

STOCK STATUS REPORT

LAURENTIAN REGION

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DFO, Atlantic Fisheries, Stock Status Report 96/51

June 1996

OCEANOGRAPHIC CONDITIONS IN THE GULF OF ST. LAWRENCE IN 1995

INTRODUCTION

An overview of the oceanographic conditions that prevailed in the Gulf of St. Lawrence (Figure 1) in 1995 is presented, based on a few key climatic indices. Monthly mean air temperatures were obtained from the Atmospheric Environment Service of Environment Canada. The location of the ice edge was obtained from the weekly ice charts produced by Ice Central of Environment Canada in Ottawa. We used the vertical profiles of temperature and salinity collected during the August-September shrimp and groundfish stock assessment survey to obtain information on the cold intermediate layer, september bottom temperatures in the southern Gulf, and layer-averaged temperatures and salinities for the whole Gulf. And finally, we used bottle data from the November-December ice forecast cruise to produce indices of dissolved oxygen content in the Laurentian Channel.

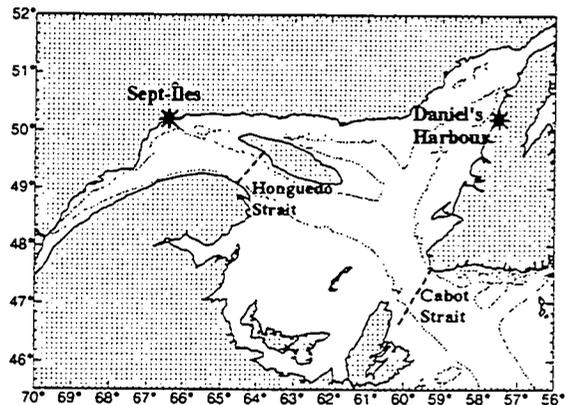


Figure 1. Map of the Gulf of St. Lawrence, showing the location of sites mentioned in the text and the 200 m isobath.

AIR TEMPERATURE

In the western Gulf at Sept-Îles (Figure 2), temperatures were consistently 1°C or more above normal from October 1994 to January 1995, and then dropped to 4°C below normal in February. The 1995 spring temperatures were close to normal, and this was followed by a warm and dry summer from June to August. In the eastern Gulf at Daniel's Harbour

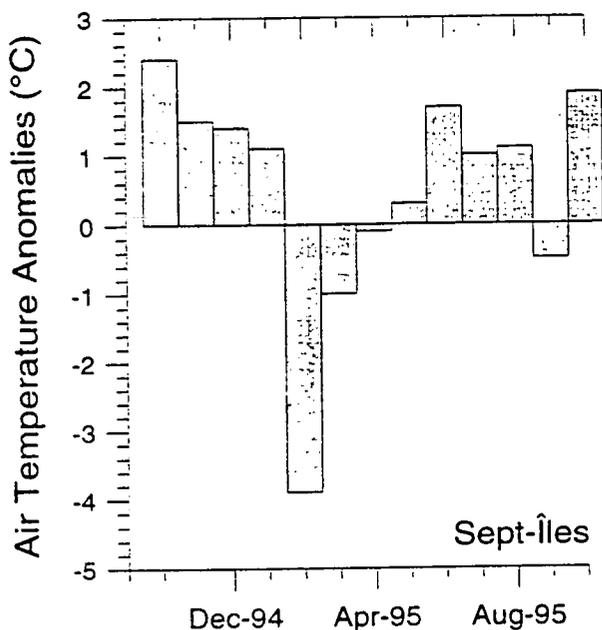


Figure 2. Deviations from the 1961-1990 mean of the monthly averaged air temperature at Sept-Îles.

(Figure 3), the 1994 fall air temperatures were close to normal, and this was followed by below normal air temperatures throughout the winter, February being the coldest month (3°C below normal). Air temperatures then bounced back to normal (within 1°C) during the spring and summer of 1995.

SEA ICE

During the first half of the ice season (Dec. 31, 1994 to Feb. 01, 1995), the ice edge was a little behind the 1962-1987 median ice extent in the western Gulf,

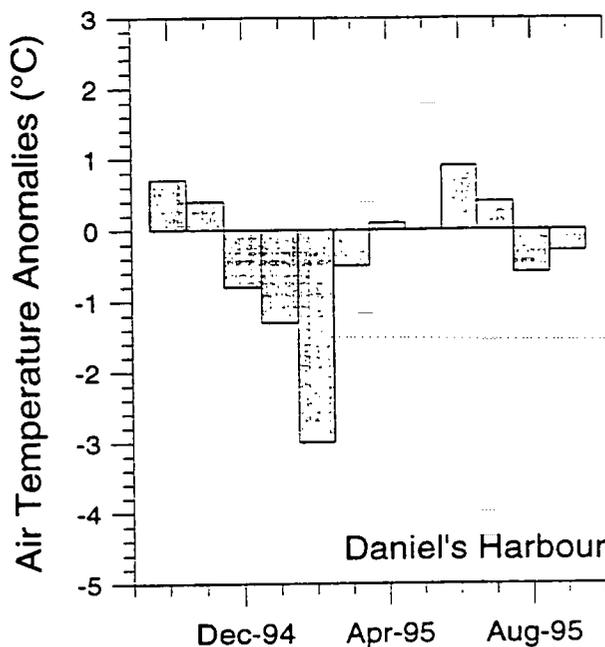


Figure 3. Deviations from the 1961-1990 mean of the monthly averaged air temperature at Daniel's Harbour.

where air temperatures were above normal (Figure 4). In the northeastern Gulf on the other hand, air temperatures were below normal during that time and the ice edge was somewhat beyond the 1962-1987 median ice extent. On March 01, the ice edge essentially coincided with the 1962-1987 median, and it remained close to the median after that. Overall, we may say that the ice cover was relatively close to normal during the winter of 1995, unlike the winters from 1990 to 1994 when heavy ice conditions prevailed.

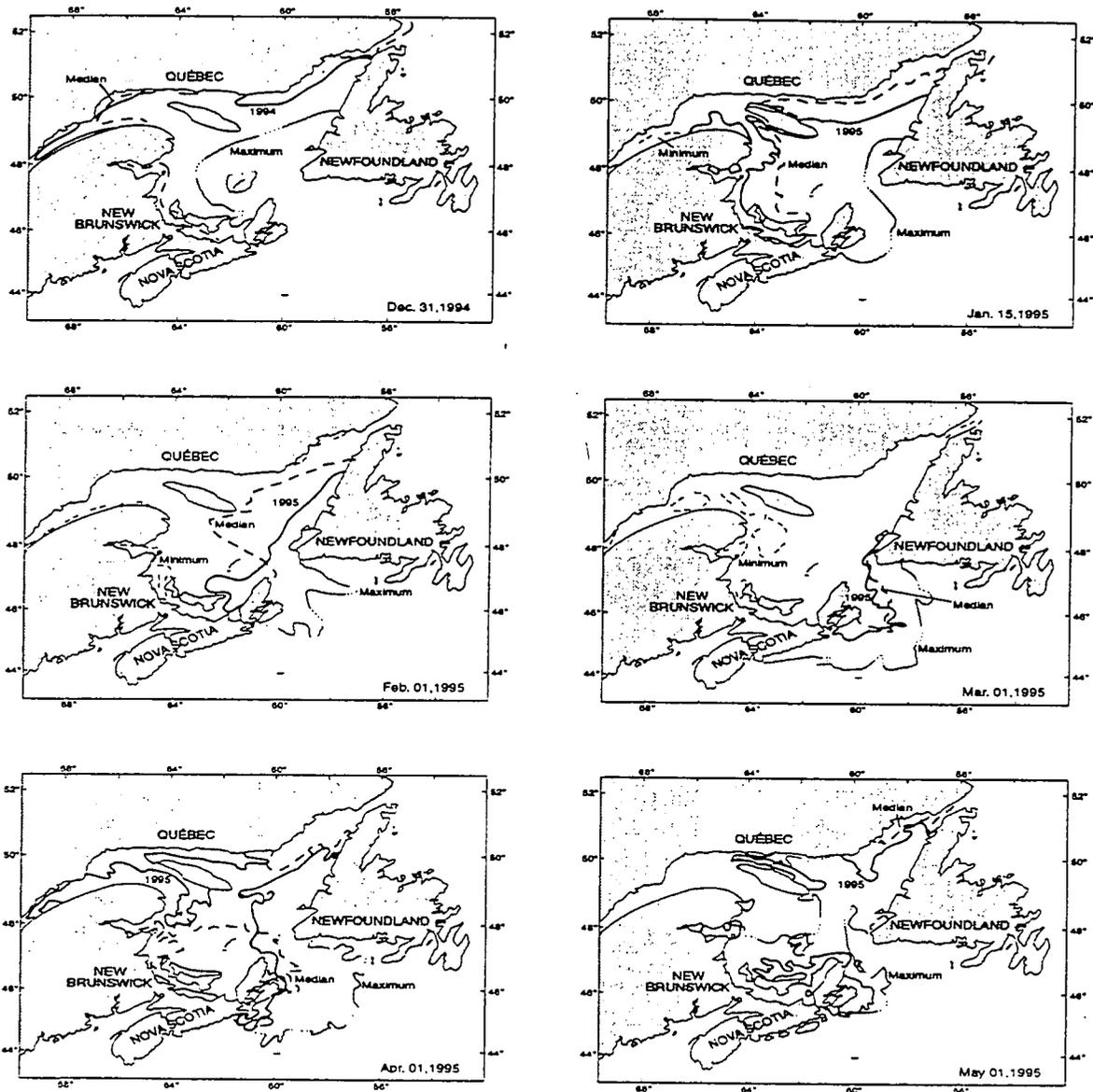


Figure 4. Location of the 1995 ice edge (thick continuous line) relative to the 1962-1987 minimum, median and maximum ice edge positions, from December 31, 1994, to May 01, 1995.

COLD INTERMEDIATE LAYER

The cold intermediate layer (CIL) is a layer of cold water, roughly 30 to 100 m deep, with warmer water both above and below it. The last six years, from 1990 to 1995, have been characterized by near record low temperatures at the core of the

CIL where the minimum temperature for the entire water column is found (Figure 5). In the summer of 1995, the maximum CIL thickness was found in the northeast Gulf, as in 1991 to 1994.

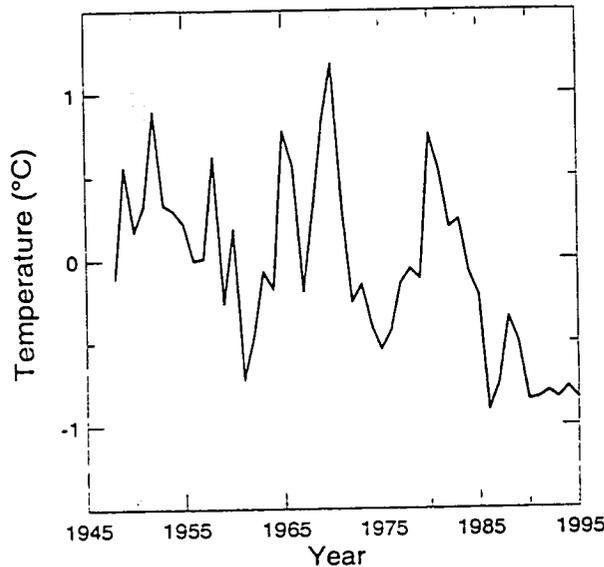


Figure 5. Composite index of CIL core temperature anomaly in the Gulf of St. Lawrence (normal=0.08°C).

SEPTEMBER BOTTOM TEMPERATURE IN THE SOUTHERN GULF

Bottom temperature in September 1995 was lowest in the central region of the Magdalen Shallows and increased shoreward and with depth along the Laurentian Channel, as usual. Estimated bottom temperature was less than 1°C over 42000 km² and less than 0°C over 25000 km² of the survey area, a new record high (Figure 6). Subzero bottom temperatures thus extended over a very large area of the southern Gulf in 1995, continuing the period of cold bottom conditions that began in 1990. This is consistent with the colder than normal CIL observed in 1995, as the CIL is in

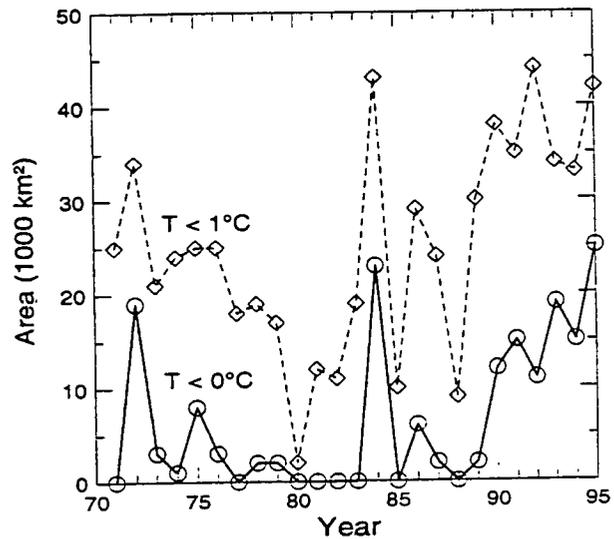


Figure 6. Bottom area with $T < 0^{\circ}\text{C}$ and $T < 1^{\circ}\text{C}$ in September in the southern Gulf of St. Lawrence.

direct contact with the bottom over much of the southern Gulf.

LAYER-AVERAGED TEMPERATURES

To simplify our analyses of the XBT and CTD observations collected aboard the Lady Hammond and Alfred Needler during the 1985 to 1995 groundfish surveys, we broke up the water column into four layers: a warm upper layer (0 to 30 m deep), a cold intermediate layer (30 to 100 m deep), and two deep layers (100 to 200 m and 200 to 300 m deep). The Gulf-wide average temperature of the 0 to 30 m layer during the August-September 1995 Needler survey was 10.9°C, about 0.5°C above normal (10.4°C). In the 30 to 100 m layer, the average temperature was 0.6°C, close to 1°C below normal (1.5°C), continuing the trend of colder

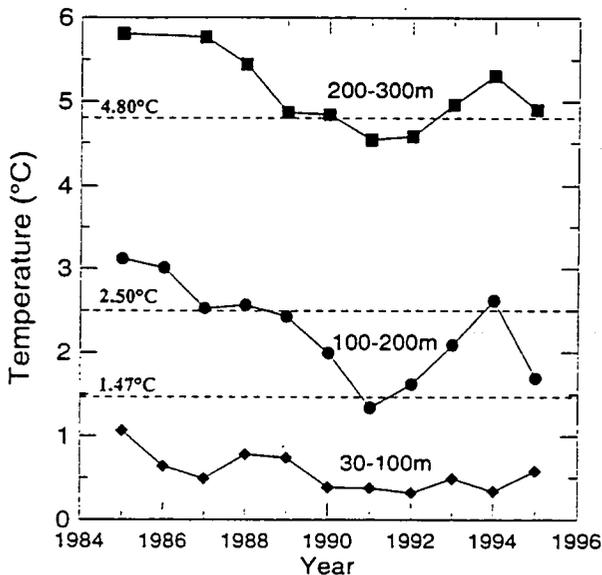


Figure 7. Layer-averaged temperatures for the whole Gulf of St. Lawrence in August-September. The dashed lines indicate the long term layer averages based on the climatological atlas of Petrie (1990).

than normal temperatures of the past few years (Figure 7). In the 100-200 m layer, the temperature dropped by about 1°C relative to 1994. The average temperature in 1995 was 1.7°C, some 0.8°C below normal (2.5°C). Finally, in the 200-300 m layer, the temperature dropped by 0.4°C relative to 1994. The 1995 temperature was 4.9°C, which is very close to normal (4.8°C).

To obtain a longer term perspective on the temperature changes that have occurred in the 200-300 m layer over the last few decades, we may look at data from the standard Cabot Strait section, where temperature measurements have been made on a regular basis since the early 1950's (Figure 8). The average temperature of the 200 to 300 m layer at

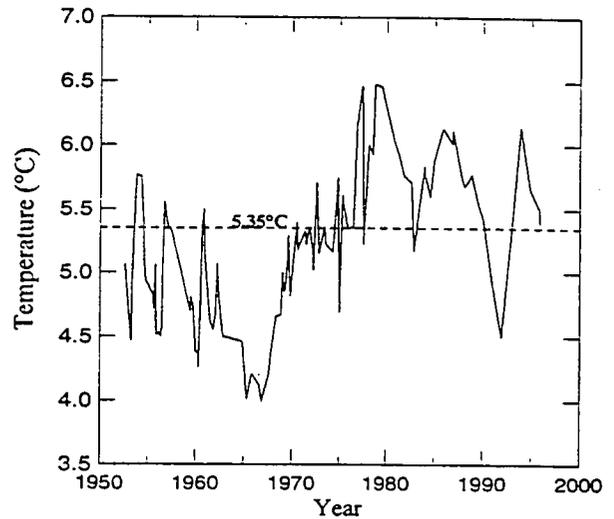


Figure 8. Average temperature of the 200-300m layer at the standard Cabot Strait section. The 1961-1990 mean (dashed line) is 5.35°C.

Cabot Strait reached record low values in the mid-sixties, followed by relatively warm conditions right until about 1988. Rapid cooling then occurred until 1991, followed by rapid warming in 1992 and 1993. A slight decrease in temperature occurred over the last two years, 1994 and 1995.

DISSOLVED OXYGEN

Below about 150 m depth, the waters of the Gulf of St. Lawrence are a mixture of Labrador Sea Water and continental Slope Water. These waters enter the mouth of the Laurentian Channel at the shelf break, some 400 km southeast of Cabot Strait. They then make a journey that takes several years towards the heads of the Laurentian, Anticosti and Esquiman channels. As the waters progress towards the heads of these channels, their

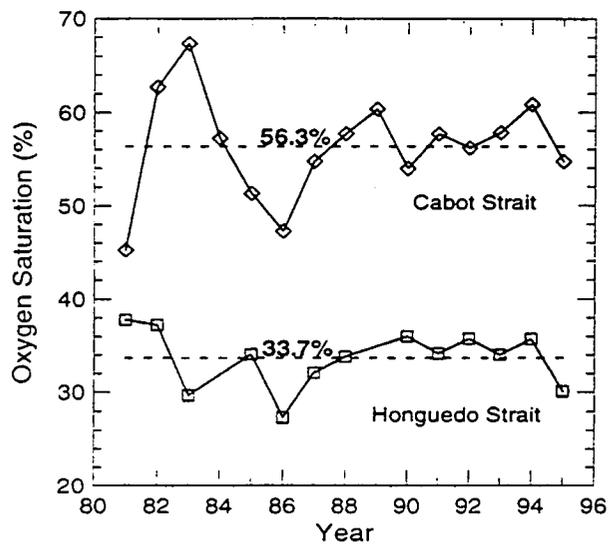


Figure 9. Dissolved oxygen saturation at two sections along the Laurentian Channel. The dashed lines indicate the 1981-1995 averages.

dissolved oxygen content is progressively consumed by the oxidation of organic matter sinking from the surface layer. Data gathered in late fall since 1981 at standard sections along the Laurentian Channel show that at Cabot Strait, the dissolved oxygen content of the 200 to 300 m layer may fluctuate between about 45% and 70% saturation (Figure 9). At Honguedo Strait (between the Gaspé Peninsula and Anticosti Island), the dissolved oxygen content of the 200 to 300 m layer typically varies between about 25% and 40% saturation. As described above, the older age of the waters at Honguedo Strait explains the lower oxygen values observed there. In 1995, the dissolved oxygen saturation of the 200-300m layer was 1.6% below the 1981-1995 average at the Cabot Strait section, and 3.6% below average at the Honguedo Strait section.

SUMMARY

The highlights for 1995 are that 1) winter air temperatures were near normal in the western Gulf, but were close to 2°C below normal in the eastern Gulf; 2) the summer was warm and dry in the western Gulf; 3) the ice cover was close to the 1962-1987 median areal extent, but with more severe ice conditions in the northeastern Gulf than in the western Gulf; 4) the core temperature of the cold intermediate layer was colder than normal for a tenth consecutive year; 5) the bottom area with a temperature below 0°C reached a record high in the southern Gulf; 6) the deep layers cooled relative to 1994, but the cooling was more intense in the 100-200 m layer (0.9°C) than in the 200-300m layer (0.4°C); 7) the dissolved oxygen saturation of the 200-300m layer in 1995 was 1.6% below the 1981-1995 average at the Cabot Strait section, and 3.6% below average at the Honguedo Strait section.

For more information:

- Bugden, G.L. 1991. Changes in the temperature-salinity characteristics of the deeper waters of the Gulf of St. Lawrence over the past several decades. In J.-C. Therriault (ed.) *The Gulf of St. Lawrence: small ocean or big estuary?* Can. Spec. Publ. Fish. Aquat. Sci. 113, p. 139-147.
- Galbraith, P. Variations of dissolved oxygen in the deep channels of the Gulf of St. Lawrence from 1981 to 1995 (in preparation).

Gilbert, D., B. Pettigrew, D. Swain, P. Galbraith 1996. État du Saint-Laurent: Conditions océanographiques en 1995. *Rap. Stat. Can. Hydrogr. Sci. Océan.* XXX (in preparation).

Gilbert, D., B. Pettigrew, D. Swain and M. Couture 1996. State of the Gulf of St. Lawrence: Oceanographic conditions in 1994. *Can. Data Rep. Hydrogr. Ocean Sci.* 143: xi + 85pp.

Petrie, B. 1990. Monthly means of temperature, salinity, and sigma-t for the Gulf of St. Lawrence. *Can. Tech. Rep. Hydrogr. Ocean Sci.* No 126: iv + 137p.

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