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Investigation of Loch Spelve  
Interim report March - August 1981

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August 1981

Phytoplankton and Mariculture Project Report No. 4.

## INTRODUCTION

This interim report describes some of the results of the investigation of phytoplankton ecology in Loch Spelve during March to August 1981.

Figure 1 is a map of Loch Spelve showing the main features, including the position of the salmon farm of Golden Sea Produce Ltd. (GSP) and the mussel farm of Caledonian Shellfish Company (Oban) Ltd. (CSC). Table 1 summarises some measurements of physical dimensions, derived mainly from Admiralty chart no. 2387.

## RESULTS AND DISCUSSION

Figure 2 shows chlorophyll concentrations measured at depths between the surface and 2 m at the two fixed stations. Most of these measurements are based on samples filtered and frozen at the fish farms. For comparison the dashed line shows chlorophyll concentration at the same time at 1 to 2 metres depth in Loch Creran. The spring increase occurred at about the same time in both lochs and was similar in maximum chlorophyll concentration at CSC. The maximum chlorophyll concentration was a little less at GSP. Subsequently, however, chlorophyll concentrations have often been higher at GSP than at CSC.

The explanation for this is probably to be found in the nature of the water column at each station. Figures 3 and 4 present results from a visit on 20 July 1981 (with stations worked on that date). At the salmon farm (SM3 = GSP) the water column was nearly uniform, no doubt due to mixing by turbulence generated by tidal friction over the sill and over the shallower regions of the loch. At the mussel farm (J1 = CSC) freshwater

inflow from the River Lussa gave rise to a salinity (and temperature) stratified water column, with the greatest chlorophyll concentrations at the bottom of the pycnocline. Such subsurface chlorophyll maxima have been observed in other occasions at CSC.

Microscopic analysis of Lugol-preserved samples for phytoplankton species composition is proceeding. Most of the resulting data has as yet received only preliminary processing.

In addition to measurement of dissolved nitrate at several stations on each visit to Spelve, measurements of dissolved phosphate and ammonia have been <sup>made</sup> near GSP, to provide additional data for estimation of nutrient input to the loch by the caged fish. A staff gauge has been installed on the River Lussa.

#### CONCLUSIONS

The results of 20 July in particular suggest that the two arms of Loch Spelve behave differently. The north-east arm probably has a typical fjord-type estuarine mean circulation, as suggested in figure 3 ('residual currents'), with most phytoplankton to be found at the bottom of the brackish layer and thus 2 to 10 metres below the surface. The south-west arm suffers strong tidal mixing, and its mean circulation (after subtracting tidal ebb and flow) is probably irregular; it may be dominated by horizontal mixing or by wind driven currents.

Our results suggest that under some conditions the brackish layer ends in a thermohaline front which might persist for hours or days. Such a front could provide a site for the development of large algal blooms, and perhaps accounts for the bloom of red photosynthetic ciliates seen in Spelve during the summer of 1980.

#### ACKNOWLEDGEMENTS

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#### FIGURE LEGENDS

- Figure 1. Map of Loch Spelvie showing low water and 20 metre depth contours. Most freshwater enters the loch in the River Lussa.
- Figure 2. Chlorophyll concentrations between 0 and 2 m depth at the mussel farm (CSC) and salmon farm (GSP) in Loch Spelve. The thin dashed line shows chlorophyll concentrations at a similar depth in Loch Creran.
- Figure 3. Diagram of deduced hydrography of Loch Spelve on 20 July '81. It is likely that, superimposed on the tidal ebb and flow there was a residual fjordic-estuarine-type circulation in the North-east (mussel farm) arm of the loch, driven by freshwater inflow from the River Lussa. Surface observations show that on some occasions a well defined front exists where the brackish layer meets mixed water.
- Figure 4. Profiles of chlorophyll, nitrate and salinity at 3 stations on 20 July '81. Note the low surface nutrient concentration and subsurface chlorophyll maximum at J1 (=CSC).

Table 1 : Dimensions of Loch Spelve

	I. Loch	II Sill	III Total
AREAS — km <sup>2</sup>			
1. Surface area	8.5	0.95	9.5
2a. River Lussa catchment	54	-	} 78
b. Other catchment	22	2.5	
DEPTHS — m			
3a. Mean depth below CD	16	6	-
b. greatest depth below CD	58	-	-
c. least depth below CD	-	5	-
4a. Height MLWS above CD	-	-	0.6
b. Height MLWN above CD	-	-	1.5
5a. Range, MLWS - MHWS	-	-	3.0
b. Range, MLWN - MHWN	-	-	4.0
VOLUMES — 10 <sup>6</sup> m <sup>3</sup>			
6a. Volume below CD	139	5.6	145
7a. Volume, CD-10 m depth	74	4.3	78
b. Volume, 10-20 m depth	44	1.3	45
c. Volume, 10-30 m depth	17	0.0	17
d. Volume below 30 m depth	4	0.0	4
8a. Volume below MLWS	146	6.3	152
b. Volume below MLWN	155	7.3	162
c. Volume below MHWN	163	8.4	171
d. Volume below MHWS	174	9.4	183
9a. Tidal exchange, springs	28.0	3.1	31
b. Tidal exchange, neaps	7.3	1.1	8.4
RATIOS			
10. Catchment to loch area. (2.III/1.III)	-	-	8.2
11. Loch tidal exchange to loch volume -			
a. springs (9a.I/8a.I)	0.19	-	-
b. neaps (9b.I/8b.I)	0.047	-	-
12. Total tidal exchange to sill volume -			
a. springs (9a.III/8d.II)	-	3.3	-
b. neaps (9b.III/8c.II)	-	1.0	-

Fig. 1:  
LOCH SPELVE

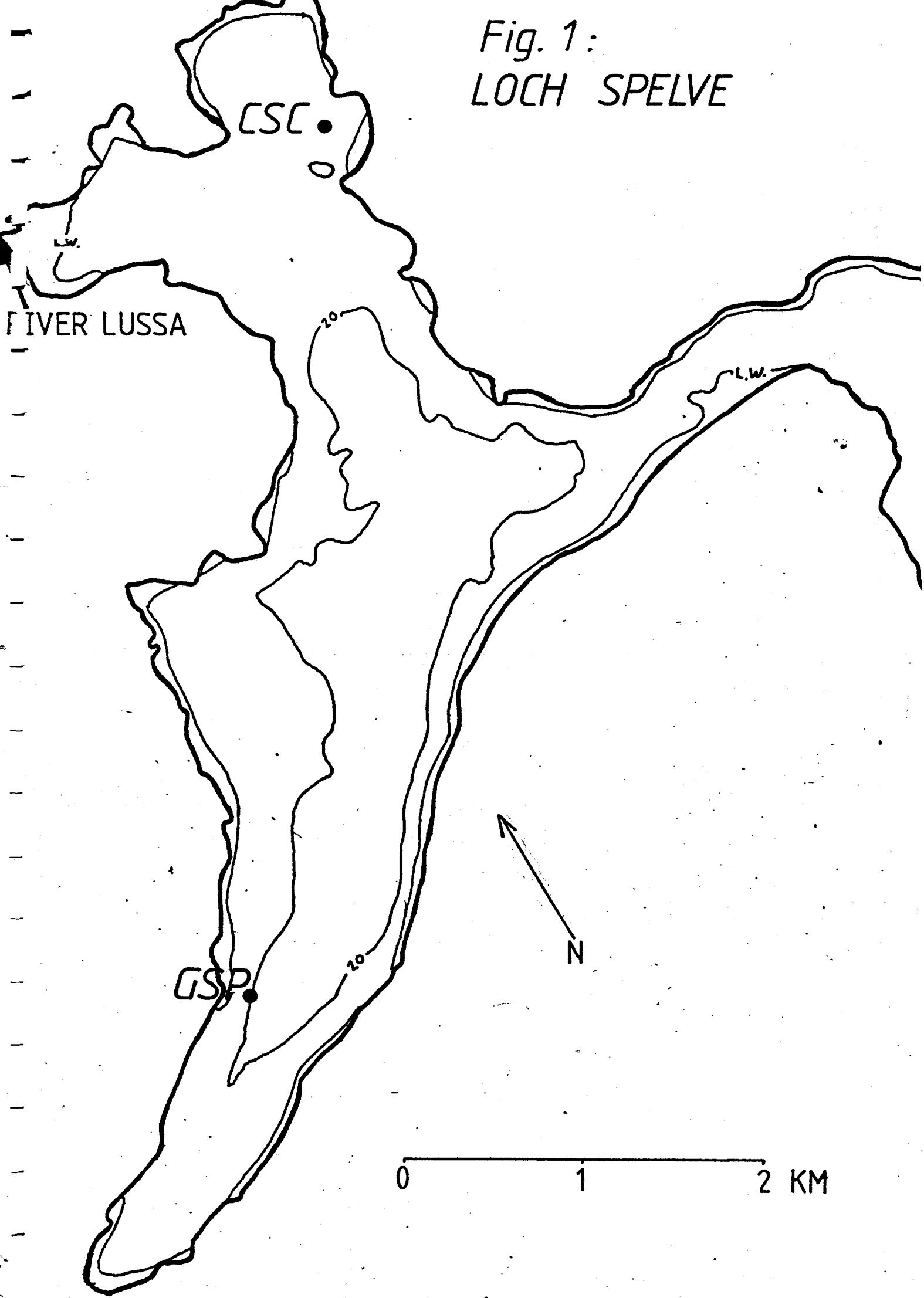
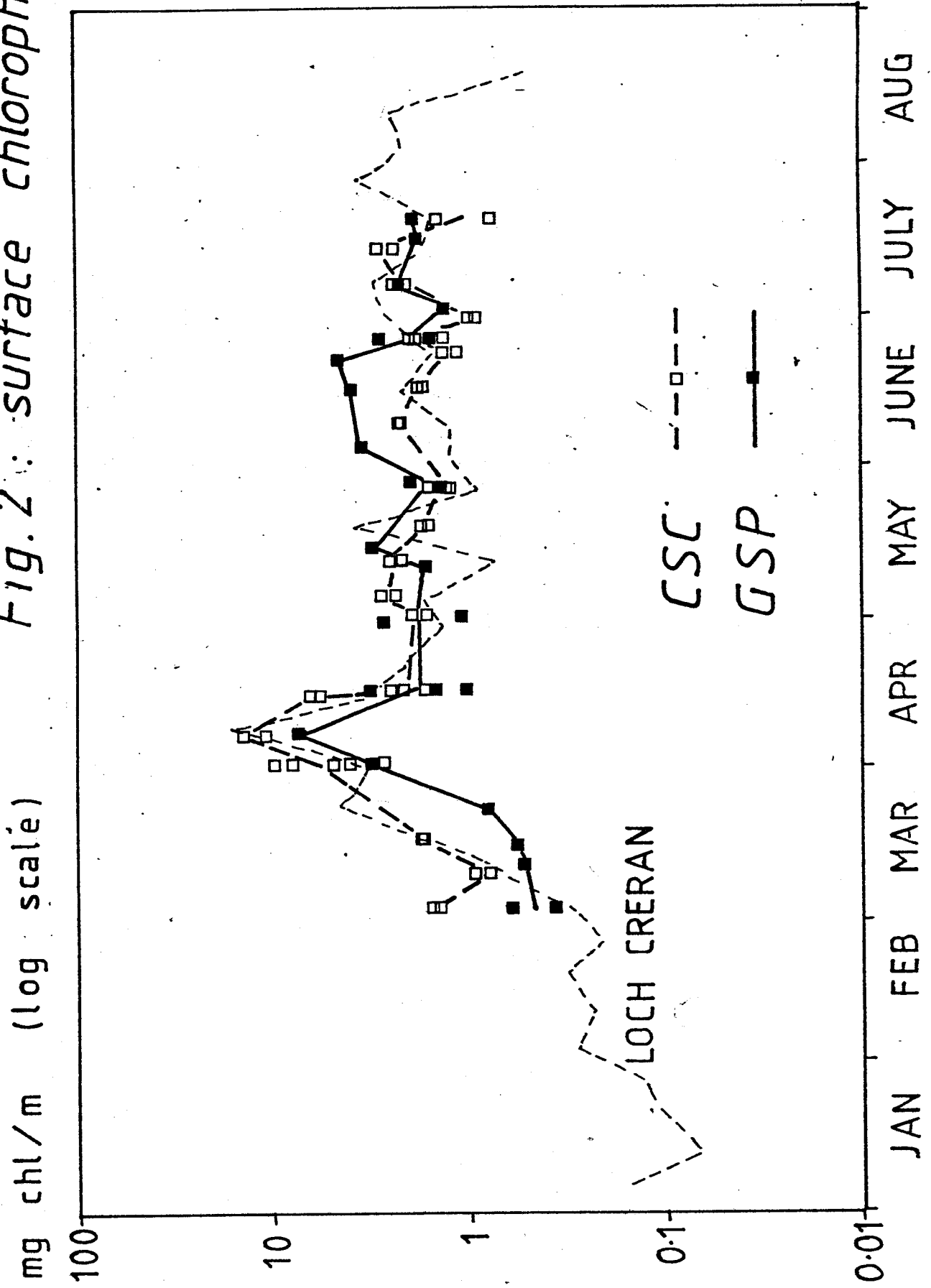


Fig. 2: surface chlorophyll





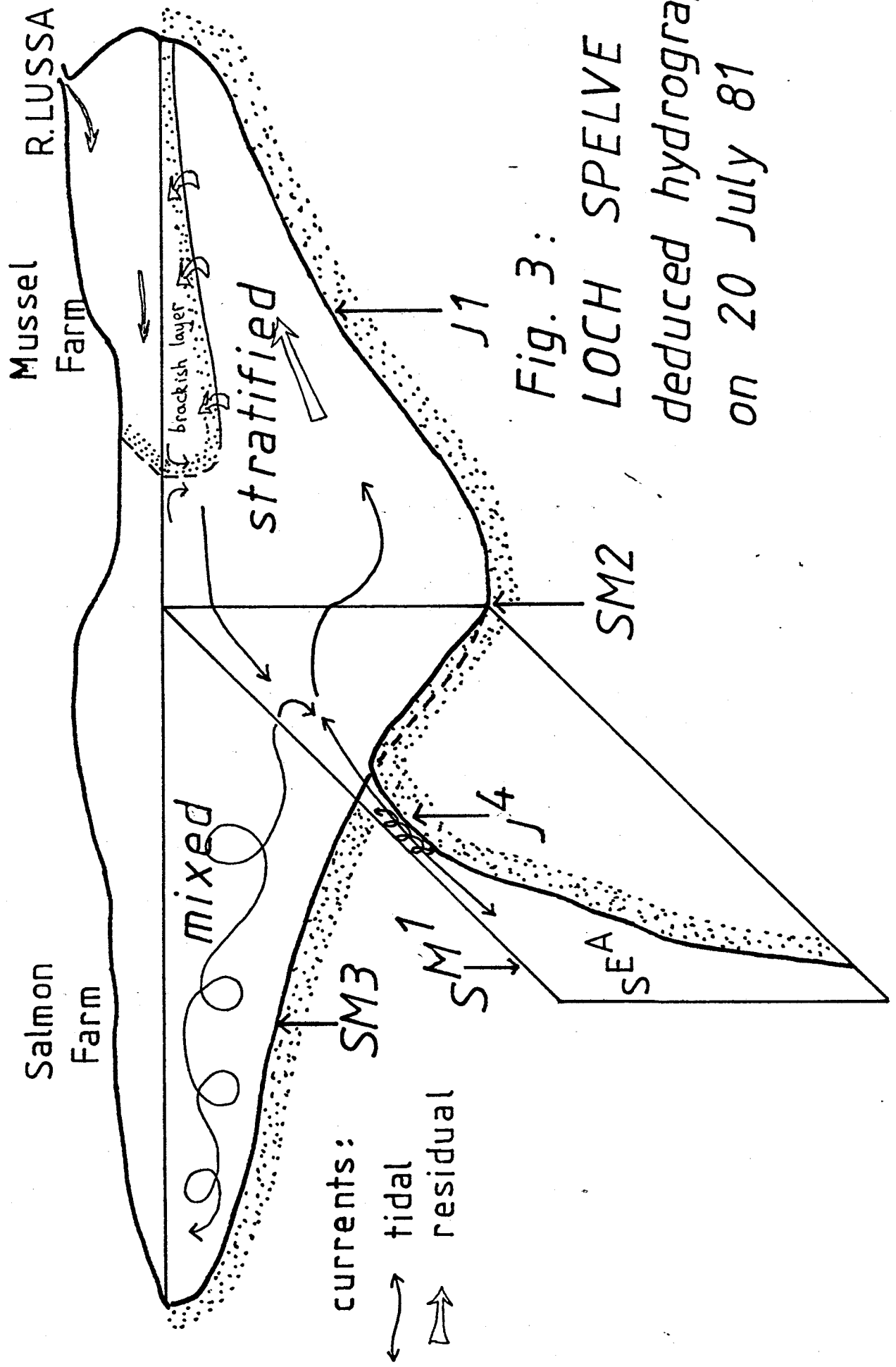


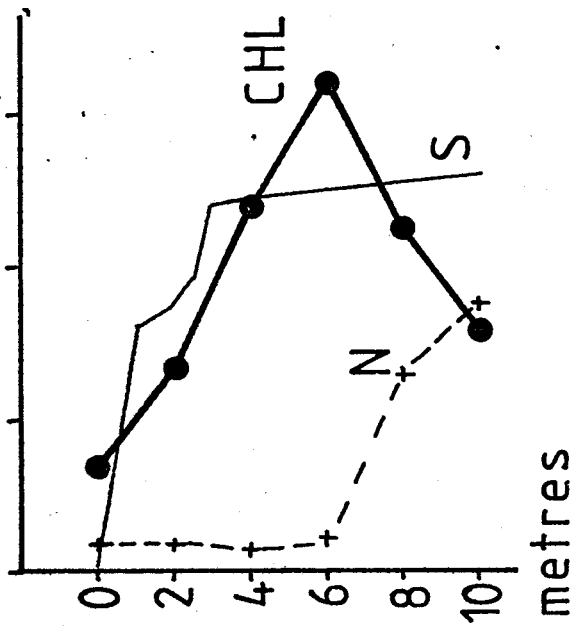
Fig. 3:

LOCH SPELVE

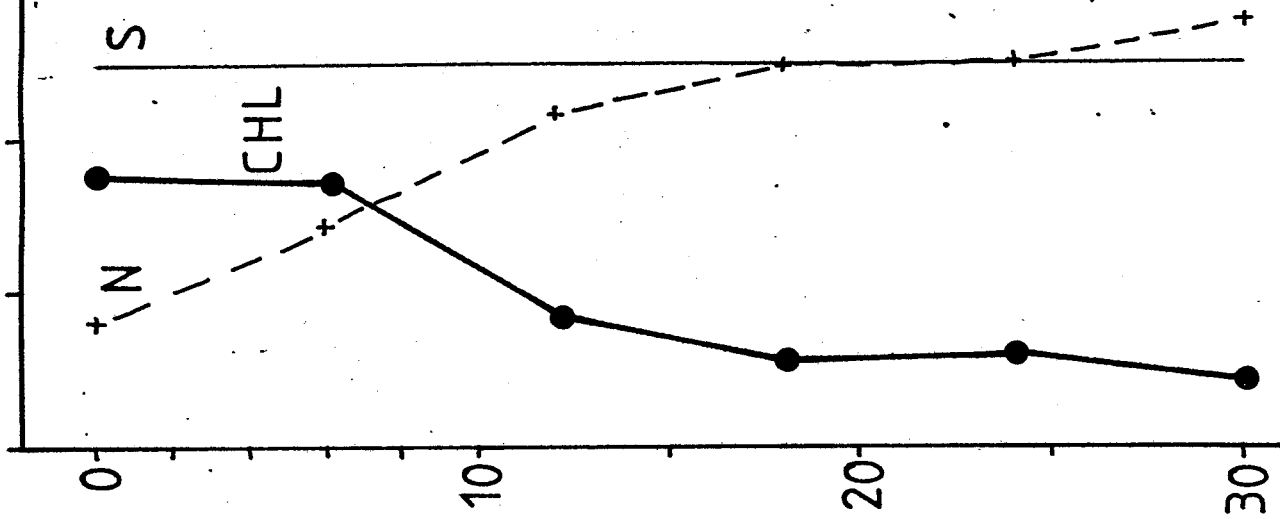
deduced hydrography

on 20 July 81

J1



SM2



SM3

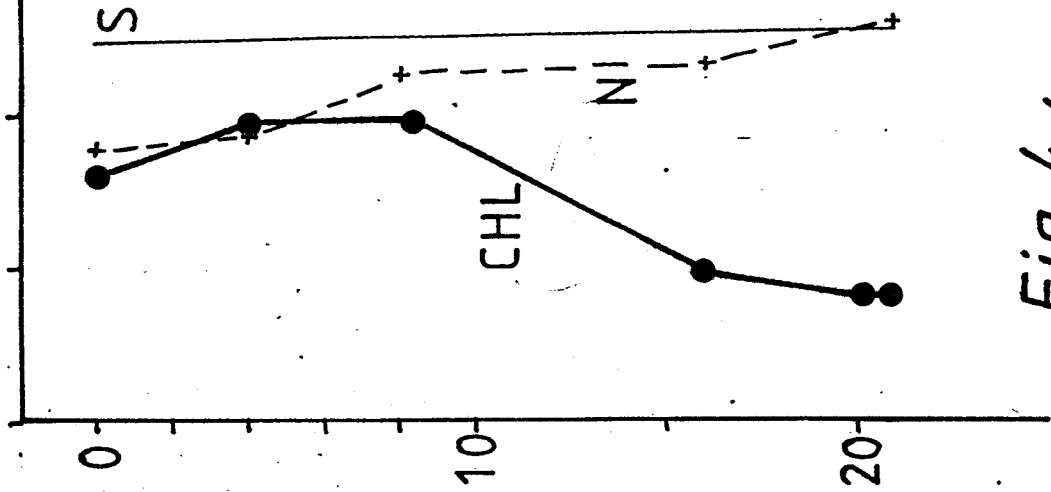


Fig. 4:  
LOCH SPELVE  
20 July 81