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Ödsmål, Kville sn, Bohuslän

Hällristning
Fiskare från
bronsåldern

Rock carving
Bronze age
fishermen



MEDDELANDE från

HAVSFISKELABORATORIET · LYSEKIL

Hydrografiska avdelningen, Göteborg

nr
210

Observations along the Swedish Coast and
in the Deep Basins in the Baltic, 1975.
by Sven Engström and Stig Fonselius

Hydrography of the Kattegat and the
Skagerrak Area, Swedish Observations, 1975
by Artur Svansson

(Contributions to ICES "Annales Biologiques")

December 1976

Hydrography of the Kattegat and the Skagerrak Area 1975

In the Figures 2 and 3 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. All temperature deviations were positive.

Temperature, salinity and total phosphorus were measured 10 times at a position $N 58^{\circ} 17'$, $E 11^{\circ} 02'$ at 10 depths. Data were published in Anon. (1976).

The Skagerrak Deep (M 6) was visited 5 times during the year (Table 1). Temperature dropped slightly which may indicate a small renewal of water with rise in oxygen content.

Table 2 shows the oxygen saturation values at station Fladen in N. Kattegat. The deep minimum apparently occurred quite normally in September; there are few measurements thereafter, however.

Since August 1974 there is a project of determining transports of water and matter through a section Frederikshavn - Göteborg. In connection with this project total phosphorus was measured once a day at the Danish lightvessel Läsö Nord, later Läsö Trindel, simultaneously with the ordinary hydrographic work. Table 3 presents monthly means. Whereas simultaneous values differ only slightly vertically, there is a maximum in February and minimum in June - August.

Reference:

Anon. 1976: Oceanographical Data 1975, Swedish Coast Guard, Meddelande från Havs fisklaboratoriet, Nr. 198.

Artur Svansson

Table 1

M 6 58°10'N 09°30'E

Depth m	Temp. °C	S ‰	O ₂ ml/l
February 16			
200	7.12	35.095	6.19
300	6.59	35.132	6.15
400	6.26	35.132	6.24
500	6.12	35.124	6.32
600	6.03	35.129	6.31
April 14			
200	7.04	35.094	6.42
300	6.75	35.143	6.23
400	6.48	35.146	6.57
500	6.24	35.147	6.10
600	6.10	35.144	6.06
July 02			
200	6.48	35.122	6.69
300	6.27	35.131	6.64
400	6.09	35.138	6.42
500	6.02	35.138	6.63
600	5.92	35.138	6.75
August 25			
200	6.42	35.122	6.49
300	6.19	35.132	6.38
400	6.07	35.132	6.34
500	6.00	35.131	6.44
600	5.96	35.135	6.58
October 23			
200	6.53	35.130	6.44
300	6.35	35.133	6.44
400	6.14	35.136	6.41
500	6.03	35.140	6.37
600	5.95	35.141	6.56

Table 2.

Percentage Oxygen Saturation at 57°11.5'N 114°40'E (Fladen O₂%)

Depth m	Jan. 12	Feb. 05	Feb. 08	Mar. 03	Mar. 21	Apr. 19	May 20
30	103	100	97	99	96	97	96
40	106	100	97	97	92	94	95
50	92	100	97	97	93	94	92
60	92	99	96	97	91	92	93
70	92	99	96	96	91	92	94

	May 30	June 23	Aug. 09	Sep. 11	Sep. 17	Oct. 29	Dec. 11
30	92	95	79	84	95	88	103
40	89		72	74	93	84	101
50	89	84	69	70	76	82	93
60	91	84	68	68	66	83	96
70	89	81	67	65	65	83	96

Fig. 1.

Stations referred to in the text.

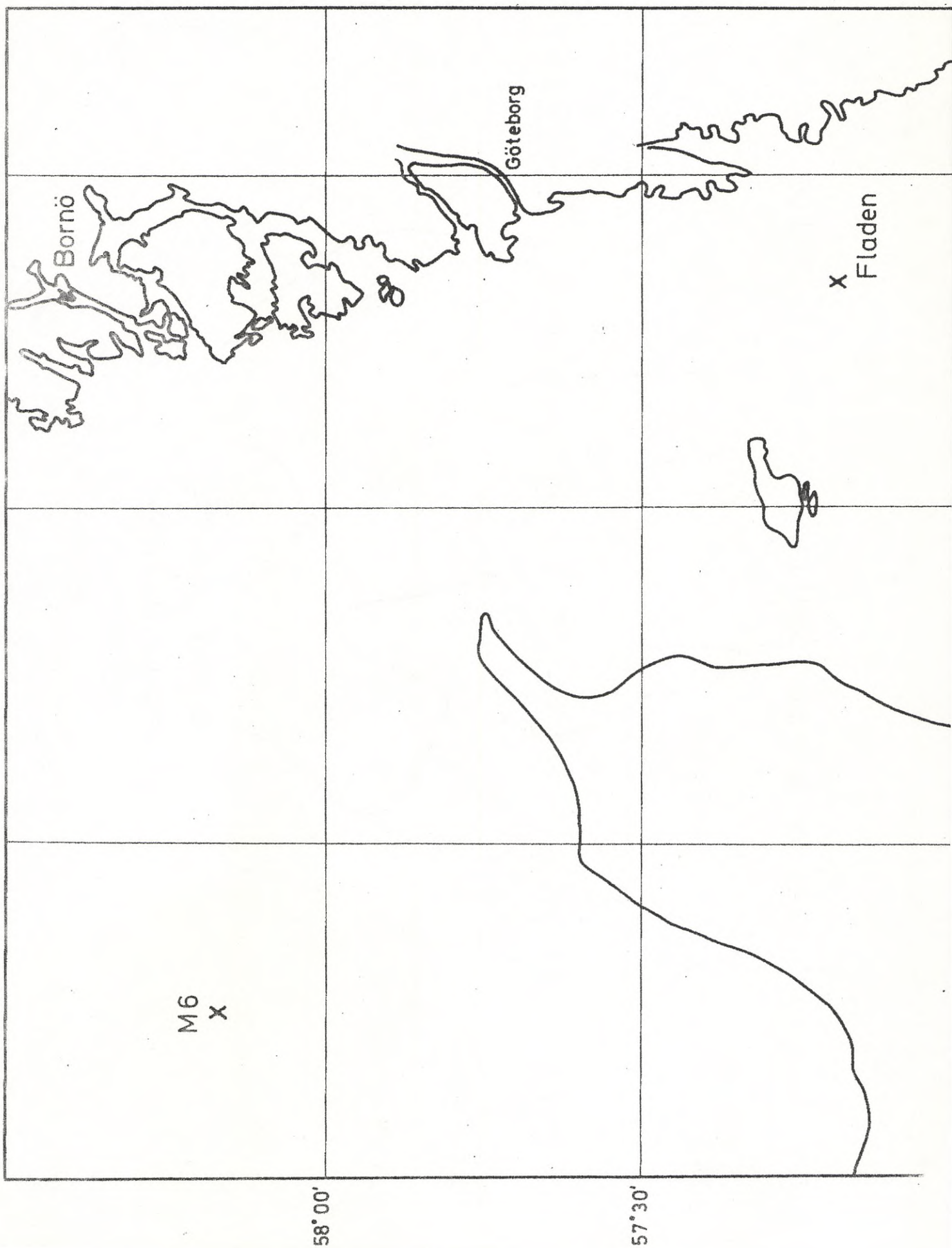


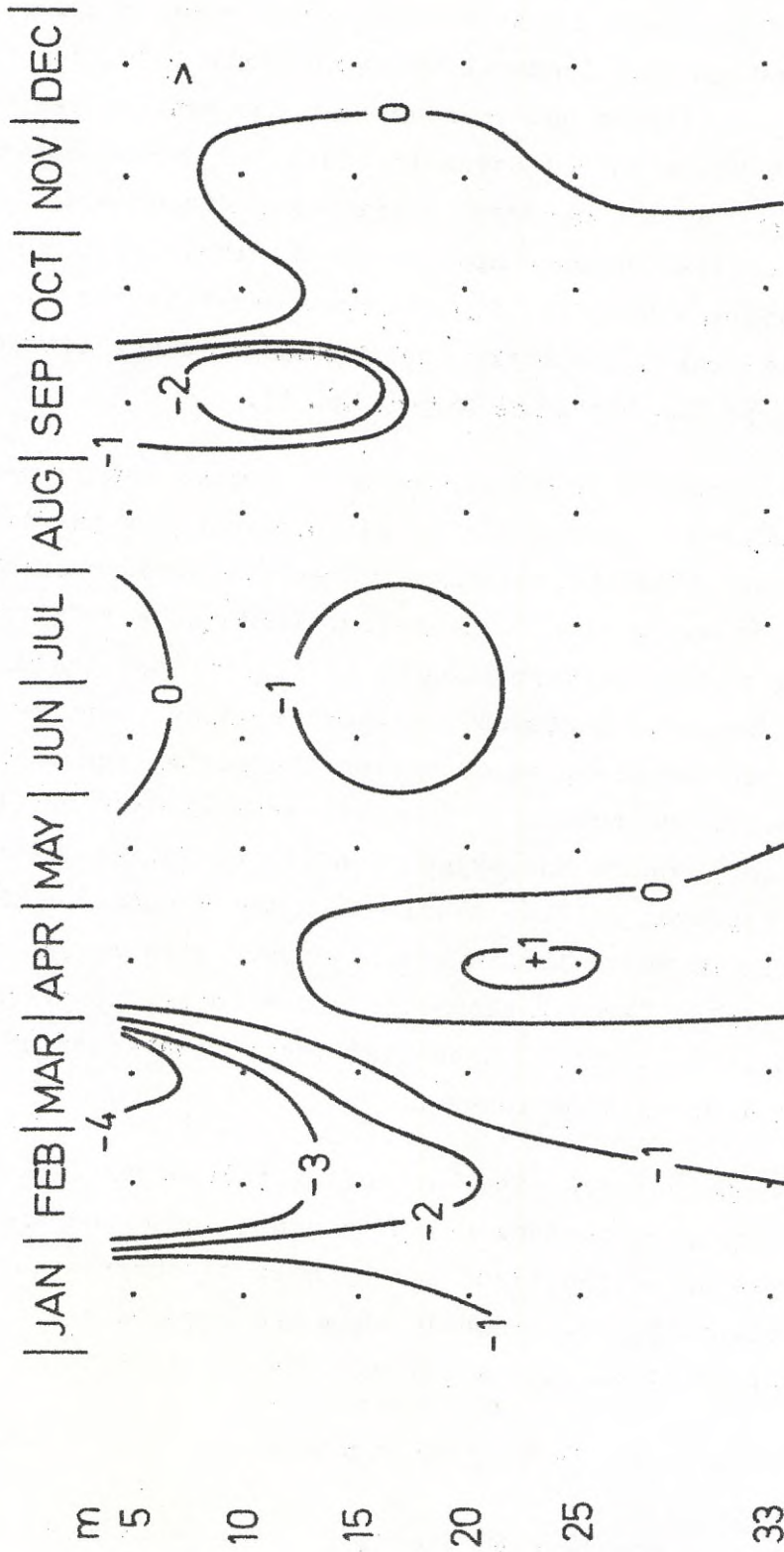
Fig. 2.



BORNÖ 1975

Temperature Deviations °C

Fig. 3.



BORNÖ 1975

Salinity Deviations ‰

Observations along the Swedish coast and in the Deep Basins in the Baltic in 1975 and the beginning of 1976.

In the Baltic the oxygen situation in the deep water was severe already in the beginning of the year. Small amounts of hydrogen sulfide were found in the Gotland and the Landsort Deeps in March (fig. 1). In May-June the hydrogen sulfide had increased in the eastern parts of the Baltic (fig. 2). Now also the Bornholm basin had become contaminated, but in the Landsort Deep the hydrogen sulfide had disappeared. In September the oxygen conditions had impaired in the whole Baltic proper, except in the Landsort Deep (fig. 3). In November-December the hydrogen sulfide disappeared from the Western Gotland Basin, but a little contamination was found in the Landsort Deep (fig. 4).

The severe winter storms in December, however, forced in new water through the sounds. Fig. 5 shows the salinity changes in the Arkona Basin. It can be seen that the salinity suddenly increased in the bottom water after the last expedition in December. In January 1976 the salinity in the bottom water was more than 20 ‰. Fig 6 shows the oxygen conditions in the Bornholm Basin during the same time. Here we can see how the hydrogen sulfide disappeared during the winter and that the oxygen value close to the bottom at 90 m was as high as 6.28 ml/l, in January 1976. Fig. 7 shows the oxygen conditions in the Gotland Deep during 1975. The hydrogen sulfide remained in the deep water through the whole year. Fig. 8 shows the inflow of oxygen rich water into the Baltic, measured by the "Argos" along the standard section from BY 3 to BY 15 in March 1976. It is obvious that the bottom water of the Gotland Deep very soon will be renewed.

Surface water with higher salinity was during the autumn forced into the Baltic. The increased surface salinity can be observed along the whole Swedish coast up to the Åland Sea by help of observations from the coast guard ships. Fig:s. 9 and 10 show the surface salinities at the coast guard observation points during 1974 and 1975.

Sven G. Engström and Stig H. Fonselius

Acknowledgement.

This work has been supported with grants from the National Swedish Environment Protection Board, contracts No. 7-69/76, 7-66/75 and 7-66/76.

Table 1a.

Arkona Deep

55°00'N 14°05'E

Depth m	Temp. °C	S ‰	O ₂ ml/l	pH	PO ₄ -P µgat/l	Tot.P µgat/l	Alkal. Mval/l	Si µgat/l	NO ₃ -N µgat/l	NO ₂ -N µgat/l	NH ₄ -N µgat/l	Tot.N µgat/l
January 28												
000	5.51	8.377	8.39			0.82						
010	5.46	8.418	8.29									
030	5.43	8.541	8.27									
047	6.82	14.583	6.17			1.47						
March 4												
000	3.72	8.189	9.19	8.24	0.29	0.75	1.528	21.5	2.4	0.15	0.31	13
010	3.68	8.183	9.19	8.24	0.56	0.72	1.523	21.5	2.6	0.15	0.24	
030	3.62	8.557	8.94	8.22	0.58	0.79	1.528	21.0	2.9	0.15	0.34	11
045	5.53	12.612	6.34	7.96	1.02	1.25	1.670	32.5	8.4	0.10	0.17	
May 21												
000	8.42	8.057	8.68	8.34	0.07	0.50	1.534	6.5	0.3	0.00	0.99	18
010	8.43	8.055	8.69	8.36	0.06	0.48	1.539	7.5	0.1	0.00	0.95	17
030	6.15	8.234	8.59	8.30	0.14	0.42	1.532	8.5	0.1	0.00	1.01	21
040	4.33	8.789	7.81	8.08	0.32	0.69	1.553	10.5	0.1	0.00	1.92	25

Arkona Deep
55°00'N 14°05'E

Depth m	Temp. °C	S ‰	O ₂ ml/l	pH	PO ₄ -P µgat/l	Tot.P µgat/l	Alkal. Mval/l	Si µgat/l	NO ₃ -N µgat/l	NO ₂ -N µgat/l	NH ₄ -N µgat/l	Tot.N µgat/l
June 24												
000	14.61	8.074	7.62	8.24	0.13	0.41		11.0				
010	13.83	8.063	7.71	8.31	0.14	0.40		11.0				
030	6.51	8.126	7.70	8.06	0.36	0.63		13.5				
047	8.81	15.120	4.06	7.76	0.98	1.37		33.0				
September 10												
000	18.73	7.820	6.50	8.26	0.13	0.57	1.577	12.5	0.08	0.01	1.05	15.0
010	18.69	7.819	6.56	8.31	0.09	0.46	1.574	13.0	0.06	0.01	0.80	16.9
030	11.00	8.120	6.25	7.95	0.41	0.63	1.566	17.0	0.13	0.17	0.51	13.9
048	14.50	13.376	1.66	7.50	1.26		1.747	46.0	6.31	0.13	0.29	24.7
December 10												
000	6.79	8.953	8.27		0.48			14.0	2.7	0.30	0.82	
010	6.77	8.953	8.27		0.54			13.5	2.7	0.31	0.92	
030	5.90	11.674	8.14		0.76			19.0	3.7	0.41	1.49	
049	8.12	17.889	6.20		1.01			22.0	4.7	0.20	1.45	

Table 1b.

Bornholm Deep
55° 15'N 15° 59'E

Depth m	Temp. °C	S ‰	O ₂ ml/l	pH	PO ₄ -P µgat/l	Tot.P µgat/l	Alkal. Mval/l	Si µgat/l	NO ₃ -N µgat/l	NO ₂ -N µgat/l	NH ₄ -N µgat/l	Tot.N µgat/l	H ₂ S µgat/l
January 22													
000	4.77	7.727				0.69							
010	4.86	7.726											
030	4.81	7.774											
050	5.38	8.858	6.10										
070	8.45	14.542	1.42										
090	7.33	15.490	0.39	6.11									
March 5													
000	3.81	7.870	8.93	8.13	0.56	0.79	1.537	21.5	2.4	0.05	0.32	13	
010	3.79	7.867	8.94	8.18	0.59	0.78	1.509	21.0	1.8	0.05	0.65		
030	3.79	7.869	8.90	8.18	0.57	0.74	1.516	21.0	1.6	0.03	0.16		
050	3.82	7.876	8.86	8.18	0.57	0.81	1.542	21.0	2.6	0.04	0.18		
070	8.51	13.929	2.19	7.50	1.56	1.71	1.720	50.5	6.4	<0.02	0.07	21	
090	6.21	15.451	0.27	7.43	1.98	2.06	1.844	83.0	4.2	0.06	0.32	15	
June 4													
000	8.63	8.021	8.41	8.22	0.19	0.64	1.535	12.5	0.1	0.01	1.28	29	
010	8.66	8.027	8.41	8.28	0.19	0.51	1.524	11.0	0.1	0.01	0.64		
030	7.99	8.042	8.38	8.27	0.20	0.52	1.524	12.0	0.1	0.01	2.10		
050	4.10	8.101	8.28	8.08	0.48	0.78	1.529		0.2	0.03	1.33		
070	7.76	13.692	1.25	7.40	1.64	2.04	1.724	55.0	7.5	0.03	0.34		
090	7.42	15.291		7.42	5.54	6.28	1.884	85.0	0.2	0.00	2.55	34	

Table No.

3.5

Bornholm Deep

55°15'N 15°59'E

Depth m	Temp. °C	S ‰	O ₂ ml/l	pH	PO ₄ -P µgat/l	Tot.P µgat/l	Alkal. Mval/l	Si µgat/l	NO ₃ -N µgat/l	NO ₂ -N µgat/l	NH ₄ -N µgat/l	Tot.N µgat/l	H ₂ S µgat/l
June 25													
000	13.82	7.874	7.76	8.23	0.24	0.54		11.5					
010	13.68	7.853	7.79	8.32	0.22	0.54		11.5					
030	7.47	7.885	8.26	8.22	0.33	0.58		12.0					
050		8.066	8.20		0.63	0.74		16.5					
070	7.34	13.145	1.64	7.42	1.83	1.96		50.0					
091	7.71	15.055	0	7.39	4.43	4.97		89.0					3.0
September 9													
000	18.43	7.976	6.60	8.23	0.08	0.45	1.552	13.0	0.05	0.03	1.15	14.2	
010	18.42	7.974	6.55	8.30	0.11	0.44	1.570	11.5	0.05	0.02	0.28	14.3	
030	9.67	7.904	7.10	8.03	0.41	0.75	1.555	13.5	0.05	0.04	0.17	14.4	
050	5.15	8.031	7.59	7.94	0.57	0.80	1.555	18.5	0.22	0.17	0.28	11.9	
070	7.13	11.526	2.61	7.49	1.55	1.77	1.692	54.5	5.78	0.05	0.35	39.7	
091	7.64	14.984	0	7.45	9.50	10.43	1.947	87.0	0.05	0.04	9.59	27.1	6.7
November 24													
000	8.41	8.044	7.83	8.56	0.43	0.56		33.5	2.0	0.28	0.66	16	
010	8.44	8.036	7.83	8.61	0.54	0.51		35.0	2.0	0.27	0.14	15	
030	8.50	8.035		8.16	0.40	0.49		29.0	2.0	0.25	0.20	15	
050	8.54	8.062	7.71	8.60	0.40	0.53		26.0	2.0	0.25	0.12	13	
070	9.62	13.308	1.53	7.87	2.76	2.80		102	8.9	0.03	0.08	17	
092	8.10	14.913	0	7.92	9.39	9.39		112	0.2	0.01	8.17	21	1.5

Table 2b.

Gotland Deep
57°20'N 20°00'E

Depth m	Temp. °C	S ‰	O ₂ ml/l	pH	PO ₄ -P µgat/l	Tot.P µgat/l	Alkal. Mval/l	Si µgat/l	NO ₃ -N µgat/l	NO ₂ -N µgat/l	NH ₄ -N µgat/l	Tot.N µgat/l	H ₂ S µgat/l
March 14													
000	3.63	7.820	9.07	8.19	0.51	0.77	1.526	17.0	2.8	0.04	0.56	14	
070	3.51	7.832	8.96	8.25	0.54	0.68	1.521	17.0	3.0	<0.02	0.15		
100	5.34	11.172	0.93	7.43	2.33	2.44	1.651	61.5	5.9	<0.02	0.15		
150	5.58	12.299	0.36	7.40	2.79	2.85	1.706	75.5	4.7	<0.02	0.66		
200	5.50	12.511	0	7.47	4.34	4.52	1.774	91.0	<0.1	<0.02	1.78	12	3.0
240	5.48	12.565	0	7.53	5.58	6.60	1.812	106.0	<0.1	<0.02	6.42		21.8
June 2													
000	7.13	7.609	9.02	8.35	0.10	0.53	1.556	11.0	0.1	0.00	1.04	39	
070	4.02	8.084	7.42	7.93	0.52	0.75	1.549	22.0	0.6	0.06	1.10		
100	5.32	10.766	0.94	7.34	2.16	2.42	1.643	58.5	5.6	0.04	1.01		
150	5.61	11.996	0.55	7.32	2.48	2.73	1.681	68.0	5.7	0.03	0.87		
200	5.51	12.456	0	7.37	3.95	4.36	1.752	81.5	0.0	0.01	2.16		2.5
240	5.57	12.525	0	7.30	5.34	6.18	1.799	91.0	0.0		5.96	30	16.5
June 29													
000	12.03	7.471											
070	4.26	8.118	5.38										
100	5.31	10.628	0.89										
150	5.63	11.941	0.61										
200	5.53	12.440	0										
240	5.49	12.563	0										

Table 3a.

Gotland Deep

57° 20' N 20° 00' E

Depth m	Temp. °C	S ‰	O ₂ ml/l	pH	PO ₄ -P µgat/l	Tot.P µgat/l	Alkal. Mval/l	Si µgat/l	NO ₃ -N µgat/l	NO ₂ -N µgat/l	NH ₄ -N µgat/l	Tot.N µgat/l	H ₂ S µgat/l
September 4													
000	18.90	6.983	6.39	8.37	0.06	0.49	1.470	10.5	0.03	0.01	0.39	18.3	
070	4.17	8.418	5.36	7.62	1.06	1.19	1.574	26.5	1.83	0.04	0.28	12.5	
100	5.42	11.012	0.65	7.33	2.45	2.50	1.666	54.5	5.92	0.02	0.06	20.4	
150	5.61	12.064	0.27	7.32	2.94	2.99	1.714	63.0	4.66	0.04	0.12	14.9	
200	5.54	12.448		7.38	4.44	4.65	1.782	74.0	0.01	0.01	1.80	10.9	8
240	5.47	12.530		7.42	6.37	7.21	1.836	84.5	0.01	0.00	8.45	25.6	28.5
November 25													
000	7.70	7.360	8.05		0.20	0.46		17.0	1.5	0.24	0.54	16	
070	4.26	8.004	6.31		0.80	0.93		28.0	3.5	0.02	0.00	14	
100	5.20	10.417	0.76		2.75	2.71		72.0	8.6	0.00	0.00	19	
150	5.63	11.907	0.23		3.00	3.13		86.5	4.6	0.03	0.00	15	
200	5.54	12.415			4.05	4.36		115	0.2	0.00	1.68	12	
240	5.54	12.504			5.22	6.28		112	0.2	0.00	2.71	16	

Table 3b.

Landsort Deep
58°35'N 18°14'E

Depth m	Temp. °C	S ‰	O ₂ ml/l	pH	PO ₄ -P µgat/l	Tot.P µgat/l	Alkal. Mval/l	Si µgat/l	NO ₃ -N µgat/l	NO ₂ -N µgat/l	NH ₄ -N µgat/l	Tot.N µgat/l
March 12												
000	3.30	7.651	9.24	8.17	0.54	0.64	1.502	18.5	3.2	0.06	0.38	17
070	4.71	7.929	7.93	8.06	0.81	0.86	1.516	23.0	3.1	<0.02	0.16	
100	4.81	10.444	0.65	7.41	2.82	2.73	1.647	67.0	2.6	0.02	0.13	
150	4.92	10.934	0.24	7.38	3.11	2.97	1.670	73.0	0.7	0.03	0.21	
200	4.96	10.997	0.25	7.40	3.16	3.11	1.680	73.0	0.3	0.08	0.13	8
440	5.03	11.140	0	7.41	4.13	4.25	1.712	76.0	<0.1	<0.02	2.05	
May 22												
000	7.05	6.383	8.87	8.25	0.08	0.52	1.324	18.0	0.05	0.03	1.00	13
070	4.63	9.437	2.39	7.42	2.02	2.59	1.597		2.83	0.11	0.93	17
100	4.86	10.435	0.84	7.32	2.62	2.81	1.645	69.5	2.85	0.04	0.94	17
150	4.97	10.751	0.58	7.32	2.69	2.77	1.652	69.5	3.37	0.03	0.84	23
200	5.01	10.932	0.45	7.32	2.83	3.27	1.656		3.01	0.03	0.93	10
440	4.99	11.082	0.24	7.32	3.30	3.54	1.681	78.0	0.30	0.05	0.97	12
June 28												
000	13.66	6.594										
070	4.11	8.601										
100	4.86	10.539	0.58									
150	5.10	10.853	0.58									
200	5.11	10.898	0.57									
440	5.08	11.076	0.23									
						3.53						

Table 4a.

Landsort Deep
58°35'N 18°14'E

Depth m	Temp. °C	S ‰	O ₂ ml/l	pH	PO ₄ -P µgat/l	Tot.P µgat/l	Alkal. Mval/l	Si µgat/l	NO ₃ -N µgat/l	NO ₂ -N µgat/l	NH ₄ -N µgat/l	Tot.N µgat/l
September 2												
000	18.46	6.805	7.28	8.34	0.08	0.57	1.430	10.5	0.06	0.00	0.40	21.0
070	4.25	8.792	4.13	7.51	1.61	1.89	1.581	35.0	2.69	0.00	0.00	16.8
100	5.00	10.701	0.32	7.26	2.69	2.97	1.677	56.5	3.40	0.01	0.00	15.9
150	5.07	10.960	0.28	7.30	2.87	3.09	1.696	59.0	2.80	0.08	0.00	16.0
200	5.10	10.993	0.31	7.30	2.90	3.16	1.696	59.0	3.01	0.24	0.21	16.1
440	5.12	11.041	0.26	7.32	2.94	3.22	1.714	60.0	1.14	0.18	0.00	14.6
November 26												
000	6.32	7.467	8.25		0.45	0.55		18.5	1.2	0.21	0.91	
070	4.65	9.546	2.06		2.29	2.44		56.0	4.4	0.00	0.14	
100	4.84	10.284	0.56		2.82	2.84		67.0	3.7	0.00	0.23	
150	4.95	10.560	0.31		2.91	3.59		70.5	3.1	0.00	0.48	
200	5.01	10.733	0.22		2.96	3.05		71.0		0.00	0.40	
440	5.16	11.026			3.42	4.37		75.0		0.02	0.63	

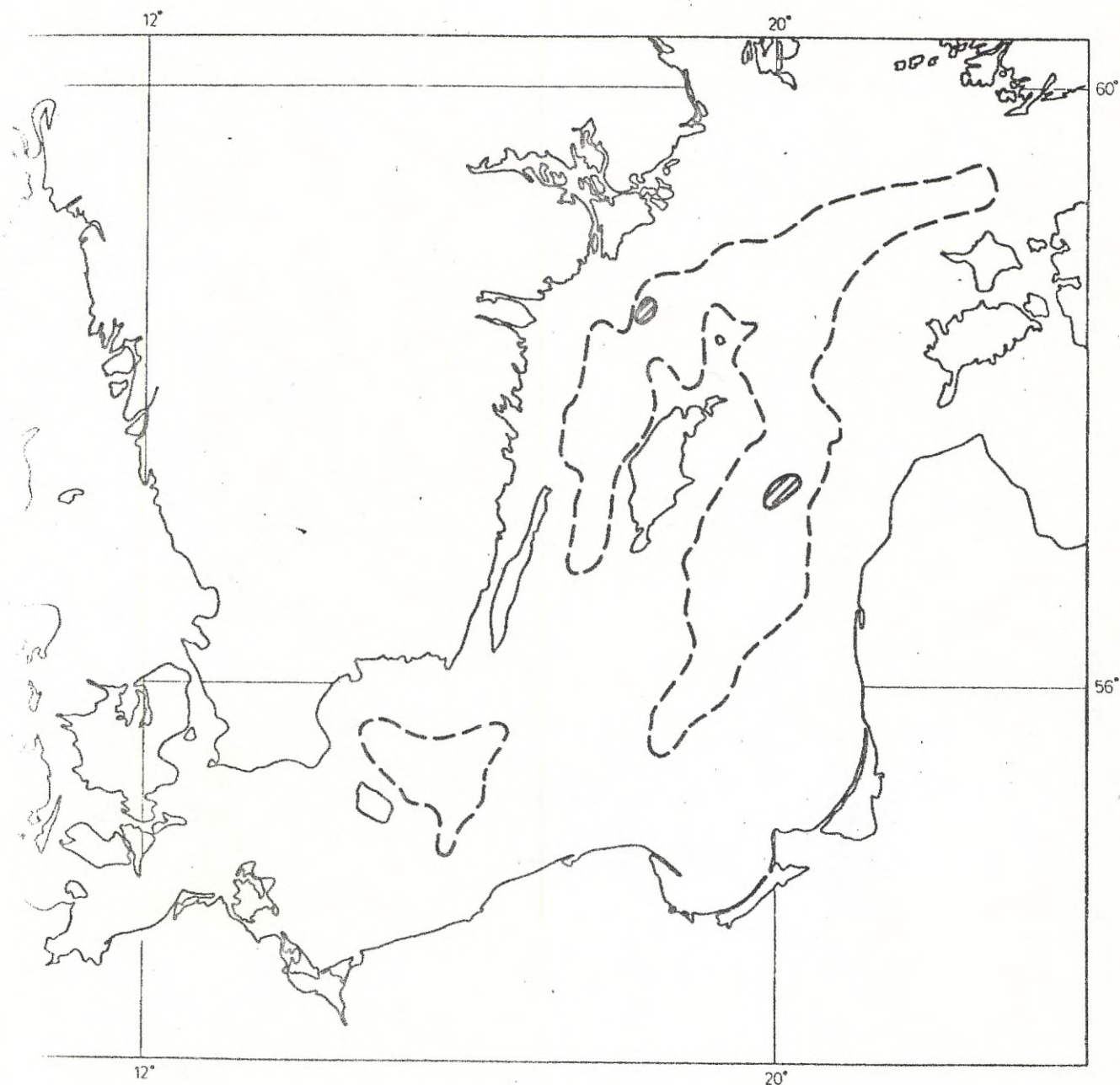
Table 4b.

Fig. 1.

The oxygen deficient areas and the hydrogen sulfide distribution in the Baltic deep water in March, 1975.

--- $O_2 < 2 \text{ ml/l}$

//// H_2S



The oxygen deficient areas and the hydrogen sulfide distribution in the Baltic deep water in May - June 1975.

--- $O_2 < 2 \text{ ml/l}$

//// H_2S

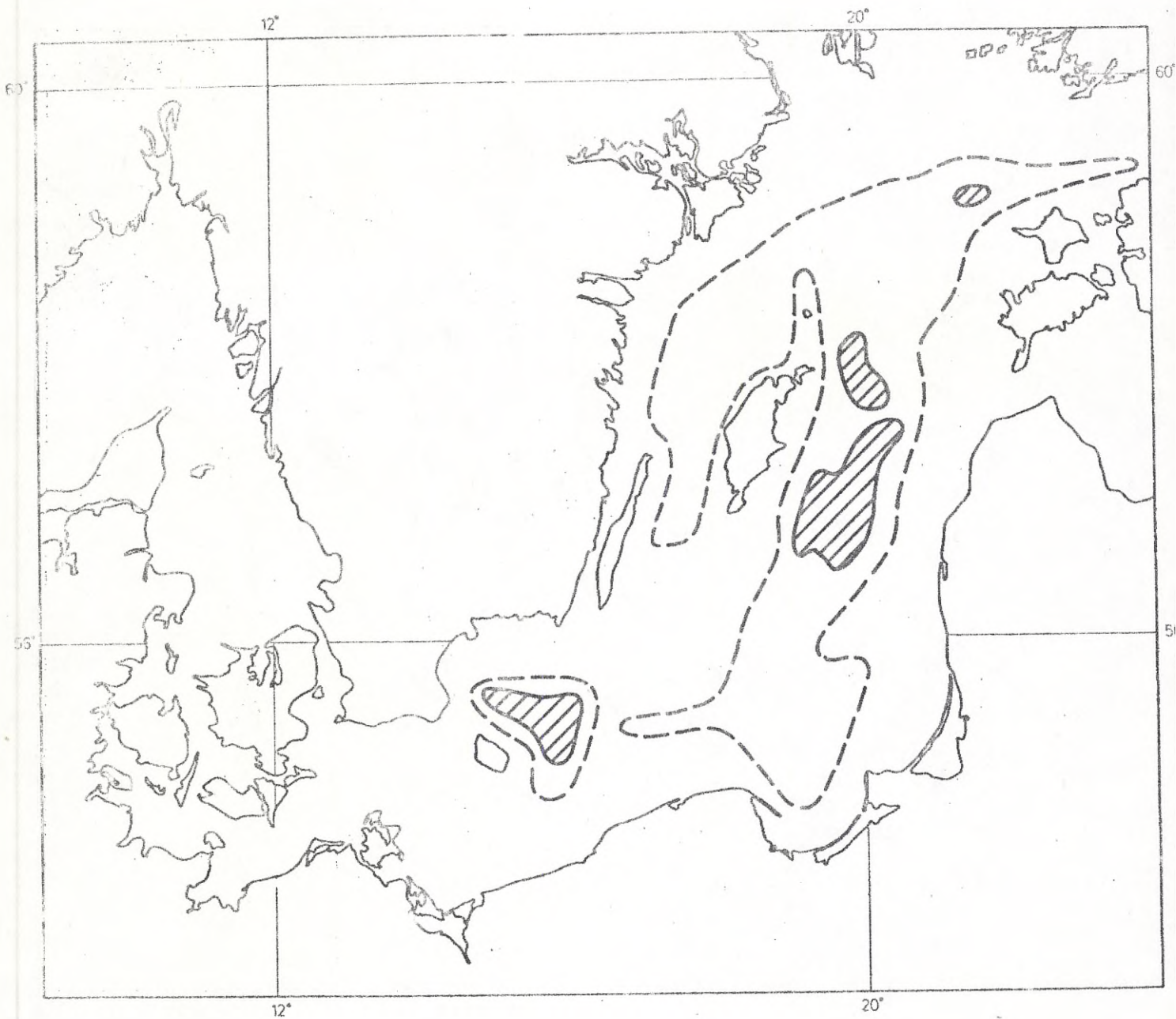


Fig. 3.

The oxygen deficient areas and the hydrogen sulfide distribution in the Baltic deep water in September 1975.

--- $O_2 < 2 \text{ ml/l}$

//// H_2S

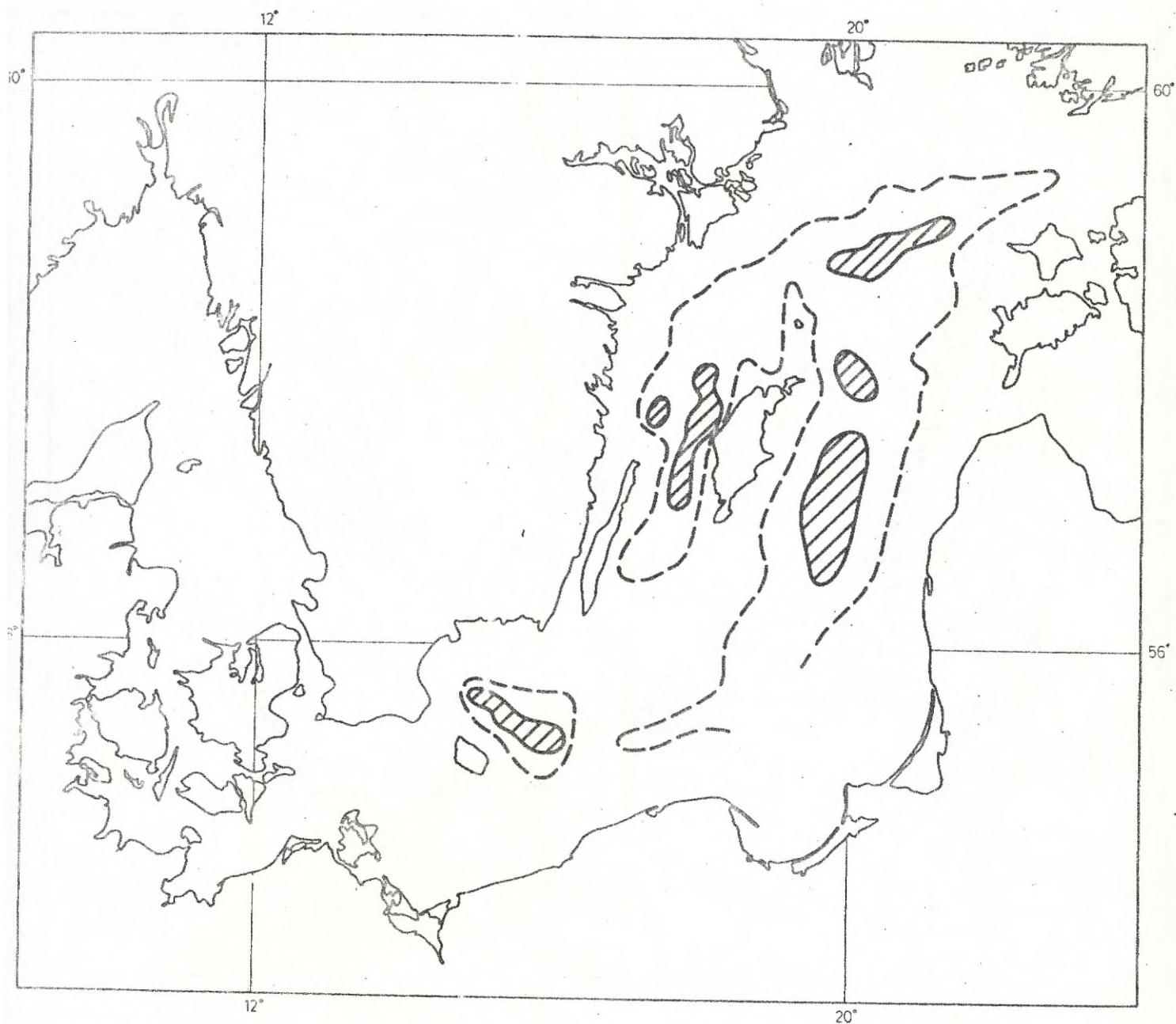
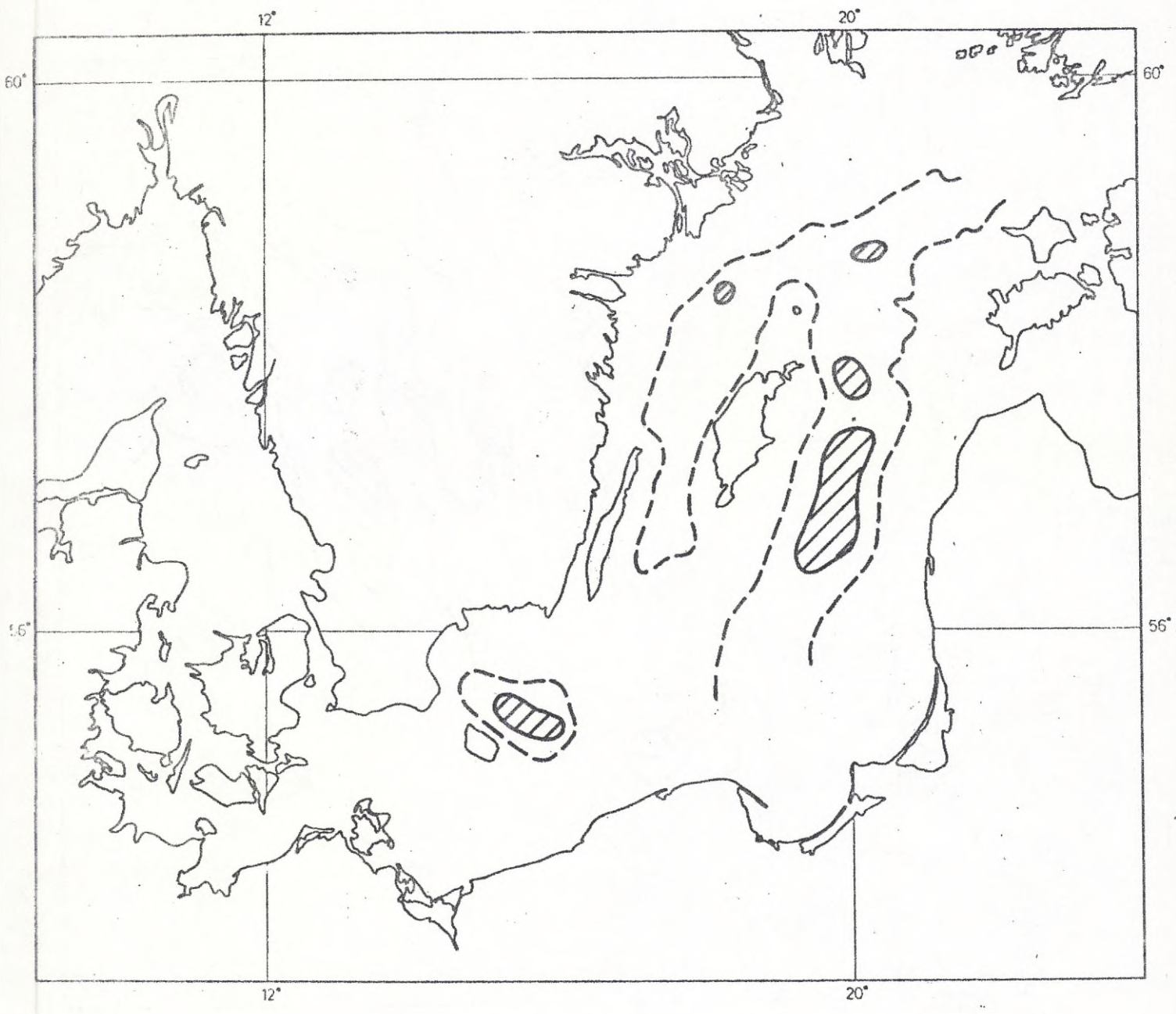


Fig. 4.

The oxygen deficient areas and the hydrogen sulfide distribution in the Baltic deep water in November - December 1975.

--- $O_2 < 2 \text{ ml/l}$

//// H_2S



The salinity distribution in the Arkona basin during 1975.

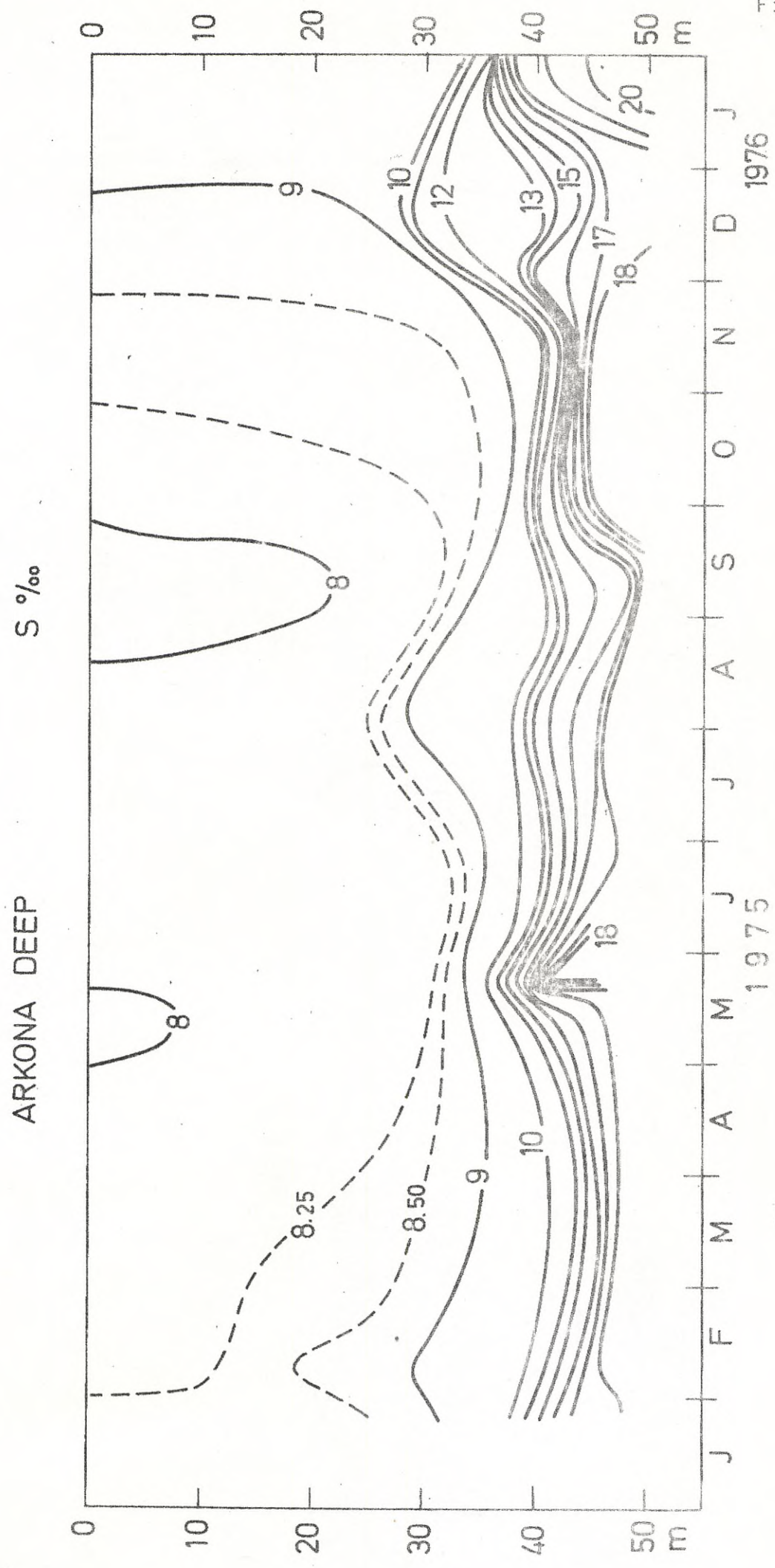


Fig. 5.

The oxygen and hydrogen sulfide distribution in the Bornholm Deep during 1975.

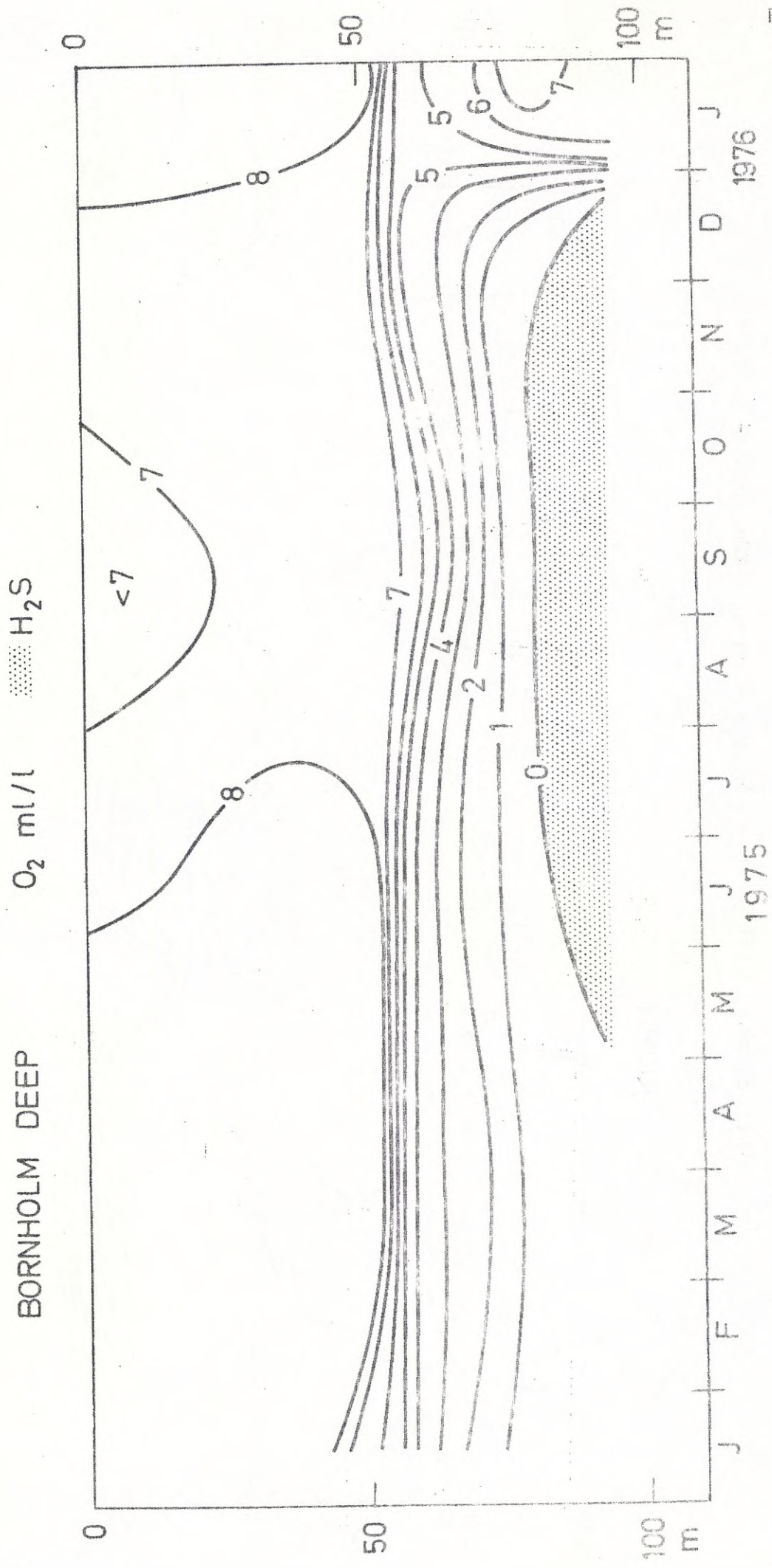


Fig. 6.

The oxygen and hydrogen sulfide distribution
in the Gotland Deep during 1975.

GOTLAND DEEP

O₂ ml/l

H₂S

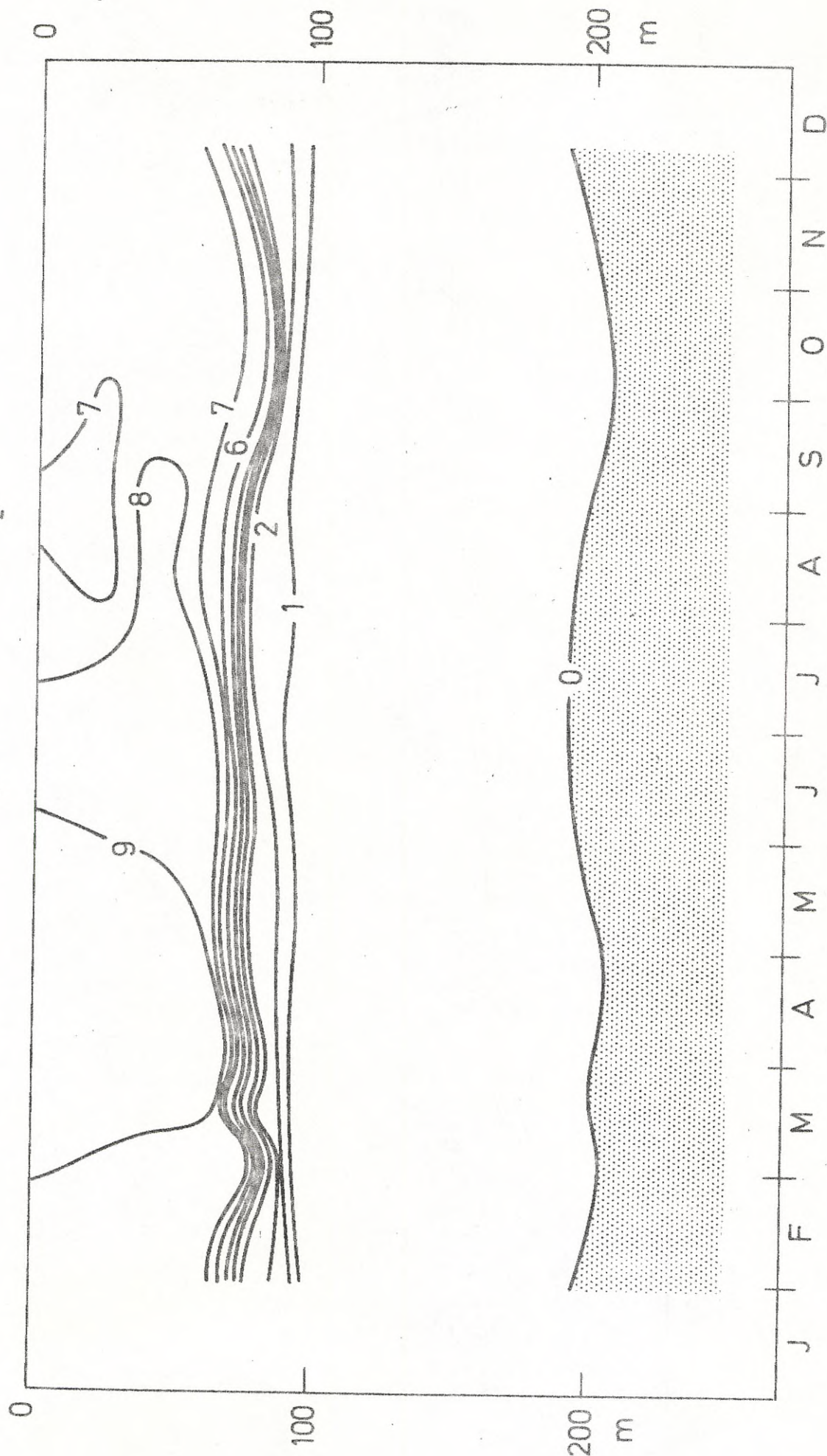
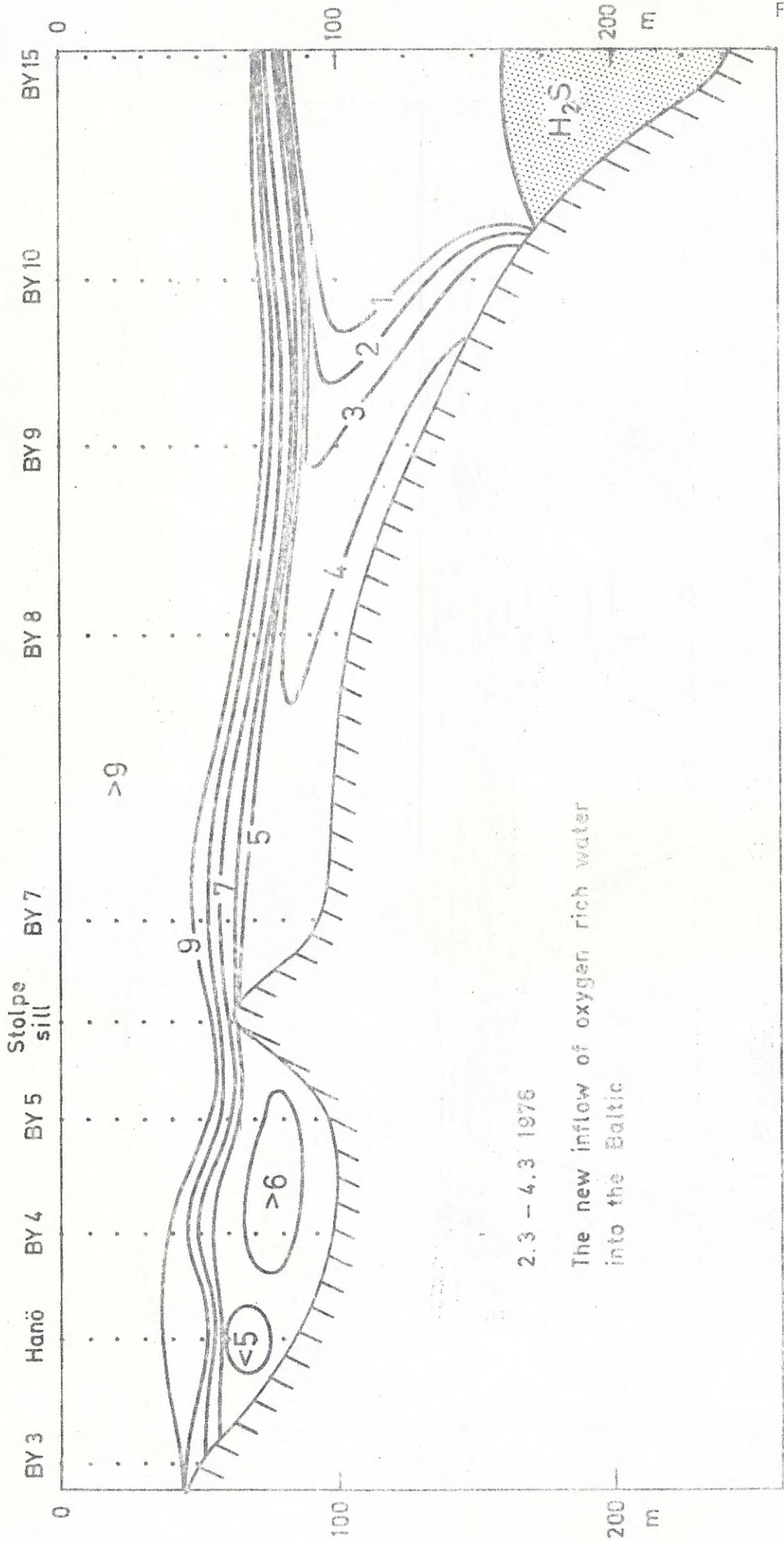


Fig. 7.

1975

The new inflow of oxygen rich water into the Baltic in the beginning of 1976.



2.3 - 4.3 1976

The new inflow of oxygen rich water into the Baltic

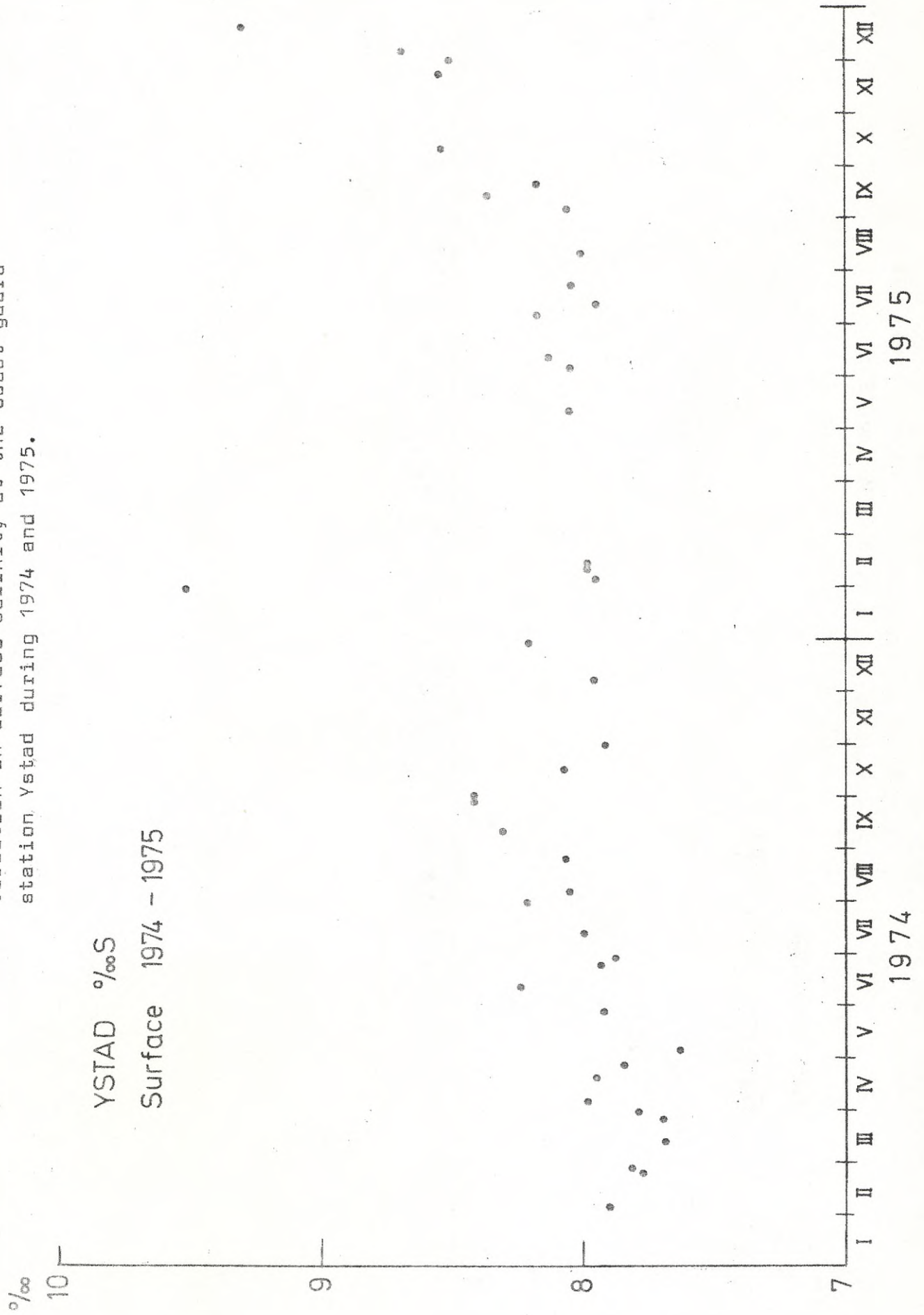
Fig. 8.

Fig. 9a.

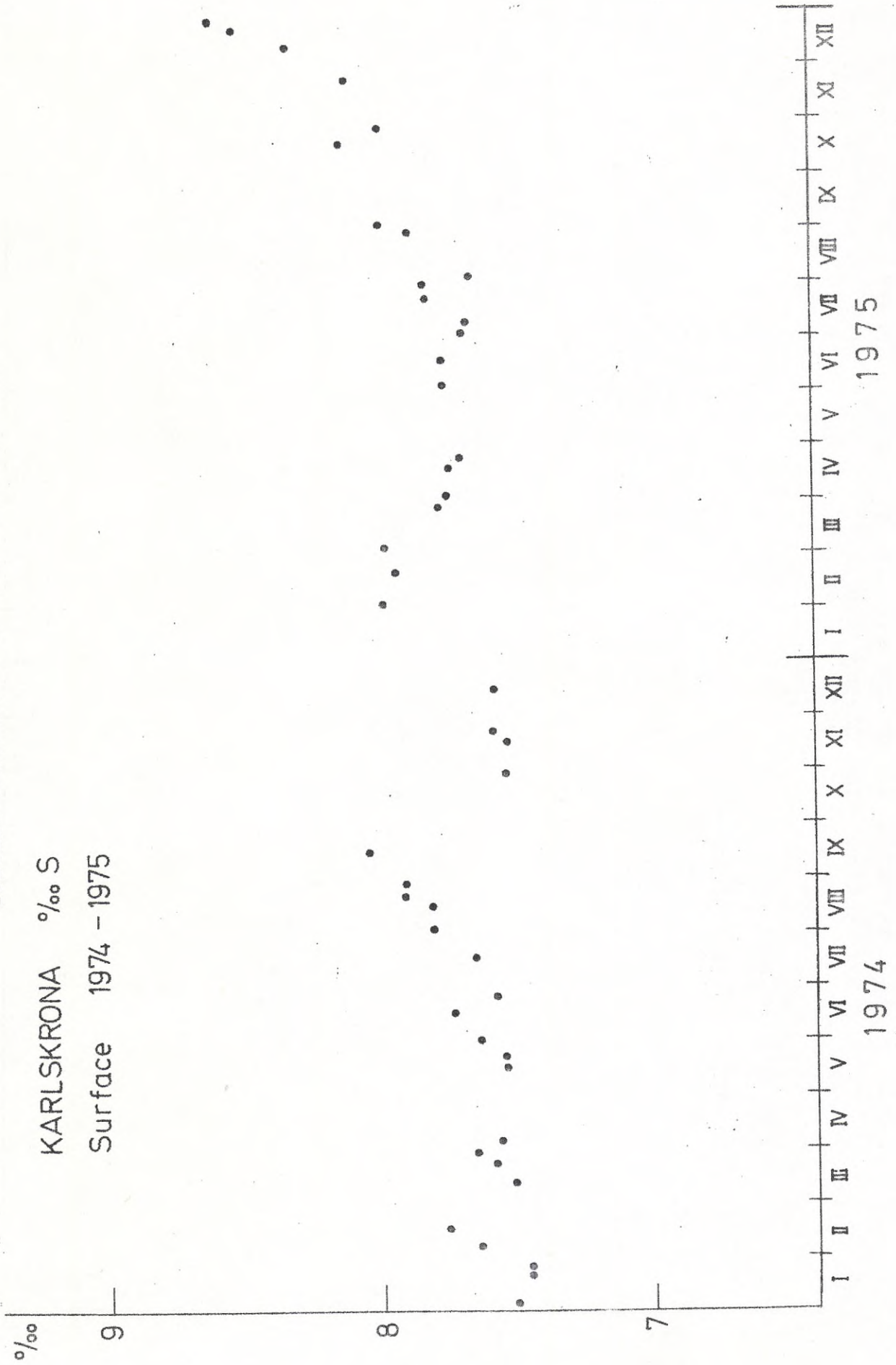
Variation in surface salinity at the coast guard station, Ystad during 1974 and 1975.

YSTAD ‰S

Surface 1974 - 1975



Variation in surface salinity at the coast guard station Karlskrona during 1974 and 1975.

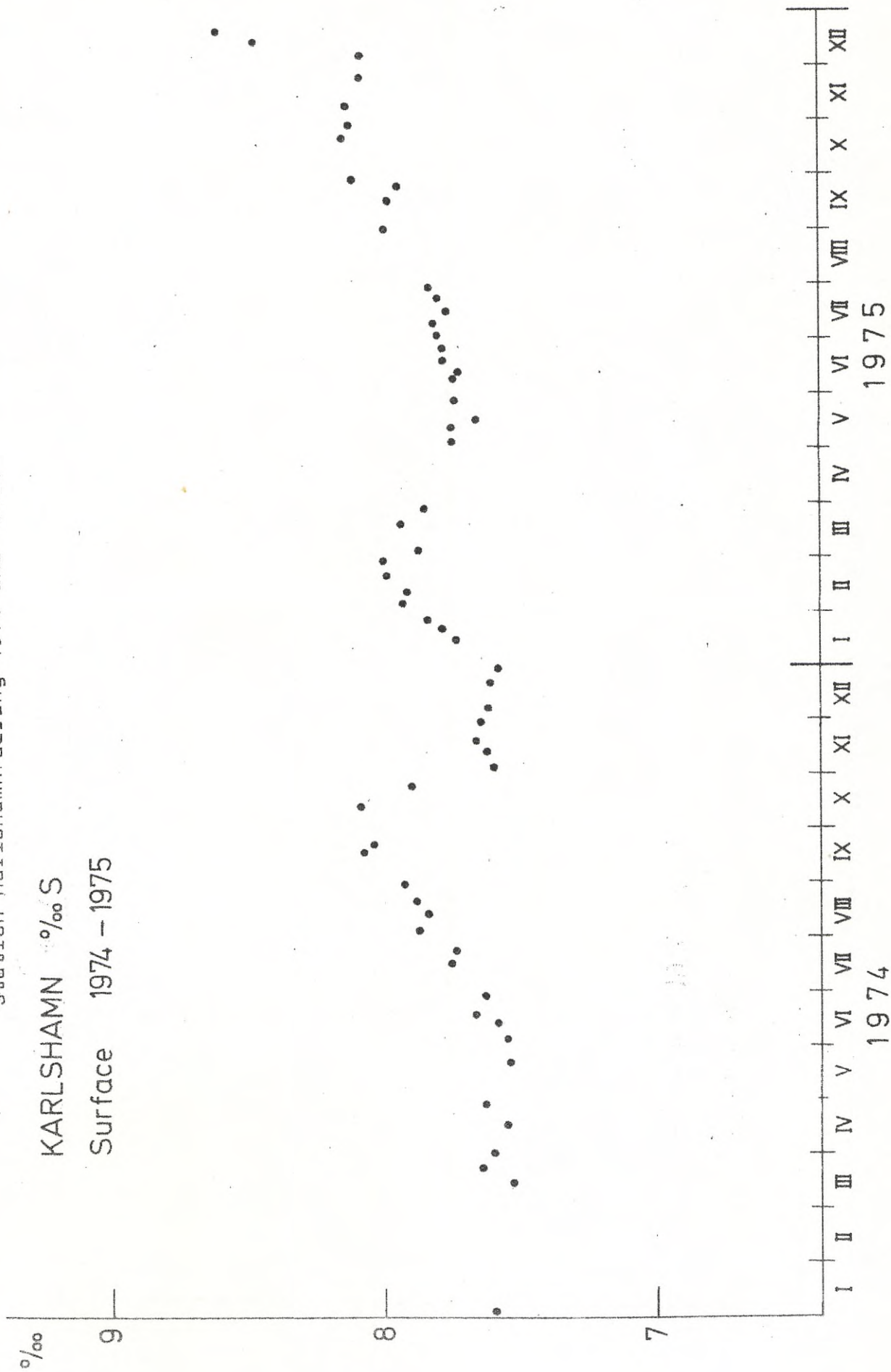


1974

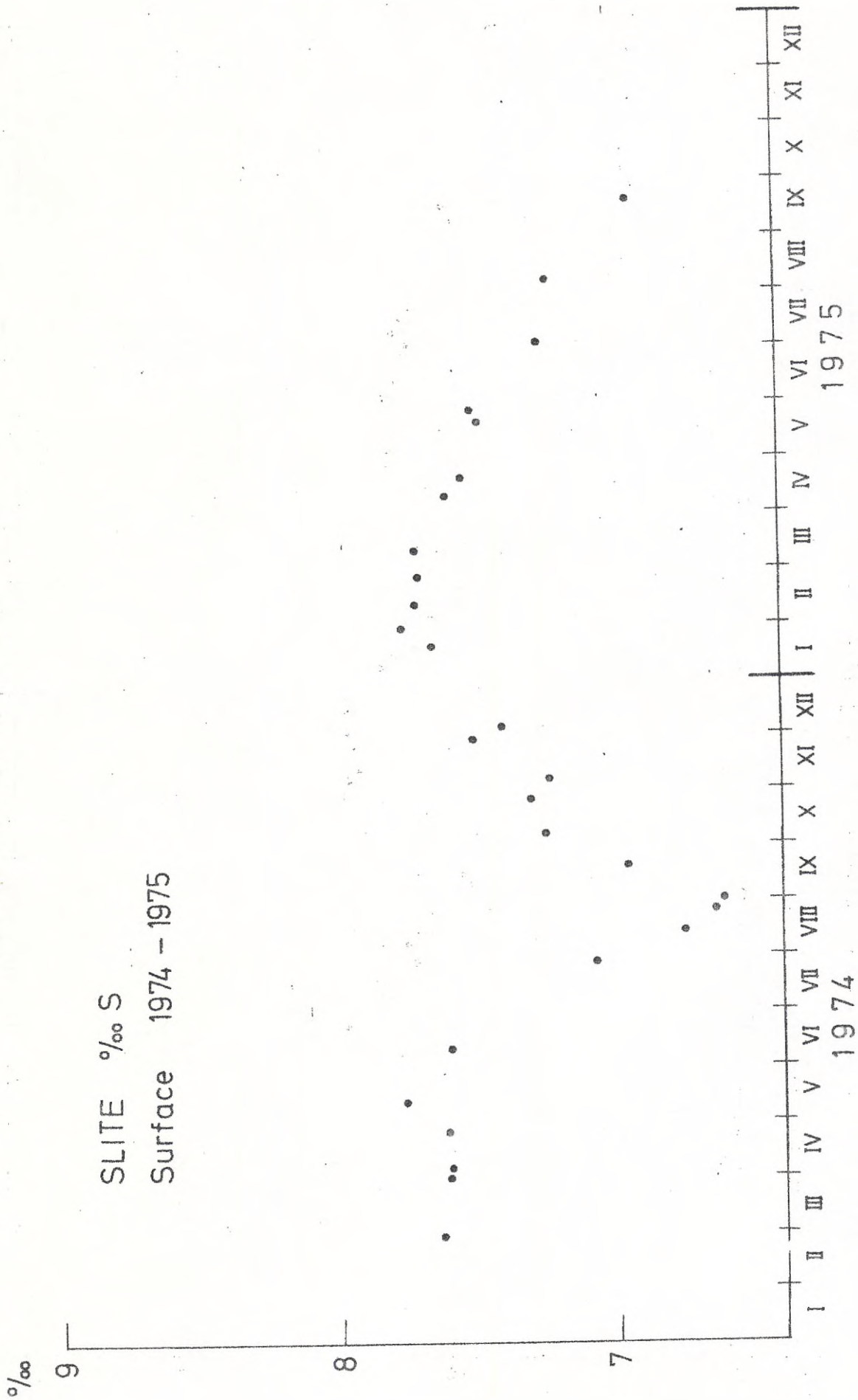
1975

Variation in surface salinity at the coast guard station Karlshamn during 1974 and 1975.

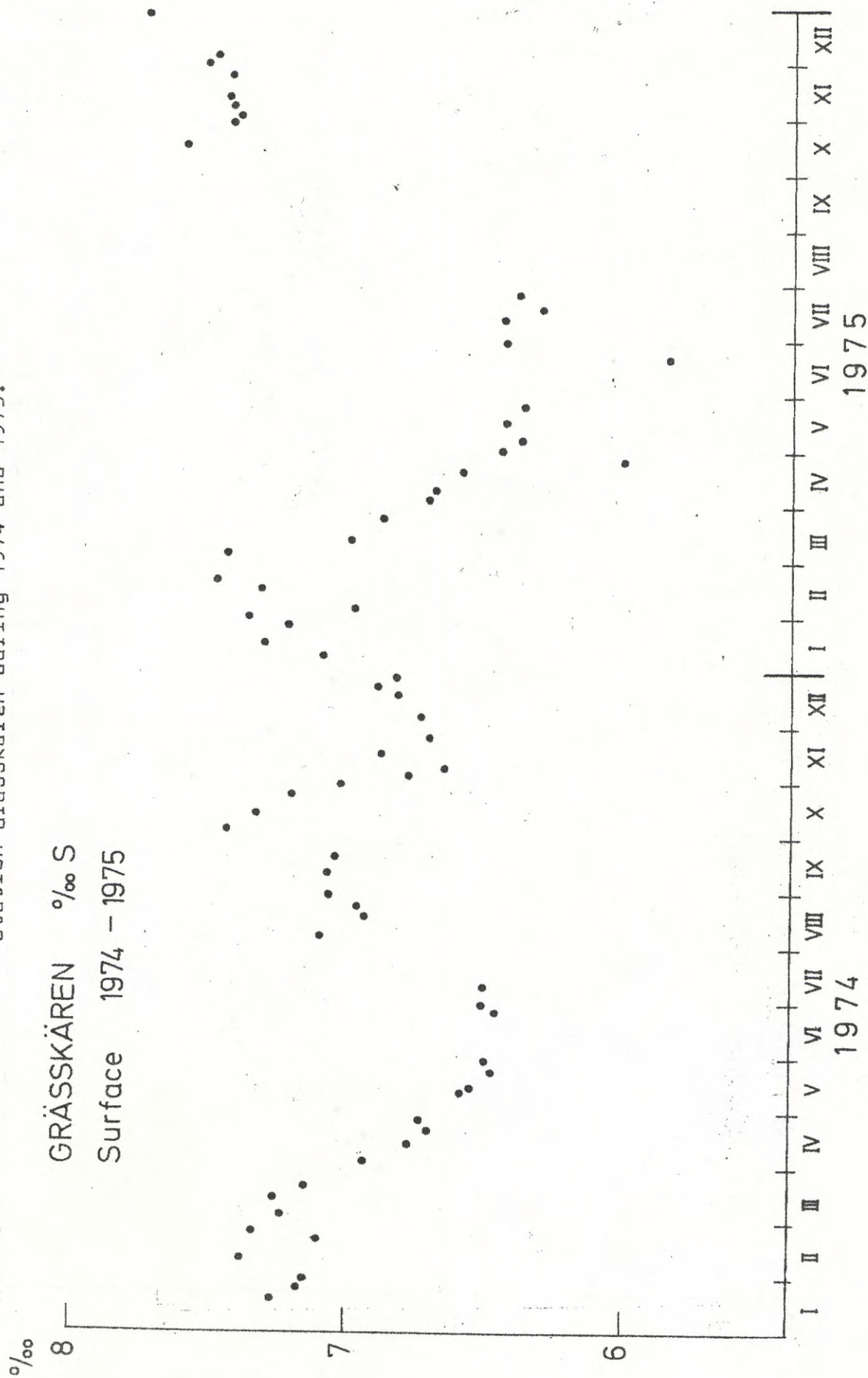
KARLSHAMN ‰S
Surface 1974 - 1975



Variation in surface salinity at the coast guard station Slite during 1974 and 1975.



Variation in surface salinity at the coast guard station Gräskären during 1974 and 1975.



Variation in surface salinity at the coast guard station Singö during 1974 and 1975.

