

This paper not to be cited without prior refernce to the authors

International Council for  
the Exploration of the Sea

C.M.1984/Gen:15  
Mini-Symposium

CLIMATIC VARIATIONS IN THE BARENTS SEA DURING THE 1970'S.

by

Harald Loeng and Lars Midttun  
Institute of Marine Research  
Bergen, Norway

## 1. Introduction

Recently three small reports were presented by members of the Institute of Marine research, Bergen, viz: Midttun, Nakken and Raknes (1981), Loeng, Nakken and Raknes (1983) and Sætersdal and Loeng (1984) all describing biological reactions to climatic variations in the Barents Sea. The biological reactions were observed in the two larger fish stocks of the area, the Arctic Cod and the Barents Sea Capelin. It is of considerable interest to study the nature of the biological reaction processes, and equally important is it to try to understand the mechanisms causing the climatic variations. The latter is however beyond the scope of this paper which is merely just a recording of climatic variations observed in the Barents Sea in the period 1970-1983. The paper may be seen as an introduction to the two papers dealing with some biological variables observed in Capelin (Gjørseter and Loeng 1984) and Cod (Nakken and Raknes 1984) during recent years.

## 2. Climatic conditions in the Barents Sea.

The Barents Sea is in the north and east covered with Arctic water masses, where ice is formed in winter and melts again during the summer season. In the south and west the inflowing Norwegian Coastal Current and the Barents Sea branch of the Atlantic Current form the Sub-Arctic water masses bordered from the Arctic area by the Polar Front. (Fig. 1) The climatic conditions in the Barents Sea are therefore determined both by effects from variation in the inflow from the west and by processes taking place in the sea itself.

Several authors have studied the climatic conditions of the Barents Sea, among others Helland-Hansen and Nansen (1909), Lee (1963), Kislyakov (1964), Midttun (1969), Dickson, Midttun and Mukhin (1970), Buchkov (1976), Blindheim and Loeng (1981), Loeng (1983, 1984), Dickson and Blindheim (1984).

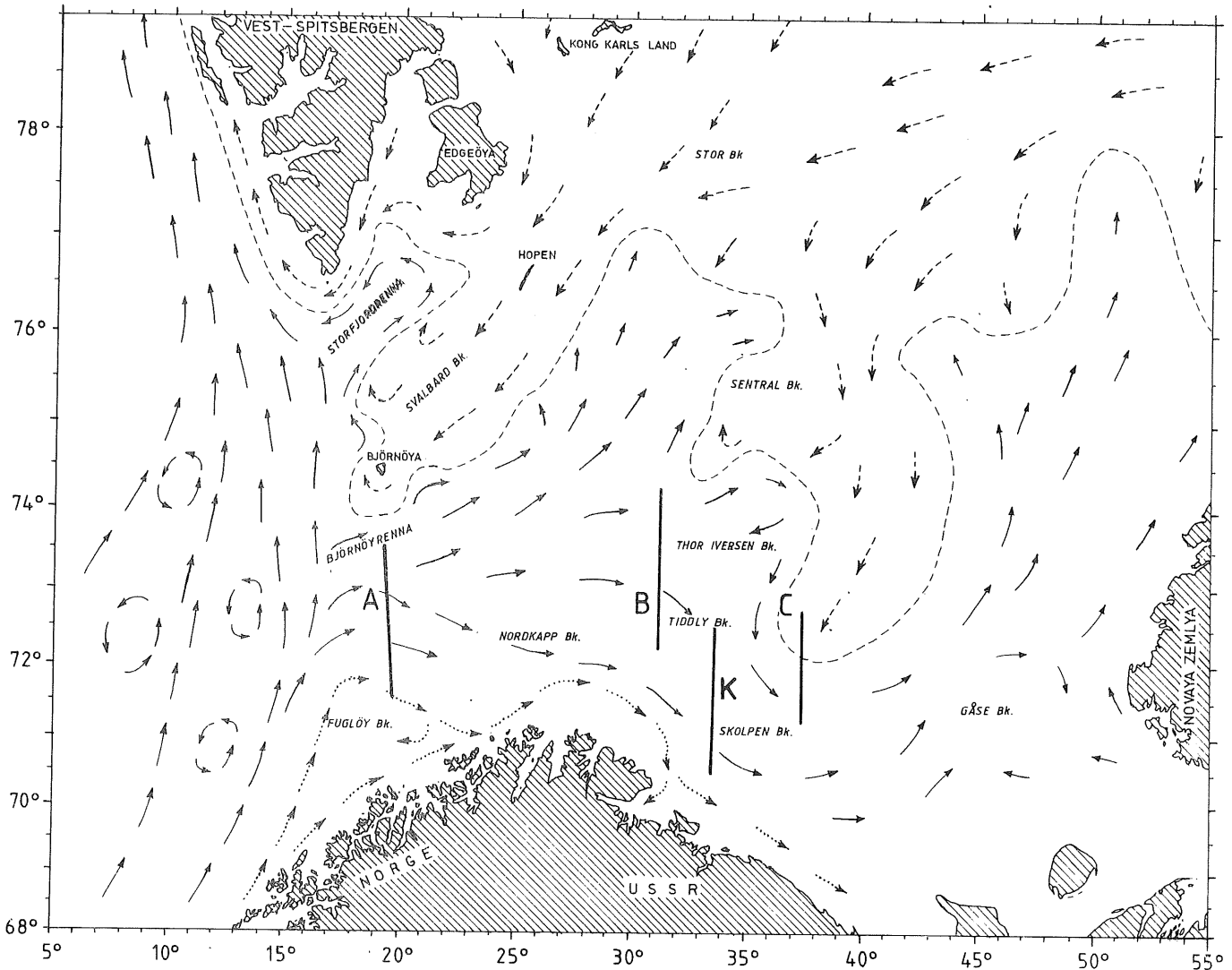


Fig. 1. Location of the four sections A, B, K, and C seen in relation to the circulation pattern of the Barents Sea. —> : Atlantic water, - - - -> : Arctic water, .....> : Coastal water. The polar front is indicated by a broken line.

A general conclusion is that the climatic conditions of the Barents Sea depend mainly on the activity and property in the inflowing water from the west. Climatic variations can therefore be recorded in the sections crossing the inflowing water masses.

### 3. Variations in standard sections

The locations of the standard sections dealt with below are shown in Fig 1. The three sections A, B, and C have been observed by Norwegian reserach vessels since the early 1950's,

but at various seasons. Regular observations have been taken in late August - early September since 1953. From 1977 the sections are more frequently observed, (section A: 6 times, section B: 4 times and section C: 2 times yearly). Blindheim and Loeng (1981), Loeng (1983) and Loeng (1984) have studied the variability of temperature and salinity in the three sections, in particular those divisions of the sections containing the salinity cores and therefore reflecting the Atlantic influence.

The section denoted K(Fig.1) shows the location of the famous Kola section. With exception of the two periods 1906-20 and 1941-44, regular observations are recorded back to 1900. Monthly mean temperature for the depth layer 0-200 m between  $70^{\circ}30$  N and  $72^{\circ}30$  N have been made available to the Institute of Marine Research, Bergen by the Knipowich Polar Research Institute of Marine Fisheries and Oceanography, Murmansk. Midttun, Nakken and Raknes (1981) have calculated monthly 60 years mean temperatures for the periods 1921-1980 and anomalies from those mean values have been calculated for the whole observation period up to 1983. The complete series of anomalies is shown in a paper by Setersdal and Loeng (1984). The section is crossing the eastward flowing current at location of its maximum temperature, therefore the Kola section do not represent exactly the same watermasses as the Norwegian sections are observing. But as is shown below, the main trends are similar in all the series.

#### 4. Variations in the period 1970 - 1983.

Fig. 2. shows temperature and salinity variations in the three Norwegian sections A, B and C and the corresponding temperature observed in the Kola section, the latter taken from Anon. (1983). The curves represent mean values in the layer 50-200 m, observed in late August-early September each year.

The salinity curves have similar trends in all the three sections A, B and C. The salinity is gradually decreasing from 1970 until

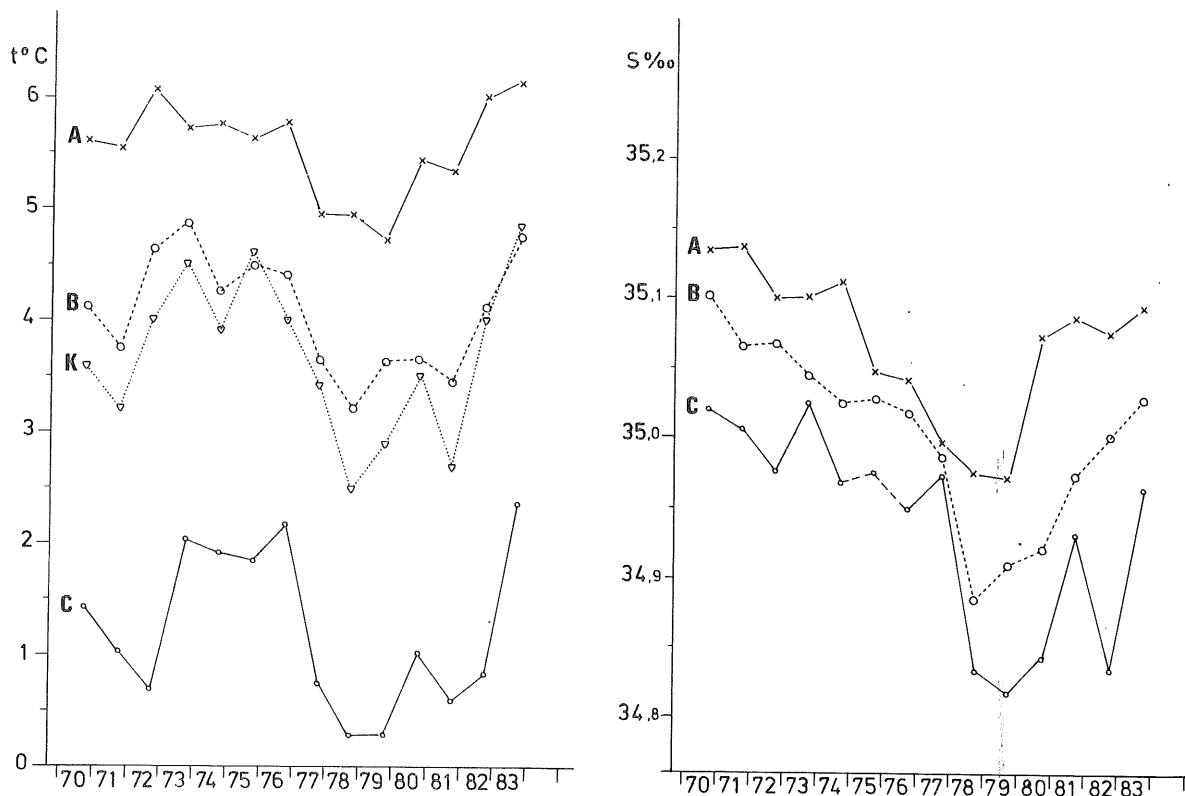


Fig. 2. Temperature (left) and salinity (right) of the 50-200 m layer in the three sections A, B, C and temperature in 50-200 m in the Kola section. August-September, 1970-1983.

1978-1979 when the lowest values are observed. Later on the salinities are generally increasing up to normal values in 1983. The variations are greatest in the east (section C) where the standard deviation for the period 1964-1983 is 0.07 compared to 0.05 in the west (section A).

Also the temperature curves show parallell trends, most pronounced is the cold period 1977-1981, which in the Kola section is the longest period with negative anomalies observed after 1920.

The curves of Fig. 2 are all based on only one observation per year and may therefore be encumbered with accidental short term variations. Since 1977 the sections A, B and C have been more frequently observed. In order to eliminate the seasonal changes anomalies have been calculated for the period 1977-1983. (Fig. 3-5).

The three curve sets show the same trends in the climatic variations as was described above. The salinity was decreasing

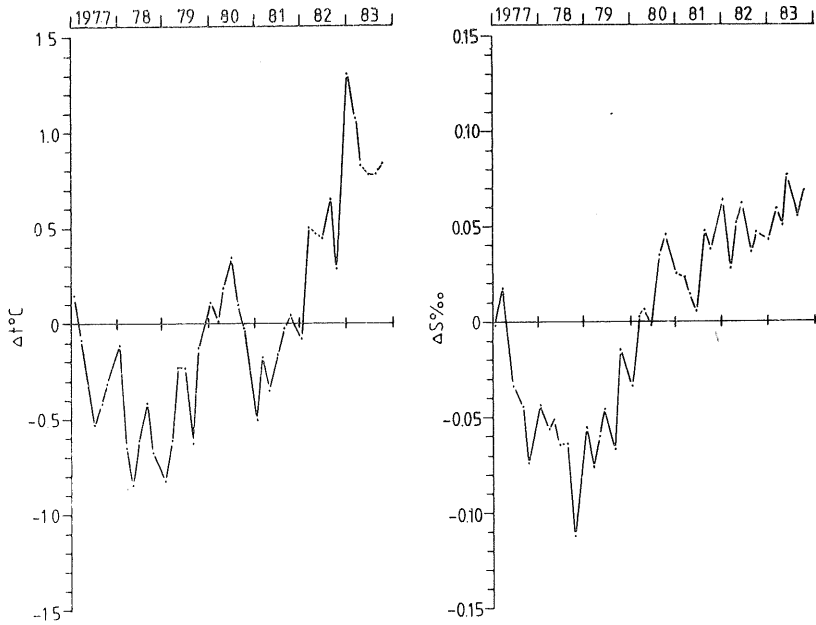


Fig. 3. Anomalies in temperature (left) and salinity (right) in the depth layer 50-200 m in section A ( $71^{\circ}30'$  -  $73^{\circ}30'$ N) in the period 1977-83.

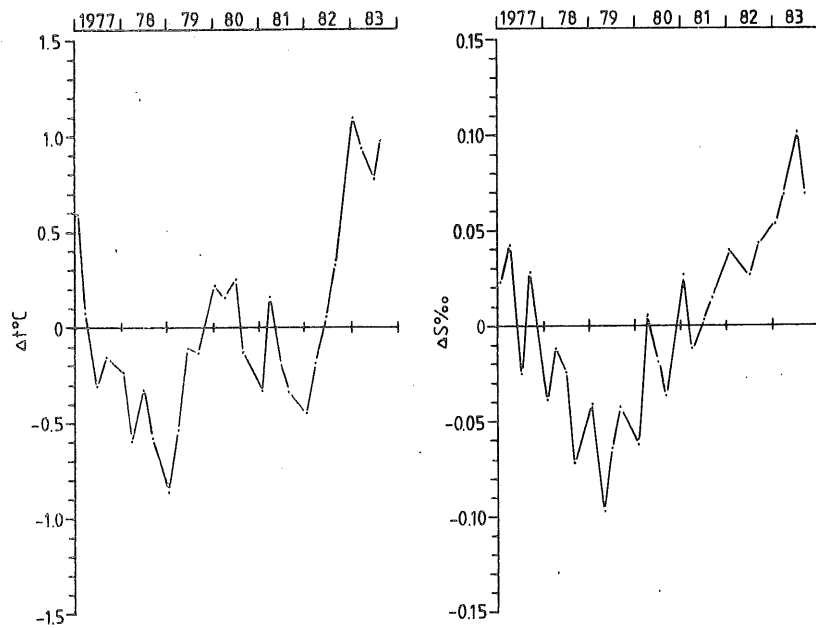


Fig. 4. Anomalies in temperature (left) and salinity (right) in the depth layer 50-200 m in section B ( $72^{\circ}15'$  -  $74^{\circ}15'$ N) in the period 1977-83.

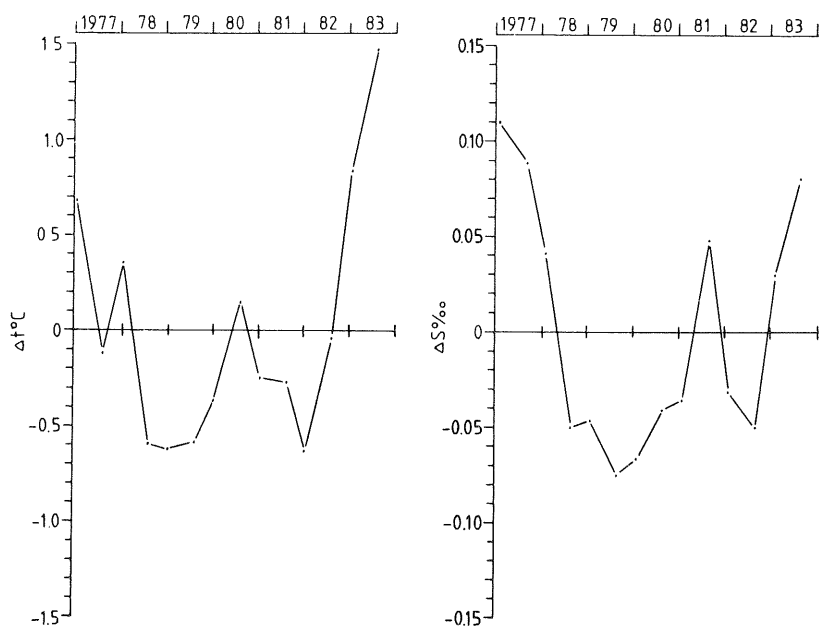


Fig. 5. Anomalies in temperature (left) and salinity (right) in the depth layer 50-200 m in section C ( $71^{\circ}15'$  -  $72^{\circ}45'$ N) in the period 1977-83.

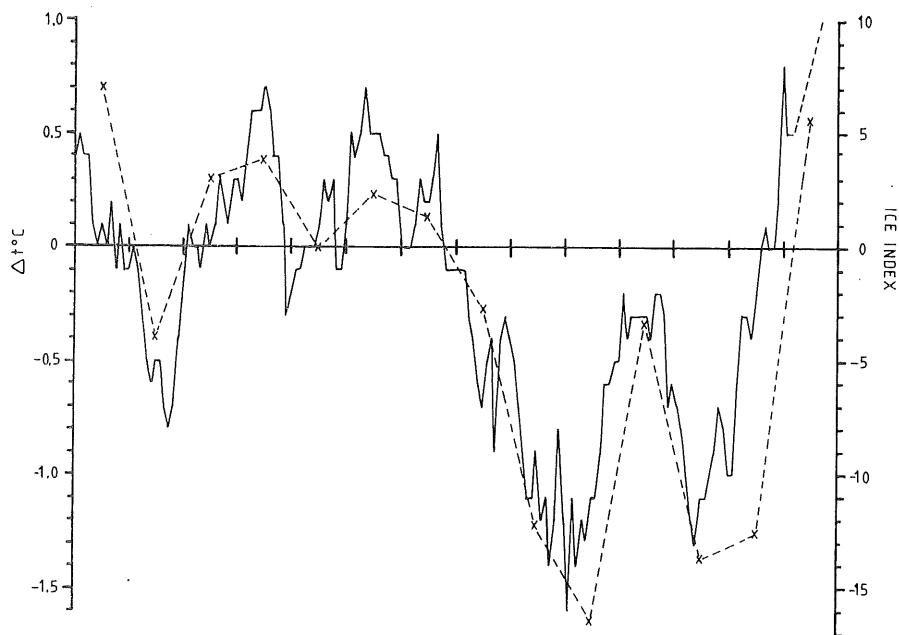


Fig. 6. Temperature anomalies of the 0-200 m layer in the Kola section (continuous line) together with the ice index (broken line).

in the beginning of this period until lowest value in 1978-1979. Later on the salinity have been increasing. There seems to be a lag in the alteration from west to east as would be expected. The relative high salinity value in section C observed in August 1981 is difficult to explain. The temperature curves as well have similar trends. The lowest values were observed in 1978-1979, some warming through 1980, but again lower values in 1981. Since early 1982 the temperature has generally been increasing.

The best description of the climatic variations in the period 1970-1983 is presented in Fig. 6 which shows the temperature anomalies observed in the Kola section (section K). The normal in the 0-200 m layer are monthly means for the period 1921-1980. In the same figure is also indicated the variation in the ice coverage in the Barents Sea taken from Sætersdal and Loeng (1984).

##### 5. Concluding remarks.

Large variations have been observed in the climatic conditions in the Barents Sea during the 1970's. The second half of the decade was characterized by low temperature, low salinity and large ice coverage. Through the beginning of the 1980's temperature and salinity are generally increasing and the ice coverage becomes smaller.

The climatic variations are mainly determined by variation in the Atlantic inflow to the Barents Sea.



References

- Anon. 1983. Preliminary report of the International 0-group fish survey in the Barents Sea and adjacent waters in August-September 1983. Coun. Meet. Int. Coun. Explor. Sea, 1983 (G 35): 1-27. (Mimeo.)
- Blindheim, J. and Loeng, H. 1981. On the variability of Atlantic influences in the Norwegian and Barents Seas. Fisk. Dir. Skr. Ser. HavUnders. 17: 161-189.
- Buchkov, Yu.A. 1976. On the effect of solar activity of various periodicity on the thermal regime of the Barents Sea. Coun. Meet. Int. Coun. Explor. Sea, 1976. (C 2):1-19. (Mimeo.)
- Dickson, R., Midttun, L. and Mukhin, A. 1970. The hydrographic conditions in the Barents Sea in August-September 1965-1968 in: Dragesund, O. (Ed.) International 0-group survey in the Barents Sea 1965-1968. ICES Cooperativ Research Report A (18).
- Dickson, R. and Blindheim, J. 1984. On the abnormal hydrographic conditions in the European Arctic during the 1970's. Jens Smed Volume, Rapports et procès-Verbeaux. (In press).
- Helland-Hansen, B. and Nansen, F. 1909. The Norwegian Sea. Fisk. Dir. Skr. Ser. HavUnders. 2 (2): 1-360.
- Kislyakov, A.G. 1964. Horizontal circulation of water on the Watershed of the Norwegian and Barents Sea. Trudy polyar. nauchno-issled. Inst. morsk. ryb. khoz. Okeanogr. 16 : 215-225. (In russian).
- Lee, A. 1963. The hydrography of the European Arctic and Subarctic Seas. Oceanogr. Mar. & Biol., 1: 47-76.

- Loeng, H. 1983. Climatic variations in three hydrographic sections in the Barents Sea during the period 1977-1982. Fisken Hav. 1983 (3): 5-21. (In Norwegian, abstract in English).
- Loeng, H. 1984. The climate in the Barents Sea in 1983. Fisken Hav. 1984 (1): 9-15. (In Norwegian, abstract in English).
- Loeng, H., Nakken, O. and Raknes, A. 1983. The distribution of capelin in the Barents Sea in relation to the water temperature in the period 1974-1982, Fisken Hav., 1983 (1): 1-17 (In Norwegian, abstract in English.)
- Midttun, L. 1969. Variability of temperature and salinity at some localities off the coast of Norway. Prog. Oceanogr. 5: 41-54.
- Midttun, L., Nakken, O. and Raknes, A. 1981. Variations in the geographical distribution of cod in the Barents Sea in the period 1977-1981. Fisken Hav., 1981 (4): 1-16. (In Norwegian, abstract in English.)
- Sætersdal, G. and Loeng H. 1984. Ecological adaption of reproduction in Arctic Cod. P. 13-35 in Godø, O.R. and Tilseth, S. ed. Proc. of the Soviet-Norwegian Symp. Reproduction and Recruitment of Arctic Cod, Leningrad, 26-30. September 1983. Institute of Marine Research, Bergen 1984.