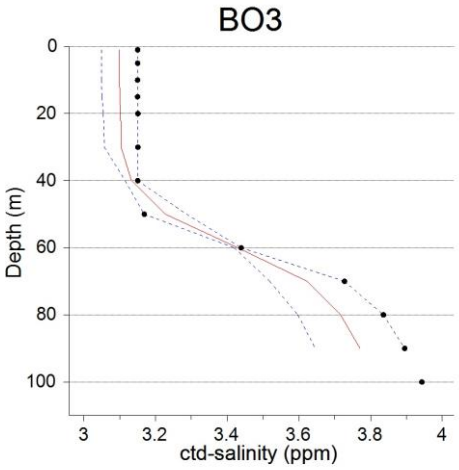

US5B
Depth (m)
20
50
80
110
140
170
200
15
20
25
30
35
40
45
silicate (µmol/l)

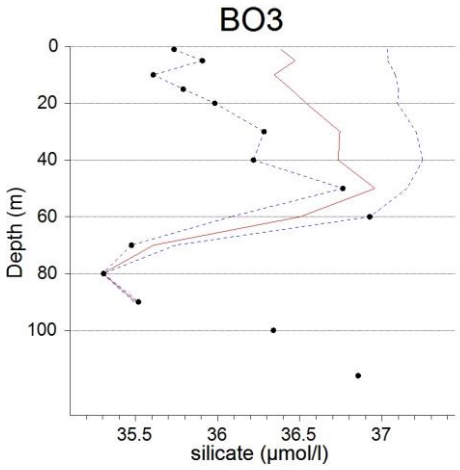

US5B
Depth (m)
20
50
80
110
140
170
200
0
2
4
6
8
nitrate-nitrite (µmol/l)

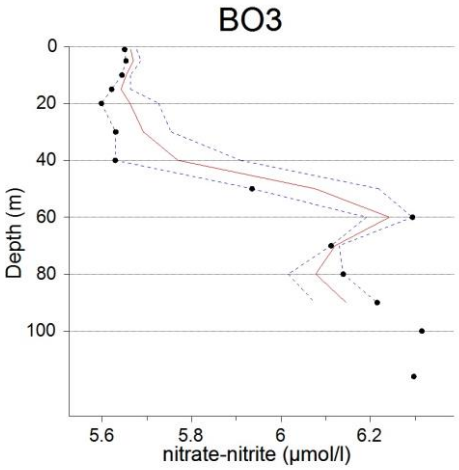

US5B
Depth (m)
20
50
80
110
140
170
200
0.5
1
1.5
phosphate (µmol/l)

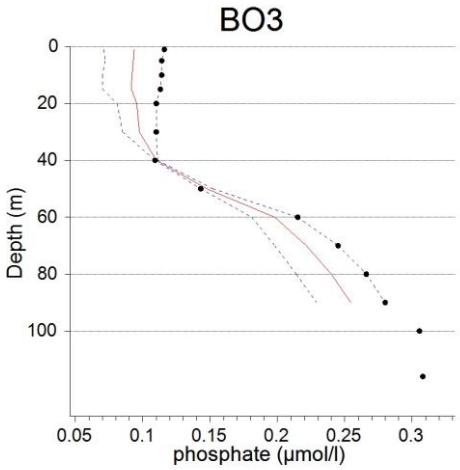

BO3
Depth (m)
0
20
40
60
80
100
0
0.5
1
ctd-temperature (deg C)


BO3
Depth (m)
0
20
40
60
80
100
8.5
9
9.5
ctd-oxygen


BO3
Depth (m)
0
20
40
60
80
100
3
3.2
3.4
3.6
3.8
4
ctd-salinity (ppm)


BO3
Depth (m)
0
20
40
60
80
100
35.5
36
36.5
37
silicate (µmol/l)


BO3
Depth (m)
0
20
40
60
80
100
5.6
5.8
6
6.2
nitrate-nitrite (µmol/l)


BO3
Depth (m)
0
20
40
60
80
100
0.05
0.1
0.15
0.2
0.25
0.3
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	60.16182	24.90157		2024-04-13	07.05											
2024010060	Gordyi_wreck	59.80082	24.36773	58	2024-04-13	11.58	x	x	x	x				x			x
Tammasaari	Tammasaari	60.16182	24.90155		2024-04-13	19.47											
2024010061	39A	60.06685	24.98005	43	2024-04-13	21.57	x	x	x	x				x			
2024010062	LL7D	59.84647	24.83785	102	2024-04-14	00.58	x	x	x	x	x			x			
2024010063	GF2	59.83870	25.85632	85	2024-04-14	05.45	x	x	x	x				x			x
2024010064	XIV3	60.20298	26.19263	80	2024-04-14	09.22	x	x	x	x				x			x
2024010065	XV1	60.25977	27.23367	54	2024-04-14	14.33	x	x	x	x	x			x			
2024010066	LL3A	60.06712	26.34682	70	2024-04-14	18.40	x	x	x	x	x			x			
2024010067	LL5	59.91703	25.59742	69	2024-04-14	22.26	x	x	x	x				x			
2024010068	AALTO_HKI	59.96478	25.23513	69	2024-04-15	02.14											
2024010069	Ville_mooring	59.88427	24.77830	42	2024-04-15	04.28											
2024010070	SST_KYTO	60.06093	24.69672	19	2024-04-15	09.36											
Tammasaari	Tammasaari	60.16182	24.90157		2024-04-15	11.01											
2024010071	GF1	59.70488	24.68197	84	2024-04-16	08.52	x	x	x	x	x			x			x
2024010072	LL9	59.70015	24.03028	67	2024-04-16	13.14	x	x	x	x	x			x			x
2024010073	JML	59.58212	23.62702	81	2024-04-16	15.57	x	x	x	x				x			
2024010074	F62	59.33348	23.26365	97	2024-04-16	19.34	x	x	x	x				x			
2024010075	LANDER_UTO	59.77162	21.42068	63	2024-04-17	06.04											
2024010076	Uto_V_bouy	59.73873	21.38112	67	2024-04-17	12.10											
2024010077	IU7	59.81508	21.33677	93	2024-04-17	13.22	x	x	x	x	x			x			x
2024010078	IU5	60.05815	21.19848	90	2024-04-17	17.54	x	x	x	x				x			
2024010079	IU3	60.33323	21.11335	50	2024-04-17	21.49	x	x	x	x				x			
2024010080	IU2_ADCP	60.58128	21.13363	54	2024-04-18	00.34											
2024010081	IU1	60.76693	20.84662	33	2024-04-18	03.16	x	x	x	x				x			
2024010082	SR7	61.08338	20.59680	78	2024-04-18	06.51	x	x	x	x				x			x
2024010083	SR8	61.12648	20.92973	48	2024-04-18	10.13	x	x	x	x				x			x
2024010084	MS9	61.76685	20.53058	101	2024-04-18	15.12	x	x	x	x				x			x
2024010085	AALTO_SM	61.79578	20.23317	107	2024-04-18	18.03											
2024010086	F26	61.98337	20.06305	137	2024-04-18	20.16	x	x	x	x				x			
2024010087	US7	62.60015	20.83010	28	2024-04-19	02.03	x	x	x	x				x			
2024010088	US6B	62.60015	20.26352	82	2024-04-19	04.56	x	x	x	x				x			x
2024010089	US5B	62.58623	19.96913	222	2024-04-19	08.12	x	x	x	x	x	x		x			x
2024010090	F16	63.51678	21.06245	48	2024-04-19	20.50	x	x	x	x	x			x			
2024010091	F15	63.51655	21.51202	47	2024-04-19	23.25	x	x	x	x				x			
2024010092	BO3	64.30018	22.33927	117	2024-04-20	09.16	x	x	x	x	x			x			x
2024010093	AUTOHOLO	64.25757	22.42687	87	2024-04-20	11.13											
2024010094	F13	63.78613	21.48170	64	2024-04-20	15.31	x	x	x	x				x			x
2024010095	F18_SUOMI	63.31425	20.39992	95	2024-04-20	21.15	x	x	x	x				x			
2024010096	US3	62.75887	19.19547	177	2024-04-21	03.02	x	x	x	x				x			
2024010097	MS3	62.13470	18.16283	84	2024-04-21	09.06	x	x	x	x							x
2024010098	MS6	61.98365	19.16250	72	2024-04-21	13.52	x	x	x	x				x			x
Maarianhamina	Maarianhamina	60.09570	19.92622		2024-04-22	07.19											
2024010099	F69	59.78675	19.93085	201	2024-04-22	21.20	x	x	x	x				x			
2024010100	LL19	58.88055	20.31155	170	2024-04-23	05.03	x	x	x	x				x			x
2024010101	BY15	57.32032	20.04953	239	2024-04-23	17.29	x	x	x	x		x		x			x
2024010102	LL17	59.03318	21.07962	172	2024-04-24	06.39	x	x	x	x	x			x			x
2024010103	AALTO_PI	59.24583	20.99895	111	2024-04-24	10.00											x
2024010104	TPDEEP1	59.37833	21.44147	218	2024-04-24	14.17	x	x	x	x				x			x
2024010105	TPDEEP1	59.37835	21.44148	215	2024-04-24	17.22	x		x								
2024010106	TPDEEP1	59.37832	21.44147	218	2024-04-24	20.13	x		x								
2024010107	TPDEEP1	59.37828	21.44145	218	2024-04-24	23.08											
2024010108	LL15	59.18335	21.74617	131	2024-04-25	02.26	x	x	x	x				x			
2024010109	LL12	59.48350	22.89685	83	2024-04-25	08.13	x	x	x	x	x			x			x
2024010110	STORFJARDEN	59.85640	23.26312	35	2024-04-25	12.28	x	x	x	x				x			x
2024010111	LANGDEN	59.77683	23.26367	58	2024-04-25	14.58	x	x	x	x	x			x			x
2024010112	AMN	59.69058	23.25718	55	2024-04-25	16.59	x	x	x	x				x			
2024010113	LL11	59.58343	23.29695	67	2024-04-25	22.38	x	x	x	x				x			
2024010114	XII3	59.86423	23.98553	37	2024-04-26	02.40	x	x	x	x				x			
2024010115	LL6A	59.91697	25.02997	73	2024-04-26	06.44	x	x	x	x				x			x
Helsinki	Helsinki	60.16180	24.90158		2024-04-26	10.28											

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