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Paul Tett

Firth of Lorne Study: Report No. 4

Hydrography, nutrients and chlorophyll in the Firth
of Lorne and its associated sea lochs, 7th-11th February 1983.

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December 1983.

S.M.B.A. Internal Report No.

Introduction

This report presents nutrient, chlorophyll and hydrographic data from the Firth of Lorne and associated sea lochs obtained on a cruise of R.V. 'Calanus' between 7th and 11th February 1983. This work forms part of a study of long term changes in the physical and chemical characteristics of water in the Firth of Lorne, and the biological consequences of these changes.

The report contains a full set of data obtained during the survey and a brief discussion of the results.

Methods

Temperature and Salinity

Temperature and salinity were measured with a Braystoke STM500 T/S probe. Each profile was calibrated against reversing thermometer and precision salinometer measurements. At stations with depths greater than the length of the probe cable (130 m) deeper temperature and salinity measurements were taken with the reversing thermometers and bottle samples.

Nutrients

Measurements of dissolved nutrients (nitrate, phosphate and silicate) were carried out on board 'Calanus' using a Technicon Autoanalyzer with an additional Chemlab colorimeter.

The Autoanalyzer was controlled by a Hewlett-Packard 9825 computer and a 6940B Multiprogrammer, which also logged the data and calculated the results in units of concentration.

Results and Discussion

The stations sampled are listed in Table 1 and their positions are shown on the map (figure 1). A full set of tabulated data is given in the Appendix.

Chlorophyll levels were low, as might be expected in winter, ranging from 0.01 to 0.18 mg/m³, and will not therefore be discussed further.

Hydrography

Longitudinal sections of temperature (figure 2) and salinity (figure 3) showed considerable differences from results obtained a year earlier. Temperature distribution in February 1983 was almost uniform throughout the system, seawards of the Corran Narrows, with temperatures between 6.7 and 7.6°C, slightly higher than those obtained in February 1982 (6.4 to 7.2°C), (Grantham 1983). In upper Loch Linnhe a different situation was found. In February 1982 the temperature varied between 5.5 and 7.1°C increasing with depth, similar to the distribution found in the Lynn of Morvern and the Firth of Lorne. In February 1983 in upper Loch Linnhe there was a pocket of warmer water, at up to 9.4°C. Since the last time that water above 9°C was available in Loch Linnhe was probably in December 1982 (see Grantham, 1981, for temperature cycle in Loch Eil and Lynn of Lorne), this warm water must have been left over from the previous

autumn. This feature, absent in February 1982, was also not apparent in 1979 or 1980. Comparable data for 1981 are, unfortunately, not available.

Salinities in upper Loch Linnhe and Loch Eil were lower in February 1983 than those found a year earlier (Grantham, 1983), but in the rest of Loch Linnhe and the Firth of Lorne were higher. For instance, in the deep basin of upper Loch Linnhe (station LL1) the salinity in February 1982 was 32.4‰, whereas in 1983 it was only 31‰. The differences found in Loch Eil were even greater. At station E70 (60 m) salinities were 30.4‰ in February 1982 and 24.9‰ in 1983. In contrast at station LM1 in the Lynn of Morvern the salinity in February 1982 was 33.2‰ at 120 m, and in 1983 at the same depth was similar at 33.6‰. This similarity extended throughout lower Loch Linnhe and the Firth of Lorne, with slightly higher salinities being found in February 1983.

Nutrients

Longitudinal nitrate, silicate and phosphate sections are shown in figures 4, 5 and 6. Nitrate appeared to be uniformly distributed but levels were considerably higher overall than those found in February 1982 (Grantham, 1983). For instance, at station LL1, in upper Loch Linnhe, nitrate values ranged from 5.29 to 6.90 $\mu\text{g-at}/\ell$ in February 1982, whereas on this survey the range was 7.28 to 8.10 $\mu\text{g-at}/\ell$. Even greater differences were found at station FL1 off Colonsay, between the February 1982 range, (7.29 to 7.60 $\mu\text{g-at}/\ell$), and that for February 1983, (8.75 to 9.97 $\mu\text{g-at}/\ell$). In Loch Eil values were very similar on each of the two surveys.

The silicate results showed a somewhat different picture to that of nitrate. Throughout most of the system, excluding station FL1 at Colonsay, silicate values were higher in February 1983 than in February 1982. In Loch Eil, the difference was more marked. At station E70 the range of silicate values in 1982 was 10.11 to 10.68 $\mu\text{g-at}/\ell$, whereas in 1983 the range was 13.5 to 16.3 $\mu\text{g-at}/\ell$.

The differences between the two years seem related to the different weather patterns of each year. The winter of 1981/82 was characterized by an early cold spell in December, with low temperatures, calm conditions and low precipitation. This was followed by average conditions for the rest of the winter. By contrast, the winter of 1982/83 had mild, wet and windy weather in December and January, followed by a cold spell in February. The stronger westerly winds and higher than average rainfall in the winter of 1982/83 both tended to strengthen the fjordic circulation pattern of the Firth of Lorne system, drawing in deep water from the coastal shelf and the North Channel, and increasing the distribution of nutrients regenerated in the deep basins. The higher than normal silicate values, particularly in Loch Eil, may be attributed to the greater rainfall in the winter of 1982/83, since freshwater run-off is the major source of silicate, particularly in the upper reaches of the Firth of Lorne system.

Phosphate was not measured in February 1982. In 1983 the phosphate distribution showed interesting results: there was a marked difference in phosphate levels between the Firth of Lorne and Loch Linnhe. In the Firth of Lorne, seaward of the Lady Rock, phosphate was almost uniform,

at about $0.8 \mu\text{g-at}/\ell$. In Loch Linnhe, values were lower, ranging from $0.55 \mu\text{g-at}/\ell$ at station LM1 to $0.75 \mu\text{g-at}/\ell$ at station LL3, seaward of the Corran Narrows. In upper Loch Linnhe, higher values ($> 0.85 \mu\text{g-at}/\ell$) were associated with the pocket of warm water, presumably left over from the previous autumn.

The differences between the Firth of Lorne and Loch Linnhe may reflect changes in the water entering the Firth of Lorne over the winter months, which gradually work their way landwards in the compensation current. An alternative hypothesis, which might merit further investigation, is that the input of water to Loch Linnhe derives from two sources, the Firth of Lorne, and the Sound of Mull, which have different characteristics. The Firth of Lorne water is derived from the North Channel water flowing between Northern Ireland and the Mull of Kintyre, and might be expected to contain some proportion of high nutrient Clyde water. The water flowing down the Sound of Mull originates from the coastal current and contains a greater proportion of shelf water, of lower nutrient content.

Presumably the balance of inflows from the Firth of Lorne and the Sound of Mull are affected by the meteorological conditions, particularly the wind strength and direction. A more westerly wind would favour flow through the Sound of Mull, while a southerly wind would favour the Firth of Lorne. Year to year changes in the effective wind pattern might therefore affect the balance between the two inputs, and control the overall level of nutrients in Loch Linnhe in a particular winter.

Acknowledgements

We are grateful to Neil Pascoe for providing us with meteorological data.

References

Grantham, B. (1981). The Loch Eil project: chlorophyll a and nutrients in the water column of Loch Eil. J. exp. mar. Biol. Ecol., V. 55: 283-297.

Grantham, B. (1983). Firth of Lorne study: report no. 2. Hydrography, nutrients and chlorophyll in the Firth of Lorne and its associated sea lochs, 3rd-19th February 1982. S.M.B.A. Internal Report no. 87.

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Table 1 Station List

Station E24

Loch Eil, lat. $56^{\circ}51'N$, long. $5^{\circ}16'.9 W$, depth 40 m.

Station E70

Loch Eil, lat. $56^{\circ}51'.1N$, long. $5^{\circ}12'.6W$, depth 65 m.

Station LL2

Upper Loch Linnhe, lat. $56^{\circ}47'.7N$, long. $5^{\circ}9'.1 W$, depth 110 m.

Station LL1

Upper Loch Linnhe, lat. $56^{\circ}40'.8N$, long. $5^{\circ}12'.5W$, depth 150 m.

Station LL3

Loch Linnhe, lat. $56^{\circ}40'.8 N$, long. $5^{\circ}17'.8 W$, depth 70 m.

Station LM1

Lynn of Morvern, lat. $56^{\circ}29'.6N$, long. $5^{\circ}38'.4W$, depth 200 m.

Station C5

Loch Creran, lat. $56^{\circ}32'.1 N$, long. $5^{\circ}19'.4 W$, depth 20 m.

Station C3

Loch Creran, lat. $56^{\circ}31'N$, long. $5^{\circ}22'.4 W$, depth 45 m.

Station LY1

Lynn of Lorne, lat. $56^{\circ}28'.9 N$, long $5^{\circ}30'.1 W$, depth 43 m.

Station FL3

Firth of Lorne, lat. $56^{\circ}19'.4 N$, long. $5^{\circ}43'.2 W$, depth 210 m.

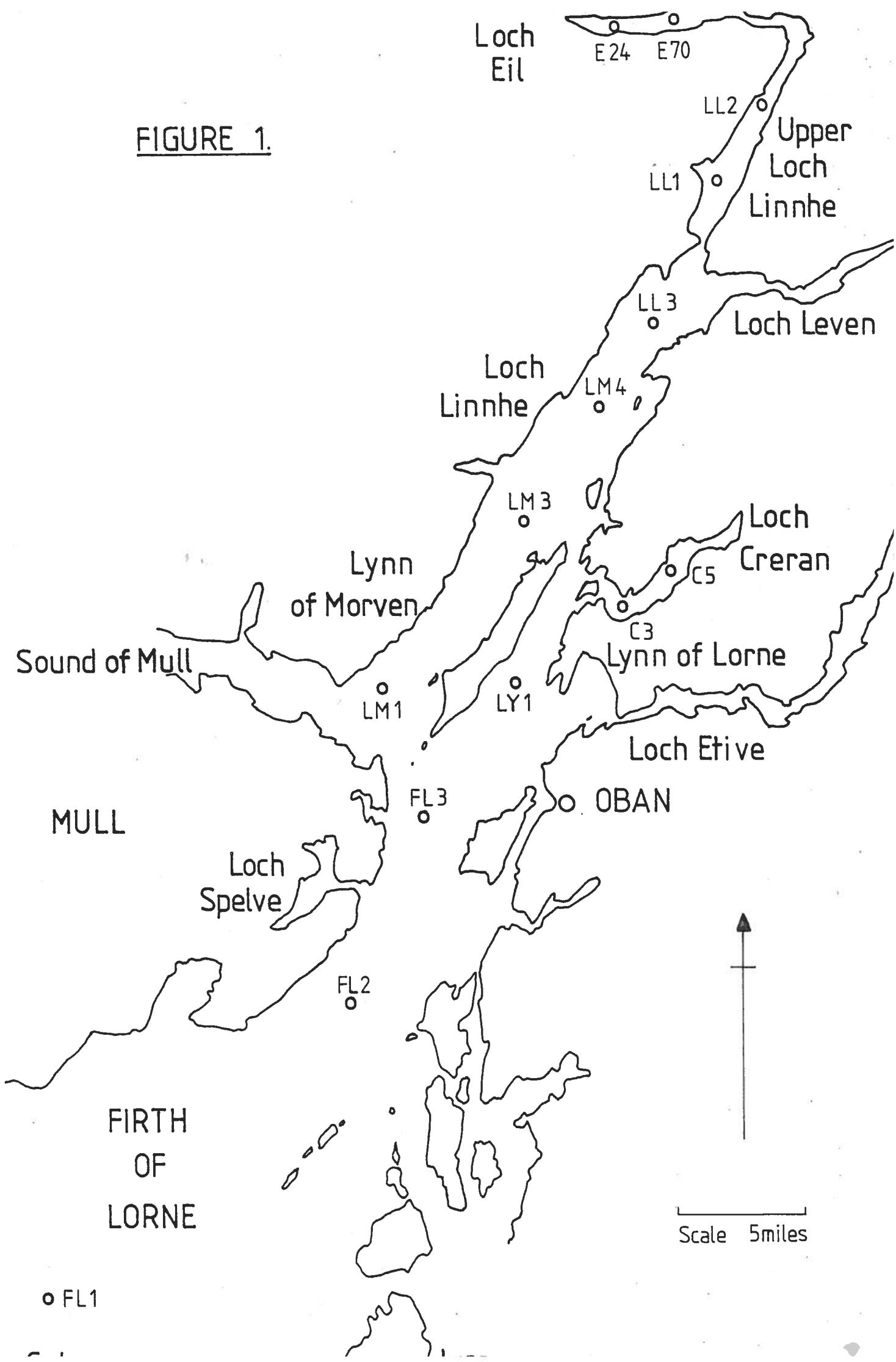
Station FL2

Firth of Lorne, lat. $56^{\circ}24'.7 N$, long. $5^{\circ}36'.5 W$, depth 210 m.

Station FL1

Off Ccolnsay, lat. $56^{\circ}11'N$, long. $6^{\circ}4'.5 W$, depth 80 m.

FIGURE 1.



TEMPERATURE °C

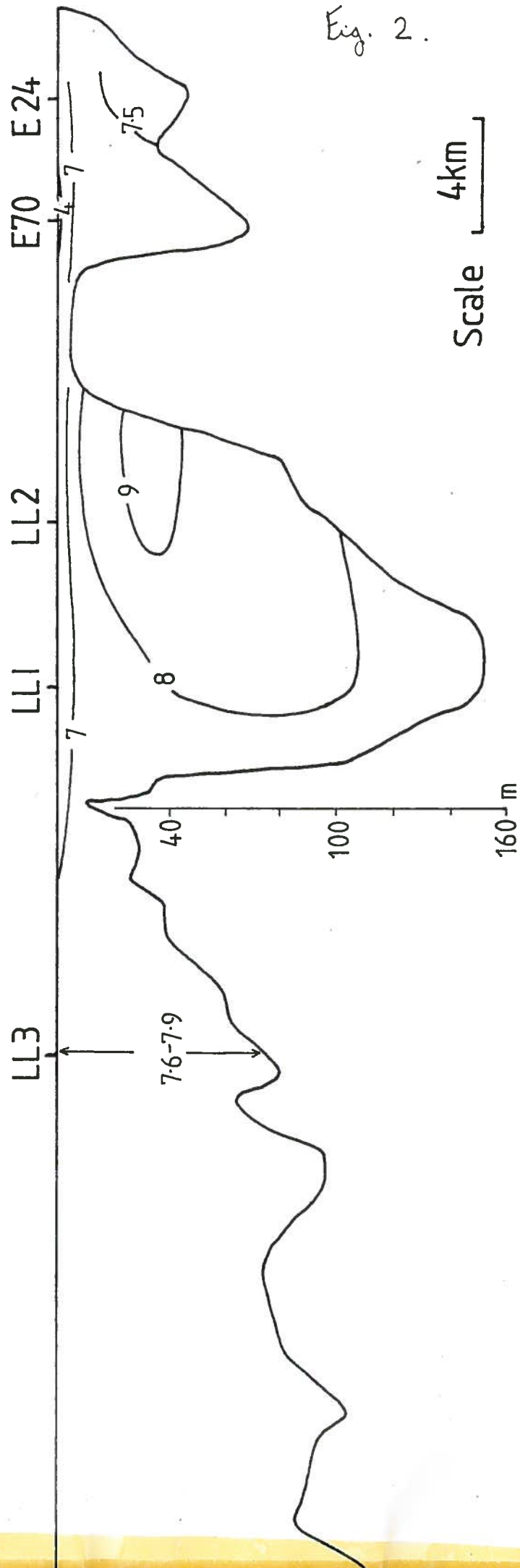
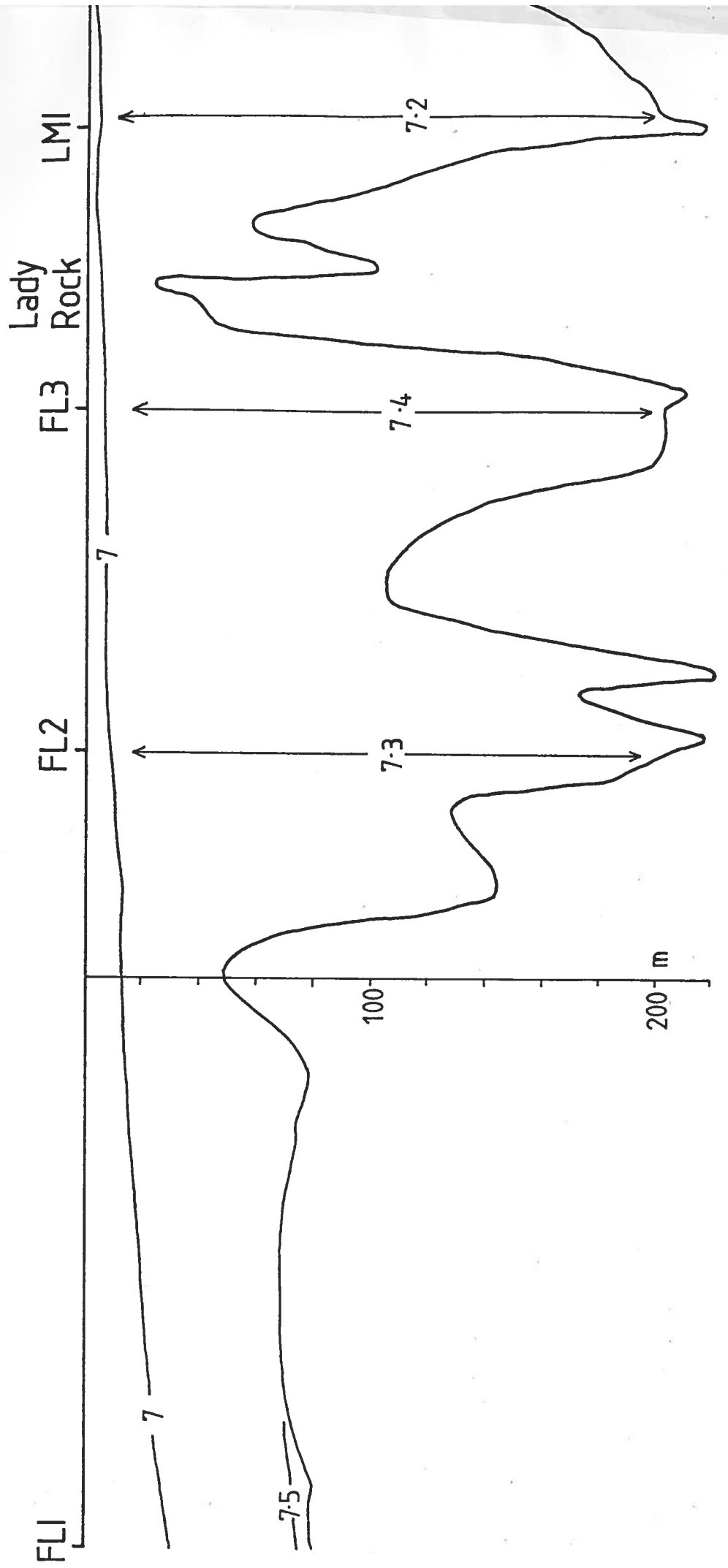


Fig. 2.



SALINITY ‰

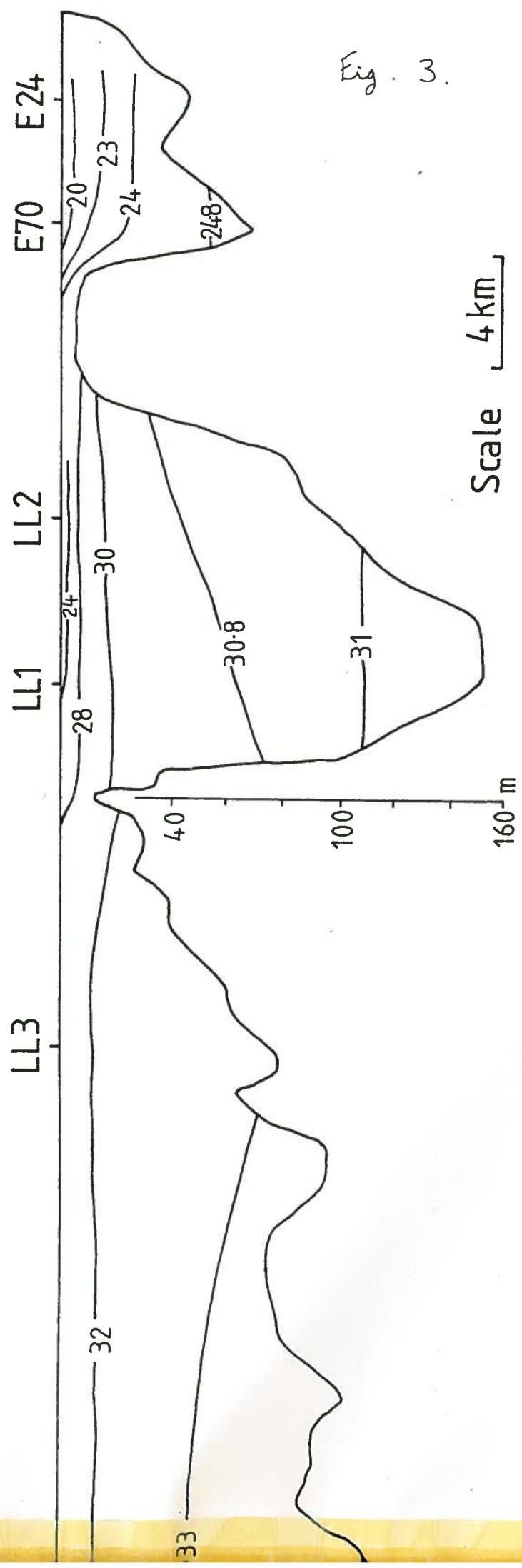
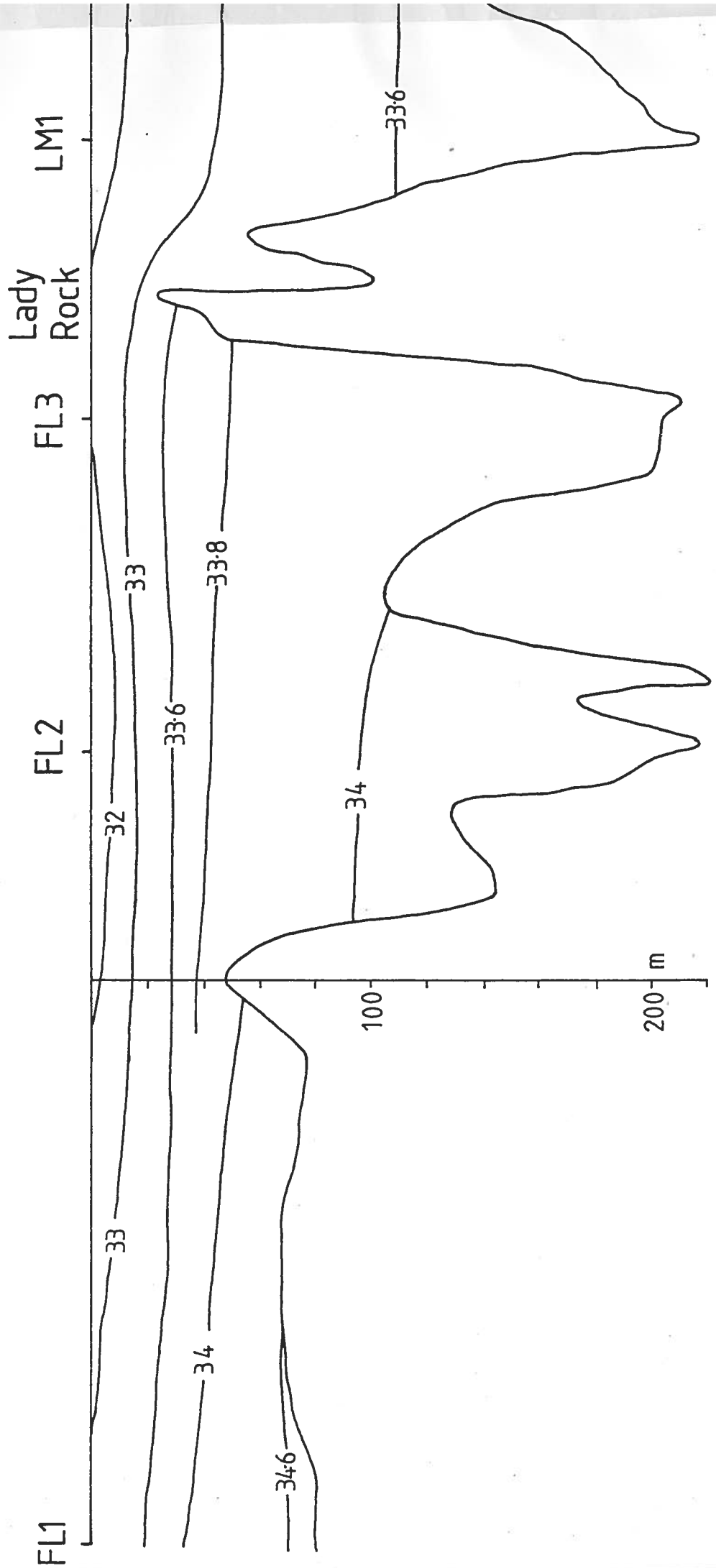


Fig. 3.

Scale 4 km



NITRATE (+NITRITE) $\mu\text{g-at/l}$

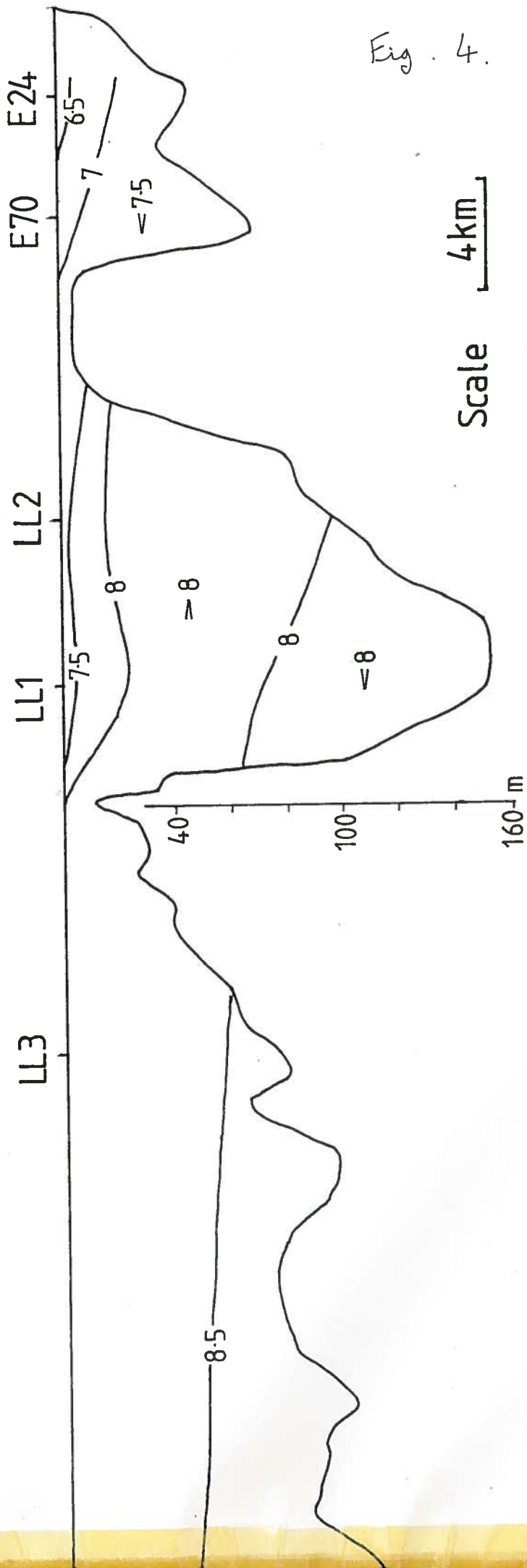
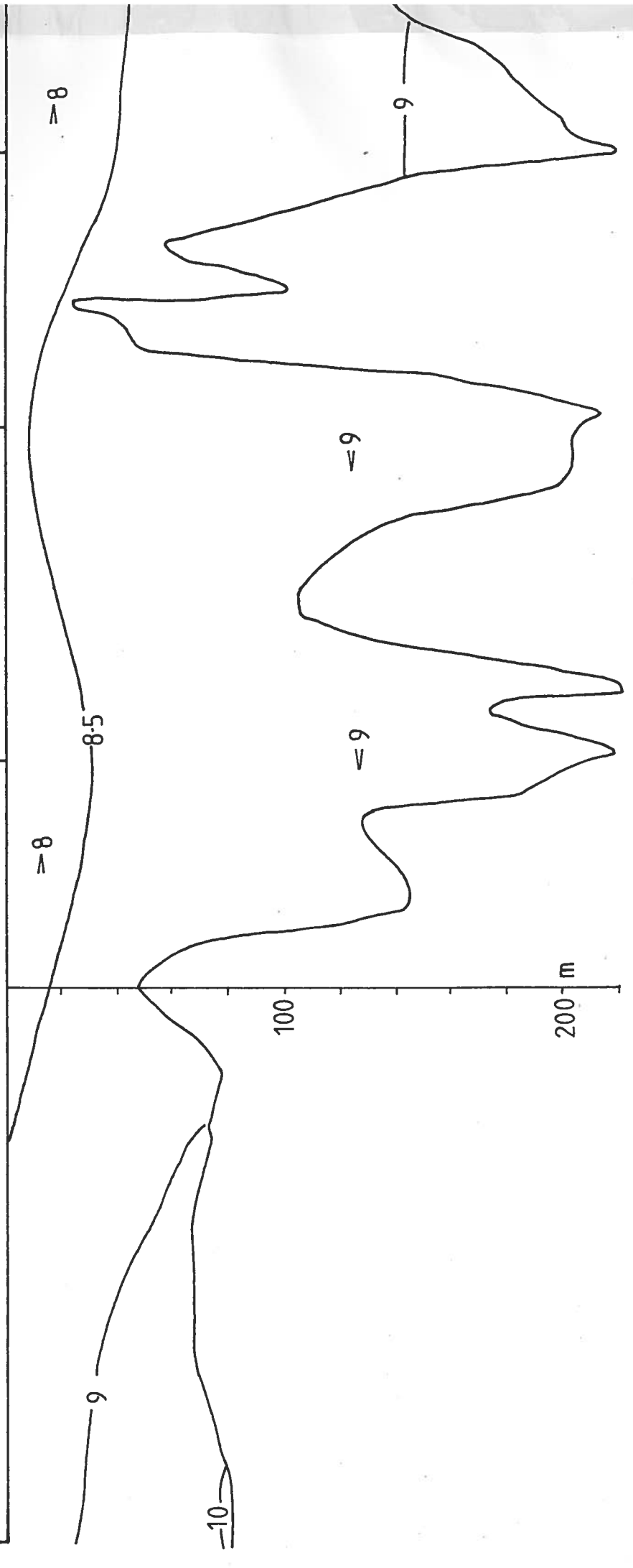


Fig. 4.

Scale 4km

FL1 FL2 FL3 Lady Rock LM1



SILICATE $\mu\text{g-at/l}$

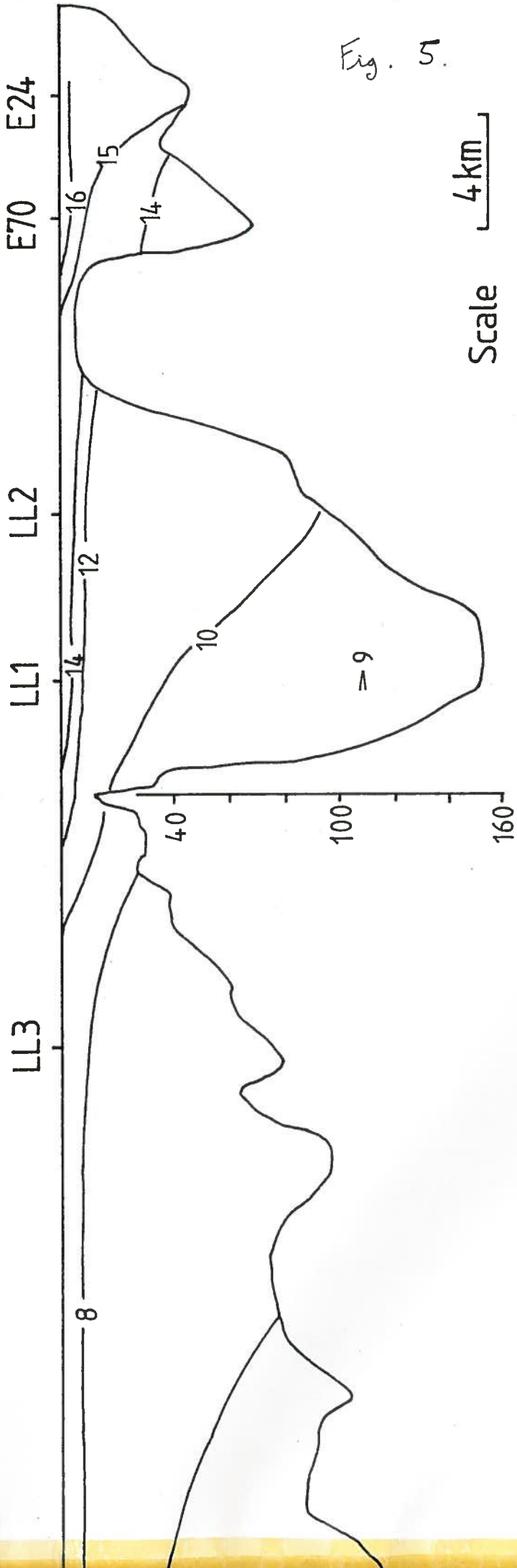
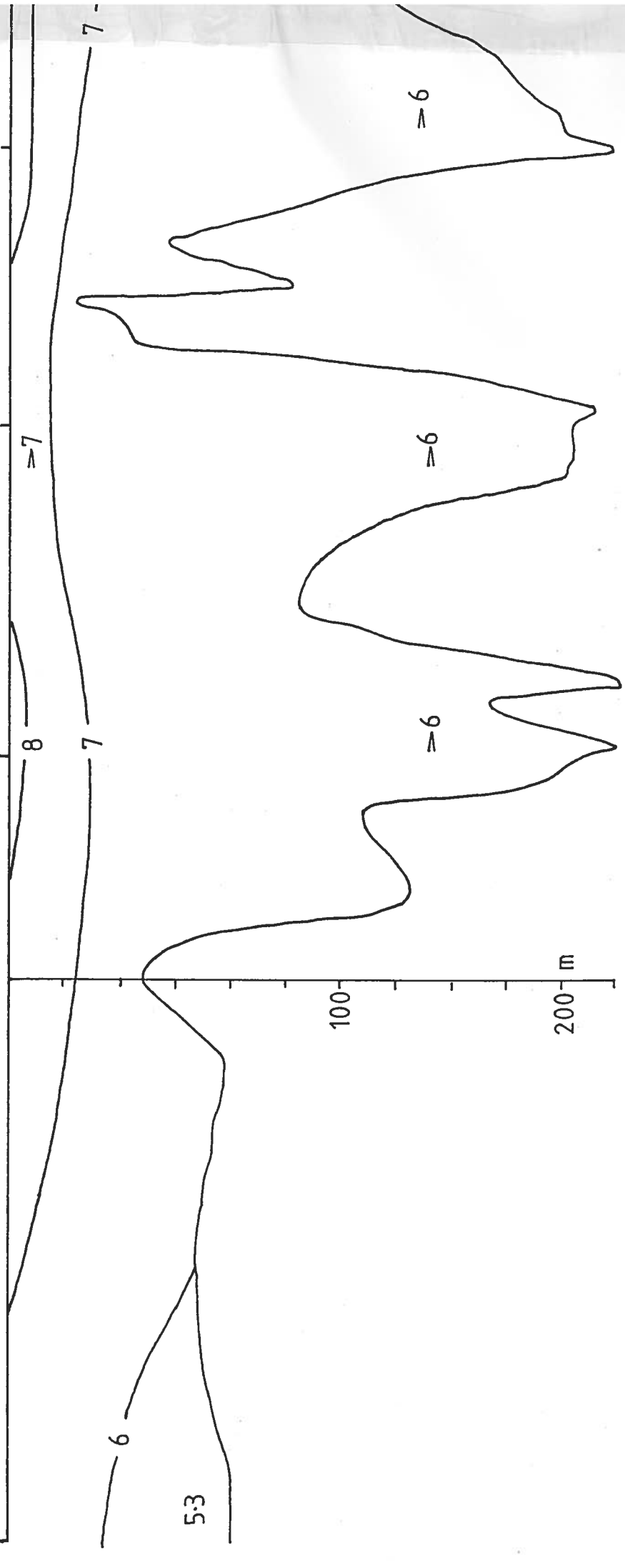


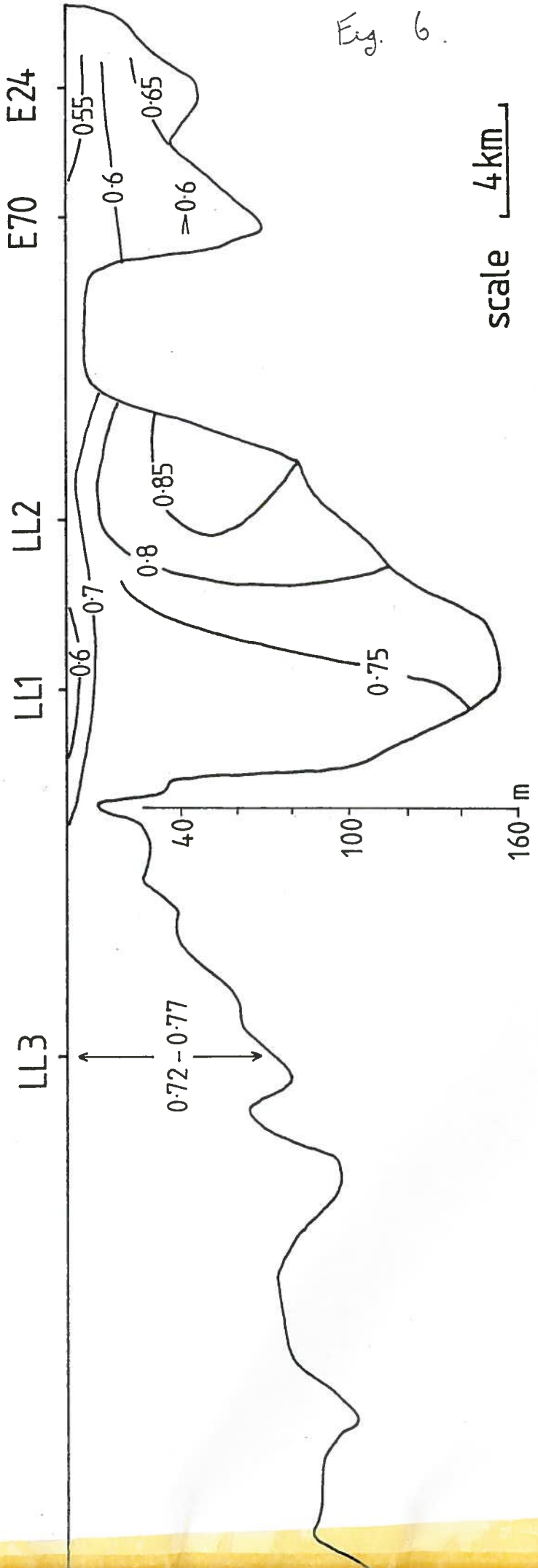
Fig. 5.

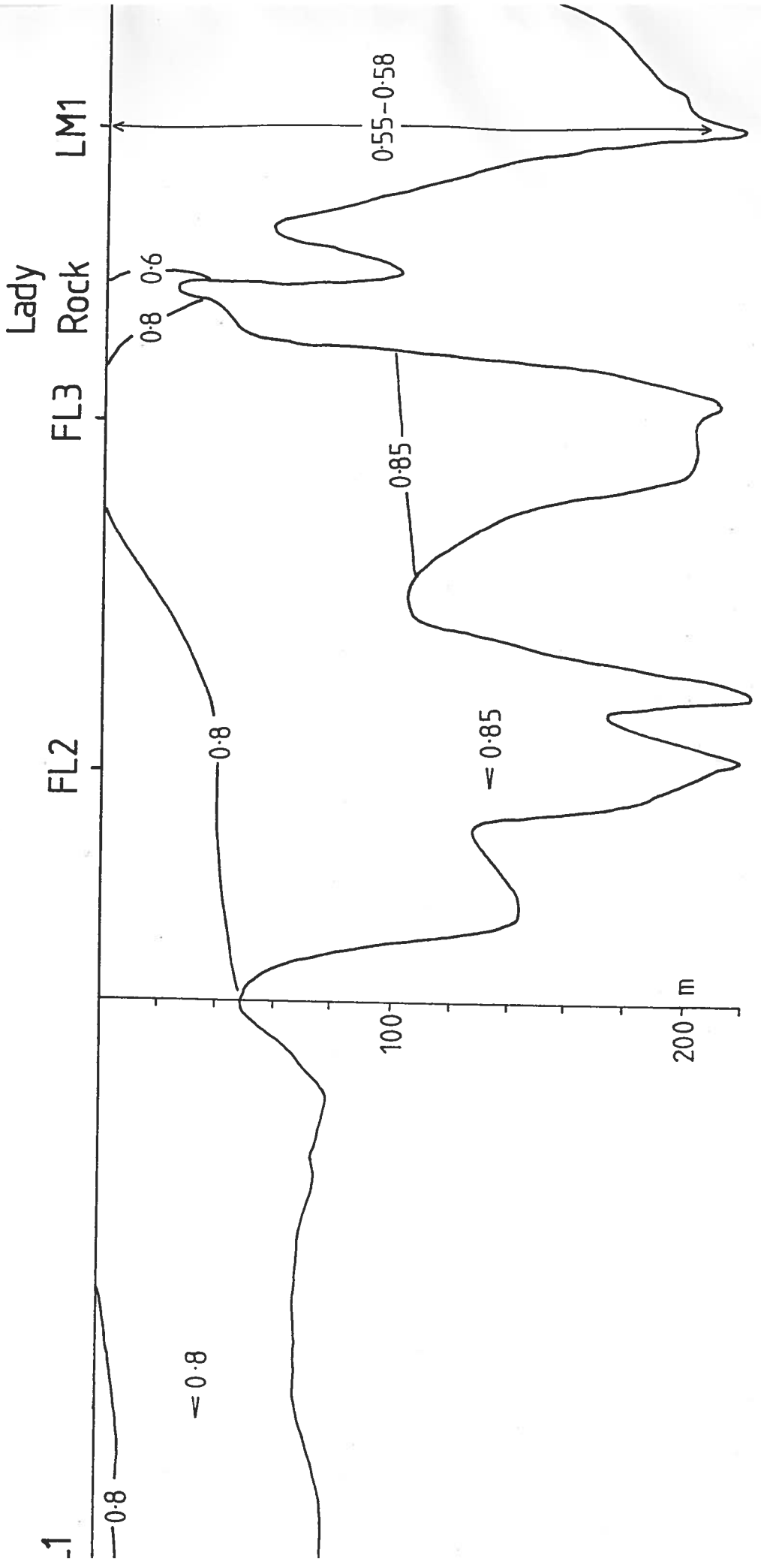
Scale 4 km

FL1 FL2 FL3 Lady Rock LM1



PHOSPHATE $\mu\text{g-at/l}$





Appendix

Units

The units used throughout the report are as follows:-

Depth	- metres	m
Temperature	- degrees Celcius	°C
Salinity	- parts per thousand	‰
Dissolved Inorganic Phosphate	- microgram-atoms per litre	µg-at/l
Dissolved Organic Phosphate	- microgram-atoms per litre	µg-at/l
Dissolved Inorganic Nitrate	- microgram-atoms per litre	µg-at/l
Dissolved Organic Nitrogen	- microgram-atoms per litre	µg-at/l
Silicate	- microgram-atoms per litre	µg-at/l
Chlorophyll <u>a</u>	- milligrams per cubic metre	mg/m ³
Phaeopigment	- milligrams per cubic metre	mg/m ³
Acid Ratio	- ratio (dimensionless)	

Station E24 (Loch Eil). 9 FEBRUARY 1983. 13.00 G.M.T. Misty, fine drizzle, calm.

Depth	Temperature	Salinity	D.I.P.	D.I.N.	Silicate	Chlorophyll	Phaeopigment	Acid Ratio
0 m	4.8	18.6						
1 m	5.5	19.6						
2 m	6.6	20.8	0.52 d	6.36 d	16.7 d	0.05 ld	0.05 ld	1.51 d
4 m	7.1	21.5						
6 m	7.2	21.9						
8 m	7.2	22.2						
10 m	7.2	22.6	0.59 d	6.96 d	15.4 d	0.03 ld	0.06 ld	1.30 d
15 m	7.3	23.1						
20 m	7.6	23.6						
25 m	7.6	24.0						
30 m	-	-	0.67 d	7.09 d	15.1 d	0.03 ld	0.08 ld	1.29 d
31 m	7.6	24.0						
2-10 m Mix.			0.54 d	6.61 d	15.3 d	0.03 ld	0.06 ld	1.33 d

d denotes mean of duplicates

ld denotes logarithmic mean of duplicates

Station E70 (Loch Eil). 9 FEBRUARY 1983. 11.30 G.M.T. Misty, fine drizzle, calm.

Depth	Temperature	Salinity	D.I.P.	D.I.N.	Silicate	Chlorophyll	Phaeopigment	Acid Ratio
0 m	3.9	18.0						
2 m	5.9	20.2	0.56 d	6.73 d	16.3 d	0.04 ld	0.06 ld	1.39 d
6 m	7.0	22.4						
10 m	7.1	23.0	0.59 d	7.30 d	14.9 d	0.02 ld	0.06 ld	1.23 d
15 m	7.1	23.4						
20 m	7.1	23.7						
25 m	7.1	24.0						
30 m	7.1	24.2						
35 m	7.2	24.4						
40 m	7.3	24.6	0.64 d	7.47 d	13.9 d	0.02 ld	0.07 ld	1.27 d
45 m	7.4	24.7						
50 m	7.2	24.7						
55 m	7.2	24.8						
60 m	7.25	24.9	0.64 d	7.39 d	13.5 d	0.01 ld	0.05 ld	1.29 d
65 m	7.3	24.9						
2-10 m Mix.			0.55 d	7.04 d	15.7 d	0.03 ld	0.06 ld	1.37 d

d denotes mean of duplicates

ld denotes logarithmic mean of duplicates

Station LL2 (Upper Loch Linnhe) 9 FEBRUARY 1983. 14.30 G.M.T. Misty, fine drizzle, wind NE1.

Depth	Temperature	Salinity	D.I.P.	D.I.N.	Silicate	Chlorophyll	Phaeopigment	Acid Ratio
0 m	6.4	23.2						
2 m	6.9	24.7	0.63 d	7.35 d	14.7 d	0.03 ld	0.05 ld	1.38 d
6 m	7.8	28.8						
10 m	8.2	29.7	0.80 d	7.93 d	10.5 d	0.02 ld	0.05 ld	1.29 d
15 m	8.2	30.0						
20 m	8.5	30.3						
30 m	9.2	30.6						
40 m	9.4	30.9						
50 m	8.5	30.8	0.86 d	8.46 d	10.6 d	0.03 ld	0.05 ld	1.35 d
60 m	8.3	30.8						
70 m	8.2	30.8						
80 m	8.2	30.8						
90 m	8.1	30.8						
100 m	8.09	30.86						
110 m	8.0	30.9	0.83 d	8.23 d	9.9 d	0.04 ld	0.08 ld	1.33 d
2-10 m Mix.			0.69 d	7.68 d	11.3 d	0.03 ld	0.05 ld	1.34 d

d denotes mean of duplicates

ld denotes logarithmic mean of duplicates

Station LL1 (Upper Loch Linnhe) 10 FEBRUARY 1983. 11.00 G.M.T. Sunny periods, snow flurries, wind NNE 6.

Depth	Temperature	Salinity	D.I.P.	D.I.N.	Silicate	Chlorophyll	Phaeopigment	Acid Ratio
0 m	6.4	24.1						
2 m	6.4	24.1	0.58	7.28	15.8	0.06	0.05	1.54
5 m	7.1	27.9						
9 m	7.4	29.3	0.70	7.81	10.8	0.04	0.05	1.46
18 m	7.6	30.1						
27 m	7.6	30.2						
36 m	7.9	30.5						
45 m	8.2	30.6	0.73	8.10	10.0	0.03	0.05	1.41
54 m	8.2	30.7						
63 m	8.2	30.8						
73 m	8.1	30.8						
82 m	8.1	30.8						
91 m	8.1	30.9	0.72	7.94	9.6	0.04	0.07	1.35
100 m	8.07	30.89						
109 m	8.0	31.0						
118 m	7.9	31.0						
136 m	-	-	0.75	7.94	9.5	0.04	0.09	1.29
141 m	7.91	30.99						
2-10 m Mix.			0.58	7.43	13.5	0.05	0.05	1.49

Station LL3 (Loch Linnhe) 7 FEBRUARY 1983. 11.30 G.M.T. Sunny periods, wind N5.

Depth	Temperature	Salinity	D.I.P.	D.I.N.	Silicate	Chlorophyll	Phaeopigment	Acid Ratio
0 m	7.6	31.4						
2 m	7.6	31.4	0.74 d	8.07 d	8.5 d	0.06 ld	0.04 ld	1.62 d
6 m	7.7	31.6						
10 m	7.8	32.5	0.72 d	8.10 d	7.9 d	0.06 ld	0.04 ld	1.56 d
15 m	7.9	32.6						
20 m	7.8	32.6						
25 m	7.8	32.7						
30 m	7.8	32.7						
35 m	7.8	32.7						
40 m	7.8	32.7	0.77 d	8.29 d	7.5 d	0.05 ld	0.06 ld	1.45 d
45 m	7.7	32.8						
50 m	7.6	32.8						
55 m	7.6	32.8						
60 m	7.6	32.8	0.76 d	8.54 d	7.4 d	0.06 ld	0.06 ld	1.50 d
62 m	7.6	32.8						
2-10 m Mix.			0.75 d	8.35 d	8.0 d	0.06 ld	0.05 ld	1.57 d

d denotes mean of duplicates

ld demotes logarithmic mean of duplicates

Station LM1 (Lynn of Morven). 11 FEBRUARY 1983. 10.45 G.M.T. Sunny periods, wind NW2.

Depth	Temperature	Salinity	D.I.P.	D.T.N.	Silicate	Chlorophyll	Phaeopigment	Acid Ratio
0 m	6.7	31.1						
2 m	6.7	31.1	0.55 d	8.24 d	8.5 d	0.07 ld	0.05 ld	1.59 d
6 m	7.1	31.5						
10 m	7.2	31.9	0.58 d	8.03 d	7.7 d	0.06 ld	0.05 ld	1.55 d
20 m	7.2	32.4						
30 m	7.2	32.6						
40 m	7.1	32.8						
50 m	7.2	33.2	0.57 d	8.59 d	6.6 d	0.09 ld	0.08 ld	1.53 d
60 m	7.2	33.3						
70 m	7.2	33.3						
80 m	7.2	33.4						
90 m	7.2	33.5						
100 m	7.2	33.53	0.56 d	8.83 d	6.2 d	0.12 ld	0.13 ld	1.47 d
110 m	7.2	33.6						
120 m	7.2	33.6						
130 m	7.2	33.6						
150 m	-	-	0.55 d	9.02 d	6.1 d	0.14 ld	0.13 ld	1.53 d
200 m	7.2	33.76	0.58 d	9.13 d	6.2 d	0.14 ld	0.18 ld	1.44 d
2-10 m Mix.			0.68 d	8.28 d	8.4 d	0.05 ld	0.04 ld	1.56 d

d denotes mean of duplicates

ld denotes logarithmic mean of duplicates

Station C5 (Loch Creran) 10 FEBRUARY 1983. 14.30 G.M.T. Sunny periods, wind NE5.

Depth	Temperature	Salinity	D.I.P.	D.I.N.	Silicate	Chlorophyll	Phaeopigment	Acid Ratio
0 m	6.3	29.9						
1 m	6.3	29.9						
2 m	6.3	29.9	0.75 d	8.19 d	10.0 d	0.12 ld	0.06 ld	1.65 d
4 m	6.3	29.9						
6 m	6.4	29.9						
8 m	6.4	30.0						
10 m	6.4	30.0	0.76 d	8.29 d	10.0 d	0.11 ld	0.07 ld	1.63 d
12 m	6.4	30.1						
14 m	6.4	30.5						
16 m	6.5	30.5						
18 m	6.4	30.7						
20 m	6.51	30.97	0.76 d	8.39 d	8.8 d	0.11 ld	0.08 ld	1.56 d
25 m	6.5	31.0						
2-10 m Mix.			0.77 d	8.27 d	10.1 d	0.11 ld	0.07 ld	1.60 d

d denotes mean of duplicates

ld denotes logarithmic mean of duplicates

Station C3 (Loch Creran) 10 FEBRUARY 1983. 15.50 G.M.T. Sunny periods, wind NNE 3.

Depth	Temperature	Salinity	D.I.P.	D.I.N.	Silicate	Chlorophyll	Phaeopigment	Acid Ratio
0 m	5.3	28.9						
1 m	5.3	29.0						
2 m	5.3	28.9	0.67 d	7.35 d	10.9 d	0.11 ld	0.03 ld	1.81 d
4 m	5.7	29.6						
6 m	5.9	29.8						
8 m	6.0	29.9						
10 m	6.2	30.3	0.75 d	8.19 d	9.3 d	0.17 ld	0.07 ld	1.71 d
15 m	6.3	30.6						
20 m	6.5	31.0						
25 m	6.5	31.1						
30 m	6.6	31.2						
35 m	6.6	31.3						
40 m	6.6	31.44	0.79	8.40 d	9.1 d	0.13 ld	0.35 ld	1.31 d
2-10 m Mix.			0.74 d	7.93 d	10.6 d	0.15 ld	0.08 ld	1.67 d

d denotes mean of duplicates

ld denotes logarithmic mean of duplicates

Station LY1 (Lynn of Lorne) 7 FEBRUARY 1983. 16.30 G.M.T. Sunny periods, wind NNE 7.

Depth	Temperature	Salinity	D.I.P.	D.I.N.	Silicate	Chlorophyll	Phaeopigment	Acid Ratio
0 m	7.1	32.2						
1 m	7.1	32.2						
2 m	7.1	32.2	0.89 d	8.71 d	8.2 d	0.08 ld	0.07 ld	1.55 d
4 m	7.1	32.2						
6 m	7.1	32.3						
8 m	7.2	32.4						
10 m	7.2	32.5	0.78 d	8.49 d	8.2 d	0.08 ld	0.08 ld	1.53 d
15 m	7.2	32.7						
20 m	7.4	33.2						
25 m	7.3	33.3						
30 m	7.4	33.3						
35 m	7.4	33.5						
40 m	7.4	33.54	0.88 d	8.90 d	7.5 d	0.11 ld	0.10 ld	1.54 d
2-10 m Mix.			0.84	8.10	8.2	0.07 ld	0.06 ld	1.55 d

d denotes mean of duplicates

ld denotes logarithmic mean of duplicates

Station FL3 (Firth of Lorne). 8 FEBRUARY 1983. 15.00 G.M.T. Hazy, wind N2.

Depth	Temperature	Salinity	D.I.P.	D.I.N.	Silicate	Chlorophyll	Phaeopigment	Acid Ratio
0 m	6.9	32.2						
2 m	6.9	32.2	0.82 d	8.43 d	7.8 d	0.10 ld	0.08 ld	1.55 d
6 m	7.1	32.6						
10 m	7.2	32.9	0.83 d	8.65 d	7.1 d	0.10 ld	0.12 ld	1.46 d
20 m	7.3	33.4						
30 m	7.4	33.7						
40 m	7.4	33.7						
50 m	7.4	33.8	0.83 d	8.66 d	6.4 d	0.11 ld	0.10 ld	1.52 d
60 m	7.4	33.8						
70 m	7.4	33.8						
80 m	7.4	33.9						
90 m	7.4	33.9						
100 m	7.36	33.90	0.85 d	8.80 d	6.2 d	0.13 ld	0.14 ld	1.48 d
110 m	7.4	33.9						
120 m	7.4	33.9						
130 m	7.4	33.9						
150 m	-	-	0.84 d	8.83 d	6.3 d	0.14 ld	0.13 ld	1.52 d
200 m	7.35	33.92	0.85 d	8.75 d	6.3 d	0.14 ld	0.18 ld	1.43 d
2-10 m Mix.			0.81 d	8.74 d	7.5 d	0.09 ld	0.08 ld	1.53 d

d denotes mean of duplicates

ld denotes logarithmic mean of duplicates

Station FL2 (Firth of Lorne) 8 FEBRUARY 1983. 14.30 G.M.T. Hazy, sun, wind N2.

Depth	Temperature	Salinity	D.I.P.	D.I.N.	Silicate	Chlorophyll	Phaeopigment	Acid Ratio
0 m	6.8	31.8	0.77	8.24	8.3	0.09	0.07	1.56
2 m	6.8	31.8	0.77	8.24	8.3	0.09	0.07	1.56
6 m	6.9	31.9	0.77	8.33	7.7	0.10	0.07	1.59
10 m	7.0	32.4	0.77	8.33	7.7	0.10	0.07	1.59
20 m	7.3	33.4						
29 m	7.3	33.6						
39 m	7.3	33.8						
49 m	7.3	33.8	0.81	8.87	6.3	0.12	0.10	1.55
59 m	7.3	33.9						
69 m	7.3	33.9						
79 m	7.3	33.9						
89 m	7.3	33.9						
98 m	7.3	34.0	0.82	8.89	6.3	0.08	0.07	1.54
108 m	7.3	34.0						
118 m	7.3	34.0						
126 m	7.3	34.0						
148 m	-	-	0.82	8.80	6.1	0.14	0.15	1.49
200 m	7.28	34.00	0.80	8.83	6.2	0.15	0.16	1.47
2-10 m Mix.						0.10	0.12	1.46

Station FL1 (off Colonsay) 8 FEBRUARY 1983. 10.30 G.M.T. Hazy sun, wind N3.

Depth	Temperature	Salinity	D.I.P.	D.I.N.	Silicate	Chlorophyll	Phaeopigment	Acid Ratio
0 m	6.7	33.1	0.79 d	8.75 d	6.9 d	0.13 ld	0.09 ld	1.60 d
2 m	6.7	33.1	0.79 d	8.75 d	6.9 d	0.13 ld	0.09 ld	1.60 d
6 m	6.8	33.3	0.80 d	8.73 d	6.6 d	0.15 ld	0.09 ld	1.62 d
10 m	6.8	33.3	0.80 d	8.73 d	6.6 d	0.15 ld	0.09 ld	1.62 d
15 m	6.9	33.5						
20 m	6.9	33.6						
30 m	7.0	33.7						
40 m	7.2	34.2	0.79 d	9.21 d	5.9 d	0.13 ld	0.12 ld	1.54 d
50 m	7.3	34.4						
60 m	7.4	34.47						
70 m	7.4	34.5						
80 m	7.6	34.8	0.78 d	9.97 d	5.3 d	0.18 ld	0.14 ld	1.55 d
2-10 m Mix.			0.81 d	8.76 d	6.8 d	0.13 ld	0.09 ld	1.58 d

d denotes mean of duplicates ld denotes logarithmic mean of duplicates