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On the hydrography of the Southern Laurentian Channel (ICNAF Div. 3P, 4V)

by

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Introduction

The Laurentian Channel runs from the mouth of the St. Lawrence river into the Gulf of St. Lawrence through the Cabot Strait in south-easterly direction up to the continental slope with an average depth of about 500 m. Whilst the hydrographic features within the Gulf of St. Lawrence are often observed and comprehensivly described (Lauzier, Trites and Hachey, 1957; Lauzier and Bailey, 1957), for the outer part of the Laurentian Channel such a description has not yet been made, although observations are recently presented in the ICNAF annual research reports specially from Canada and USSR, and a contribution to the situation in spring 1970 has been given by L'Herou and Minet (1971). The following work , now, is an attempt to generalize the view into the hydrographic characters of the water masses in this area.

Description of water masses

Because of the U-shaped cross-section with smooth slopes throughout most of the 200 miles long channel, it should be possible to trace the movements of the waters within the channel by hydrographic sections perpendicular to the channel.

In 1972 the German F/R/V "Walther Herwig" has worked up twice such a hydrographic section: in late winter (15. March) and in fall (14. Nov.). The position is marked in fig. 1. The measurements were done by Nansen casts and bathythermograph. Fig. 2 shows the two sections drawn separatly for temperature and salinity: A remarkable stratification is visible caused by interaction of different water masses.

These water masses reveal fairly well their characteristics and origin on a T/S-diagram (fig.3). By this method four different water masses can be identified, which are named and described below:

A) Surface layer
B) Intermediate layer
C) Warm water body
D) Bottom water

A. The shadowed area on the left in fig. 3 represents the surface layer which is exposed to the seasonal change of the air temperature. The lowest salinity values were found on the western side of the channel and during winter time, which is a result of the outflow out of the Gulf of St. Lawrence (as it can also be seen on ice charts).

B. The intermediate layer is a layer of complicated inner structure. In winter and spring it was like a thermocline but with a positive temperature gradient, whereas during fall a rest of cold water from the Labrador Current, which came probably around Cape Race and around the Grand Banks (sections C-E in Templeman, 1972), has penetrated into this layer according to its density. This water is of Canadian Arctic origin ($T < 0^{o}C$, $S \leq 33$ ‰) and can be traced well in the T/S-diagram. In this time the intermediate layer was bordered by two thermoclines, the upper one with a negative and the lower one with a positive temperature gradient. The vertical salinity distribution remained the same, in November the isohalines were shallower as in March by about 50 m.

C. The warm water body appeared in depths between 150 and 300 m. In the core the temperature exceeded 8^{o} C in both times. With the T/S-diagram this water can be identified as "slope water" comming from the continental slope south of the channel. In the March-section the core was leaned against the eastern wall of the trough underlining the interpretation of northward movement.

D. Below 400 m bottom water filled the channel with temperatures slightly below 5^{o} C and salinities above 34.8 ‰ as it is found in the western part of the Northatlantic Ocean in similar depths. Since temperature and salinity near the bottom in the section were the same in March and November, one may assume that no large scale movements took place here.

Within the upper 200 m in all sections on the right, the eastern side of the Lauerntian Channel the isopleths are risen, which means that here temperatures and salinities were slightly higher than elsewhere in equal depths caused probably by upwelling processes in connection with the northward flow in the warm water body.

Periodical and irregular variations

For these four water masses found in the southern Laurentian Channel the characteristics are determined now for late winter (March) and fall (November) in 1972. But by looking into the data-archive of the WODC one can find that the values of depth, salinity and especially of temperature within theses water masses may vary unusually not only during a year but also from year-to-year. To give an idea about the amount of the variation and its irregularity some values of maximum resp. minimum temperature are given in fig. 4 for the years 1967, 1968, 1970. The values in the diagram are taken from USSR standard sections published by Sigaev (1969) and Konstantinov and Noskov (1971); this section crosses the Laurentian Channel farther to the south than ours does. The maximum temperature is chosen from the core of the warm water body neglecting the case that during summer the highest temperature appears in the surface layer, whilst the minimum temperature represents the lowest temperature between surface and bottom, which however can be only within the surface or intermediate layer. In the diagram corresponding values are also given from our investigations in 1972. The following features are evident: The temperature in the warm water body can be high throughout the year - or not; but if not, then the highest values appear in the summer season. In the upper two layers the lowest temperature is found in summer and/or fall, however again not always, as e.g. in 1972. It is misleading to assume there is a mutual dependence of the two extreme temperatures, although it looks like, because they are results from processes in quite different areas far away from the Laurentian Channel.

Response of fish behavior to irregularities?

Although it is unsatisfactory not yet to be able to explain the irregular variations of the temperature, it gives us an excellent chance to study the dependence of fish upon temperature within the Laurentian Channel (Lenz and v. Seydlitz, 1972). Usually it is difficult to understand the way, in which the environment with its seasonal variation influences the behavior of fish. Here now we have the case where at least one parameter to measure the environment, the temperature, sometimes does not follow the normal seasonal variation and it should give interesting results to look how fishes react on those irregularities.

Acknowledgements

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WODC World Oceanographic Data Center - Washington, D.C.

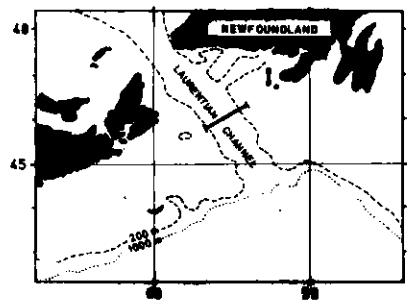

Fig. 1. Position of the section
across the Laurentian Channel.

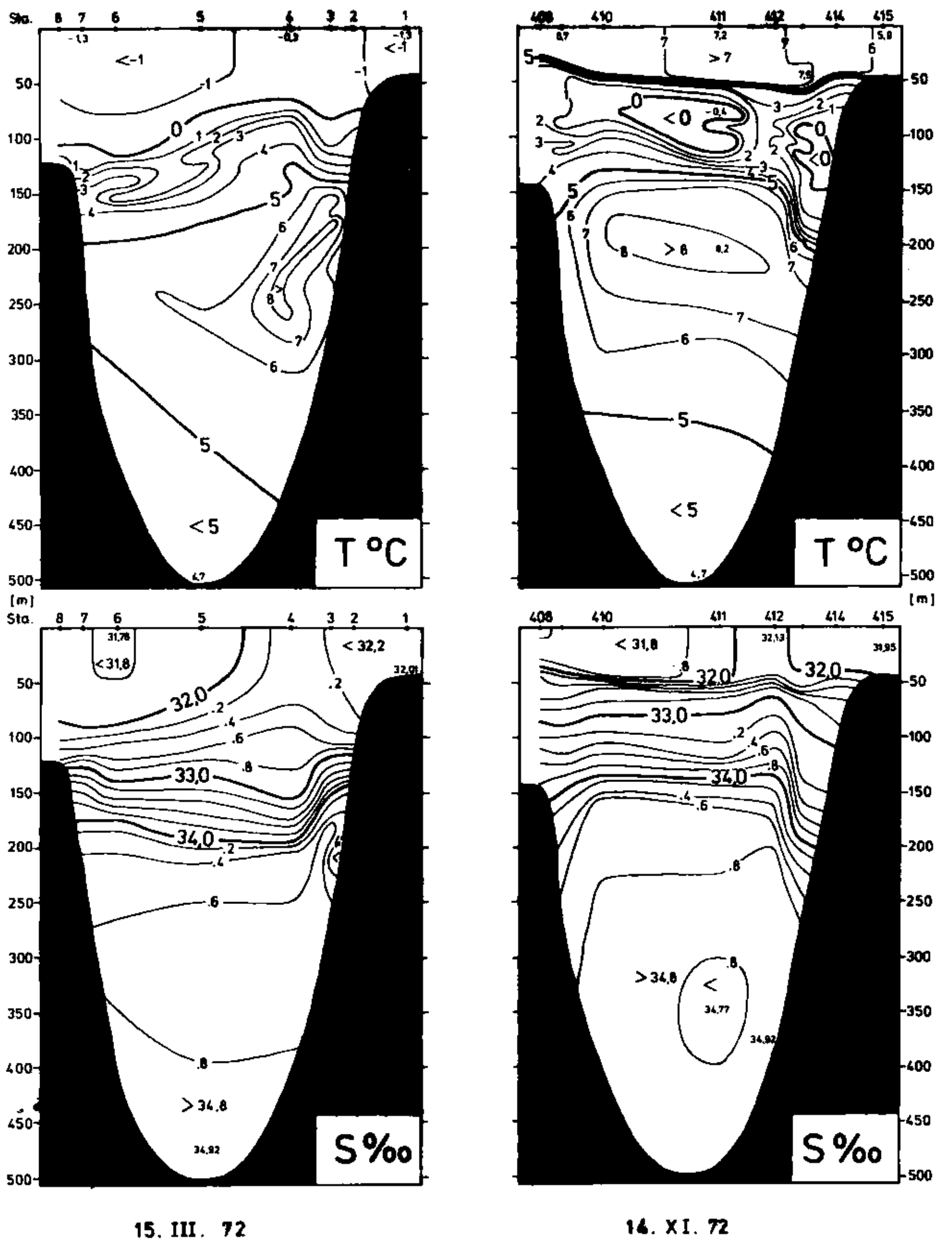

Fig. 2. Vertical temperature and salinity distribution across the Laurentian Channel in March and November 1972.

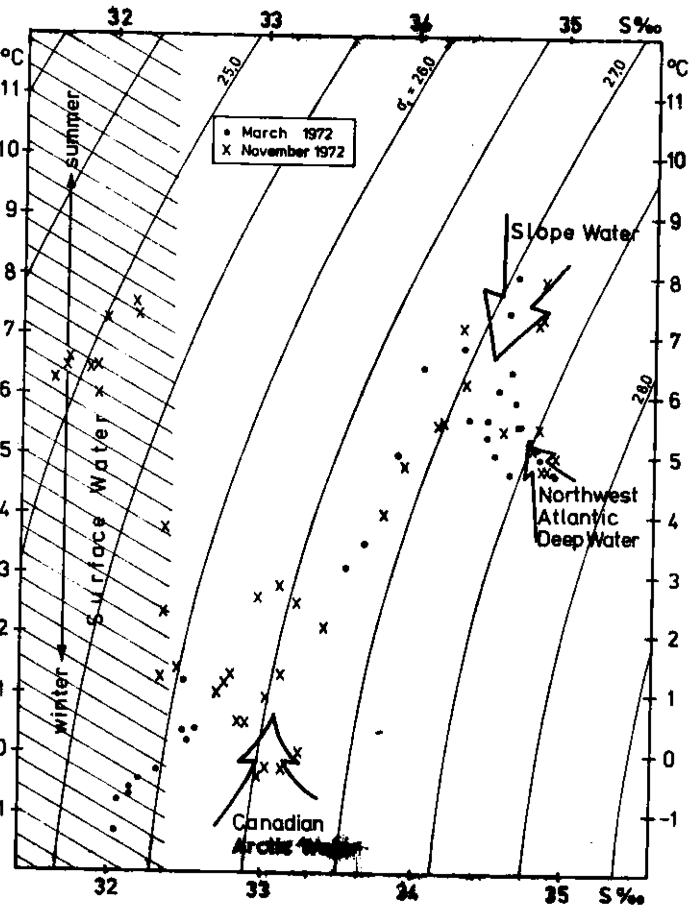

Fig. 3. T/S-daigram from Nansen cast values out of the Laurentian Channel with indicated origins of different water masses.

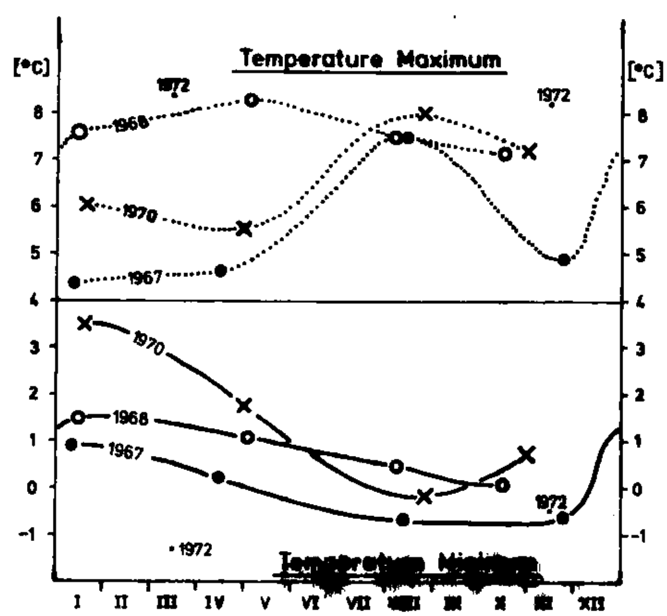

Fig. 4. Seasonal and annual variations of extreme temepratures found in the Laurentian Channel (after USSR standard section).