Suomen ympäristökeskus
Finlands miljöcentral
Finnish Environment Institute

ILMATIETEEN LAITOS

CRUISE REPORT

R/V Aranda

Cruise 06/2026

Combine 3

11.8.2026 – 24.8.2026

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

Objectives of the cruise

The objectives of the cruise were:
The objectives of the 1st leg of the cruise were:

1) Monitoring of general hydrography, nutrients, chlorophyll and phyto- and zooplankton communities of the Baltic Sea according to HELCOM COMBINE program and sampling of phycotoxins, POC, TOC, DOC and alkalinity.
2) Maintenance work for wave buoys. 2 hydrophones deployed on seabed. In addition, sampling of cyanobacterial toxins and zooplankton for automated imaging instrument developments (PlanktoScope).
   The 1st leg of the cruise had special emphasis on the Gulf of Finland.

The objectives of the 2nd leg of the cruise were:

1) Monitoring of hydrography and water chemistry, chlorophyll-a, phytoplankton and zooplankton.
2) Sampling of oil compounds and phytotoxins samples for monitoring purposes.
3) Studies on carbon cycle (POC, TOC, DOC, CDOM)
4) Maintenance of hydrophones, wave buoys, current meters and anchoring and recovery of underwater recorders
5) recovering sediment corer of GSF (Geological Survey of Finland).

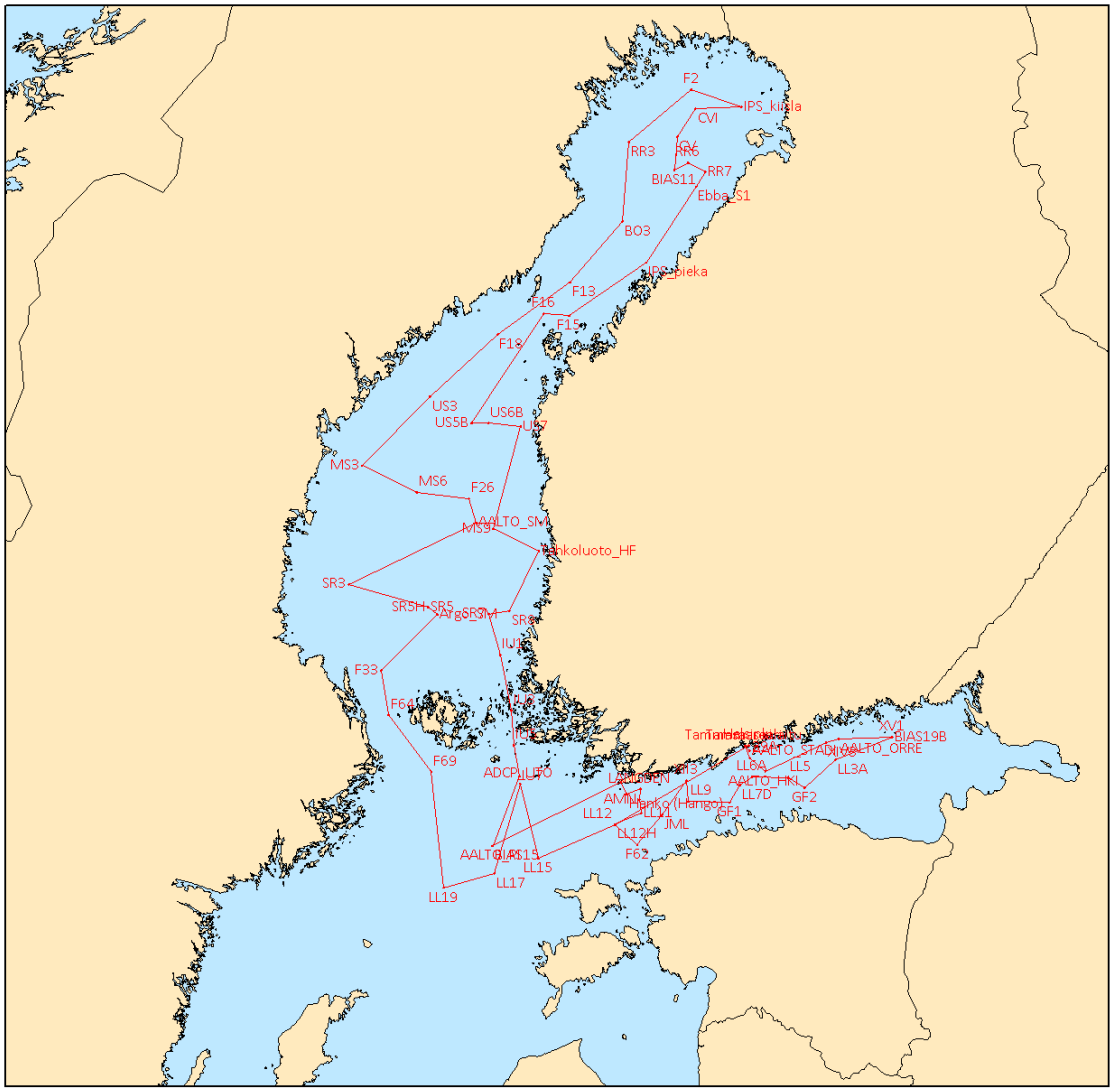
Table 1 The scientific crew

Name	On board	Organization
Maiju Lehtiniemi	**11.-14.08.2026**	**Syke**
Samu Elovaara	**11.-24.8.2026**	**Syke**
Heini Jalli	**11.-24.8.2026**	**FMI**
Meri Smedberg	**11.-24.8.2026**	**FMI**
Ilkka Lastumäki	**11.-24.8.2026**	**Syke**
Tanja Kinnunen	**11.-24.8.2026**	**Syke**
Pia Varmanen	**11.-24.8.2026**	**Syke**
Mira Granlund	**11.-24.8.2026**	**Syke**
Niklas Trebs	**11.-24.8.2026**	**Syke**
Siru Tasala	**11.-24.8.2026**	**Syke**
Jarkko Moberg	**11.-24.8.2026**	**Syke**
Adam Makatun	**11.-24.8.2026**	**Univ. of Gdansk**
Andre Welti	**11.-24.8.2026**	**FMI**
Tuomo Roine	**11-14.8.2026**	**FMI**
Mari Vanharanta	**11-14.8.2026**	**Syke**
Pinja Suomensalo	**11.-14.8.2026**	**Univ. of Helsinki**
Pekka Kotilainen	**14.-24.8.2026**	**Syke**
Joonas Virtasalo	**14.-24.8.2026**	**GSF**

Cruise Route

The 1st leg of the cruise started from Helsinki on the 11th of August 2026 at 10:00. The leg started with the maintenance of the wave buoy (AALTO_STADI) of FMI. After that the vessel went back to port to pick up one more scientist whose flight was canceled from the previous day, then the cruise continued with sampling on the stations 39A, XIV3 and XV1 towards the eastern Gulf of Finland. In the eastern GoF also one hydrofone BIAS19B was deployed. In the eastern Gulf of Finland a wave buoy was maintained (AALTO_ORRE). Then stations towards the middle of the GoF were sampled: LL3A, GF2, LL5. Wave buoy (AALTO_HKI) of FMI was lifted for the maintenance in the middle of the GoF. Then sampling continued on stations LL6A, LL7, GF1 and in the westernmost Gulf of Finland: LL9, XII3, JML, F62, LL12, LL11, AMN, and LANGDEN. Close to LL12 sampling station one more hydrophone was deployed LL12H.After all sampling stations were completed, the cruise headed to Hanko port. The first leg of the cruise ended up to Hanko on Friday 14 August 2026 at 14:00 hours.

The 2nd leg of the cruise started from Hanko and headed first to the wave buoy to be maintained in the Northern Baltic Proper. Next to the wave buoy a hydrophone was anchored. Cruise headed to the Archipelago Sea and IU transect of four sites were sampled (IU7, IU5, IU3 and IU1). The stations in the southeastern part of the Bothnian Sea were SR8 and SR7: A hydrophone which had been anchored in June, during the Combine 2 cruise. The place was quite a challenge, too close to windmill stations. Next stations MS9, US7, US6b and US5b were monitored and cruise continued to Quarken, F16 and F15. An ice radar and an ADCP were recovered to at IPS_pieka near Kokkola. Outside Raahe a lost vibrating corer were lifted with a sample. Stations RR7 and RR6 with a BIAS11 hydrophone anchoring followed the lifting operation. The sites CV and CVI were sampled next and after another ice radar with ADCP were removed. The northernmost station, F2 was sampled late in the evening on the 18th of August. RR3 and BO3 were the last stations in the Bothnian Bay. At the Quarken stations F13 and F18 were sampled. The cruise continued along the Swedish coast through the stations US3, MS3 and MS6. F26 in the southern part of the Bothnian Sea were sampled and another wave buoy were maintained. SR3 and SR5 were monitored, and a hydrophone SR5_HF was anchored near station. A floating and diving instrument ARGO_SM was launched before the station, F33. Close to Åland Islands, the station, F64, the deepest station of the cruise were monitored and the cruise moved to the Northern Baltic and stations F69, LL19, LL17 and LL15 were sampled. Lastly an ADCP which was supposed to be maintained were approached near UTÖ and maintenance was carried out. Due to the Baltic Sea Day event, some zooplankton were sampled alive for visitors of the venue. The cruise ended up to Helsinki at Katajanokka Quai on the 24th of August 2026.



Cruise route

Observations and conclusions

1st leg

Gulf of Finland

The oxygen was depleted in the deeps of the Gulf of Finland (hypoxic bottom waters, hydrogen sulphide in deep waters on many sampling stations) and low concentrations were also found from the shallower stations in the eastern Gulf of Finland. Phoshate concentrations close to the sea bed were at the average levels or a bit above the average while nitrate concentrations were lower compared to the past years.

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2nd leg

Archipelago Sea

In the southern part of the Archipelago Sea at IU7, higher salinity values than on average at deep layers were observed. Simultaneously, low oxygen values near bottom indicate that saline and anoxic water had flown in the area.

Similarly, higher than on average, PO_4 and P_{tot} concentrations were observed in the southern part of the Archipelago Sea. Observations give further evidence that slight inflow of saline and nutrient rich water has flown in the region.

Bothnian Sea

Hydrography

High salinity values for the region at deep water stations sites F64, F33 and SR5 were observed,

Nutrients

Higher inorganic nutrient concentrations than the long-term average were observed especially at the southwestern site F33 and at F64.

High salinity and inorganic nutrient concentrations indicate intrusion of saline and nutrient rich water from the main basin.
In organic nutrient concentrations have slowly increased since 2000 in deep waters > 100 m, but this summer were mainly at the level of long-term average.

Quarken

Hydrography

Typical stratification of summer and average oxygen concentrations were observed.

Nutrients

Nutrient concentrations were at normal level (long-term average).
Higher concentrations at F18 were observed that the rest of the sites in the region (F13, F15 and F16). This is due to the location of F18, on the edge of the Northern Bothnian Sea and the Quarken.

Bothnian Bay

Hydrography

Observed salinity was higher than on average in the region and oxygen concentrations below the long-term average, respectively. However, measured oxygen concentrations were still at high level, mainly above 7 ml/l.

Silicate

Observed concentrations were high and above the long-terms average at several sites

Nutrients

Typically, in the region observed concentrations were low and near limit of detection. in recent years some increase of dissolved nutrient concentration have been observed. During the cruise no signs of continuous increase were observed in the region.

Northern Baltic Proper

Site LL17 had to be skipped due to heavy wind > 20 m/s in gusts from NW-NE.

Hydrography

Typical summer thermocline was observed at 20-30 meters in the region.
H_2S were fairly high, higher than the long-term averages, but might be related to the prevailing northern winds of several days during the cruise. This was also seen in oxygen, as the anoxic layer was observed at lower depth than in previous years. Anoxic layer was met at 60 m depth. Oxygen condition is weakening at the Lågskär deep, site F69.
In recent years site LL12 has been monitored twice during the cruise to observe any short-term change at the site. Deep water fluctuation between the Gulf of Finland and the Northern Baltic Proper occurs and depends on prevailing winds during the cruise.
One meter above the bottom hypoxia was observed at the site and H_2S concentration measured 10 days later.

Silicate

High concentrations of silicate were observed in the region.

Nutrients

Observed nutrient concentrations were the highest of the cruise as usual. The main basin deep water serves as a nutrient reservoir of the Baltic Sea. Repeated monitoring at LL12 showed that the dissolved phosphorus concentration near bottom increased from 2.75 µmol/l to 4.63 µmol/l in 10 days. Observed concentration was higher than the concentrations at deeper stations LL15 and LL19. This might indicate that some internal loading took place at LL12.

Conclusions

The waters below halocline, close to the bottom were oxygen depleted, rich in hydrogen sulphide and phosphorus in the Gulf of Finland.

Oxycline in the Northermn Baltic Proper reached 60 m depth. but might be temporal.
Some intrusion of saline and low oxygen water to the southwestern part of the Bothnian Sea and in the southern Archipelago Sea.
Nutrient concentrations at deep tend to increase, but no major changes.
Silicate concentration is being increased in general, reason for the increase should be land-based or inflow of higher silicate from the Baltic Proper, but remains unclear.

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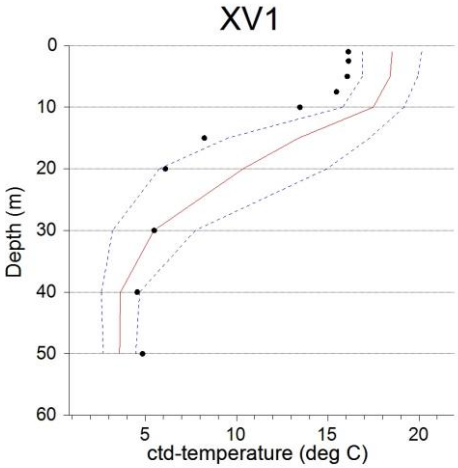
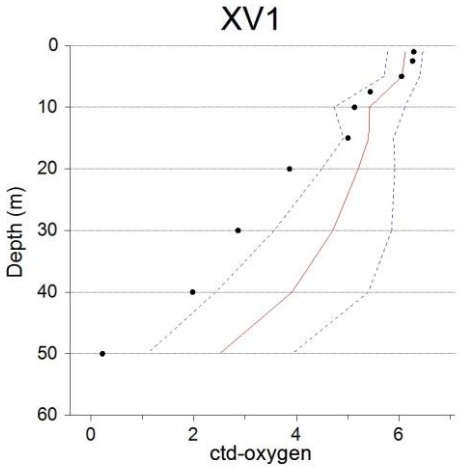
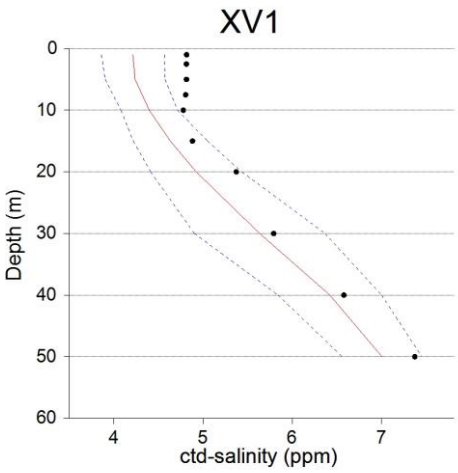
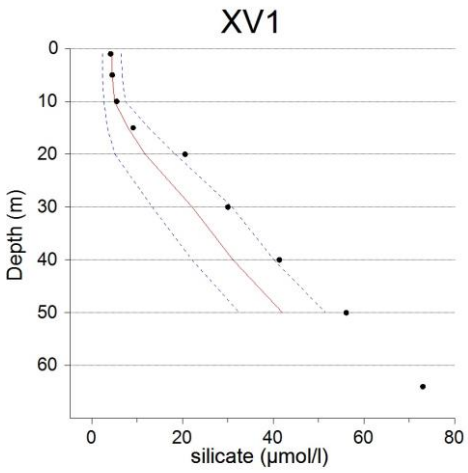
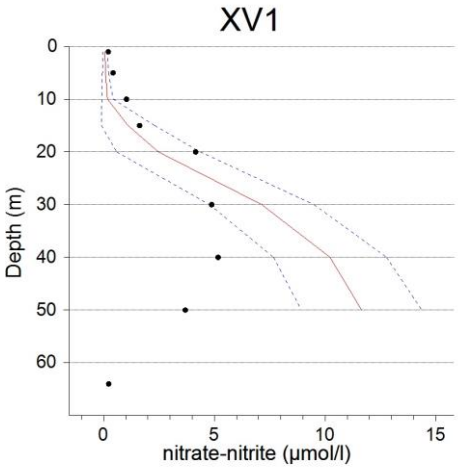
Annex 1. Selected variables at the stations XV1, LL12 (double observations on 13th and 23rd of Aug 2026) , LL17, F64, SR5, US5B, BO3 and F2. Mean (red solid line) and standard deviation (blue dotted lines) represent the data collected at the same time of season since the year 2000.

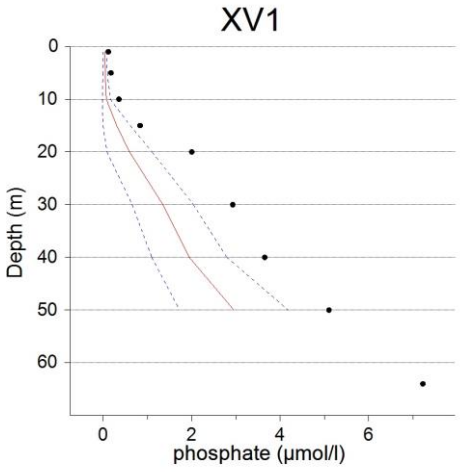


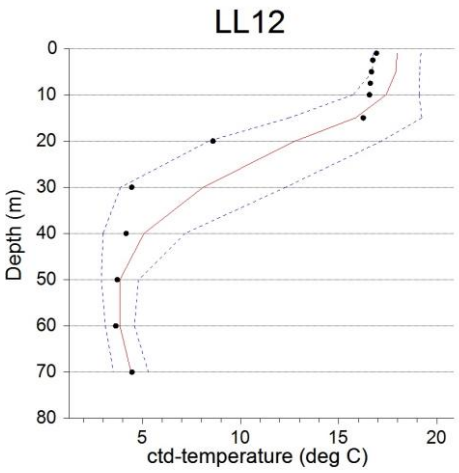


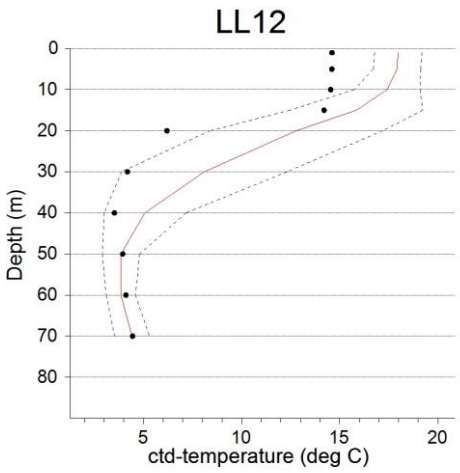









LL12
Depth (m)
0
10
20
30
40
50
60
70
80
5
10
15
20
ctd-temperature (deg C)


LL12
Depth (m)
0
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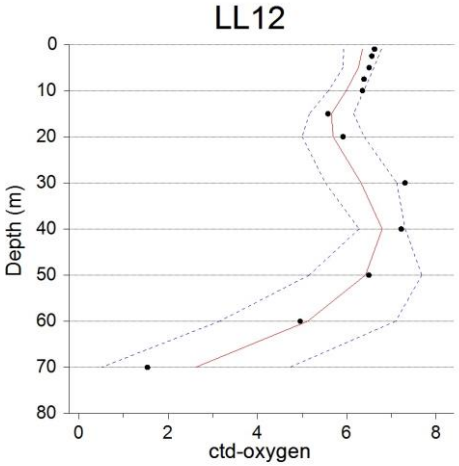
20
ctd-temperature (deg C)


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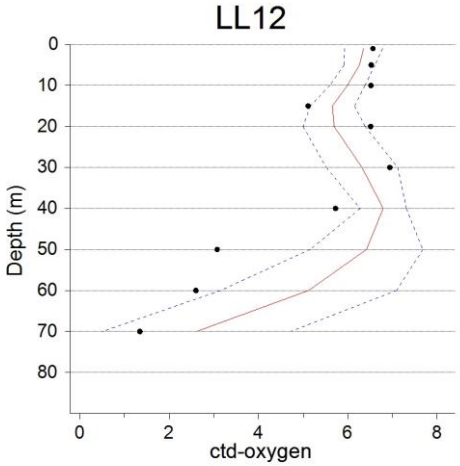
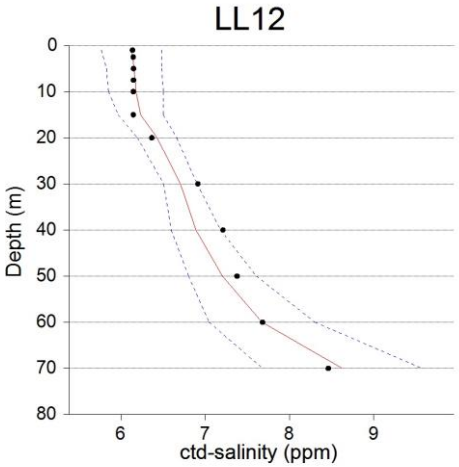
60
70
80
0
2
4
6
8
ctd-oxygen


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


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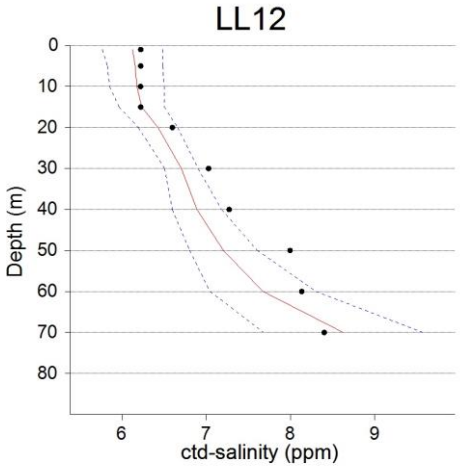
70
80
6
7
8
9
ctd-salinity (ppm)


LL12
Depth (m)
0
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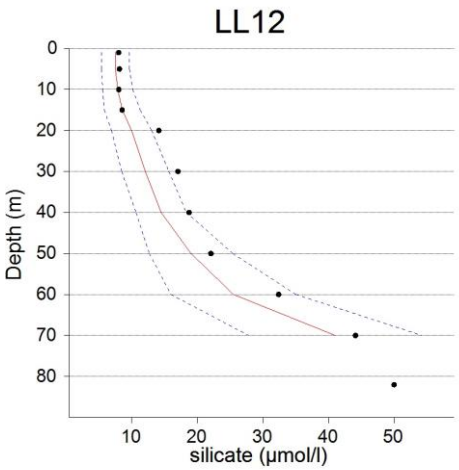
70
80
6
7
8
9
ctd-salinity (ppm)


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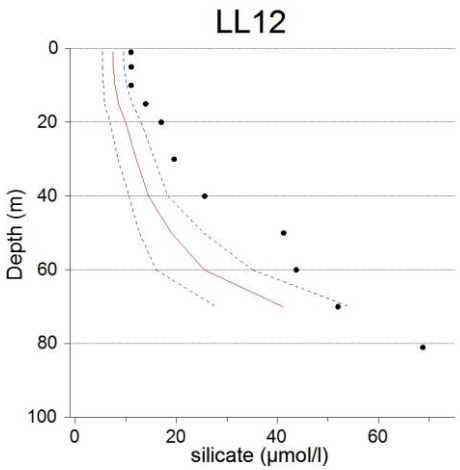
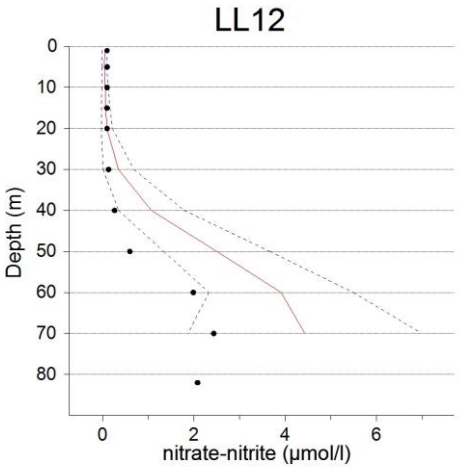
70
80
10
20
30
40
50
silicate (µmol/l)


LL12
Depth (m)
0
20
40
60
80
100
0
20
40
60
silicate (µmol/l)


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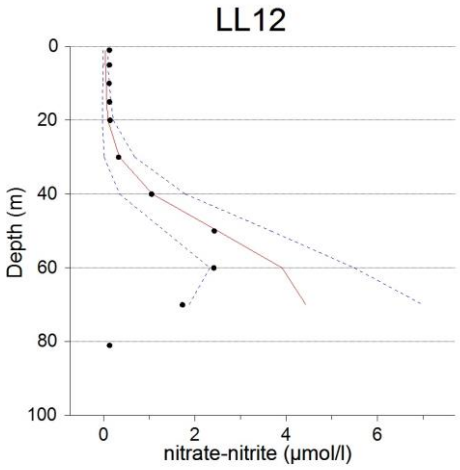
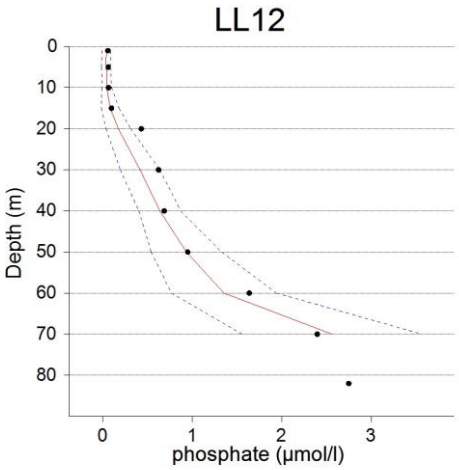
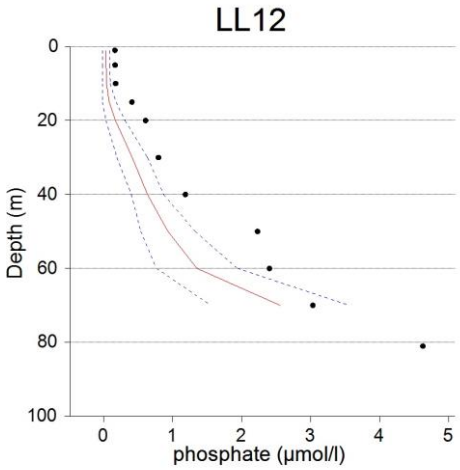
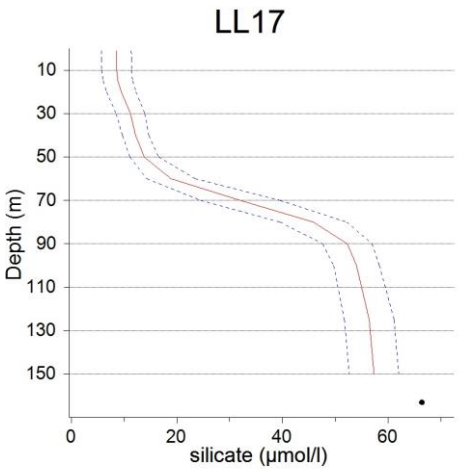
10
20
30
40
50
60
70
80
0
2
4
6
nitrate-nitrite (µmol/l)


LL12
Depth (m)
0
20
40
60
80
100
0
2
4
6
nitrate-nitrite (µmol/l)


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


LL12
Depth (m)
0
20
40
60
80
100
0
1
2
3
4
5
phosphate (µmol/l)


LL17
Depth (m)
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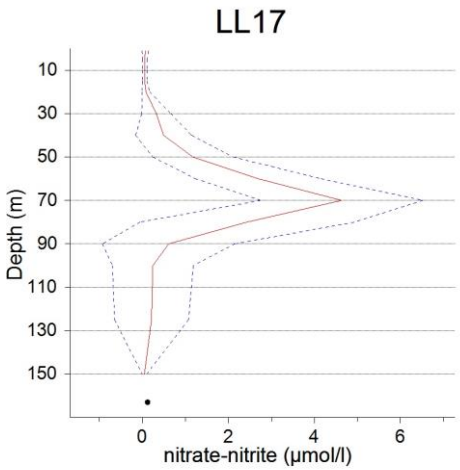
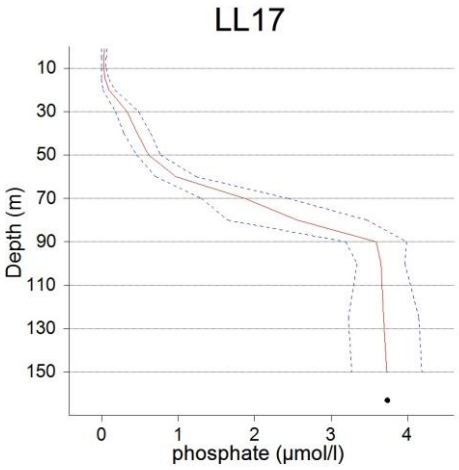
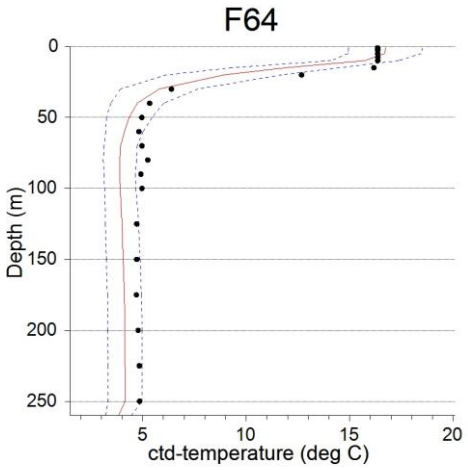
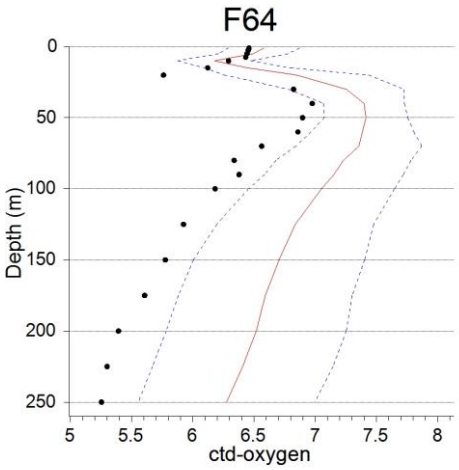
30
50
70
90
110
130
150
0
20
40
60
silicate (µmol/l)


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
5
10
15
20
ctd-temperature (deg C)


F64
Depth (m)
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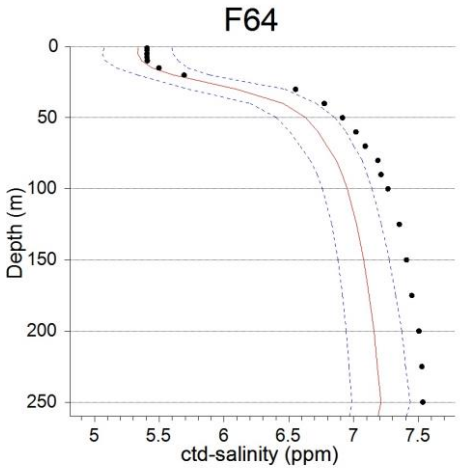
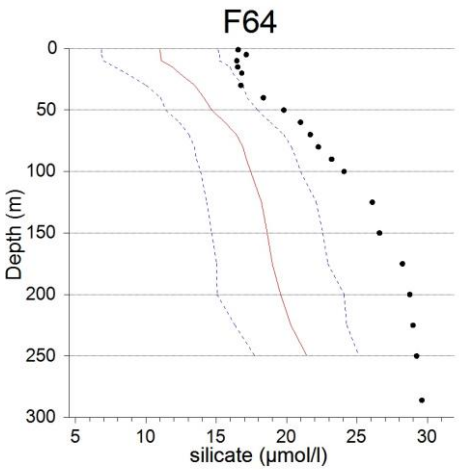
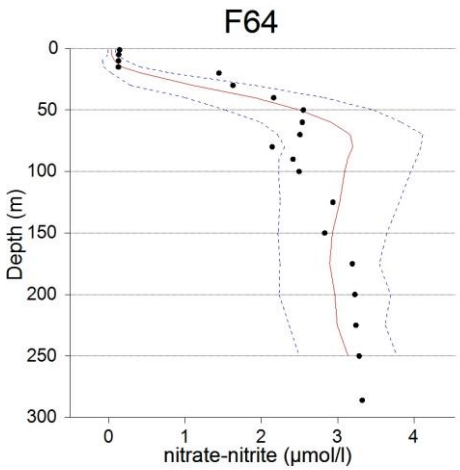
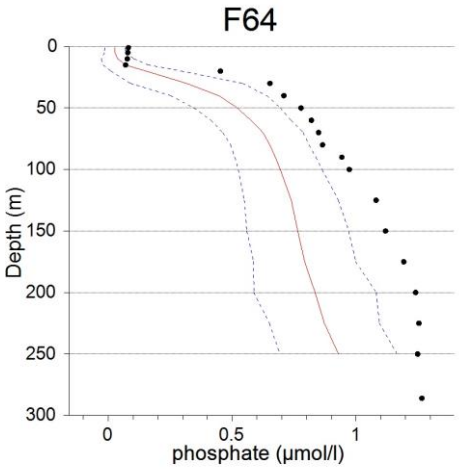
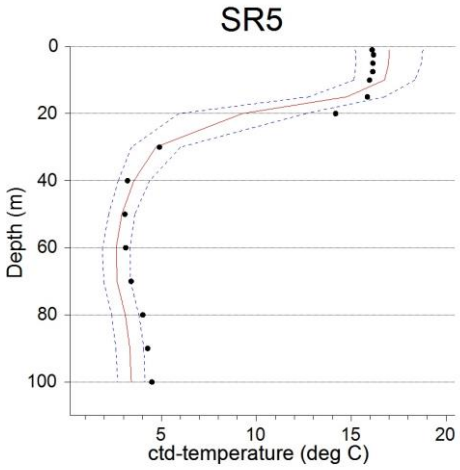
50
100
150
200
250
5
5.5
6
6.5
7
7.5
8
ctd-oxygen

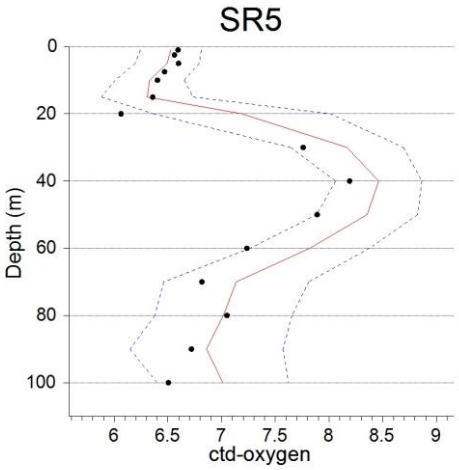

F64
Depth (m)
0
50
100
150
200
250
5
5.5
6
6.5
7
7.5
ctd-salinity (ppm)

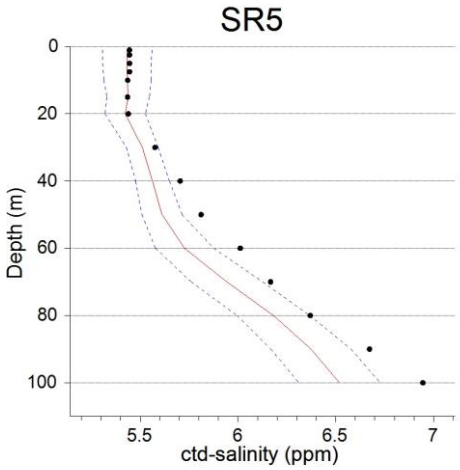

F64
Depth (m)
0
50
100
150
200
250
300
5
10
15
20
25
30
silicate (µmol/l)

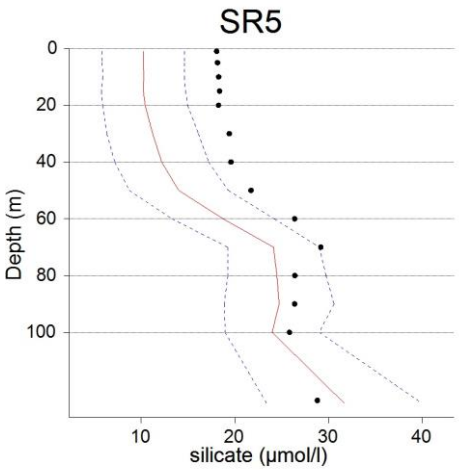

F64
Depth (m)
0
50
100
150
200
250
300
0
1
2
3
4
nitrate-nitrite (µmol/l)

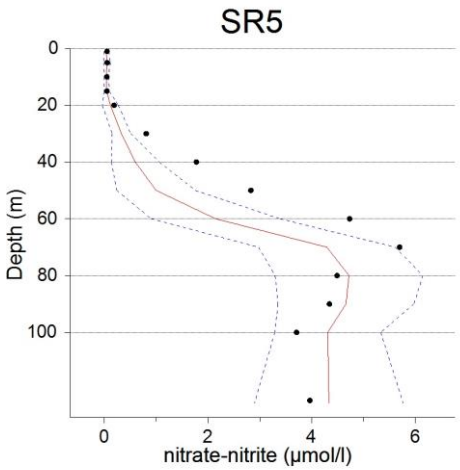

F64
Depth (m)
0
50
100
150
200
250
300
0
0.5
1
phosphate (µmol/l)

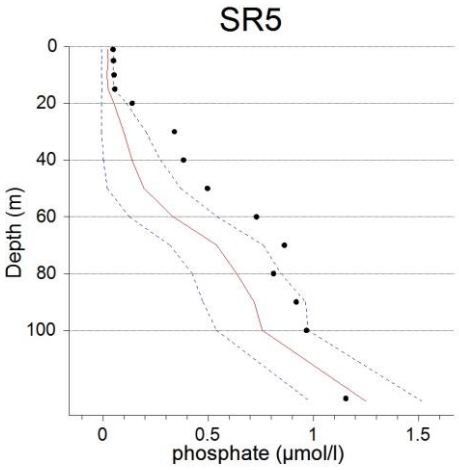

SR5
Depth (m)
0
20
40
60
80
100
5
10
15
20
ctd-temperature (deg C)

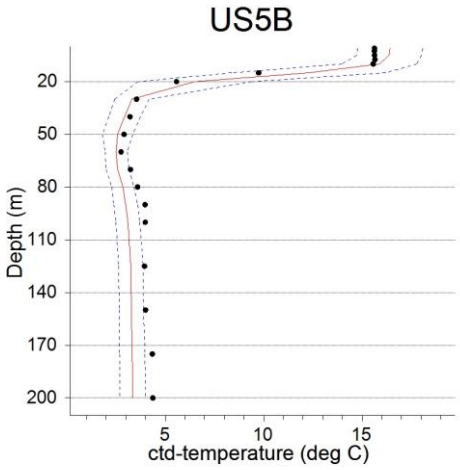

SR5
Depth (m)
0
20
40
60
80
100
6
6.5
7
7.5
8
8.5
9
ctd-oxygen

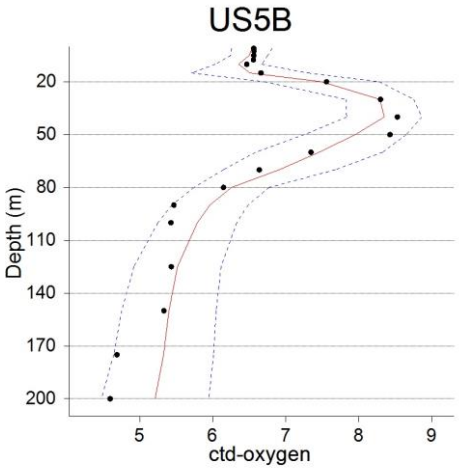

SR5
Depth (m)
0
20
40
60
80
100
5.5
6
6.5
7
ctd-salinity (ppm)

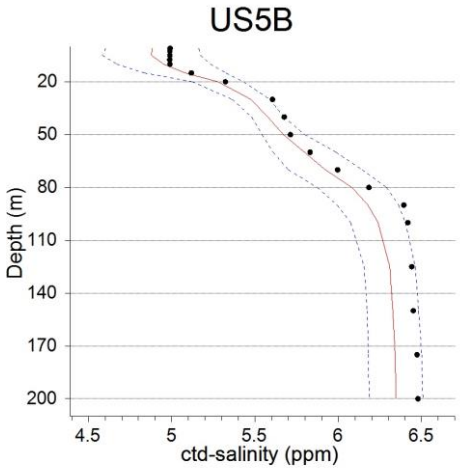

SR5
Depth (m)
0
20
40
60
80
100
10
20
30
40
silicate (µmol/l)

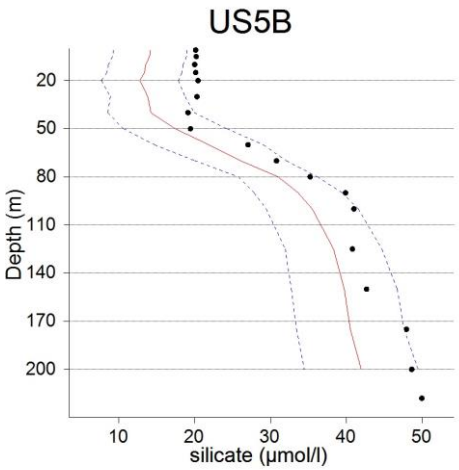

SR5
Depth (m)
0
20
40
60
80
100
0
2
4
6
nitrate-nitrite (µmol/l)

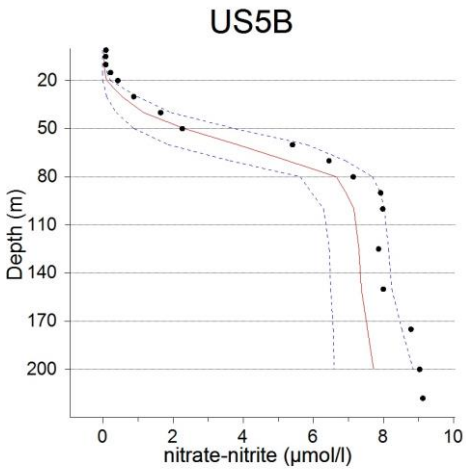

SR5
Depth (m)
0
20
40
60
80
100
0
0.5
1
1.5
phosphate (µmol/l)

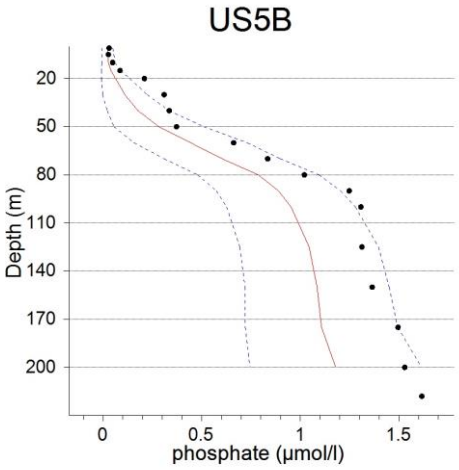

US5B
Depth (m)
20
50
80
110
140
170
200
5
10
15
ctd-temperature (deg C)

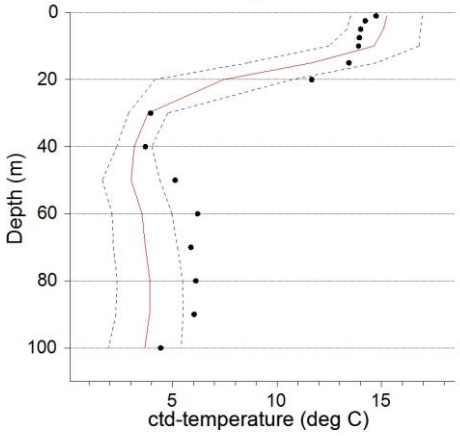

US5B
Depth (m)
20
50
80
110
140
170
200
5
6
7
8
9
ctd-oxygen

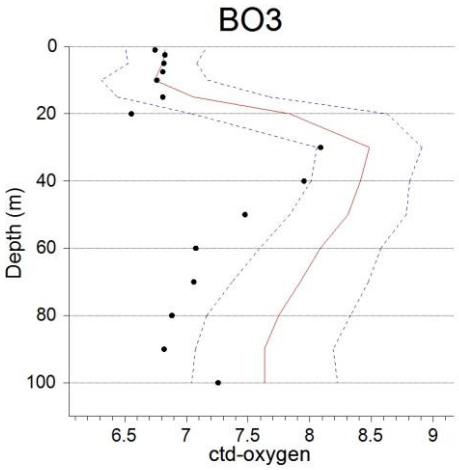

US5B
Depth (m)
20
50
80
110
140
170
200
4.5
5
5.5
6
6.5
ctd-salinity (ppm)

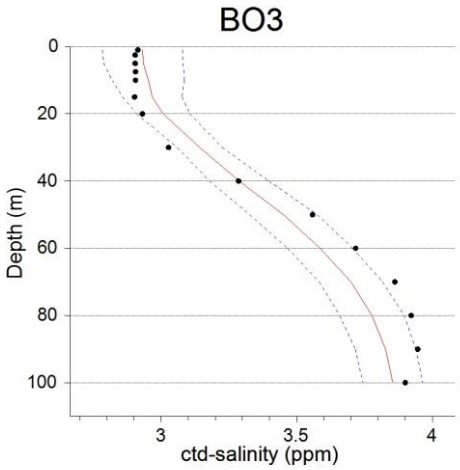

US5B
Depth (m)
20
50
80
110
140
170
200
10
20
30
40
50
silicate (µmol/l)

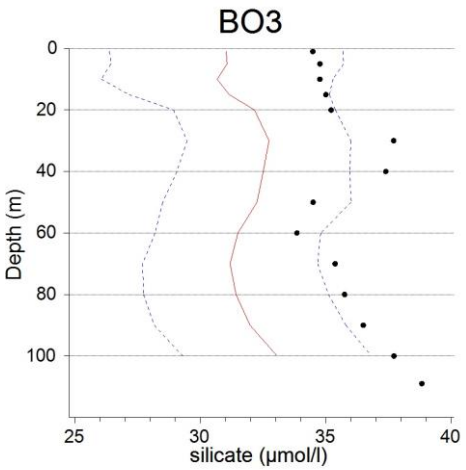

US5B
Depth (m)
20
50
80
110
140
170
200
0
2
4
6
8
10
nitrate-nitrite (µmol/l)

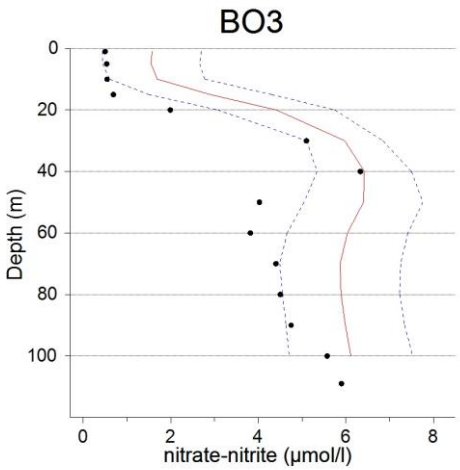

US5B
Depth (m)
20
50
80
110
140
170
200
0
0.5
1
1.5
phosphate (µmol/l)

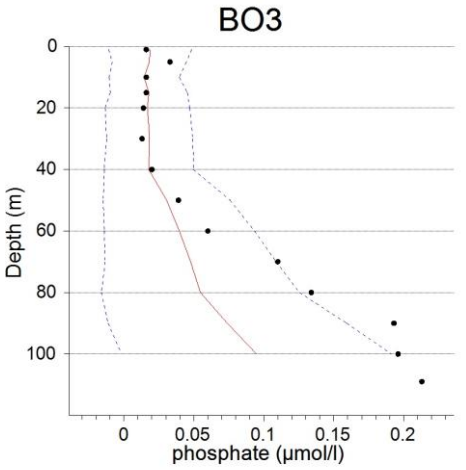

BO3
Depth (m)
0
20
40
60
80
100
5
10
15
ctd-temperature (deg C)

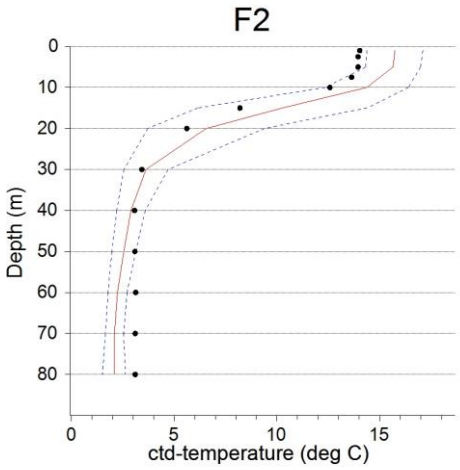

BO3
Depth (m)
0
20
40
60
80
100
6.5
7
7.5
8
8.5
9
ctd-oxygen

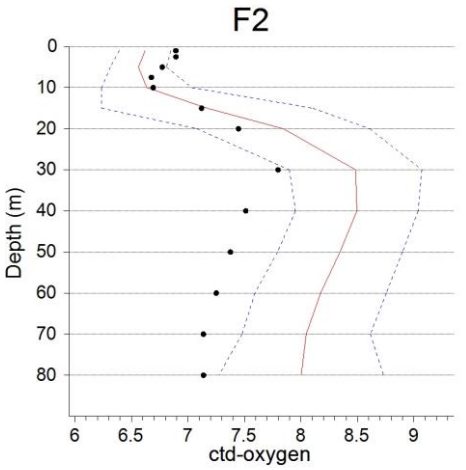

BO3
Depth (m)
0
20
40
60
80
100
3
3.5
4
ctd-salinity (ppm)

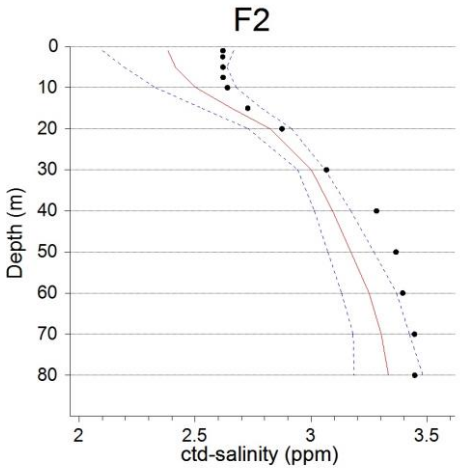

BO3
Depth (m)
0
20
40
60
80
100
25
30
35
40
silicate (µmol/l)

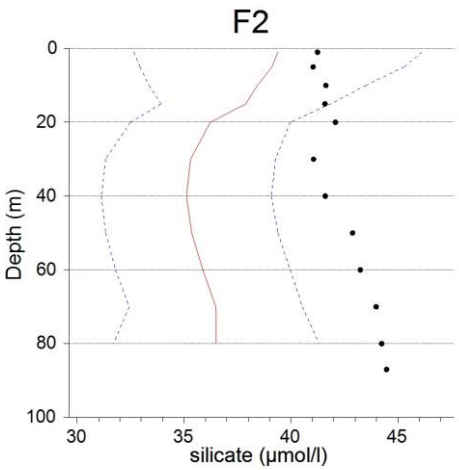

BO3
Depth (m)
0
20
40
60
80
100
0
2
4
6
8
nitrate-nitrite (µmol/l)

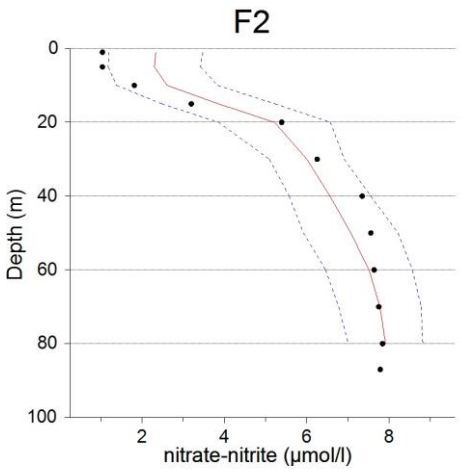

BO3
Depth (m)
0
20
40
60
80
100
0
0.05
0.1
0.15
0.2
phosphate (µmol/l)

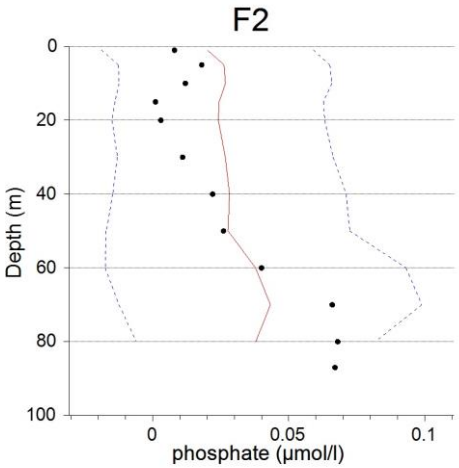

F2
Depth (m)
0
10
20
30
40
50
60
70
80
0
5
10
15
ctd-temperature (deg C)

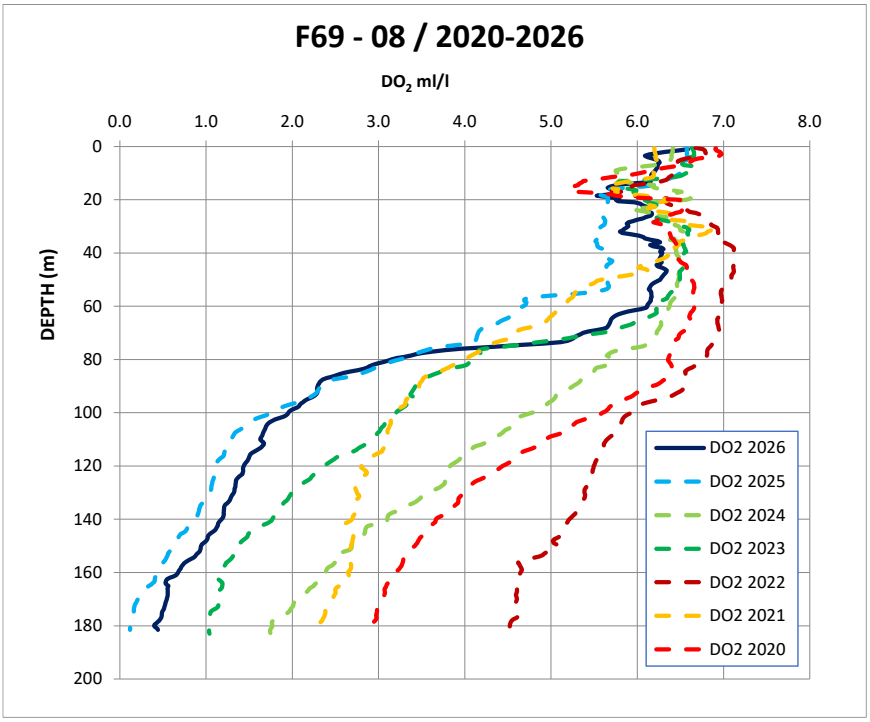

F2
Depth (m)
0
10
20
30
40
50
60
70
80
6
6.5
7
7.5
8
8.5
9
ctd-oxygen


F2
Depth (m)
0
10
20
30
40
50
60
70
80
2
2.5
3
3.5
ctd-salinity (ppm)









Observed DO_2 profiles at F69 (Lågskär deep) in August 2020-2026.

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
TammasaarenlaituriTammasaarenlaitu		60.16167	24.90143		2026-08-11	07.22											
2026010207	AALTO_STADI	60.12297	24.97328	22	2026-08-11	08.45											
Tammasaari	Tammasaari	60.16170	24.90173		2026-08-11	10.55											
2026010208	39A	60.06685	24.98000	43	2026-08-11	12.43	x	x	x	x				x			x
2026010209	AALTO_HKI	59.96448	25.23382	54	2026-08-11	14.56											
2026010210	XIV3	60.20318	26.19253	79	2026-08-11	21.38	x	x	x	x				x			
2026010211	AALTO_ORRE	60.23290	26.39040	29	2026-08-12	01.53											
2026010212	BIAS19B	60.24853	27.24708	64	2026-08-12	07.03											
2026010213	XV1	60.24993	27.24677	65	2026-08-12	07.36	x	x	x	x	x	x		x			
2026010214	LL3A	60.06717	26.34620	69	2026-08-12	14.08	x	x	x	x	x	x		x	x		x
2026010215	GF2	59.83850	25.85647	86	2026-08-12	18.48	x	x	x	x				x			
2026010216	LL5	59.91687	25.59660	70	2026-08-12	21.17	x	x	x	x				x			
2026010217	LL6A	59.91693	25.02985	73	2026-08-13	00.34	x	x	x	x				x			
2026010218	LL7D	59.84665	24.83755	102	2026-08-13	03.02	x	x	x	x	x	x		x	x		x
2026010219	GF1	59.70505	24.68187	84	2026-08-13	07.02	x	x	x	x	x	x		x			x
2026010220	LL9	59.70007	24.02978	67	2026-08-13	10.48	x	x	x	x	x	x		x			x
2026010221	XII3	59.86413	23.98560	36	2026-08-13	13.43	x	x	x	x				x			x
2026010222	JML	59.58178	23.62700	81	2026-08-13	16.35	x	x	x	x				x			x
2026010223	F62	59.33335	23.26350	97	2026-08-13	19.41	x	x	x	x				x			
2026010224	LL12	59.48323	22.89698	83	2026-08-13	23.08	x	x	x	x	x	x		x	x		
2026010225	LL12H	59.48582	22.89695	86	2026-08-14	01.42											
2026010226	LL11	59.58343	23.29708	67	2026-08-14	03.28	x	x	x	x				x			x
2026010227	AMN	59.69037	23.25732	56	2026-08-14	05.43	x	x	x	x				x			x
2026010228	LANGDEN	59.77683	23.26312	58	2026-08-14	07.30	x	x	x	x	x	x		x			x
Hanko (Hango)	Hanko (Hango)	59.72867	23.05487		2026-08-14	10.30											
Hanko (Hango)	Hanko (Hango)	59.82158	22.94877		2026-08-14	10.30											
2026010229	AALTO_PI	59.24810	21.00162	110	2026-08-14	22.21											
2026010230	BIAS15	59.24975	21.01593	92	2026-08-15	01.31											
2026010231	IU7	59.81522	21.33657	93	2026-08-15	05.30	x	x	x	x	x	x		x			x
2026010232	IU5	60.05808	21.19842	90	2026-08-15	09.15	x	x	x	x				x			x
2026010233	IU3	60.33323	21.11357	49	2026-08-15	12.58	x	x	x	x				x			x
2026010234	IU1	60.76675	20.84683	34	2026-08-15	17.05	x	x	x	x				x			x
2026010235	SR7	61.08350	20.59678	78	2026-08-15	20.03	x	x	x	x				x			
2026010236	SR8	61.12643	20.93023	48	2026-08-15	22.30	x	x	x	x				x			

INDEX	STATION	latitude	longitude	depth	DATE	time	ctd	pH	ox	nu	ph	zo	be	chl	oil	tox	secchi
2026010237	Tahkoluoto_HF	61.62377	21.33350	33	2026-08-16	02.31											
2026010238	MS9	61.76675	20.53080	101	2026-08-16	05.40	x	x	x	x				x			x
2026010239	US7	62.60025	20.82950	28	2026-08-16	11.54	x	x	x	x				x			x
2026010240	US6B	62.60015	20.26308	82	2026-08-16	14.33	x	x	x	x				x			x
2026010241	US5B	62.58615	19.96897	219	2026-08-16	17.08	x	x	x	x	x	x		x	x		x
2026010242	F16	63.51677	21.06277	50	2026-08-17	03.39	x	x	x	x	x	x		x			x
2026010243	F15	63.51675	21.51270	47	2026-08-17	06.38	x	x	x	x				x			x
2026010244	IPS_pieka	63.98513	22.82882	24	2026-08-17	15.00											
2026010245	Ebba_S1	64.61253	23.65477	43	2026-08-17	21.01											
2026010246	RR7	64.73368	23.81272	39	2026-08-18	01.31	x	x	x	x				x			
2026010247	RR6	64.80033	23.47930	85	2026-08-18	03.36	x	x	x	x				x			
2026010248	BIAS11	64.73360	23.23232	73	2026-08-18	05.21											
2026010249	CV	65.00045	23.24650	86	2026-08-18	07.33	x	x	x	x				x			x
2026010250	CVI	65.23382	23.56303	68	2026-08-18	10.23	x	x	x	x				x			x
2026010251	IPS_kiisla	65.26240	24.43148	21	2026-08-18	13.47											
2026010252	F2	65.38377	23.46290	88	2026-08-18	19.51	x	x	x	x	x	x		x	x		
2026010253	RR3	64.93370	22.34597	94	2026-08-19	03.25	x	x	x	x				x			x
2026010254	BO3	64.30187	22.34297	110	2026-08-19	09.13	x	x	x	x	x	x			x		x
2026010255	F13	63.78347	21.47983	64	2026-08-19	15.54	x	x	x	x				x			x
2026010256	F18	63.31432	20.27290	103	2026-08-19	21.21	x	x	x	x				x			
2026010257	US3	62.75887	19.19558	176	2026-08-20	03.10	x	x	x	x				x			x
2026010258	MS3	62.13452	18.16283	85	2026-08-20	09.08	x	x	x	x				x			x
2026010259	MS6	61.98370	19.16312	73	2026-08-20	13.15	x	x	x	x				x			x
2026010260	F26	61.98350	20.06307	138	2026-08-20	16.46	x	x	x	x				x			x
2026010261	AALTO_SM	61.79912	20.23098	106	2026-08-20	19.24											
2026010262	SR3	61.18332	18.22995	72	2026-08-21	04.36	x	x	x	x				x			x
2026010263	SR5	61.08318	19.57975	125	2026-08-21	09.15	x	x	x	x	x	x		x	x		x
2026010264	SR5H	61.08152	19.57890	124	2026-08-21	12.32											
2026010265	Argo_SM	61.03303	19.74993	135	2026-08-21	13.28											
2026010266	F33	60.53293	18.93772	135	2026-08-21	18.55	x	x	x	x				x			
2026010267	F64	60.18883	19.14270	287	2026-08-21	23.29	x	x	x	x	x	x		x	x		
2026010268	F69	59.78343	19.93018	190	2026-08-22	08.34	x	x	x	x				x			x
2026010269	LL19	58.88062	20.31083	168	2026-08-22	15.33	x	x	x	x				x			x
2026010270	LL17	59.03288	21.07733	164	2026-08-22	20.42		x	x	x							
2026010271	ADCP_UTO	59.75583	21.35702	73	2026-08-23	08.15											
2026010272	LL15	59.18368	21.74662	131	2026-08-23	13.58	x	x	x	x				x			

INDEX	STATION	latitude	longitude	depth	DATE	time	ctd	pH	ox	nu	ph	zo	be	chl	oil	tox	secchi
2026010273	LL12	59.48362	22.89663	82	2026-08-23	20.56	x	x	x	x				x			
Helsinki	Helsinki	60.16625	24.95937		2026-08-24	08.51											

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