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UNDERSØKELSE AV ELDRE TEMPERATURDATA
FRA
HOLMESTRANDSOMRÅDET

(INVESTIGATIONS OF THE OLDER TEMPERATURE DATA FROM THE HOLMESTRAND AREA)

Saksbehandler : Norman Green, BA
Medarbeider : Jan Magnusson, Can.fil.

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Instituttetsjef Kjell Baalsrud

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FORWORD

This report is the result of inquiries by The Salvage Association of London where they seek long term temperature data of the subsurface water in the area of Bogen near Holmestrand. These data shall be used to determine whether the ballast water could freeze in the vessels laid up in this locality.

INTRODUCTION

The Norwegian Institute for Water Research (NIVA) has data in this area from four stations : St. 12, St. 13, St. NG-1 and St. NJ-1 shown on the map of Oslofjord, figure 1. The Holmestrand area is shown in more detail on "Norges Sjøkart" No. 3.

Station NJ-1 has been observed the longest period of time from 1963 - 1970. Stations 12 and 13 were sampled intensely for a year in a cooperative effort with "Vassdrags- og Havnelaboratoriet" (VHL) in a contract with "Norges Vassdrags og Elektrisitetsvesen". Station NG-1 was observed once in April 1963. Because of the nature of the request, data was taken during the colder months from October to May and down to 40 meters given in Tables 1 and 2. Table 3 shows the monthly mean air temperature during this time. (All temperatures are given in degrees Centigrade).

METHOD

The subsurface water is calculated from two reversing thermometers attached to a Nansen sampling bottle at the standard depths of 4, 8, 12, (16) 20, 30 and 40 meters. Accuracy of these calculations

is $\pm 0.01^{\circ}\text{C}$. Temperature from 0 or 1 meter is read from a thermometer placed in a bucket with the sample and it follows that one does not obtain as accurate readings. The air temperature was gathered from the annuals of the Norsk Meteorologiske Institutt at the Station Jeløy (see fig. 1). The monthly means (in degrees Centigrade) are computed from the formula

$$M = n - k(n - \text{Min})$$

where n is the mean of the observations made at (8) 7, 13 and 19^h C.E.T., k a factor appropriate for the station and season, and Min is the mean min-mum temperature.

RESULTS

The data is taken from the years 1962 - 74. Station 12, the nearest to Bogen, was recorded one year, 1973 - 74 where the minimum temperature recorded below the surface was 1.32°C at 4 meters in January. This winter was mild compared to those of 1963, 64, where among other lower temperatures one of -0.02°C x) was recorded at 8 meters in April 1963, St. NG-1.

The mean air temperature was also much lower during 1963 - 64 than 1973 - 74 (Table 3), which confirms the relative differences between the years.

Recorded temperatures below 40 meters are fairly consistant at $6-7^{\circ}\text{C}$ with one extreme case of 4.66°C .

COMMENTS

It should be observed that the recorded data is sampled in intervalls and does not necessarily give the lowest values during a year. Because of this, a lower temperature may be found at some intermediate time or depth. Another explanation is that the cold water at intermediate depths is not locally developed, but surface water cooled at another place and advectively brought to Breiangeren.

x) Sea water at 35 o/oo freezes at -1.91° .

The temperature wave (the penetration of temperature down in the water) is a function of depth (stratification). The wave propagation can be estimated from the data and Gade (1970) estimated the thermal diffusivity in Breiangeren to $0.7 - 0.8 \text{ cm}^2/\text{s}$ but points out that the material used is far from satisfying. For a more detailed information we can refer to Report 24 from Geophysical institute in Bergen, Norway : "Hydrografikal Investigation in the Oslofjord, a Study of Water Circulation and Exchange Process" by Herman G. Gade, especially chapters 3.2.1 and 4.4. 1.

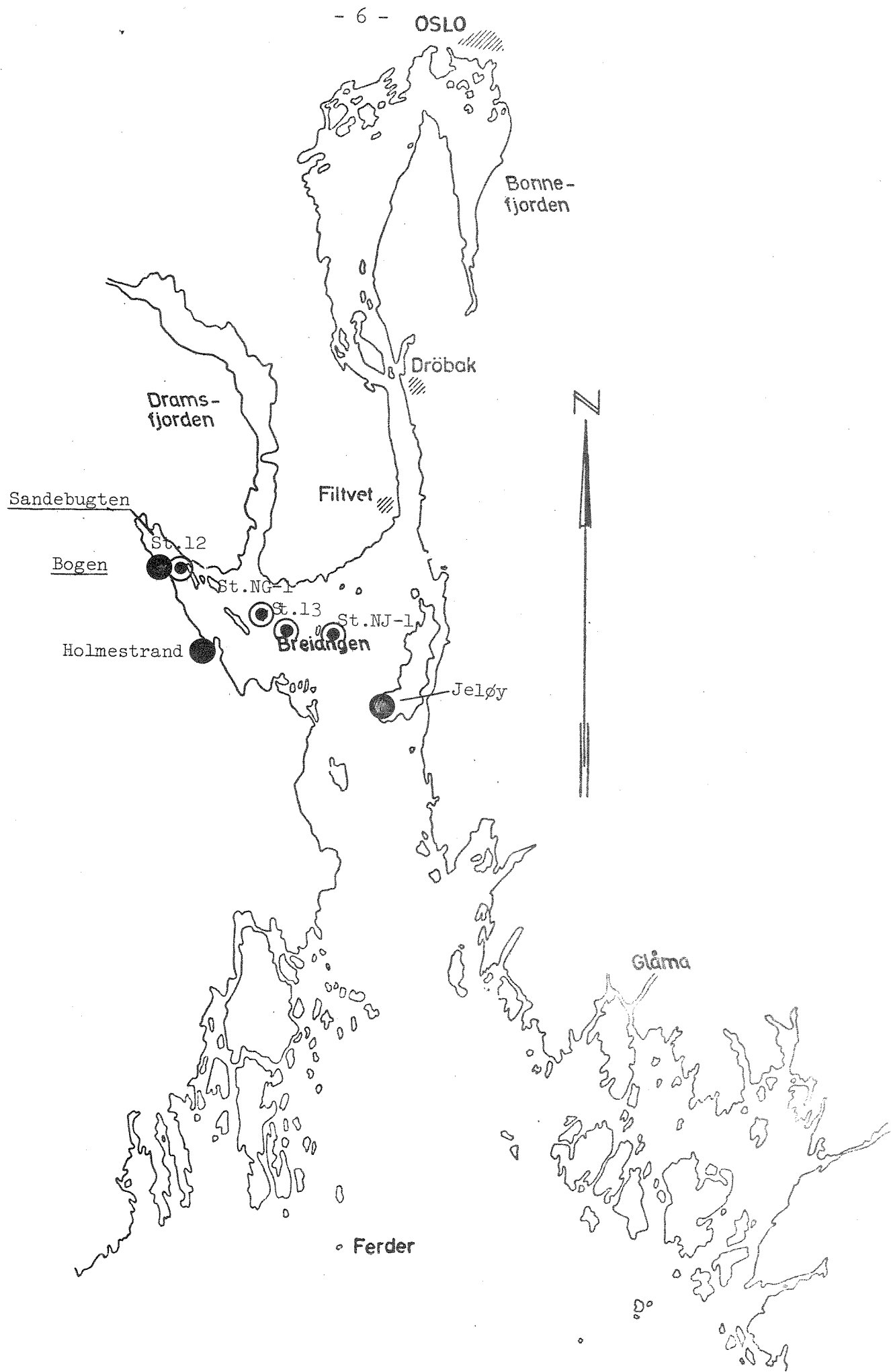


Fig.1 Oslofjorden

Table 1 Temperature data from October to May 1973-74 and down to 40 m for station 12 and 13
(T °C)

Sta- tion and depth(m)	Month		Oct		Nov		Dec		Jan		Feb		Mar		Apr			May	
	73.10.01	73.10.16	73.11.05	73.11.16	73.11.10	74.01.22	74.02.06	74.02.18	74.03.05	74.03.18	74.04.03	74.04.19	74.04.29	74.05.27					
0	10.70	8.25	7.10	4.90	4.40	0.7	1.22	2.00	1.00	1.55	5.20	7.7	10.7	12.75					
4	12.81	11.99	6.93	5.78	5.28	1.32	1.60	2.33	1.57	1.70	3.09	4.84	6.39	10.12					
8	12.90	12.44	7.33	8.89	8.93	2.20		2.59	1.97	1.91	2.36	7.05	6.72	7.69					
12	12.31	11.83	8.37	10.86	9.62	2.56	1.63	2.76	2.25	2.23	3.11	6.74	6.30	6.77					
16		11.48		11.48	9.93														
20	12.52	11.21	8.81	11.59	9.93	4.42	2.28	3.47	3.38	2.91	7.18	6.81	5.95	6.27					
30	12.45	10.37	11.66	11.20	9.72	7.21	3.45	6.48	6.50	3.23	6.76	6.08	5.84	5.89					
40	10.03	9.90	10.56	11.10	9.45	8.59	4.35	7.97	7.84	3.37	6.48	5.90	5.79	5.94					
			(73.11.14)				(74.02.05)												
0	11.50	7.80	7.30	5.60		0.15	2.18	2.60	1.50	1.8	4.10	5.9	10.	13.6					
4	12.04	9.09	7.05	6.28		1.97	1.88	2.66	1.57	1.59	3.11	6.40	7.08	10.90					
8	12.32	12.44	7.75	6.61		2.3	1.86	2.62	1.58	2.06	2.61	6.90	6.73	8.13					
12	12.33	12.55	8.20	9.55		2.29	1.96	2.80	1.87	2.23	4.42	6.75	6.36	6.80					
16		12.74		10.63			2.20												
20	12.83	12.13	9.09	11.75		3.58	2.83	4.77	3.03	3.07	6.94	6.41	5.95	6.22					
30	12.85	11.37	10.70	11.54		6.26	4.37	6.28	5.42	7.07	6.81	6.59	5.83	5.93					
40	12.91	10.67	12.02	11.74		7.99	5.69	7.40	7.50	6.94	5.99	5.90	5.79	5.81					

Table 2 Temperature data from October to May 1963-70 and down to 40 m for stations NJ-1 and NG-1 (T °C)

Station and depth (m)	Oct			Nov			Dec						Jan			
	63.10.23	64.10.21	65.10.05	63.11.14	64.11.17	65.11.02	67.11.28	63.12.17	64.12.16	65.12.07	66.12.07	68.12.10	69.12.09	64.01.16	65.01.15	66.01.27
1	9.90	10.07	12.06	6.95	6.14	9.73	5.97	4.70	6.14	5.13	4.45	1.62	4.11	2.44	5.30	0.36
4	10.71	10.17	12.86	7.42	7.85	9.73	5.98	5.78	7.85	5.81	4.71	3.14	4.23	3.16	6.20	2.20
8	11.18	10.82	13.84	7.67	8.97	9.79	6.76	9.80	8.97	8.52	4.76	5.24	5.27	5.32	6.75	3.43
12	11.58	12.09	14.13	8.05	9.50	11.36	9.17	10.23	9.50	9.04	5.05	6.20	5.64	5.73	7.22	4.81
20	12.57	12.40	13.97	9.04	10.74	11.93	11.33	10.38	10.74	9.17	5.37	7.29	7.94	7.02	7.45	6.10
30																
40	12.77	11.16	12.22	12.15	10.39	12.90	11.97	9.48	10.39	8.17	5.36	7.58	10.01	8.24	7.90	7.03
	Feb.			Mar				Apr						May		
	64.02.12	65.02.10	69.02.26	64.03.12	64.03.31	65.03.10	63.04.23	64.04.23	65.04.07	66.04.14	67.04.04	68.04.25	70.04.28	64.05.14	65.05.05	69.05.27
1	4.78	4.64	3.97	1.27	1.40	3.70	3.00	6.37	3.52	1.95	3.46	9.20	5.59	9.86	7.73	14.62
4	4.91	5.96	4.05	1.24	0.78	3.07	2.50	5.29	3.48	1.96	3.40	7.98	5.00	8.69	7.91	9.98
8	5.02	6.57	4.33	0.89	1.42	3.11	0.40	4.16	2.85	1.94	3.42	6.97	4.18	7.34	8.27	10.82
12	5.34	7.08	4.45	0.76	1.28	3.22	2.85	3.65	2.40	1.95	3.43	6.87	4.49	5.90	6.82	5.95
20	6.70	7.12	6.54	4.00	6.83	4.01	6.38	5.61	4.39	2.06	3.54	5.85	5.63	7.08	5.01	5.61
30			6.85										5.46			5.53
40	7.40	6.65	6.85	7.63	6.37	6.00	6.83	6.41	6.44	2.81	4.18	5.05	6.01	5.55	6.16	5.68
1							63.04.23									
4							2.85									
8							2.57									
12							- 0.02									
20							1.10									
40							6.21									
							6.84									

TABLE 3. MEAN MONTHLY AND YEARLY AIR TEMPERATURES (T°C) 1963 - 70, 1973 - 74 AT STATION JELØY

Year/ Month	1963	1964	1965	1966	1967	1968	1969	1970	1973	1974
I	- 5,4	- 0,9	- 1,3	- 6,5	- 5,0	- 4,1	- 2,2	- 6,0	0,5	1,3
II	- 7,2	- 1,9	- 0,2	- 9,0	- 1,7	- 3,5	- 6,4	- 11,1	1,2	1,4
III	- 3,5	- 0,2	0,3	0,3	3,2	1,8	- 2,0	- 1,0	3,8	1,7
IV	3,1	4,8	4,3	1,3	4,6	6,3	4,3	2,7	4,8	7,5
V	10,0	10,9	9,1	9,3	8,9	9,2	9,7	11,6	10,4	11,5
VI	15,9	12,9	14,2	16,6	14,1	15,8	16,7	17,8	15,6	15,1
VII	16,1	14,5	14,6	17,0	17,1	16,0	16,9	15,2	18,4	15,7
VIII	15,2	15,1	14,3	15,1	16,4	16,5	18,4	16,5	15,5	15,9
IX	18,8	11,4	12,5	12,2	12,7	12,7	13,2	11,9	11,2	12,8
X	8,1	6,9	8,6	6,8	8,4	6,7	9,1	7,9	5,3	5,9
XI	2,7	3,3	- 1,1	2,9	4,9	- 0,5	1,5	1,0	1,7	3,0
XII	- 1,2	- 0,5	- 5,4	- 0,9	- 1,6	- 2,6	- 2,4	0,5	- 0,1	1,7
Year Mean	5,5	6,4	5,8	5,4	6,8	6,2	6,4	5,6	7,4	7,8

Months with no
corresponding water
temperature data

REFERENCE

Gade, Herman G. (1970) Hydrographic Investigations in the Oslofjord, a study of Water Circulation and Exchange Processes.

Geographical Institute of Berge, Norway. Report 24, September 1970.

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