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Ödsmål, Kville sn, Bohuslän

Hällristning  
Fiskare från  
bronsåldern

Rock carving  
Bronze age  
fishermen



**MEDDELANDE från**  
**HAVSFISKELABORATORIET · LYSEKIL**

nr  
**173**

Hydrografiska avdelningen, Göteborg.

Observations along the Swedish coast and  
in the Deep Basins in the Baltic, 1973

Hydrography of the Kattegatt and the  
Skagerrak Area, Swedish Observations, 1973.

(Contribution to ICES "Annales Biologiques")

by Stig Fonselius and Artur Svansson

Februari 1975

## Hydrography of the Baltic, Swedish Observations in 1973.

Regular hydrographical measurements have been started by help of Swedish coast guard patrol boats along the Swedish coasts. Some of the international stations are also visited monthly. These measurements replace the earlier measurements carried out on the light ships.

One of these patrol boats has monthly visited the Arkona Deep in the Arkona basin, if weather conditions have permitted. The same station has also been visited by Swedish research ships. Therefore it has been possible to get a rather continuous series of measurements during the last years. Fig. 1 shows the salinity variations in the Arkona basin during 1973 measured by Swedish ships. Unfortunately the weather conditions in November and December were extremely bad when ships were available and no measurements could be carried out. From the figure it can be seen that there has obviously occurred a rather strong inflow of new water during February-March 1973. Fig. 2 shows the oxygen conditions during the same period. Also here the inflow may be recognized through high oxygen values in the bottom water.

In order to study the inflow closer, longitudinal sections for dissolved oxygen from the Arkona basin to the Gotland Deep have been constructed for three Swedish expeditions during the same period. The first section (Fig. 3) shows the oxygen conditions in January 1973. An inflow began in November 1972 (Fonselius 1974) and it seems now to penetrate through the Stolpe Channel into the Central basin. The next section (Fig. 4) is from May. The inflow has now ceased. The oxygen values in the deep water of the Bornholm basin are decreasing and a limited water mass with oxygen values above 2 ml/l is entering the border of the Gotland Deep.

Fig. 5 is from September and shows that this water mass did not penetrate down into the bottom water of the Gotland Deep. Hydrogen sulfide was found in the deepest part of the basin. In the Bornholm basin the oxygen values continued to decrease and at the station BY 8 the deep values were below 2 ml/l.

Table 1 shows results of the hydrographical measurements on the international main deep stations in the Baltic proper measured by Swedish research ships.

The figures 6-8 show maps of the oxygen deficient deep areas and the distribution of hydrogen sulfide in the Baltic proper during 1973. It has to be stressed that the deep basins and sills are not marked on the maps and that they only give a general picture of the conditions.

Sven G. Engström and Stig H. Fonselius

#### References

- Fonselius S.H., 1974: Observations along the Swedish coast and in the deep basins in the Baltic, 1972.  
Ann.Biol. Vol. XXIX 1972 (1974).

#### Text to the figures:

- Fig. 1 The salinity distribution in the Arkona basin during 1973.  
Fig. 2 The oxygen distribution in the Arkona basin during 1973.  
Fig. 3 The oxygen distribution in the deep water of the southern Baltic in January 1973.  
Fig. 4 The oxygen distribution in the deep water of the southern Baltic in May 1973.  
Fig. 5 The oxygen distribution in the deep water of the southern Baltic in September 1973.  
Fig. 6 The oxygen deficit areas and the hydrogen sulfide distribution in the Baltic deep water in January 1973.  
Fig. 7 The oxygen deficit areas and the hydrogen sulfide distribution in the Baltic deep water in May 1973.  
Fig. 8 The oxygen deficit areas and the hydrogen sulfide distribution in the Baltic deep water in September 1973.

Arkona Deep

55°00'N 14°05'E

Depth m	Temp. °C	S ‰	O <sub>2</sub> ml/l	pH	PO <sub>4</sub> -P µgat/l	Tot.P µgat/l	Alkal. Mval/l	Si µgat/l	NO <sub>3</sub> -N µgat/l	NO <sub>2</sub> -N µgat/l	NH <sub>4</sub> -N µgat/l	Tot.N µgat/l
January 10												
000	4.00	8.377	8.71	8.16	0.30	0.48	1.608	9.0				
010	4.02	8.299	8.65	8.17	0.30	0.55	1.616	9.0				
030	4.39	9.008	8.62	8.21	0.28	0.64	1.648	8.5				
049	7.44	15.639	5.46	7.95		1.59	1.879	26.0				
May 22												
000	9.54	8.232	8.42		0.11	0.21	1.619	10.0	0.13	<0.01	1.05	8.1
010	8.94	8.128	8.48		0.09	0.54	1.599	7.0	<0.05		0.88	
030	5.44	8.574	8.01		0.22	0.54	1.647	5.5	<0.05	<0.01	1.62	6.2
047	4.72	13.228	7.44		0.61	0.97	1.832	12.5	0.69		1.14	
September 20												
000	15.61	8.419	6.85	8.26	0.12	0.49		3.0				
010	15.58	8.544	6.86	8.30	0.13	0.51		3.0				
030	15.11	9.486	6.01	8.16	0.26	0.54		3.5				
048	14.51	15.928	2.65	7.69	1.29	1.56		14.0				

Bornholm Deep

55°15'N 15°59'E

Depth m	Temp. °C	S ‰	O <sub>2</sub> ml/l	pH	PO <sub>4</sub> -P µgat/l	Tot.P µgat/l	Alkal. Mval/l	Si µgat/l	NO <sub>3</sub> -N µgat/l	NO <sub>2</sub> -N µgat/l	NH <sub>4</sub> -N µgat/l	Tot.N µgat/l
January 11												
000	5.05	7.731	8.62	8.11	0.27	0.59	1.610	8.0				
010	5.03	7.704	8.56	8.16	0.23	0.40	1.592	7.0				
030	5.05	7.706	8.55	8.18	0.25	0.50	1.610	7.5				
050	5.25	7.970	8.55	8.17	0.23	0.56	1.594	6.0				
070	7.76	16.027	2.14	7.60	1.19	1.68	1.891	42.0				
092	5.12	17.151	2.09	7.59	1.17	1.80	1.936	42.5				
May 23												
000	8.85	7.884	8.85	8.08	0.05	0.48	1.613	10.0	0.18	<0.01	0.72	6.2
010	8.06	7.849	8.90	8.23	0.04	0.71	1.611	8.0	<0.05		0.20	
030	5.21	7.980	8.49	8.05	0.26	0.55	1.611	9.5	<0.05		0.97	
050	4.65	9.746	5.41	7.60	0.80	1.14	1.692	20.5	0.34		1.08	
070	4.43	13.843	6.26	7.63	0.76	1.08	1.829	22.0	4.5		0.16	
091	5.62	16.760	1.16	7.31	1.41	1.88	1.919	53.0	6.5	<0.01	0.51	22
September 10												
000	16.95	7.914	6.91	8.27	0.1	0.41	1.581	6.5	0.06	0.03	0.43	14
010	16.93	7.914	6.90	8.30	0.1	0.44	1.602	7.0	0.14		0.42	
030	16.93	7.910	6.82	8.31	0.1	0.44	1.583	8.0	0.05	0.05	0.48	4.4
050	5.61	8.136	7.21	7.94	0.4	0.79	1.583	12.0	0.36	0.2	0.85	12
070	5.55	13.050	4.46	7.65	1.0	1.20	1.767	27.0	2.8		0.34	
094	5.89	16.560	0.37	7.39	1.6	1.80	1.917	63.0			0.52	

Gotland Deep

57° 20' N 20° 03' E

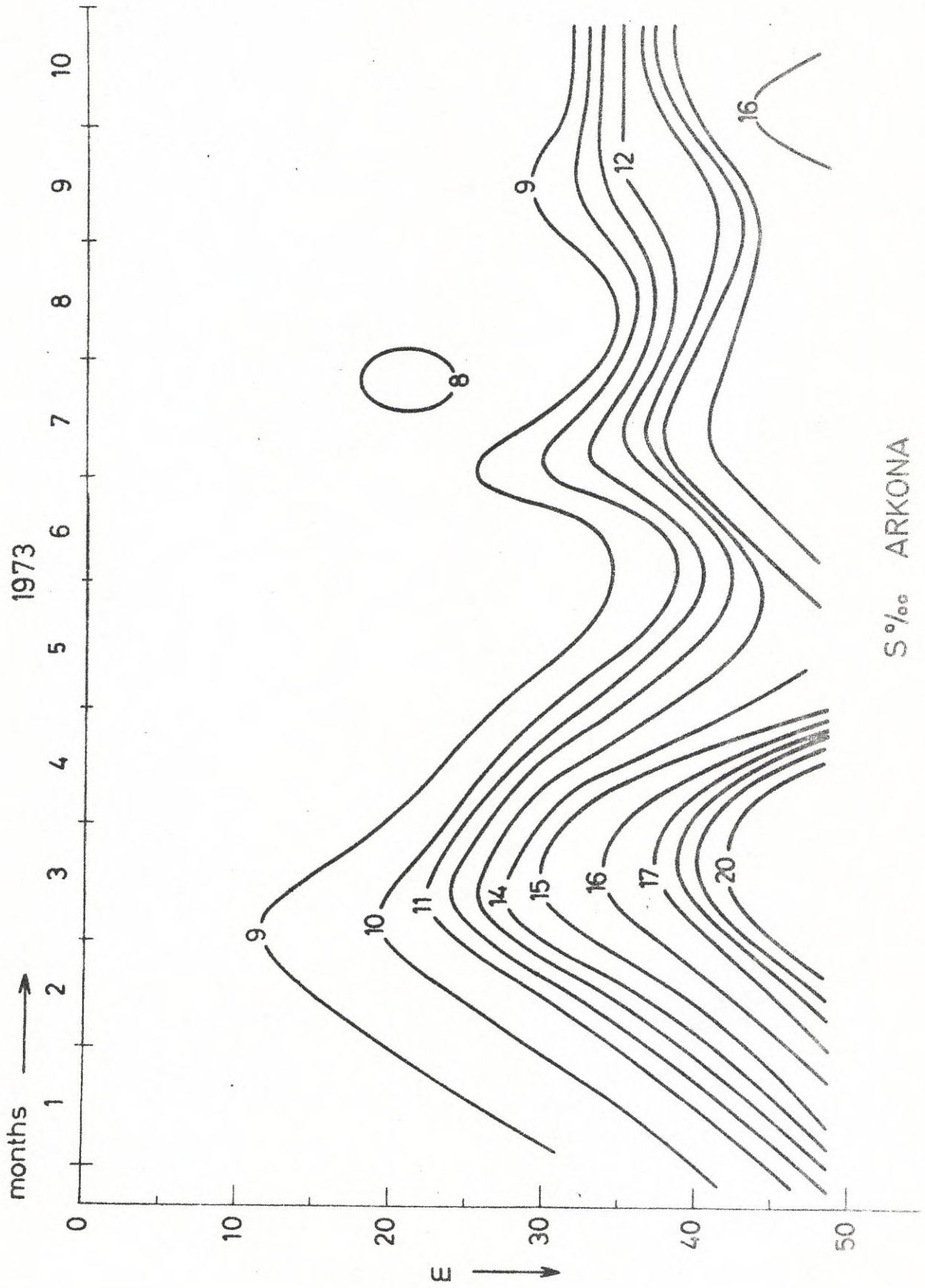
Depth m	Temp. °C	S %	O <sub>2</sub> ml/l	pH	PO <sub>4</sub> -P µgat/l	Tot.P µgat/l	Alkal. Mval/l	Si µgat/l	NO <sub>3</sub> -N µgat/l	NO <sub>2</sub> -N µgat/l	NH <sub>4</sub> -N µgat/l	Tot.N µgat/l	H <sub>2</sub> S µgat/l
January 17													
000	4.13	7.504	8.76		0.34	0.26	1.576	13.0					
070	4.26	7.732	7.75		0.52	0.93	1.586	17.0					
100	5.11	11.484	0.93		2.30	3.18	1.770	58.5					
150	5.30	12.389	0.37		3.00	4.13	1.802	68.5					
200	5.28	12.610	0.25		3.15	4.17	1.810	69.5					
225	5.12	12.669	0.56		2.96	4.01	1.825	68.5					
May 24													
000	9.07	7.558	9.28	8.27	0.11	0.42	1.609	17.5	0.09	<0.01	0.68	8.0	
070	4.51	9.906	1.55	7.32	1.85	2.36	1.647	47.0	2.4		0.29		
100	5.57	11.639	0.96	7.26	1.92	2.11	1.793	57.5	4.6	<0.01	0.77	17	
150	5.58	12.438	0.39	7.16	2.97	3.18	1.823	66.0	3.7		0.26		
200	5.29	12.607	0.12	7.15	3.26	3.57	1.840	77.5	3.3		0.42		
237	5.20	12.690	0.15	7.33	3.20	3.50	1.860	76.5	3.1		1.20		0
September 11													
000	14.56	7.188	7.26	8.22	0.1	0.40	1.539	9.0	0.09	0.02	0.92	13	
070	4.14	9.129	3.01	7.48	1.5	1.68	1.641	37.0	3.07		0.34		
100	5.13	11.108	0.53	7.34	2.4	2.42		60.0	5.22		1.51		
150	5.46	12.365	0.24	7.32	3.1	3.37	1.765	72.0	3.32		0.22		
200	5.47	12.607	0.19	7.33	3.3	3.31	1.782	77.0	3.84		0.21		
240	5.36	12.685	0	7.46	3.7	4.04	1.865	83.5	0.14	0.04	1.05	13	3.7

Landsort Deep

58°35'N 18°14'E

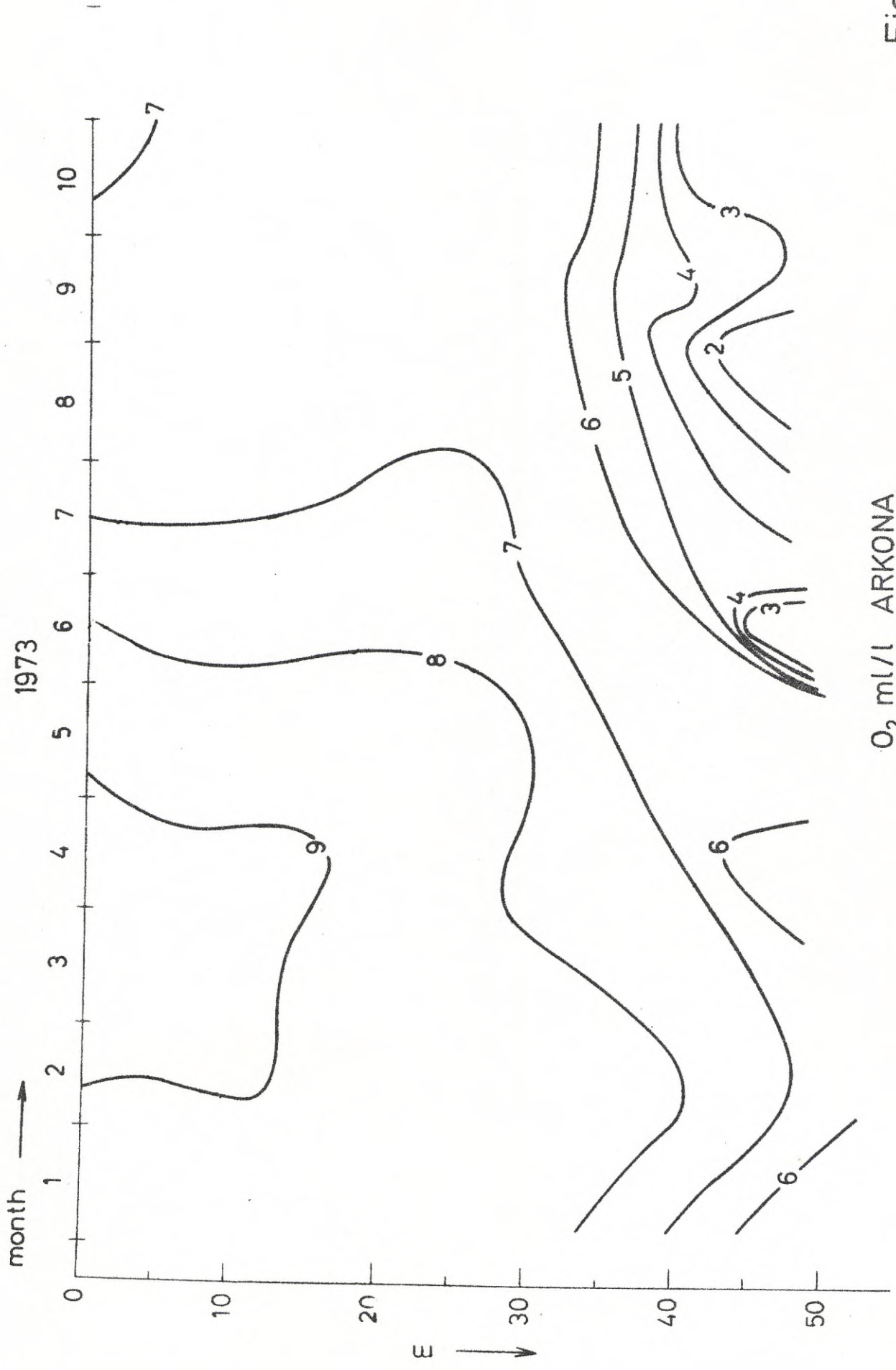
Depth m	Temp. °C	S ‰	O <sub>2</sub> ml/l	pH	PO <sub>4</sub> -P µgat/l	Tot.P µgat/l	Alkal. Mval/l	Si µgat/l	NO <sub>3</sub> -N µgat/l	NO <sub>2</sub> -N µgat/l	MH <sub>4</sub> -N µgat/l	Tot.N µgat/l	H <sub>2</sub> S µgat/l
January 15													
000	3.63	7.426	8.83		0.45	0.82	1.547	17.0					
070	3.86	8.744	4.07		1.32	1.91	1.654	34.0					
100	4.49	10.350	0.34		2.63	3.62	1.738	62.0					
150	4.74	10.725	0		2.83	4.00	1.756	67.0					2.3
200	4.78	10.844	0		2.94	4.24	1.778	68.0					7.6
425	4.89	10.980	0		2.98	4.49	1.748	69.5					9.9
May 25													
000	8.28	7.310	9.18	8.31	0.19	0.68	1.558	18.5	0.05	<0.01	1.00	9.7	
070	3.95	9.034	3.25	7.37	1.77	2.01	1.676	43.0	1.44		0.32		
100	4.46	10.596	0.25	7.07	2.82	2.98	1.730	67.0	1.26	<0.01	0.39	10	
150	4.71	10.725	0	7.06	3.00	3.35	1.779	71.0	<0.05		1.72		2.3
200	4.75	10.802	0	7.06	3.13	3.39	1.773	72.0	0.08		1.92		1.5
440	4.83	10.946	0.16	7.06	2.91	3.22	1.761	69.0	2.48		0.94		0
September 19													
000	11.72	6.847	8.21	8.13	0.21	0.52	1.449	12.5	0.12	0.05	0.99	27	
070	4.41	10.107	0.32	7.33	2.77	2.93	1.704	54.0	1.52		0.51		
100	4.72	10.699	0.09	7.38	2.81	3.01	1.723	56.0	1.77		0.59		
150	4.92	10.971	0.11	7.34	2.72	2.95	1.752	57.5	2.15		0.44		
200		11.059	0.11		2.88	2.99	1.746	57.5	2.48		0.31		
440	5.04	11.208	0.18	7.32	2.74	2.96	1.762	59.0	3.56	0.07	0.74	18	0





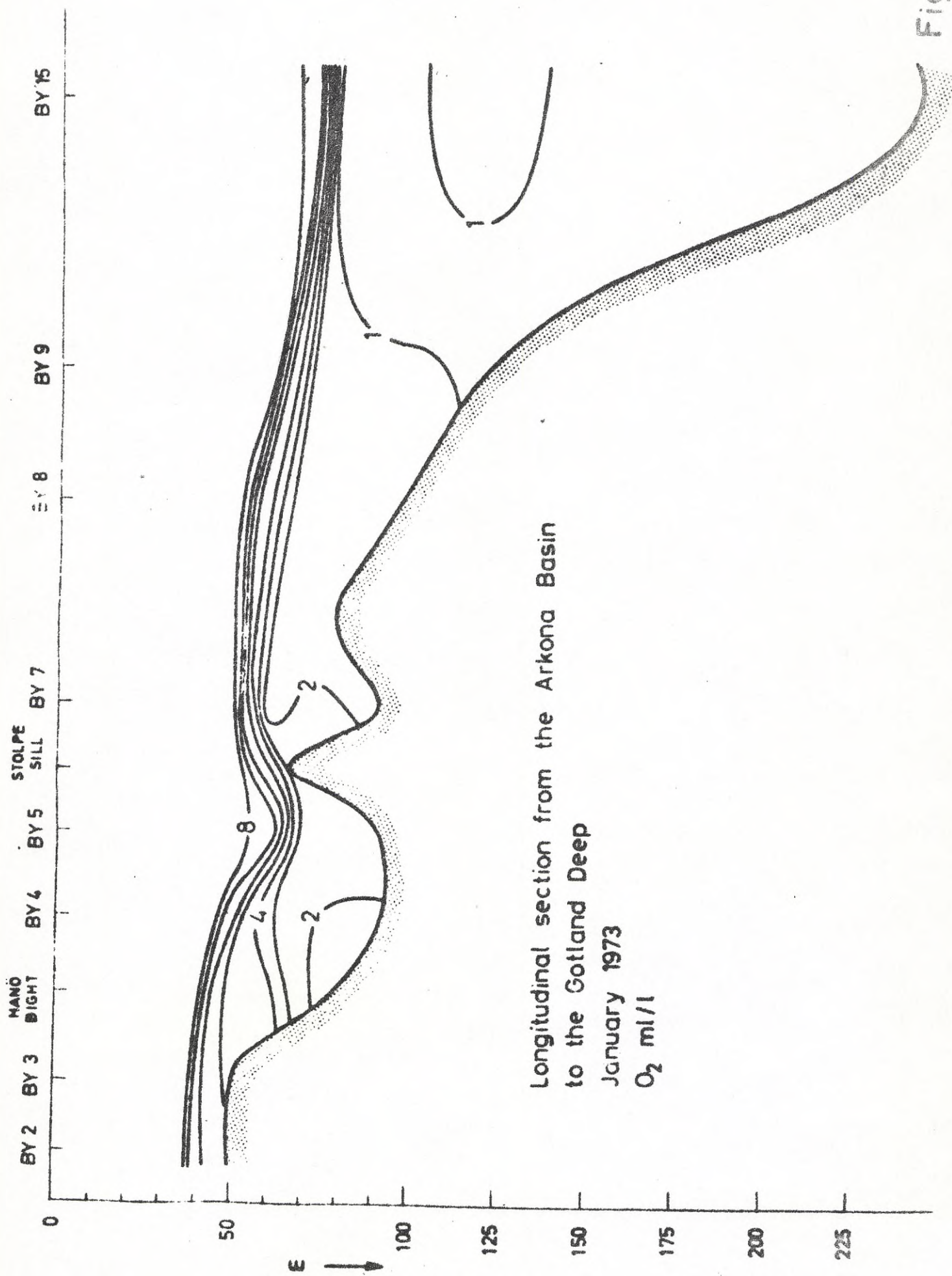
S‰ ARKONA

Fig. 1

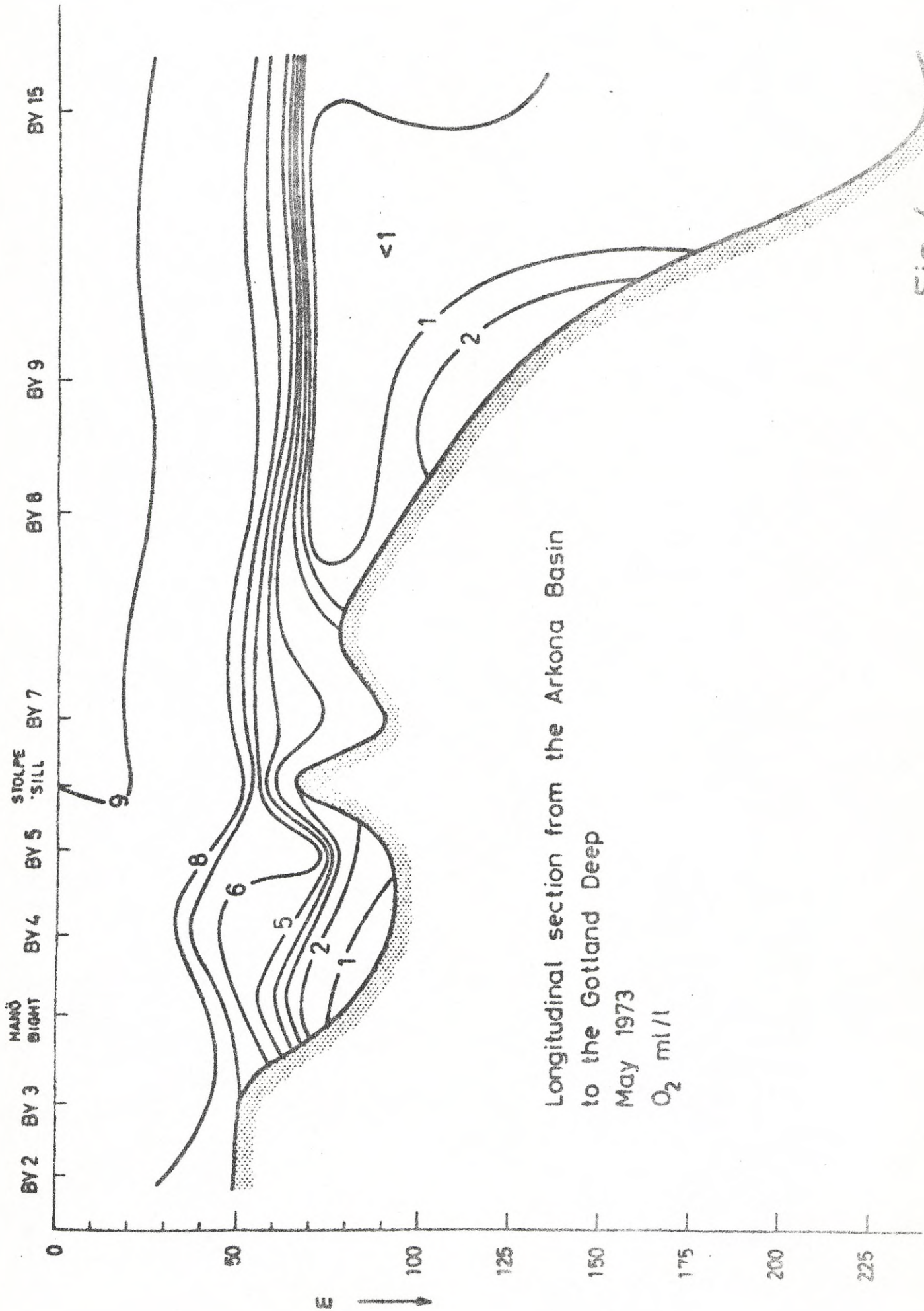


O<sub>2</sub> ml/l ARKONA

Fig. 2

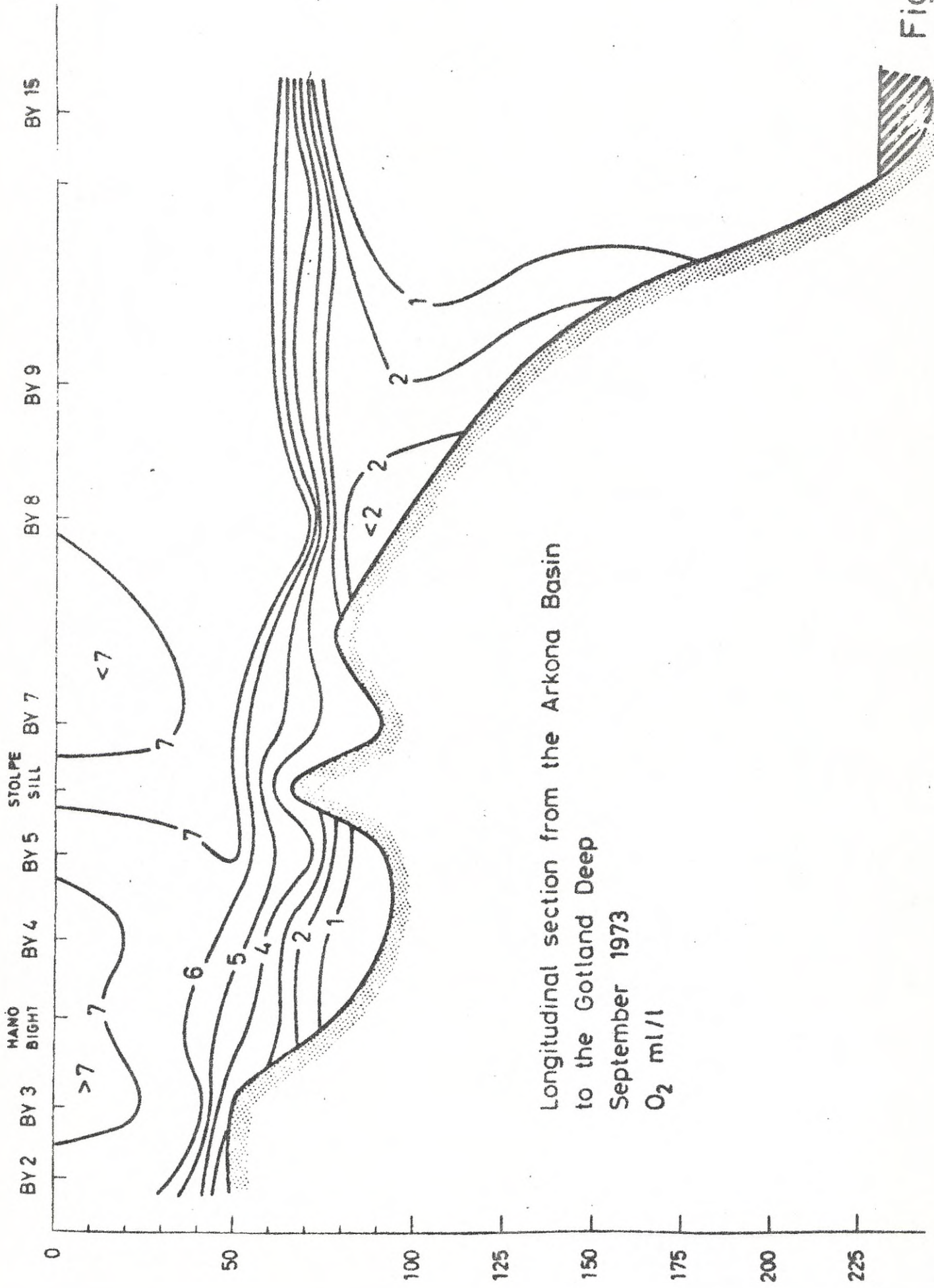


Longitudinal section from the Arkona Basin  
to the Gotland Deep  
January 1973  
O<sub>2</sub> ml/l



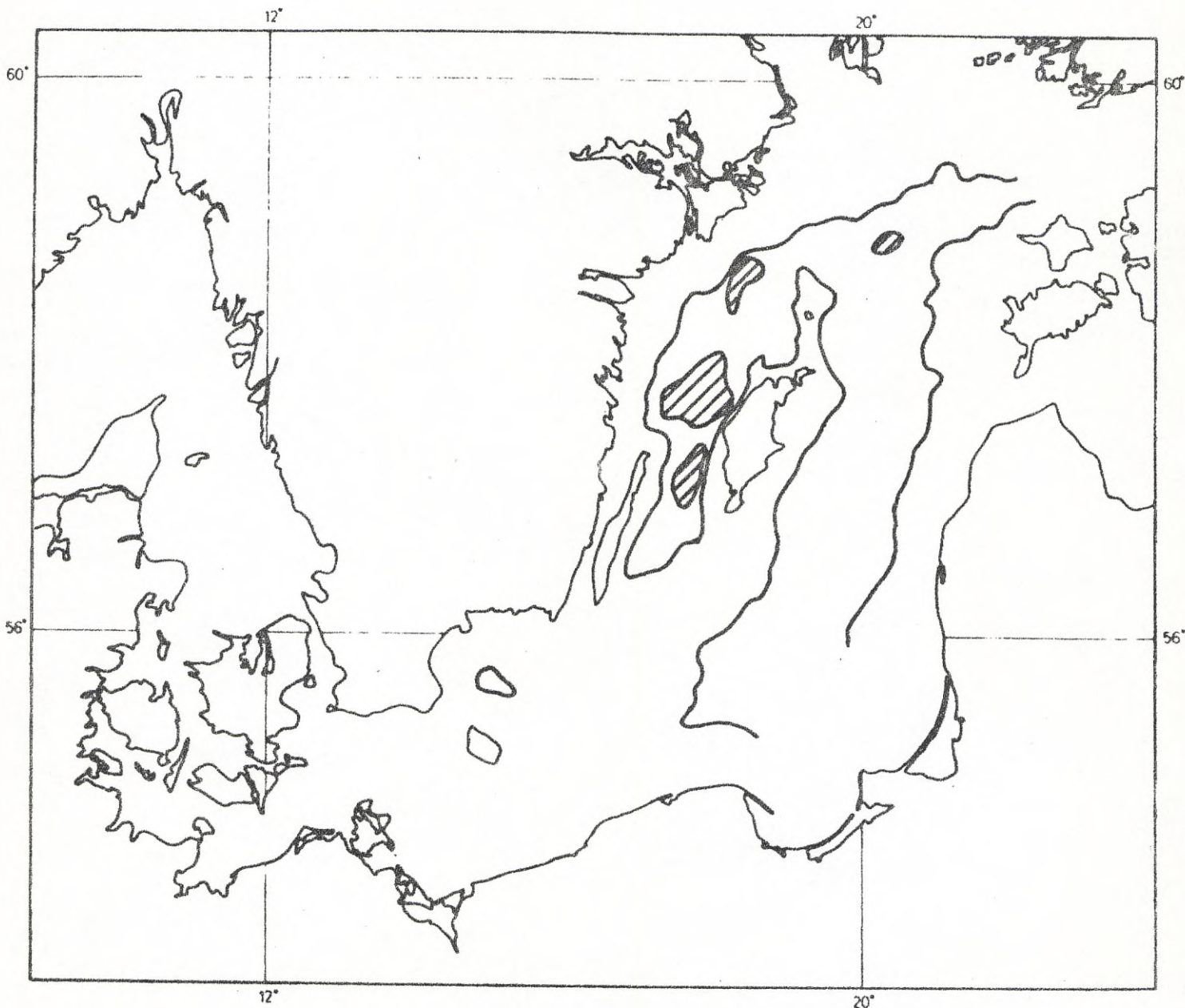
Longitudinal section from the Arkona Basin  
 to the Gotland Deep  
 May 1973  
 $O_2$  ml/l

Fig. 4

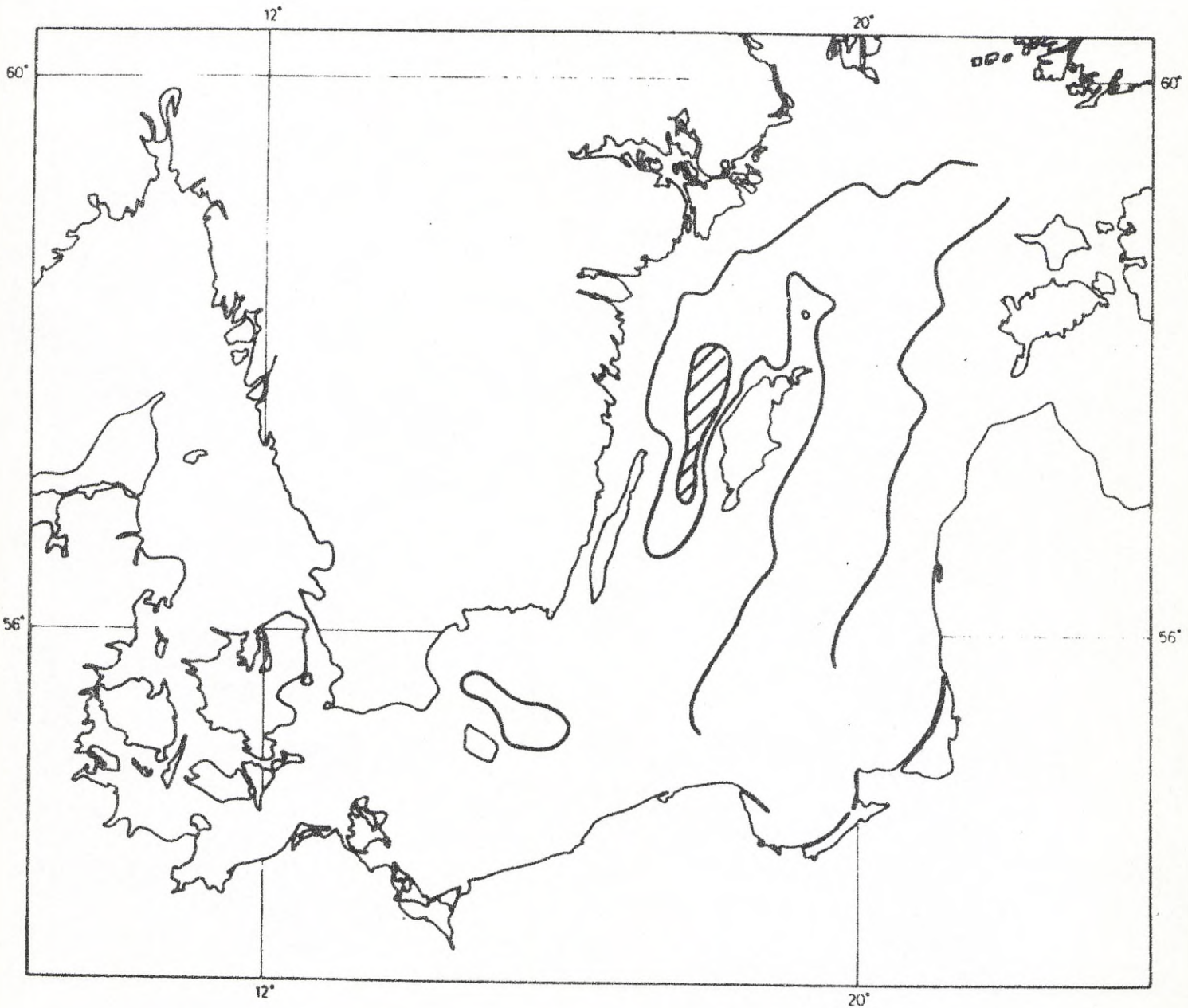


Longitudinal section from the Arkona Basin  
to the Gotland Deep  
September 1973  
 $O_2$  ml/l

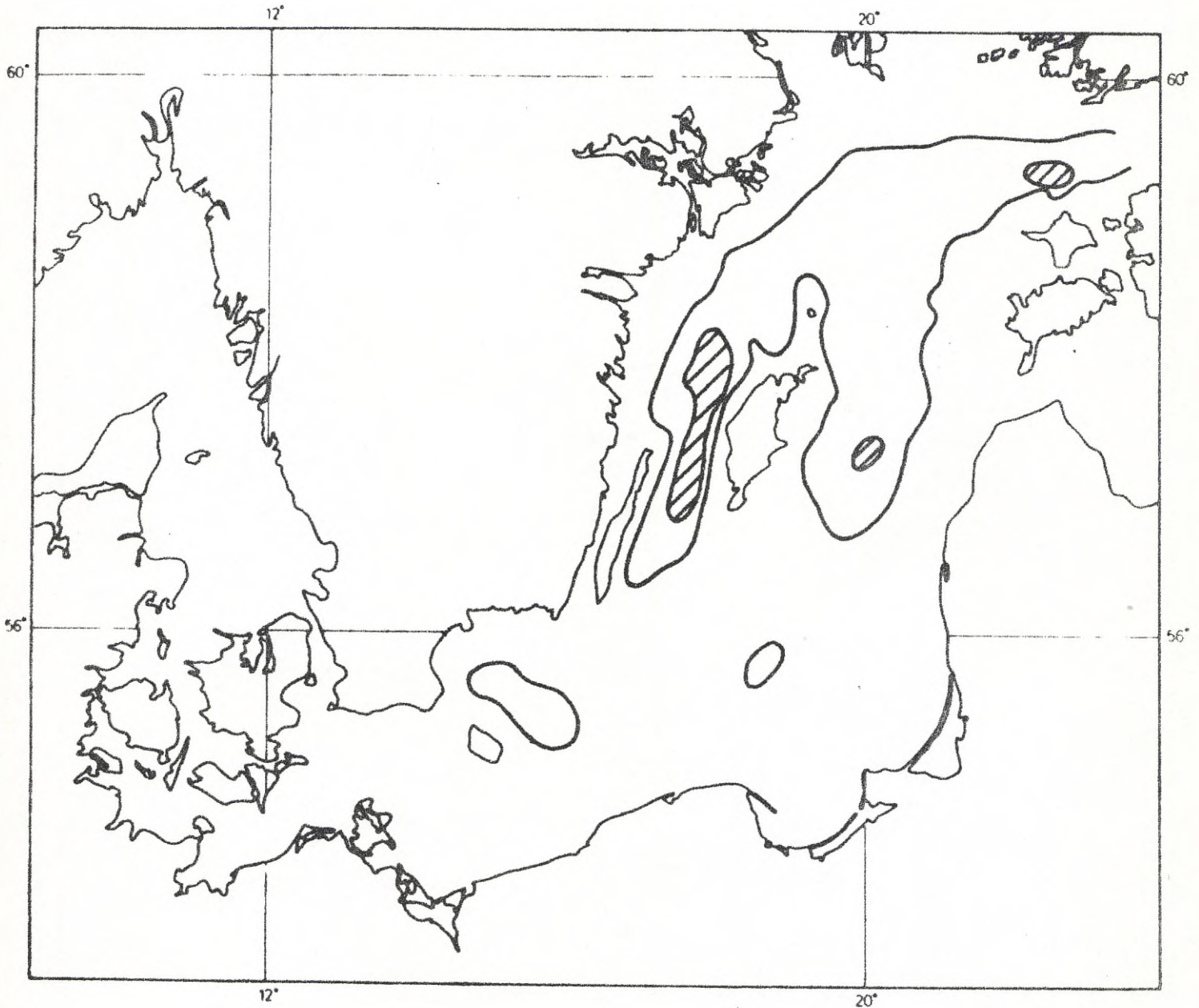
——  $O_2 < 2 \text{ ml/l}$   
////  $H_2S$



——  $O_2 < 2 \text{ ml/l}$   
////  $H_2S$



—  $O_2 < 2 \text{ ml/l}$   
////  $H_2S$





## Hydrography of the Kattegat and the Skagerrak Area 1973.

In Figures 1 and 2 results of daily measurements at Bornö station (  $58^{\circ} 22.85'N, 11^{\circ} 35.05'E$  ) in the Gullmar fiord are presented as deviations in temperature and salinity from the mean values 1931 - 1960 (cf Svansson 1974 regarding long-term means of salinity). The mean annual deviations at 5 m depth were 0.0 ‰ S and +0.6 °C.

Total phosphorus was measured once a month at 10 depths, 0 - 90 m, at a position  $57^{\circ} 17.0'N, 11^{\circ} 02.0'E$ . Mean values of measurements at 0, 10 and 20 m were 0.9, 0.7, 0.7, 0.7, 0.6, 0.5, 0.5, 1.1 (!), --, 0.6, 0.6 and 0.7  $\mu\text{gat/l}$  respectively.

Table 1 presents the oxygen saturation values at a station in the northern Kattegat. The minimum (at 50 m depth) occurred in September, which is quite normal.

Table 2 shows that only very small changes occurred in the Skagerrak Deep.

For positions see Fig. 3.

Artur Svansson

### Reference:

Svansson, A., 1974: Decade Mean Values of Salinities Measured on Swedish Lightships 1880 - 1970. Meddelande från Havsfiskelaboratoriet, No 162.

Table 1.

## Percentage Oxygen Saturation at 57°11.5'N 11°40'E (Fladen).

Depth m	Jan. 19	Febr. 19	Mar. 22	Apr. 9	Apr. 24	May 29
30	97	101	94	98	90	90
40	96	89	94	95	87	87
50	96	98	94	93	86	88
60	96	96	94	91	85	90
70	93	95	95	91	85	88

Depth m	June 30	Aug. 2	Sep. 11	Oct. 18	Oct. 15	Nov. 17
30	89	80	85	89	82	96
40	84	77	72	85	84	92
50	84	76	67	82	83	92
60	83	75	67	78		91
70	83	75	65	77	75	89

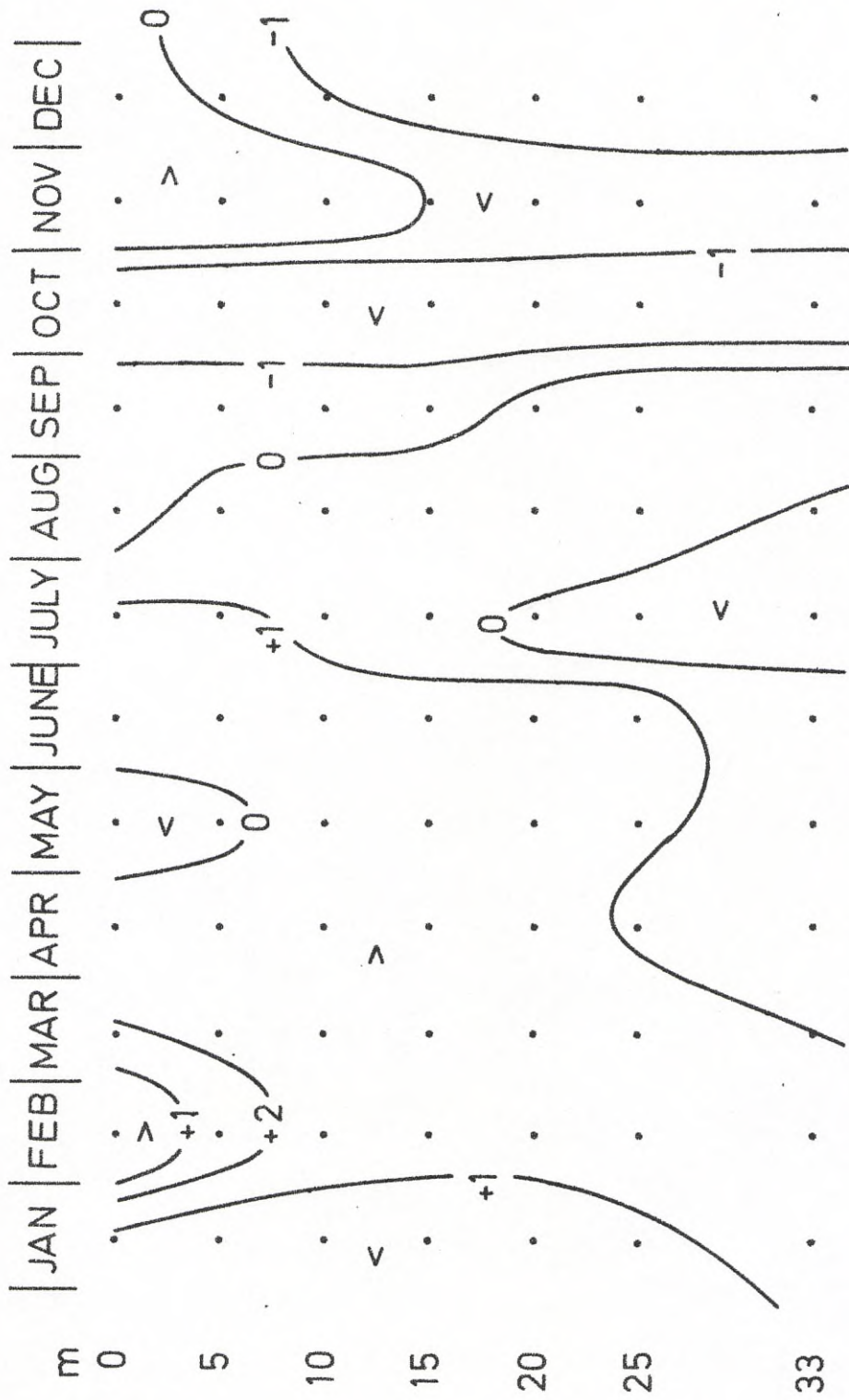
Table 2.

M 6

58°10'N 09°30'E

Depth m	Temp. °C	S ‰	O <sub>2</sub> ml/l
January 30			
200	7.49	35.203	6.20
300	6.47	35.144	5.93
400	5.89	35.130	6.06
500	5.61	35.121	6.07
600	5.51	35.116	6.05
March 27			
200	7.11	35.173	6.14
300	6.19	35.139	6.10
400	5.86	35.129	6.11
500	5.68	35.120	6.07
600	5.65	35.118	6.08
August 22			
200	7.12	35.191	6.69
3-400	6.77	35.184	6.49
400	6.01	35.126	6.11
500	5.81	35.122	6.05
600	5.75	35.122	6.01
October 17			
200	7.16	35.191	6.20
300	6.99	35.203	6.75
400	6.25	35.153	5.88
500	5.84	35.128	6.02
600	5.64	35.127	5.93

Fig. 1.



Bornö 1973  
Temperature Deviations °C

Fig. 2.



Bornö 1973

Salinity Deviations ‰

Fig. 3.

