Ödsmål, Kville sn, Bohuslän

Hällristning
Fiskare från bronsåldern

Rock carving
Bronze age fishermen

MEDDELANDE från
HAVSFISKELABORATORIET · LYSEKIL

nr 246

Hydrografiska avdelningen, Göteborg

Observations along the Swedish coast and in the Deep Basins in the Baltic, 1977.

Hydrography of the Kattegat and the Skagerrak Area, Swedish Observations, 1977.

(Contribution to ICES "Annales Biologiques")

by Stig Fonselius and Artur Svansson

March 1979

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Havsfiskelaboratoriet
Hydr. avd. Fack, 403 10 Göteborg

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17 Författare/Författare

Engstedt Sven
Fonselius Stig
Svansson Artur

18 Sammandrag (ange gärna målsättning, metod, teknik, resultat m m)

Redogörelse för dagliga mätningar av temperatur och salthalt vid Bornö Station i Gullmaren. Temperatur, salinitet och totalfosfor har mätts på en position i Skagerrak, men redovisas senare. Station M6 har besökts två gånger. Dagliga mätningar av totalfosfor vid Läsö Trindel redovisas i figurer. Från Östersjön redovisas mätning av temperatur, salinitet, syrgashalt, svavelväte och närsalter på 4 huvudstationer. Resultaten diskuteras och kartor över syrgasfördelningen i djupvattnet redovisas.

19 Sammandraget skrivet av

Författaren

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Hydrografi, salinitet, temperatur, syrgashalt, svavelväte, närsalter
Kattegatt, Skagerrak, Östersjön

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Postadress
Jordbruksdepartementet
Fack
103 20 STOCKHOLM

Telefon
08 - 763 10 00

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Hydrography of the Kattegat and the Skagerrak Area 1977.

In the Figures 2 and 3 results of daily measurements of temperature and salinity at Bornö Station in the Gullmar Fiord (Fig. 1) are presented as deviations from the mean values 1931 - 1960.

Temperature, salinity and total phosphorus were measured at a position N 58°17', E 11°02' at 10 depth. Data will be published during 1978.

The Skagerrak Deep (M 6) was visited 2 times (Table 1). There was a remarkable decrease in salinity as well as in temperature from March to October.

Table 2 shows the oxygen saturation values at station Fladen in N Kattegat. The deep minimum occured in September - October.

During August 1974 - December 1977 there was a project of determining transports of water and matter through a section Frederikshavn - Göteborg. In connection with this project total phosphotus was measured once a day at the Danish lightvessel Läsö Trindel simultaneously with the ordinary hydrographic work. Table 3 presents monthly means January - November.

Artur Svansson
National Board of Fisheries
Sweden
Institute of Marine Research
Hydrographic Department
Fack
S-403 10 Göteborg, Sweden

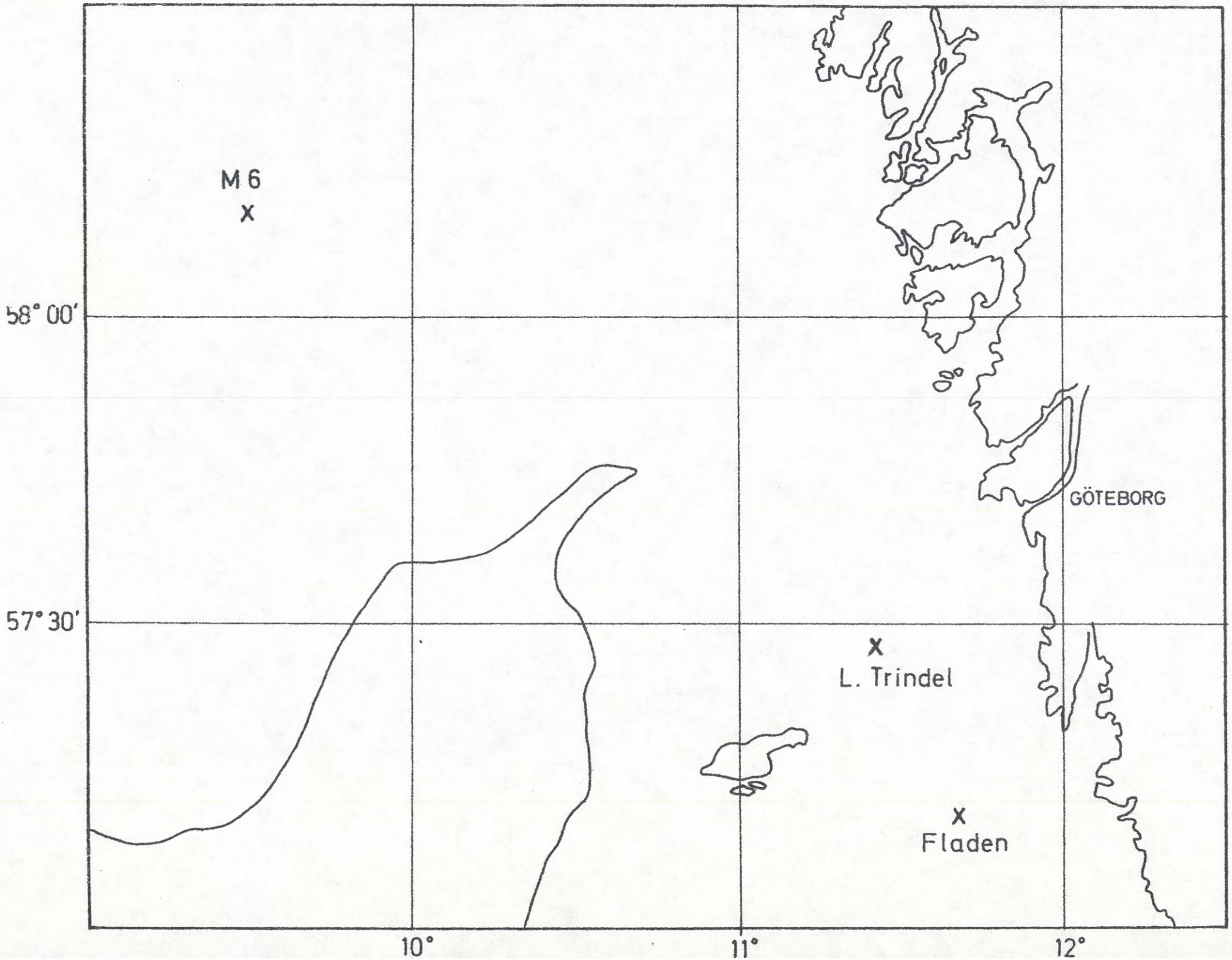
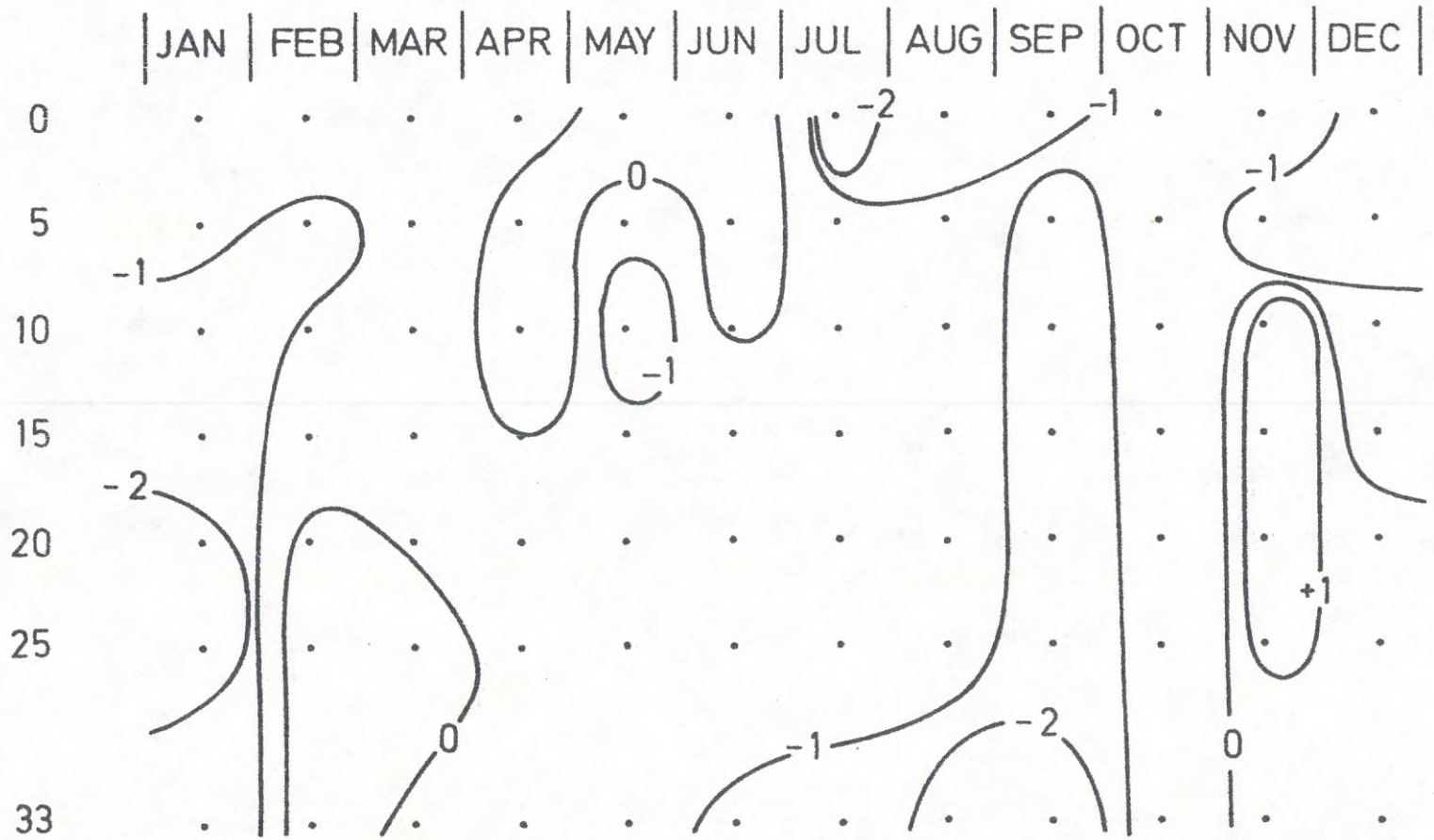


Fig. 1



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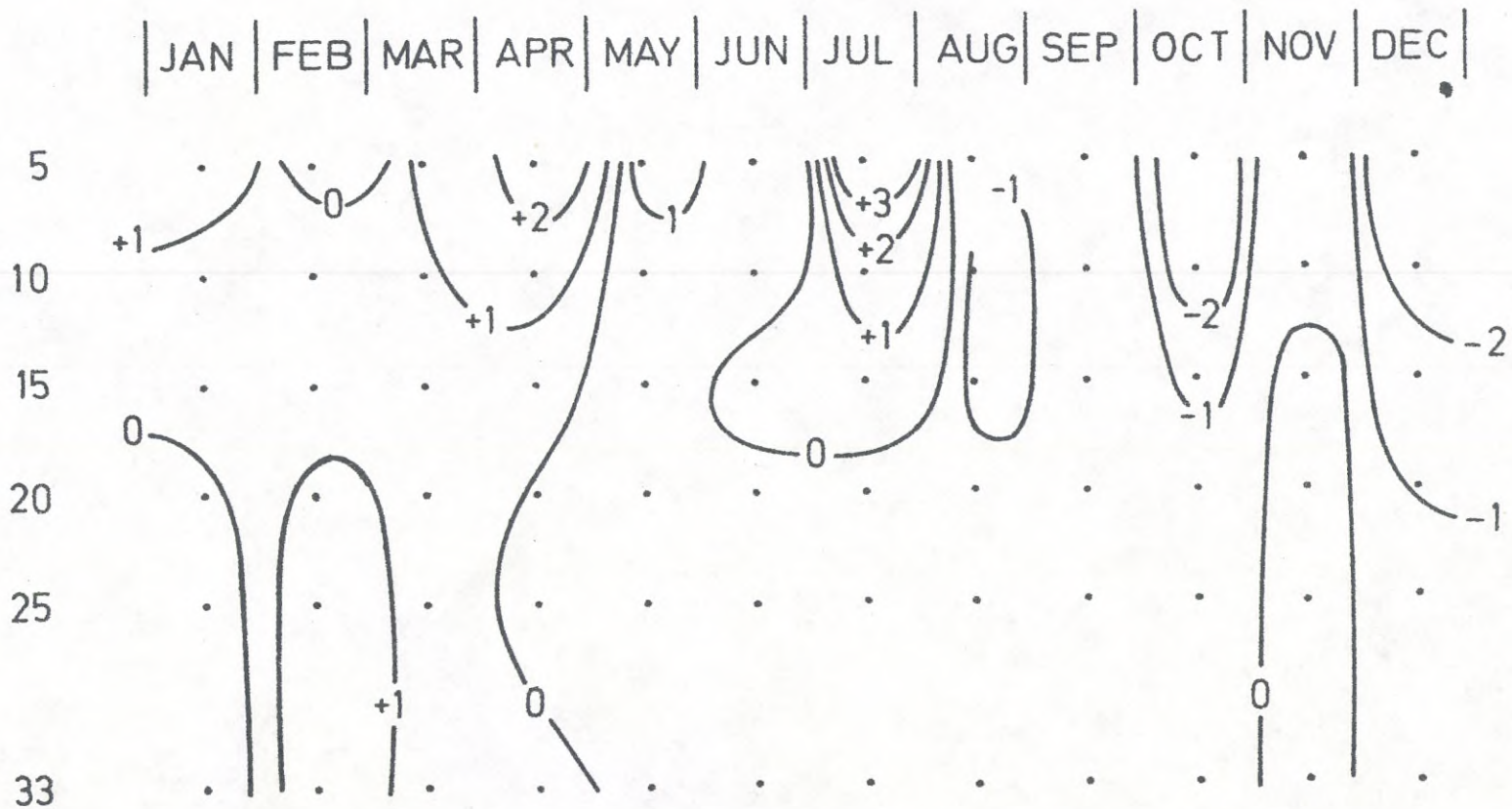
Temperature Deviations °C

Fig. 2



BORNÖ 1977

Salinity Deviations ‰

Fig. 3

Table 1

M 6 58°10'N 09°30'E

Depth m	Temp. °C	S ‰	σ_t	O_2 ml/l	O_2 %
		March 23			
200	6.60	35.096	27.57	5.77	85
300	6.31	35.127	27.63	5.97	87
400	6.09	35.136	27.67	6.26	91
500	6.04	35.147	27.68	6.31	91
600	6.01	35.185	27.72	6.30	91
		October 10			
200	6.12	35.064	27.61	5.93	86
300	5.67	35.028	27.64	6.27	90
400	5.81	35.073	27.66	6.20	89

Percentage Oxygen Saturation at 57° 11.5′ N 11° 40′ E (Fladen O_2 %)

Depth m	Mar. 08	May 31	June 15	Aug 29	Sep 21	Oct 10	Nov 18	Dec 04
30	93	95	90	72	82	80	90	91
40	93	91	86	73	72	83	89	94
50	93	88	83	75	71	67	86	96
60	93	83	81	75	69	66	86	92
70	93	83		75	66	64	89	

Table 2

LIGHTVESSEL LASO TRINDEL

TOTAL PHOSPHORUS, MICROGRAMATOMS/L

MEAN VALUE, STANDARD DEVIATION AND COEFF OF VARIATION [%] (NO=NUMBER OF SAMPLES).

PERIOD		00 M	05 M	10 M	15 M	20 M	28 M
770101 - 770131	MV	0.81	0.82	0.80	0.81	0.81	0.86
	SD	0.12	0.13	0.09	0.12	0.09	0.07
	CV	14	16	11	15	11	8
	NO	24	24	25	25	24	24
770201 - 770228	MV	0.74	0.73	0.76	0.76	0.84	0.86
	SD	0.18	0.20	0.21	0.21	0.22	0.24
	CV	25	28	28	27	26	29
	NO	28	28	28	28	28	28
770301 - 770331	MV	0.61	0.65	0.71	0.85	0.88	0.88
	SD	0.18	0.22	0.20	0.17	0.18	0.15
	CV	29	33	28	20	20	17
	NO	31	31	31	31	31	31
770401 - 770430	MV	0.55	0.60	0.63	0.66	0.70	0.76
	SD	0.08	0.09	0.12	0.09	0.13	0.16
	CV	14	15	18	14	19	21
	NO	29	29	29	29	29	29
770501 - 770531	MV	0.52	0.55	0.57	0.59	0.57	0.62
	SD	0.09	0.10	0.10	0.11	0.10	0.09
	CV	18	17	18	18	18	15
	NO	29	29	29	30	29	28

Table 3a

LIGHTVESSEL LASO TRINDEL

TOTAL PHOSPHORUS, MICROGRAMATOMS/L

MEAN VALUE, STANDARD DEVIATION AND COEFF OF VARIATION [%] (NO=NUMBER OF SAMPLES).

PERIOD		00 M	05 M	10 M	15 M	20 M	28 M
770801 - 770830	MV	0.42	0.45	0.48	0.49	0.48	0.57
	SD	0.08	0.13	0.12	0.11	0.10	0.14
	CV	18	28	25	24	20	25
	NO	28	28	26	28	28	27
770701 - 770731	MV	0.63	0.73	0.65	0.67	0.66	0.77
	SD	0.13	0.16	0.13	0.13	0.07	0.18
	CV	20	22	20	20	11	23
	NO	31	31	29	30	31	31
770801 - 770831	MV	0.66	0.69	0.65	0.57	0.57	0.71
	SD	0.11	0.13	0.16	0.11	0.11	0.13
	CV	17	20	24	19	20	18
	NO	29	29	29	29	29	29
770901 - 770930	MV	0.65	0.70	0.63	0.60	0.60	0.59
	SD	0.12	0.23	0.13	0.14	0.16	0.12
	CV	18	32	21	24	27	21
	NO	28	28	28	26	28	28
771001 - 771031	MV	0.66	0.64	0.64	0.64	0.61	0.63
	SD	0.15	0.12	0.13	0.11	0.09	0.14
	CV	23	18	20	17	15	22
	NO	30	30	29	30	29	27

Table 3b

LIGHTVESSEL LASO TRINDEL

TOTAL PHOSPHORUS, MICROGRAMATOMS/L

MEAN VALUE, STANDARD DEVIATION AND COEFF OF VARIATION [%] (NO=NUMBER OF SAMPLES).

PERIOD		00 M	05 M	10 M	15 M	20 M	28 M
771101 - 771130	MV	0.66	0.66	0.65	0.70	0.70	0.72
	SD	0.14	0.11	0.10	0.13	0.14	0.13
	CV	21	17	16	19	20	18
	NO	19	19	19	19	19	19

Table 3c

Observations along the Swedish coast and in the deep basins of the Baltic 1977.

During the autumn of 1976 an inflow of unusually warm water into the Baltic occurred (Fonselius 1977). When the R/V "Argos" in the beginning of February 1977 visited the Gotland Deep (BY 15), the bottom water there had been renewed. At 240 m depth the salinity had increased to 13.280 ‰ from 12.514 ‰ in November 1976. The temperature of the new water was at the same depth 7.43 °C, the highest temperature ever recorded in the bottom water of the Gotland Deep.

During 1977 no important inflows of new water seem to have occurred and the temperature of the bottom water had decreased continously, but was still 7.08 °C in November 1977. At the same occasion the salinity at 240 m was 13.111 ‰. Also the oxygen values show a similar decreasing, from 2.62 ml/l in February to 0.13 ml/l in November at 240 m.

In the Bornholm Deep the oxygen values have decreased from 3.45 ml/l in March, to 1.27 ml/l in June, to 0.31 ml/l in August, to 0.15 ml/l in September and to 0.09 ml/l in November at around 90 m. The salinity decreased during the same period from 17.413 ‰ to 16.533 ‰ at the same depth.

The inflows of new water seem to occur very slowly in the Landsort Deep (BY 31). In January 1977 the temperature, salinity and oxygen concentration at 440 m were 5.18 °C, 10.927 ‰ and 0.39 ml/l respectively. In March the temperature was almost unchanged, the salinity had increased to 11.035 ‰ and the oxygen had increased to 0.83 ml/l. In June the temperature had increased to 5.40 °C, the salinity to 11.261‰ and the oxygen to 1.04 ml/l. In September the temperature had increased to 5.46 °C and the salinity to 11.311 ‰, but the oxygen had begun to decrease and was 0.63 ml/l. In December the maximum of temperature and salinity had passed and all three parameters had begun to decrease. The temperature was 5.43 °C, the salinity was 11.297 ‰ and the oxygen value was 0.52 ml/l.

All this clearly shows that no important inflows have occured during the year after the inflow in the autumn of 1976. A large stagnant area is developing in the Baltic proper and during the summer of 1978 hydrogen sulfide formation in the bottom water may be expected.

During 1977 very small amounts of hydrogen sulfide have been found in the bottom water of the deep basins. In January - February no hydrogen sulfide was found and in May only in the Karlsö Deep (BY 38). In September also the Gdansk Deep was visited in connection with the BOSEX 77 program. Hydrogen sulfide was found there and also in the Karlsö Deep. In November hydrogen sulfide was only found at station BY 27 at the mouth of the Gulf of Finland. The areas with hydrogen sulfide and oxygen concentrations below 2 ml/l are shown in the maps in figures 1, 2, 3 and 4.

Reference:

Fonselius, S.H., 1977: An Inflow of unusually warm water into the Baltic Deep Basins. Medd. Havsfiskelaboratoriet, Hydrografiska avdelningen, Göteborg, Nr 229.

Sven G. Engström and Stig H. Fonselius
National Board of Fisheries, Sweden
Institute of Marine Research
Hydrographic Department
Fack
S-403 10 Göteborg, Sweden

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	SiO_2 µgat/l	NO_2-N µgat/l	NO_3-N µgat/l	NH_4-N µgat/l	Tot.N µgat/l
						14 March						
000	2.14	8.224	9.23	8.26	0.47	0.66	1.490	17.0	0.29	3.6	0.32	20
010	2.07	8.654	9.04	8.27	0.47	0.71	1.544	17.0	0.36	3.9	0.30	21
030	1.60	11.053	8.96	8.27	0.49	0.67	1.567	15.5	0.62	4.4	0.67	21
048	3.50	16.016	8.16	8.19	0.69	0.99	1.729	17.2	0.56	7.7	1.53	25
						1 June						
000	10.68	7.809	8.33	8.47	0.06	0.53	1.536	4.3	0.07	0.60	0.16	18
010	9.44	7.899	8.42	8.46	0.05	0.48	1.511	5.3	<0.02	0.10	0.25	15
030	4.13	10.350	7.31	8.05	0.31	0.86	1.546	8.4	<0.02	<0.1	0.62	19
048	3.63	14.673	4.28	7.75	0.80	1.22	1.729	27.2	0.17	1.47	1.71	21
						28 June						
000	14.40	7.820	7.21									
010	14.37	7.828	7.27									
030	5.59	10.395	6.51									
046	4.93	15.571	2.97									

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	SiO_2 µgat/l	NO_2-N µgat/l	NO_3-N µgat/l	NH_4-N µgat/l	Tot.N µgat/l
					30 August							
000	16.83	7.576	6.90	8.40	0.11	0.79	1.579	9.5	<0.02	<0.1	0.78	18
010	16.49	7.623	6.73	8.40	0.10	0.71	1.542	9.1	<0.02	<0.1	0.39	19
030	8.78	8.603	5.53	7.95	0.65	0.88	1.563	12.8	0.41	1.08	0.57	16
049	11.35	12.134	2.43	7.70	1.32	1.54	1.668	38.1	0.06	6.74	0.21	22
					20 September							
000	14.31	8.355	7.09	8.34	0.14	0.66		11.2				
010	14.30	8.371	7.14	8.36	0.15	0.89		11.1				
030	14.61	10.781	5.90	8.25	0.33	0.77		12.9				
047	14.08	19.353	3.60	8.02	1.29	1.63		29.3				
					22 November							
000	8.97	9.335	7.37	8.24	0.39	0.72	1.535	11.7	0.39	2.03	0.81	18
010	9.01	9.471	7.45	8.24	0.38	0.67	1.541	12.6	0.39	2.23	0.56	19
030	9.49	10.465	7.17	8.22	0.46	0.73	1.586	14.0	0.36	2.60	0.65	19
047		19.659	4.31	7.99	1.56	1.86	1.846	32.6	0.16	5.94	1.78	22

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	SiO_2 µgat/l	NO_2-N µgat/l	NO_3-N µgat/l	NH_4-N µgat/l	Tot.N µgat/l
						14 March						
000	1.70	7.595	9.21	8.21	0.50	0.79	1.445	20.0	0.17	3.0	0.47	18
010	1.70	7.602	9.19	8.24	0.50		1.455	19.5	0.16	3.1	0.40	18
030	1.82	7.747	9.12	8.24	0.49	0.72	1.460	18.5	0.12	3.1	0.38	18
050	3.55	8.999	8.06	8.14	0.56	0.81	1.508	16.1	0.02	4.5	0.29	19
070	6.76	16.025	3.70	7.75	1.19	1.34	1.740	38.0	0.02	6.8	0.28	21
090	6.89	17.413	3.45	7.75		1.81	1.765	46.6	0.07	8.6	0.61	23
						1 June						
000	8.14	7.689	9.28	8.51	0.12	0.65	1.480	9.2	<0.02	<0.1	0.19	18
010	8.11	7.687	9.29	8.58	0.11	0.64	1.465	8.8	<0.02	<0.1	0.20	14
030	5.95	7.753	8.83	8.42	0.14	0.45	1.470	9.1	<0.02	<0.1	0.23	14
050	3.07	8.502	7.83	8.08	0.34	0.68	1.516	11.9	0.03	<0.1	0.30	14
070	6.20	15.654	3.33	7.65	1.40	1.53	1.729	38.8	0.05	6.89	0.19	23
090	6.68	17.196	1.27	7.46	1.41	1.58	1.750	61.5	0.07	8.60	0.23	21
						31 August						
000	16.18	7.491	6.63	8.38	0.10	0.49	1.492	8.7	<0.02	<0.1	0.32	15
010	16.19	7.491	6.67	8.37	0.09	0.52	1.502	8.1	<0.02	<0.1	0.24	16
030	15.95	7.562	6.42	8.34	0.13	0.51	1.510	9.0	<0.02	<0.1	0.35	28
050	5.50	8.214	6.55	7.95	0.49	0.71	1.537	12.3	0.26	0.60	0.45	17
070	5.64	12.47	2.02	7.57	1.59		1.784	44.0	0.03	8.48	0.17	23
089	6.58	16.965	0.31	7.49	1.61	2.12	1.842	66.1	0.09	7.37	0.20	20

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	SiO_2 µgat/l	NO_2-N µgat/l	NO_3-N µgat/l	NH_4-N µgat/l	Tot.N µgat/l
						20 September						
000	13.59	7.572	6.97	8.28	0.10	0.59		8.0				
010	13.46	7.578	7.02	8.34	0.12	0.61		7.9				
030	12.96	7.601	6.80	8.30	0.11	0.52		8.4				
050	4.07	8.474	6.37	7.97	0.54	0.84		14.4				
070	5.39	15.233	1.98	7.68	1.48	1.60		46.1				
092	6.52	16.813	0.15	7.56	1.82	1.93		63.8				
						22 November						
000	8.51	7.851	7.31	8.14	0.36	0.58	1.497	14.7	0.16	2.12	0.06	17
010	8.38	7.852	7.38	8.21	0.33	0.59	1.502	13.2	0.16	2.12	0.30	17
030	8.52	7.854	7.44	8.19	0.38	0.60	1.489	13.5	0.16	2.03	0.17	17
050	6.14	9.844	3.95	7.74	1.42	1.69	1.571	38.3	0.06	6.09	0.22	21
070	6.21	15.768	0.34	7.56	2.14	2.33	1.764	79.5	0.03	10.60	0.22	21
091		16.533	0.09	7.57	2.56	2.70	1.803	80.2	0.52	4.57	0.30	17

Gotland Deep

57°20′N 20°03′E

Depth m	Temp. °C	S ‰	O_2 ml/l	pH	PO_4-P µgat/l	Tot.P µgat/l	Alkal. Mval/l	SiO_2 µgat/l	NO_2-N µgat/l	NO_3-N µgat/l	NH_4-N µgat/l	Tot.N µgat/l
						2 February						
000	2.11	8.051	8.71			0.80						
070	4.92	10.011	3.18			1.88						
100	5.45	11.466	2.36			2.05						
150	5.66	12.163	0.97			2.98						
200	6.28	12.580	0.58			3.96						
240	7.43	13.280	2.62			2.04						
						15 March						
000	1.30	7.914	9.30	8.19	0.64	0.85	1.510	17.5	0.07	3.4	0.67	
070	4.97	9.944	3.65	7.59	1.71	1.90	1.567	40.0	0.02	6.4	0.39	
100	5.75	11.505	2.19	7.48	1.50	2.24	1.623	48.0	0.02	7.4	0.10	
150	6.16	12.373	1.22	7.42	2.53	3.11	1.653	60.5	0.02	5.3	0.19	
200	6.98	12.947	1.98	7.51	1.68	2.51	1.658	54.5	<0.02	6.9	0.25	
240	7.31	13.231	1.82	7.54	1.55	2.40	1.679	52.5	0.04	9.1	0.46	
						2 June						
000	8.67	7.883	9.65	8.50	0.13	0.60	1.516	7.4	<0.02	0.31	0.39	18
070	4.77	9.810	3.54	7.54	1.86	2.07	1.572	40.7	0.02	5.18	0.19	20
100	5.76	11.582	2.24	7.49	2.20	2.52	1.628	51.1	0.02	6.48	0.16	21
150	6.30	12.504	1.71	7.46	2.58	2.62	1.648	56.8	0.03	5.56	0.22	19
200	6.83	12.870	1.67	7.49	2.32	2.32	1.668	52.0	0.02	6.70	0.21	19
240	7.23	13.167	0.75	7.46	2.33	2.35	1.694	56.8	0.11	9.47	0.52	23

Gotland Deep

57°20′N 20°03′E

Depth m	Temp. °C	S ‰	O_2 ml/l	pH	PO_4-P µgat/l	Tot.P µgat/l	Alkal. Mval/l	SiO_2 µgat/l	NO_2-N µgat/l	NO_3-N µgat/l	NH_4-N µgat/l	Tot.N µgat/l
						5 July						
000	13.44	7.803	7.44									
085	5.09	10.444	2.27									
110	5.74	11.691	2.11									
150	6.06	12.422	1.31									
200	6.86	12.941	1.19									
240	7.16	13.119	0.86									
						23 November						
000	8.05	7.591	7.62	8.16	0.11	0.58	1.492	12.7	0.19	1.62	0.44	20
070	4.05	9.089	6.39	7.72	1.46	1.60	1.563	36.6	<0.02	5.62	0.23	21
100	5.07	11.243	2.05	7.58	2.18	2.27	1.621	61.5	<0.02	7.54	0.31	23
150	5.39	12.393	1.33	7.55	2.54	2.64	1.655	70.0	<0.02	7.14	0.62	22
200	6.47	12.803	1.08	7.55	2.38	2.52	1.703	73.0	<0.02	8.19	1.35	24
240	7.08	13.111	0.13	7.61	3.34	3.52	1.687	90.0	0.14	1.48	1.60	19

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	SiO_2 µgat/l	NO_2-N µgat/l	NO_3-N µgat/l	NH_4-N µgat/l	Tot.N µgat/l
					18 January							
000	2.04	7.334	8.75			0.71						
070	3.63	8.035	7.21			0.97						
100	4.74	9.895	1.20			2.70						
150	5.05	10.633	0.50			3.11						
200	5.17	10.726	0.28			3.26						
440	5.18	10.927	0.39			3.28						
					16 March							
000	0.20	6.920	9.58	8.14	0.47	0.99	1.368	20.2	0.25	4.0	0.45	17
070	4.45	9.556	2.08	7.43	2.26	2.90	1.556	52.7	0.02	4.5	0.35	17
100	4.80	10.045	0.86	7.34	2.62	3.15	1.577	58.8	0.02	4.0	0.35	16
150	5.15	10.797	0.50	7.33	2.94	3.47	1.607	63.4	0.02	3.6	0.45	16
200	5.14	10.926	0.83	7.35	2.74	3.05	1.618	61.4	<0.02	4.8	0.40	16
440	5.19	11.035	0.83	7.36	2.74	3.10	1.607	61.6	0.02	5.2	0.49	16
					13 June							
000	10.56	7.083	8.51	8.43	0.08		1.409	11.0	0.03	<0.1	0.29	14
070	4.40	9.496	1.86	7.45	2.61		1.546	52.0	0.04	4.09	0.26	19
100	4.03	10.649	0.66	7.39	3.32		1.587	57.7	0.03	3.83	0.31	21
150	5.18	10.981	0.62	7.37	3.35		1.612	57.7	0.08	4.69	0.48	18
200	5.33	11.191	0.93	7.39	3.04		1.618	59.1	0.04	5.32	0.37	19
440	5.40	11.261	1.04	7.40	2.99		1.618	49.7	0.06	5.69	0.48	23

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	SiO_2 µgat/l	NO_2-N µgat/l	NO_3-N µgat/l	NH_4-N µgat/l	Tot.N µgat/l
						1 September						
000	16.13	6.205	6.88	8.38	0.07	0.57	1.318	18.9	<0.02	<0.1	0.45	32
070	4.62	10.110	0.52	7.38	3.06	2.98	1.644	65.2	0.02	4.73	0.25	16
100	5.12	10.818	0.46	7.27		2.97	1.660	66.0	0.02	4.94	0.24	16
150	5.23	10.971	0.53	7.28	2.93	3.21	1.665	67.0	0.02	5.90	0.35	18
200	5.35	11.212	0.66	7.30	2.79	3.31	1.673	66.0	0.02	6.15	0.58	21
440	5.46	11.311	0.63	7.29	2.89	2.80	1.684	69.8	0.10	7.41	0.48	21
						2 December						
000	6.50	7.357	7.90	7.96	0.31	0.51	1.435	11.5	0.23	1.43	0.73	17
070	3.73	8.902	4.44	7.60	1.54	1.66	1.557	25.1	0.02	4.19	0.25	19
100	4.89	10.508	0.79	7.39	2.96	3.03	1.625	46.9	0.02	6.15	0.24	18
150	5.23	11.004	0.54	7.38	3.08	3.08	1.638	46.7	0.02	6.32	0.34	20
200	5.40	11.097	0.57	7.38	3.02	3.08	1.636	46.2	0.02	6.43	0.27	19
440	5.43	11.297	0.52		3.05	3.10	1.636	49.8	0.04	7.76	0.34	20

R/V Argos 1977 03 08 - 1977 03 24

---- Oxygen concentration less than 2 ml/l

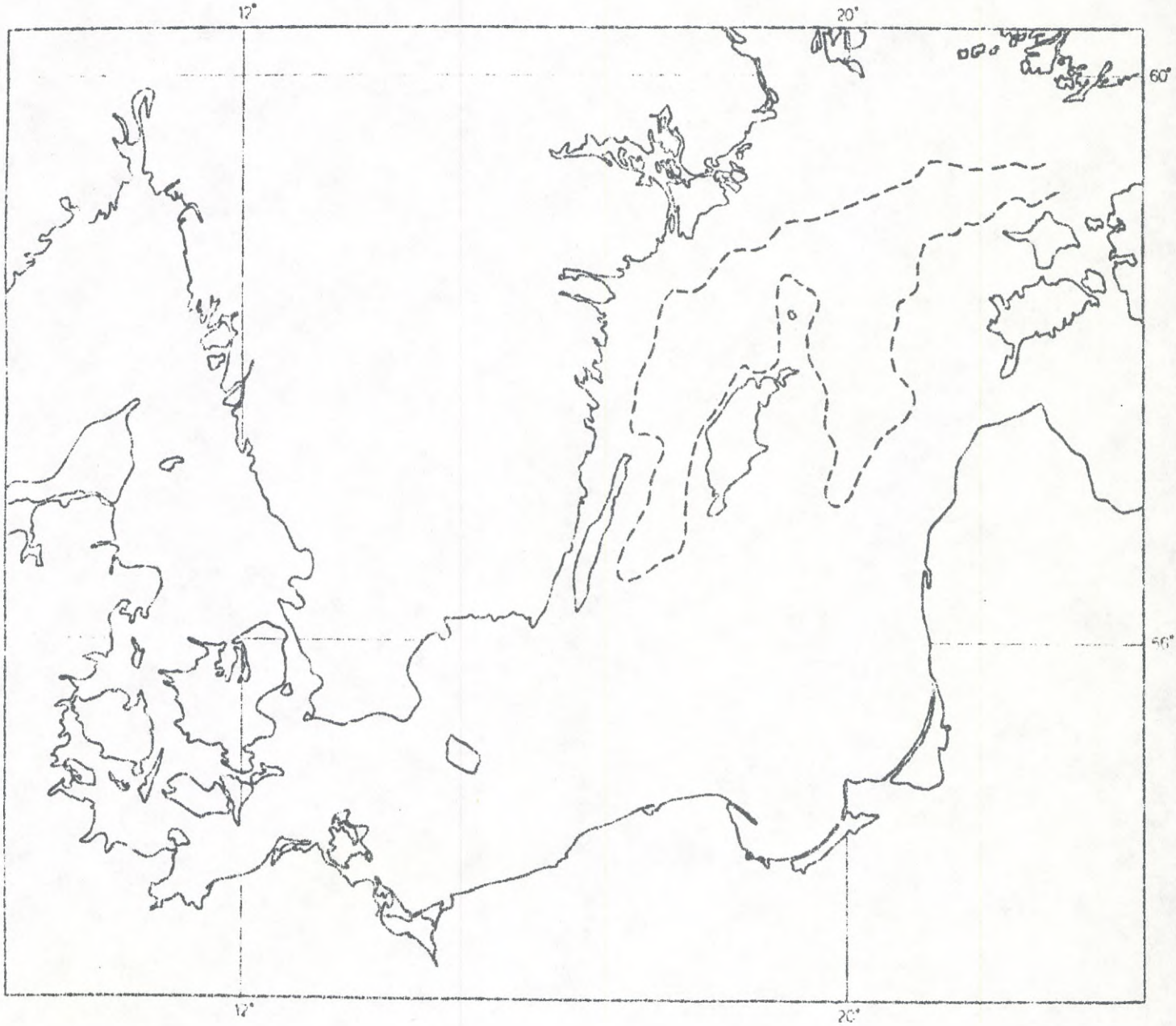


Fig. 2

R/V Argos 1977 05 31 - 1977 06 15

---- Oxygen concentration less than 2 ml/l

\\\\\ Area with hydrogen sulfide containing water

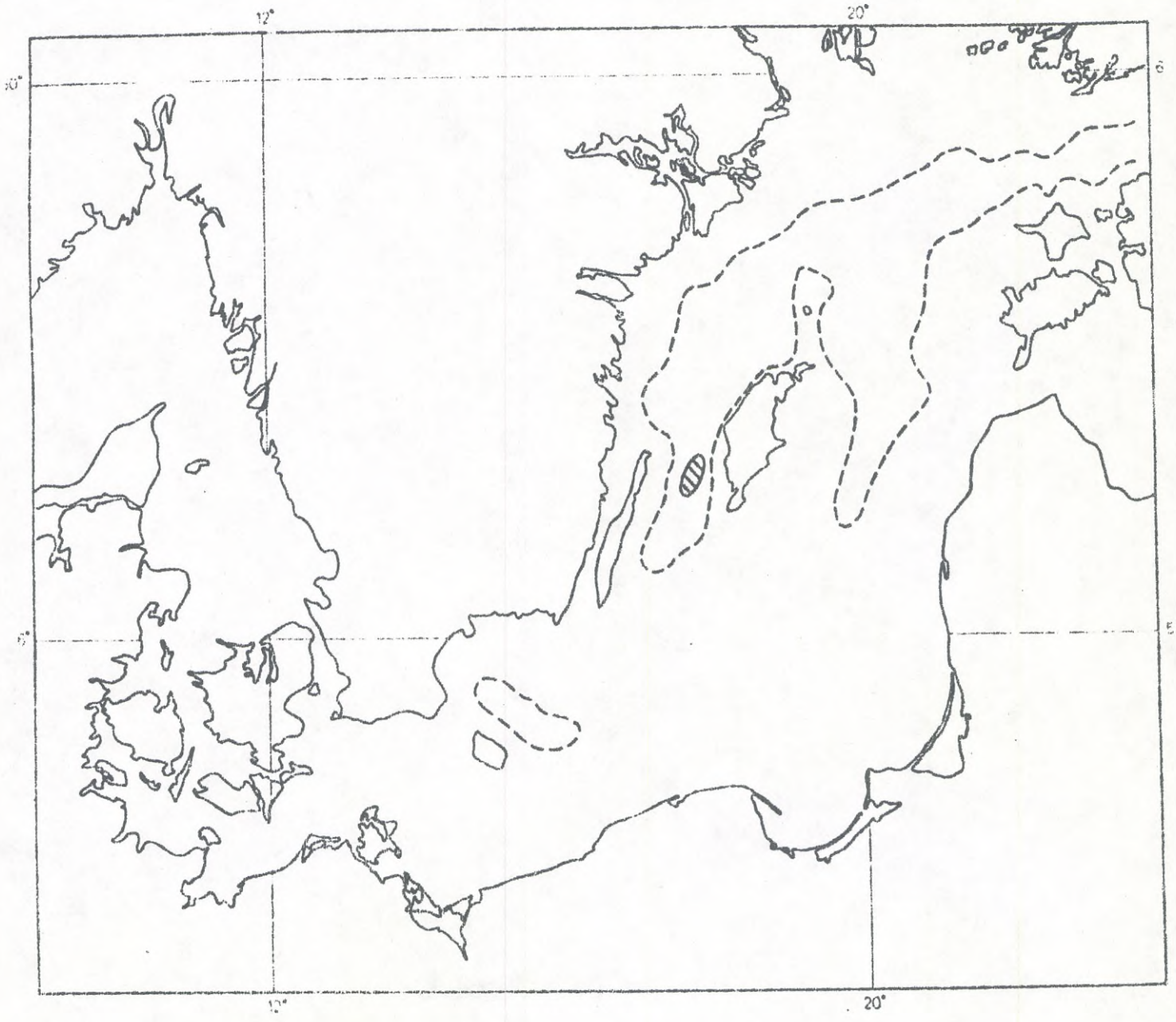


Fig. 3

R/V Argos 1977 08 29 - 1977 09 21

---- Oxygen concentration less than 2 ml/l

\\\\\ Area with hydrogen sulfide containing water

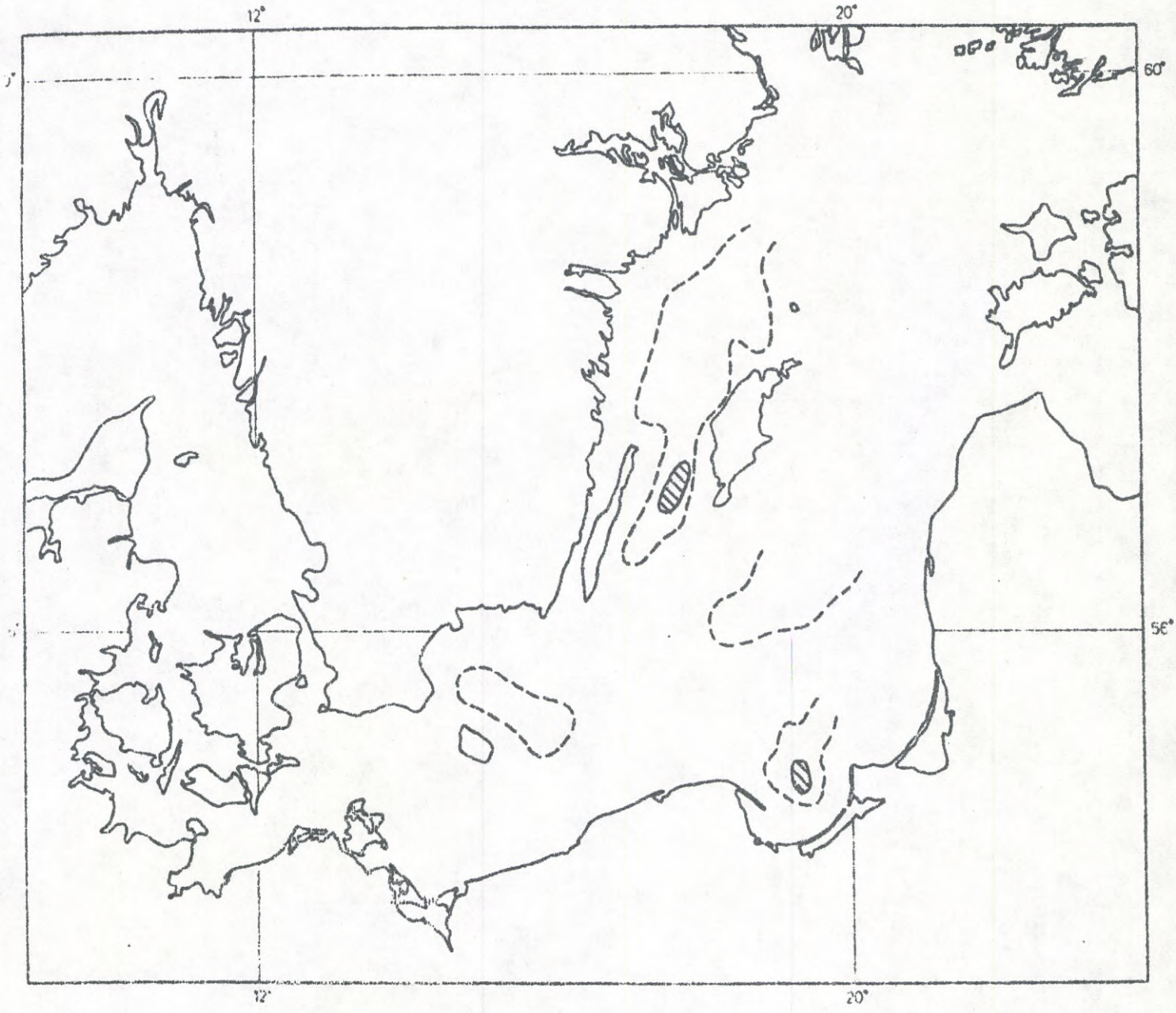


Fig. 4

R/V Argos 1977 11 21 - 1977 12 04

---- Oxygen concentration less than 2 ml/l

\\\\\ Area with hydrogen sulfide containing water