

CRUISE REPORT



R/V Aranda

Cruise 07/2021

COMBINE 3 leg 1
2.8.2021 – 10.8.2021

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

Objectives of the cruise

- 1) The objectives of the cruise were:
 - a. to monitor water hydrography and chemistry;
 - b. to conduct chlorophyll a, phyto- and zooplankton sampling and sampling of oil in surface water and phytotoxins;
 - c. to recover underwater hydrophones of SYKE in the Northern Baltic Proper
 - a. and in the Bothnian Bay and additional underwater noise related studies will be
 - b. conducted;
 - d. to carry out maintenance of wave buoys and a current profiler of FMI in the Northern Baltic Proper and in the Bothnian Sea;
 - e. to recover of incubated mussels (mussel cages) were recovered in order to impact of hazardous substances to mussels. The mussels were prepared on board for further analysis; and
 - f. to take additional zooplankton samples for lipid analysis.

- 2) Measured parameters were water temperature, salinity, conductivity, oxygen, H₂S, pH silicate and nutrients (ammonium, nitrite – nitrate, nitrite, phosphate, total nitrogen and total phosphorus).
Chlorophyll α samples were filtered on board to be analyzed later in laboratory.

Table 1. Scientific crew

Name	On board	Organization
Pekka Kotilainen	2.-10.8.2021	SYKE
Siru Tasala	2.-10.8.2021	SYKE
Anne-Mari Lehto	2.-10.8.2021	SYKE
Emmi Vähä	2.-10.8.2021	SYKE
Ilkka Lastumäki	2.-10.8.2021	SYKE
Pia Varmanen	2.-10.8.2021	SYKE
Jere Riikonen	2.-10.8.2021	SYKE
Tanja Kinnunen	2.-10.8.2021	SYKE
Mira Granlund	2.-10.8.2021	SYKE
Raisa Turja	2.-10.8.2021	SYKE

Antti Raika	2.-10.8.2021	SYKE
Heini Jalli	2.-10.8.2021	FMI
Pekka Kosloff	2.-10.8.2021	FMI
Sami Pusa	2.-10.8.2021	FMI
Ella von Weissenberg	2.-10.8.2021	NOVIA
Lisa Naeve	2.-10.8.2021	NOVIA

Cruise Route

The 1st leg

The 1st leg of the R/V Aranda's summer cruise COMBINE 3 started from her home port, Helsinki, Tammasaari on the 2nd of August 2021 at 10 am.

The first stations of the cruise were to recover the mussel incubation cages outside Helsinki and a nearby station 39A.

Northern Baltic Proper

Then Aranda headed to the west LL12, which is located south of Hanko. The next stations were of a transect LL15, LL17 and LL19.

After the transect an underwater hydrophone was recovered at BIAS15 and some instrument maintenance was conducted at AALTOPI. The maintenance consisted of cleaning of a wave buoy, replacement of its' battery pack and reading of the memory card. Station F69 located to south of the Åland Islands was sampled before the cruise headed to the Bothnian Sea.

The Bay of Bothnia

The cruise headed towards the north, F64 and further to F33. The station SR5 in the southern part of the Bothnian Sea was followed by SR3, MS6 and MS3, near the Swedish Coast. The stations F18 and F13 were sampled at Kvarken and then the cruise continued to RR3 and the turning point stations F2. Stations CVI, CV, RR6 and RR7 were sampled after the F2 and at BIAS11, another underwater noise recorder was recovered. The station BO3 was the southernmost station in the Bothnian Bay, which was sampled. On the way to the south F16 and F15 at Kvarken were sampled. In the Northern part of the Bothnian Sea US7, US6b and US5b were sampled. Tentatively planned wave buoy maintenance at AALTO_SM had to be skipped due to bad weather. After the trial cruise headed to MS9 and outside Pori another mussel cage was recovered at CAGEPORI. The stations SR8 and SR7 were sampled before the cruise entered the Archipelago Sea.

Archipelago Sea

Cruise continued to the stations IU1, IU3 and IU5. In the Archipelago Sea also the third mussel incubation cage setup was recovered and an ADCP workhorse, recording water currents at the spot, was recovered and replaced with a fresh instrument.

Finally, the last station on the edge of the Archipelago Sea was taken at IU7 and the first leg ended up to the Port of Hanko, Lansisatama, on the 10th of August 2021 at 16.30, Quai Ro-Ro1.

Conclusions

Northern Baltic Proper

Hydrography

Observed salinity in deep layers was lower than in 2019. Water column was anoxic below 80m depth in the Northern Baltic Proper oxycline found deeper than in 2019, when oxycline was found at 60m depth. Observed H₂S concentrations were higher than in average (in August 2000-2020).

Nutrients

Nutrient and silicate concentrations were observed to be above the summer average (2000-2020), especially in the deep layers.

Bothnian Sea

Hydrography

Salinity values were at the average level (2000-2020). Low oxygen concentrations were observed, especially in deep waters. Oxygen demand has increased in deep waters, probably due to extensive algal blooms in 2020. Still, observed oxygen saturation was over 50%.

Nutrients

High nutrient concentrations were observed especially in deep layers and even silicate concentrations were at some stations well above the average (2000-2020)

Kvarken

Hydrography

Some upwelling had probably taken place in the area recently as observed temperatures were lower than in average below the productive layer and observed salinity higher, respectively.

Nutrients

In general, low nutrient concentrations were observed in the productive layer and slightly higher nutrient concentrations were observed than in average. There is a need to follow the development of nutrient concentrations of the region in the future.

Bothnian Bay

Hydrography

Observed temperature, salinity and oxygen levels were typical for the region and season, respectively.

Nutrients

Observed dissolved nutrient concentrations were at many stations higher than the long-term average concentrations, but still at low level. Development of nutrient concentrations in the region should be followed.

Archipelago Sea

Hydrography

A typical summer stratification was observed. Detected temperature, salinity and measured oxygen concentrations were within the long-term averages.

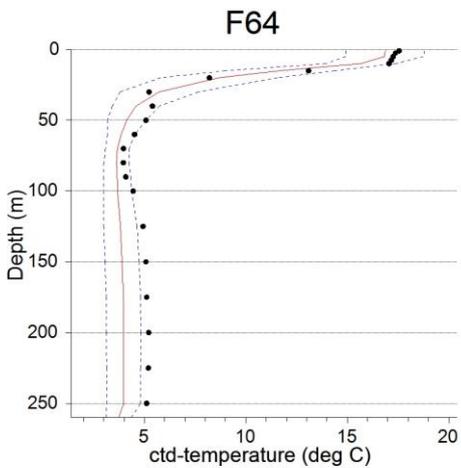
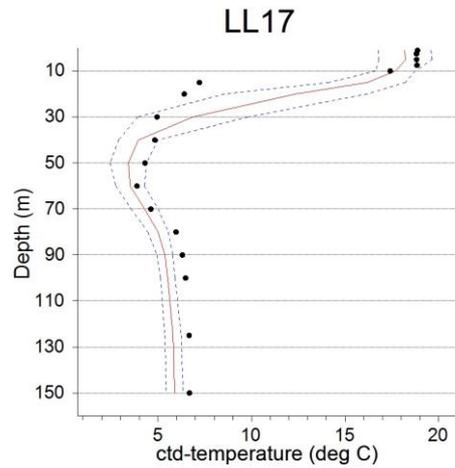
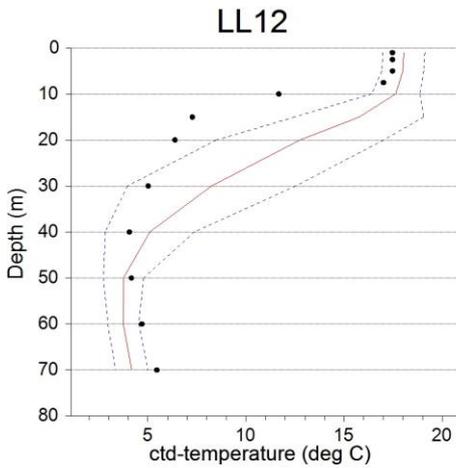
Nutrients

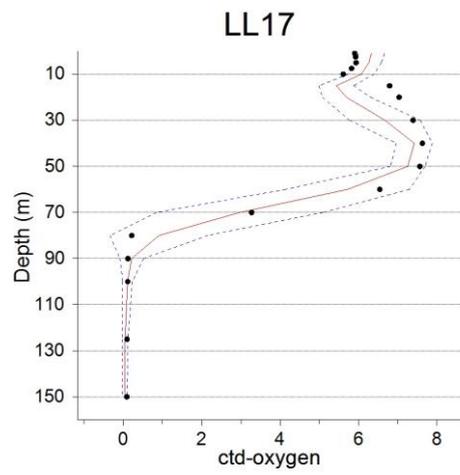
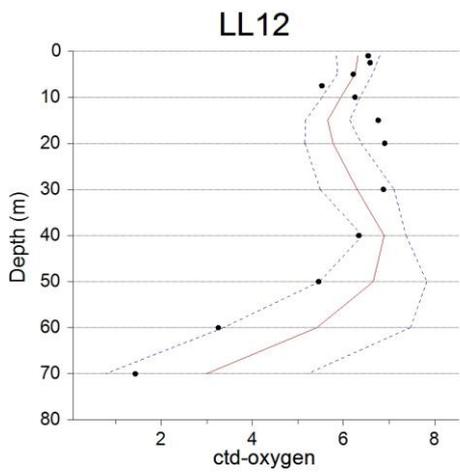
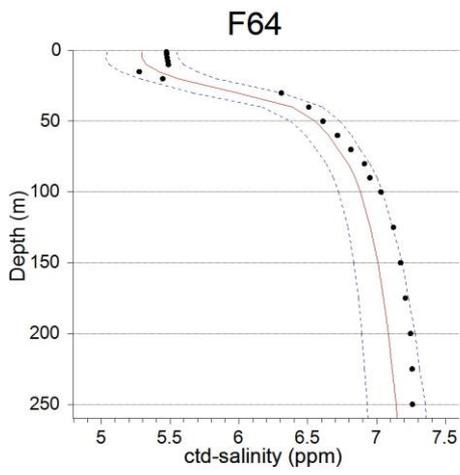
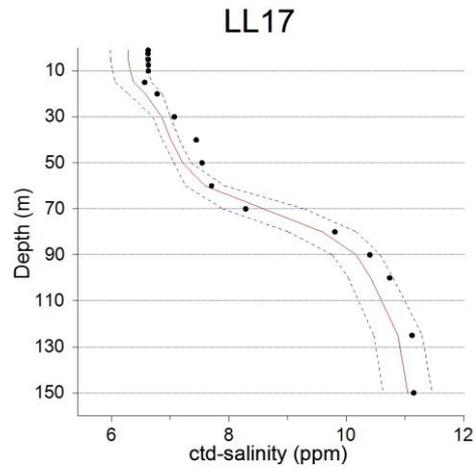
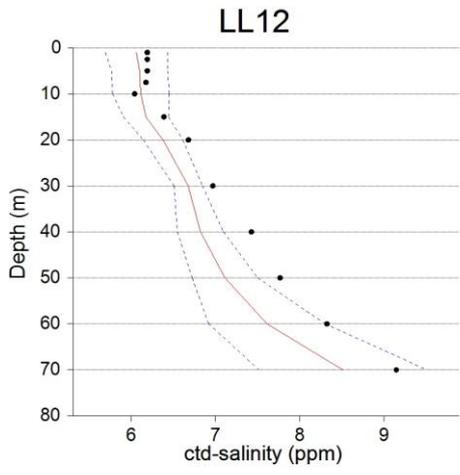
Observed nutrient concentrations were at the typical level of the area and season.

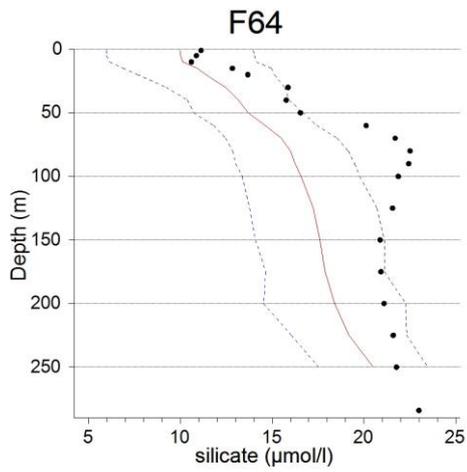
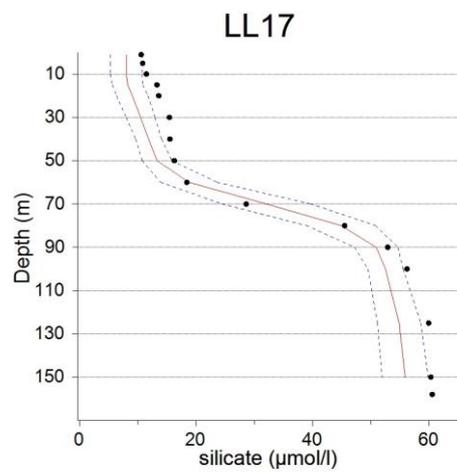
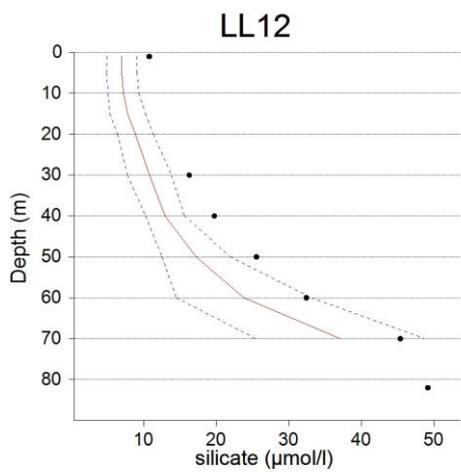
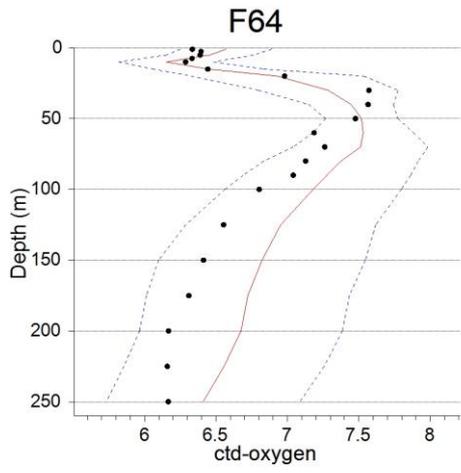
Observations

Annex 1. Selected variables at the stations LL12, LL17, F64, SR5, US5B, BO3 and F2 of the 1st leg and selected variables at the stations of the 2nd leg, XV1, LL7. Mean (red solid line) and standard deviation (blue dotted lines) represent the data collected at the same time of season since the year 2000.

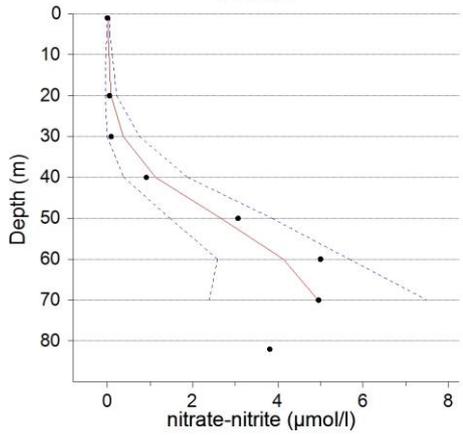
Northern Baltic Proper



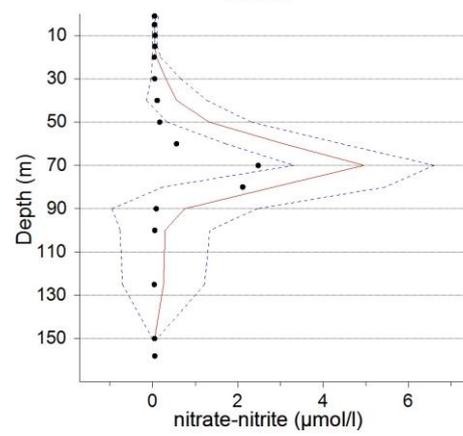




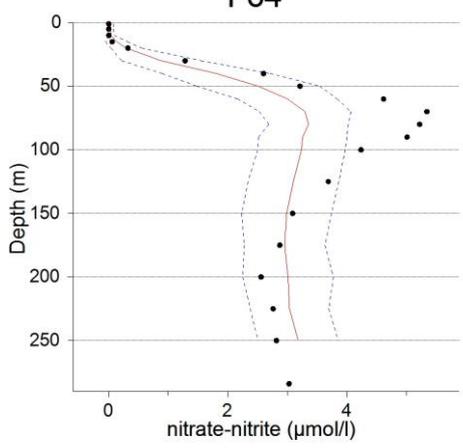
LL12



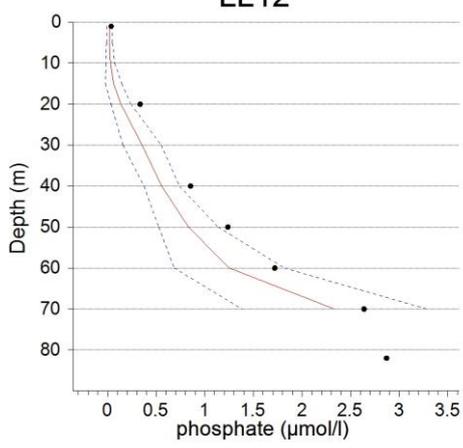
LL17



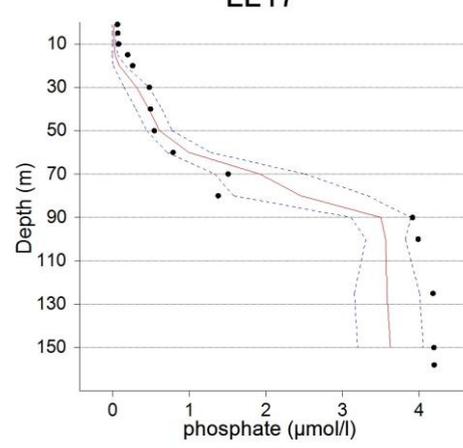
F64

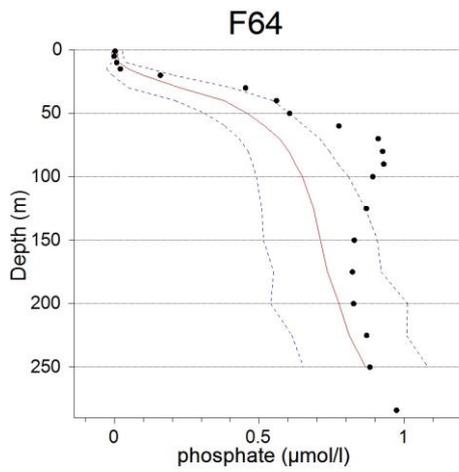


LL12

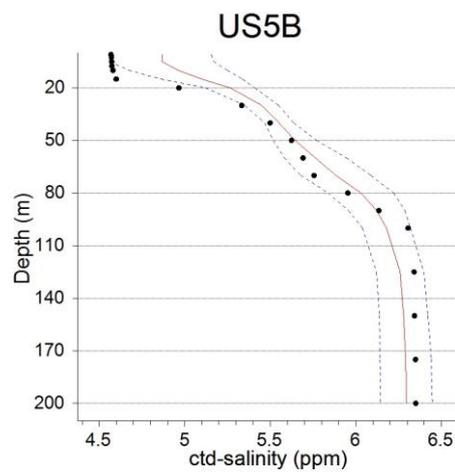
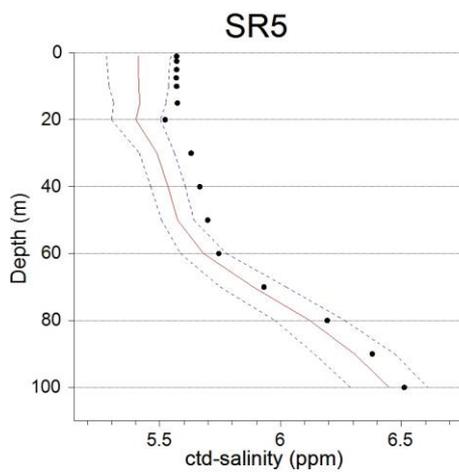
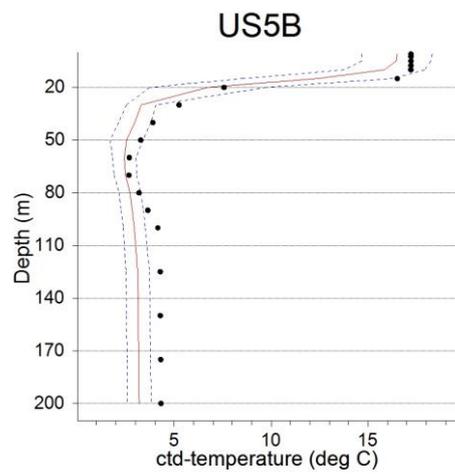
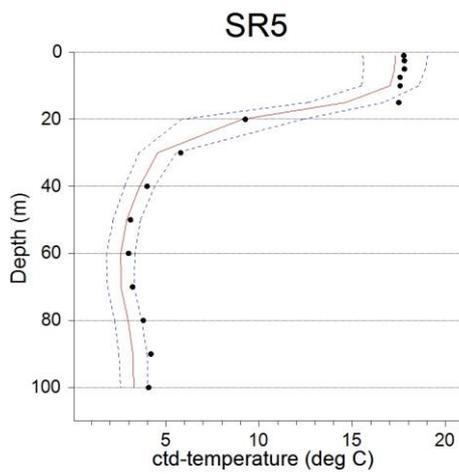


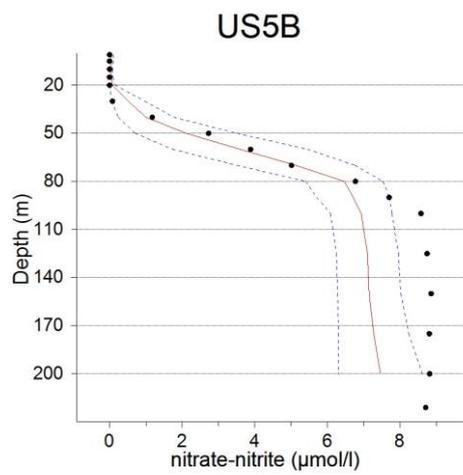
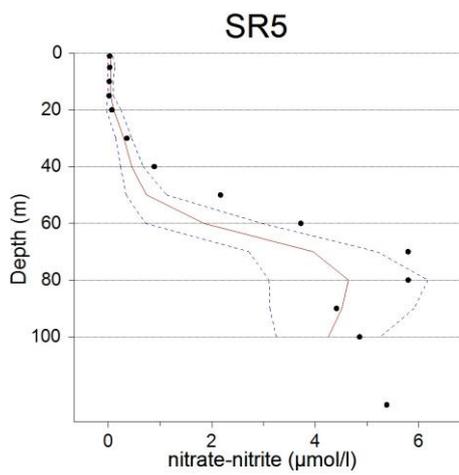
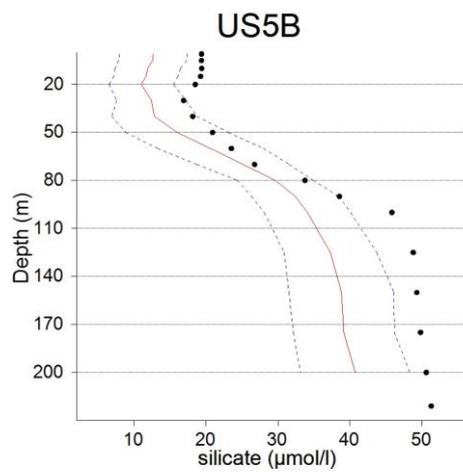
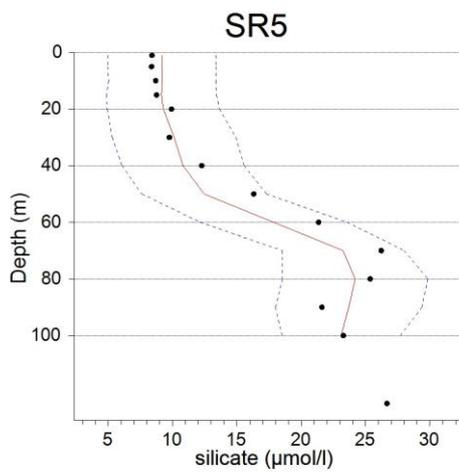
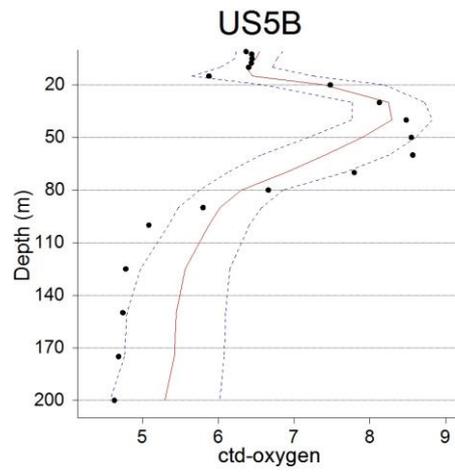
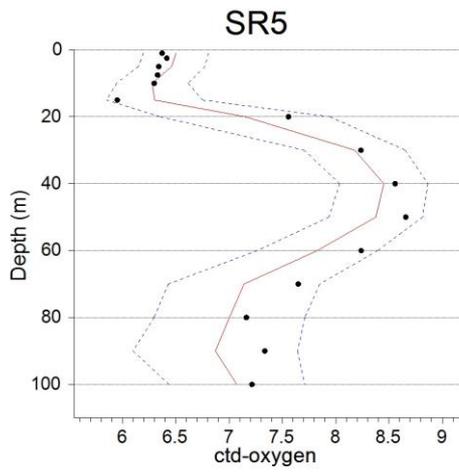
LL17



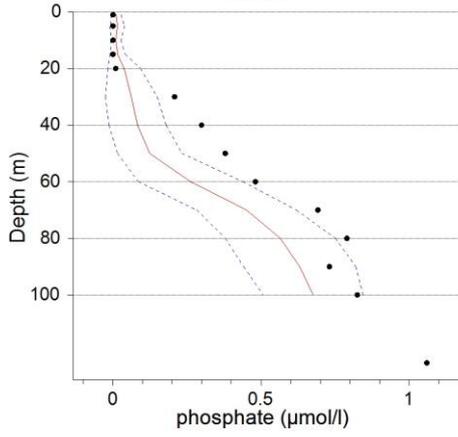


Bothnian Sea

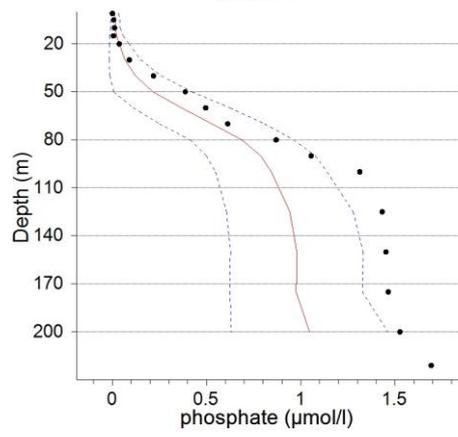




SR5

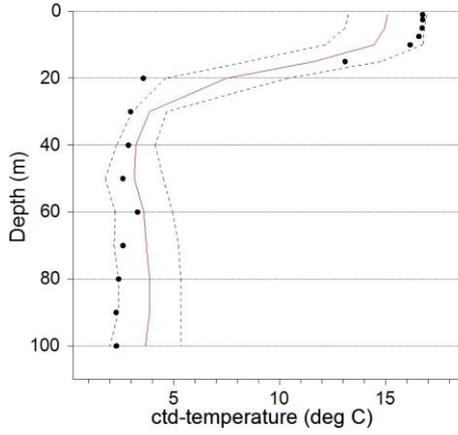


US5B

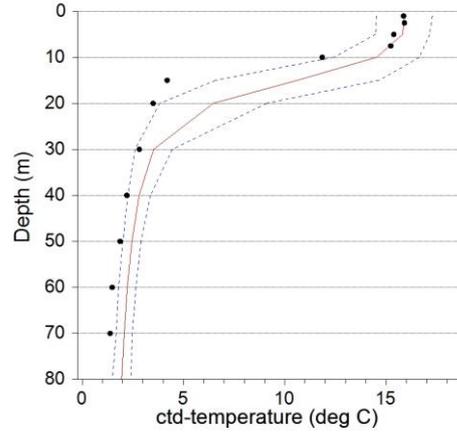


Bothian Bay

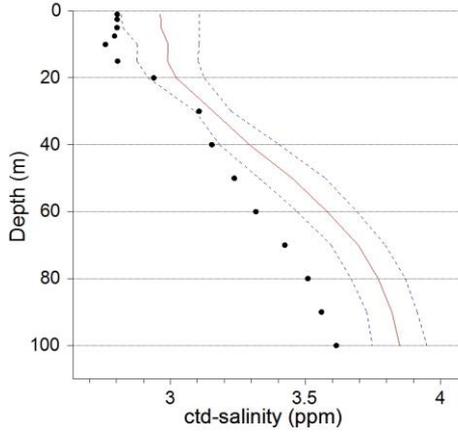
BO3



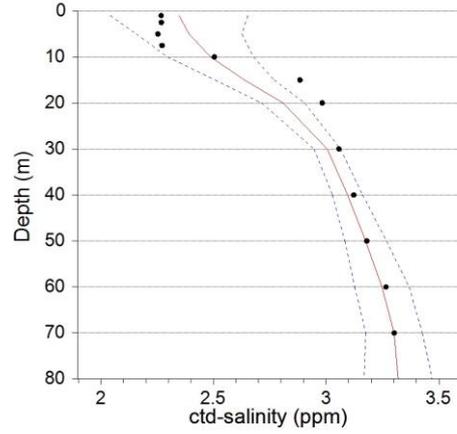
F2

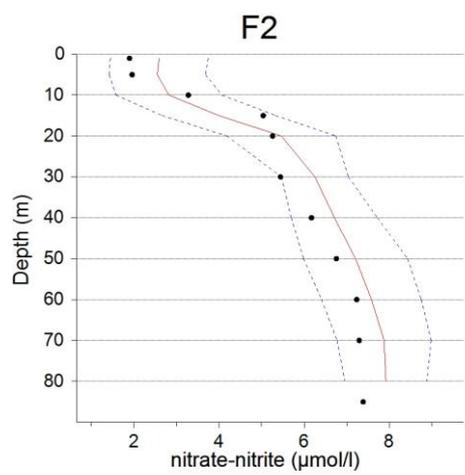
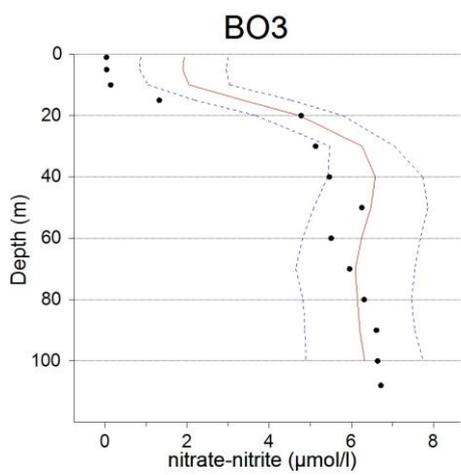
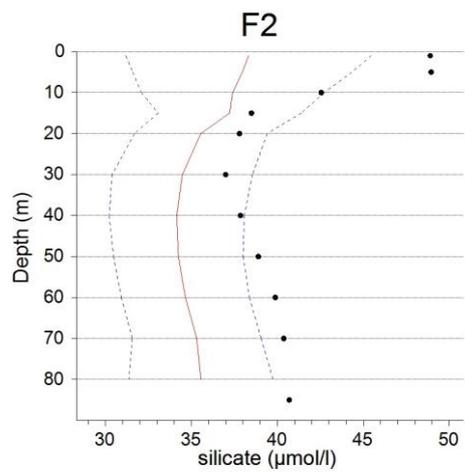
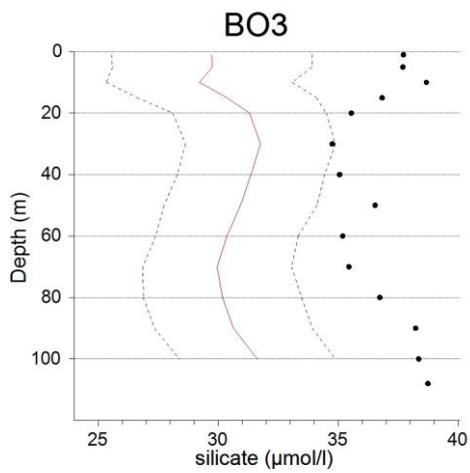
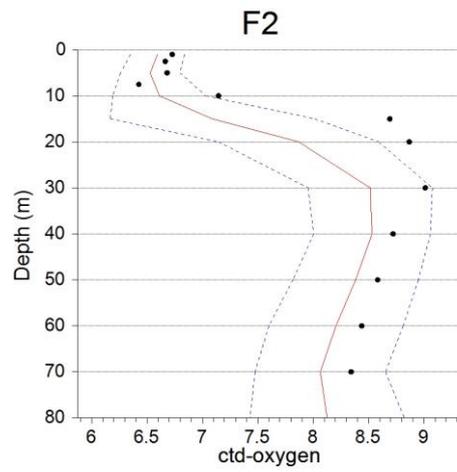
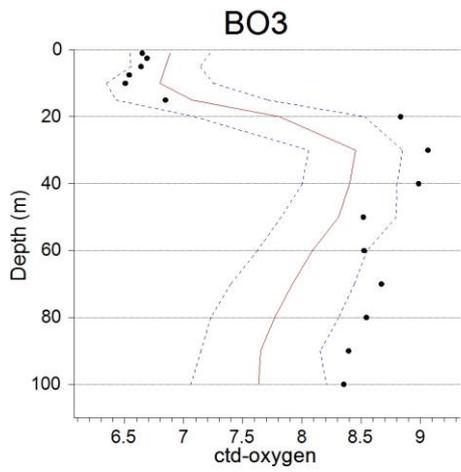


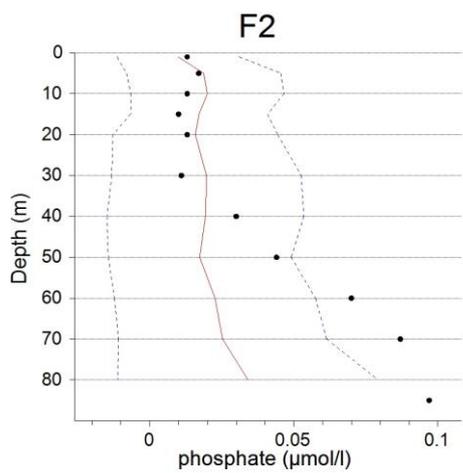
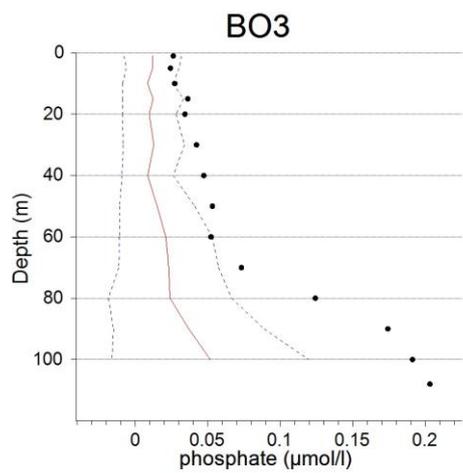
BO3



F2







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	60.16183	24.90158		2021-08-02	07:02											
2021010305	CAGEHELSINKI	60.08622	24.91308	21	2021-08-02	08:09	x										x
2021010306	39A	60.06680	24.98013	42	2021-08-02	10:59	x	x	x	x				x			x
2021010307	LL12	59.48338	22.89658	83	2021-08-02	19:43	x	x	x	x		x		x	x		
2021010308	LL15	59.18335	21.74667	131	2021-08-03	02:53	x	x	x	x				x			x
2021010309	LL17	59.03333	21.06802	159	2021-08-03	07:08	x	x	x	x	x	x		x			x
2021010310	LL19	58.88060	20.31083	169	2021-08-03	13:31	x	x	x	x	x	x		x	x		x
2021010311	BIAS15	59.24968	21.01433	90	2021-08-03	20:00											
2021010312	AALTOPI	59.24993	20.99372	98	2021-08-03	22:41	x										
2021010313	F69	59.78325	19.93000	192	2021-08-04	04:08	x	x	x	x				x			x
2021010314	F64	60.18898	19.14250	285	2021-08-04	09:29	x	x	x	x	x	x		x	x		x
2021010315	F33	60.53317	18.93770	136	2021-08-04	15:45	x	x	x	x				x			x
2021010316	SR5	61.08330	19.57972	125	2021-08-04	21:03	x	x	x	x	x	x		x	x		
2021010317	SR3	61.18335	18.22975	73	2021-08-05	03:28	x	x	x	x				x			x
2021010318	MS6	61.98370	19.16362	72	2021-08-05	09:35	x	x	x	x				x			
2021010319	MS3	62.13455	18.16305	83	2021-08-05	15:39	x	x	x	x				x			x
2021010320	MS3LAATU	62.13457	18.16303	84	2021-08-05	16:26	x										
2021010321	US3	62.75897	19.19560	175	2021-08-05	21:28	x	x	x	x				x			
2021010322	F18	63.31433	20.27267	102	2021-08-06	02:52	x	x	x	x				x			
2021010323	F13	63.78352	21.47950	65	2021-08-06	08:12	x	x	x	x				x			x
2021010324	RR3	64.93367	22.34593	93	2021-08-06	15:49	x	x	x	x				x			x
2021010325	F2	65.38360	23.46237	86	2021-08-06	20:55	x	x	x	x	x	x		x	x		
2021010326	CVI	65.23375	23.56288	69	2021-08-07	00:18	x	x	x	x				x			
2021010327	CV	65.00032	23.24618	86	2021-08-07	02:51	x	x	x	x				x			
2021010328	RR6	64.80040	23.47978	86	2021-08-07	05:16	x	x	x	x				x			x
2021010329	RR7	64.73367	23.81285	39	2021-08-07	07:19	x	x	x	x				x			x
2021010330	BIAS11	64.68497	23.23173	79	2021-08-07	09:33	x										
2021010331	BO3	64.30203	22.34295	109	2021-08-07	14:30	x	x	x	x	x	x		x	x		x
2021010332	F15	63.51680	21.51285	48	2021-08-07	21:56	x	x	x	x							
2021010333	F16	63.51695	21.06255	47	2021-08-08	00:07	x	x	x	x	x			x			
2021010334	US7	62.60018	20.82960	27	2021-08-08	08:09	x	x	x	x				x			
2021010335	US6B	62.60020	20.26302	82	2021-08-08	10:29	x	x	x	x				x			x
2021010336	US5B	62.58620	19.96900	222	2021-08-08	12:49	x	x	x	x	x	x		x	x		x
2021010337	F26	61.98360	20.05128	139	2021-08-08	20:14	x	x	x	x				x			
2021010338	AALTOSM	61.80417	20.23368	110	2021-08-08	22:47	x										
2021010339	MS9	61.76690	20.53042	101	2021-08-09	00:06	x	x	x	x				x			
2021010340	CAGEPORI	61.49752	21.34480	23	2021-08-09	06:07	x										x
2021010341	SR8	61.12655	20.93005	47	2021-08-09	09:07	x	x	x	x				x			x
2021010342	SR7	61.08338	20.59640	78	2021-08-09	11:07	x	x	x	x				x			
2021010343	IU1	60.76687	20.84668	33	2021-08-09	14:06	x	x	x	x				x			x
2021010344	IU3	60.33335	21.11335	51	2021-08-09	17:58	x	x	x	x		x		x			x
2021010345	CAGESM	60.14412	21.37925	31	2021-08-09	22:05	x										
2021010346	IU5	60.05815	21.19847	90	2021-08-09	23:29	x	x	x	x				x			
2021010347	ADCP_SM20	60.07233	20.97605	70	2021-08-10	03:29	x										
2021010348	IU7	59.81518	21.33668	92	2021-08-10	06:04	x	x	x	x	x	x		x			x
HANKO	HANKO	59.82322	22.94815		2021-08-10	13:45											

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