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MRV LOUGH FOYLE CRUISE REPORT. LF1790; 27-29/11/90

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Cruise Objectives: To compare the clean sea water supply in the laboratory with the 5m depth water over the side; to map the nutrient distribution of the NW Irish Sea.

Cruise Narrative:

A straight course was taken to Beaufort Dyke, taking a surface sample at a point over the 100m depth line. At Beaufort Dyke, the rosette sampler and CTD were deployed to the bottom of the Dyke. The Day grab and multiplankton sampler (vertical haul changing nets at 40m intervals) were also deployed. The ships inflatable was launched and surface water samples taken remote from the ship. From this station onward, the ship followed a series of traverses, stopping approximately every hour to sample over the side using a Casella-type sampler kept from the ship on the telescopic crane. At each station, a matching sample was taken from the ships seawater supply in the laboratory. The Aquatracka fluorometer was run continuously monitoring the fluorescence in the lab seawater. The CTD was switched to timebased mode and monitored the seawater supply on deck. It was found necessary to immerse the probe completely, a bucket under the probe in the rosette sampler gave erroneous values. A second depth profile and Day grab sample were taken at the final station in 120m of water. Secchi disc readings were taken at each station during daylight hours on the first day.

REPORT

The weather throughout was calm and dry, and good progress was made between stations.A listing of the times and station positions is given in Table 1 and given graphically in Fig. 1.

Sampling procedure and comments

The ship's clean seawater supply was run continuously, at each station 5l sample taken and stored for nutrient analysis, chl a. A 5m depth sample was taken over the side from the telescopic crane on full extension giving an estimated 8m clearance from the ship.This worked well under the calm conditions prevailing.Each water sample was filtered and stored immediately as follows:

1. P, NH4, Si: pressure filtered through 0.45 and prefilter, stored 4C.

2. NO3: pressure filtered, stored frozen

3. Chlorophyll a: vacuum filtered GF/C, stored without solvent, frozen

The rosette sampler CTD was read on the descent. At each depth a bottle was fired and the data dumped to the line printer before moving down. Bottles were drained from the rosette into carboys for transport into the lab. Procedures for both these operations are given in Appendix 1. Problems were encountered with both the CTD and the rosette sampler. The software gave some cause for disquiet, sometimes bottles did not fire and on one occasion the keyboard locked up, we had to reboot. The multiplankton sampler was hauled vertically from 200m to surface, changing nets every 40m. Depth indication was not working from the net itself, depth was measured from the hydrographic winch. Deploying the net from the A-frame is unsatisfactory as two cable are necessary the load-bearing cable from one winch and the hydrographic wire to change nets from the other. It is necessary to match the paying out and taking in of the two cables by guess work. Problems would arise here in poor weather and one hydrographic winch working over the A frame would be much preferable.

The CTD worked well in continuous flow mode provided it was in a large container flushed with a rapid flow from the clean seawater supply. The data was logged into a file at 5minute intervals.

The fluorometer worked without any problems, the signal was logged into the TOA chart recorder,settings were 2.5V scale, chart speed 20mm/h. The blank current, ascertained by running the probe in air at the start, was not backed off, the pen was electrically zeroed from the facility on the recorder. Light was excluded from the sample bucket with black polythene.

Manning

The main nutrient sampling was run with 4 staff. During the first day, all staff worked until 5pm. Thereafter, shifts were worked 18.00-23.00,23.00-0400,04.00-08.00,08.00-12.00.

Table 1 Stations numbers, times and positions

STA.	DATE	TIME	LAT	LONG	SAMPLES
1	28-11-90	10:02	54 48.18	05 32.33	C,I
2	28-11-90	11:12	54 50.09	05 20.30	C,I
	+ CTD,MWS,Grab,Plankton,Boat				
3	28-11-90	14:47	54 51.13	05 13.23	C,I
4	28-11-90	15:53	54 43.80	05 21.07	C,I
5	28-11-90	16:52	54 34.82	05 25.71	C,I
6	28-11-90	17:52	54 35.58	05 10.26	C,I
7	28-11-90	18:57	54 36.82	04 55.51	C,I
8	28-11-90	19:52	54 37.91	04 40.12	C,I
9	28-11-90	21:14	54 37.85	04 26.46	C,I
10	28-11-90	22:06	54 31.45	04 24.10	C,I
11	28-11-90	22:56	54 30.29	04 39.59	C,I
12	28-11-90	23:55	54 29.38	04 55.52	C,I
13	29-11-90	00:35	54 28.88	05 07.97	C,I
14	29-11-90	01:26	54 27.63	05 21.71	C,I
15	29-11-90	02:10	54 20.63	05 22.14	C,I
16	29-11-90	03:05	54 20.88	05 07.11	C,I
17	29-11-90	04:11	54 21.94	04 53.13	C,I
18	29-11-90	05:24	54 23.00	04 33.69	C,I
19	29-11-90	06:22	54 17.33	04 39.94	C,I
20	29-11-90	07:16	54 16.27	04 52.14	C,I
21	29-11-90	08:11	54 15.12	05 06.17	C,I
	+ MWS,CTD, grab sample				

RESULTS

1. Differences between the ship clean seawater supply and over the side samples

The main purpose of the cruise was to validate the use of the ships clean water supply (insource) for nutrient analysis of the surface water. Samples may be compared with the over the side samples (outsource) by scatter plots (Figs 2-5). It is immediately apparent that there is poor agreement between the two sets of SRP and nitrate analyses, but that the ammonia and silica data show good correlation between the two sources. In the case of SRP (Fig 2), there is wide scatter and a plot of the difference between samples station by station (Fig 6) shows that the greatest divergences were at stations 1,2,7,13 and 22 where the outsource values were higher than the insource. Ammonia data had one outlier (station 16), but with that exception the samples almost all agreed to within 3ugN. Excluding station 16, the mean difference between 21 stations was 0.3ugN/l.Similarly with silica, there was one outlier at station 13, but the agreement between the samples was good and the mean difference (excluding station 13) was 0.005mg SiO_2/l. Nitrate concentrations were consistently highest in the outsource samples, average values were 72.8ugN/l insource and 77.7ugN/l outsource.

The difference between insource and outsource SRP and nitrate obviously requires an explanation. It is of course not clear which if either of the samples reflected the true concentrations in the sea. It might appear that the problem is in contamination of the outsource sample. In this connection it is interesting to compare the insource and outsource samples at station 2 with some further samples taken at the surface from the ship's launch, remote from the Lough Foyle. The respective values were insource SRP 16, outsource 28, launch mean 27. Furthermore, inspection of the spatial pattern of the data shows that in the middle of the study area, stations 7 and 11 to 13, the values from the outsource resemble those in adjacent stations. On the other hand, the insource values at those stations are noticeably lower (Fig 10). Comparing the insource and outsource data, the anomalies plot out in two groups in the North Channel and south of the Stranraer peninsula. A full data set is given in appendix 2.

2. Pattern of surface nutrients, temperature and salinity.

Because of the uncertainties of the SRP insource, outsource values are discussed. The mean concentration found was 21ugP/l maximum 28ugP/l at station 2. A value of 27ugP/l at station 9 was accompanied by a low salinity (33.199) and temperature (9.77 C). Water at station 9 also showed enhanced fluorescence not apparently caused by chlorophyll a . There is no clear relationship between SRP and salinity in stations 8 to 21 except that the highest SRP and the lowest salinity occurred together. Ammonia showed striking uniformity over most of the water mass until station 16, when the values increased. The silica values were uniform over the whole area.

Salinity and temperature were positively correlated (appendix 3) The lowest temperatures were found nearest to land (fig 18) and these stations also showed the lowest salinities. There are no data from stations 1 to 7, but with the remaining stations, fig 21a a plot of temperature against salinity shows the relationship.

3. Profiles

Depth profiles were taken at Beaufort's Dyke (Station 2) and station 21. At Beaufort's Dyke, the samples extended to 220m depth. The data is given in appendix 3. The top 30m were isothermal, then temperature decreased with depth to 125m, the bottom water was at 11.10C +/- 0.01C. Salinity was uniform, although there may have been a small intrusion of more saline water at 20 and 30m. There was a definite oxygen decline below 150m depth. Due to a computer problem, Station 21 was only sampled to 80m depth although the water is deeper than this. The water here was better mixed than in Beaufort's Dyke and somewhat more saline.

LIST OF FIGURES

Fig 1. STATION NUMBERS

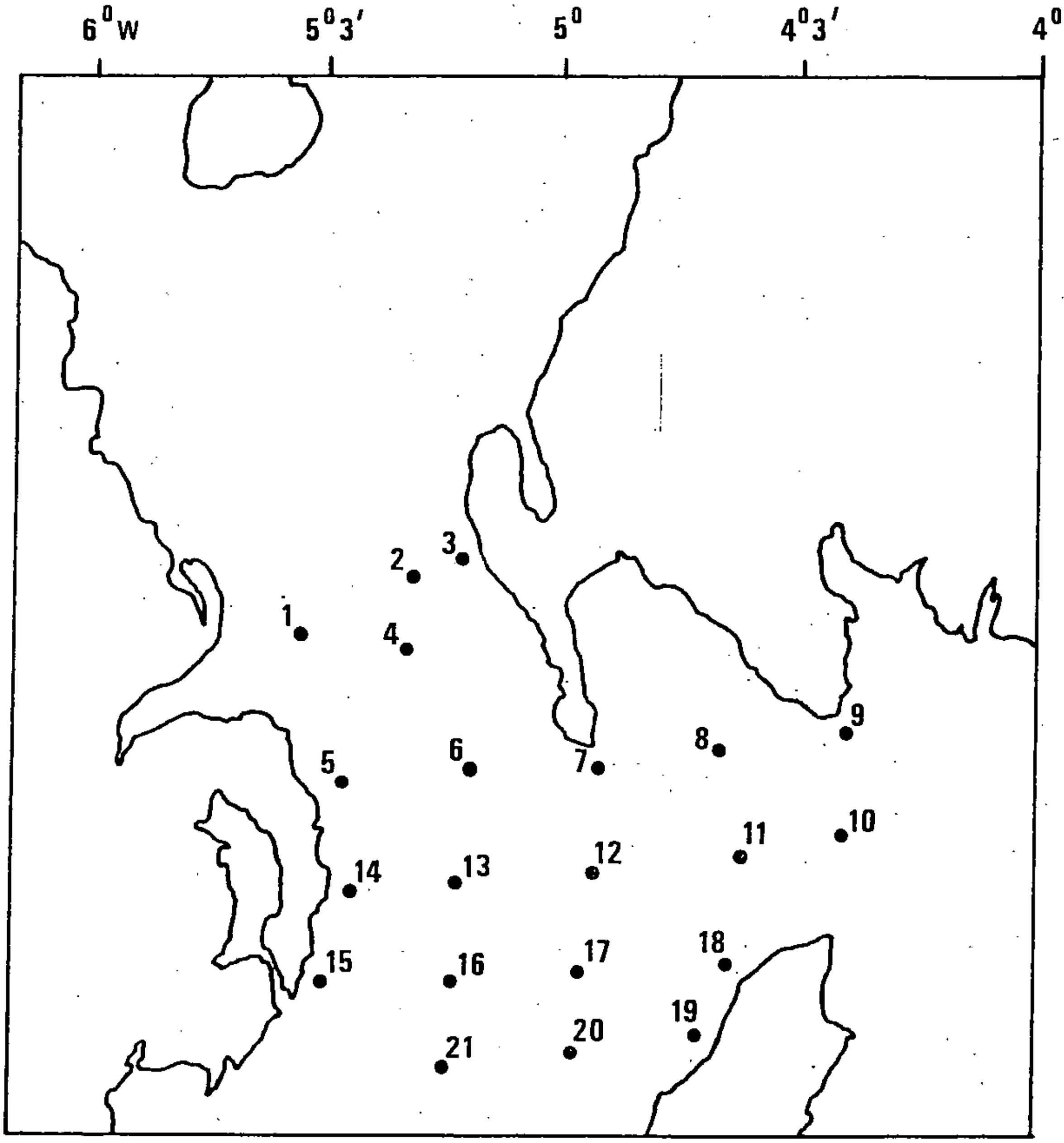


Fig 2a.

SRP concentrations inboat and overside

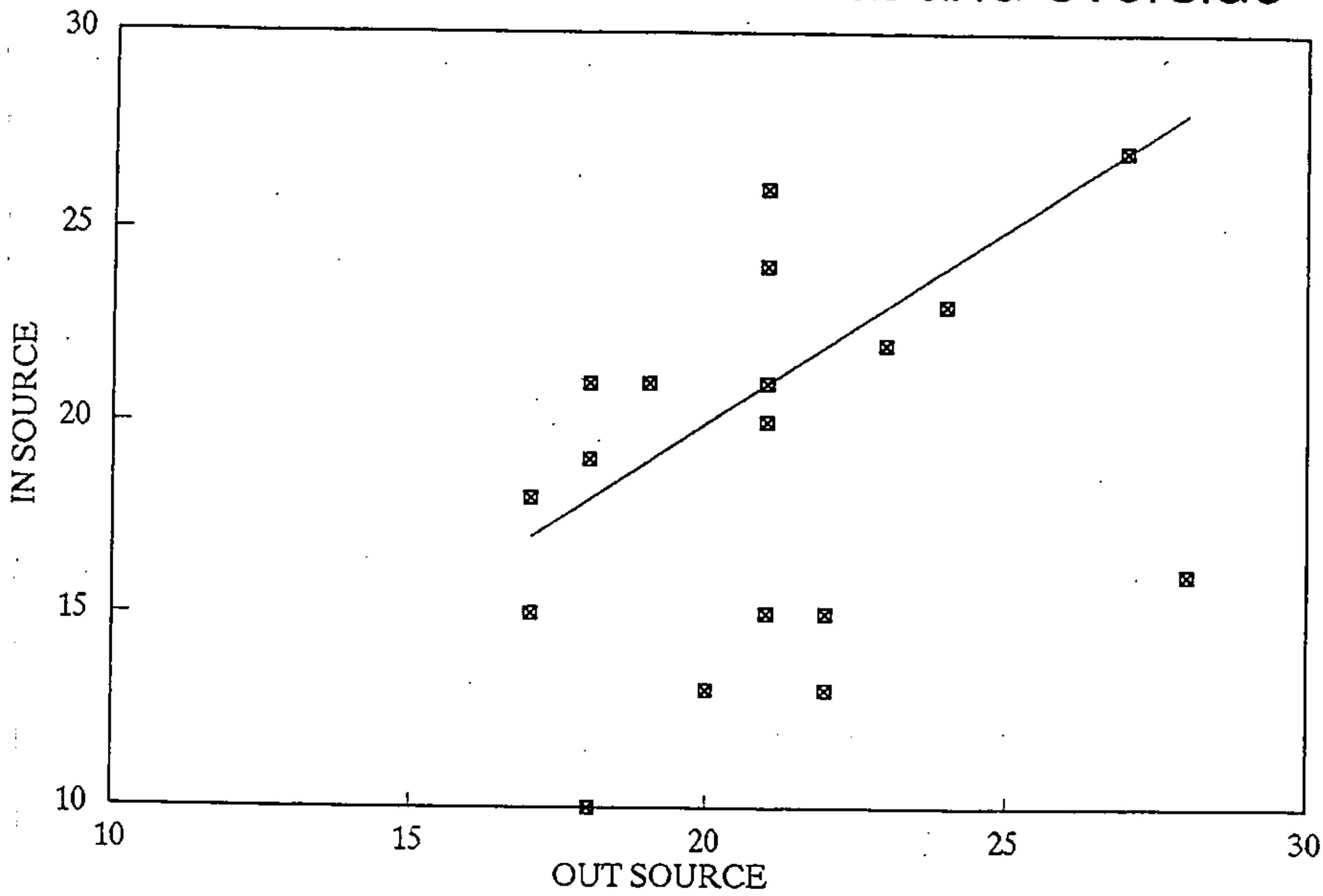


Fig 2b.

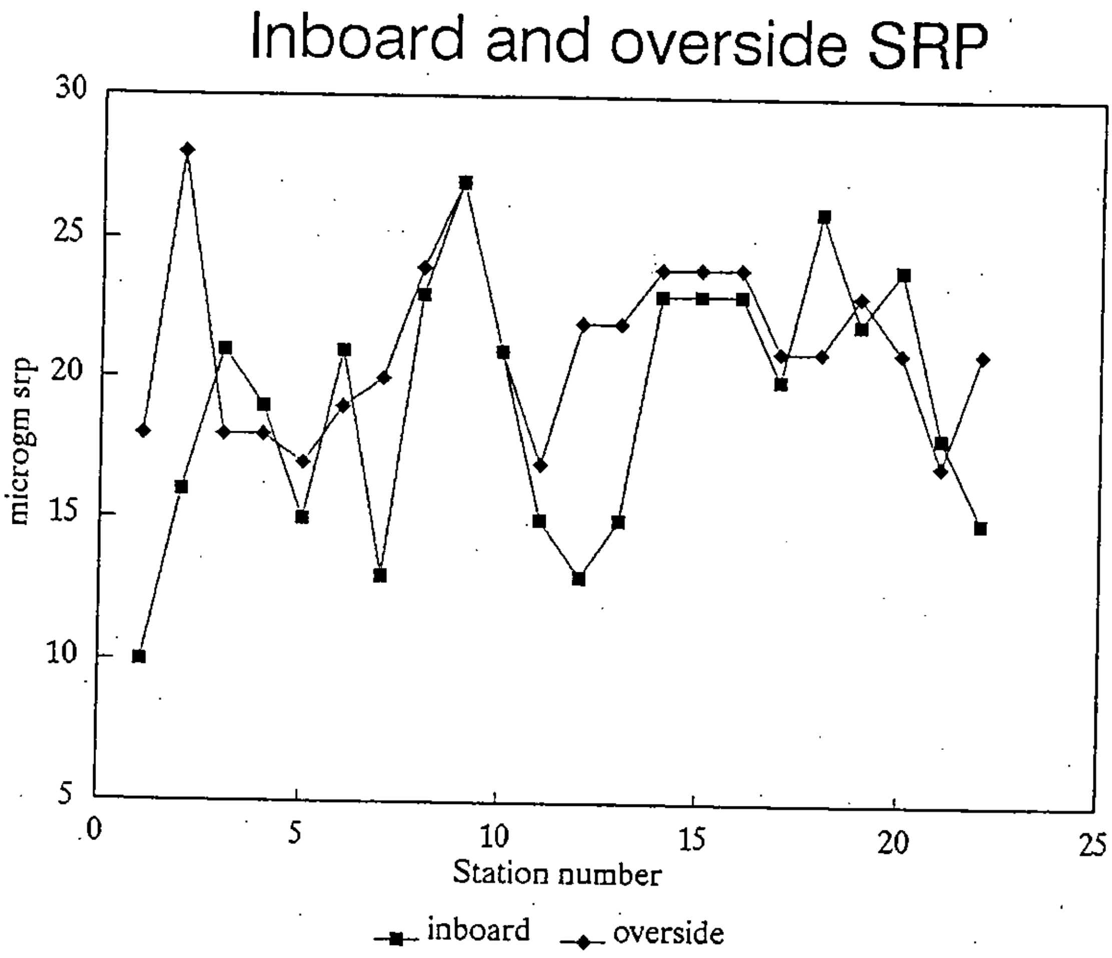

Inboard and overside SRP
30
25
20
15
10
5
microgm srp
0
5
10
15
20
25
Station number
inboard
overside

Fig 3.

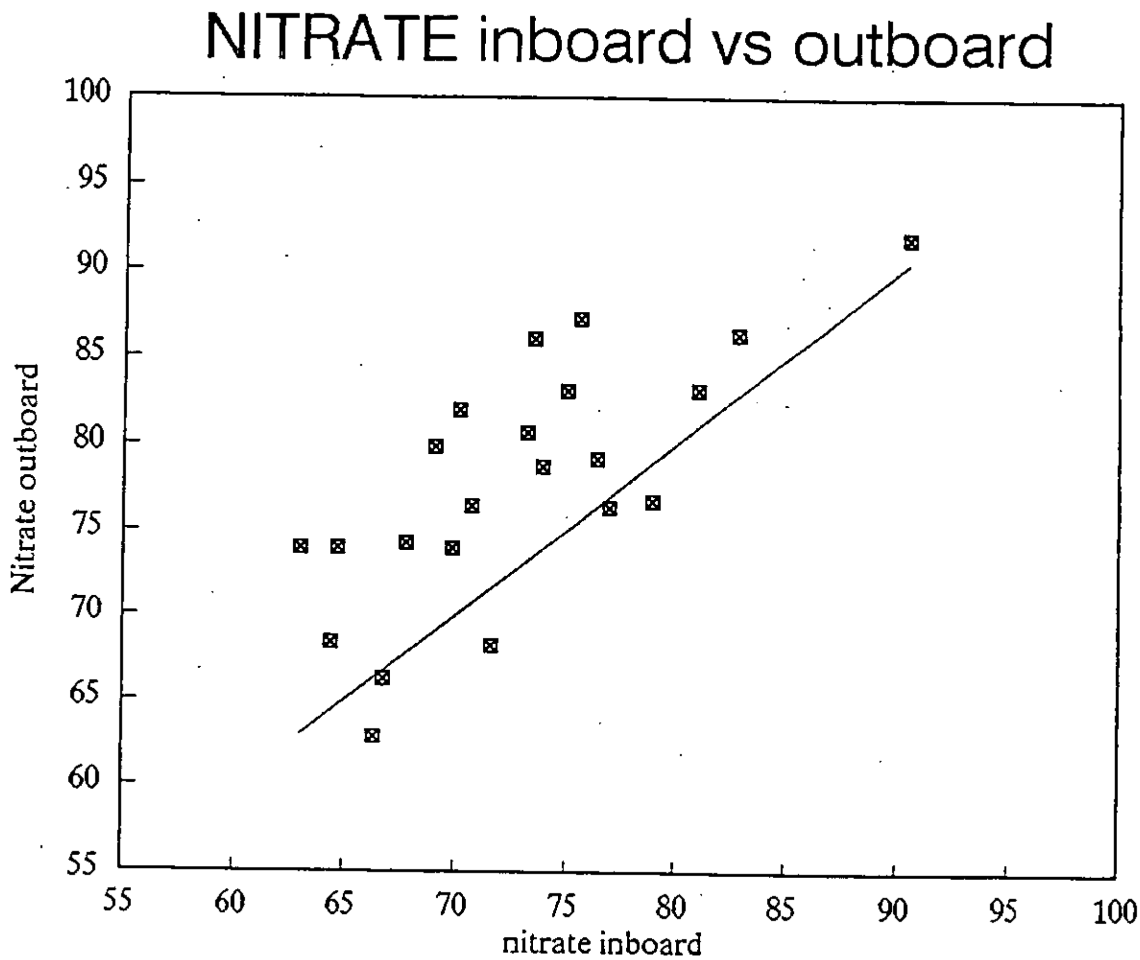

NITRATE inboard vs outboard
Nitrate outboard
100
95
90
85
80
75
70
65
60
55
55
60
65
70
75
80
85
90
95
100
nitrate inboard

Fig 4.

NH4 concentrations inboat and overside

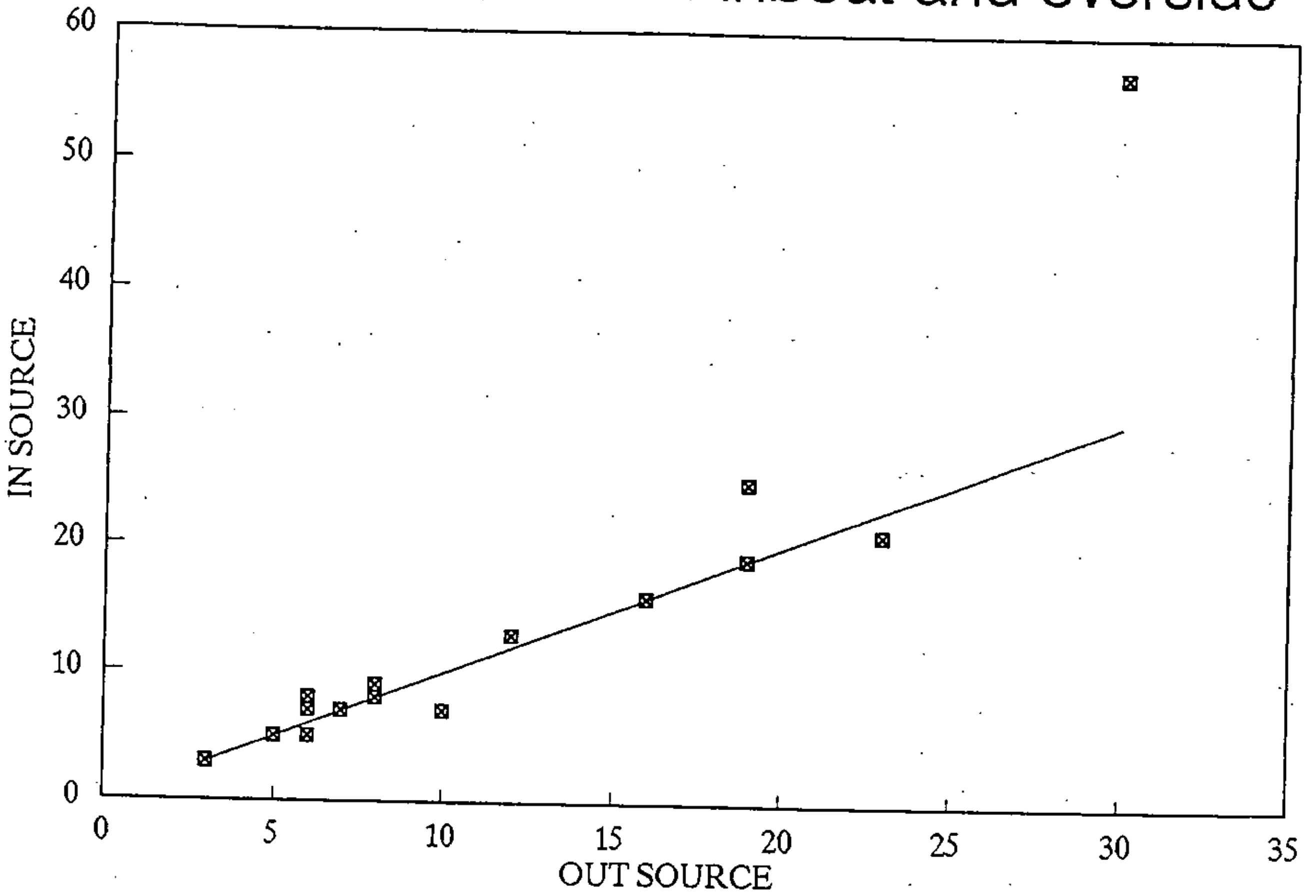
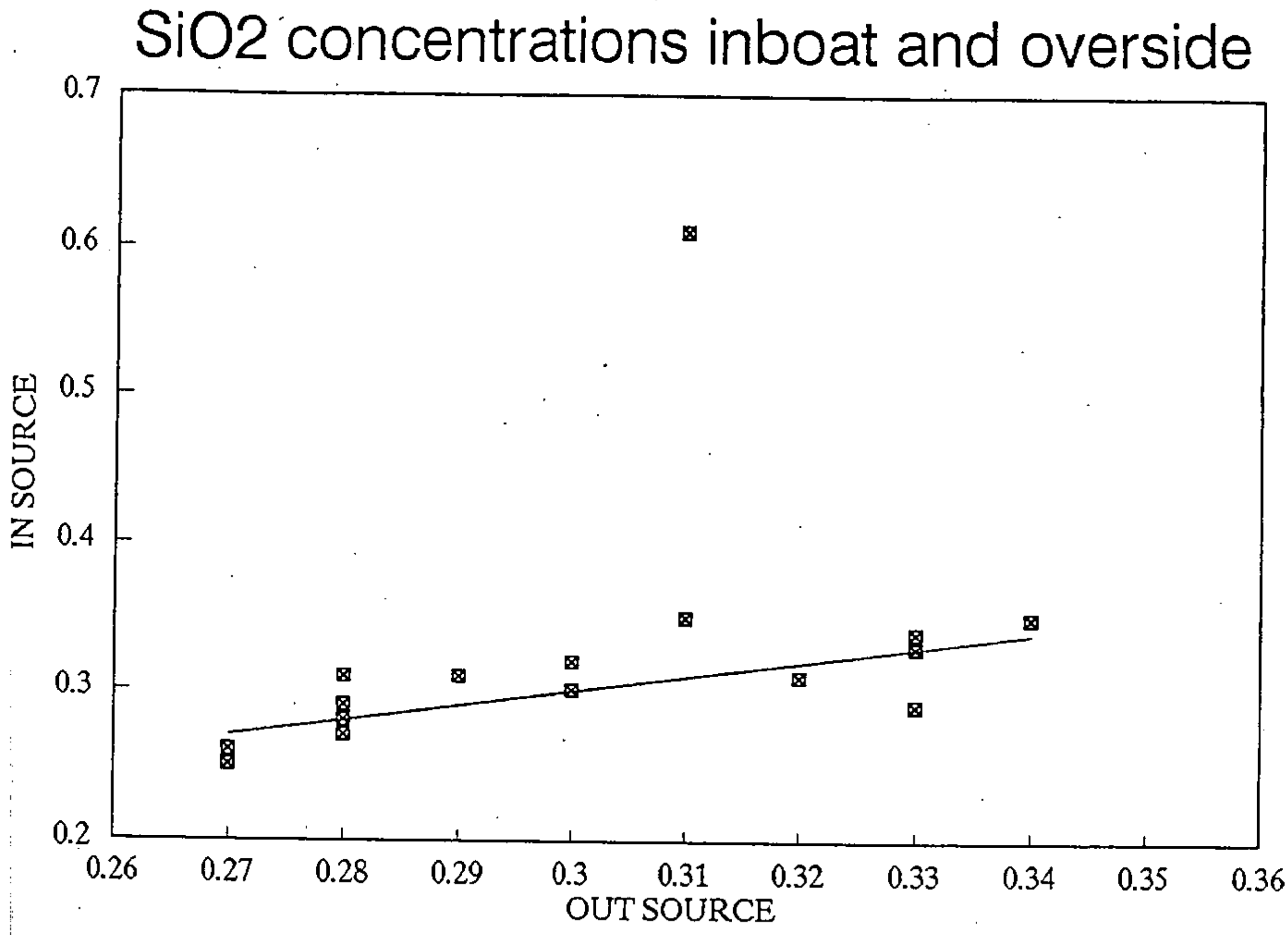
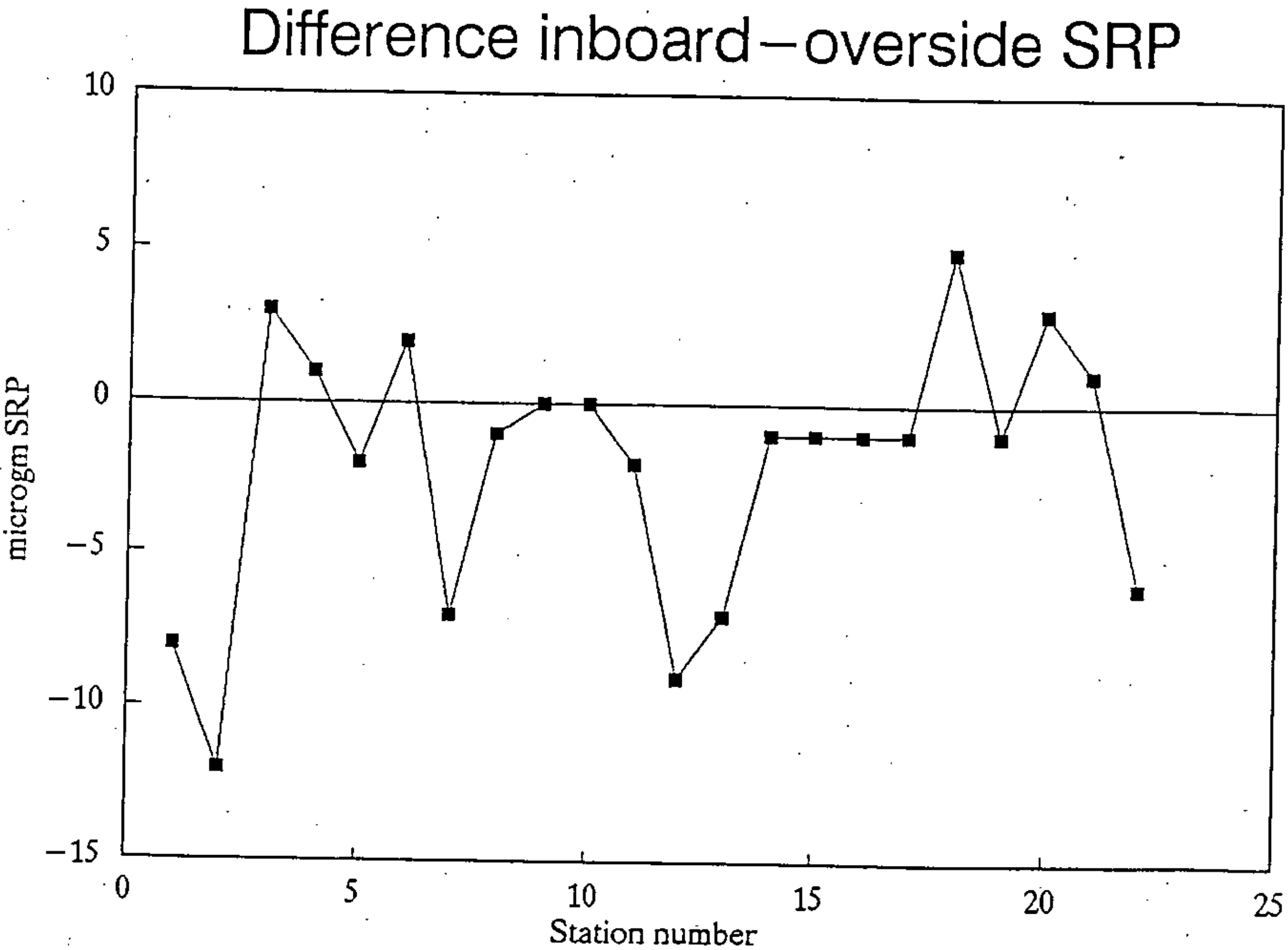


Fig 5.



SiO2 concentrations inboat and overside
0.7
0.6
0.5
0.4
0.3
0.2
IN SOURCE
0.26
0.27
0.28
0.29
0.3
0.31
0.32
0.33
0.34
0.35
0.36
OUT SOURCE

Fig 6.



Difference inboard–overside SRP
microgm SRP
Station number
10
5
0
−5
−10
−15
0
5
10
15
20
25

Fig 7.

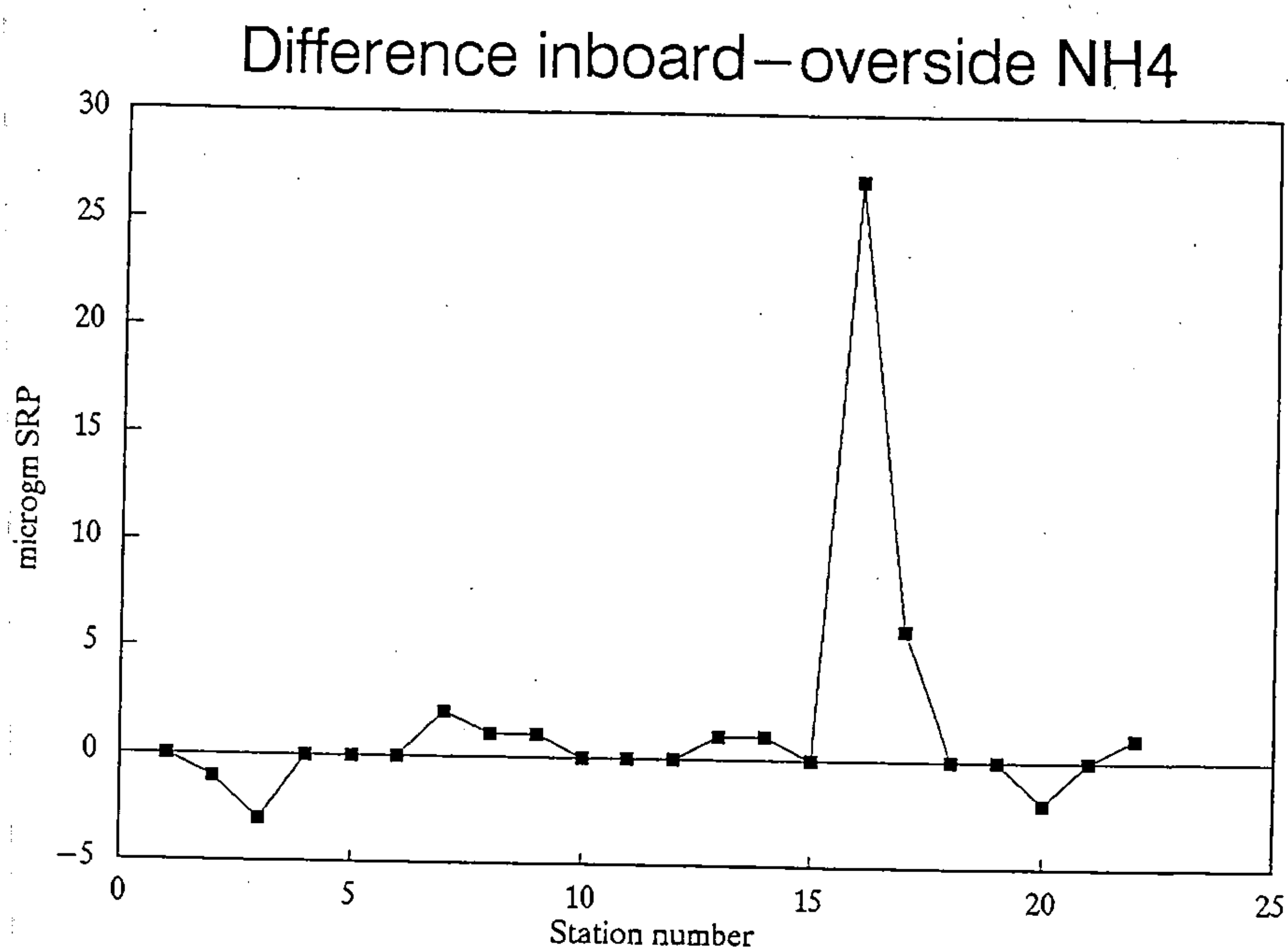
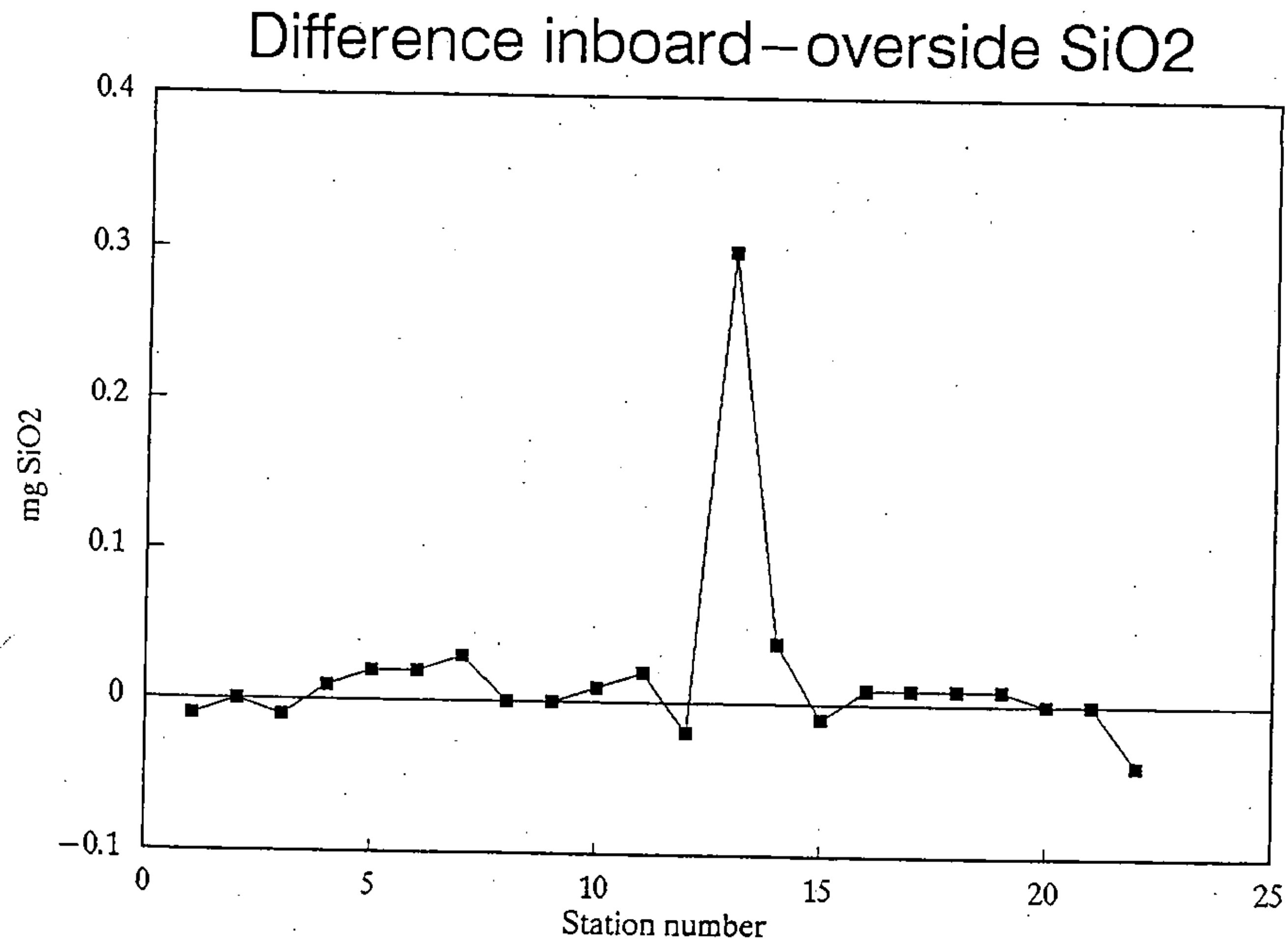

Difference inboard–overside NH4
microgm SRP
30
25
20
15
10
5
0
−5
0
5
10
15
20
25
Station number

Fig 8.



Difference inboard–overside SiO2
0.4
0.3
0.2
0.1
0
−0.1
mg SiO2
0
5
10
15
20
25
Station number

Fig 9.

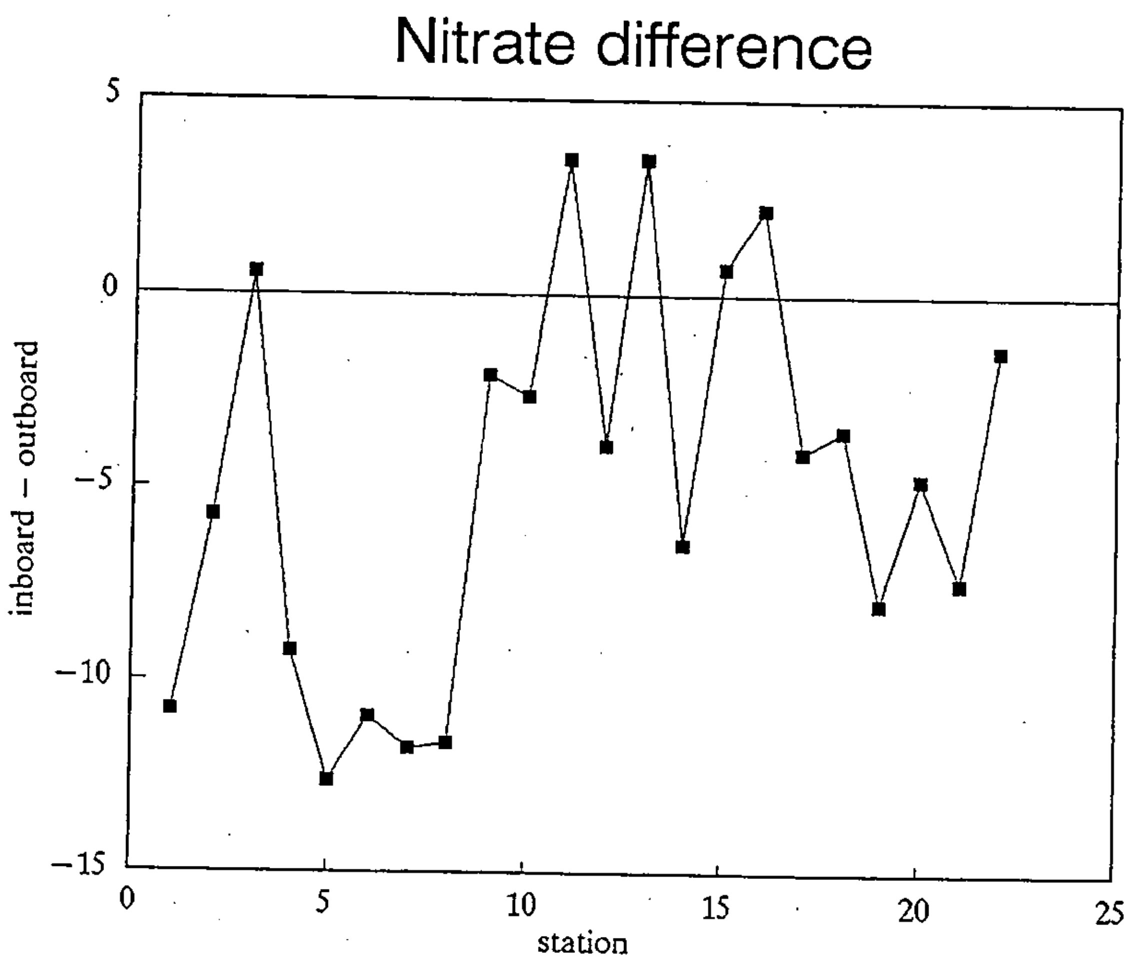

Nitrate difference
5
0
-5
-10
-15
inboard - outboard
0
5
10
15
20
25
station

Fig 10. SRP DIFFERENCE. IN-OUTSOURCE

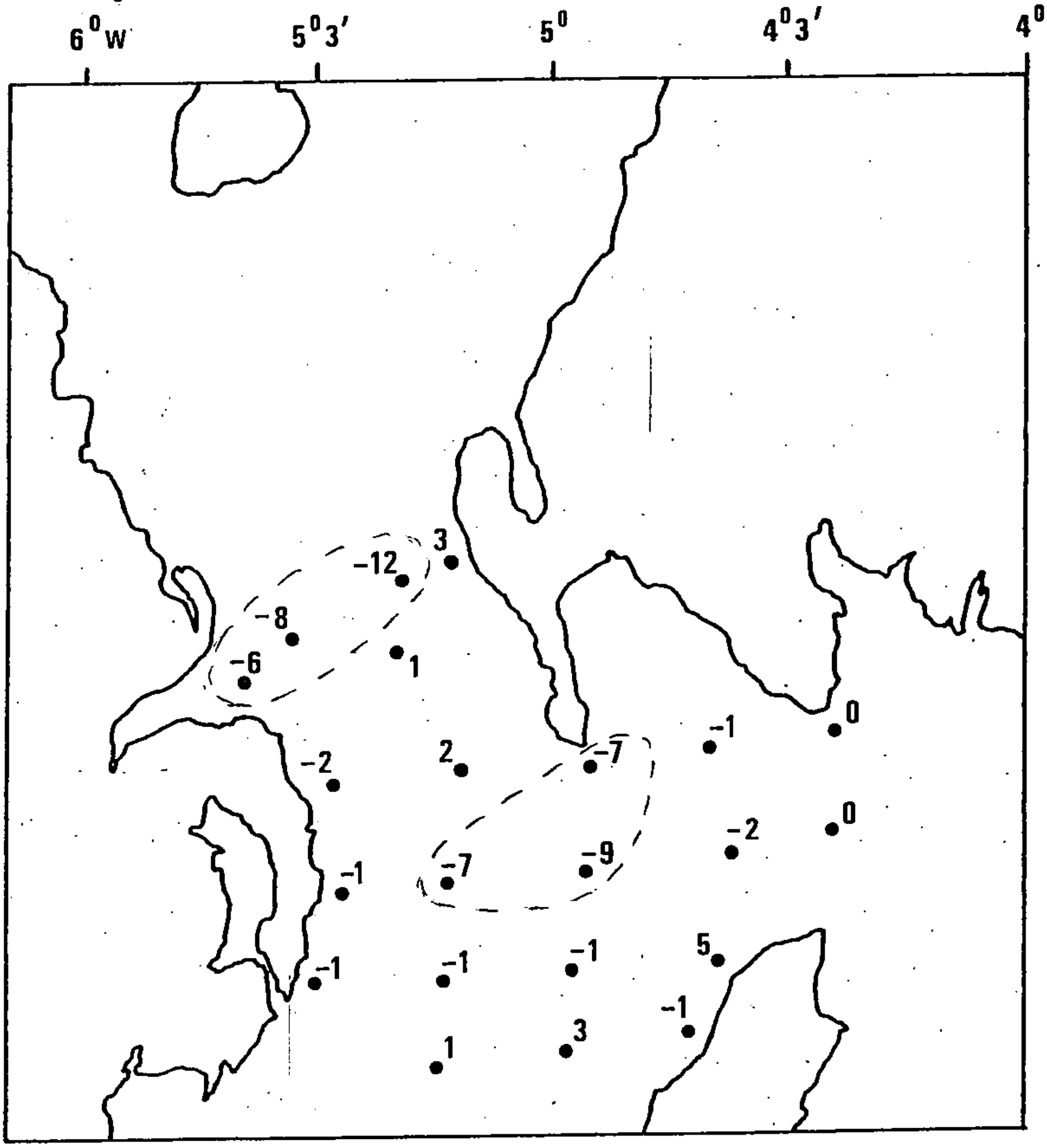


Fig 11. NO_3 DIFFERENCE μgN

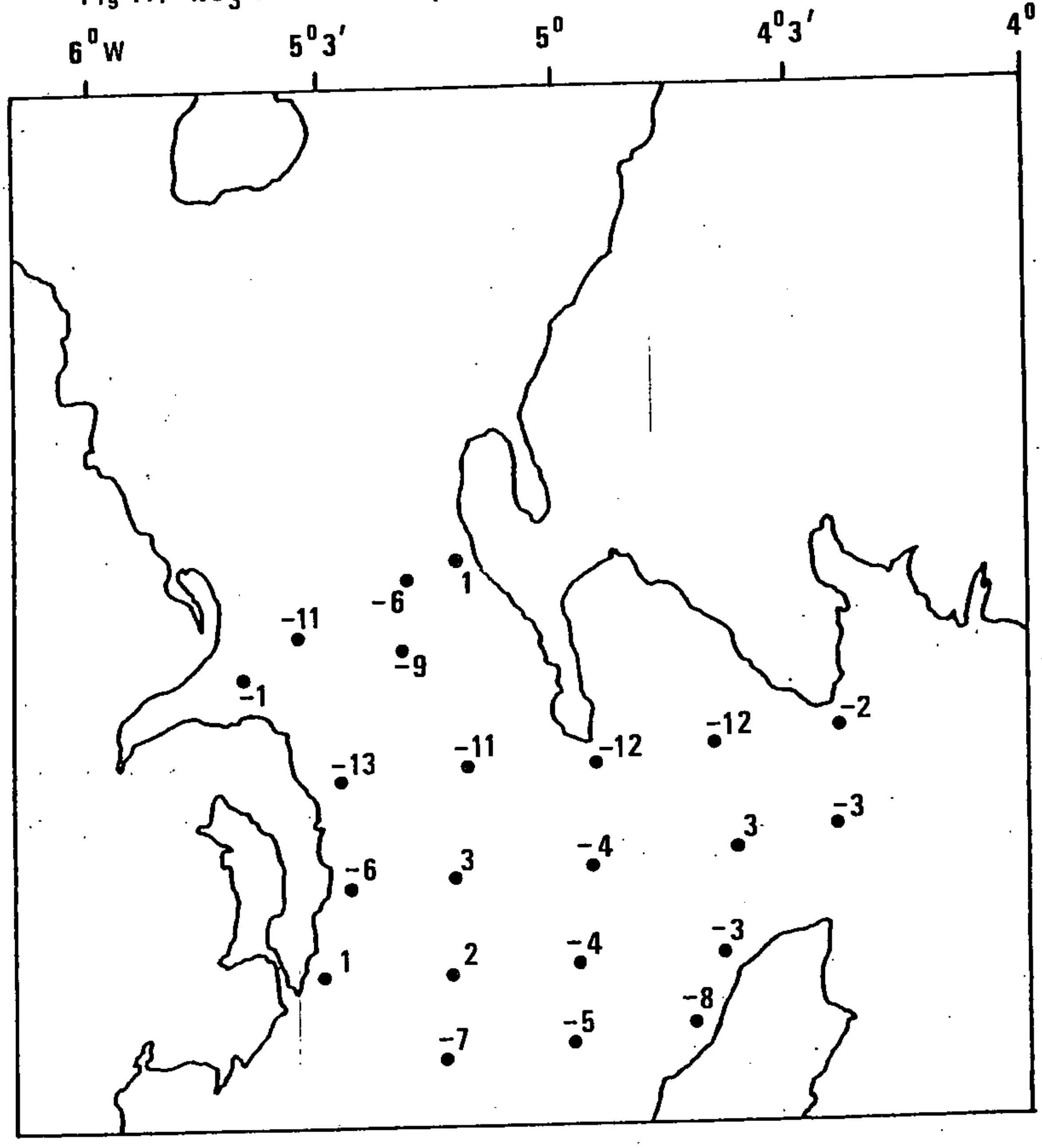


Fig 12a. SRP INBOARD. µg P/l

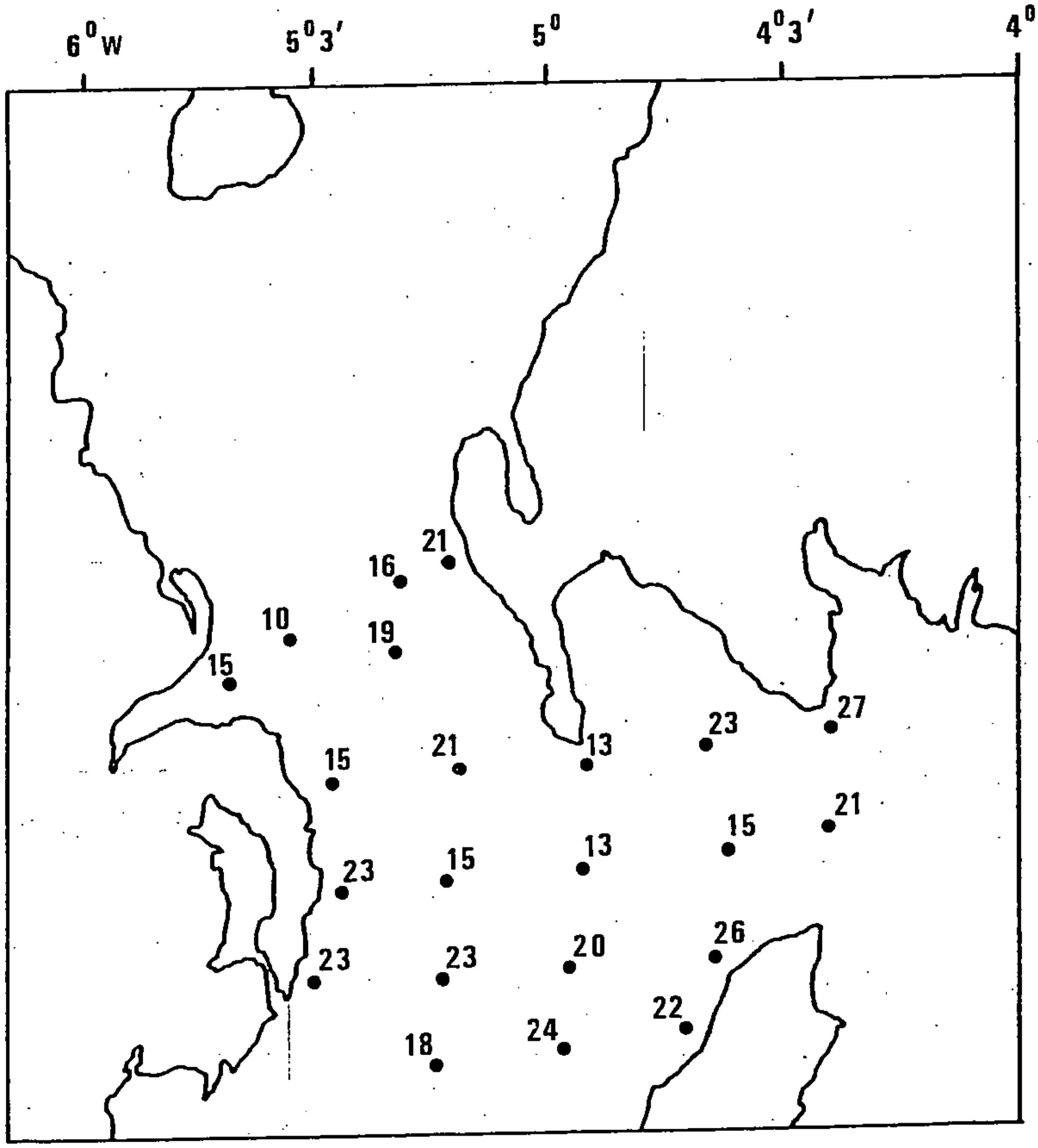


Fig 12 b. SRP OUTBOARD μg P/l

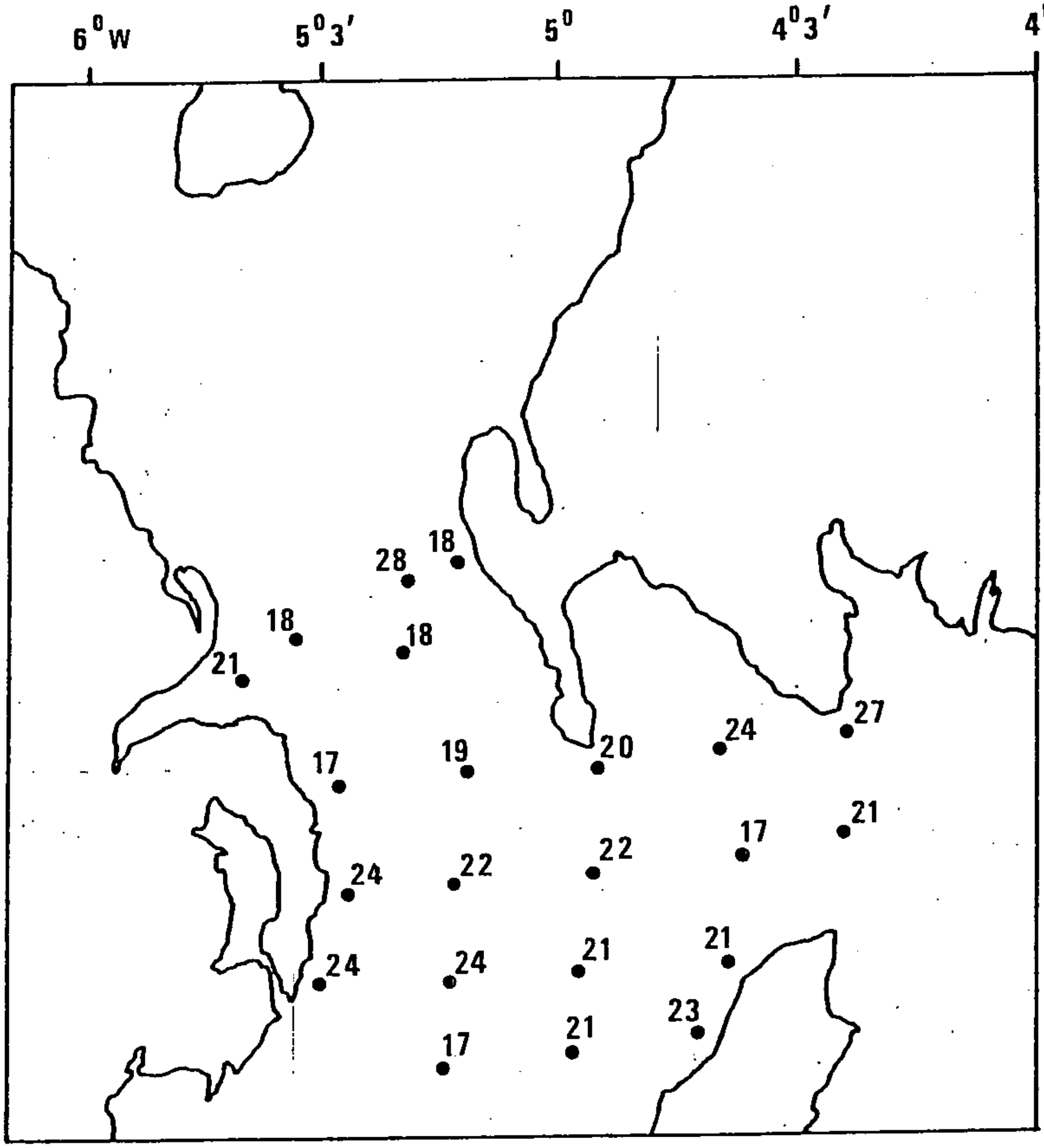


Fig 13. NO_3 INBOARD μg N

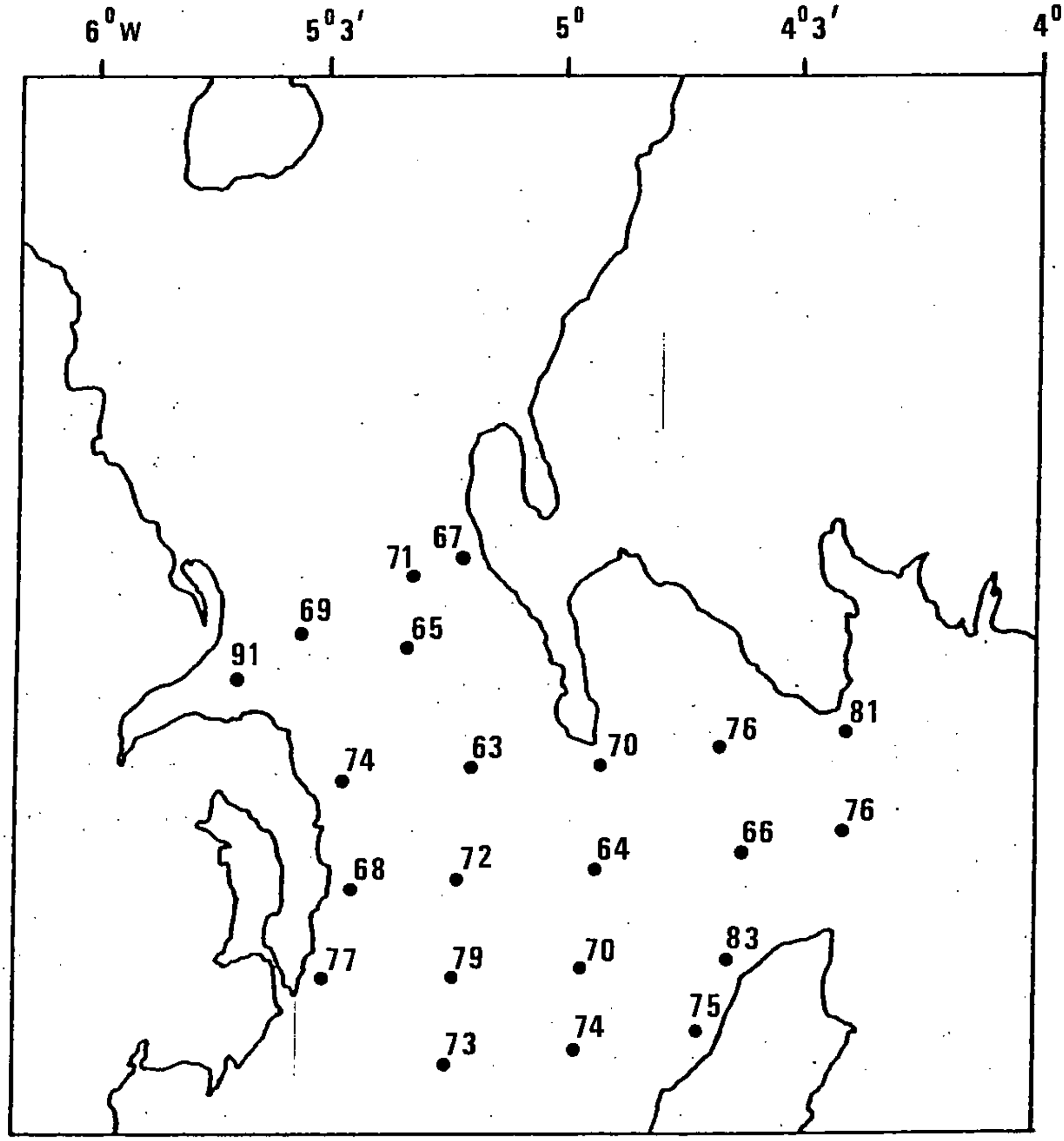


Fig 14. NH_4 μg N/l INBOARD

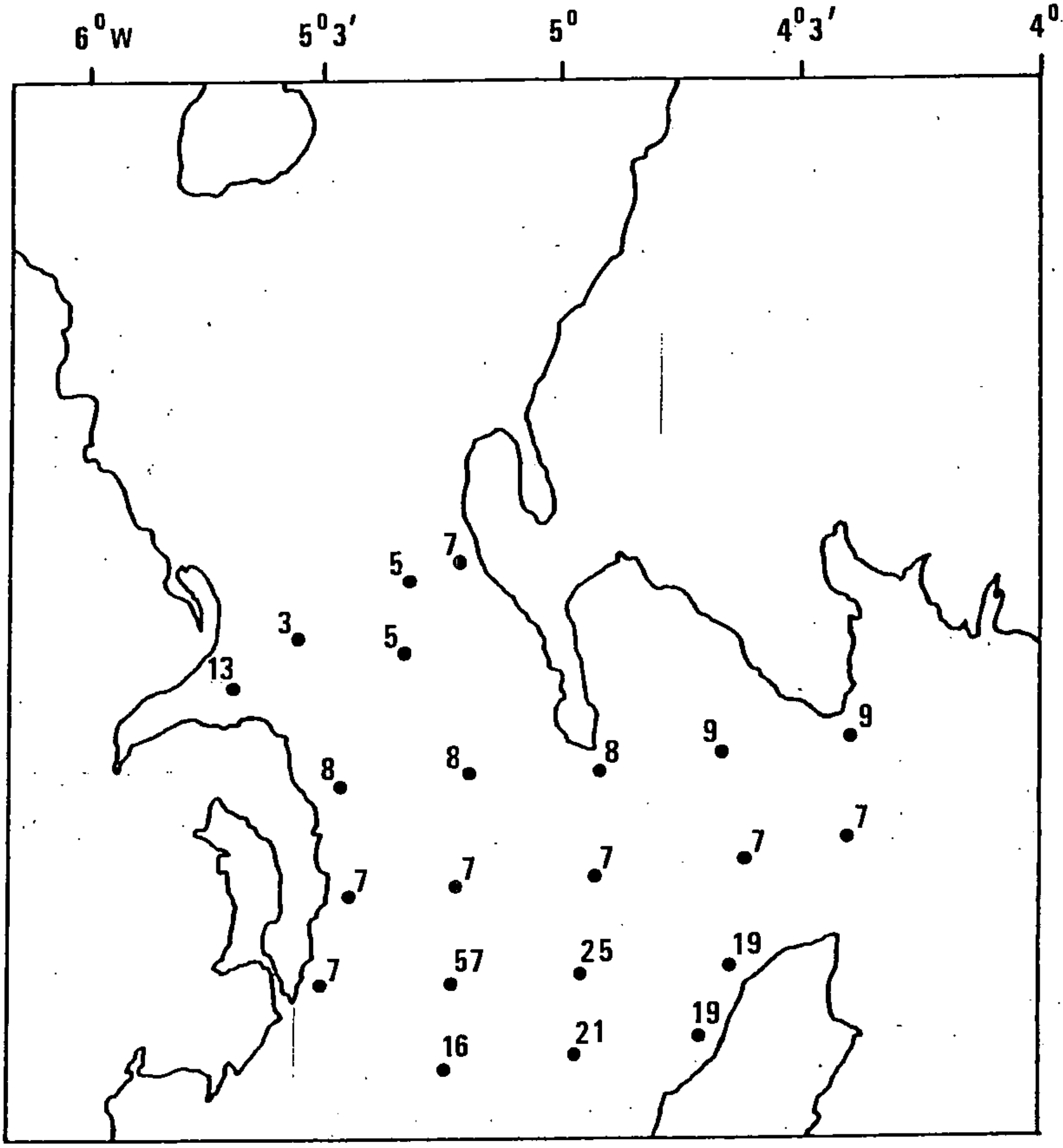


Fig 15. SiO_2 mg SiO_2/l INBOARD

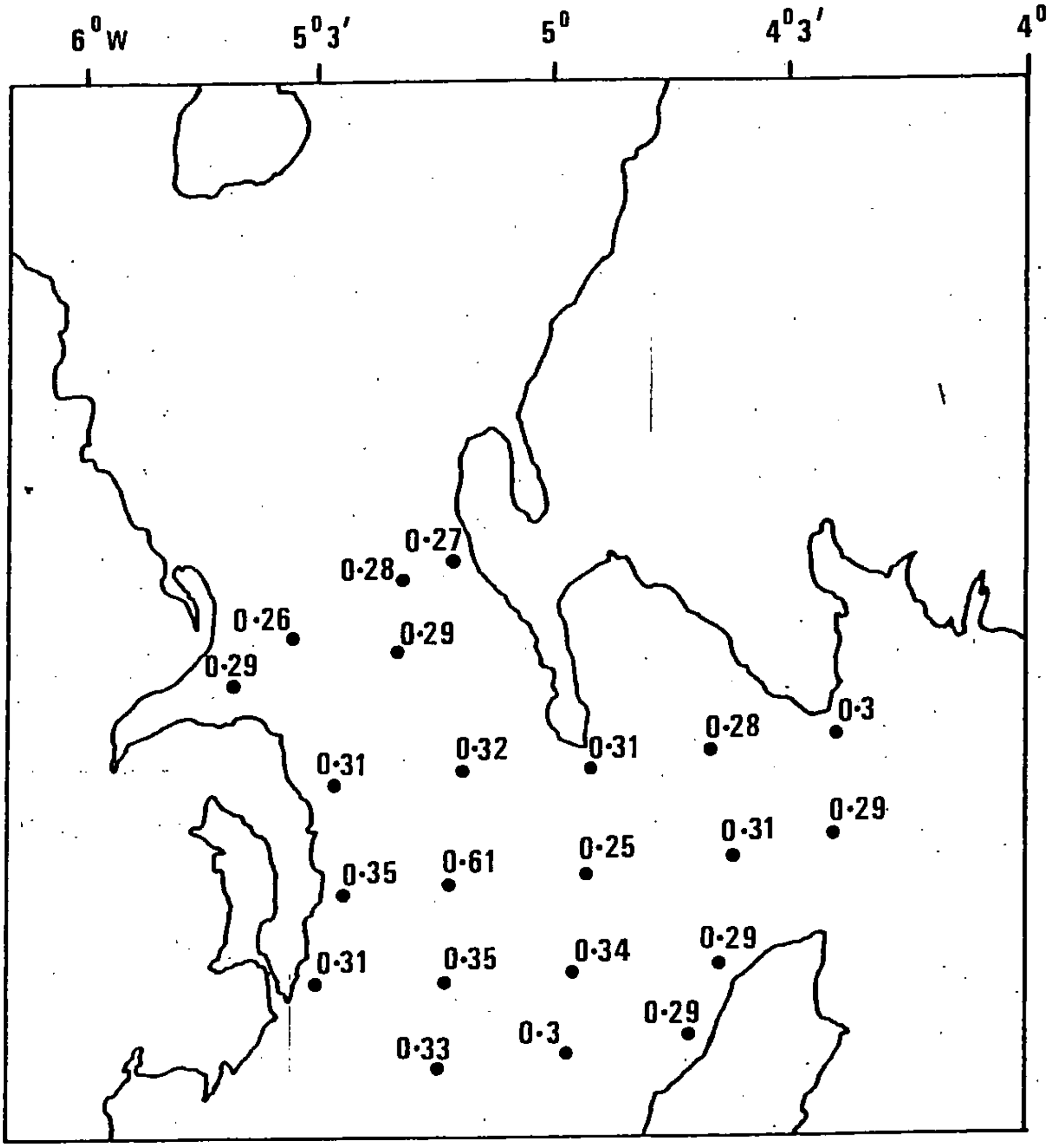


Fig 16. Cha μg/l INBOARD

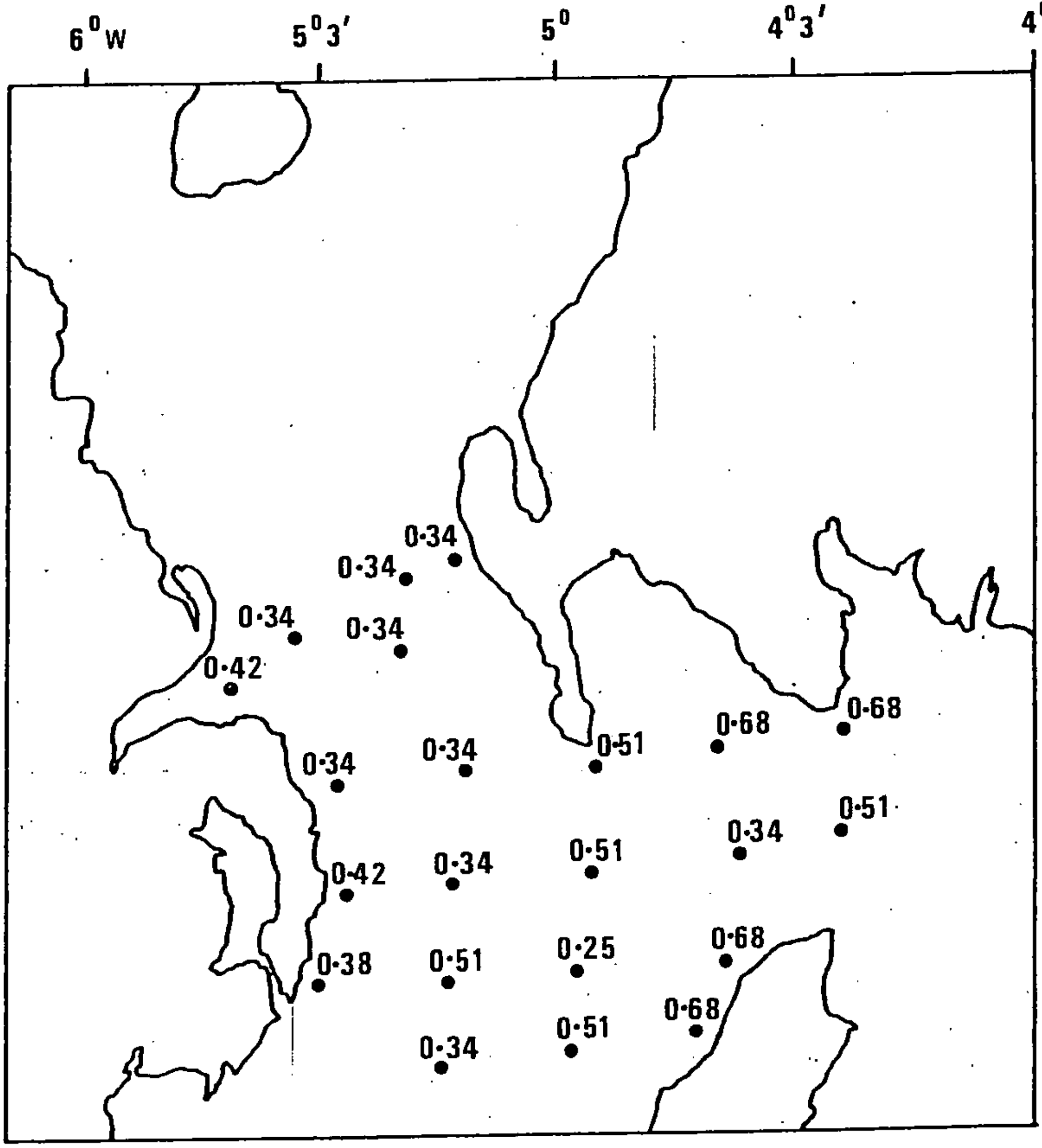


Fig 17. 480/665 INBOARD

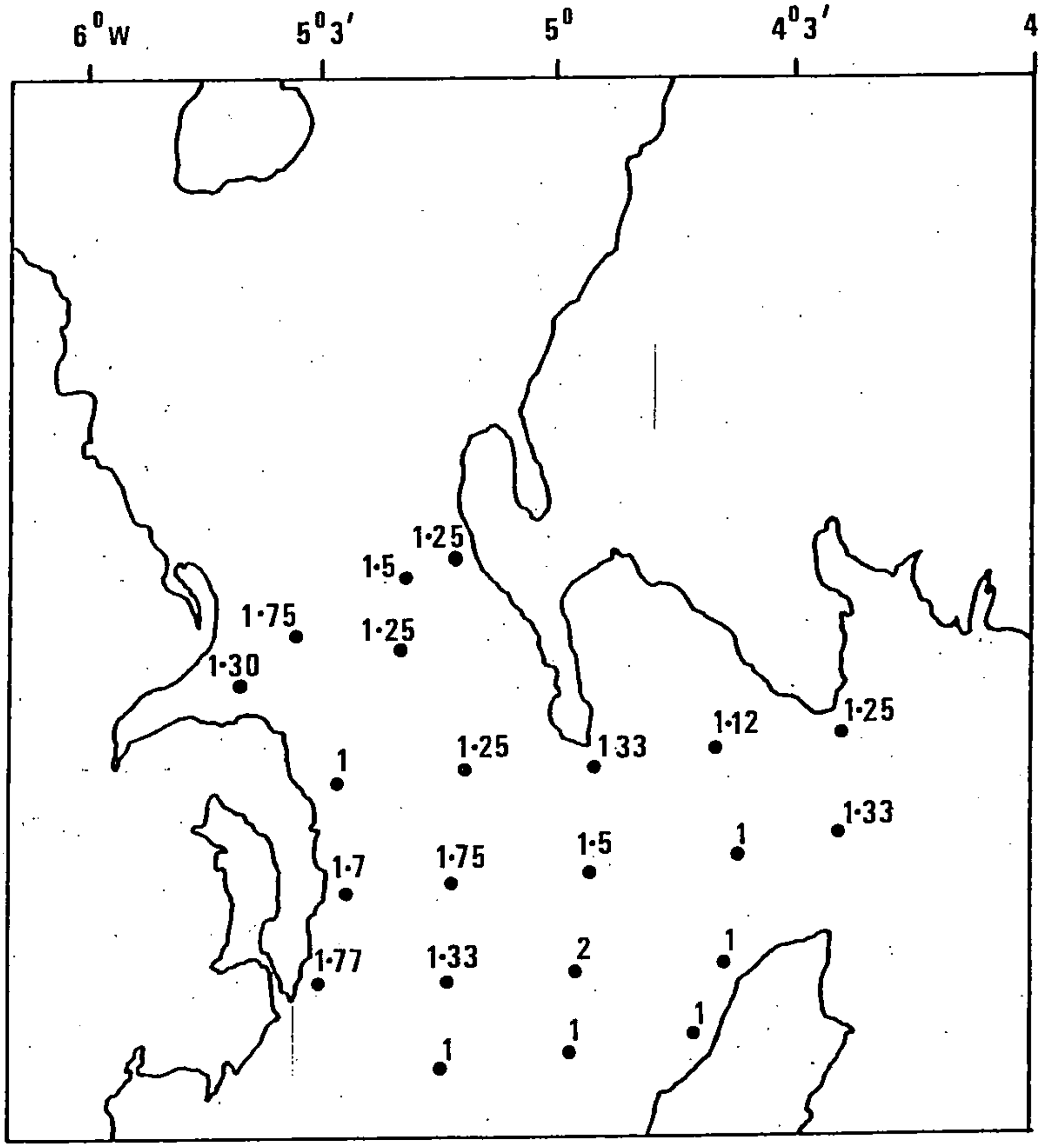


Fig 18. SURFACE WATER TEMPERATURE (CTD OUTBOARD)

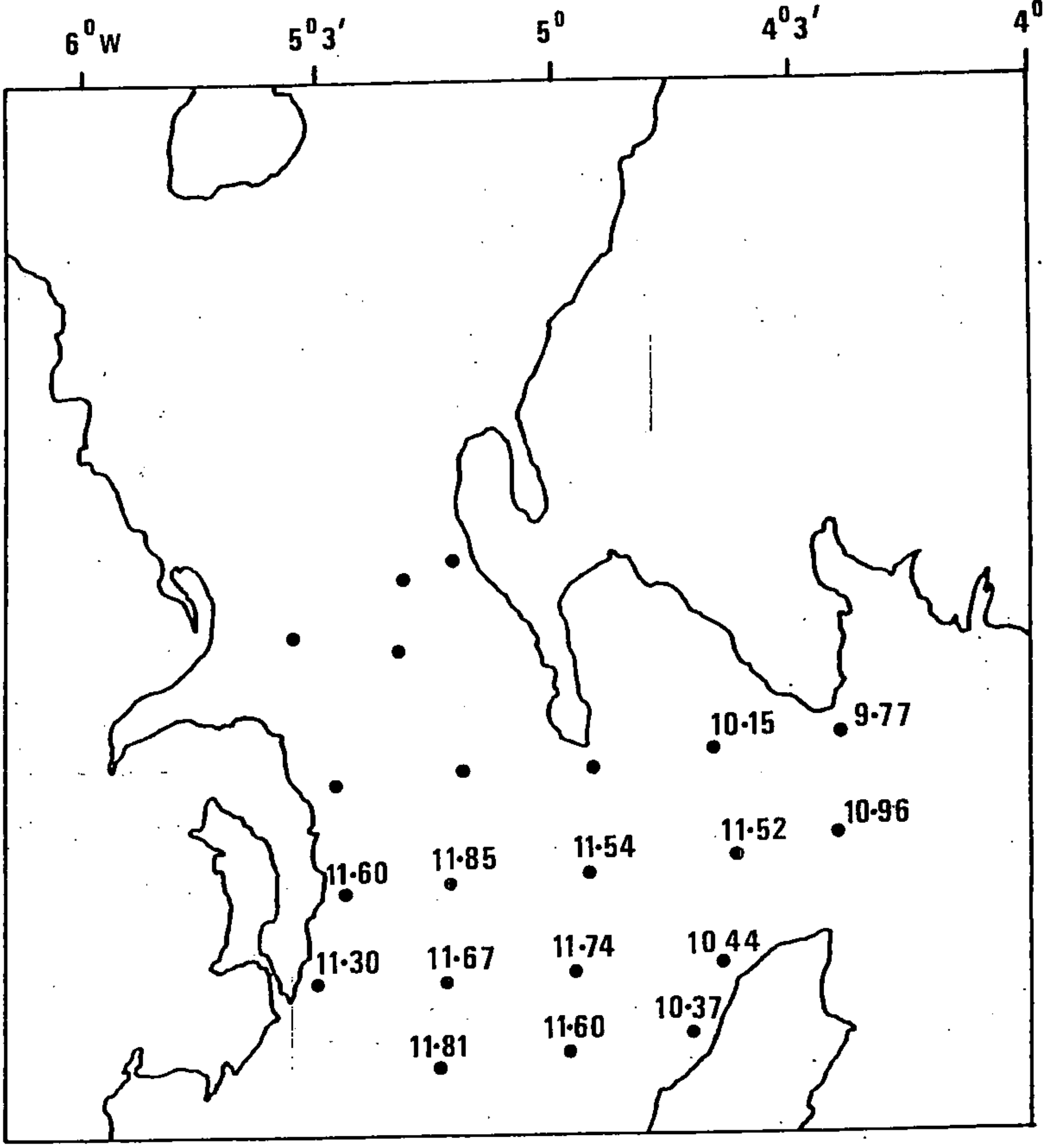


Fig 19. SURFACE SALINITY (CTD ONBOARD)

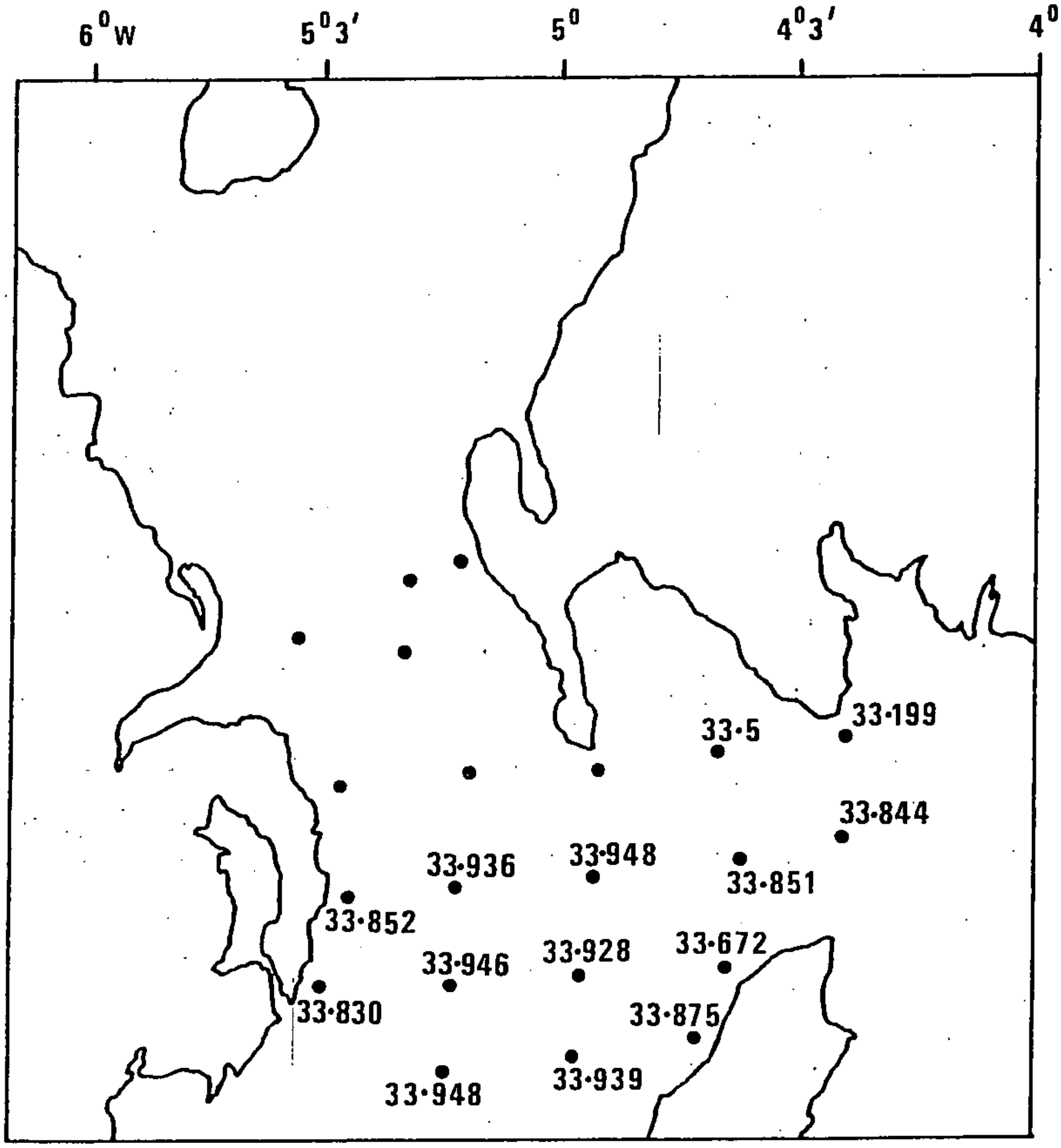


Fig 20a. SRP VS SALINITY OF SURFACE WATERS
STATIONS 8 TO 22 (OUTSOURCE)

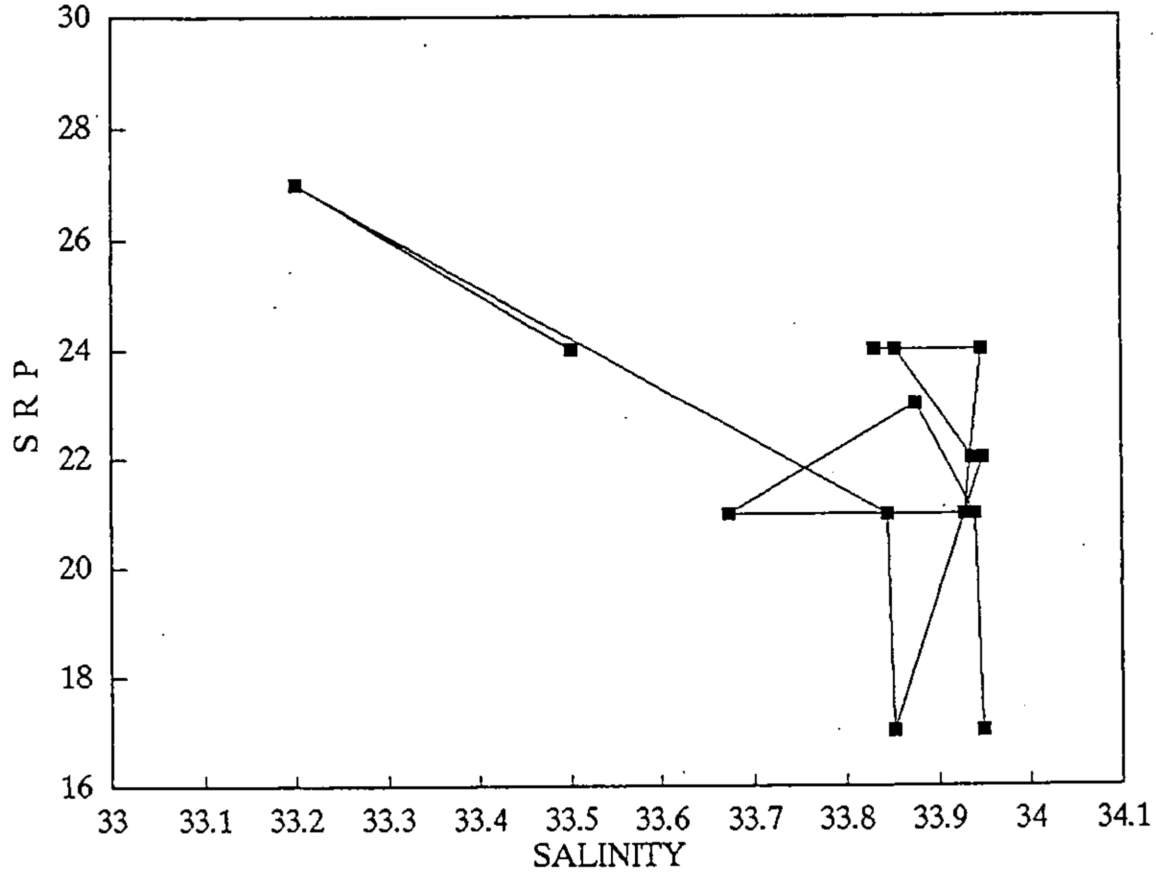


Fig 20b. SRP VS SALINITY OF SURFACE WATERS
STATIONS 8 TO 22

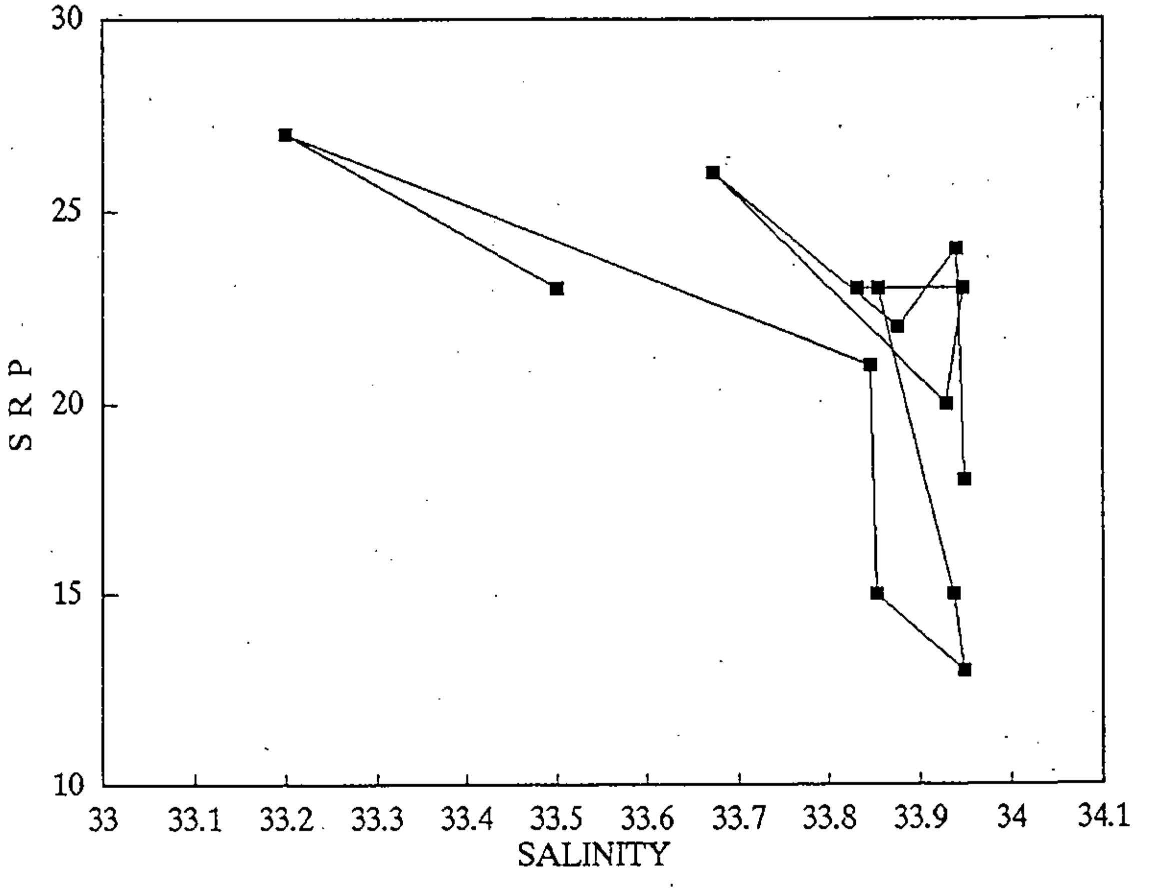
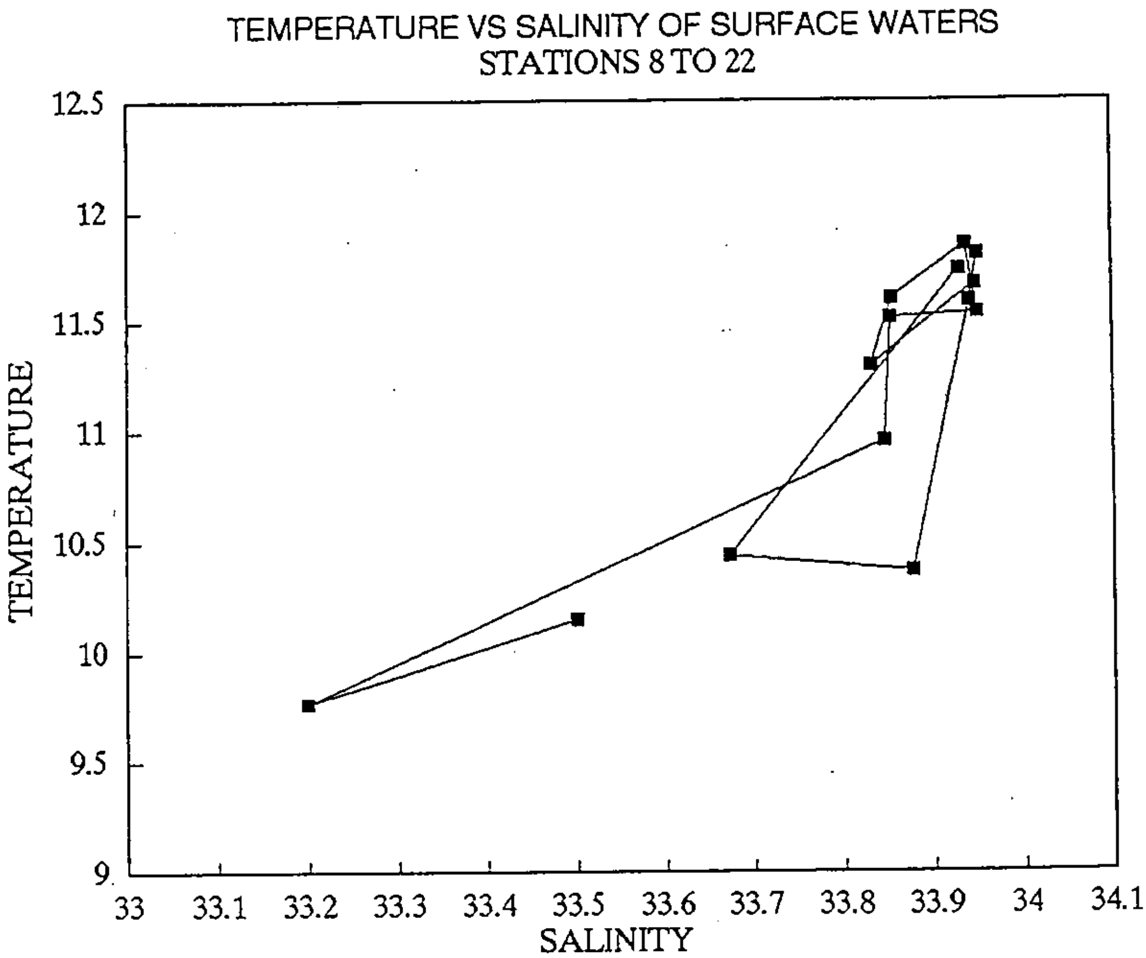


Fig 21.


TEMPERATURE VS SALINITY OF SURFACE WATERS
STATIONS 8 TO 22
12.5
12
11.5
11
10.5
10
9.5
9
TEMPERATURE
33
33.1
33.2
33.3
33.4
33.5
33.6
33.7
33.8
33.9
34
34.1
SALINITY

APPENDIX 2

IN SOURCE 28-29/11/90

STATION	SRP	NH4	NO3	SiO2	Cha	480/665
1	10	3	69	0.26	0.34	1.75
2	16	5	71	0.28	0.34	1.5
3	21	7	67	0.27	0.34	1.25
4	19	5	65	0.29	0.34	1.25
5	15	8	74	0.31	0.34	1
6	21	8	63	0.32	0.34	1.25
7	13	8	70	0.31	0.51	1.33
8	23	9	76	0.28	0.68	1.12
9	27	9	81	0.3	0.68	1.25
10	21	7	76	0.29	0.51	1.33
11	15	7	66	0.31	0.34	1
12	13	7	64	0.25	0.51	1.5
13	15	7	72	0.61	0.34	1.75
14	23	7	68	0.35	0.42	1.7
15	23	7	77	0.31	0.38	1.77
16	23	57	79	0.35	0.51	1.33
17	20	25	70	0.34	0.25	2
18	26	19	83	0.29	0.68	1
19	22	19	75	0.29	0.68	1
20	24	21	74	0.3	0.51	1
21	18	16	73	0.33	0.34	1
22	15	13	91	0.29	0.42	1.3
23					1.88	2.09
TOTAL	423.00	274.00	1602.58	6.93	11.68	31.47
AVG	19.23	12.45	72.84	0.31	0.51	1.37

OUT SOURCE 28-29/11/90

STATION	SRP	NH4	NO3	SiO2
1	18	3	80	0.27
2	28	6	76	0.28
3	18	10	66	0.28
4	18	5	74	0.28
5	17	8	86	0.29
6	19	8	74	0.3
7	20	6	82	0.28
8	24	8	87	0.28
9	27	8	83	0.3
10	21	7	79	0.28
11	17	7	63	0.29
12	22	7	68	0.27
13	22	6	68	0.31
14	24	6	74	0.31
15	24	7	76	0.32
16	24	30	77	0.34
17	21	19	74	0.33
18	21	19	86	0.28
19	23	19	83	0.28
20	21	23	79	0.3
21	17	16	81	0.33
22	21	12	92	0.33
23				
TOTAL	467.00	240.00	1708.98	6.53
AVG	21.23	10.91	77.68	0.30

DIFFERENCE IN SOURCE - OUT SOURCE

STATION	SRP	NH4	NO3	SiO2
1	-8	0	-10.78	-0.01
2	-12	-1	-5.74	0
3	3	-3	0.56	-0.01
4	1	0	-9.24	0.01
5	-2	0	-12.6	0.02
6	2	0	-10.92	0.02
7	-7	2	-11.76	0.03
8	-1	1	-11.62	0
9	0	1	-2.1	0
10	0	0	-2.66	0.01
11	-2	0	3.5	0.02
12	-9	0	-3.92	-0.02
13	-7	1	3.5	0.3
14	-1	1	-6.44	0.04
15	-1	0	0.7	-0.01
16	-1	27	2.24	0.01
17	-1	6	-4.06	0.01
18	5	0	-3.5	0.01
19	-1	0	-7.98	0.01
20	3	-2	-4.76	0
21	1	0	-7.42	0
22	-6	1	-1.4	-0.04
23	0	0	0	0
TOTAL	-44.00	34.00	-106.40	0.40
AVG	-1.91	1.48	-4.63	0.02

APPENDIX 3

DEPTH PROFILE 28-29/11/90

DEPTH	SRP	NH4	NO3	SiO2	Cha	480/665
STATION 2						
0	18	6	58	0.39	0.42	1.4
10	24	6	60	0.39	0.34	1.25
20	22	6	58	0.37	0.25	1.66
30	19	6	61	0.36	0.34	1
50	18	6	63	0.38	0.34	1.5
75	26	6	63	0.41	0.34	1
100	18	6	67	0.38	0.34	1.25
125	19	6	64	0.38	0.34	1
150	17	6	65	0.38	0.34	1.25
200	19	6	66	0.39	0.42	1.6
220	16	6	65	0.36	0.51	1.33
TOTAL	216.00	66.00	690.00	4.19	3.98	14.24
AVG	19.64	6.00	62.73	0.38	0.36	1.29

DEPTH	SRP	NH4	NO3	SiO2	Cha	480/665
STATION 21						
10	22	19	68	0.45	0.85	1.6
20	24	19	66	0.41	0.94	1.54
30	22	19	67	0.42	0.85	1.5
40	24	19	66	0.43	0.85	1.4
50	23	19	68	0.45	0.76	1.55
60	21	19	65	0.46	0.85	1.3
70	22	19	67	0.42	0.76	1.55

DEPTH	SRP	NH4	NO3	SiO2	Cha	480/665
STATION22						
0	23	14	95	0.39	0.42	1.5
10	23	14	84	0.39	0.47	1.27
20	40	16	89	0.38	0.42	1.5
30	26	15	94	0.37	0.47	1.45

CTD data from cruise 28-29/11/90

PROFILES

1.Beauforts Dyke 13.42hrs

Depth	Temp	Salin	Oxygen mg/l
10	11.54	33.739	7.77
20	11.54	33.754	7.78
30	11.55	33.766	7.82
60	11.32	33.731	7.87
75	11.27	33.734	7.71
100	11.17	33.727	7.67
125	11.12	33.721	7.63
150	11.11	33.727	7.63
200	11.09	33.728	6.12
220	11.10	33.734	6.13

2. Station 21

10	11.59	33.911	8.88
20	11.59	33.913	7.53
30	11.60	33.915	7.39
40	11.48	33.893	7.29
50	11.43	33.888	7.22
60	11.40	33.887	7.19
70	11.39	33.887	7.16
80	11.50	33.917	7.20

3. Belfast Lough station 22

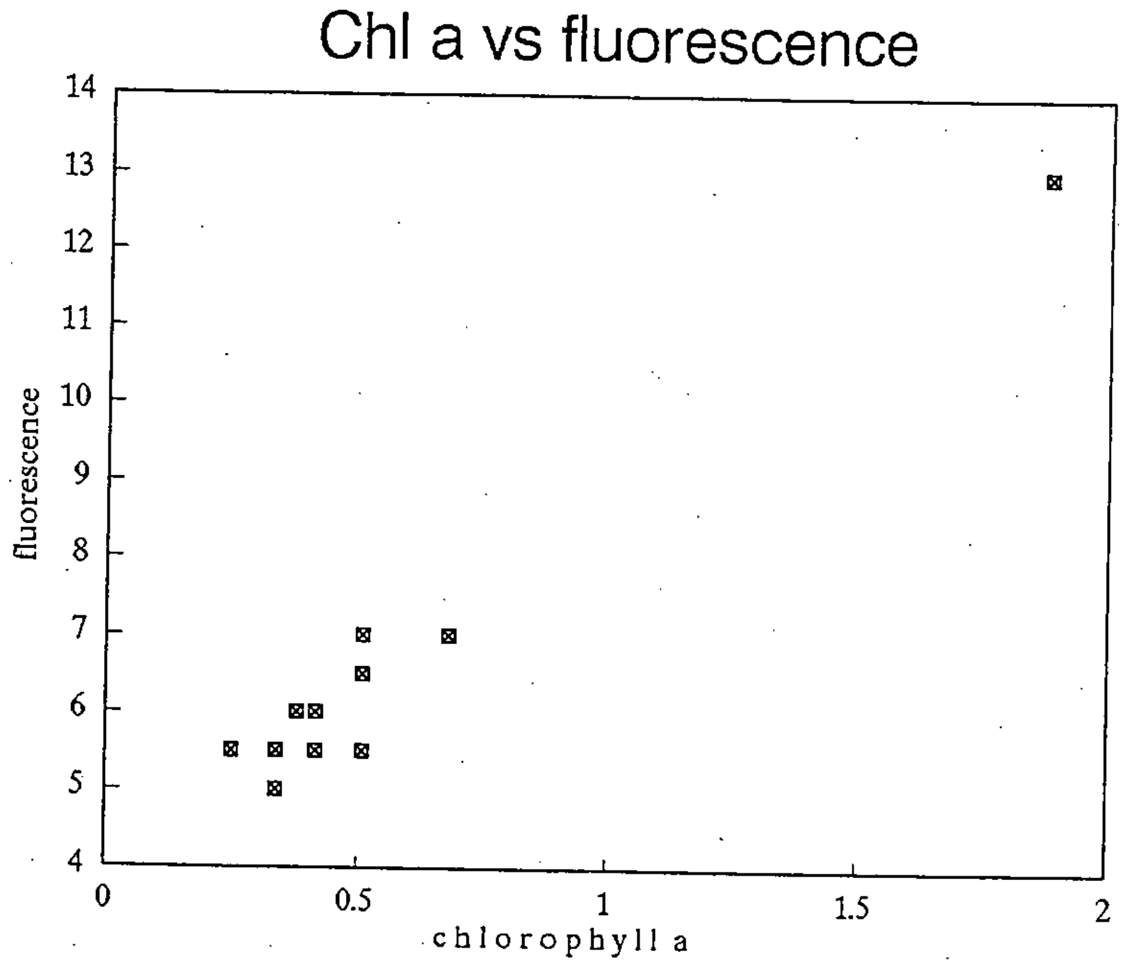
0	11.27	33.603	10.12	???
10	11.28	33.692	9.3	not stabi
20	11.275	33.723	8.67	
25	11.263	33.736	8.55	

Continuous record

Station	Time	Temp	salinity
8	19.49	10.154	33.5
9	21.05	9.773	33.199
10	22.07	10.958	33.844
11	22.54	11.52	33.851
12	23.54	11.538	33.948
13	0.34	11.85	33.936
14	1.24	11.605	33.852
15	2.09	11.296	33.83
16	3.04	11.669	33.946
17	4.09	11.738	33.928
18	5.24	10.441	33.672
19	6.24	10.374	33.875
20	7.14	11.596	33.939
21	8.04	11.806	33.948

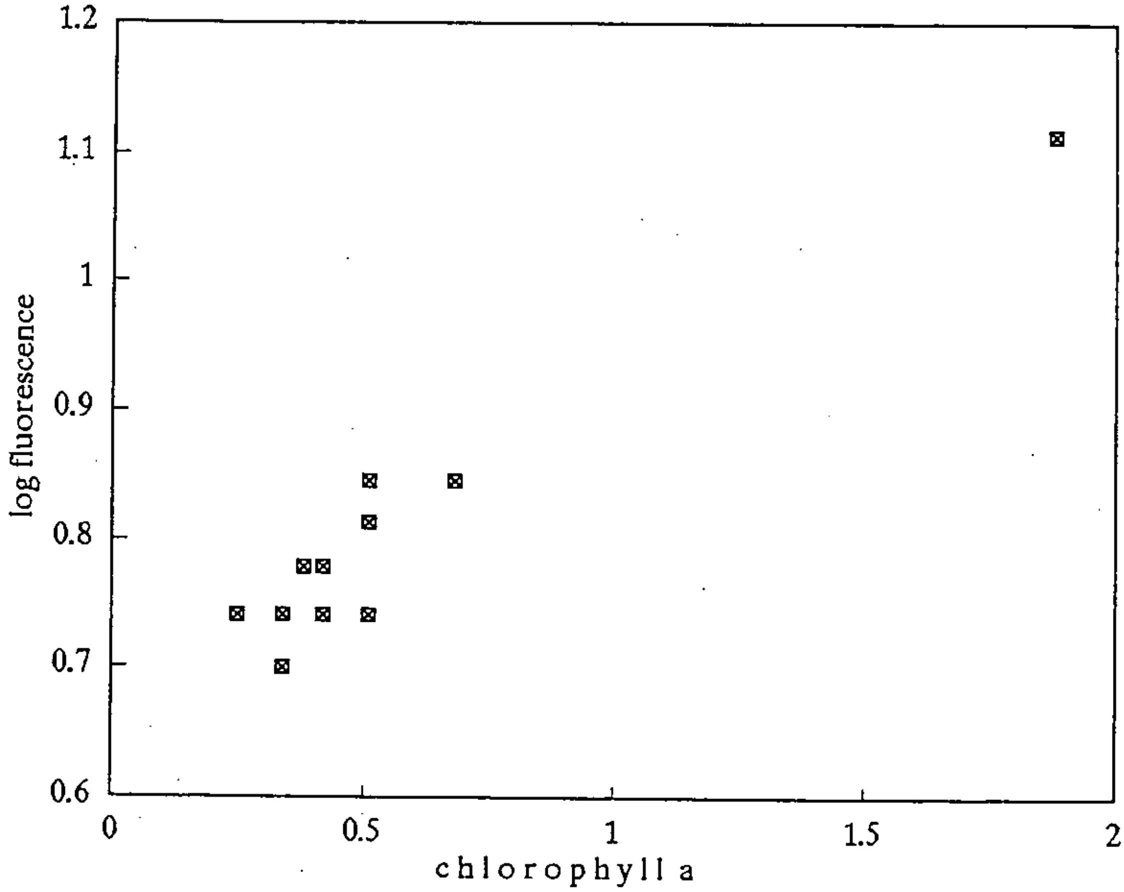
CTD data from cruise 28-29/11/90

Station	Cha	Fluorescence
1	0.34	5
2	0.34	5.5
3	0.34	5.5
4	0.34	5
5	0.34	5.5
6	0.34	5
7	0.51	5.5
8	0.68	7
9	0.68	12.5
10	0.51	6.5
11	0.34	5.5
12	0.51	6.5
13	0.34	5.5
14	0.42	5.5
15	0.38	6
16	0.51	5.5
17	0.25	5.5
18	0.68	9
19	0.68	9.5
20	0.51	7
21	0.34	5.5
22	0.42	6
23	1.88	13



Stations 9, 18 and 19 are omitted.

Chl a vs fluorescence



Regressions of chl a vs F omitting stations 9, 18 and 19

Chla vs F

Regression Output:

Constant	3.742163
Std Err of Y Est	0.403914
R Squared	0.948299
No. of Observations	20
Degrees of Freedom	18

X Coefficient(s)	4.891778
Std Err of Coef.	0.269221

Chla vs log F

Regression Output:

Constant	0.654118
Std Err of Y Est	0.030641
R Squared	0.892315
No. of Observations	20
Degrees of Freedom	18