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Decadal Changes in the Thermal Properties of the Irminger Sea and Labrador Sea

by

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Abstract

Information is given on decadal changes of temperature at depths between 400m and 1000m in the main area of redfish *Sebastes mentella* abundance in NAFO and NEAFC areas. The long-term perspective of thermal variation over the decades from the 1950s to the 1990s is given, as well as short-term variations during the decade of the 1990s for the Irminger Sea proper. The paper reveals that in the transition area from Irminger Sea to Labrador Sea, south off Greenland, the long-term climatic analysis points at the decade of the 1970s being the warmest decade, and the 1990s being the coldest decade, with 4.95°C at 400m, and 3.63°C at 1000m depth calculated for the 1970s, and the difference between the warmest decade and the coldest decade (1990s) amounts to only 0.96°C.

Introduction

During recent international redfish survey in the Irminger Sea and adjacent waters in NAFO Divisions 1F, 2H, 2J, and 3K (June/July, 2001) the abundance of deep-sea redfish *Sebastes mentella* covered areas of the Labrador Sea and the Irminger Sea (Stransky, pers. comm.). To give some background information on the environmental situation in this area, temperature data were analysed to reveal large scale climatic changes in the environment during the past five decades, and changes in the Irminger Sea proper during the decade of the 1990s.

Material and Methods

For the climatic background data from the CD-ROM Data Sets of the World Ocean Atlas 1994, and the World Ocean Database 1998 (NOAA, 1994; NOAA 1998) were used to perform an analysis of the deep ocean temperature fields of the northwest Atlantic. The variation of temperature in the Irminger Sea proper were taken from XBT measurements performed along 60°N between Greenland and Scotland during 1989-1999 (Stein, 2001). A polynome trend line was added to the data points of the time series to reveal thermal changes over the decade of the 1990s. Analysis and presentation of the horizontal thermal fields were done using the Ocean Data View Software version 5.5 (Schlitzer, 2001). A temperature index was calculated for an area south off Greenland (Fig. 5) to reveal decadal changes (see Table 1).

Results

The thermal variation in the Irminger Sea proper during the decade of the 1990s is given in Fig. 1. At 400m depth temperatures range from 3.4°C to 5.5°C at 60°N, 37°W. At 600m depth the observed changes in the Irminger Sea are rather small, ranging from 3.2°C to 4.1°C.

Variation of temperature on the large scale reveals two different scenarios at 400m depth (Fig. 2), and at 800m depth (Fig. 3): The 1950s and 1960s showed similar warm conditions at 400m depth for the Irminger Sea and the Labrador Sea. From the 1970s onwards, cooling is visible at this depth which continues into the 1980s and 1990s. The 1990s

reveal even colder conditions than the 1980s. This is influenced by the cooling observed in the first half of the decade when tremendous vertical convection took place in the central Labrador Sea (Lazier et al., 2001).

At 800m depth the 1960s reveal maximum warming whereas the 1950s were cooler, as were the 1970s, 1980s, and the 1990s. Again the 1990s point at rather cold conditions.

Discussion

According to Lazier et al. (2001) a series of unusually severe winters in the Labrador Sea region caused unusually intense winter convection during 1990-93. Depth of convection reached 2300m in those years, creating a fresh pool of Labrador Sea water (LSW). As suggested by Stein (2001) temperatures in the central Irminger Sea were also coldest during the period 1989-93. Mild winters during the rest of the decade led to increasing temperatures, both in the Labrador Sea and in the Irminger Sea where temperatures rose to 5.5°C at 400m depth during 1996. Near the end of the decade, during 1999, temperature at 400m depth had decreased to 4.1°C.

The climatic background data clearly indicate that the decade of the 1990s was the coldest during the second half of the 20th century with a widely spread water mass being less the 4°C (Figs. 2, 3). It covered the area of the Labrador Sea and most of the Irminger Sea, between 400m and 1000m depth (Fig. 4). It should be mentioned here, that most of the available data for the 1990s are from 1991-95. The decadal variation of temperature at the depth layers 400m and 1000m is rather small (Table 1, Fig. 5). Maximum temperatures in the transition area from Irminger Sea to Labrador Sea were observed for the 1970s decade with 4.95°C at 400m, and 3.63°C at 1000m depth, and the difference between the warmest decade and the coldest decade (1990s) amounts to only 0.96°C.

References

- Lazier, J., A. Clarke, I. Yashayaev, and P. Rhines. 2001. Convection and Restratification in the Labrador Sea, 1990-2000. Abstract of lecture given at: ICES Symposium Hydrobiological Variability in the ICES Area, 1990-1999. Edinburgh, Scotland, 8-10 August 2001.
- NOAA, 1994. World Ocean Atlas 1994. CD-ROM Data Sets. U.S. Department of Commerce. National Oceanic and Atmospheric Administration; National Environmental Satellite, Data, and Information Service; National Oceanographic Data Center; Ocean Climate Laboratory.
- NOAA, 1998. World Ocean Database 1998. U.S. Department of Commerce. National Oceanic and Atmospheric Administration; National Environmental Satellite, Data, and Information Service; National Oceanographic Data Center; Ocean Climate Laboratory. World Data Center-A for Oceanography.
- Schlitzer, R. 2001. Ocean Data View. <http://www.awi-bremerhaven.de/GEO/ODV>.
- Stein, M. 2001. XBT-Transects along 60°N, Greenland-Scotland, 1989-1999. Poster given at: ICES Symposium Hydrobiological Variability in the ICES Area, 1990-1999. Edinburgh, Scotland, 8-10 August 2001.

Table 1. Temperature index at 400m and 1000m depth for area 50°N-60°N, 40°W-50°W.

Decade	Mean T°C at 400m	Mean T°C at 1000m
1951-2000 Mean	4.31	3.48
1951-60	4.05	3.44
1961-70	4.29	3.55
1971-80	4.95	3.63
1981-90	4.16	3.39
1991-2000	3.99	3.21

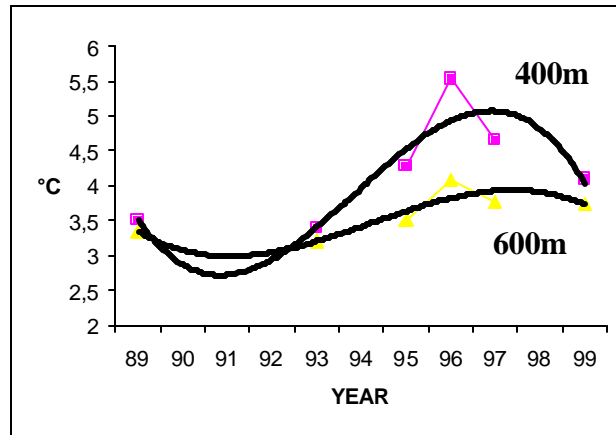


Fig. 1. Variation of temperature in the Irminger Sea proper (60°N, 37°W) at 400m and 600m depth.

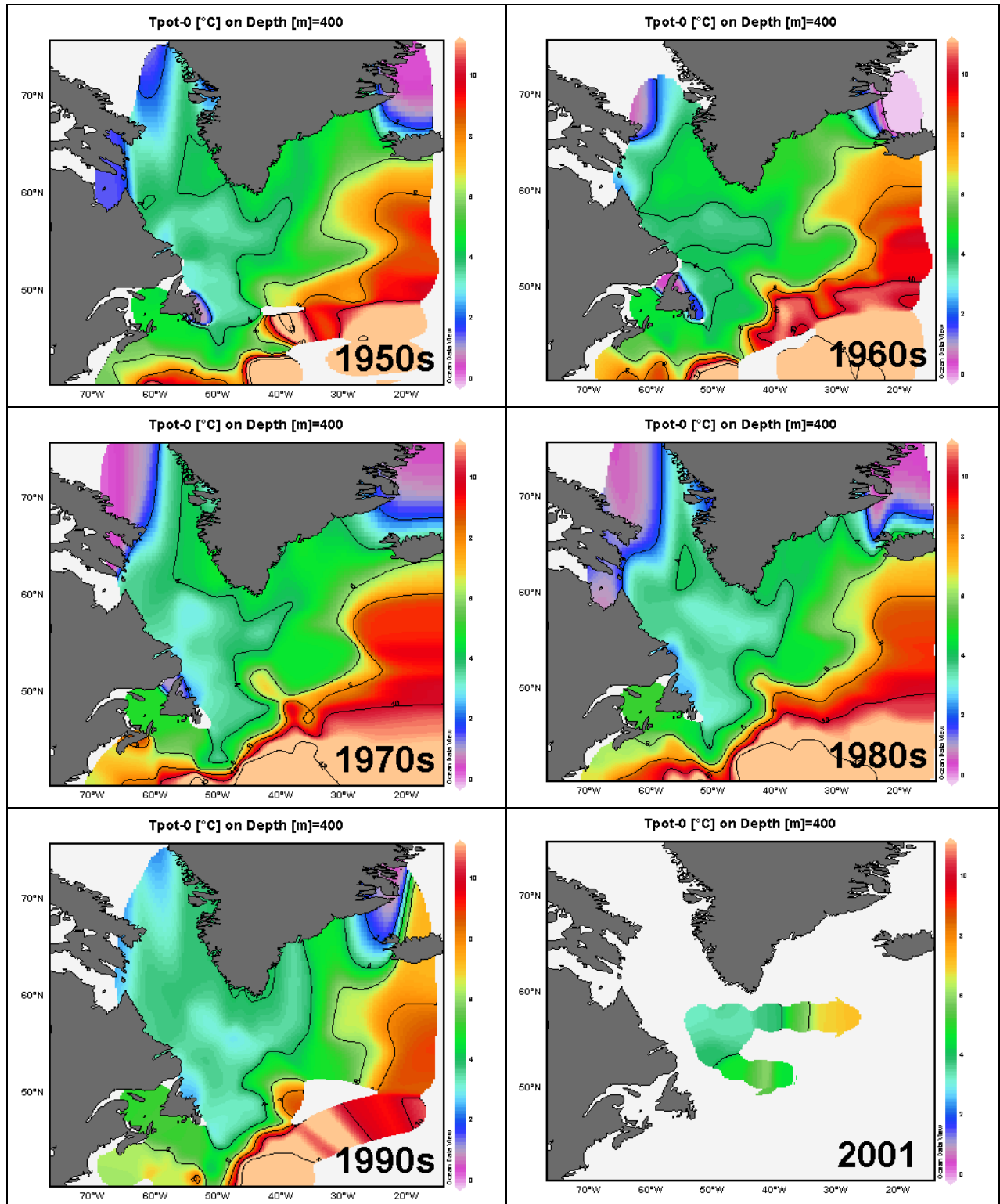


Fig. 2. Thermal conditions in the Irminger Sea and Labrador Sea during the past five decades, and during June/July 2001 at 400m depth.

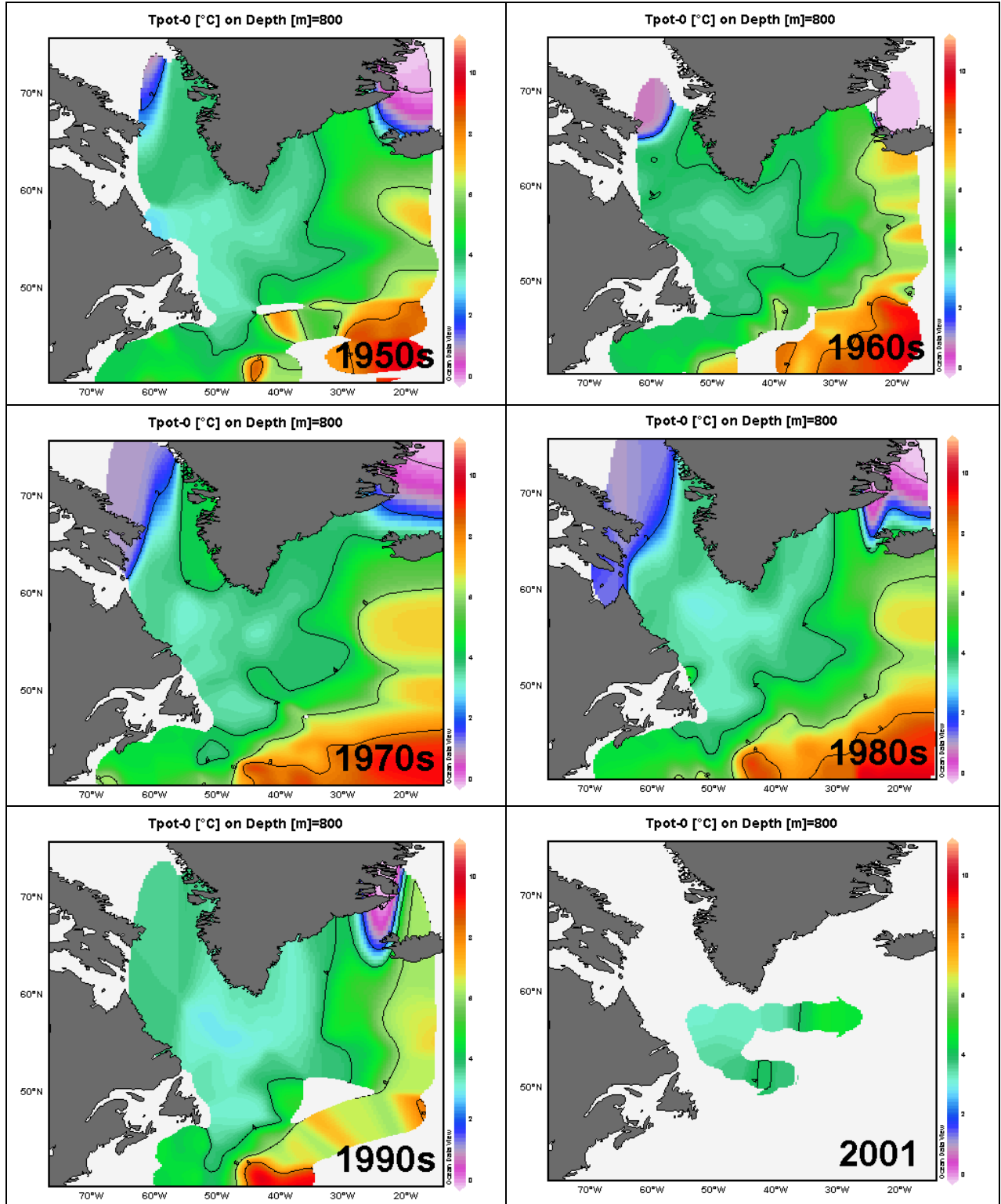


Fig. 3. Thermal conditions in the Irminger Sea and Labrador Sea during the past five decades, and during June/July 2001 at 800m depth.

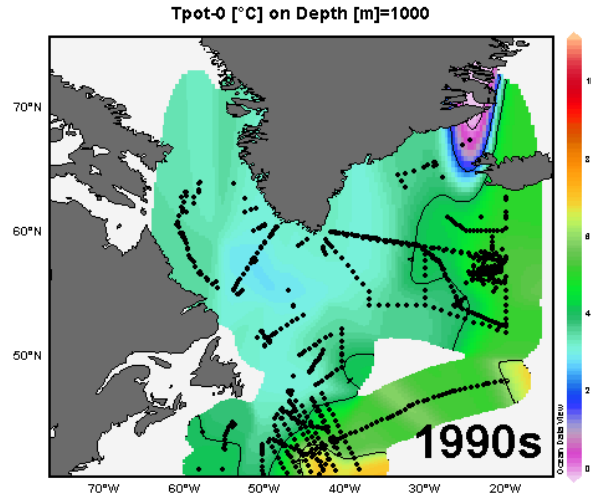


Fig. 4. Thermal conditions in the Irminger Sea and Labrador Sea during the 1990s at 1000m depth (station positions are given as black dots).

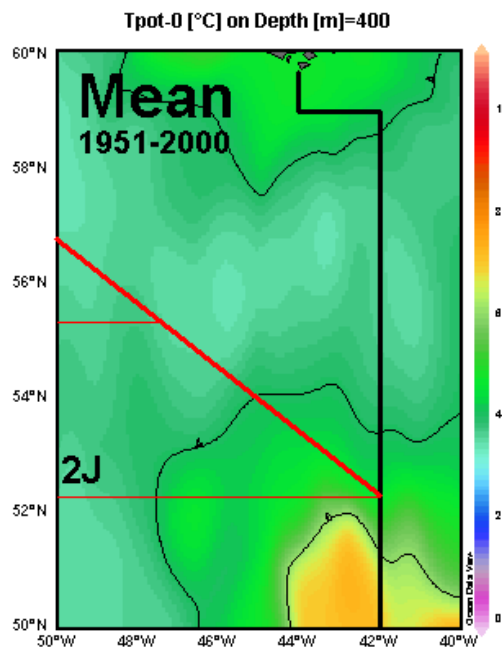


Fig. 5. Thermal conditions in the Irminger Sea and Labrador Sea south off Greenland at 400m depth (temperature index for area: 50°N-60°N, 40°W-50°W); mean conditions 1951-2000.