C.M. 1988/C:30

THE BASIC DRIVING FORCE: OCEANOGRAPHY

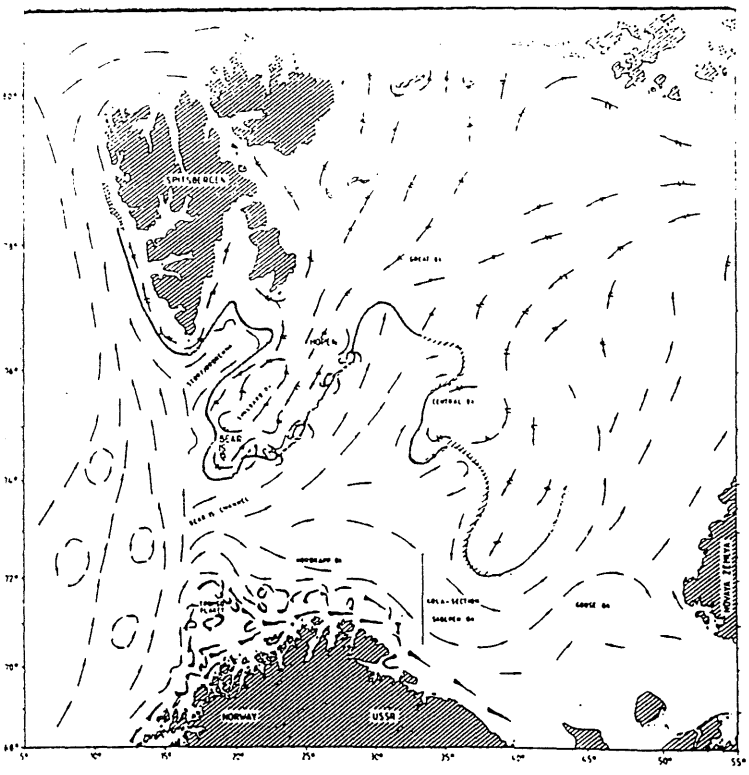
by

H. Loeng

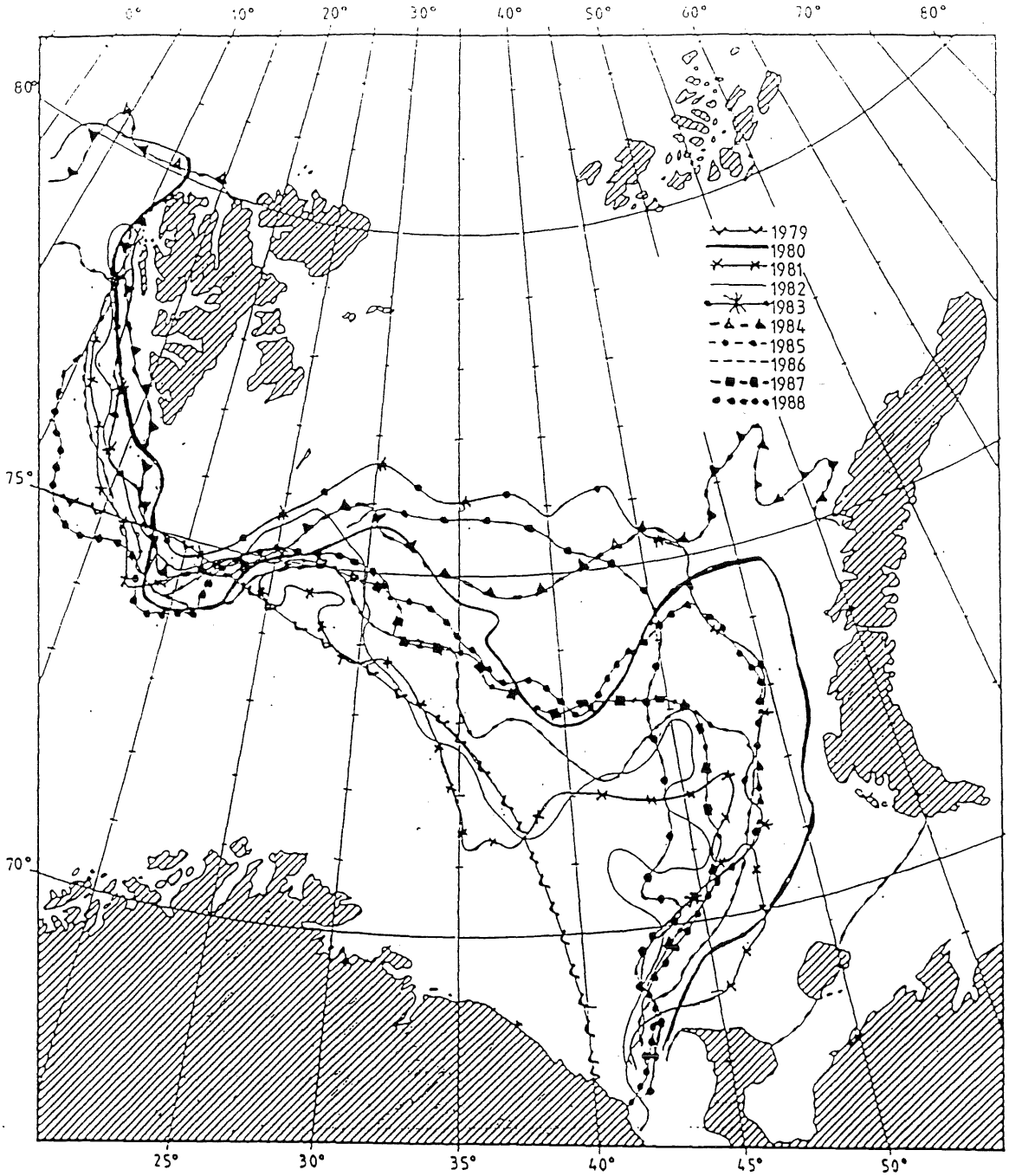
Institute of Marine Research
Bergen, Norway.

As early as the beginning of this century it was shown that variations in physical conditions have great influence on the biological conditions of various fish species. During the period 1930-1970, the magnitudes of commercial catches were used as a measure of fish concentrations and abundance, and the changes in the main fishing areas were related to variations in temperature.

The cold period from 1977 to 1982 initiated new investigations on the influence of oceanographic conditions on recruitment, distribution and growth of commercial fish species in the Barents Sea, both by Soviet and Norwegian scientists. The conclusions of these investigations are that climatic variations are of great importance to the biology of the Barents Sea.



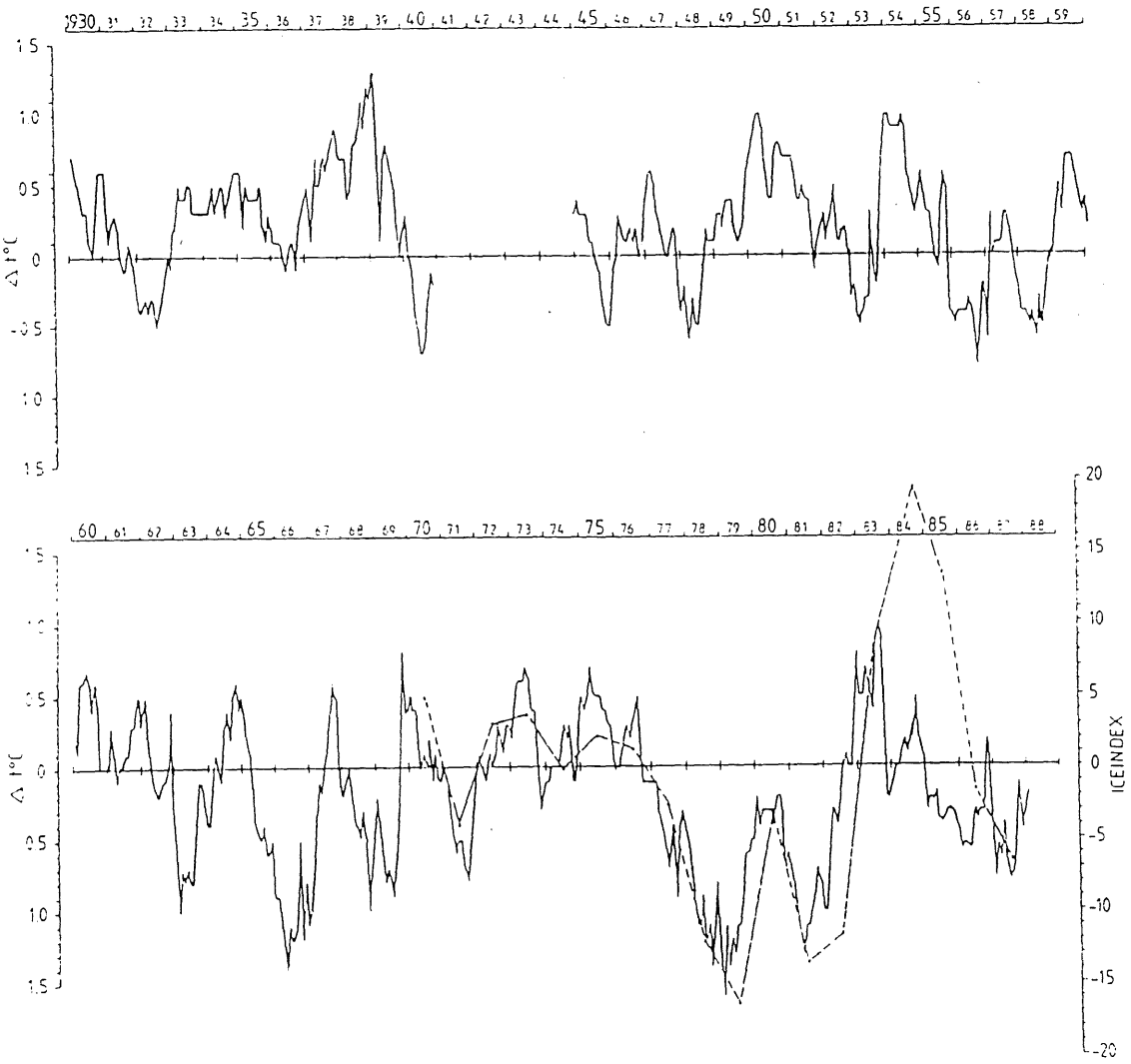
In the Barents Sea there are three main water-masses, which are related to three different current systems. The main features of these currents are shown in the figure to the left. Atlantic water (red arrows) flows into the Barents Sea through the deep channel between Norway and Bear Island. It spreads in the southern part of the sea and may be traced as far east as the coast of Novaya Zemlya. The Coastal current (green arrows) comes from the Baltic and follows the Norwegian Coast into the Barents Sea. The Arctic current system (blue arrows) covers the northern part of the sea. Between the Arctic and Atlantic water there is an area, the Polar front, where the water masses mix, and which is an important area for plankton production.



The seasonal variations of the sea ice coverage are similar from one year to another with maximum and minimum coverage in March-May and August-September, respectively. In addition to the seasonal variations there are long-term trends and short periodic variations.

The maximum ice extent during winter is determined by the heat content of the Atlantic inflow. During the ablation period, radiation plays the dominant role by its direct melting of ice and heating of surface water, which also melts the ice.

The figure above shows the maximum ice extent during the period 1979-1987. Maximum coverage occurred during cold winters, while warmer years as 1983 and 1984 had little ice during winter. There are small variations in the maximum ice coverage near Bear Island, while the largest variations occur in the eastern Barents Sea.



The climatic variations in the Barents Sea depend mainly on the activity and properties of the inflowing Atlantic water. The figure above shows temperature anomalies from the Kola-section for the period 1930-1988. Since 1970 large variations have been observed in the climatic conditions. The period 1970-76 was warm, while the second half of the decade was characterized by low temperature. In 1982 there was a marked temperature increase, and the years 1983 and 1984 were warm. An ice index for the period after 1970 shows similar trends, indicating a close relationship between variations in sea temperature and ice conditions.

In order to study the large scale circulation, variations in the inflow of Atlantic and Polar waters and the transport of fish eggs and larvae, plankton and pollution, a numerical model of the Barents Sea is being developed. Dr. Bjørn Ådlandsvik is responsible for the model in cooperation with the IBM Bergen Scientific Centre.

At present there exists a three dimensional homogeneous model of the wind-driven circulation. It uses finite difference methods with a grid size of 20 km. The wind fields are taken from the Norwegian Meteorological Institute's hindcast archives. A baroclinic model, which takes the different densities of the water masses into account, is planned.

In cooperation with the Norwegian Hydrotechnical Laboratory, Trondheim, a laboratory model for the Barents Sea is being developed. The model will provide a simulation of baroclinic flows in the sea. By varying the boundary conditions, and matching the model results to observed field observations, it will be possible to gain insight into the flow conditions.