CRUISE REPORT

R/V Aranda

Cruise 05/2020

COMBINE3 leg 1

3.8.2020 – 11.8.2020

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

Objectives of the cruise

The objectives of the cruise were:

1) The Cruise was based on the HELCOM monitoring programme and conducted in the Northern Baltic Proper, Åland Sea, Bothnian Sea, Bothnian Bay and Archipelago Sea. Measured parameters were water temperature, salinity, conductivity and oxygen / hydrogen sulfide, silicate and nutrients.

2) Chlorophyll a, phytoplankton and zooplankton, RNA of phytoplankton, phytotoxin and oil samples were also taken for later analysis;

3) Maintenance of the instruments of the Finnish meteorological Institute (FMI) were also carried out

Table 1. Scientific crew

Name	On board	Organization
Pekka Kotilainen (chief scientist)	**3-11.8.2020**	**SYKE**
Heidi Hällfors	**3-11.08.2020**	**SYKE**
Heini Jalli	**3-11.08.2020**	**FMI**
Tanja Kinnunen	**3-11.08.2020**	**SYKE**
Pekka Kosloff	**3-11.08.2020**	**FMI**
Ilkka Lastumäki	**3-11.08.2020**	**SYKE**
Okko Outinen	**3-11.08.2020**	**SYKE**
Sirpa Lehtinen	**3-11.08.2020**	**SYKE**
Jere Riikonen	**3-11.08.2020**	**SYKE**
Kirsi Rosendahl	**3-11.08.2020**	**SYKE**
Antti Räike	**3-11.08.2020**	**SYKE**
Kristiina Vuorio	**3-11.08.2020**	**SYKE**

Cruise Route

The 1st leg of the COMBINE 3 cruise started from Helsinki on the 3rd of August 2020. The first station was outside Helsinki, 39A, which is usually monitored during the leg of Gulf of Finland, was sampled during the 1st leg for practical reasons.
After the station 39A R/V Aranda headed to the northern Baltic Proper and the stations LL12, LL15, LL17 and LL19. A wave buoy was lifted, and maintenance carried out before the station LL17. After the LL19 stations F69 and F64 were sampled. The cruise passed Åland islands and headed to the west coast of the Bothnian Sea and continued at stations F33, SR3, MS3, US3. Stations at Kvarken, F18 and F13, and Aranda continued to the Bothnian Bay, where the stations RR3, F2, the northernmost station, CV, CVI, RR6, RR7 and BO3 where monitored. The cruise returned to Kvarken and stations F15, and F16, and then the transect US7, US6b, US5b were sampled. After that, followed the stations MS6, F26 and maintenance of the wave buoy (AALTO_SM) was carried out on Sunday, the 9th of August. After the maintenance of the wave

buoy MS9 and SR transect, SR5, SR7 and SR8 were sampled. The last stations were conducted in the Archipelago Sea IU1, IU3, IU5 and IU7 and the 1st leg of the cruise ended up to Hanko on the 11th of August 2020 (Figure 1).

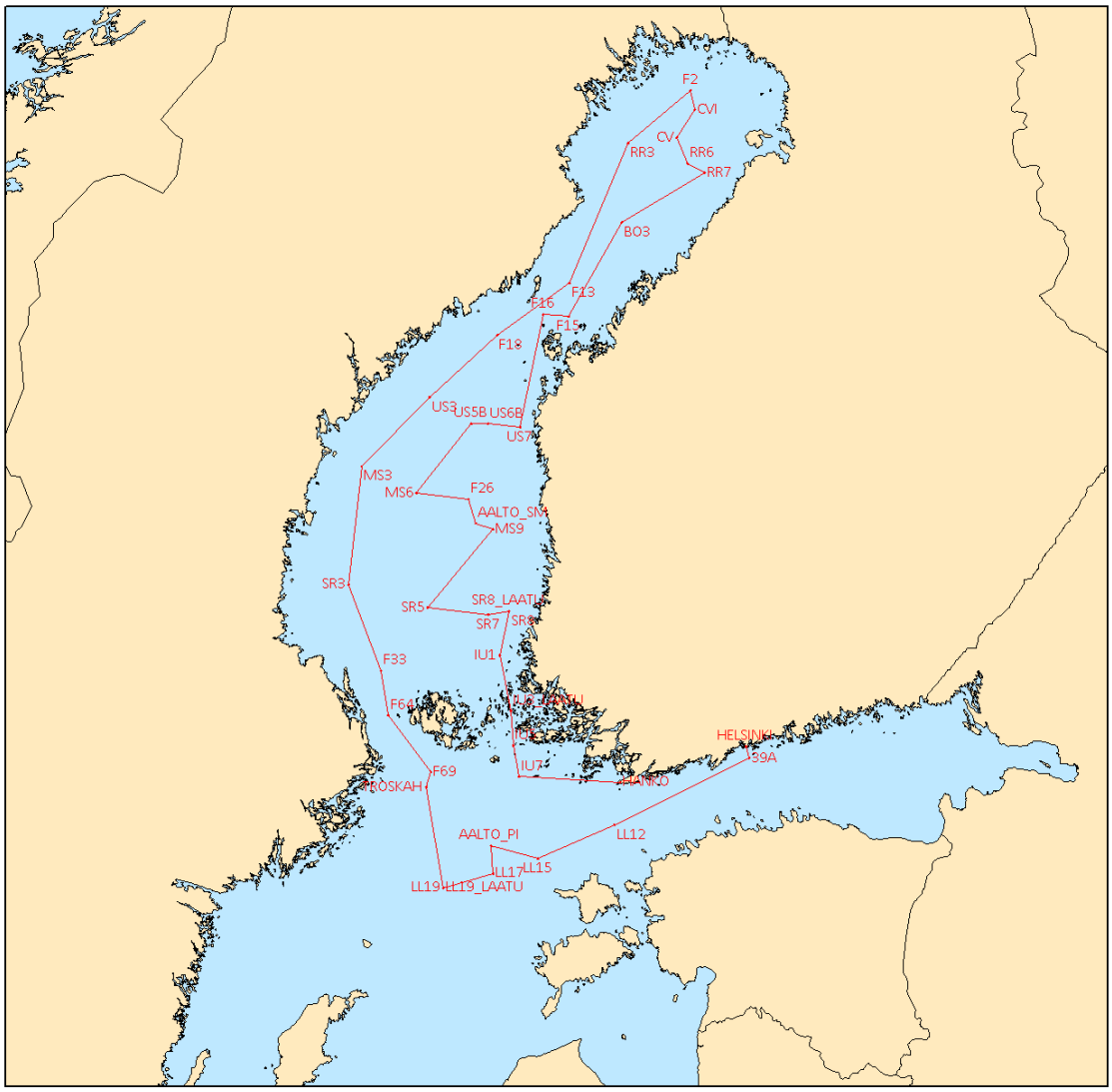


Figure 1. The Route of the 1st leg of the COMBINE 3 5/2020 cruise.

Sampling

Sampled stations have been listed in the table 2. CTD profiles were taken at every station and included in parameters temperature, salinity, oxygen and conductivity.

Dissolved (PO_4, NH_4-N, $NO_{2,3}$-N and NO_2-N) and total nutrients (P_{tot}, N_{tot}) were measured at depths, 1, 5, 10, 15, 2, 30, 40, 50, 60, 70, 80, 90, 100, 125, 150, 175, 200, 225 and 250 meters depending on the depth of a station. At some stations, also the depths of 2.5 and 7.5 meters were sampled. In addition, chlorophyll a, silicate and oxygen / hydrosulphite and pH were also sampled and analyzed.

Both phytoplankton and zooplankton samples, as well as, oil and phytotoxin samples were taken at certain stations (table 2) for later analysis.

Table 2. List of the stations

INDEX	STATION	latitude	longitude	depth	DATE	time	ctd	pH	ox	nu	ph	zo	be	chl	oil	tox	secchi
HELSINKI	HELSINKI	60.15917	24.92283		2020-08-03	09:16											
2020010121	39A	60.06688	24.98047	42	2020-08-03	15:56	x	x	x	x				x			
2020010122	LL12	59.48350	22.89700	82	2020-08-04	08:02	x	x	x	x				x	x	x	
2020010123	LL15	59.18335	21.74682	131	2020-08-04	08:09	x	x	x	x				x			
2020010124	AALTO_PI	59.25008	20.99630	97,5	2020-08-04	12:57	x										
2020010125	LL17	59.03325	21.06818	159	2020-08-04	16:44	x	x	x	x	x	x		x	x	x	x
2020010126	LL19	58.88063	20.31075	167	2020-08-04	21:44	x	x	x	x	x	x		x		x	
2020010127	LL19_LAATU	58.88063	20.31075	167	2020-08-04	23:55	x										
2020010128	TROSKAH	59.66000	19.88363	42	2020-08-05	06:27	x	x	x	x				x			
2020010129	F69	59.78337	19.93000	193	2020-08-05	08:22	x	x	x	x				x			x
2020010130	F64	60.18908	19.14237	287	2020-08-05	13:53	x	x	x	x	x	x		x	x	x	x
2020010131	F33	60.53325	18.93793	136	2020-08-05	19:45	x	x	x	x				x			
2020010132	SR3	61.18323	18.22998	72	2020-08-06	01:48	x	x	x	x	x			x			
2020010133	MS3	62.13448	18.16288	85	2020-08-06	08:39	x	x	x	x				x			x
2020010134	US3	62.75883	19.19537	174	2020-08-06	14:42	x	x	x	x				x			x
2020010135	F18	63.31440	20.27282	103	2020-08-06	20:19	x	x	x	x				x			
2020010136	F13	63.78352	21.47933	64	2020-08-07	01:54	x	x	x	x				x			x
2020010137	RR3	64.93362	22.34612	94	2020-08-07	09:55	x	x	x	x				x			x
2020010138	F2	65.38617	23.45857	93	2020-08-07	15:12	x	x	x	x	x	x		x	x		x
2020010139	CVI	65.23380	23.56272	69	2020-08-07	17:49	x		x	x				x			x
2020010140	CV	65.00040	23.24628	87	2020-08-07	20:27	x		x	x				x			
2020010141	RR6	64.80017	23.47942	87	2020-08-07	22:53	x		x	x	x			x			
2020010142	RR7	64.73368	23.81258	39	2020-08-08	01:03	x	x	x	x				x			
2020010143	BO3	64.30208	22.34297	110	2020-08-08	06:40	x	x	x	x	x	x		x	x	x	x
2020010144	F15	63.51667	21.51298	48	2020-08-08	14:06	x	x	x	x				x			x
2020010145	F16	63.51685	21.06273	47	2020-08-08	16:10	x	x	x	x	x	x		x			x
2020010146	US7	62.60025	20.82967	28	2020-08-09	00:20	x	x	x	x				x			
2020010147	US6B	62.60027	20.26285	82	2020-08-09	02:44	x	x	x	x				x			x
2020010148	US5B	62.58615	19.96897	219	2020-08-09	05:08	x	x	x	x	x	x		x	x	x	x
2020010149	MS6	61.98360	19.16357	72	2020-08-09	12:14	x	x	x	x				x			x
2020010150	F26	61.98350	20.06308	138	2020-08-09	16:00	x	x	x	x	x			x			x
2020010151	AALTO_SM	61.80020	20.23302	107	2020-08-09	19:06	x										
2020010152	MS9	61.76668	20.53075	101	2020-08-09	21:25	x	x	x	x				x			
2020010153	SR5	61.08342	19.57977	125	2020-08-10	03:44	x	x	x	x	x	x		x	x		x
2020010154	SR7	61.08350	20.59642	78	2020-08-10	08:56	x	x	x	x				x			x
2020010155	SR8	61.12648	20.92993	47	2020-08-10	11:18	x	x	x	x				x			x
2020010156	SR8_LAATU	61.12650	20.92993	47	2020-08-10	11:51	x							x			x
2020010157	IU1	60.76678	20.84668	34	2020-08-10	14:38	x	x	x	x				x			x
2020010158	IU3	60.33358	21.11322	50	2020-08-10	18:16	x	x	x	x	x			x			x
2020010159	IU3_LAATU	60.33357	21.11323	48	2020-08-10	20:08	x	x	x	x							
2020010160	IU5	60.05818	21.19835	89	2020-08-10	23:52	x	x	x	x				x			
2020010161	IU7	59.81518	21.33660	93	2020-08-11	04:13	x	x	x	x	x	x		x			x
HANKO	HANKO	59.82223	22.94743		2020-08-11	11:30											

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

Conclusions

Hydrography

Typical summer stratification was observed at sampled stations. Hypoxia was observed in the northern Baltic Proper below 75-80m (Figures 3-5). Observed oxygen concentrations at deep stations (> 100m) in the Bothnian Sea were lower than in previous years, but oxygen concentrations were still > 4ml/l.

Nutrients and silicate

Dissolved and total nutrient concentrations and silicate concentrations (dots in figures) including in average summer concentrations (red line) and standard deviations (dotted blue lines) at each station have been compiled in Annex 1.

In addition, some titrated oxygen and H_2S concentrations have been included in, as well.

Observed phosphate concentrations were close to the average in the northern Baltic Proper, but showed a clear increase in the Bothnian Sea and Bothnian Bay.

Nitrate-nitrite concentrations were occasionally higher than in average. Observed nitrite concentrations were typically at low level.

P_{tot} and N_{tot} summer concentrations were high especially in the Bothnian Sea, in Kvarken and Bothnian Bay. High summer concentrations were also observed in silicate.

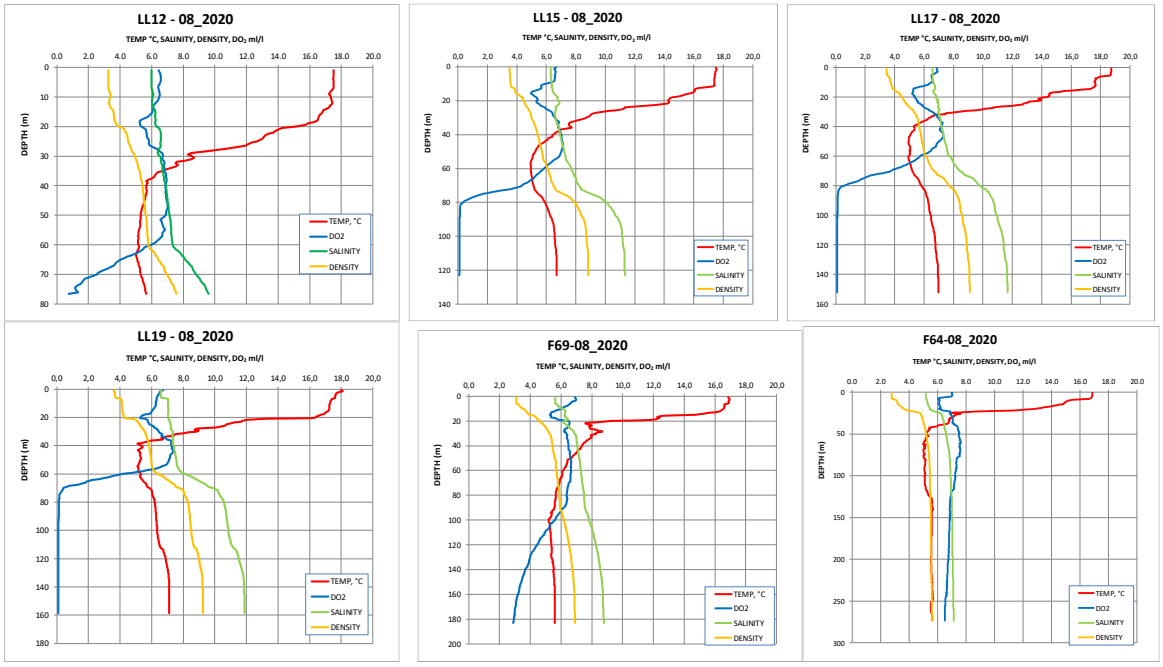
Chlorophyll a, oil and phytotoxin samples, as well as, phyto- and zooplankton samples will be analyzed during the winter.

Apart from the sampling, strong algal blooms were detected in the Bothnian Sea and in Kvarken, which were exceptional for the region.

Observations

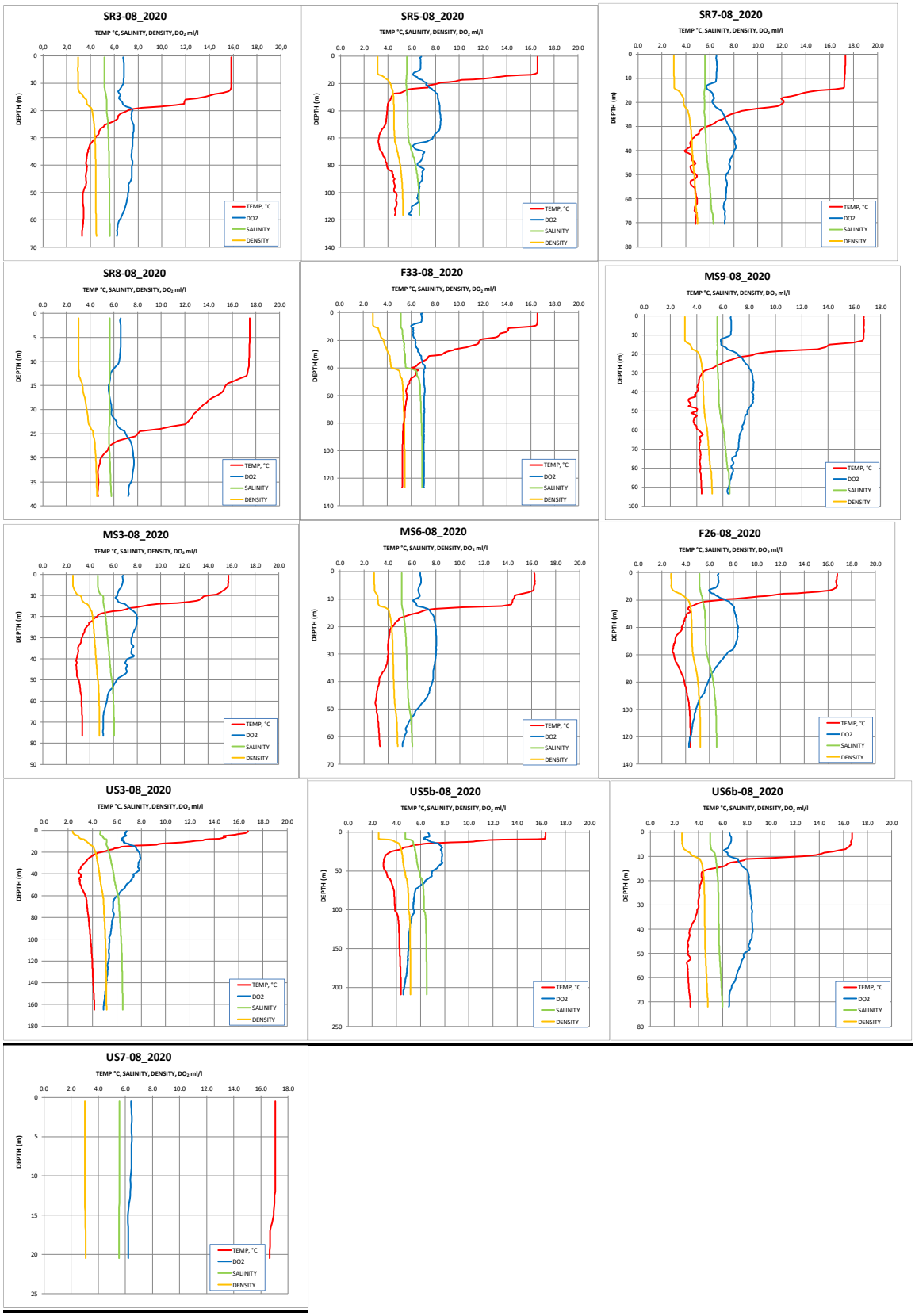
Hydrography

Northern Baltic Proper and Åland Sea



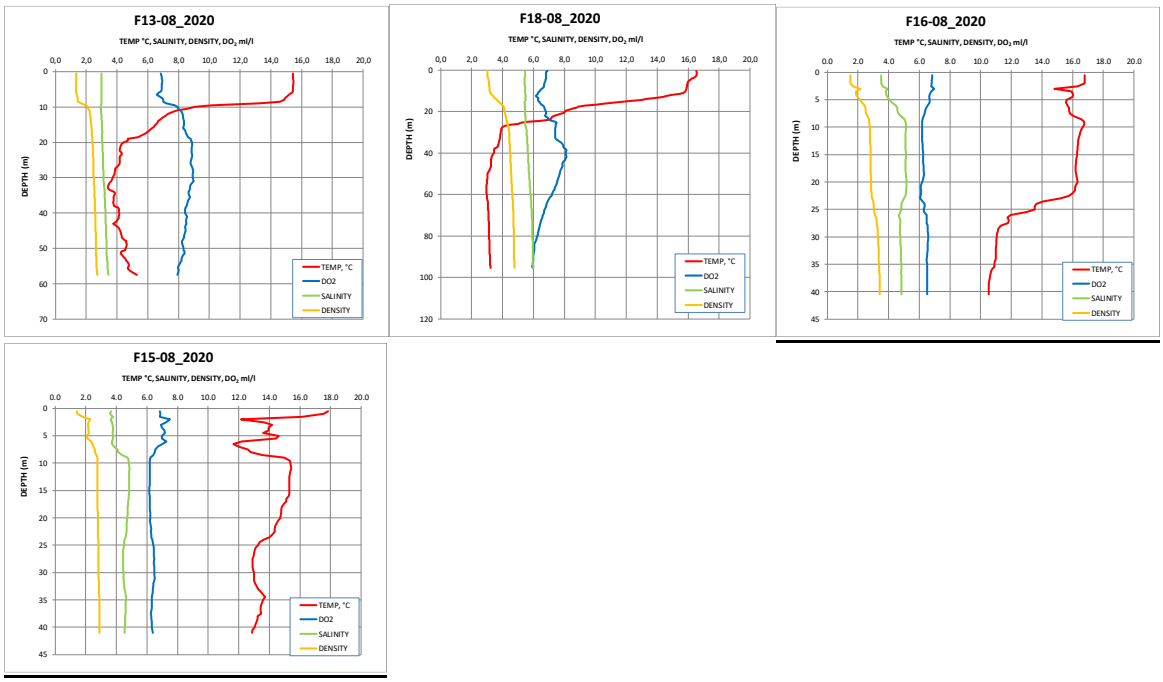
Figures 2-7. CTD profiles of the stations Ll12, Ll15, LL17, LL19, F69 and F64 in August 2020.

Bothnian Sea



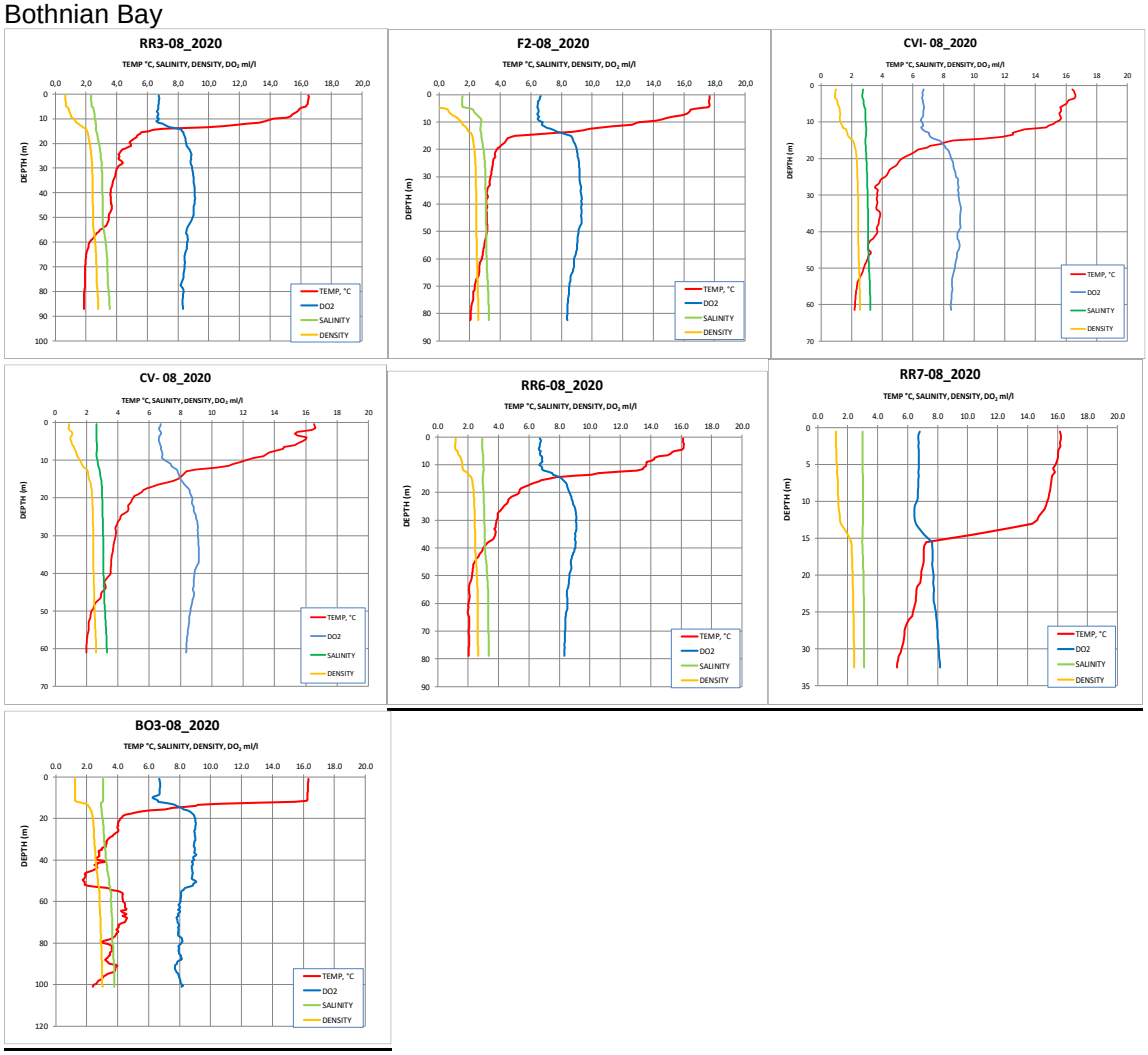
Figures 8-20. CTD profiles of the stations SR3, SR6, SR7, SR8, F33, MS9, F26, MS3, MS6, US3, US5b, US6b and US7 in August 2020.

Kvarken



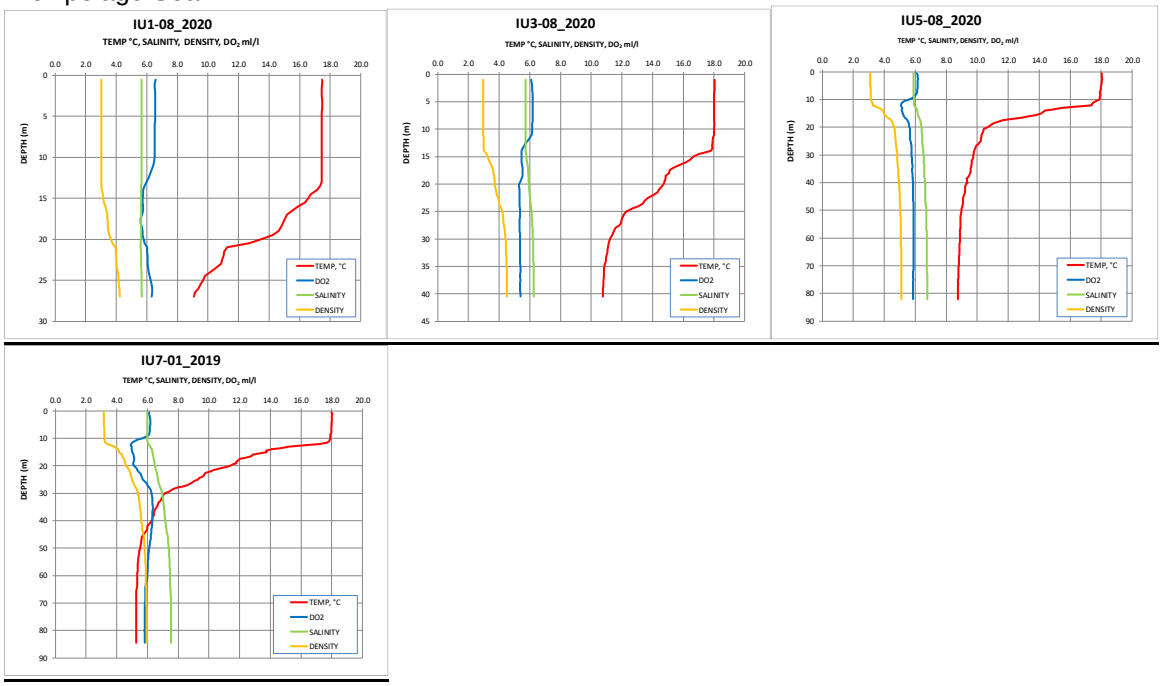
Figures 21-24. CTD profiles of the stations F13, F18, F16 and F15 in August 2020.

Bothnian Bay



Figures 25-31. CTD profiles of the stations RR3, F2, CVI, CV, RR6, RR7 and BO3 in August 2020.

Archipelago Sea

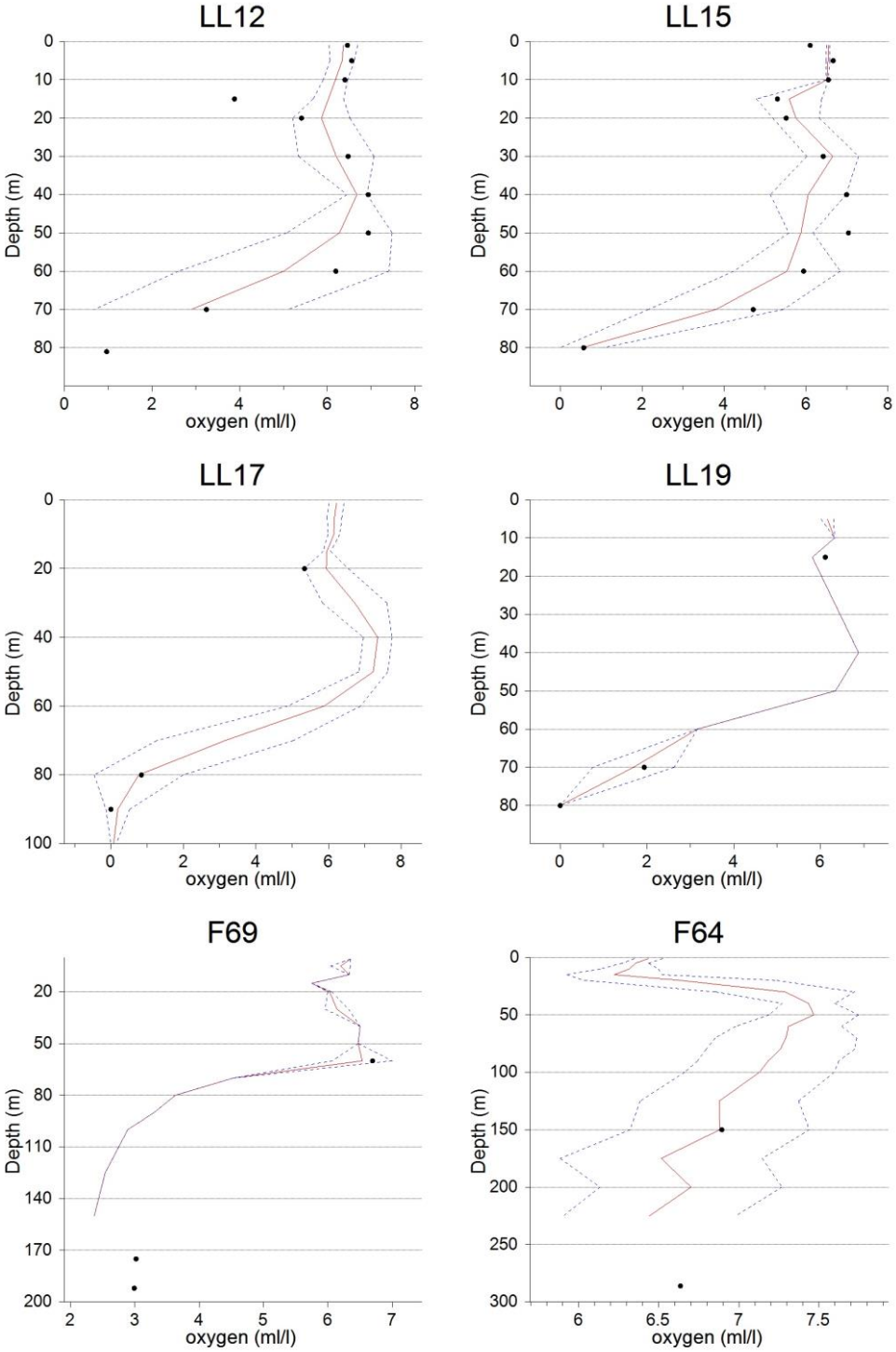


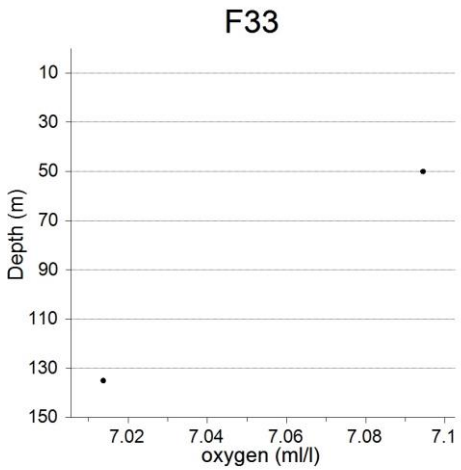
Figures 32-35. CTD profiles of the stations IU1, IU3, IU5 and IU7 in August 2020.

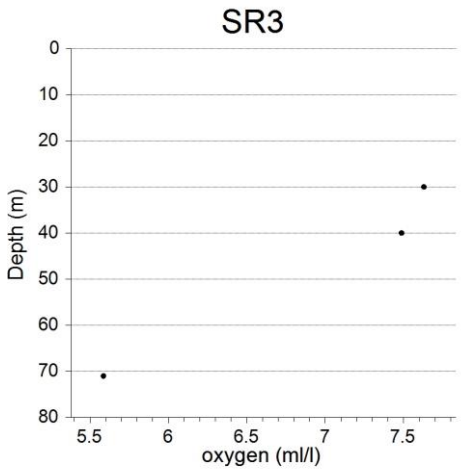
Annex 1

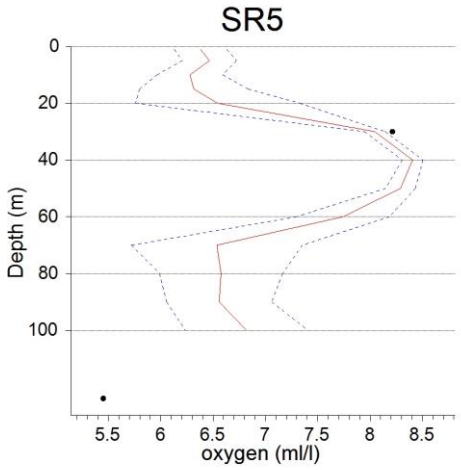
Selected variables at the stations LL12, LL15, LL17, LL19, F69, F64, F33, SR3, SR5, SR7, SR8, MS9, F26, MS6, MS3, US3, US5B, US6B, US7, F18, F15, F16, F13, BO3, RR3, RR6, RR7, CV, CVI, F2, IU1, IU3, IU5 and IU7. Mean (red solid line) and standard deviation (blue dotted lines) represent the data collected at the same time of season since the year 2000.

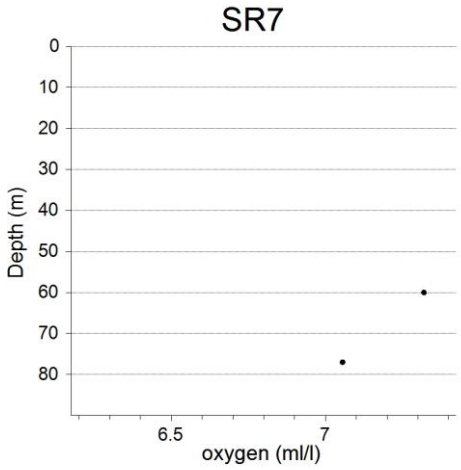
Oxygen

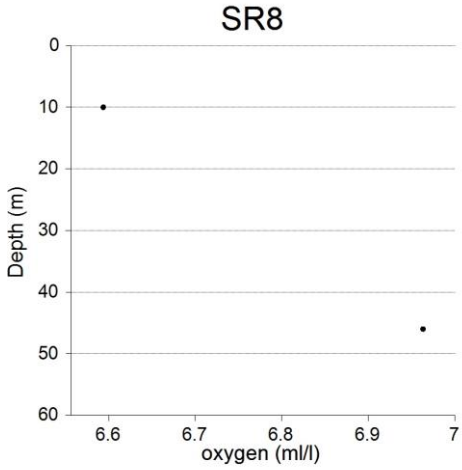


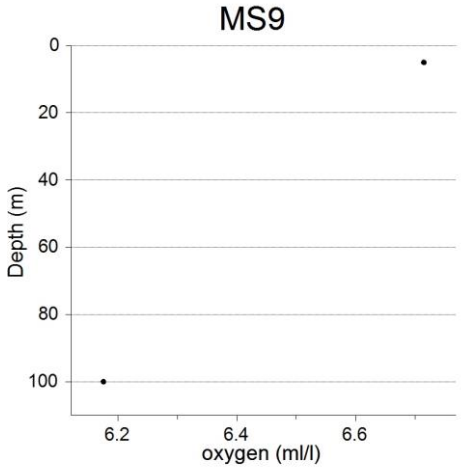

F33
Depth (m)
10
30
50
70
90
110
130
150
7.02
7.04
7.06
7.08
7.1
oxygen (ml/l)

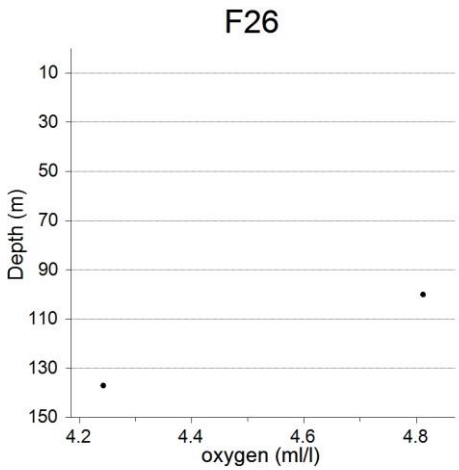

SR3
Depth (m)
0
10
20
30
40
50
60
70
80
5.5
6
6.5
7
7.5
oxygen (ml/l)

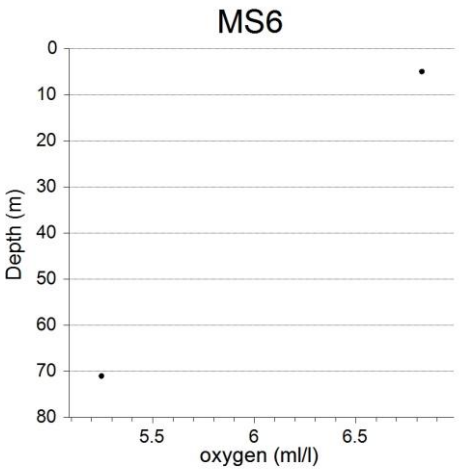

SR5
Depth (m)
0
20
40
60
80
100
5.5
6
6.5
7
7.5
8
8.5
oxygen (ml/l)

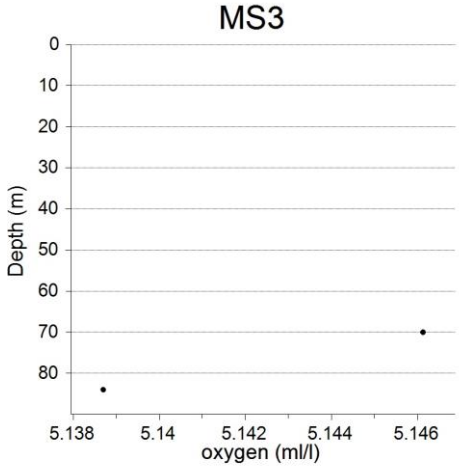

SR7
Depth (m)
0
10
20
30
40
50
60
70
80
6.5
7
oxygen (ml/l)

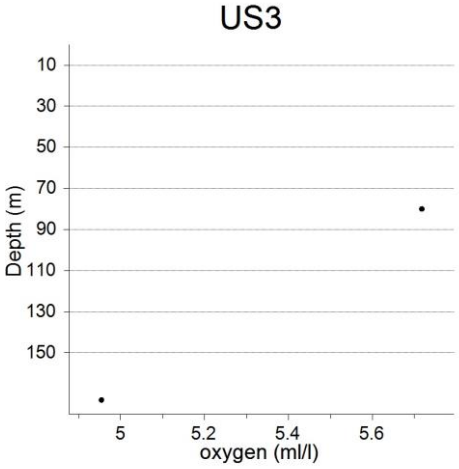

SR8
Depth (m)
0
10
20
30
40
50
60
6.6
6.7
6.8
6.9
7
oxygen (ml/l)

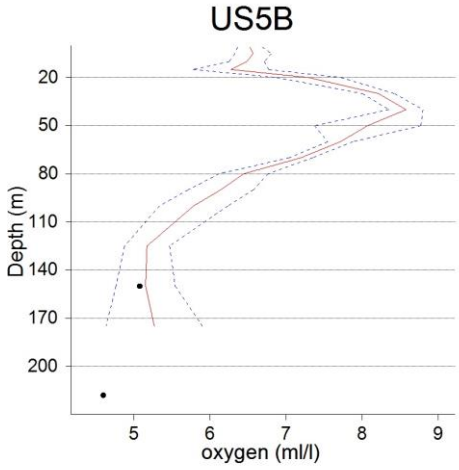

MS9
Depth (m)
0
20
40
60
80
100
6.2
6.4
6.6
oxygen (ml/l)

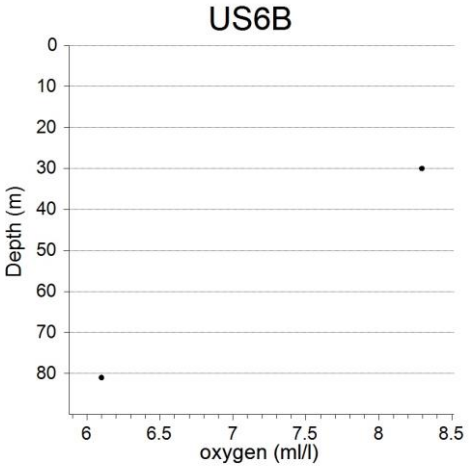

F26
Depth (m)
10
30
50
70
90
110
130
150
4.2
4.4
4.6
4.8
oxygen (ml/l)

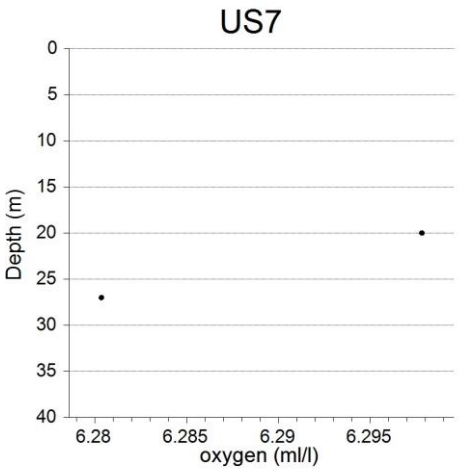

MS6
Depth (m)
0
10
20
30
40
50
60
70
80
5.5
6
6.5
oxygen (ml/l)

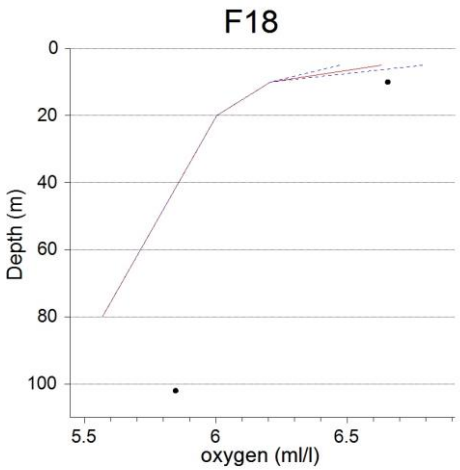

MS3
Depth (m)
0
10
20
30
40
50
60
70
80
5.138
5.14
5.142
5.144
5.146
oxygen (ml/l)

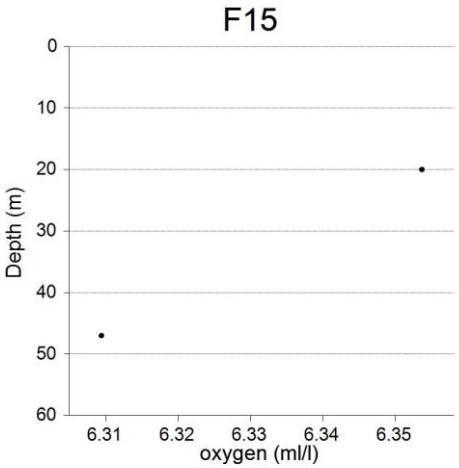

US3
Depth (m)
10
30
50
70
90
110
130
150
5
5.2
5.4
5.6
oxygen (ml/l)

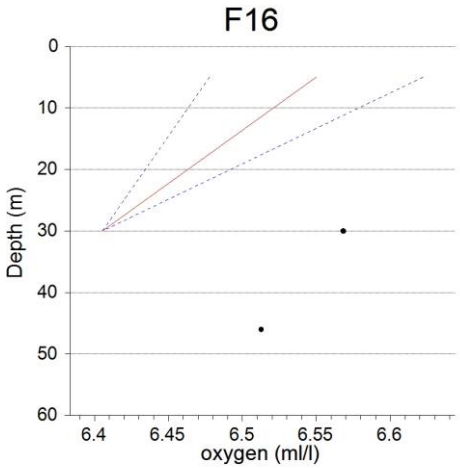

US5B
Depth (m)
20
50
80
110
140
170
200
5
6
7
8
9
oxygen (ml/l)

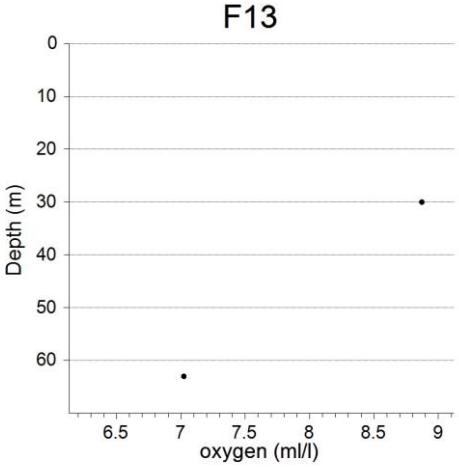

US6B
Depth (m)
0
10
20
30
40
50
60
70
80
6
6.5
7
7.5
8
8.5
oxygen (ml/l)

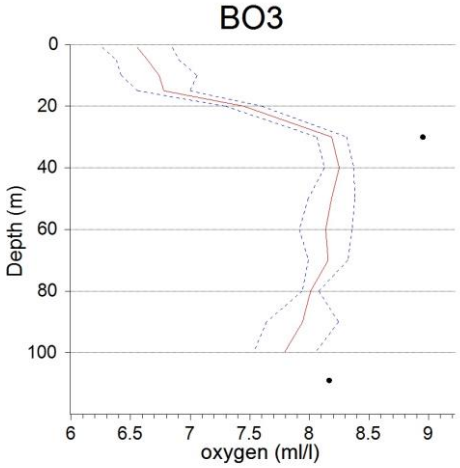

US7
Depth (m)
0
5
10
15
20
25
30
35
40
6.28
6.285
6.29
6.295
oxygen (ml/l)

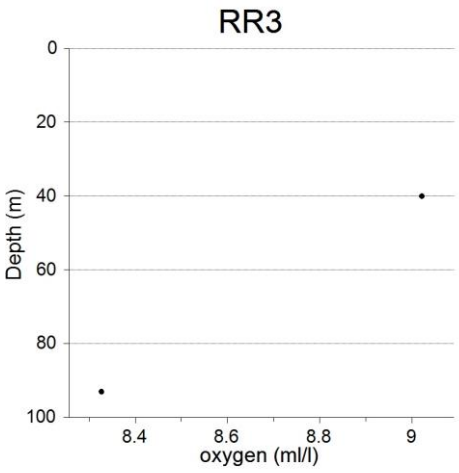

F18
Depth (m)
0
20
40
60
80
100
5.5
6
6.5
oxygen (ml/l)

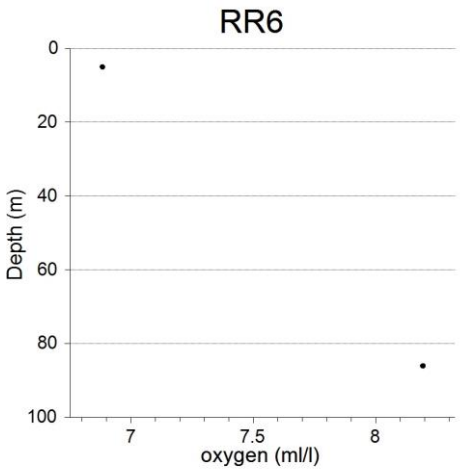

F15
Depth (m)
0
10
20
30
40
50
60
6.31
6.32
6.33
6.34
6.35
oxygen (ml/l)

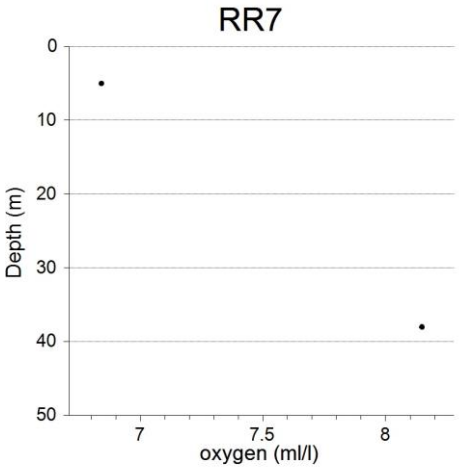

F16
Depth (m)
0
10
20
30
40
50
60
6.4
6.45
6.5
6.55
6.6
oxygen (ml/l)

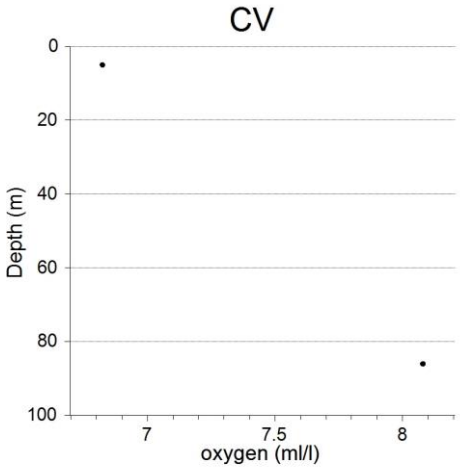

F13
Depth (m)
0
10
20
30
40
50
60
6.5
7
7.5
8
8.5
9
oxygen (ml/l)

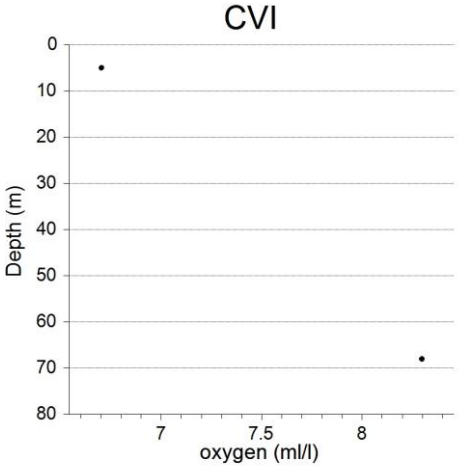

BO3
Depth (m)
0
20
40
60
80
100
6
6.5
7
7.5
8
8.5
9
oxygen (ml/l)

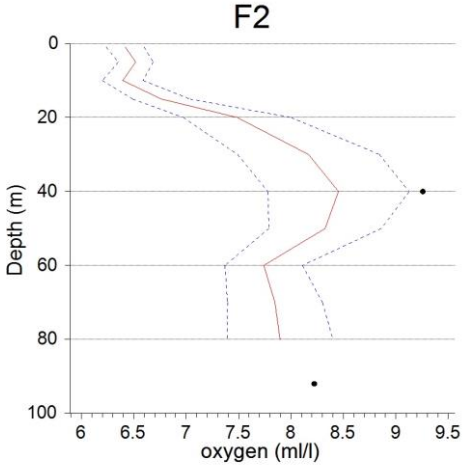

RR3
Depth (m)
0
20
40
60
80
100
8.4
8.6
8.8
9
oxygen (ml/l)

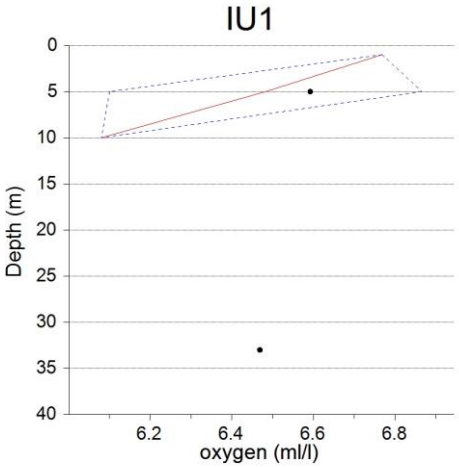

RR6
Depth (m)
0
20
40
60
80
100
7
7.5
8
oxygen (ml/l)

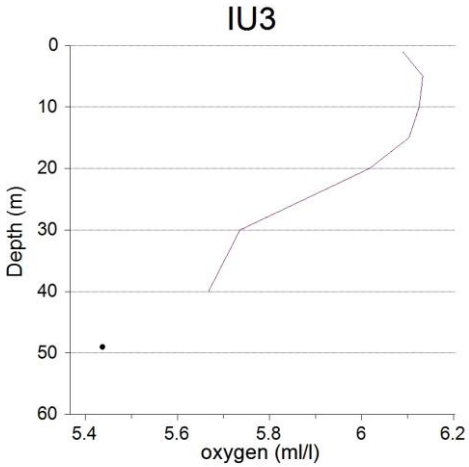

RR7
Depth (m)
0
10
20
30
40
50
7
7.5
8
oxygen (ml/l)

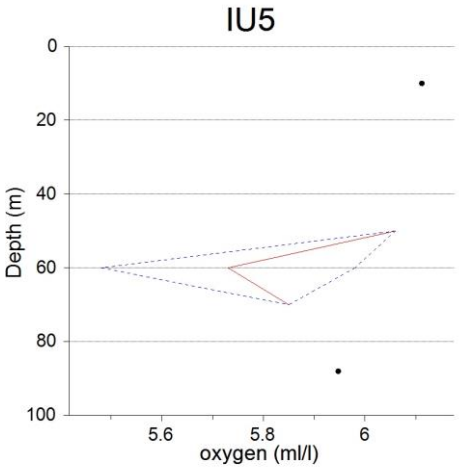

CV
Depth (m)
0
20
40
60
80
100
7
7.5
8
oxygen (ml/l)

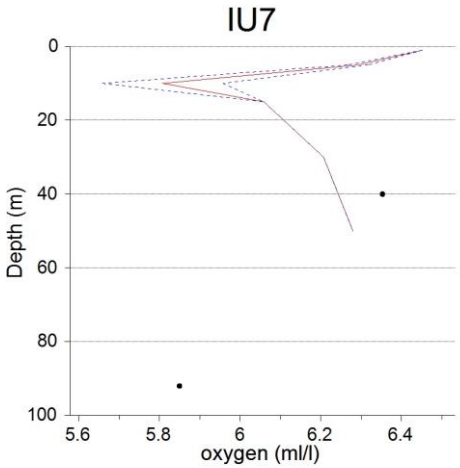

CVI
Depth (m)
0
10
20
30
40
50
60
70
80
7
7.5
8
oxygen (ml/l)


F2
Depth (m)
0
20
40
60
80
100
6
6.5
7
7.5
8
8.5
9
9.5
oxygen (ml/l)

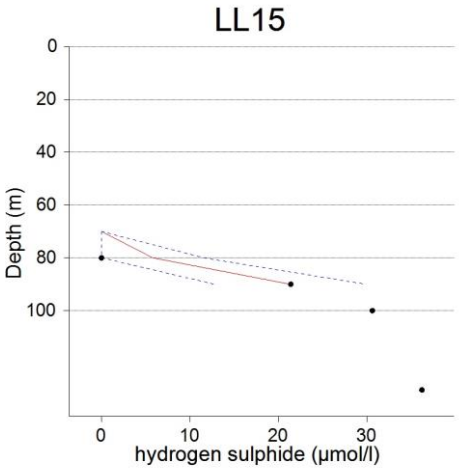

IU1
Depth (m)
0
5
10
15
20
25
30
35
40
6.2
6.4
6.6
6.8
oxygen (ml/l)

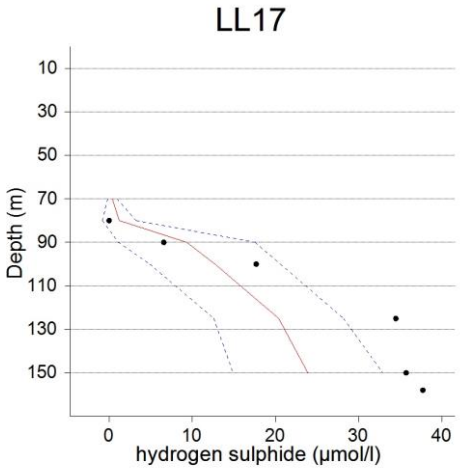

IU3
Depth (m)
0
10
20
30
40
50
60
5.4
5.6
5.8
6
6.2
oxygen (ml/l)

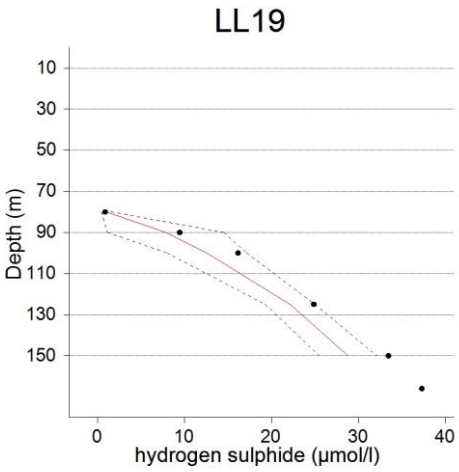

IU5
Depth (m)
0
20
40
60
80
100
5.6
5.8
6
oxygen (ml/l)


IU7
Depth (m)
0
20
40
60
80
100
5.6
5.8
6
6.2
6.4
oxygen (ml/l)

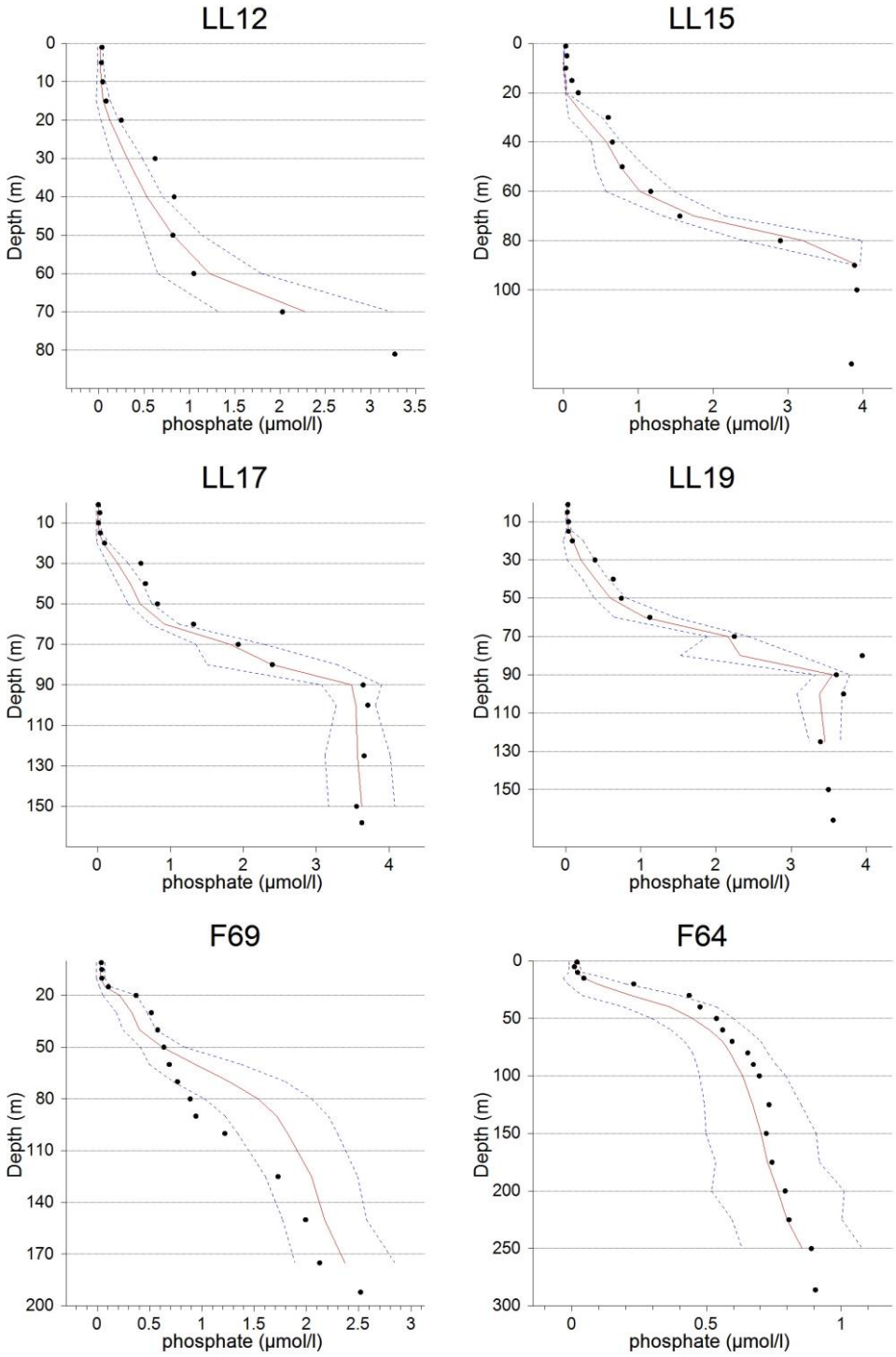
Hydrogen sulphide

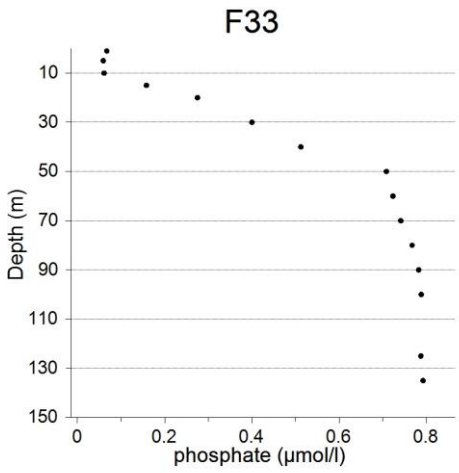


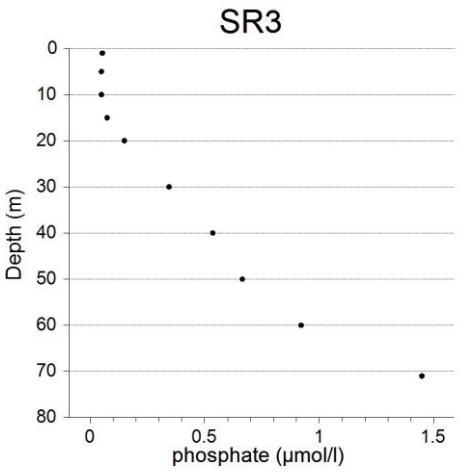


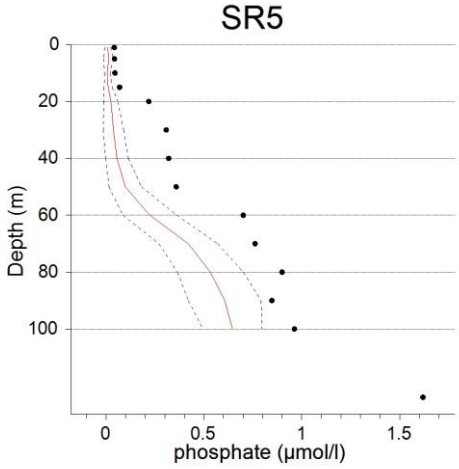


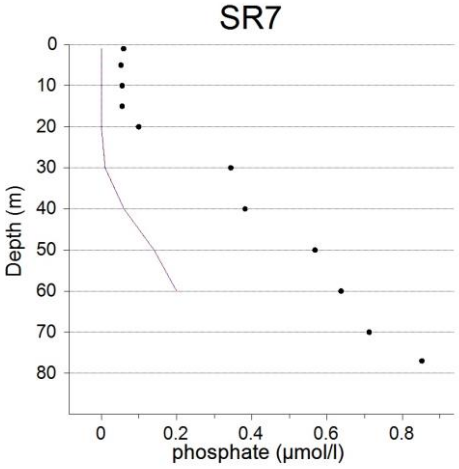
Phosphate

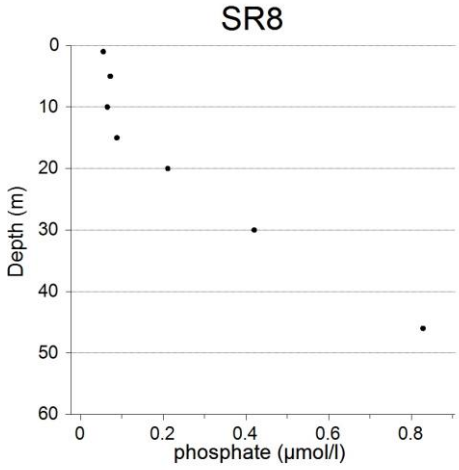

LL12
Depth (m)
phosphate (µmol/l)
LL15
Depth (m)
phosphate (µmol/l)
LL17
Depth (m)
phosphate (µmol/l)
LL19
Depth (m)
phosphate (µmol/l)
F69
Depth (m)
phosphate (µmol/l)
F64
Depth (m)
phosphate (µmol/l)

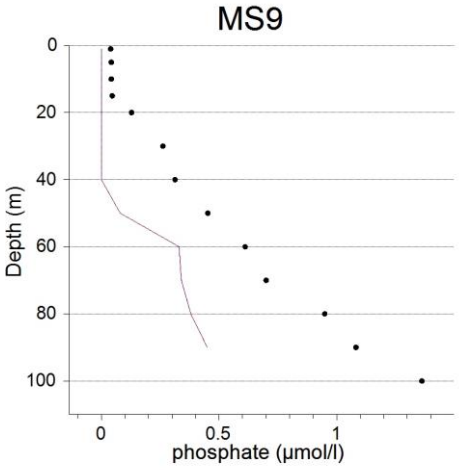

F33
Depth (m)
10
30
50
70
90
110
130
150
0
0.2
0.4
0.6
0.8
phosphate (µmol/l)

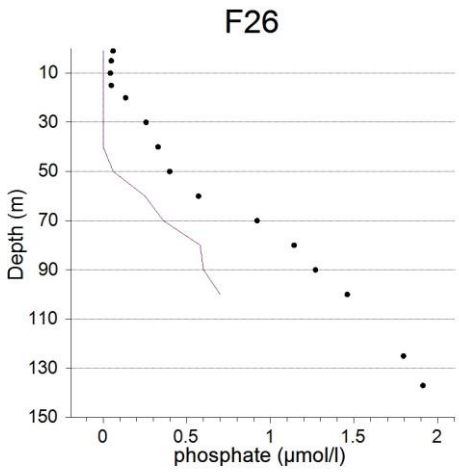

SR3
Depth (m)
0
10
20
30
40
50
60
70
80
0
0.5
1
1.5
phosphate (µmol/l)

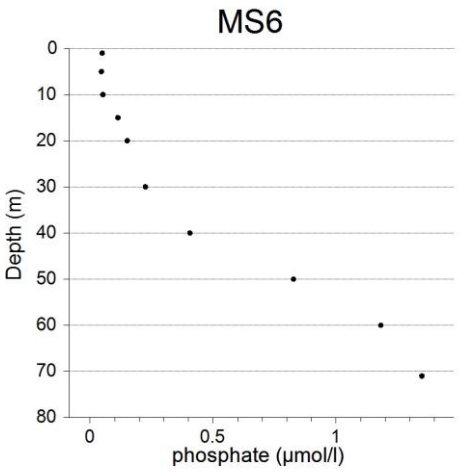

SR5
Depth (m)
0
20
40
60
80
100
0
0.5
1
1.5
phosphate (µmol/l)

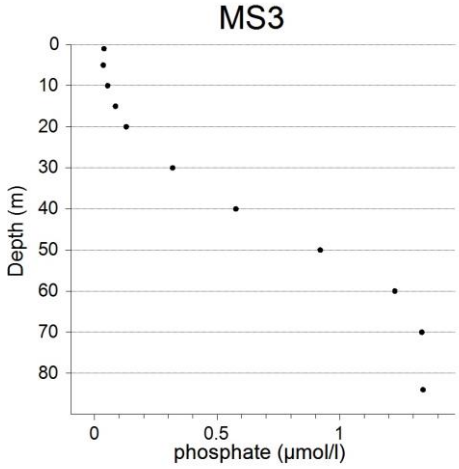

SR7
Depth (m)
0
10
20
30
40
50
60
70
80
0
0.2
0.4
0.6
0.8
phosphate (µmol/l)

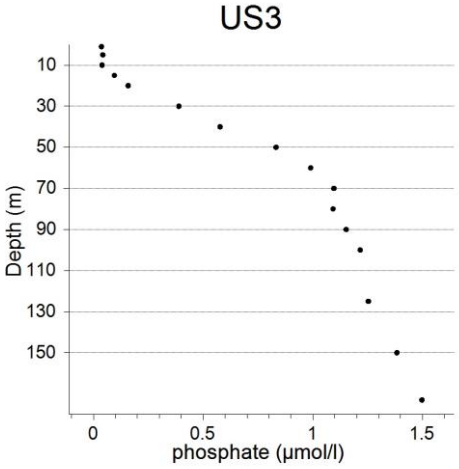

SR8
Depth (m)
0
10
20
30
40
50
60
0
0.2
0.4
0.6
0.8
phosphate (µmol/l)

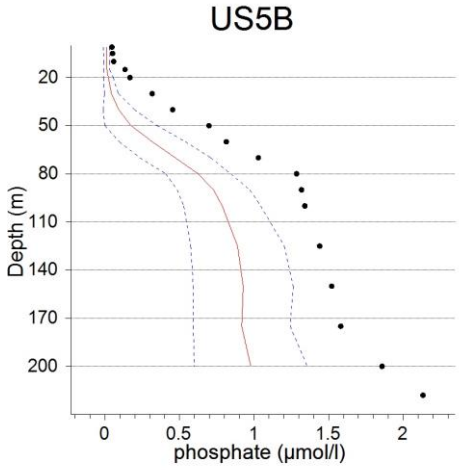

MS9
Depth (m)
0
20
40
60
80
100
0
0.5
1
phosphate (µmol/l)

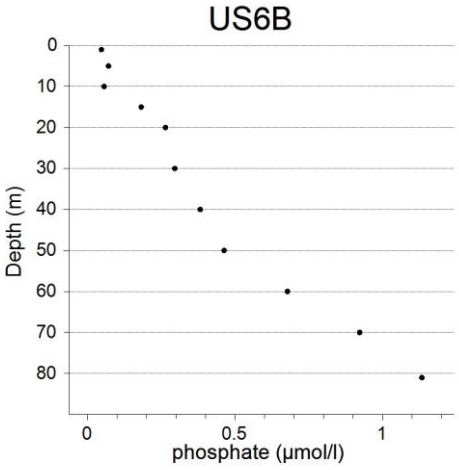

F26
Depth (m)
10
30
50
70
90
110
130
150
0
0.5
1
1.5
2
phosphate (µmol/l)

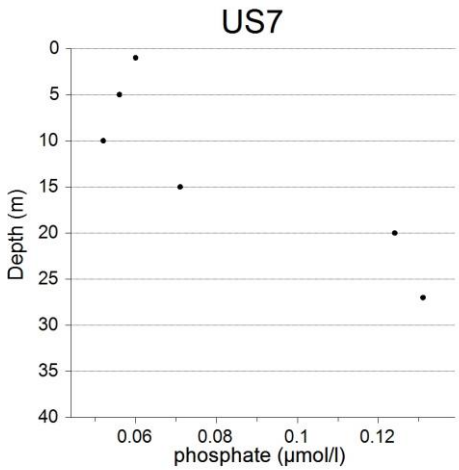

MS6
Depth (m)
0
10
20
30
40
50
60
70
80
0
0.5
1
phosphate (µmol/l)

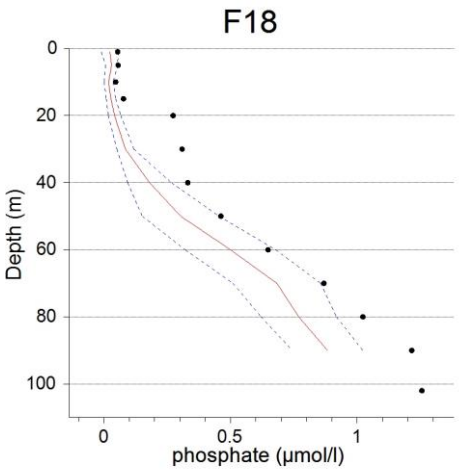

MS3
Depth (m)
0
10
20
30
40
50
60
70
80
0
0.5
1
phosphate (µmol/l)

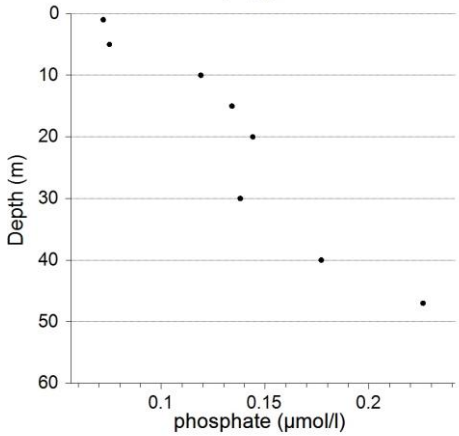

US3
Depth (m)
10
30
50
70
90
110
130
150
0
0.5
1
1.5
phosphate (µmol/l)

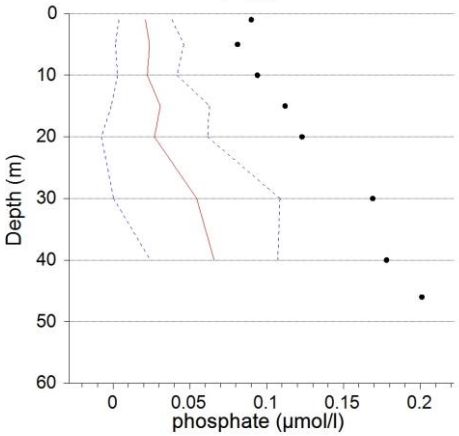

US5B
Depth (m)
20
50
80
110
140
170
200
0
0.5
1
1.5
2
phosphate (µmol/l)

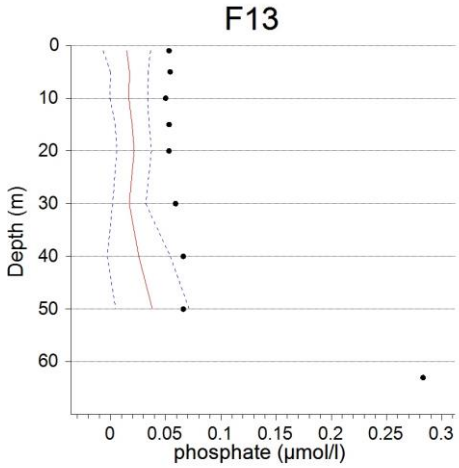

US6B
Depth (m)
0
10
20
30
40
50
60
70
80
0
0.5
1
phosphate (µmol/l)

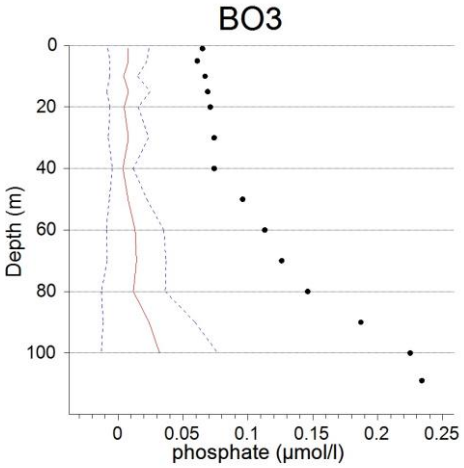

US7
Depth (m)
0
5
10
15
20
25
30
35
40
0.06
0.08
0.1
0.12
phosphate (µmol/l)

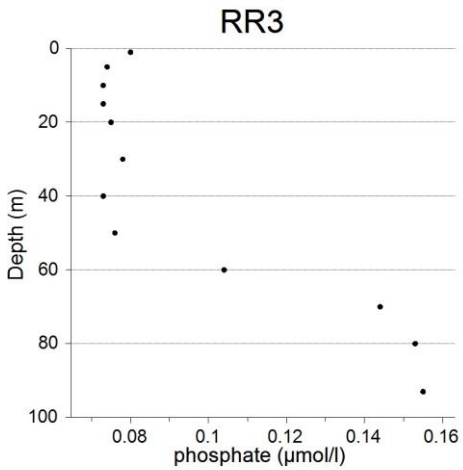

F18
Depth (m)
0
20
40
60
80
100
0
0.5
1
phosphate (µmol/l)

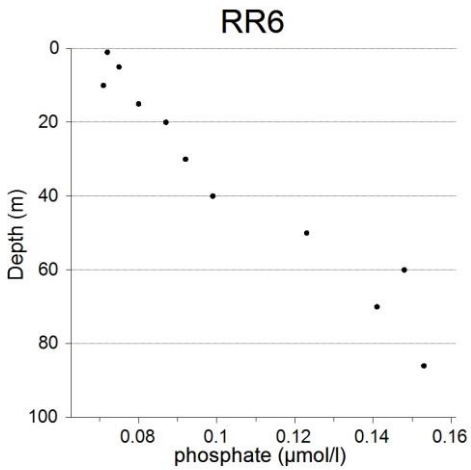

F15
Depth (m)
0
10
20
30
40
50
60
0.1
0.15
0.2
phosphate (µmol/l)

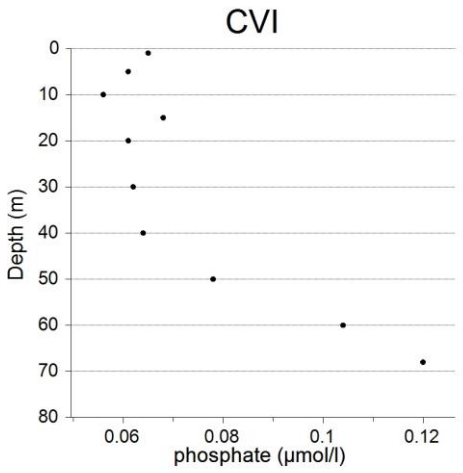

F16
Depth (m)
0
10
20
30
40
50
60
0
0.05
0.1
0.15
0.2
phosphate (µmol/l)

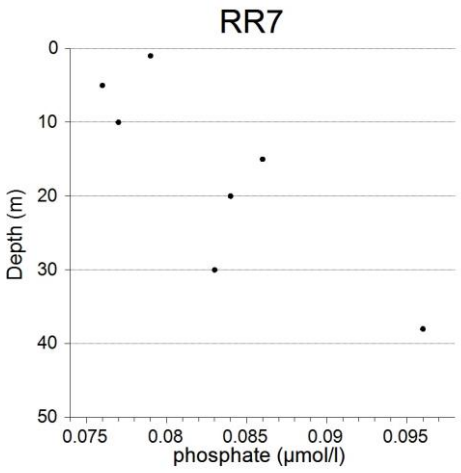

F13
Depth (m)
0
10
20
30
40
50
60
0
0.05
0.1
0.15
0.2
0.25
0.3
phosphate (µmol/l)

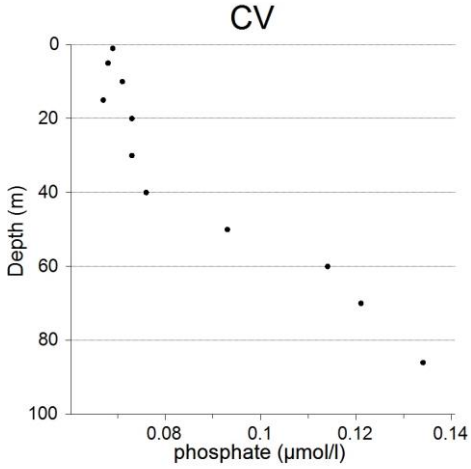

BO3
Depth (m)
0
20
40
60
80
100
0
0.05
0.1
0.15
0.2
0.25
phosphate (µmol/l)

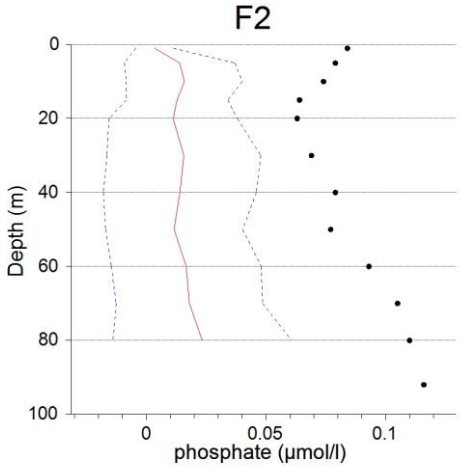

RR3
Depth (m)
0
20
40
60
80
100
0.08
0.1
0.12
0.14
0.16
phosphate (µmol/l)

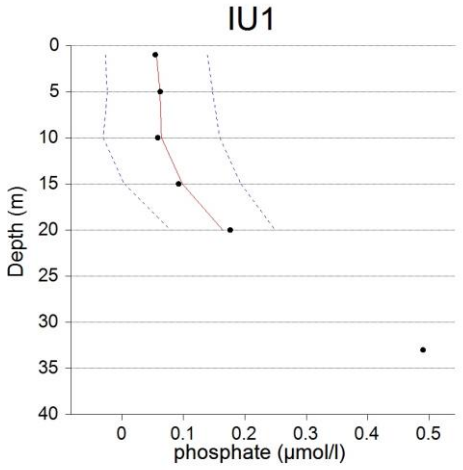

RR6
Depth (m)
0
20
40
60
80
100
0.08
0.1
0.12
0.14
0.16
phosphate (µmol/l)

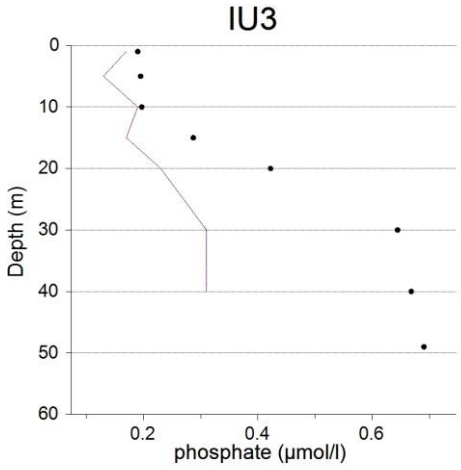

CVI
Depth (m)
0
10
20
30
40
50
60
70
80
0.06
0.08
0.1
0.12
phosphate (µmol/l)

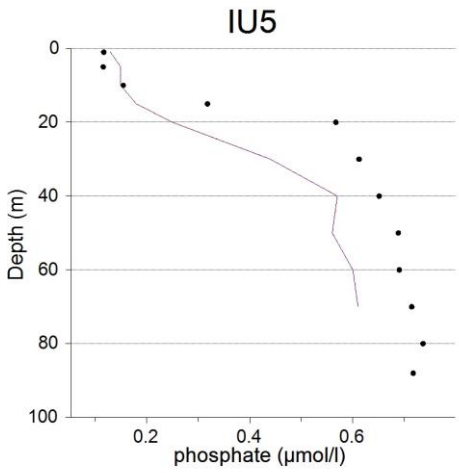

RR7
Depth (m)
0
10
20
30
40
50
0.075
0.08
0.085
0.09
0.095
phosphate (µmol/l)

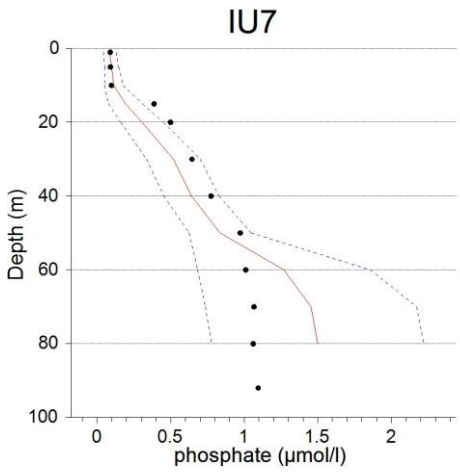

CV
Depth (m)
0
20
40
60
80
100
0.08
0.1
0.12
0.14
phosphate (µmol/l)


F2
Depth (m)
0
20
40
60
80
100
0
0.05
0.1
phosphate (µmol/l)

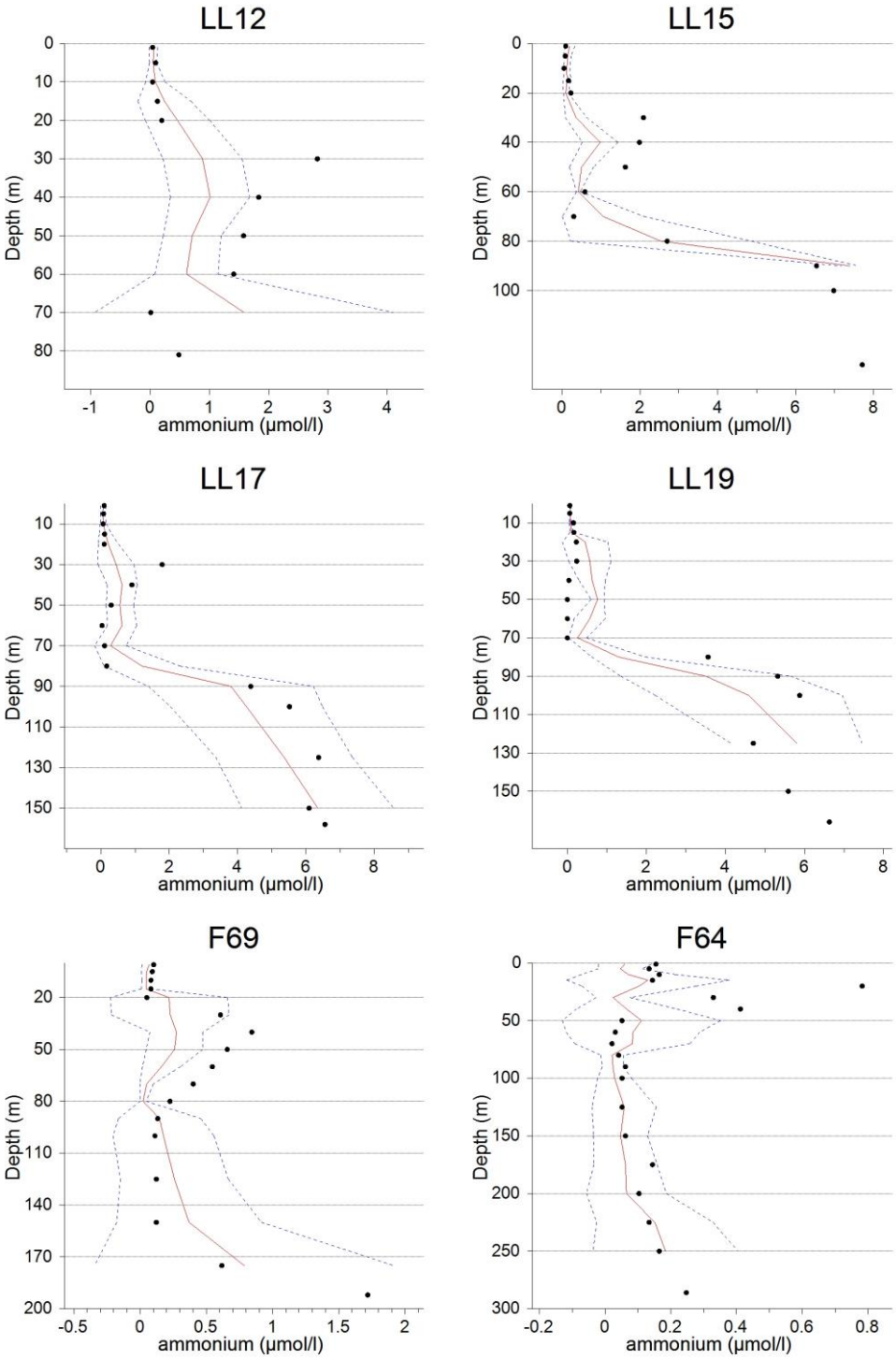

IU1
Depth (m)
0
5
10
15
20
25
30
35
40
0
0.1
0.2
0.3
0.4
0.5
phosphate (µmol/l)

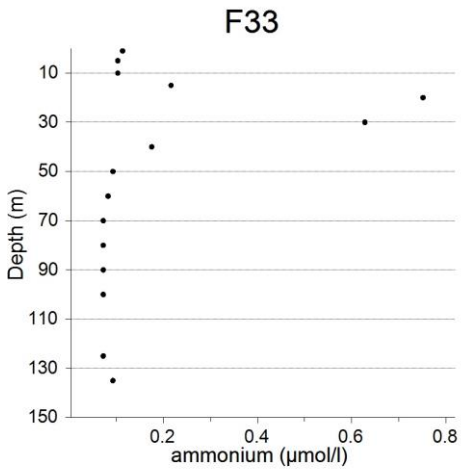

IU3
Depth (m)
0
10
20
30
40
50
60
0.2
0.4
0.6
phosphate (µmol/l)

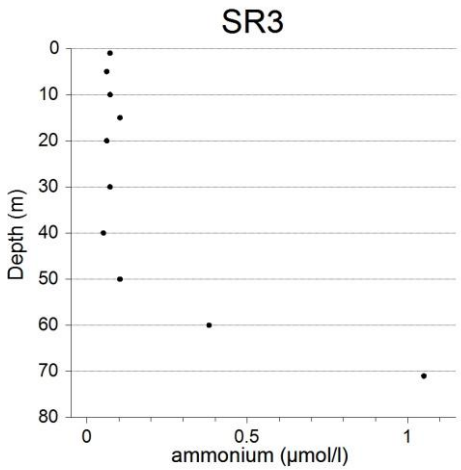

IU5
Depth (m)
0
20
40
60
80
100
0.2
0.4
0.6
phosphate (µmol/l)

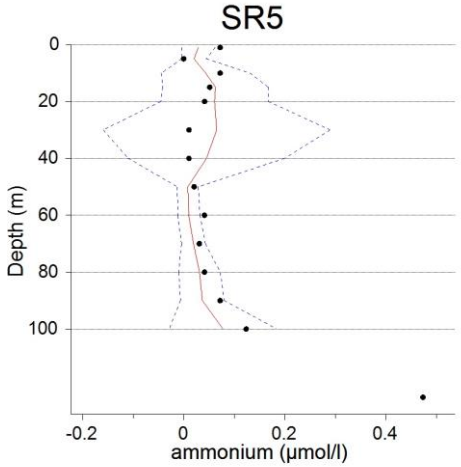

IU7
Depth (m)
0
20
40
60
80
100
0
0.5
1
1.5
2
phosphate (µmol/l)

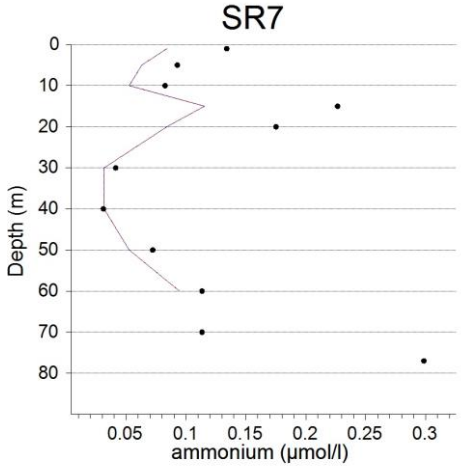
Ammonium

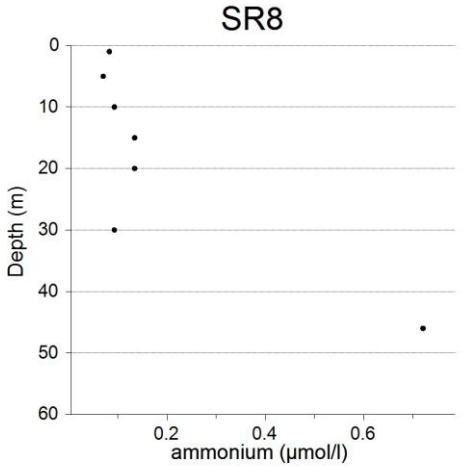

LL12
Depth (m)
ammonium (µmol/l)
LL15
Depth (m)
ammonium (µmol/l)
LL17
Depth (m)
ammonium (µmol/l)
LL19
Depth (m)
ammonium (µmol/l)
F69
Depth (m)
ammonium (µmol/l)
F64
Depth (m)
ammonium (µmol/l)

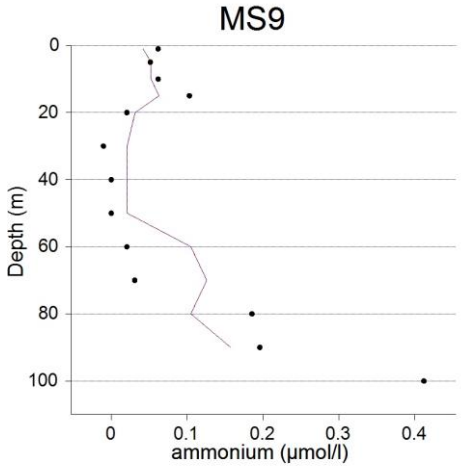

F33
Depth (m)
10
30
50
70
90
110
130
150
0.2
0.4
0.6
0.8
ammonium (µmol/l)

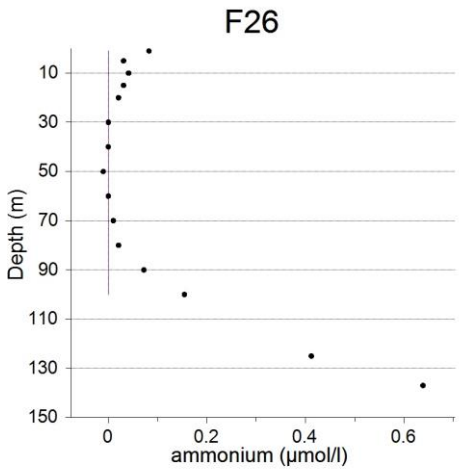

SR3
Depth (m)
0
10
20
30
40
50
60
70
80
0
0.5
1
ammonium (µmol/l)

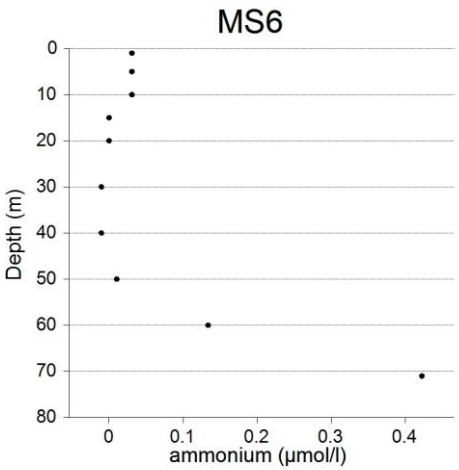

SR5
Depth (m)
0
20
40
60
80
100
-0.2
0
0.2
0.4
ammonium (µmol/l)

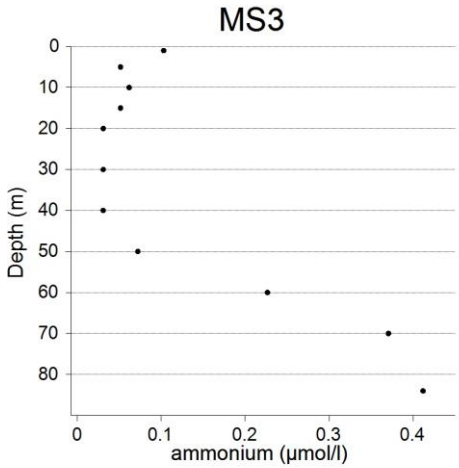

SR7
Depth (m)
0
10
20
30
40
50
60
70
80
0.05
0.1
0.15
0.2
0.25
0.3
ammonium (µmol/l)

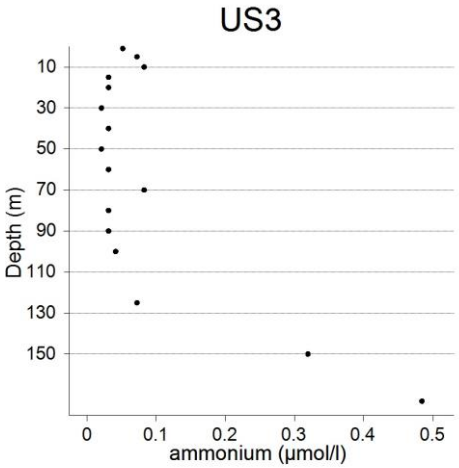

SR8
Depth (m)
0
10
20
30
40
50
60
0.2
0.4
0.6
ammonium (µmol/l)

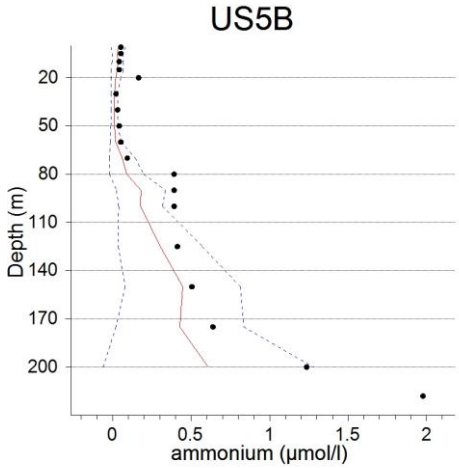

MS9
Depth (m)
0
20
40
60
80
100
0
0.1
0.2
0.3
0.4
ammonium (µmol/l)

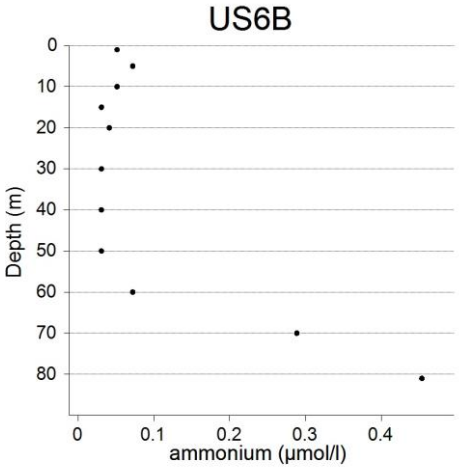

F26
Depth (m)
10
30
50
70
90
110
130
150
0
0.2
0.4
0.6
ammonium (µmol/l)

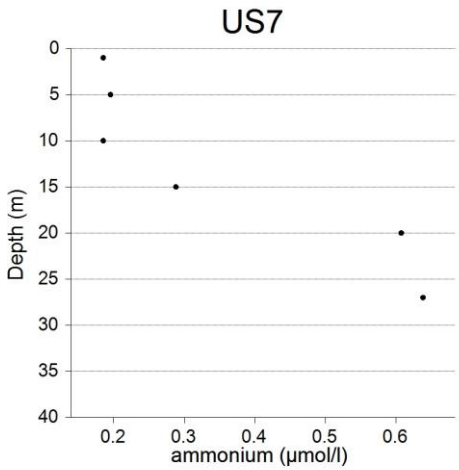

MS6
Depth (m)
0
10
20
30
40
50
60
70
80
0
0.1
0.2
0.3
0.4
ammonium (µmol/l)

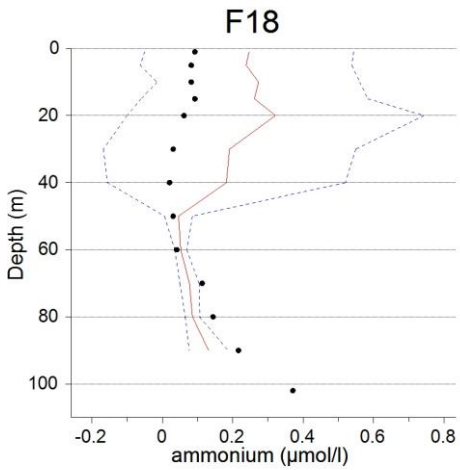

MS3
Depth (m)
0
10
20
30
40
50
60
70
80
0
0.1
0.2
0.3
0.4
ammonium (µmol/l)

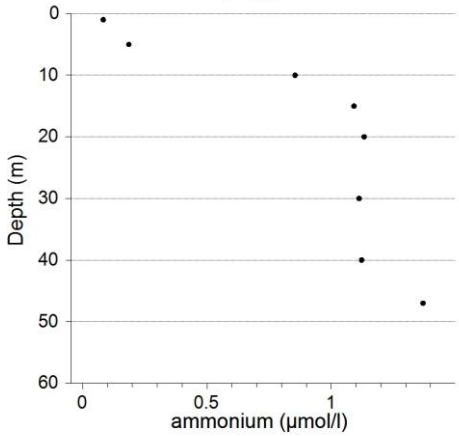

US3
Depth (m)
10
30
50
70
90
110
130
150
0
0.1
0.2
0.3
0.4
0.5
ammonium (µmol/l)

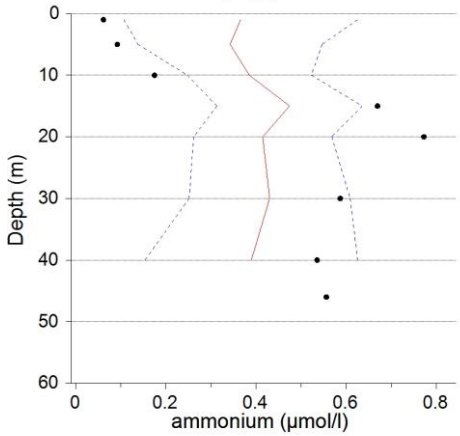

US5B
Depth (m)
20
50
80
110
140
170
200
0
0.5
1
1.5
2
ammonium (µmol/l)

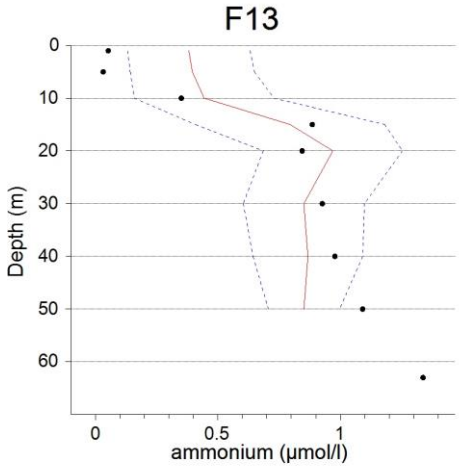

US6B
Depth (m)
0
10
20
30
40
50
60
70
80
0
0.1
0.2
0.3
0.4
ammonium (µmol/l)

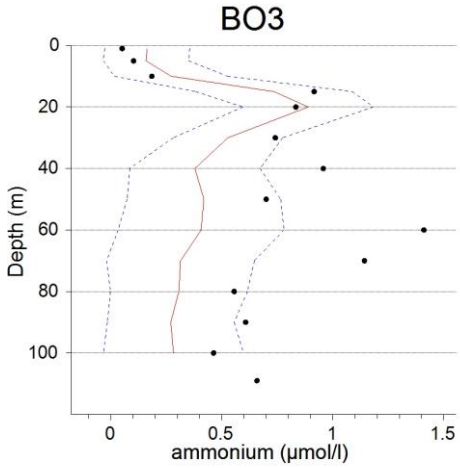

US7
Depth (m)
0
5
10
15
20
25
30
35
40
0.2
0.3
0.4
0.5
0.6
ammonium (µmol/l)

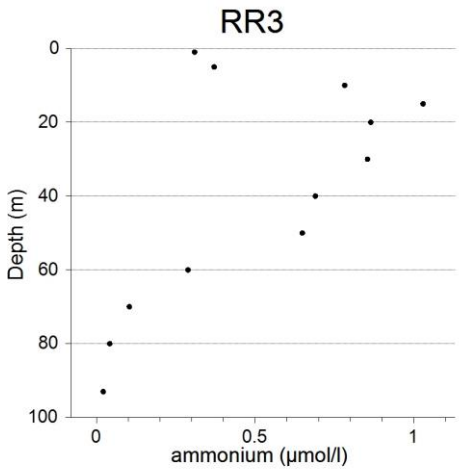

F18
Depth (m)
0
20
40
60
80
100
-0.2
0
0.2
0.4
0.6
0.8
ammonium (µmol/l)

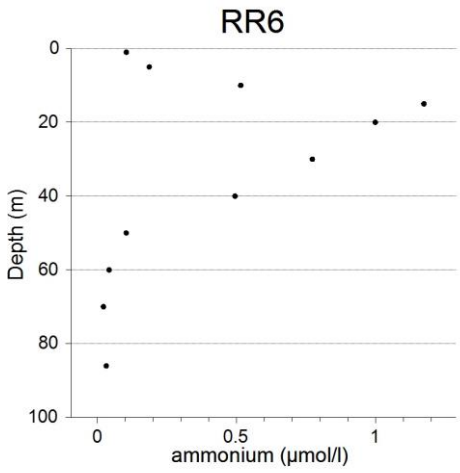

F15
Depth (m)
0
10
20
30
40
50
60
0
0.5
1
ammonium (µmol/l)

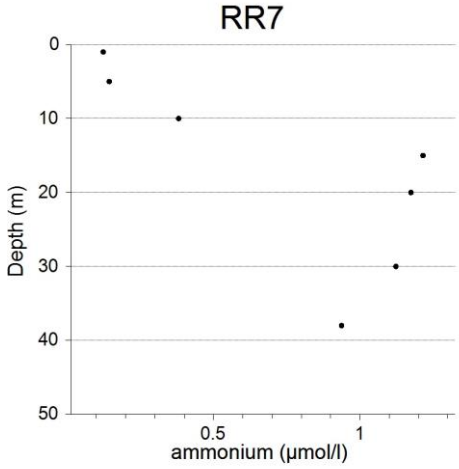

F16
Depth (m)
0
10
20
30
40
50
60
0
0.2
0.4
0.6
0.8
ammonium (µmol/l)

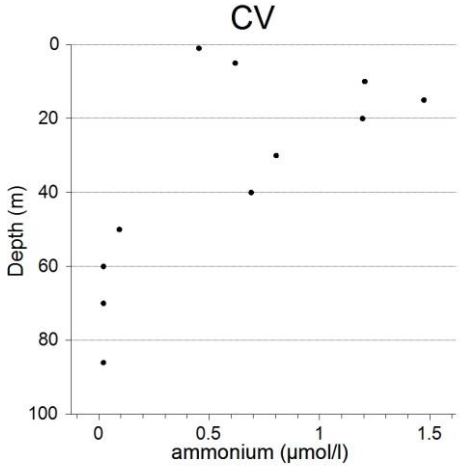

F13
Depth (m)
0
10
20
30
40
50
60
0
0.5
1
ammonium (µmol/l)

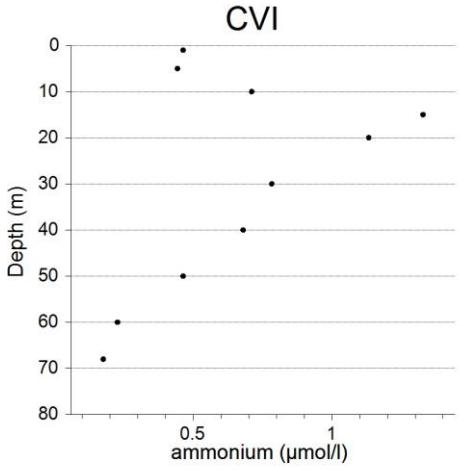

BO3
Depth (m)
0
20
40
60
80
100
0
0.5
1
1.5
ammonium (µmol/l)

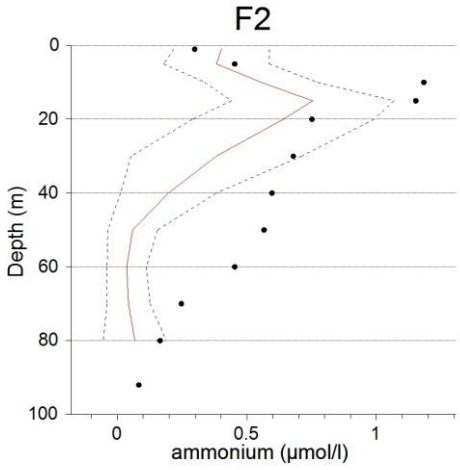

RR3
Depth (m)
0
20
40
60
80
100
0
0.5
1
ammonium (µmol/l)

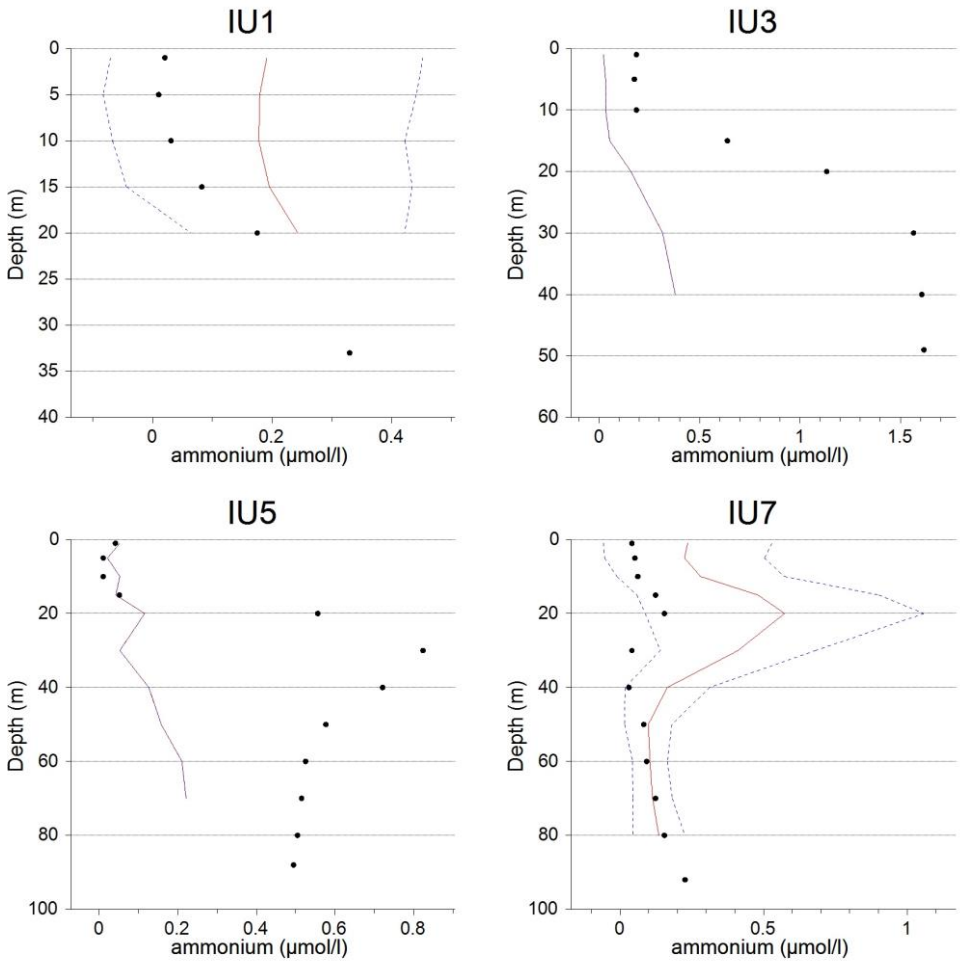

RR6
Depth (m)
0
20
40
60
80
100
0
0.5
1
ammonium (µmol/l)


RR7
Depth (m)
0
10
20
30
40
50
0.5
1
ammonium (µmol/l)

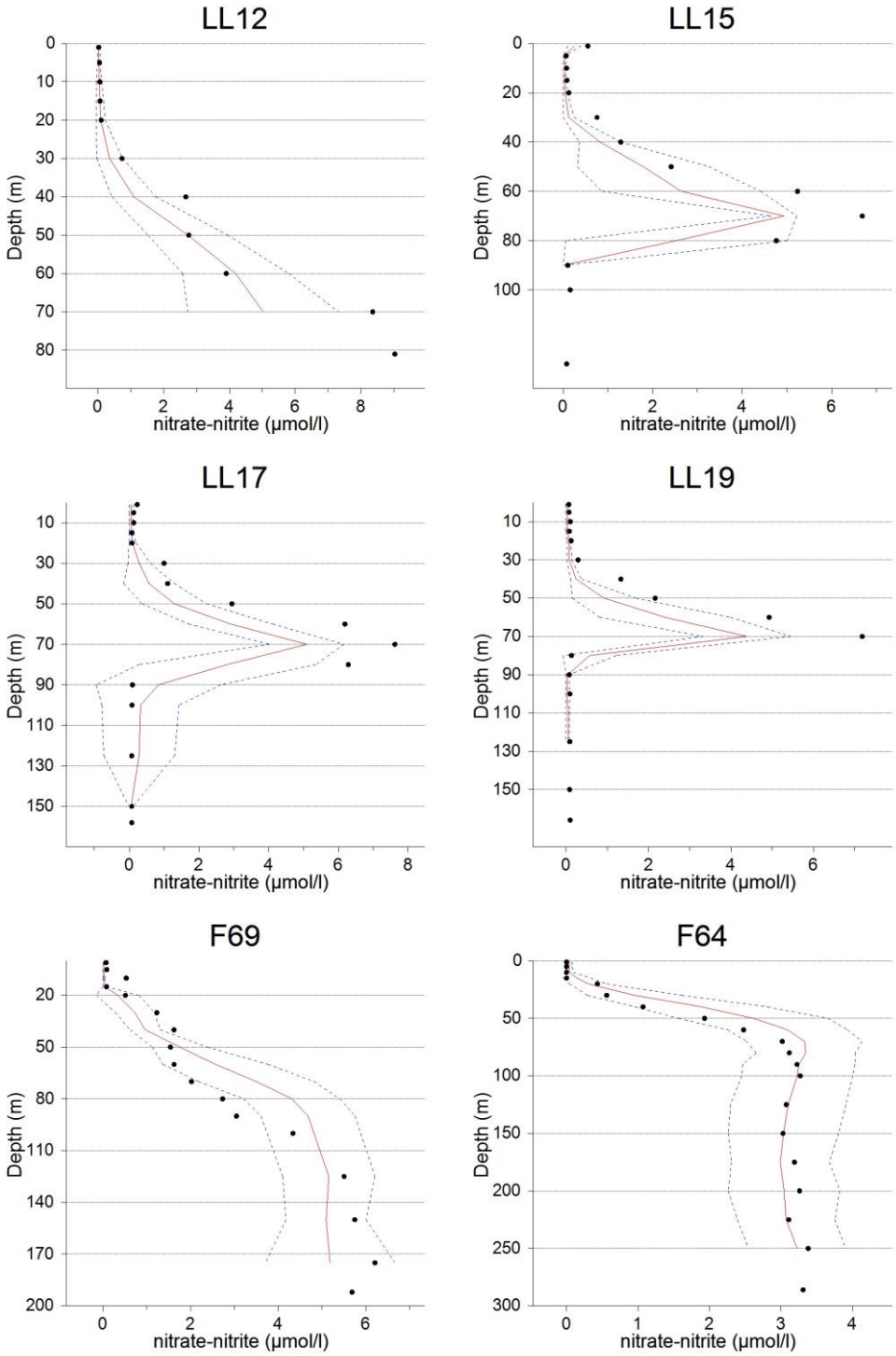

CV
Depth (m)
0
20
40
60
80
100
0
0.5
1
1.5
ammonium (µmol/l)

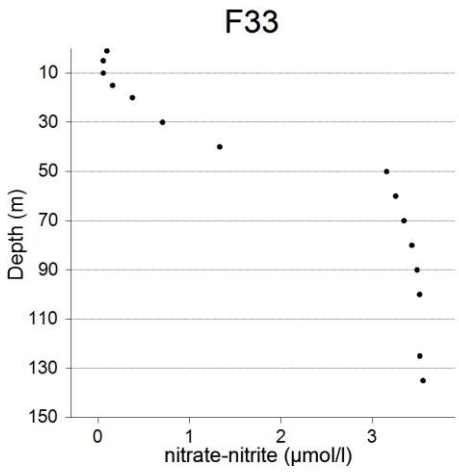

CVI
Depth (m)
0
10
20
30
40
50
60
70
80
0.5
1
ammonium (µmol/l)

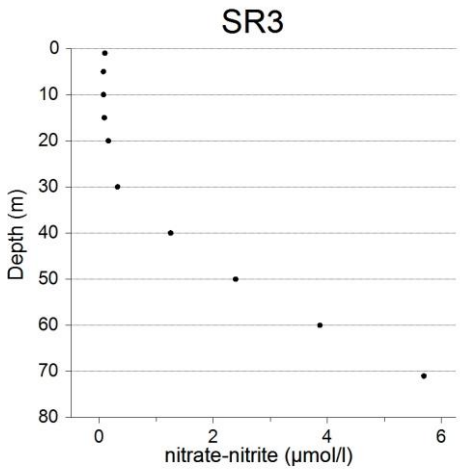

F2
Depth (m)
0
20
40
60
80
100
0
0.5
1
ammonium (µmol/l)

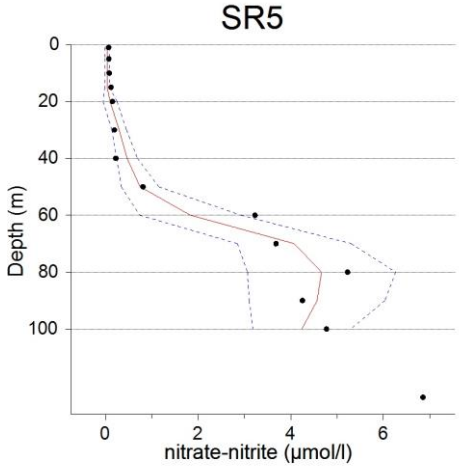

IU1
Depth (m)
0
5
10
15
20
25
30
35
40
0
0.2
0.4
ammonium (µmol/l)
IU3
Depth (m)
0
10
20
30
40
50
60
0
0.5
1
1.5
ammonium (µmol/l)
IU5
Depth (m)
0
20
40
60
80
100
0
0.2
0.4
0.6
0.8
ammonium (µmol/l)
IU7
Depth (m)
0
20
40
60
80
100
0
0.5
1
ammonium (µmol/l)

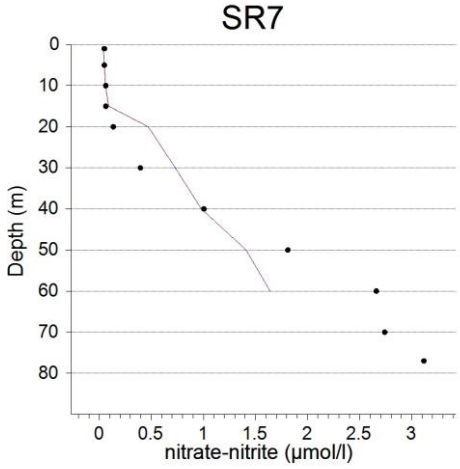
Nitrate – nitrite

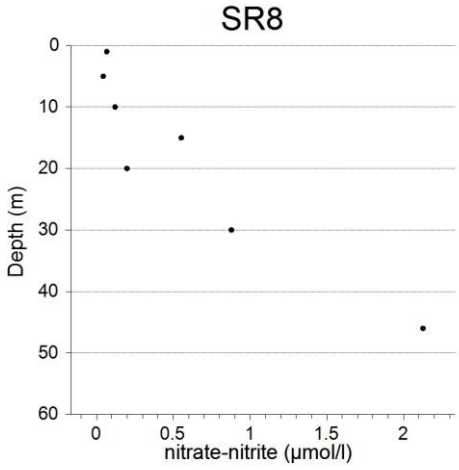


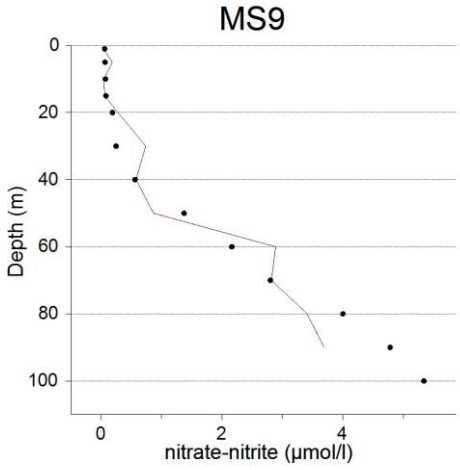

F33
Depth (m)
nitrate-nitrite (µmol/l)

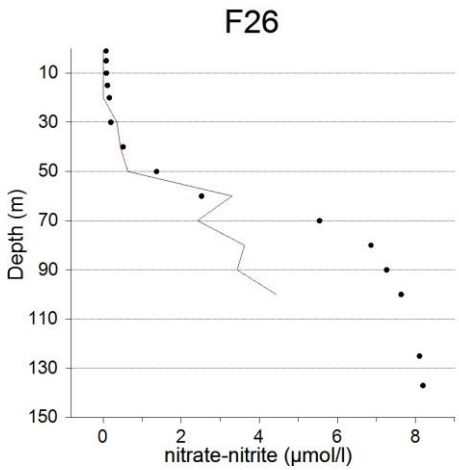

SR3
Depth (m)
nitrate-nitrite (µmol/l)

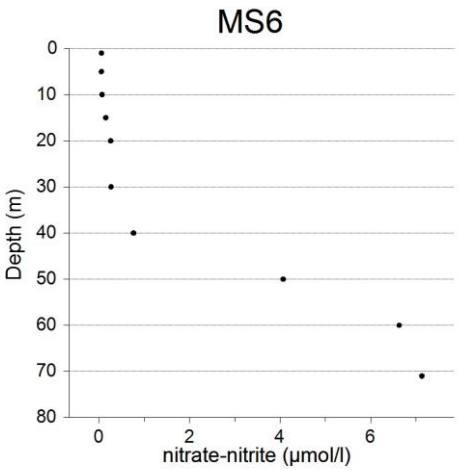

SR5
Depth (m)
nitrate-nitrite (µmol/l)

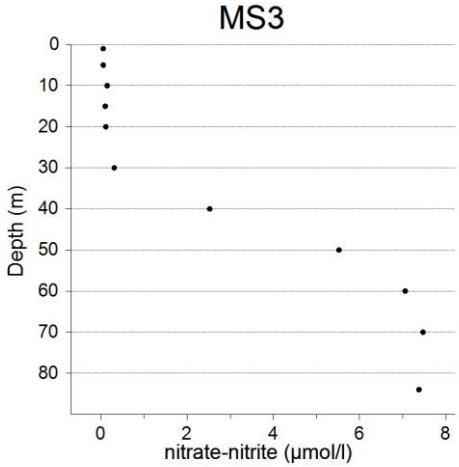

SR7
Depth (m)
nitrate-nitrite (µmol/l)

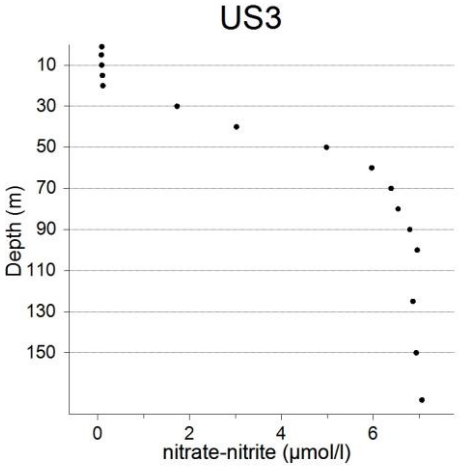

SR8
Depth (m)
nitrate-nitrite (µmol/l)

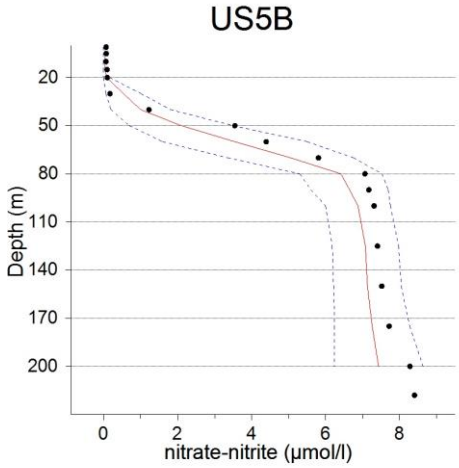

MS9
Depth (m)
nitrate-nitrite (µmol/l)

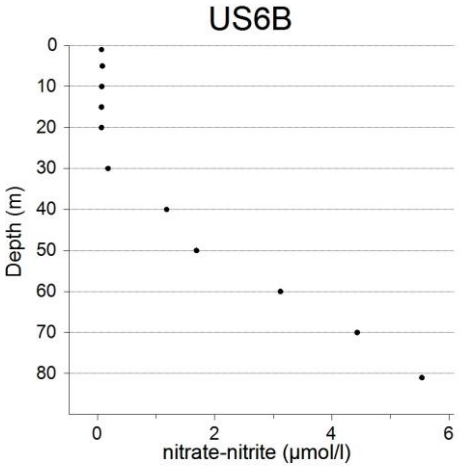

F26
Depth (m)
nitrate-nitrite (µmol/l)

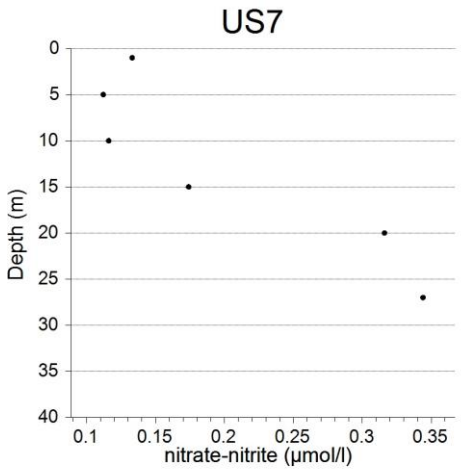

MS6
Depth (m)
nitrate-nitrite (µmol/l)

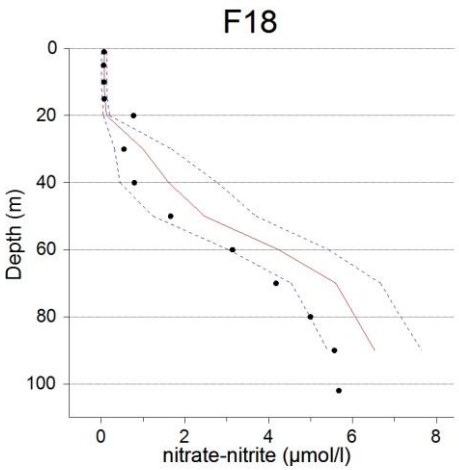

MS3
Depth (m)
nitrate-nitrite (µmol/l)

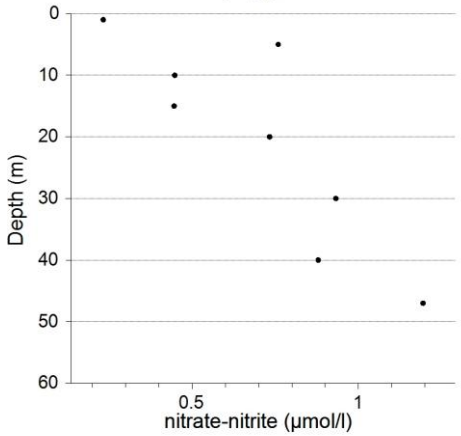

US3
Depth (m)
nitrate-nitrite (µmol/l)

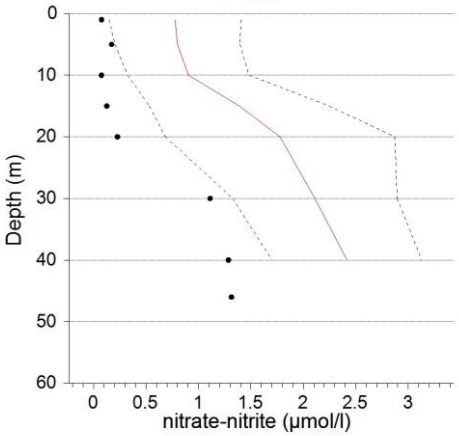

US5B
Depth (m)
nitrate-nitrite (µmol/l)

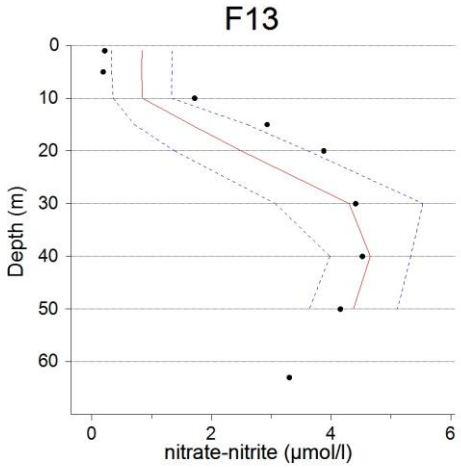

US6B
Depth (m)
nitrate-nitrite (µmol/l)

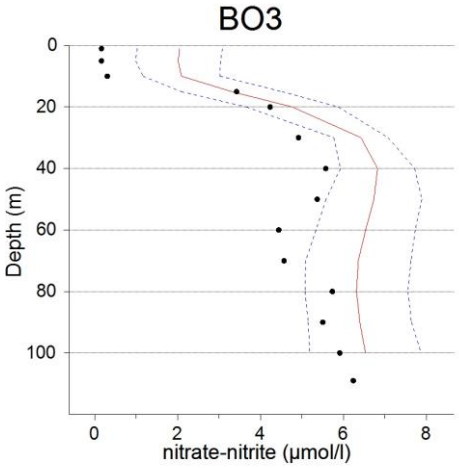

US7
Depth (m)
0
5
10
15
20
25
30
35
40
0.1
0.15
0.2
0.25
0.3
0.35
nitrate-nitrite (µmol/l)

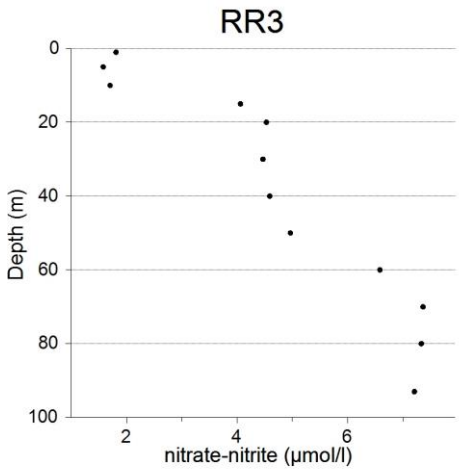

F18
Depth (m)
0
20
40
60
80
100
0
2
4
6
8
nitrate-nitrite (µmol/l)

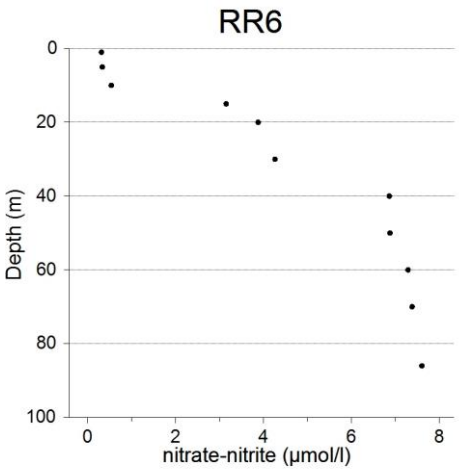

F15
Depth (m)
0
10
20
30
40
50
60
0.5
1
nitrate-nitrite (µmol/l)

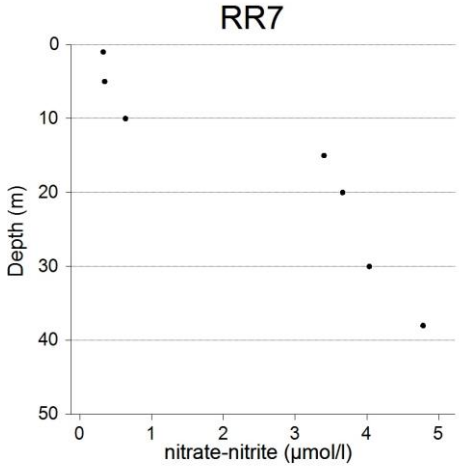

F16
Depth (m)
0
10
20
30
40
50
60
0
0.5
1
1.5
2
2.5
3
nitrate-nitrite (µmol/l)

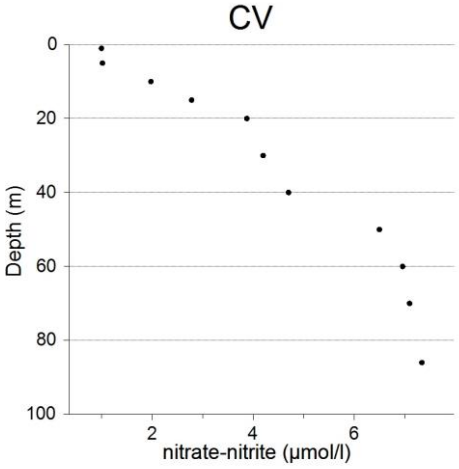

F13
Depth (m)
0
10
20
30
40
50
60
0
2
4
6
nitrate-nitrite (µmol/l)

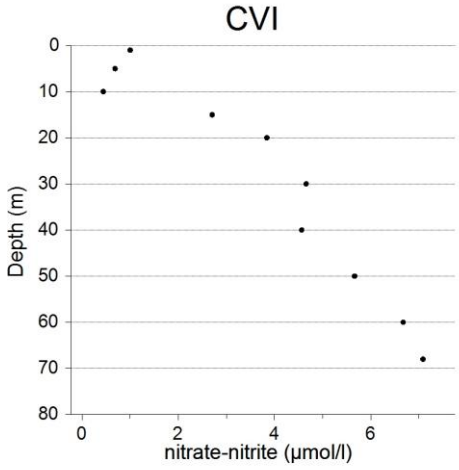

BO3
Depth (m)
0
20
40
60
80
100
0
2
4
6
8
nitrate-nitrite (µmol/l)

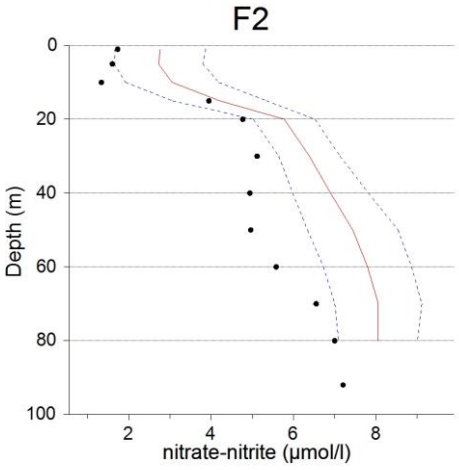

RR3
Depth (m)
0
20
40
60
80
100
2
4
6
nitrate-nitrite (µmol/l)

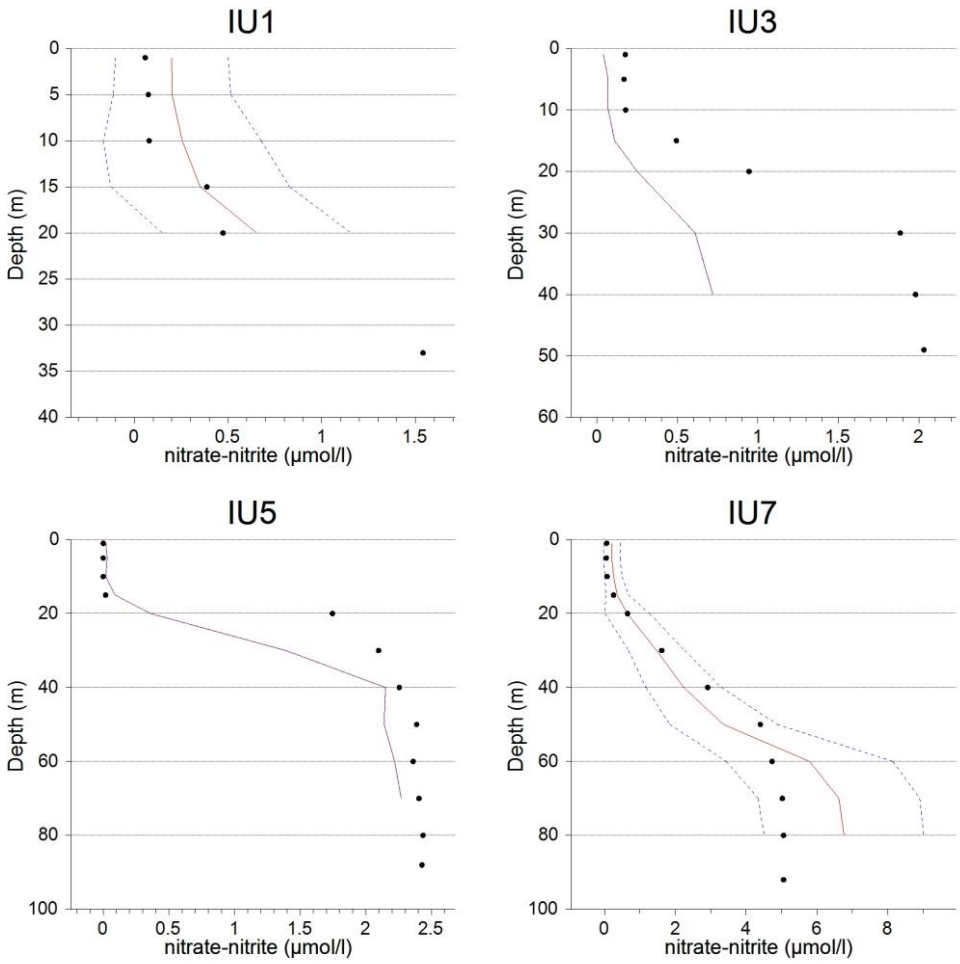

RR6
Depth (m)
0
20
40
60
80
100
0
2
4
6
8
nitrate-nitrite (µmol/l)


RR7
Depth (m)
0
10
20
30
40
50
0
1
2
3
4
5
nitrate-nitrite (µmol/l)

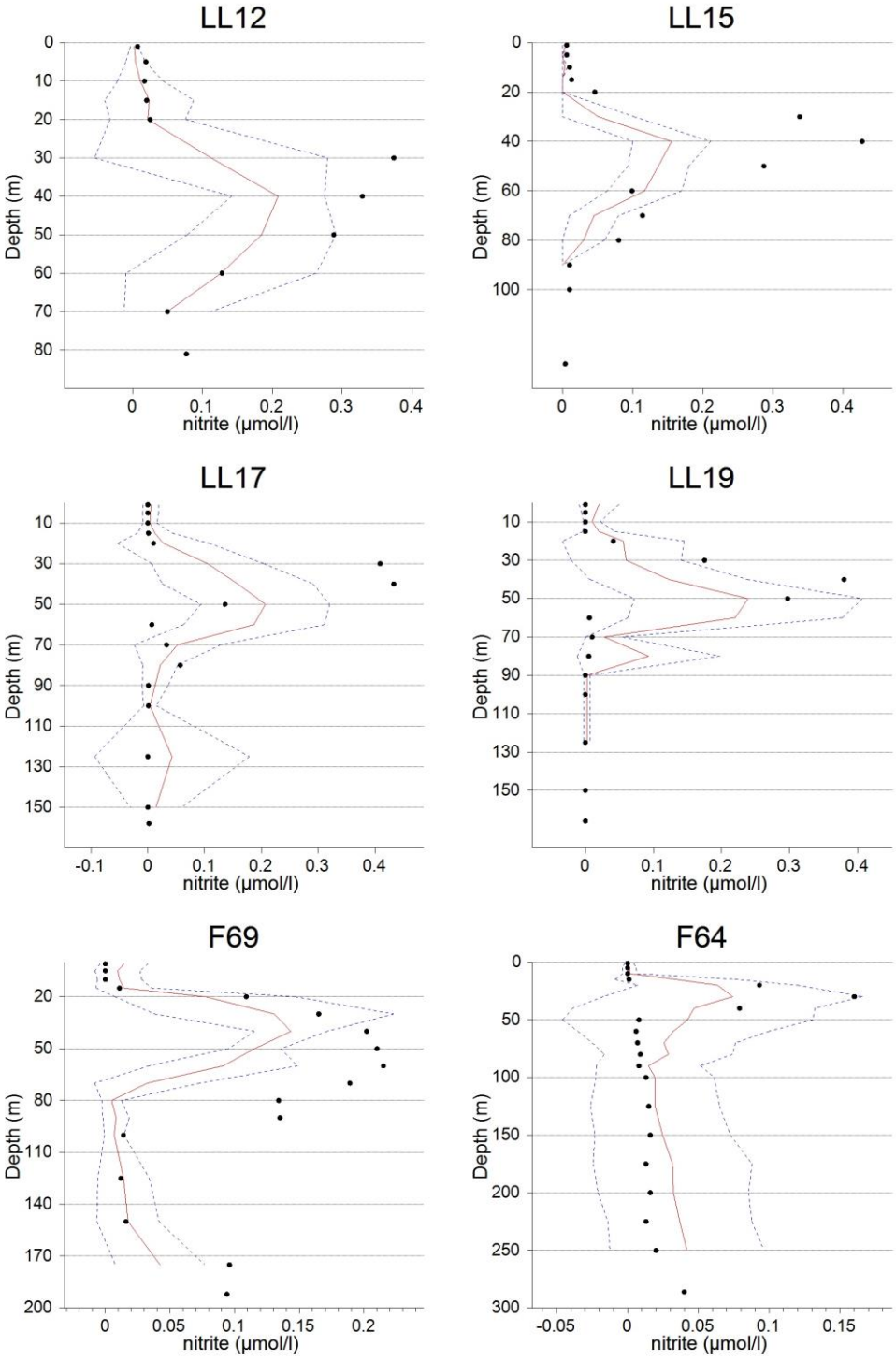

CV
Depth (m)
0
20
40
60
80
100
2
4
6
nitrate-nitrite (µmol/l)

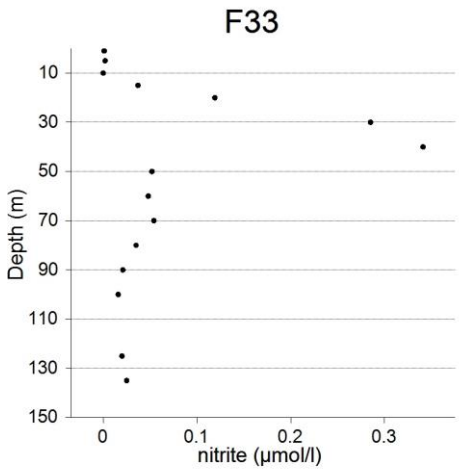

CVI
Depth (m)
0
10
20
30
40
50
60
70
80
0
2
4
6
nitrate-nitrite (µmol/l)

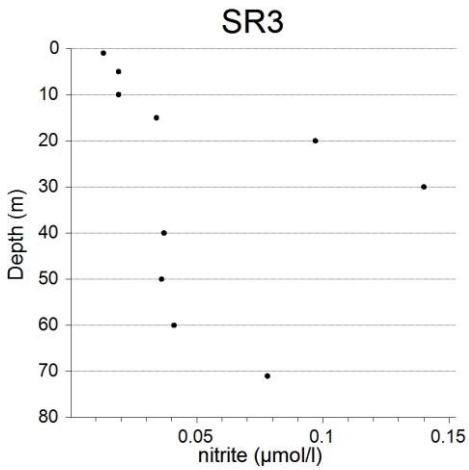

F2
Depth (m)
0
20
40
60
80
100
2
4
6
8
nitrate-nitrite (µmol/l)

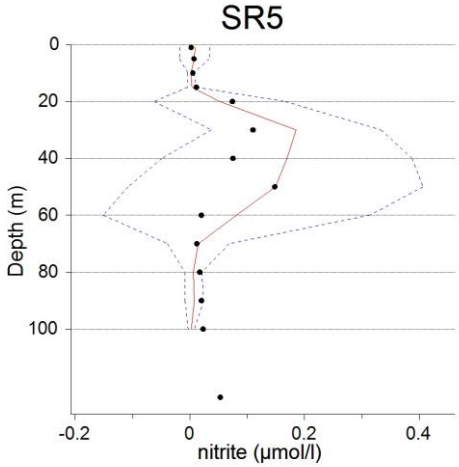

IU1
Depth (m)
0
5
10
15
20
25
30
35
40
0
0.5
1
1.5
nitrate-nitrite (µmol/l)
IU3
Depth (m)
0
10
20
30
40
50
60
0
0.5
1
1.5
2
nitrate-nitrite (µmol/l)
IU5
Depth (m)
0
20
40
60
80
100
0
0.5
1
1.5
2
2.5
nitrate-nitrite (µmol/l)
IU7
Depth (m)
0
20
40
60
80
100
0
2
4
6
8
nitrate-nitrite (µmol/l)

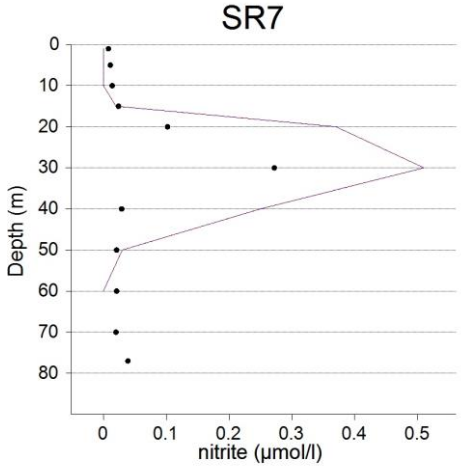
Nitrite

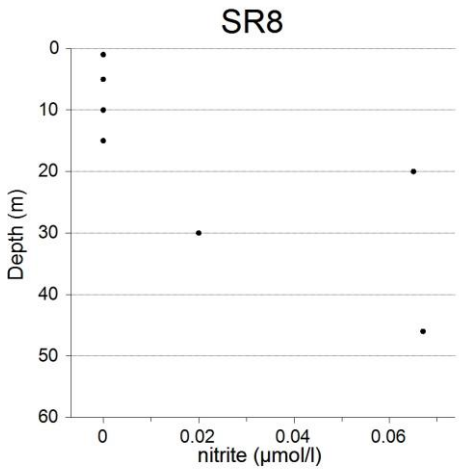

LL12
Depth (m)
nitrite (µmol/l)
LL15
Depth (m)
nitrite (µmol/l)
LL17
Depth (m)
nitrite (µmol/l)
LL19
Depth (m)
nitrite (µmol/l)
F69
Depth (m)
nitrite (µmol/l)
F64
Depth (m)
nitrite (µmol/l)

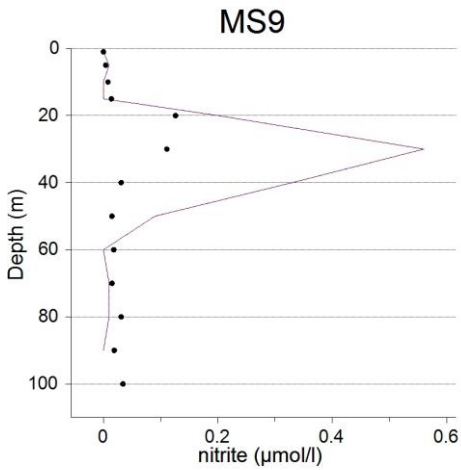

F33
Depth (m)
10
30
50
70
90
110
130
150
0
0.1
0.2
0.3
nitrite (µmol/l)

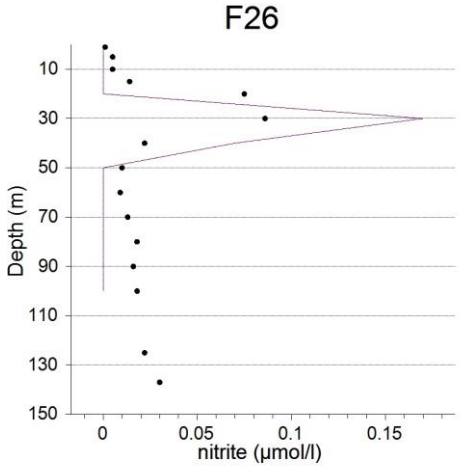

SR3
Depth (m)
0
10
20
30
40
50
60
70
80
0.05
0.1
0.15
nitrite (µmol/l)

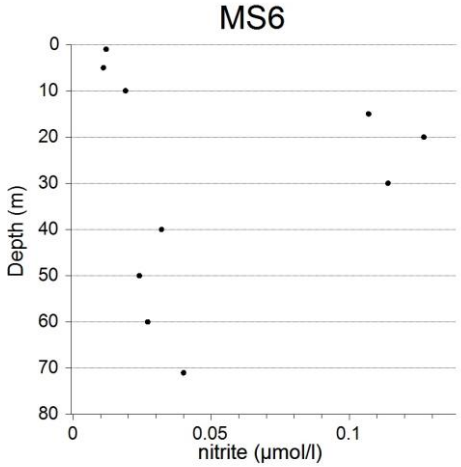

SR5
Depth (m)
0
20
40
60
80
100
-0.2
0
0.2
0.4
nitrite (µmol/l)

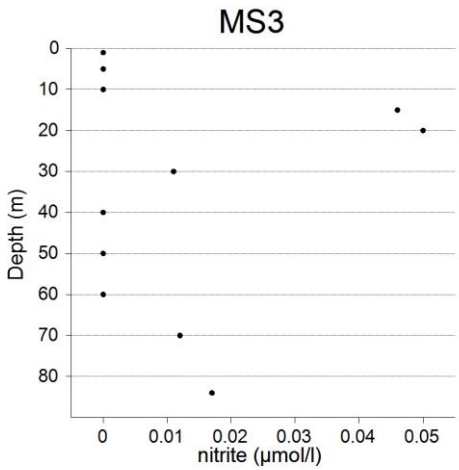

SR7
Depth (m)
0
10
20
30
40
50
60
70
80
0
0.1
0.2
0.3
0.4
0.5
nitrite (µmol/l)

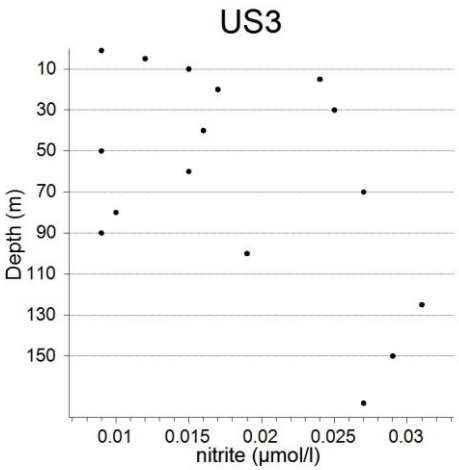

SR8
Depth (m)
0
10
20
30
40
50
60
0
0.02
0.04
0.06
nitrite (µmol/l)

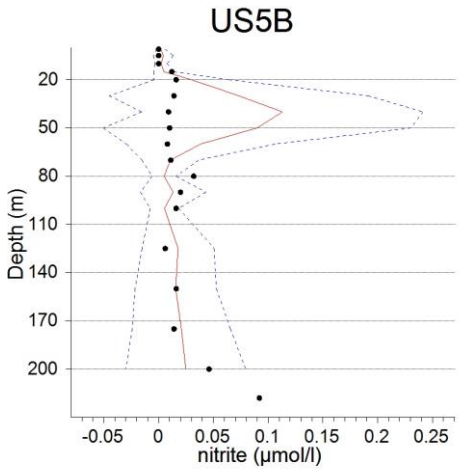

MS9
Depth (m)
0
20
40
60
80
100
0
0.2
0.4
0.6
nitrite (µmol/l)

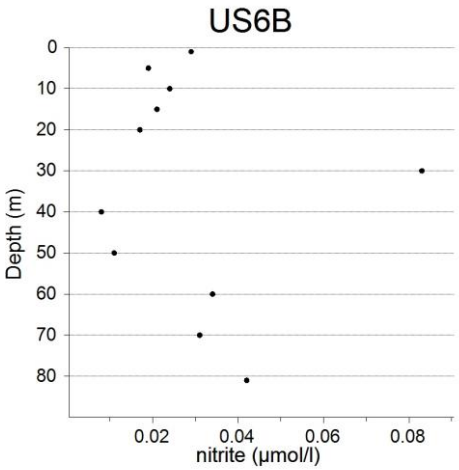

F26
Depth (m)
10
30
50
70
90
110
130
150
0
0.05
0.1
0.15
nitrite (µmol/l)

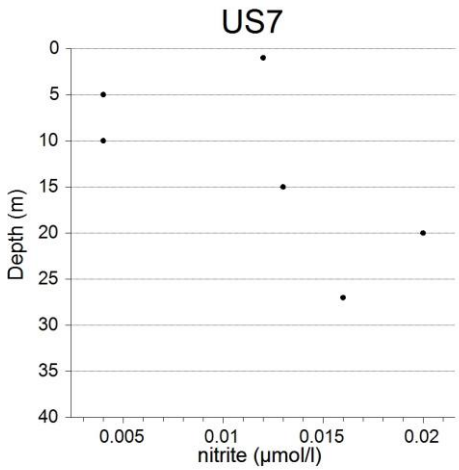

MS6
Depth (m)
0
10
20
30
40
50
60
70
80
0
0.05
0.1
nitrite (µmol/l)

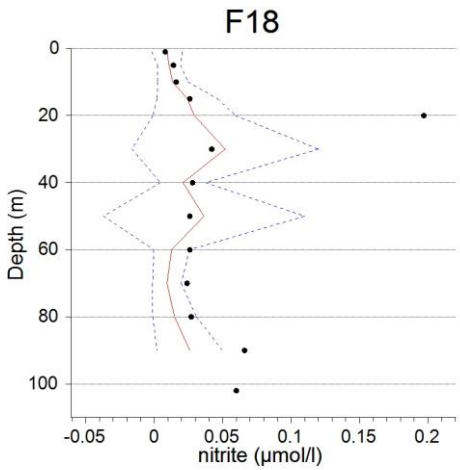

MS3
Depth (m)
0
10
20
30
40
50
60
70
80
0
0.01
0.02
0.03
0.04
0.05
nitrite (µmol/l)

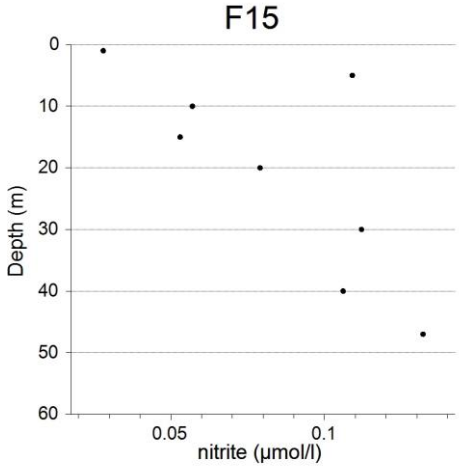

US3
Depth (m)
10
30
50
70
90
110
130
150
0.01
0.015
0.02
0.025
0.03
nitrite (µmol/l)

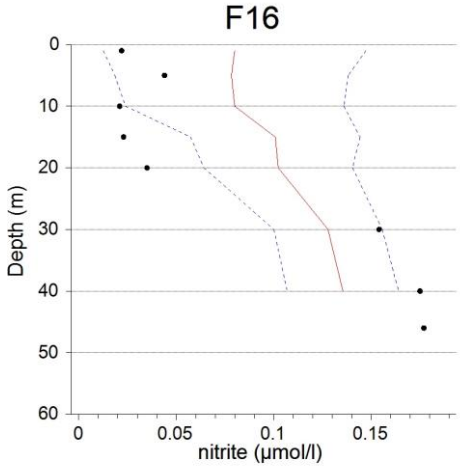

US5B
Depth (m)
20
50
80
110
140
170
200
-0.05
0
0.05
0.1
0.15
0.2
0.25
nitrite (µmol/l)

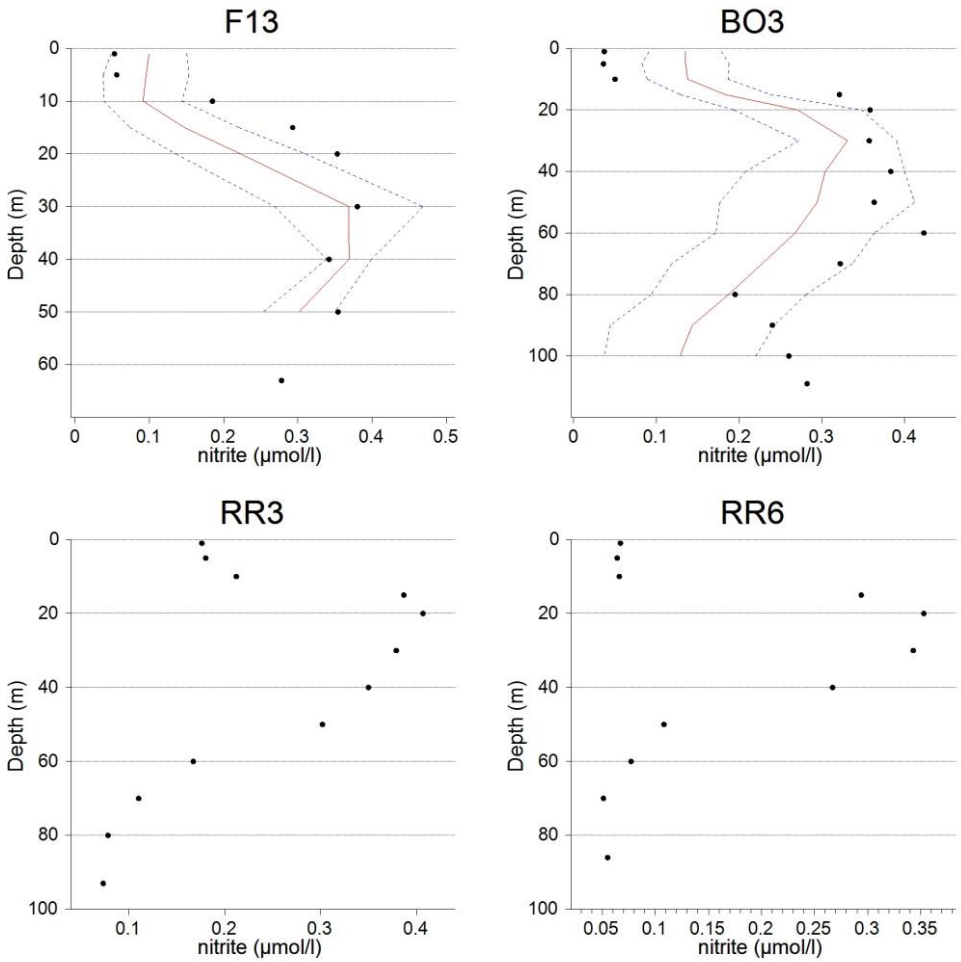

US6B
Depth (m)
0
10
20
30
40
50
60
70
80
0.02
0.04
0.06
0.08
nitrite (µmol/l)

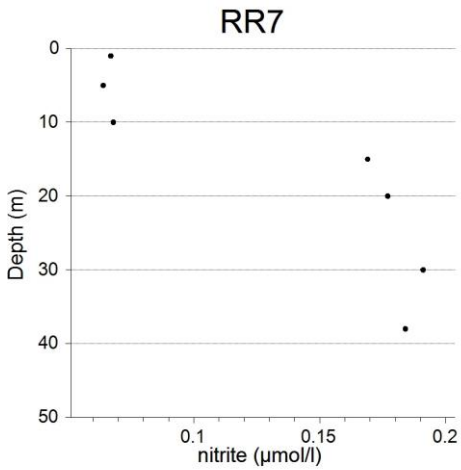

US7
Depth (m)
0
5
10
15
20
25
30
35
40
0.005
0.01
0.015
0.02
nitrite (µmol/l)

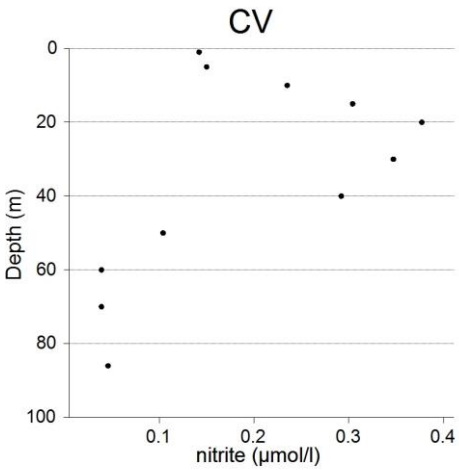

F18
Depth (m)
0
20
40
60
80
100
-0.05
0
0.05
0.1
0.15
0.2
nitrite (µmol/l)

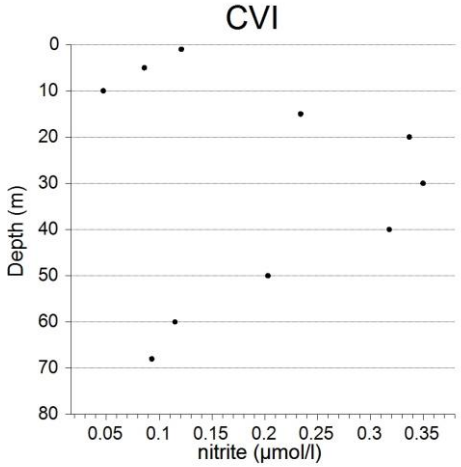

F15
Depth (m)
0
10
20
30
40
50
60
0.05
0.1
nitrite (µmol/l)

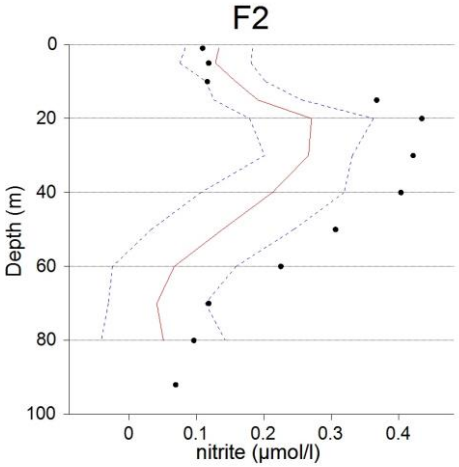

F16
Depth (m)
0
10
20
30
40
50
60
0
0.05
0.1
0.15
nitrite (µmol/l)

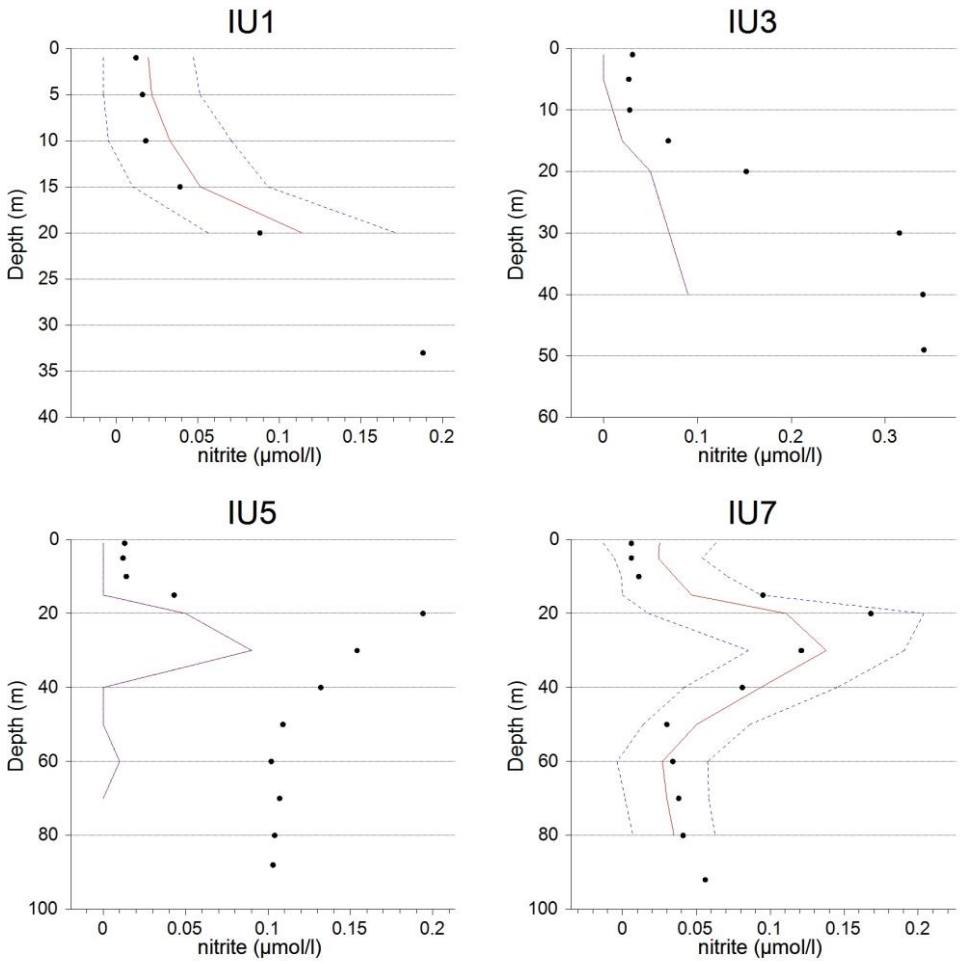

F13
BO3
RR3
RR6
Depth (m)
nitrite (µmol/l)


RR7
Depth (m)
0
10
20
30
40
50
0.1
0.15
0.2
nitrite (µmol/l)

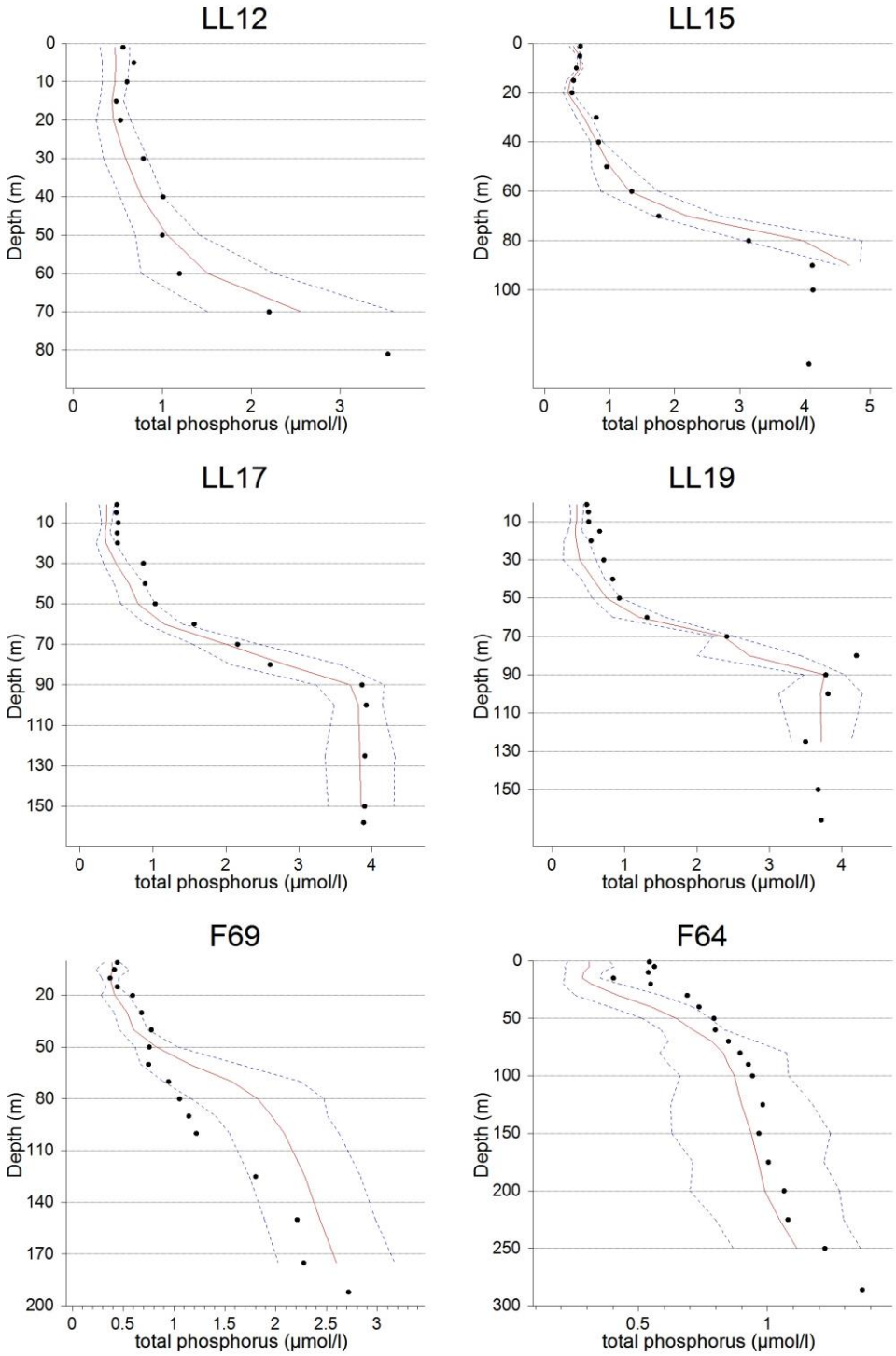

CV
Depth (m)
0
20
40
60
80
100
0.1
0.2
0.3
0.4
nitrite (µmol/l)

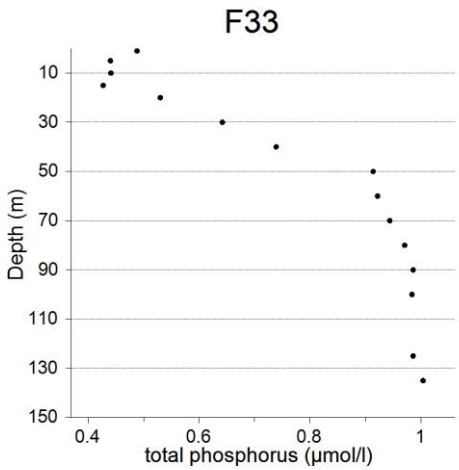

CVI
Depth (m)
0
10
20
30
40
50
60
70
80
0.05
0.1
0.15
0.2
0.25
0.3
0.35
nitrite (µmol/l)

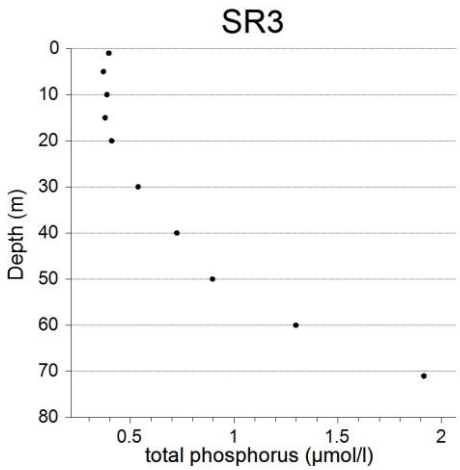

F2
Depth (m)
0
20
40
60
80
100
0
0.1
0.2
0.3
0.4
nitrite (µmol/l)

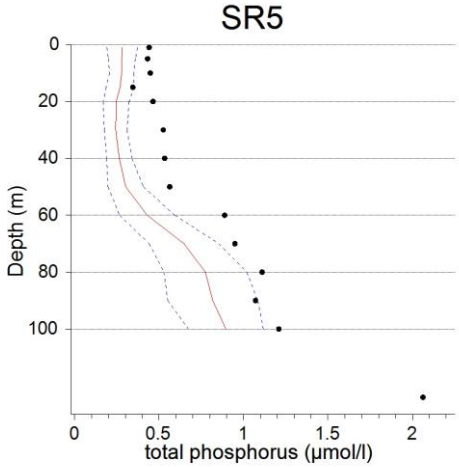

IU1
IU3
IU5
IU7
Depth (m)
nitrite (µmol/l)

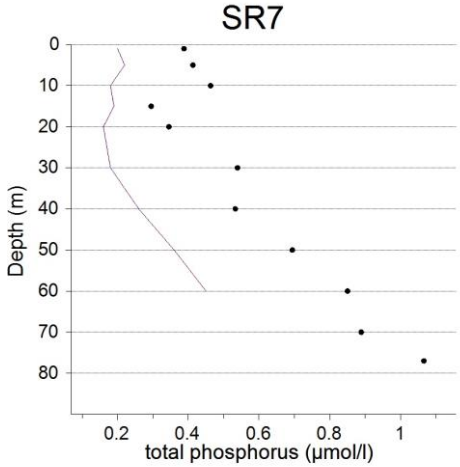
Total Phosphorus

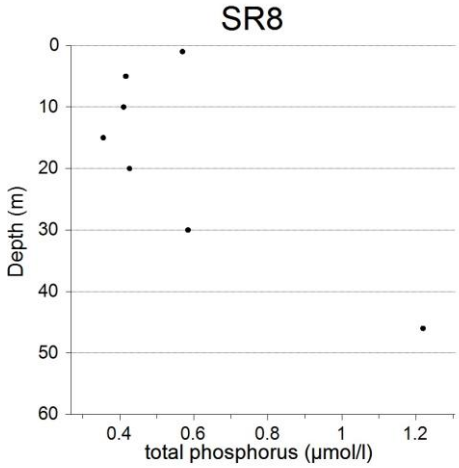


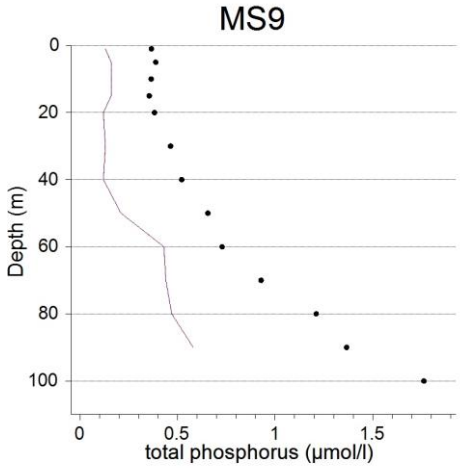

F33
Depth (m)
10
30
50
70
90
110
130
150
0.4
0.6
0.8
1
total phosphorus (µmol/l)

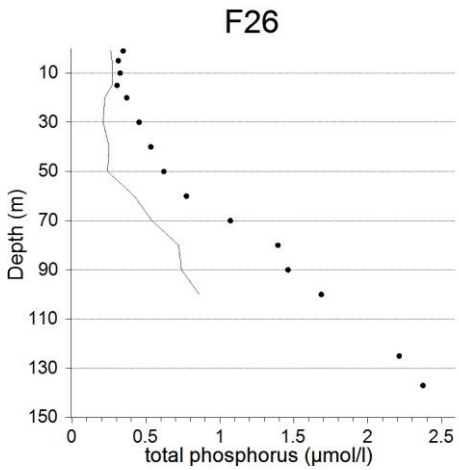

SR3
Depth (m)
0
10
20
30
40
50
60
70
80
0.5
1
1.5
2
total phosphorus (µmol/l)

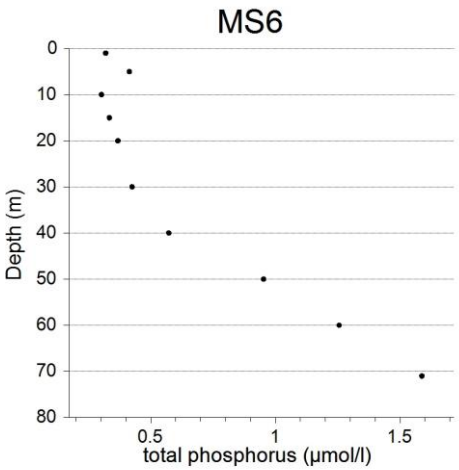

SR5
Depth (m)
0
20
40
60
80
100
0
0.5
1
1.5
2
total phosphorus (µmol/l)

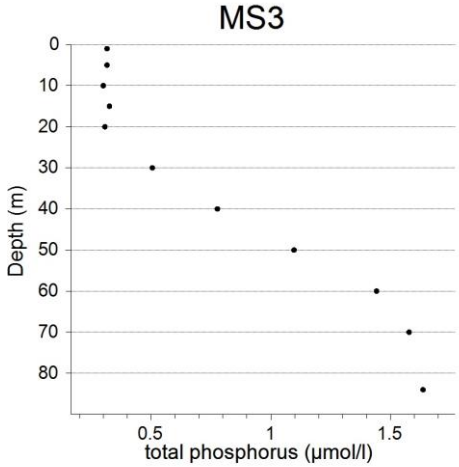

SR7
Depth (m)
0
10
20
30
40
50
60
70
80
0.2
0.4
0.6
0.8
1
total phosphorus (µmol/l)

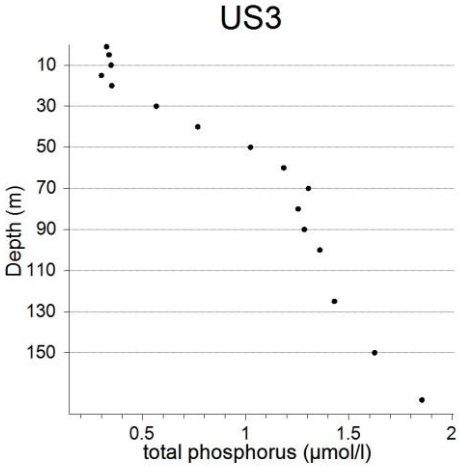

SR8
Depth (m)
0
10
20
30
40
50
60
0.4
0.6
0.8
1
1.2
total phosphorus (µmol/l)

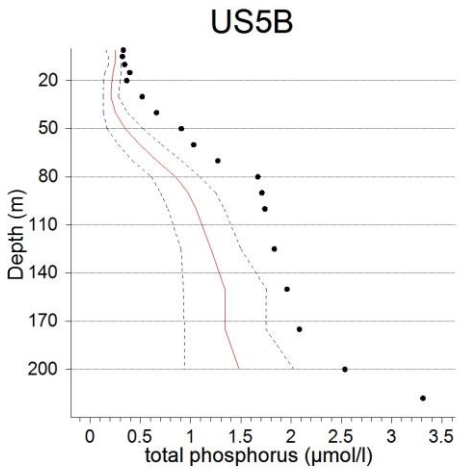

MS9
Depth (m)
0
20
40
60
80
100
0
0.5
1
1.5
total phosphorus (µmol/l)

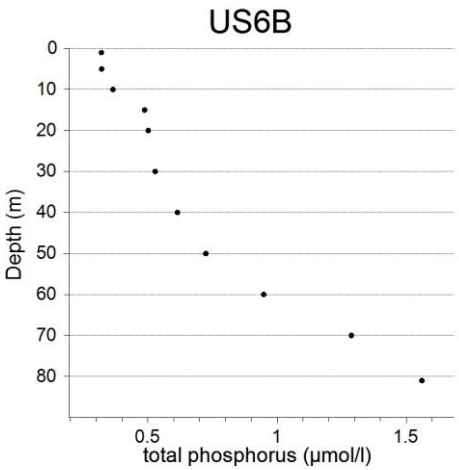

F26
Depth (m)
10
30
50
70
90
110
130
150
0
0.5
1
1.5
2
2.5
total phosphorus (µmol/l)

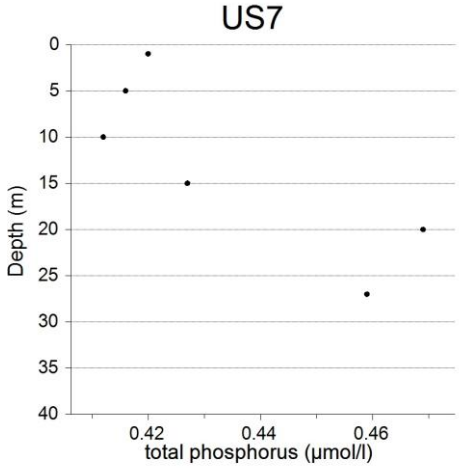

MS6
Depth (m)
0
10
20
30
40
50
60
70
80
0.5
1
1.5
total phosphorus (µmol/l)

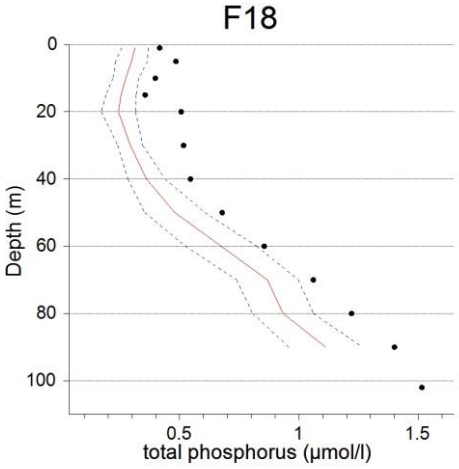

MS3
Depth (m)
0
10
20
30
40
50
60
70
80
0.5
1
1.5
total phosphorus (µmol/l)

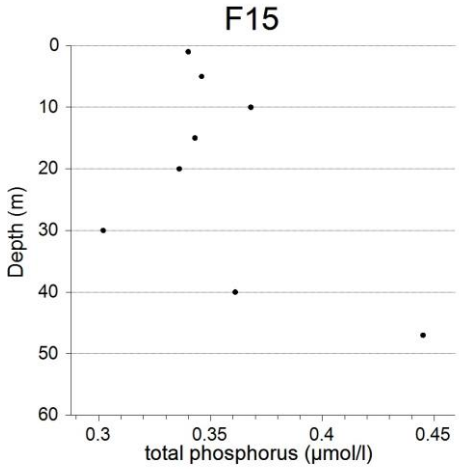

US3
Depth (m)
10
30
50
70
90
110
130
150
0.5
1
1.5
2
total phosphorus (µmol/l)

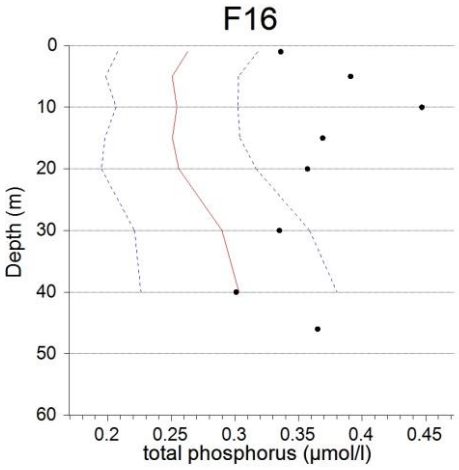

US5B
Depth (m)
20
50
80
110
140
170
200
0
0.5
1
1.5
2
2.5
3
3.5
total phosphorus (µmol/l)

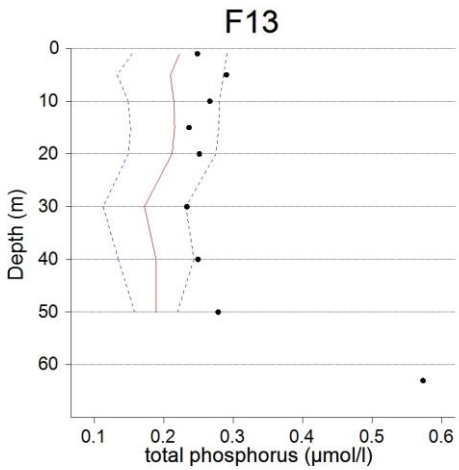

US6B
Depth (m)
0
10
20
30
40
50
60
70
80
0.5
1
1.5
total phosphorus (µmol/l)

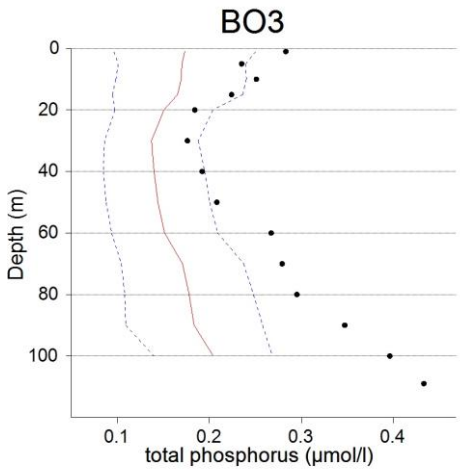

US7
Depth (m)
0
5
10
15
20
25
30
35
40
0.42
0.44
0.46
total phosphorus (µmol/l)

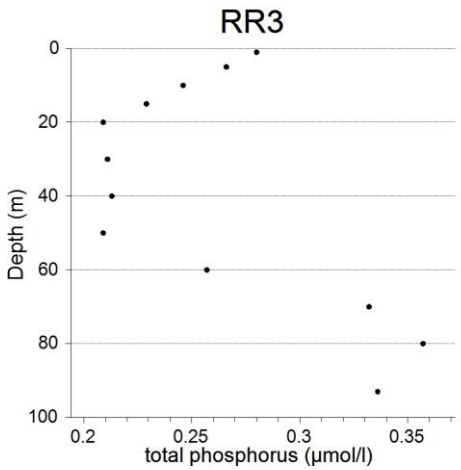

F18
Depth (m)
0
20
40
60
80
100
0.5
1
1.5
total phosphorus (µmol/l)

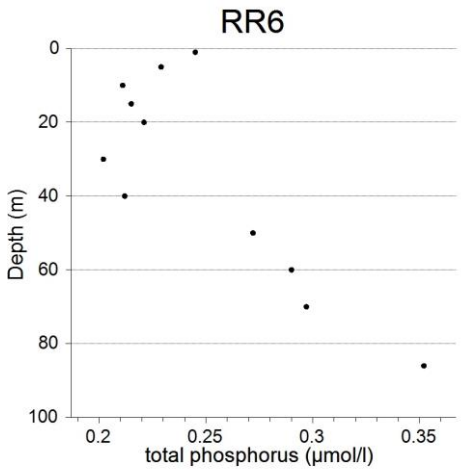

F15
Depth (m)
0
10
20
30
40
50
60
0.3
0.35
0.4
0.45
total phosphorus (µmol/l)

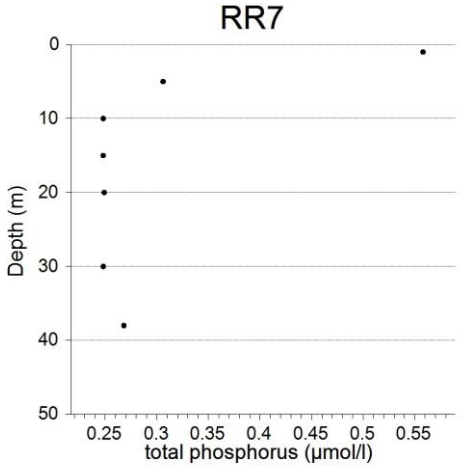

F16
Depth (m)
0
10
20
30
40
50
60
0.2
0.25
0.3
0.35
0.4
0.45
total phosphorus (µmol/l)

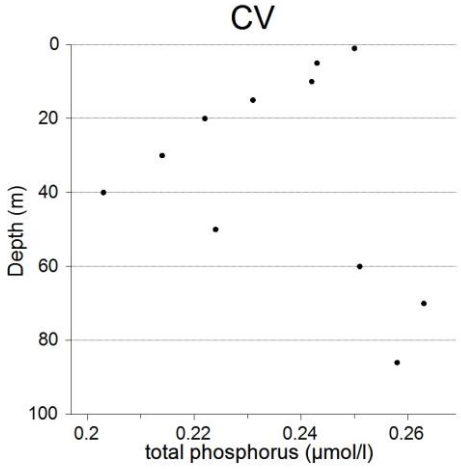

F13
Depth (m)
0
10
20
30
40
50
60
0.1
0.2
0.3
0.4
0.5
0.6
total phosphorus (µmol/l)

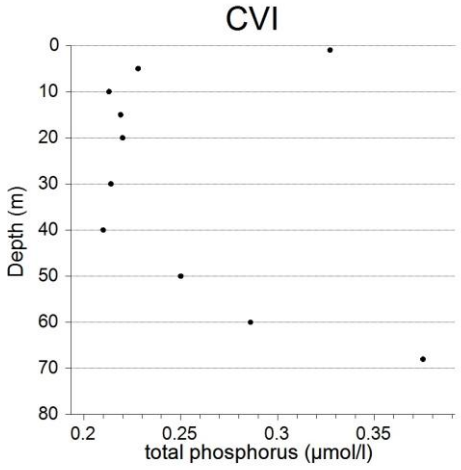

BO3
Depth (m)
0
20
40
60
80
100
0.1
0.2
0.3
0.4
total phosphorus (µmol/l)

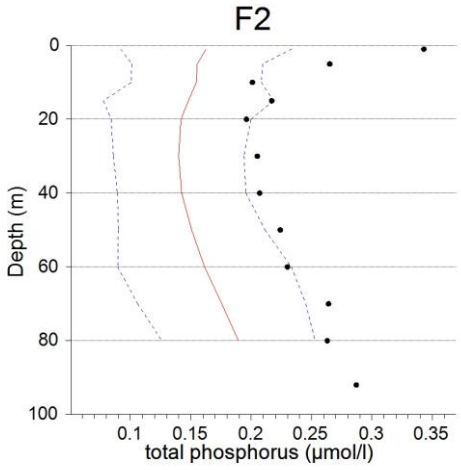

RR3
Depth (m)
0
20
40
60
80
100
0.2
0.25
0.3
0.35
total phosphorus (µmol/l)

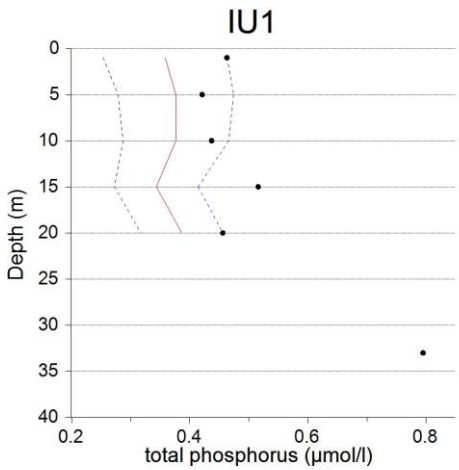

RR6
Depth (m)
0
20
40
60
80
100
0.2
0.25
0.3
0.35
total phosphorus (µmol/l)

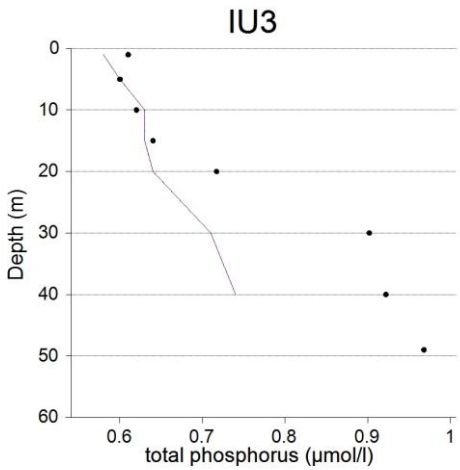

RR7
Depth (m)
0
10
20
30
40
50
0.25
0.3
0.35
0.4
0.45
0.5
0.55
total phosphorus (µmol/l)

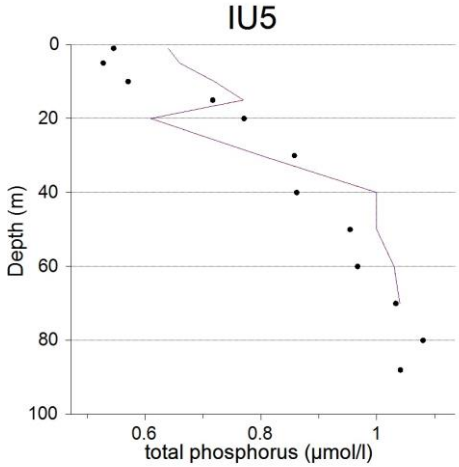

CV
Depth (m)
0
20
40
60
80
100
0.2
0.22
0.24
0.26
total phosphorus (µmol/l)

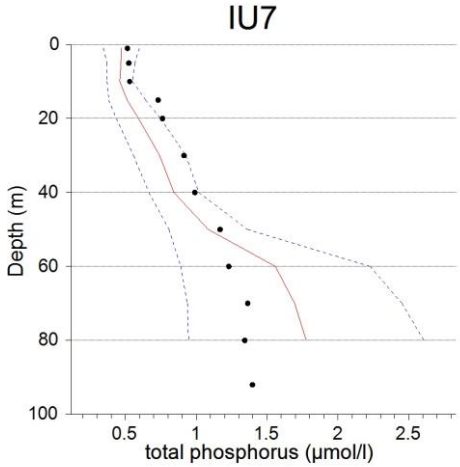

CVI
Depth (m)
0
10
20
30
40
50
60
70
80
0.2
0.25
0.3
0.35
total phosphorus (µmol/l)


F2
Depth (m)
0
20
40
60
80
100
0.1
0.15
0.2
0.25
0.3
0.35
total phosphorus (µmol/l)

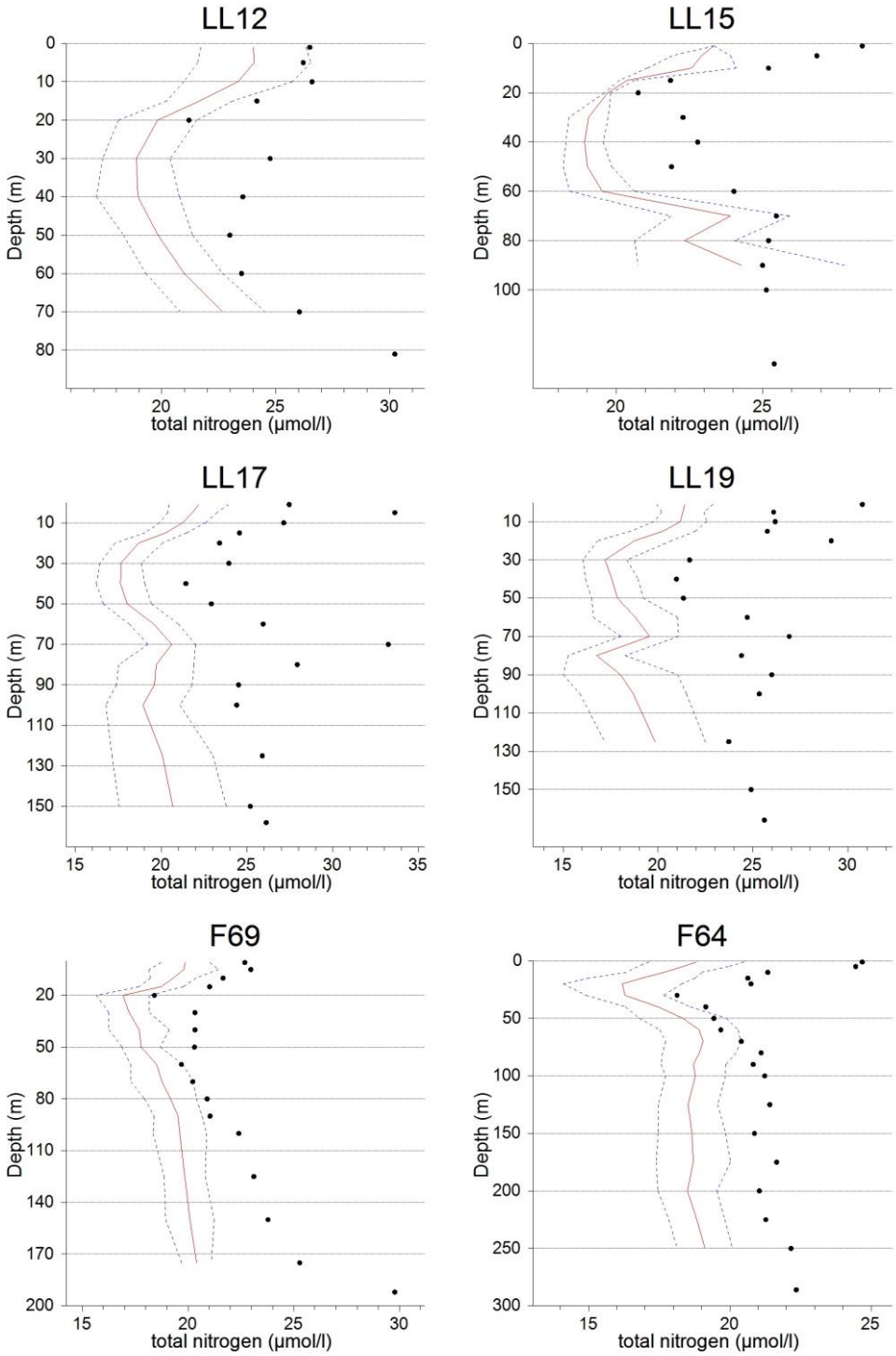

IU1
Depth (m)
0
5
10
15
20
25
30
35
40
0.2
0.4
0.6
0.8
total phosphorus (µmol/l)

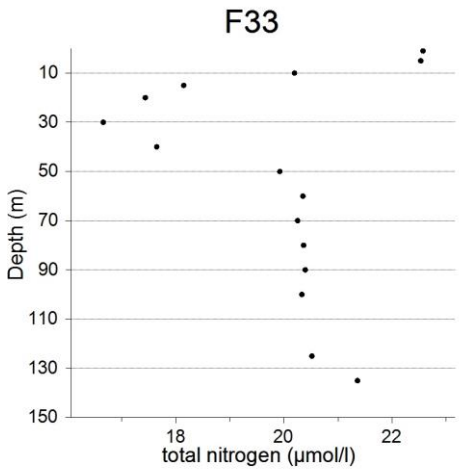

IU3
Depth (m)
0
10
20
30
40
50
60
0.6
0.7
0.8
0.9
1
total phosphorus (µmol/l)

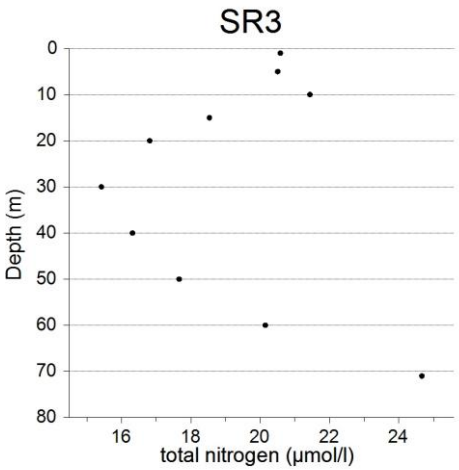

IU5
Depth (m)
0
20
40
60
80
100
0.6
0.8
1
total phosphorus (µmol/l)

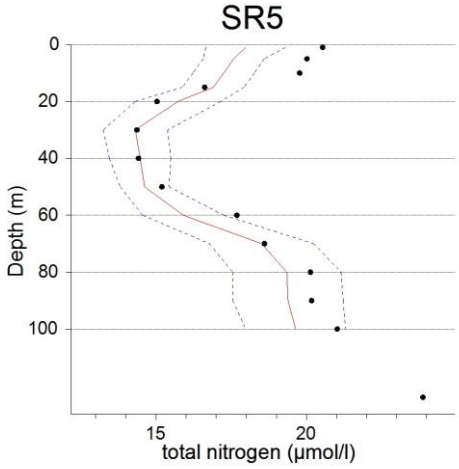

IU7
Depth (m)
0
20
40
60
80
100
0.5
1
1.5
2
2.5
total phosphorus (µmol/l)

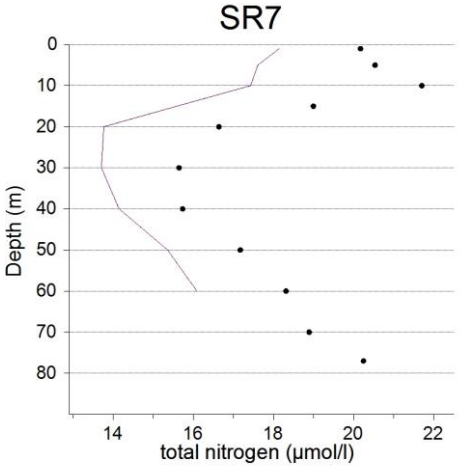
Total Nitrogen

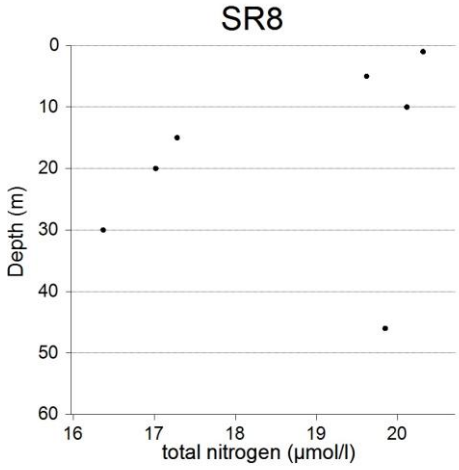


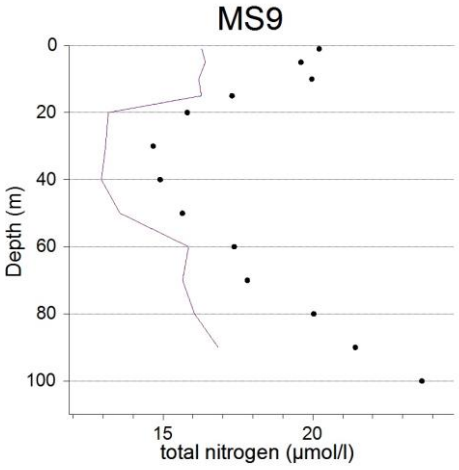

F33
Depth (m)
10
30
50
70
90
110
130
150
18
20
22
total nitrogen (µmol/l)

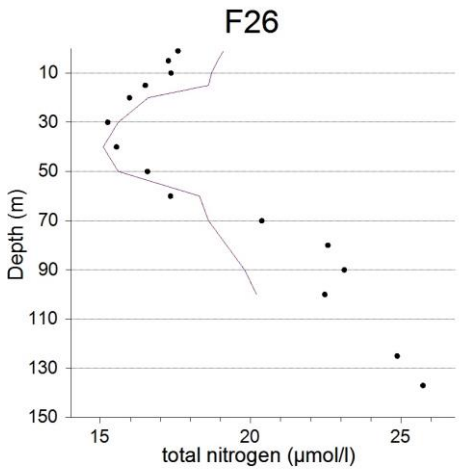

SR3
Depth (m)
0
10
20
30
40
50
60
70
80
16
18
20
22
24
total nitrogen (µmol/l)

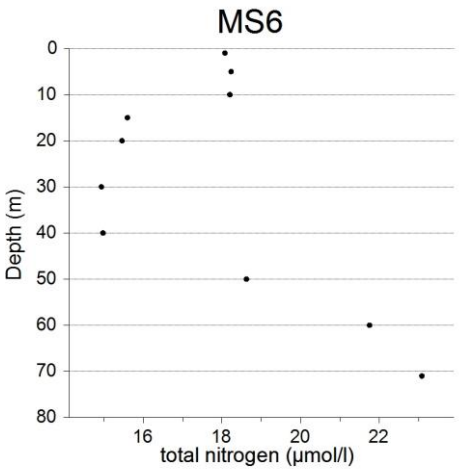

SR5
Depth (m)
0
20
40
60
80
100
15
20
total nitrogen (µmol/l)

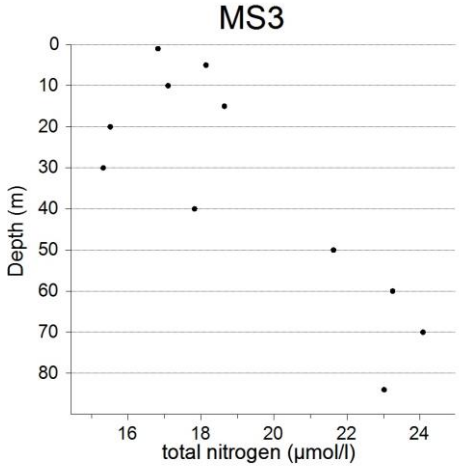

SR7
Depth (m)
0
10
20
30
40
50
60
70
80
14
16
18
20
22
total nitrogen (µmol/l)

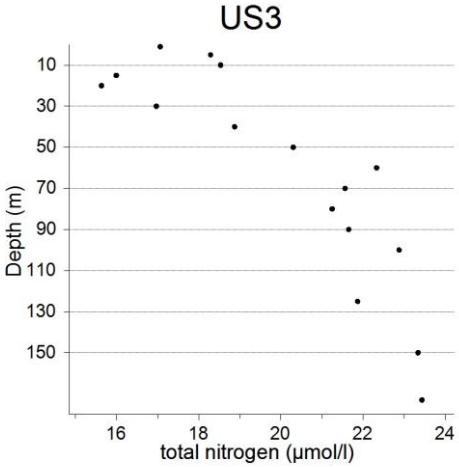

SR8
Depth (m)
0
10
20
30
40
50
60
16
17
18
19
20
total nitrogen (µmol/l)

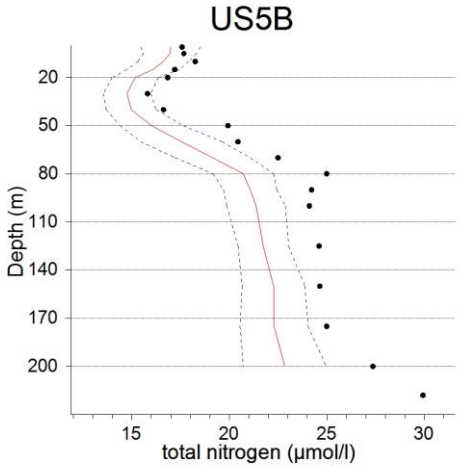

MS9
Depth (m)
0
20
40
60
80
100
15
20
total nitrogen (µmol/l)

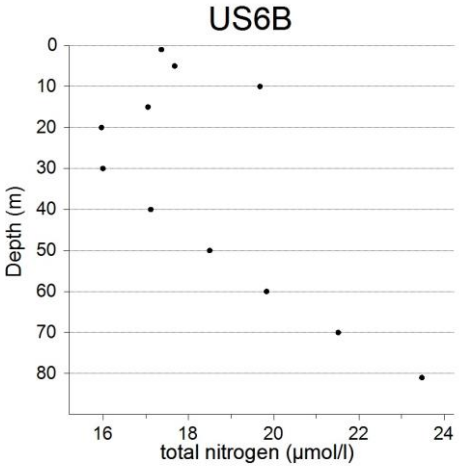

F26
Depth (m)
10
30
50
70
90
110
130
150
15
20
25
total nitrogen (µmol/l)

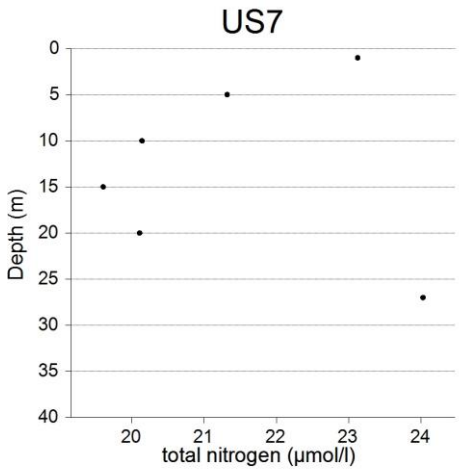

MS6
Depth (m)
0
10
20
30
40
50
60
70
80
16
18
20
22
total nitrogen (µmol/l)

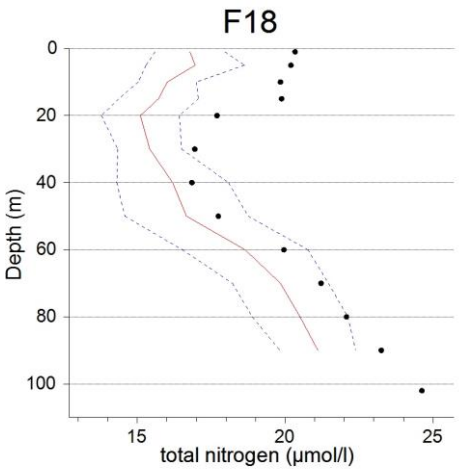

MS3
Depth (m)
0
10
20
30
40
50
60
70
80
16
18
20
22
24
total nitrogen (µmol/l)

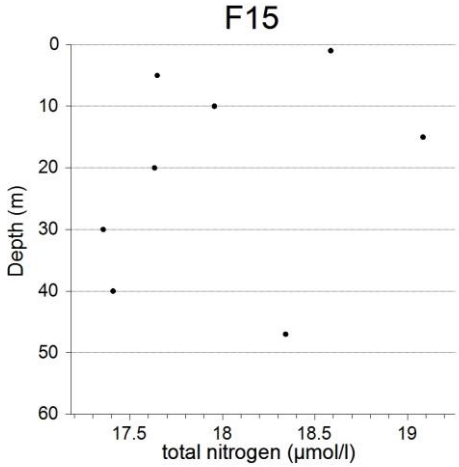

US3
Depth (m)
10
30
50
70
90
110
130
150
16
18
20
22
24
total nitrogen (µmol/l)

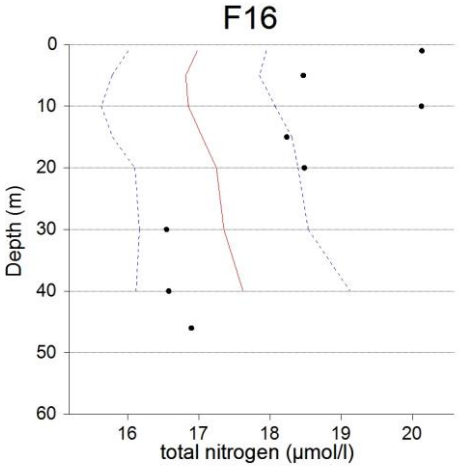

US5B
Depth (m)
20
50
80
110
140
170
200
15
20
25
30
total nitrogen (µmol/l)

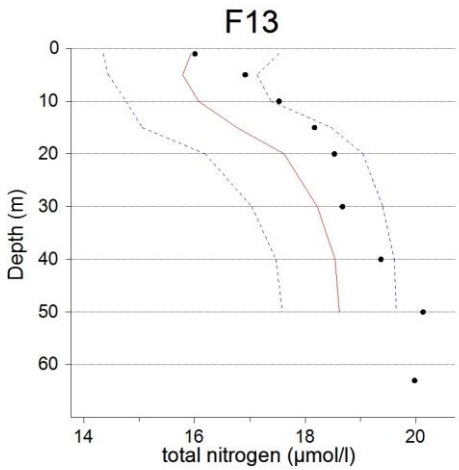

US6B
Depth (m)
0
10
20
30
40
50
60
70
80
16
18
20
22
24
total nitrogen (µmol/l)

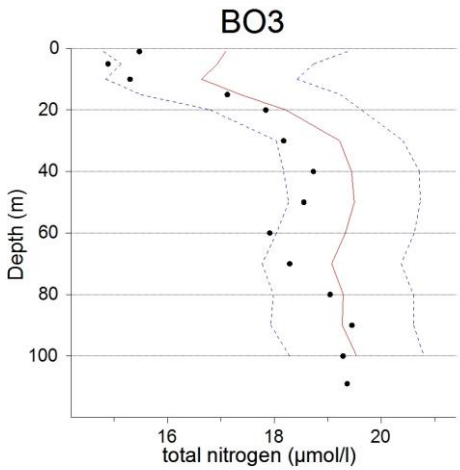

US7
Depth (m)
0
5
10
15
20
25
30
35
40
20
21
22
23
24
total nitrogen (µmol/l)

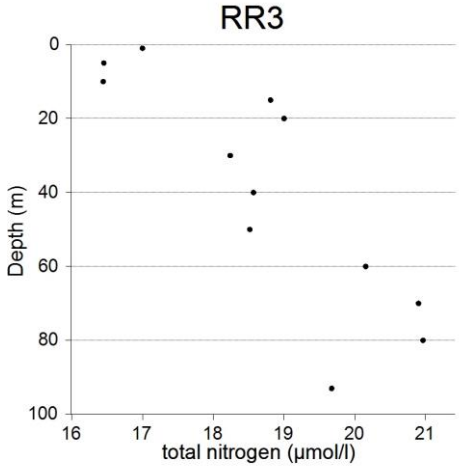

F18
Depth (m)
0
20
40
60
80
100
15
20
25
total nitrogen (µmol/l)

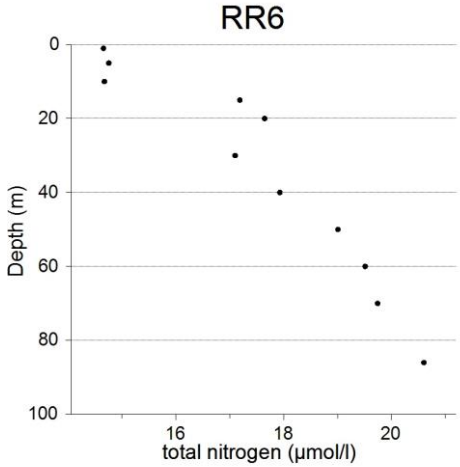

F15
Depth (m)
0
10
20
30
40
50
60
17.5
18
18.5
19
total nitrogen (µmol/l)

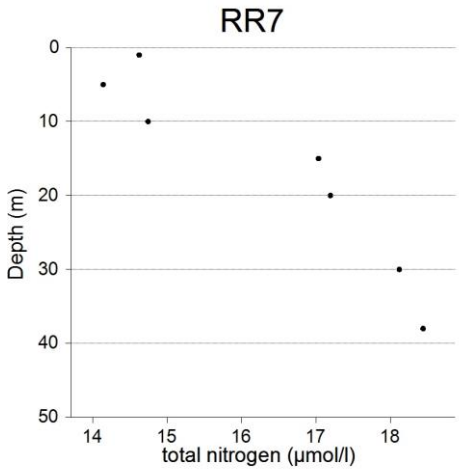

F16
Depth (m)
0
10
20
30
40
50
60
16
17
18
19
20
total nitrogen (µmol/l)

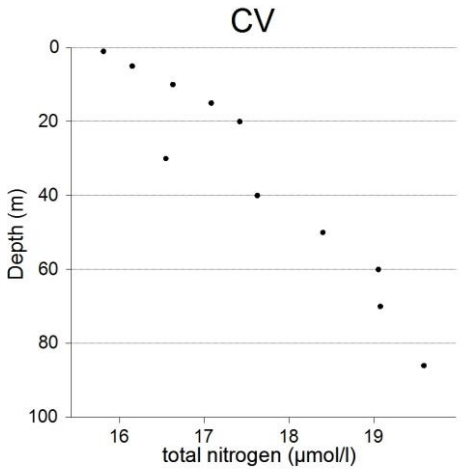

F13
Depth (m)
total nitrogen (µmol/l)

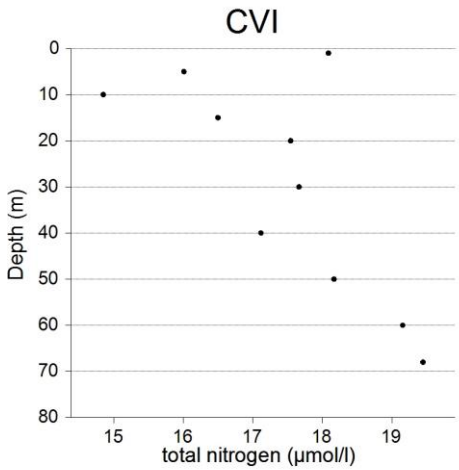

BO3
Depth (m)
total nitrogen (µmol/l)

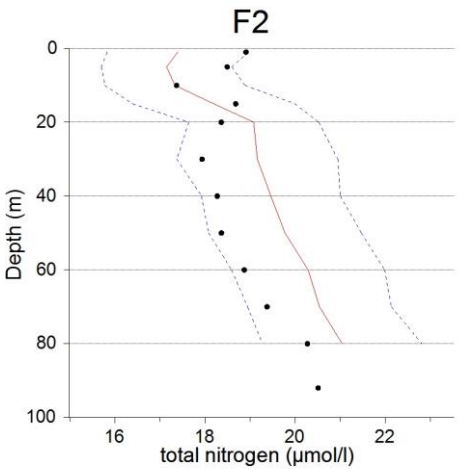

RR3
Depth (m)
total nitrogen (µmol/l)

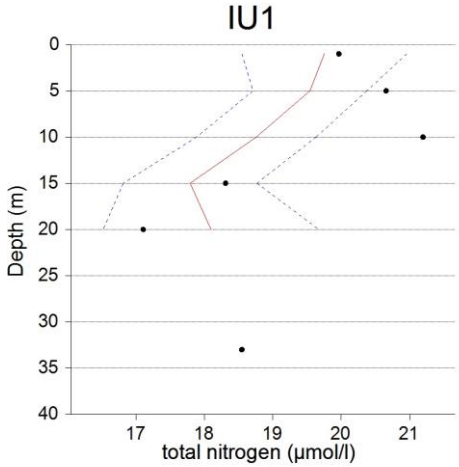

RR6
Depth (m)
total nitrogen (µmol/l)

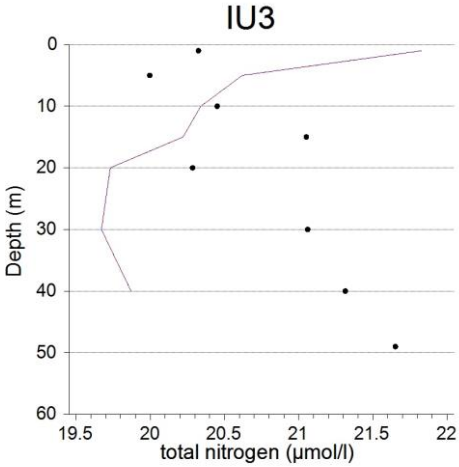

RR7
Depth (m)
total nitrogen (µmol/l)

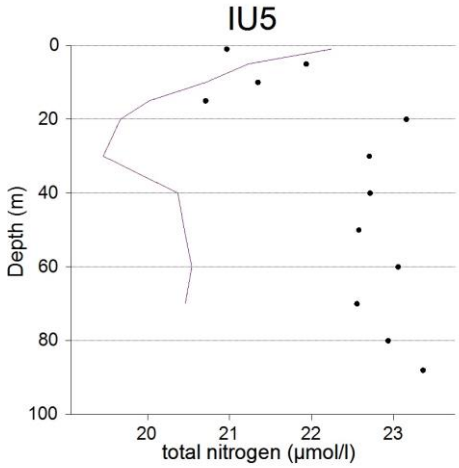

CV
Depth (m)
total nitrogen (µmol/l)

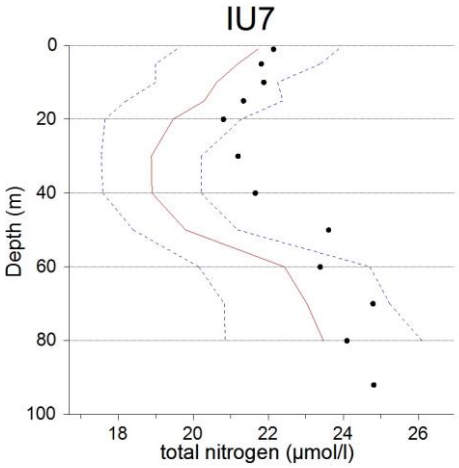

CVI
Depth (m)
0
10
20
30
40
50
60
70
80
15
16
17
18
19
total nitrogen (µmol/l)


F2
Depth (m)
0
20
40
60
80
100
16
18
20
22
total nitrogen (µmol/l)

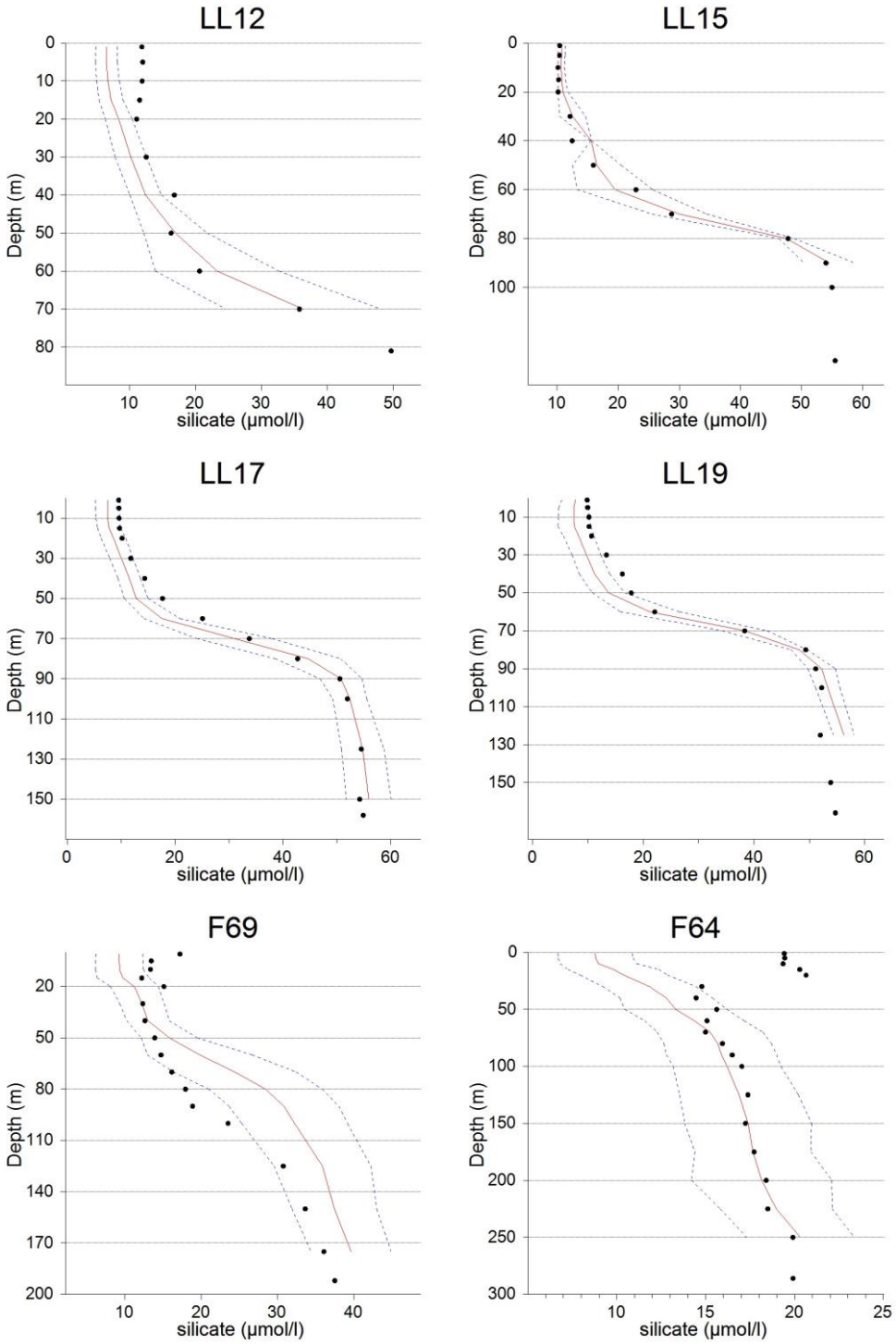

IU1
Depth (m)
0
5
10
15
20
25
30
35
40
17
18
19
20
21
total nitrogen (µmol/l)

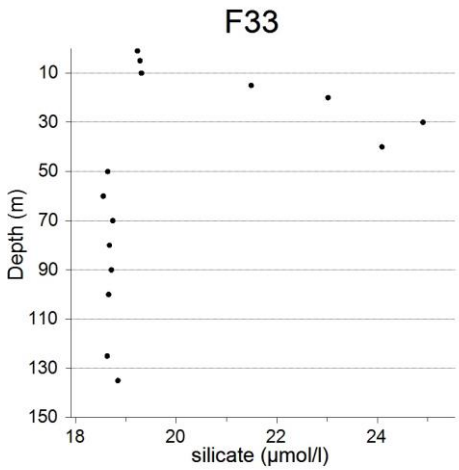

IU3
Depth (m)
0
10
20
30
40
50
60
19.5
20
20.5
21
21.5
22
total nitrogen (µmol/l)

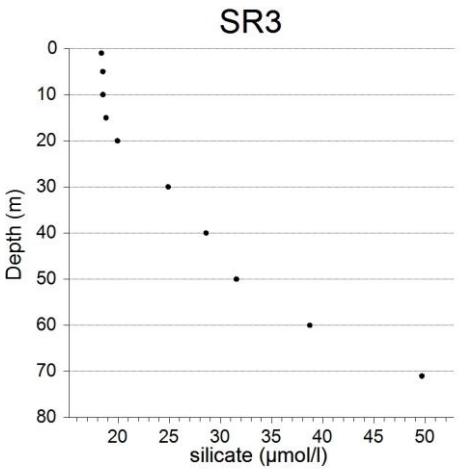

IU5
Depth (m)
0
20
40
60
80
100
20
21
22
23
total nitrogen (µmol/l)

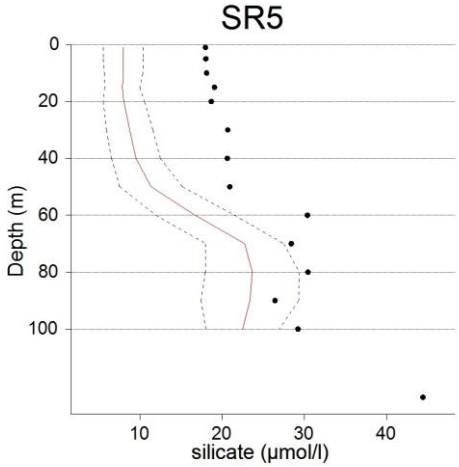

IU7
Depth (m)
0
20
40
60
80
100
18
20
22
24
26
total nitrogen (µmol/l)

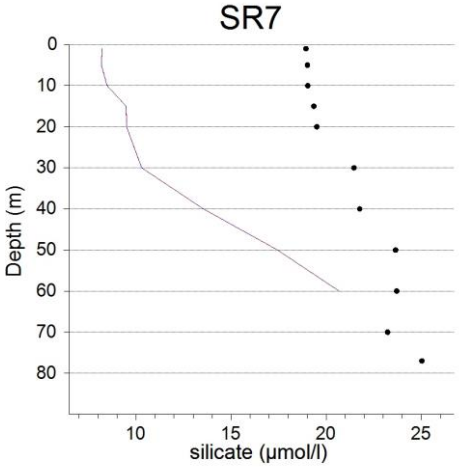
Silicate

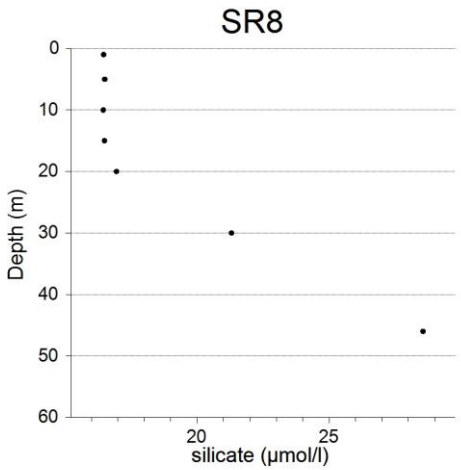

LL12
Depth (m)
silicate (µmol/l)
LL15
Depth (m)
silicate (µmol/l)
LL17
Depth (m)
silicate (µmol/l)
LL19
Depth (m)
silicate (µmol/l)
F69
Depth (m)
silicate (µmol/l)
F64
Depth (m)
silicate (µmol/l)

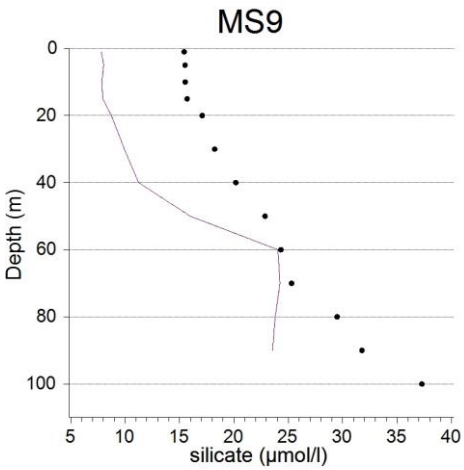

F33
Depth (m)
10
30
50
70
90
110
130
150
18
20
22
24
silicate (µmol/l)

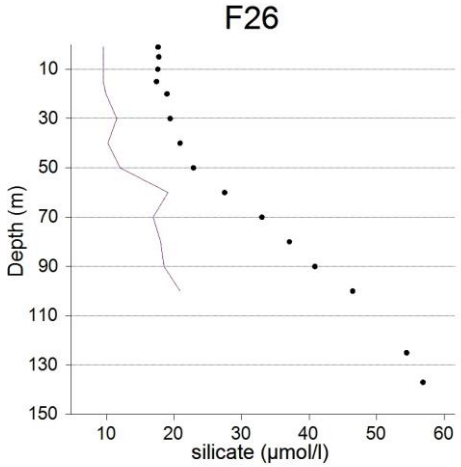

SR3
Depth (m)
0
10
20
30
40
50
60
70
80
20
25
30
35
40
45
50
silicate (µmol/l)

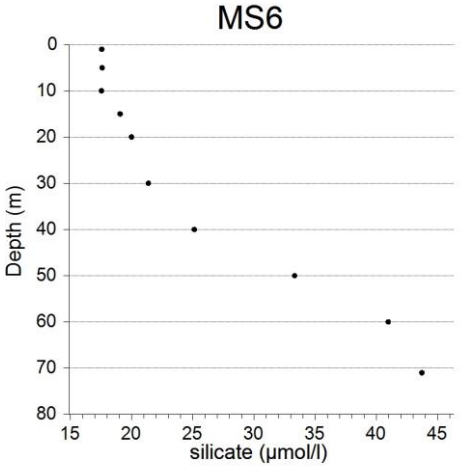

SR5
Depth (m)
0
20
40
60
80
100
10
20
30
40
silicate (µmol/l)

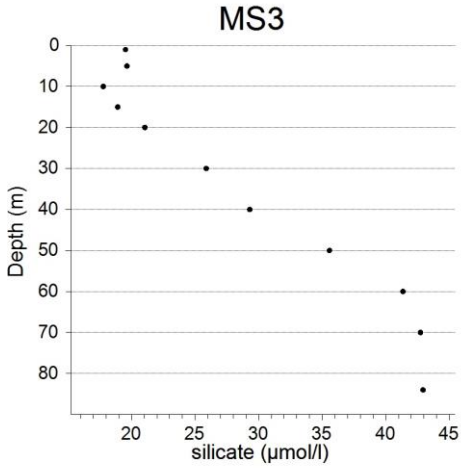

SR7
Depth (m)
0
10
20
30
40
50
60
70
80
10
15
20
25
silicate (µmol/l)

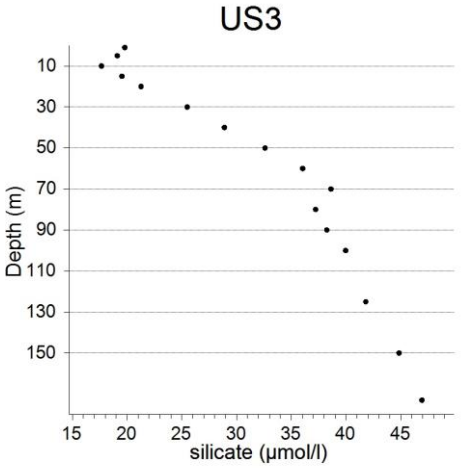

SR8
Depth (m)
0
10
20
30
40
50
60
20
25
silicate (µmol/l)

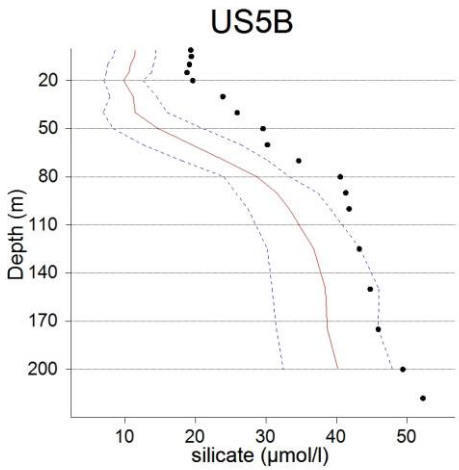

MS9
Depth (m)
0
20
40
60
80
100
5
10
15
20
25
30
35
40
silicate (µmol/l)

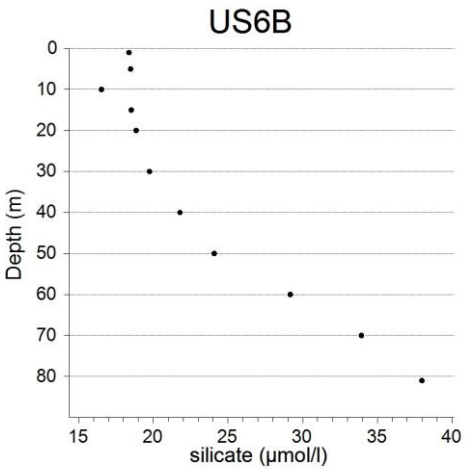

F26
Depth (m)
10
30
50
70
90
110
130
150
10
20
30
40
50
60
silicate (µmol/l)

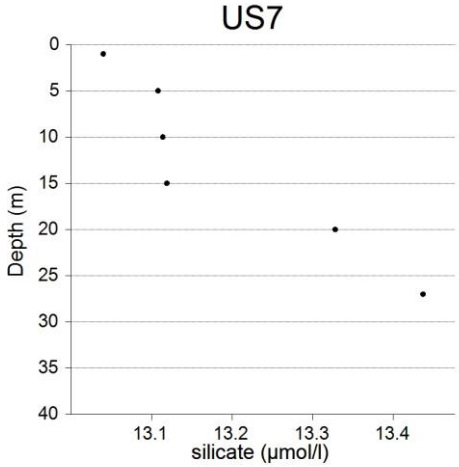

MS6
Depth (m)
0
10
20
30
40
50
60
70
80
15
20
25
30
35
40
45
silicate (µmol/l)

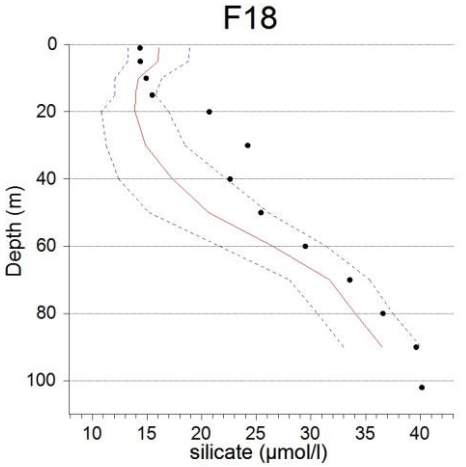

MS3
Depth (m)
0
10
20
30
40
50
60
70
80
20
25
30
35
40
45
silicate (µmol/l)

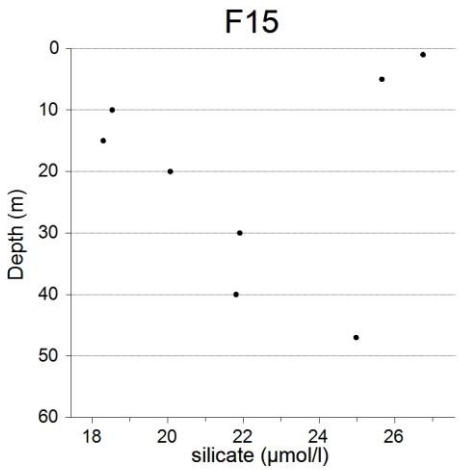

US3
Depth (m)
10
30
50
70
90
110
130
150
15
20
25
30
35
40
45
silicate (µmol/l)

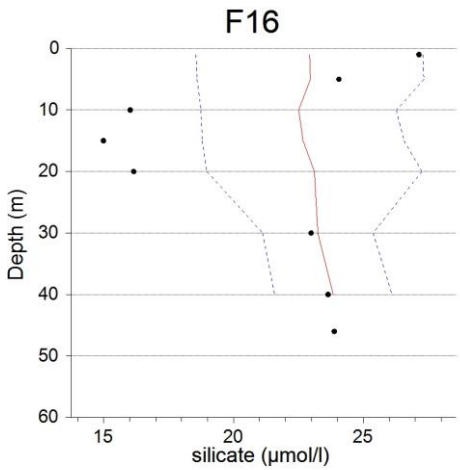

US5B
Depth (m)
20
50
80
110
140
170
200
10
20
30
40
50
silicate (µmol/l)

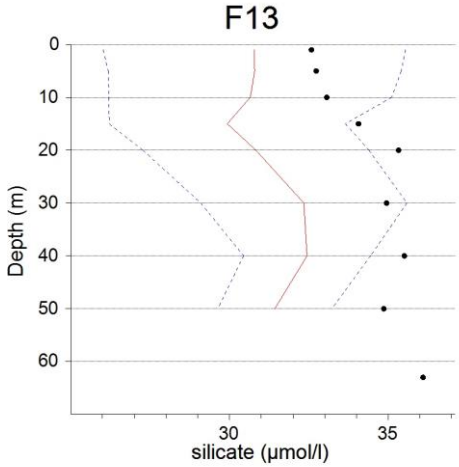

US6B
Depth (m)
0
10
20
30
40
50
60
70
80
15
20
25
30
35
40
silicate (µmol/l)

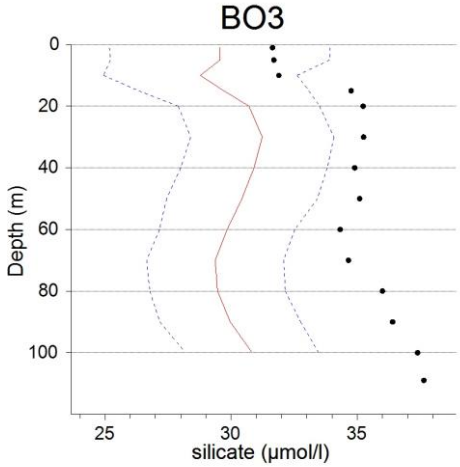

US7
Depth (m)
0
5
10
15
20
25
30
35
40
13.1
13.2
13.3
13.4
silicate (µmol/l)

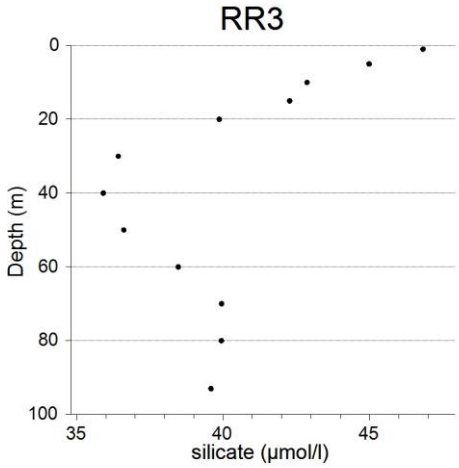

F18
Depth (m)
0
20
40
60
80
100
10
15
20
25
30
35
40
silicate (µmol/l)

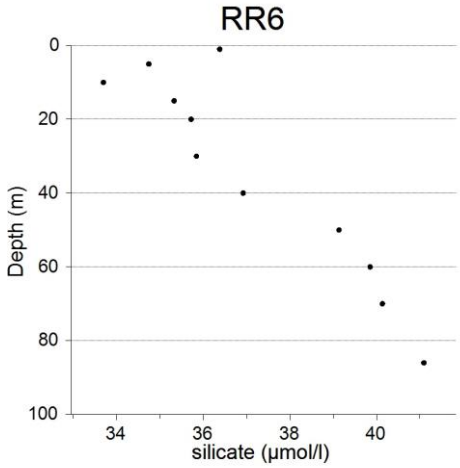

F15
Depth (m)
0
10
20
30
40
50
60
18
20
22
24
26
silicate (µmol/l)

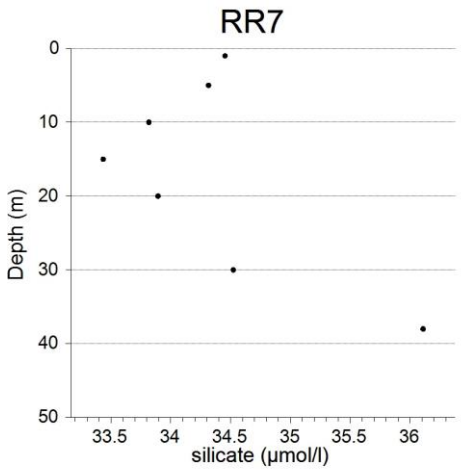

F16
Depth (m)
0
10
20
30
40
50
60
15
20
25
silicate (µmol/l)

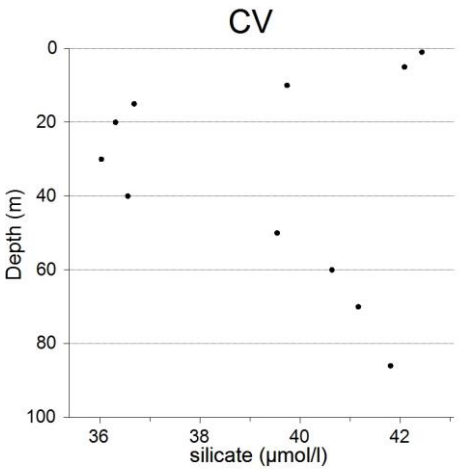

F13
Depth (m)
0
10
20
30
40
50
60
30
35
silicate (µmol/l)

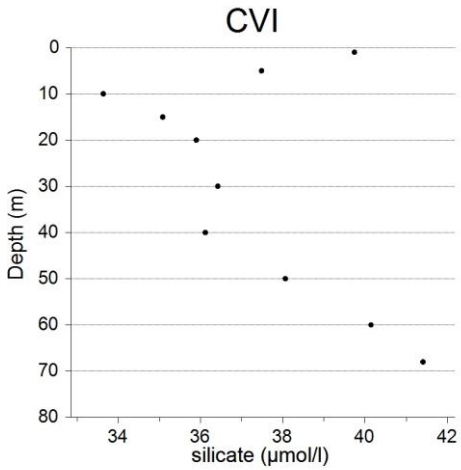

BO3
Depth (m)
0
20
40
60
80
100
25
30
35
silicate (µmol/l)

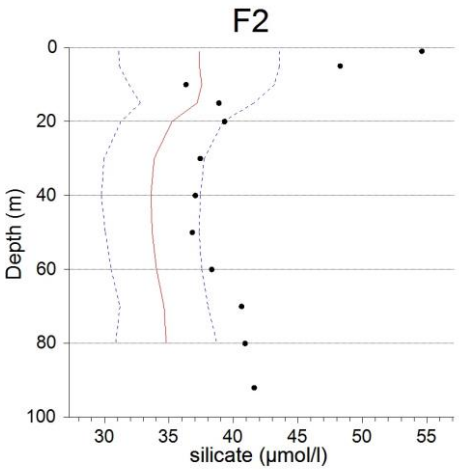

RR3
Depth (m)
0
20
40
60
80
100
35
40
45
silicate (µmol/l)

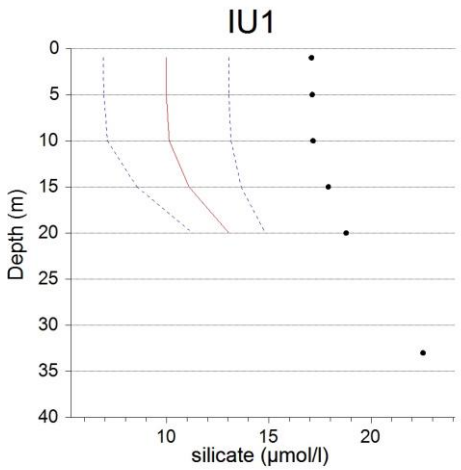

RR6
Depth (m)
0
20
40
60
80
100
34
36
38
40
silicate (µmol/l)

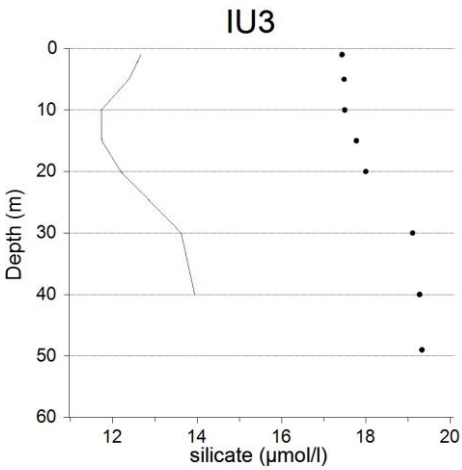

RR7
Depth (m)
0
10
20
30
40
50
33.5
34
34.5
35
35.5
36
silicate (µmol/l)

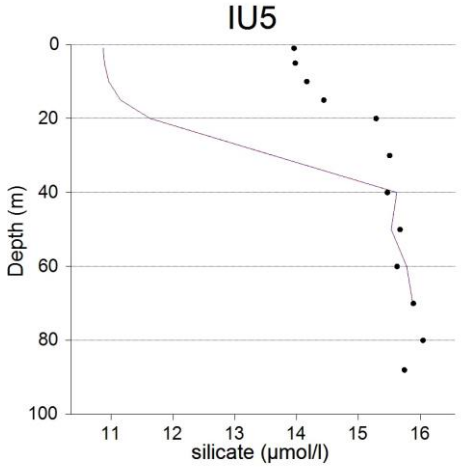

CV
Depth (m)
0
20
40
60
80
100
36
38
40
42
silicate (µmol/l)

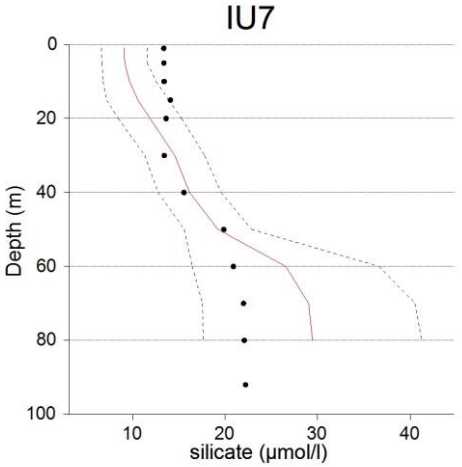

CVI
Depth (m)
0
10
20
30
40
50
60
70
80
34
36
38
40
42
silicate (µmol/l)


F2
Depth (m)
0
20
40
60
80
100
30
35
40
45
50
55
silicate (µmol/l)


IU1
Depth (m)
0
5
10
15
20
25
30
35
40
10
15
20
silicate (µmol/l)


IU3
Depth (m)
0
10
20
30
40
50
60
12
14
16
18
20
silicate (µmol/l)


IU5
Depth (m)
0
20
40
60
80
100
11
12
13
14
15
16
silicate (µmol/l)


IU7
Depth (m)
0
20
40
60
80
100
10
20
30
40
silicate (µmol/l)