

CRUISE REPORT



R/V Aranda

Cruise 03/2021

Combine spring
20.4.2021 – 26.4.2021

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

Objectives of the cruise

- 1) Monitoring of the Gulf of Finland, Northern Baltic Proper, Åland Sea and the Southern part of the Bothnian Sea. Measured parameters were inorganic nutrients, Chlorophyll a (Chla), pH, O₂ and H₂S
- 2) There were additionally taken samples for eDNA to see if this could be a tool that could be developed for plankton community monitoring.
- 3) There were also measurements of bacterial production and extracellular enzyme production to investigate the breakdown of dissolved organic matter.

Table 1 The scientific crew

| Name | On board | Organization |
|-------------------|-----------|--------------|
| Kristian Spilling | 20.4-26.4 | SYKE |
| Panu Hänninen | 20.4-26.4 | SYKE |
| Ilkka Lastumäki | 20.4-26.4 | SYKE |
| Noora Haavisto | 20.4-26.4 | SYKE |
| Mari Vanharanta | 20.4-26.4 | SYKE |
| Mira Granlund | 20.4-26.4 | SYKE |
| Kirsi Rosendahl | 20.4-26.4 | SYKE |
| Jere Riikonen | 20.4-26.4 | SYKE |
| Tanja Kinnunen | 20.4-26.4 | SYKE |
| Jacqueline Jerney | 20.4-26.4 | SYKE |
| Teresa Camarena | 20.4-26.4 | SYKE |
| Elisa Lindgren | 20.4-26.4 | IL |
| Tuomo Roine | 20.4-26.4 | IL |

Cruise Route

We left Helsinki in the morning of Tuesday 20 April 2021 and we sampled in the Gulf of Finland before heading into the Northern Baltic Proper, Åland Sea, Bothnian Sea and with a final sampling point in the Archipelago Sea before returning to Uusikaupunki where there was a shift of crew for the back-to-back Maameri cruise.

Most stations were regular monitoring stations, but there was deployment of current meters (ADCP) in Gulf of Finland and close to Utö, Northern Baltic Proper. We made additionally a deployment of a sediment trap moored just outside of Utö.

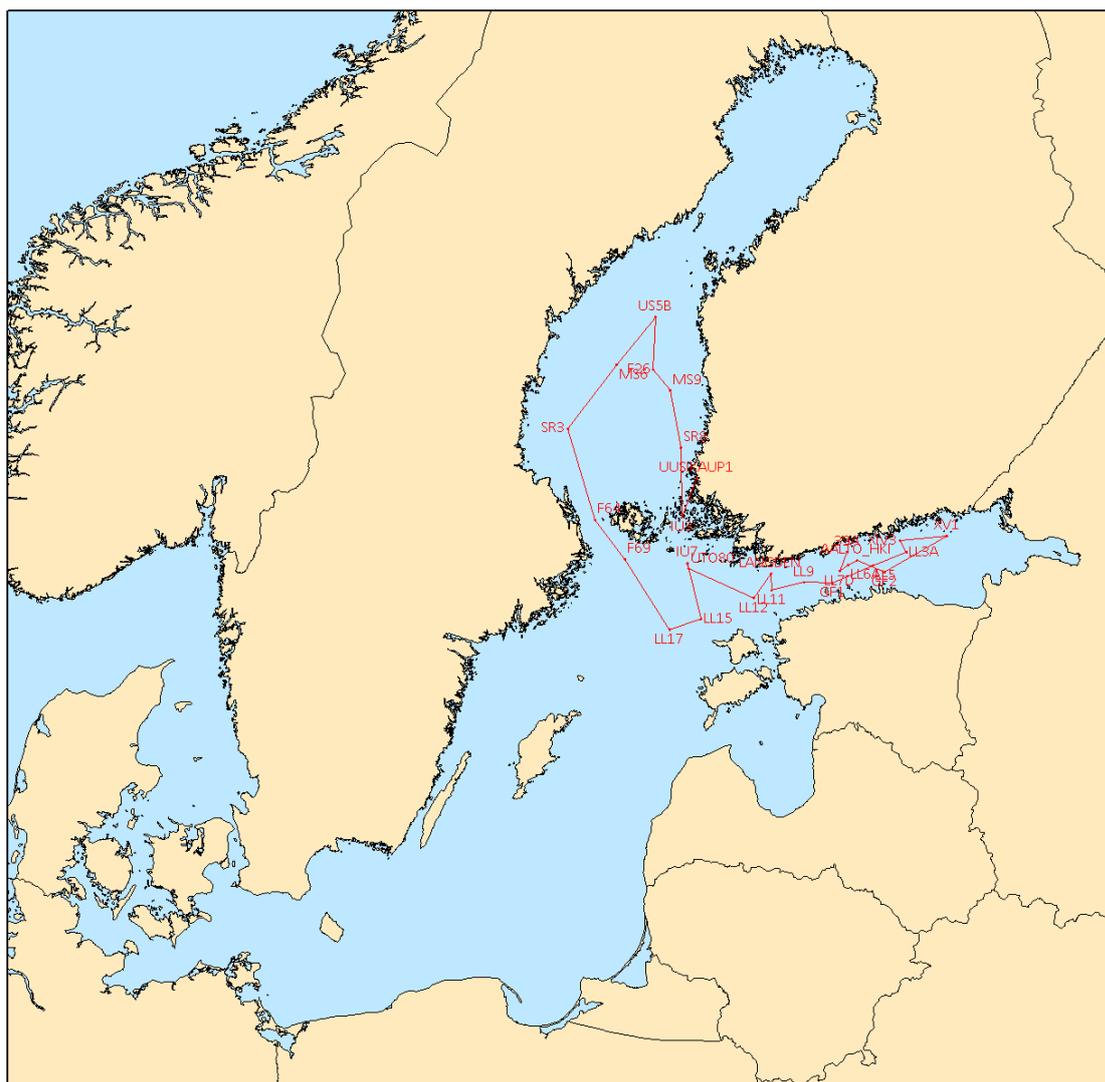


Fig 1. The cruise route

Observations

The main aim of the cruise was to monitor the spring bloom of phytoplankton and we hit the peak of the bloom in several of the stations in the Gulf of Finland. At these stations there were nitrate concentrations below detection limit and Chl a concentration $>20 \mu\text{g L}^{-1}$ (Figs 2 and 3) which is close to the average annual maximum Chl a peak in the area. Further west, the Chl a was lower but the nitrate concentration close to or at depletion suggesting also here that the bloom was at or past the peak of the bloom. In the Bothnian Sea we were clearly before the main peak as there was inorganic nutrients available and Chl a concentration was in the range $3 - 6 \mu\text{g Chl a L}^{-1}$, except for the station SR8 where it was $12.7 \mu\text{g Chl a L}^{-1}$

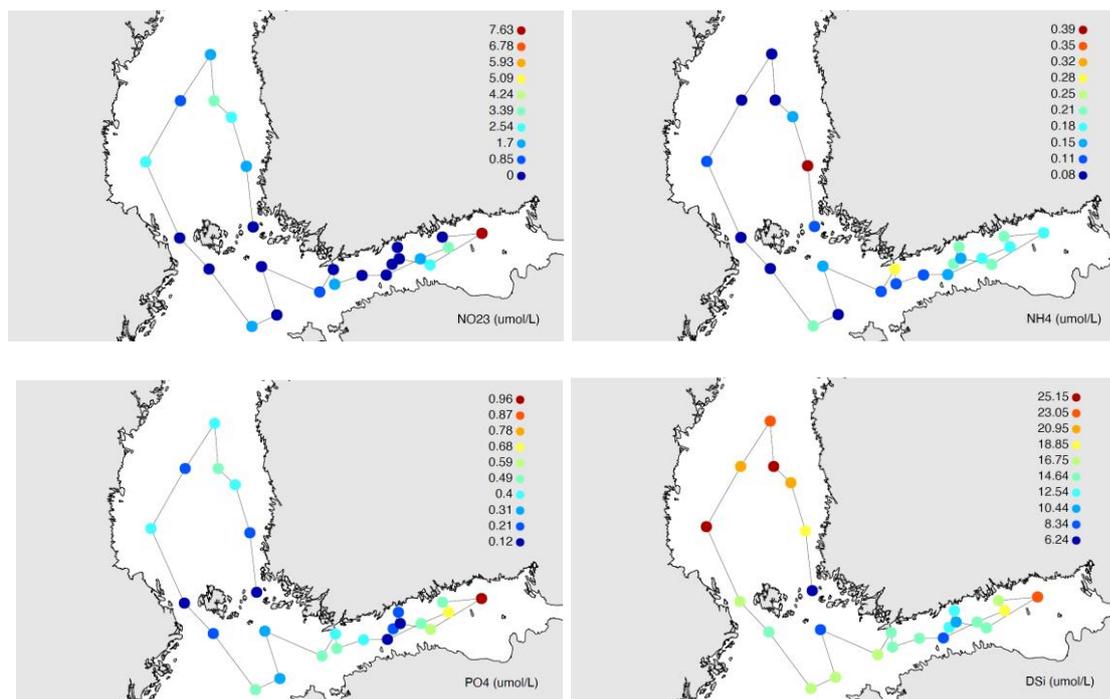


Fig 2. The inorganic nutrient concentration at the surface (1 m depth): nitrate -nitrite (NO₃+NO₂) upper left, ammonium (NH₄) upper right, phosphate (PO₄) lower left and dissolved silicate (DSi) lower right. All values in μmol L⁻¹.

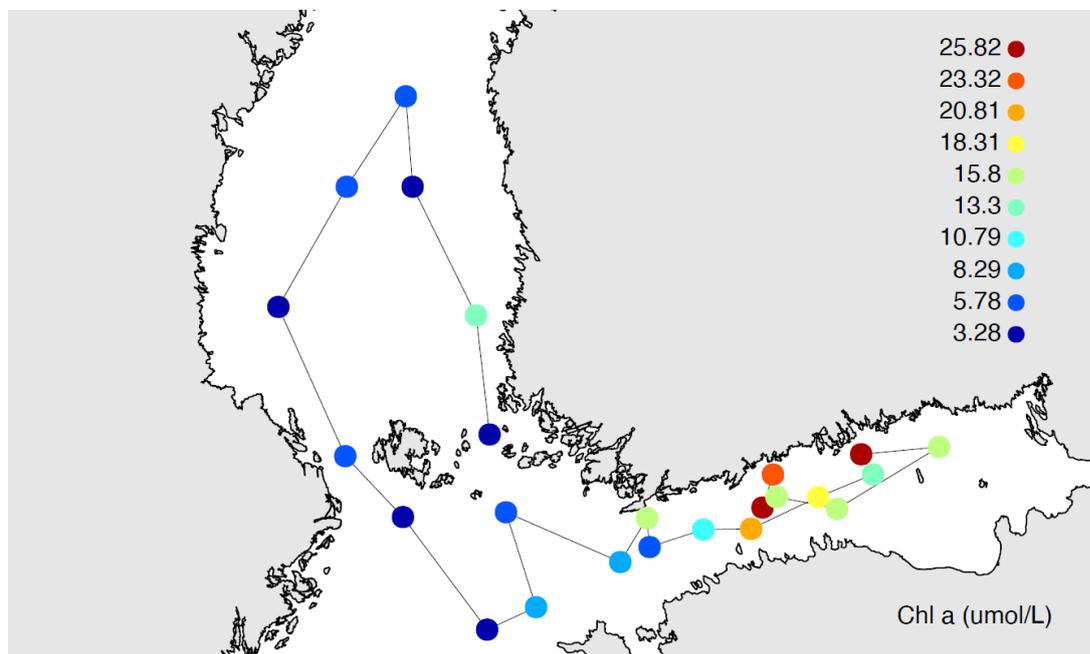


Fig 3. The chlorophyll a (Chl a) concentration in the surface (1 m depth) in μg L⁻¹.

The temperature was average for the season in the surface waters, but in some stations in the Gulf of Finland and Northern Baltic Proper the water temperature was relatively high ($>5\text{ }^{\circ}\text{C}$) in the bottom waters (Fig 4).

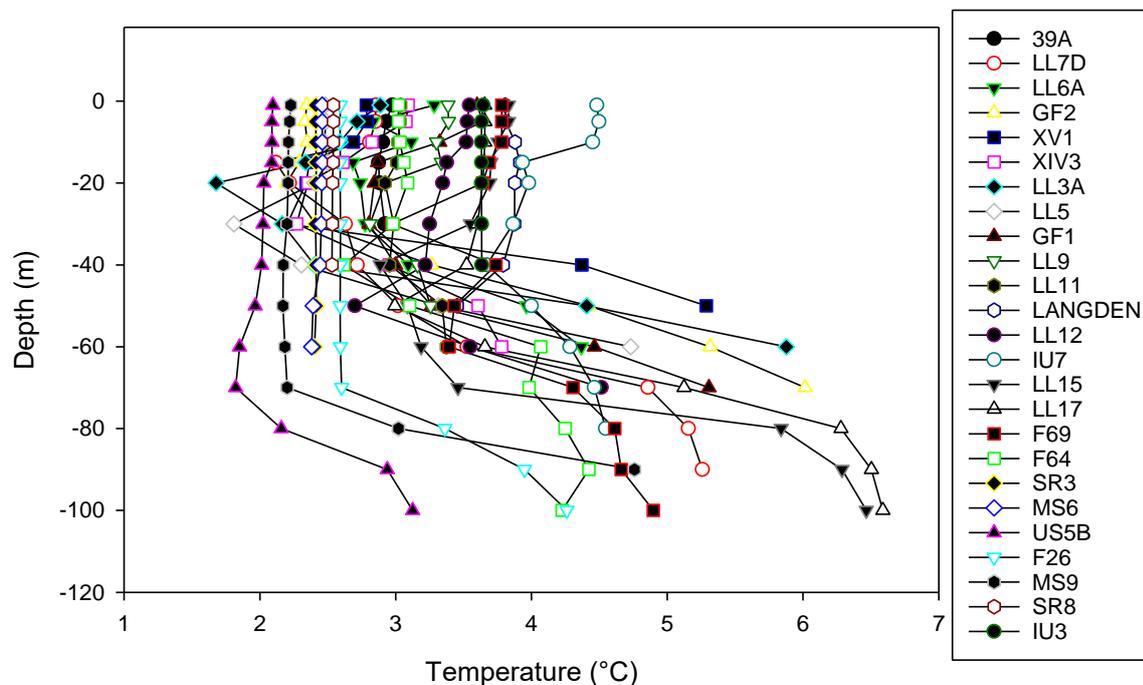


Fig 4. Temperature profile in all the stations down to a maximum of 100 m.

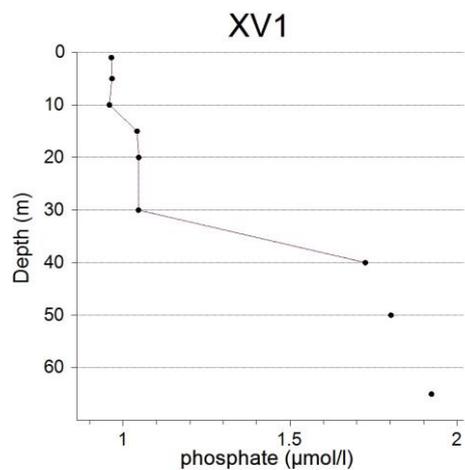
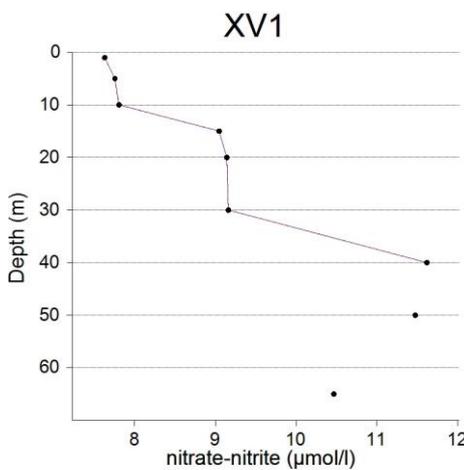
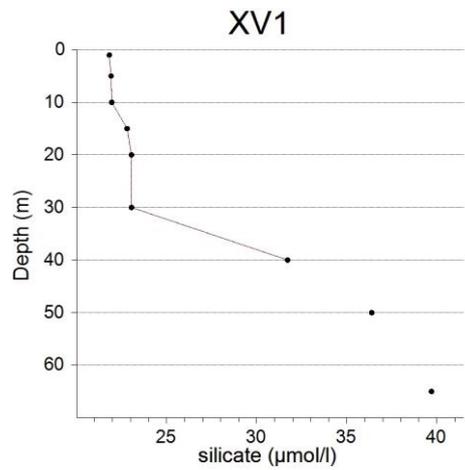
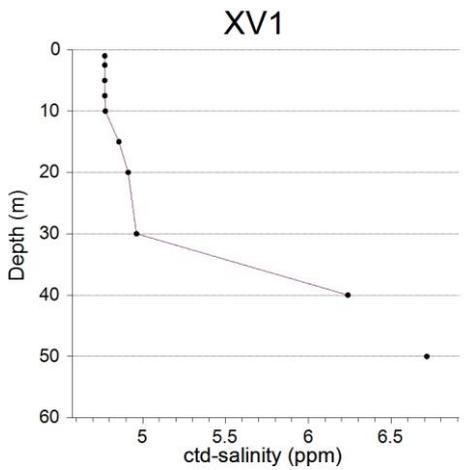
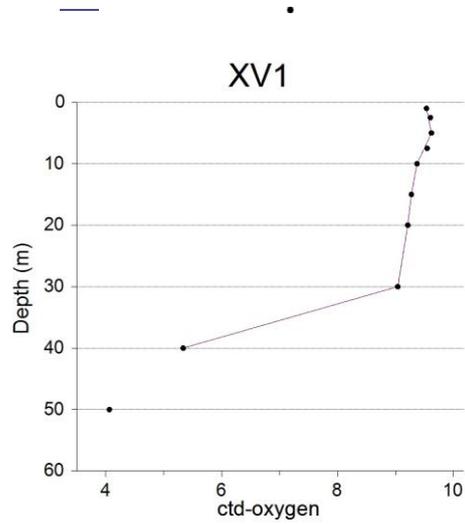
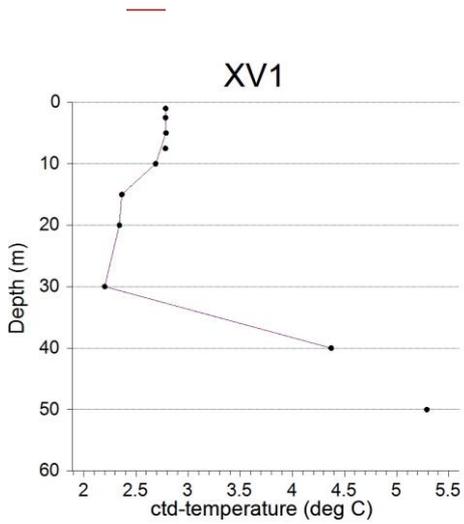
Conclusions

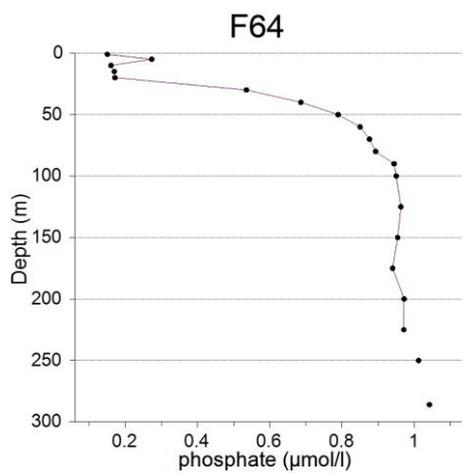
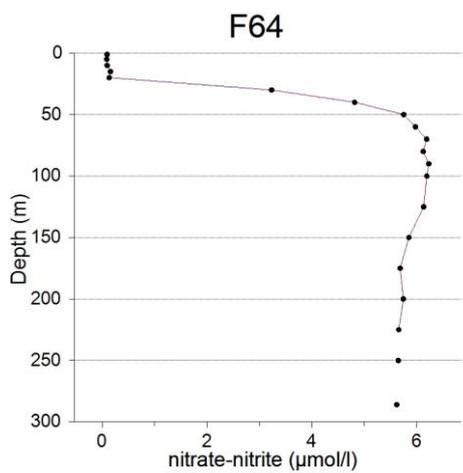
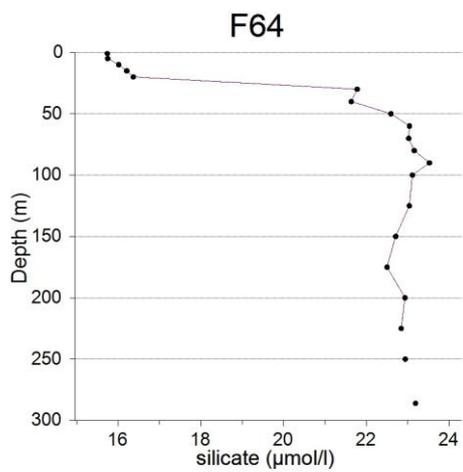
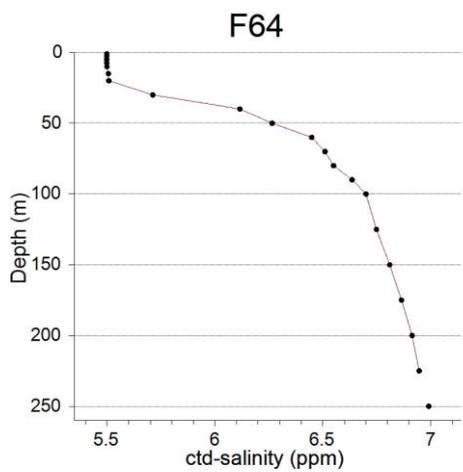
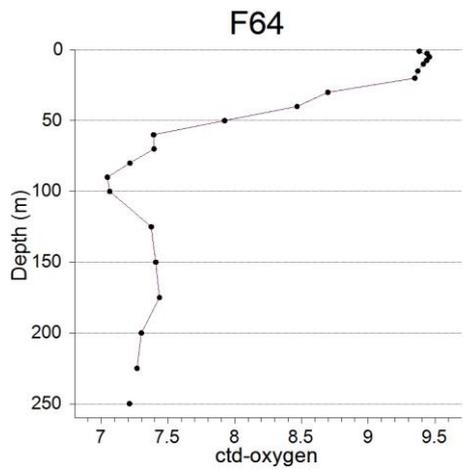
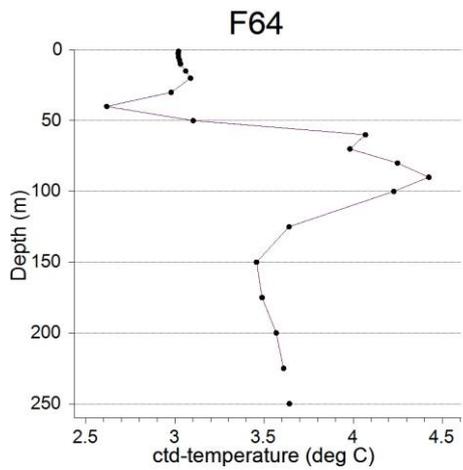
The spring phytoplankton bloom occurs every year due to the mixing of the water column and high inorganic nutrient concentration after winter. The increasing irradiance and onset of stratification supports what in many areas of the Baltic Sea is the highest annual primary production event.

During the cruise the biomass was heterogeneously distributed in the Gulf of Finland due to water movement. In some stations we sample close to or at the peak of the spring bloom indicated by high Chla a and low NO_3 concentrations. In the Northern Baltic Proper the annual Chla peak is normally lower compared with the Gulf of Finland and here the bloom was at or past the peak with low to no nitrate remaining in the surface waters. Further to the north, in the Bothnian Sea, the bloom was in an earlier phase and the bloom here is typically 2-4 weeks later compared with the Gulf of Finland.

Surface temperature was average in most stations, but the deep water ($> 100\text{ m}$) was in the upper quartile in the western Gulf of Finland and Northern Baltic Proper.

Annex 1. Selected variables at the stations XV1 and F64. Mean (red solid line) and standard deviation (blue dotted lines) represent the data collected at the same time of season since the year 2021.





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 |
|------------|-----------|----------|-----------|-------|------------|-------|-----|----|----|----|----|----|----|-----|-----|-----|--------|
| 2021010066 | 39A | 60.06685 | 24.98013 | 42 | 2021-04-20 | 07:57 | x | x | x | x | | | | x | | | x |
| 2021010067 | LL7D | 59.84650 | 24.83763 | 104 | 2021-04-20 | 10:47 | x | x | x | x | x | | | x | | | x |
| 2021010068 | LL6A | 59.91685 | 25.03013 | 73 | 2021-04-20 | 14:22 | x | x | x | x | | | | x | | | x |
| 2021010069 | AALTO_HKI | 59.97175 | 25.22653 | 34 | 2021-04-20 | 17:22 | x | | | | | | | | | | |
| 2021010070 | GF2 | 59.83843 | 25.85675 | 85 | 2021-04-20 | 20:09 | x | x | x | x | | | | x | | | |
| 2021010071 | XV1 | 60.24998 | 27.24700 | 66 | 2021-04-21 | 02:23 | x | x | x | x | x | | | x | | | |
| 2021010072 | XIV3 | 60.20165 | 26.18490 | 75 | 2021-04-21 | 07:14 | x | x | x | x | | | | x | | | x |
| 2021010073 | LL3A | 60.06717 | 26.34685 | 68 | 2021-04-21 | 09:32 | x | x | x | x | x | | | x | | | x |
| 2021010074 | LL5 | 59.91685 | 25.59692 | 69 | 2021-04-21 | 13:20 | x | x | x | x | | | | x | | | x |
| 2021010075 | GF1 | 59.70502 | 24.68213 | 84 | 2021-04-21 | 17:43 | x | x | x | x | x | | | x | | | |
| 2021010076 | LL9 | 59.70018 | 24.03022 | 66 | 2021-04-21 | 21:07 | x | x | x | x | x | | | x | | | |
| 2021010077 | LL11 | 59.58355 | 23.29678 | 67 | 2021-04-22 | 00:40 | x | x | x | x | | | | x | | | |
| 2021010078 | LANGDEN | 59.77687 | 23.26285 | 58 | 2021-04-22 | 02:57 | x | x | x | x | x | | | x | | | x |
| 2021010079 | LL12 | 59.48358 | 22.89692 | 82 | 2021-04-22 | 06:50 | x | x | x | x | x | | | x | | | x |
| 2021010080 | UTO80 | 59.75297 | 21.37305 | 80 | 2021-04-22 | 17:49 | x | | x | | | | | | | | |
| 2021010081 | IU7 | 59.81507 | 21.33657 | 93 | 2021-04-22 | 19:17 | x | x | x | x | | | | x | | | |
| 2021010082 | LL15 | 59.18320 | 21.74700 | 132 | 2021-04-23 | 00:20 | x | x | x | x | | | | x | | | |
| 2021010083 | LL17 | 59.03332 | 21.07930 | 170 | 2021-04-23 | 04:20 | x | | x | x | x | | | x | | | |
| 2021010084 | F69 | 59.78338 | 19.93008 | 190 | 2021-04-23 | 14:38 | x | | x | x | | | | x | | | |
| 2021010085 | F64 | 60.18900 | 19.14252 | 287 | 2021-04-23 | 20:07 | x | x | x | x | x | | | x | | | |
| 2021010086 | SR3 | 61.18320 | 18.22967 | 70 | 2021-04-24 | 07:11 | x | | x | x | | | | x | | | |
| 2021010087 | MS6 | 61.98362 | 19.16347 | 72 | 2021-04-24 | 15:15 | x | x | x | x | | | | x | | | |
| 2021010088 | US5B | 62.58605 | 19.96865 | 216 | 2021-04-24 | 21:07 | x | x | x | x | x | | | x | | | |
| 2021010089 | F26 | 61.98352 | 20.06295 | 135 | 2021-04-25 | 03:02 | x | x | x | x | | | | x | | | |
| 2021010090 | MS9 | 61.76695 | 20.53012 | 97 | 2021-04-25 | 06:30 | x | x | x | x | x | | | x | | | |
| 2021010091 | SR8 | 61.12640 | 20.92943 | 47 | 2021-04-25 | 12:13 | x | x | x | x | | | | x | | | |
| 2021010092 | IU3 | 60.33328 | 21.11337 | 49 | 2021-04-25 | 18:13 | x | x | x | x | | | | x | | | |
| UUSIKAUP1 | UUSIKAUP1 | 60.79672 | 21.37513 | | 2021-04-26 | 07:23 | | | | | | | | | | | |

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