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Environmental Studies in ICNAF Div. 3P and 4V in Spring 1970

by

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In spring 1970 the R/V Thalassa completed a cruise in ICNAF Div. 3P and 4V in order to study the stocks of fish there. During the cruise, various hydrographic observations were made: on the one hand, temperatures were taken with bathythermographs at depths of 0-300 m after each trawl haul; on the other hand, from 13-17 April, temperature and salinity measurements were made over a network of 28 stations. Conjointly, vertical plankton hauls were made.

A. Hydrographic Conditions

I. Distribution of surface and near bottom temperature

On the surface (Fig. 1) cold waters of 1-2°C descend from the Gulf of St. Lawrence and extend along the coasts of Cape Breton Island. A lobe of 2-3°C water spreads to the centre of the Laurentian Channel when there is an overlay of 5-6°C water rising from the bottom to the western shores of Saint Pierre Bank. In addition, on the eastern "platier", there is 2-3°C water coming from Newfoundland banks.

Near bottom (Fig. 2) we note, as on the surface, that there is a progression of Gulf of St. Lawrence waters along the shores and banks of Nova Scotia. South of Burin Peninsula two cold lobes (0°C), resulting from mixing of waters from Labrador and Newfoundland, are felt near the eastern part of St. Pierre Bank and give rise to a very strong thermal gradient (1°-7°C) along the western shores of the bank.

II. Hydrographic sections - temperatures and salinities

This study results from 28 hydrographic stations divided into 5 sections and occupied at the positions listed in Table 1 and referred to in Fig. 3.

At each station, Nansen reversing bottles were lowered to standard depths. Two hundred and fifty-eight temperature samples were taken, using Richter & Wiese protected and non-protected thermometers. Temperature corrections were made on board, using the Culbertson method. For salinity study, 258 sea water samples, collected in duplicate, were analyzed in the laboratory using the Auto-Lab induction salinometer (Sydney, Australia).

1. Section I - Burin Peninsula to South of St. Pierre Bank (Fig. 4, A and B)

Continental shelf waters consist of a surface layer which is slightly warmer in early spring (T = 1.15-1.25°C) and an intermediate cold water layer of Labrador origin (T = 0.88-0.95°C and S = 32.00-32.20°/₀₀) which spreads to St. Pierre Bank without overflowing from the slope. In the channel separating the Newfoundland coast and the northern shore of St. Pierre Bank, we find a residue of water which was formed in the winter with below 0° temperatures (T = -0.13 to -0.26°C) and higher salinities (T = 32.20-32.50°/₀₀).

At approximately the 140-m depth, a lobe of water of warmer and more saline gradient than surface and underlying waters (T = 3.78°C; S = 33.59°/₀₀) appears on the south shores of St. Pierre Bank. Moreover, this water, arising from a mixture of intermediate slope and surface waters, sends a second lobe to the 75-m depth at Station 08.

Between the 200- and 280-m depth, we observe a very strong temperature gradient

(5°C at 80 m) and salinity gradient (33.04-34.11°/₀₀) which becomes slope water clearly influenced by warm open sea waters (T = 7.0°C; S = 34.11°/₀₀ at 300 m).

2. Section II - South Banquereau Bank to South St. Pierre Bank (Fig. 5, A and B)

There again, we find a cold layer which spreads on St. Pierre Bank (Section I) and which, this time, overflows to the southeast shore of the bank (T = -0.11 to 0.99°C at 75-m depth).

In a parallel direction, we observe two lobes of intermediate slope water influenced by the Atlantic; the first is on the southwest shores of Banquereau Bank (T = 7.0°C; S = 34.72°/₀₀) at the 200-m depth; the second is on the southeast shores of St. Pierre Bank (T = 7.84°C; S = 34.76°/₀₀) at the 220-m depth and extends to the centre of the Laurentian Channel (T = 8.07°C; S = 34.60°/₀₀ at 100-m depth).

This warm water therefore enters the Laurentian Channel on the left and especially on the right of the section, thus isolating a mixture of colder water between the 250-m depth and the bottom (T = 6.00-4.50°C; S = 34.65-34.84°/₀₀).

3. Section III - Cape Breton to South Banquereau (Fig. 6, A and B)

Laying near the Nova Scotia coast (Station 23 and 24) we notice very cold and much less saline water (T = -1.00 to 0.0°C; S = 31.00-31.20°/₀₀), produced from the Gulf of St. Lawrence and spreading southeast.

An intermediate cold layer, warm at the surface, spreads from the shelf to the shores at 100-m depth, without overflowing the slope (T = 2.00-4.00°C; S = 32.50-32.70°/₀₀).

Between 150 and 250 m, warmer intermediate slope water is observed, originating from the open sea and spilling onto the southern shores of Banquereau (T = 6.00-7.00°C; S = 34.00-34.50°/₀₀); at 300-2500-m depths, this water makes room for deep slope water whose temperature (4.50°C at 300 m, 3.50°C at 2,000 m) decreases and salinity (34.60°/₀₀ at 250 m, 34.92°/₀₀ at 300-2,500 m) increases with depth.

4. Section IV - Across Laurentian Channel, north of Misaine Bank to north of St. Pierre Bank (Fig. 7, A and B)

As in Section III, we observe a cold lobe (T = 1.00°C; S = 32.00°/₀₀) which is produced by the Gulf of St. Lawrence and which results from a mixture of Labrador water and St. Lawrence estuary water, spreading to the shores of Nova Scotia. In addition, we notice, on St. Pierre Bank and in the middle of the Laurentian Channel, at 100-m depth, water originating from Newfoundland banks.

Above this cold intermediate water resulting from a successive mixture, we observe a slightly warmer surface layer originating from the Newfoundland coast.

Beneath this cold intermediate layer, the intermediate slope water is clearly felt on St. Pierre shores, at 200-250-m depths (T = 6.95°C; S = 34.50°/₀₀). This advance of water clinging to St. Pierre Bank draws an accumulation of overlying waters (T = 2.00-5.00°C; S = 33.00-34.00°/₀₀) from the Nova Scotia shores.

From 300 m to the bottom of the Laurentian Channel, deep slope waters are always present (T = 5.14°C at 300 m, and 4.54°C at bottom; S = 34.66°/₀₀ at 300 m and 34.88°/₀₀ at bottom).

5. Section V - Cabot Strait (Fig. 8, A and B)

This section shows, more clearly again, the relative position of the different formations of water.

As in Section IV, the flow of Gulf of St. Lawrence water along the coast of Cape Breton Island is very clear (T = -1.00 to 0.0°C; S = 3.00-31.50°/₀₀).

Along the south coast of Newfoundland, to the right of the section, the 1.50°C isotherm and 31.80°/₀₀ and 32.00°/₀₀ isohalines show an accumulation of mixed water

(Labrador and Newfoundland) which progresses towards the Gulf of St. Lawrence.

Under the cold intermediate layer (T = 1.50-3.00°C; S = 32.50-33.50°/₀₀), the advance of the intermediate slope water makes its influence felt up to this level, and also along the shores of Newfoundland (T = 5.00-6.00°C; S = 34.00-34.50°/₀₀).

Underneath the 300-m depth, we again find the deep slope waters (T = 5.11-4.57°C; S = 34.72-34.89°/₀₀).

B. Zooplankton Distribution

Vertical plankton hauls are made with a 72-cm-diam. Hensen net which is raised from the bottom at 1 m/3 sec. A total of 133 stations were occupied.

The following steps were taken for each sample: on the one hand, volumetric analysis of total plankton collected; on the other hand, inventory of eggs and larvae of fish collected in each sampling.

I. Quantitative Zooplankton Distribution

Plankton volume is measured by displacement of filtered sea water (in $cm^3/10\ m^3$) using a distribution card (Fig. 9).

We immediately establish that, in the spring, the whole section studied is all very weak in plankton. However, we observe that there are heavier concentrations in some zones of the southern part of St. Pierre, Banquereau and Misaine Banks.

Surface and near bottom temperature relationships

In comparing plankton distribution with surface and near bottom temperatures (Fig. 1 and 2 respectively), we notice that zones of heavier concentrations correspond with 0°-3°C temperatures, while in sections of lighter concentrations, the temperature varies from 3-6°C on the bottom and 3-4°C on the surface.

II. Inventory of Eggs and Larvae of Fish Identified in Plankton

In the following table are listed the eggs and larvae of fish which have been identified in the plankton samples.

Eggs		Larvae	
Species	Number	Species	Number
Gadus morhua	108	Ammodytes dubius	189
Hippoglossoides pl. platessoides	375	Gadus morhua	3
		Sebastes m. marinus	138
		Sebastes m. mentella	28
		Hippoglossoides pl. platessoides	13

No distribution table is given for the american plaice (Hippoglossoides pl. platessoides) as their number is too small. Regarding the eggs for this species (Fig. 10), we establish that the spawning, of however little importance, is of interest to the different shores along the Laurentian Channel where in the latter we find little, if any, eggs.

The limited number of larvae taken confirms the little importance of the spawning of this fish which reproduces in this area from March-May, with the maximum in April.

Cod eggs, Gadus morhua, are equally very limited but this is explained by the fact that this time of the year is the end of the reproduction period; on the other hand, only three larvae were counted which tends to show that recruitment was very weak in the section studied.

Redfish larvae, Sebastes marinus marinus and Sebastes marinus mentella, are fairly well represented if one considers that it is only the beginning of the reproduction period for both species.

Conclusion

Though these observations contribute to a better environmental knowledge of the area studied, they are nevertheless insufficient since they are limited to one time of the year.

In order to define all phenomena and to follow their development in time, a seasonal study will be undertaken beginning in July 1971 by R/V Cryos which is attached to the laboratory of l'Institut des Peches maritimes at St. Pierre and Miquelon. The 28 stations presented here (Table 1) will provide a background for the study which will be complemented by the 69 bathythermographs taken every 20 nautical miles. A plankton haul will also be made at each station.

TABLE 1. Positions of hydrographic stations.

Dates	Sections	Stations	Positions	
			Latitude	Longitude
13.IV.70	I	04	46° 35' 5 N	55° 46' 7 W
		05	46° 10' 0 N	55° 47' 0 W
		06	45° 50' 0 N	55° 45' 0 W
14.IV.70		07	45° 25' 9 N	55° 44' 0 W
		08	44° 56' 1 N	55° 47' 0 W
	II	10	45° 11' 0 N	56° 05' 0 W
		11	45° 01' 0 N	56° 25' 5 W
		12	44° 47' 8 N	56° 44' 0 W
		13	44° 30' 5 N	57° 10' 6 W
		14	44° 23' 0 N	57° 26' 0 W
15.IV.70	III	15	43° 50' 2 N	57° 40' 0 W
		16	44° 05' 8 N	57° 55' 8 W
		18	44° 23' 0 N	58° 13' 0 W
		19	44° 40' 2 N	58° 30' 2 W
		20	44° 56' 2 N	58° 47' 0 W
		22	45° 12' 1 N	59° 03' 0 W
		23	45° 27' 8 N	59° 20' 0 W
16.IV.70		24	45° 44' 2 N	59° 36' 7 W
	IV	25	45° 41' 0 N	58° 55' 0 W
		26	46° 04' 6 N	58° 14' 8 W
		27	46° 17' 0 N	57° 53' 5 W
		28	46° 32' 0 N	57° 27' 5 W
		29	46° 56' 5 N	56° 45' 6 W
17.IV.70	V	30	47° 34' 1 N	59° 18' 7 W
		31	47° 29' 0 N	59° 26' 2 W
		32	47° 14' 7 N	59° 47' 0 W
		33	47° 06' 0 N	59° 59' 5 W
		34	47° 00' 6 N	60° 06' 7 W

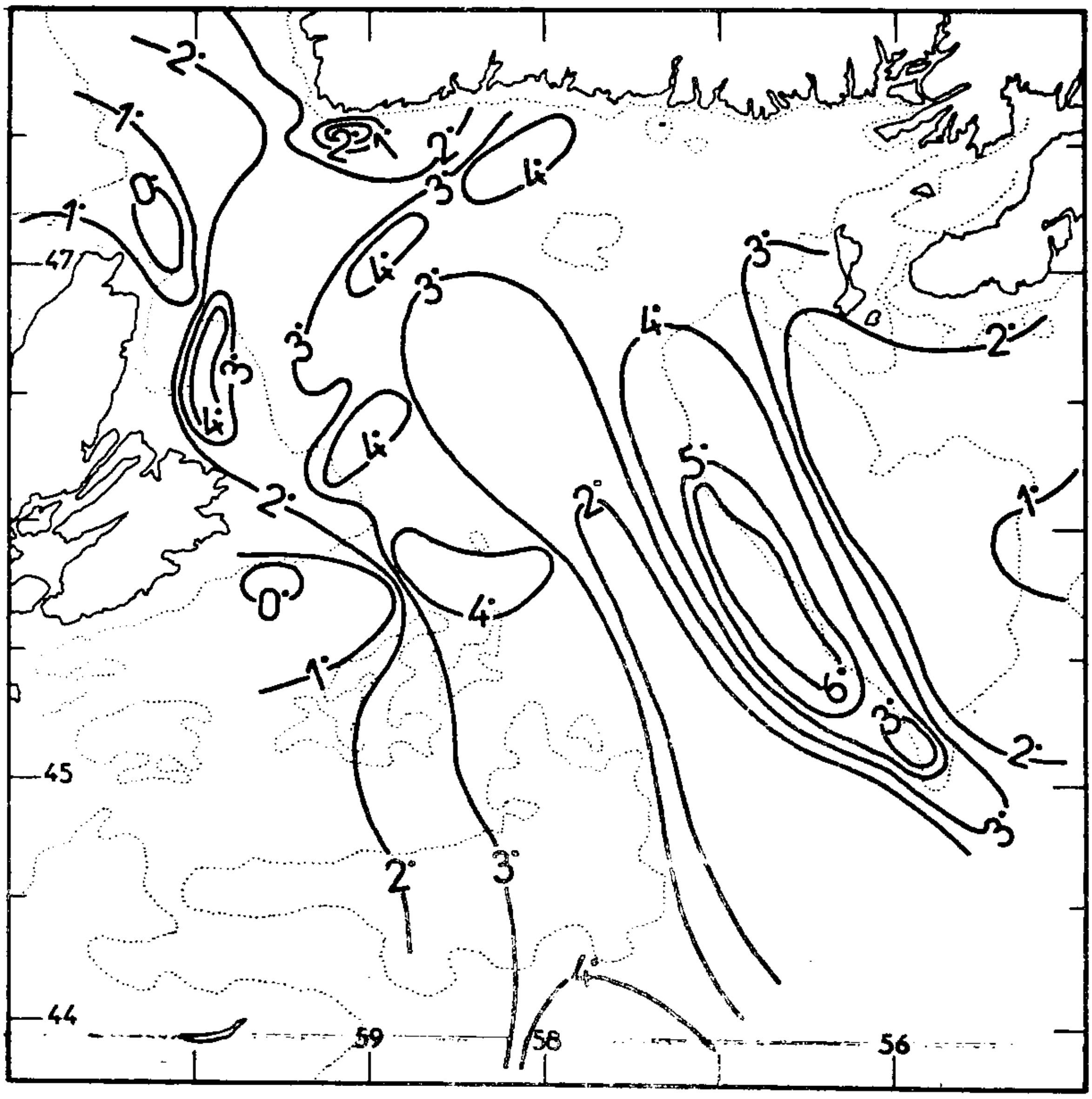

Fig. 1. Distribution of surface temperature.

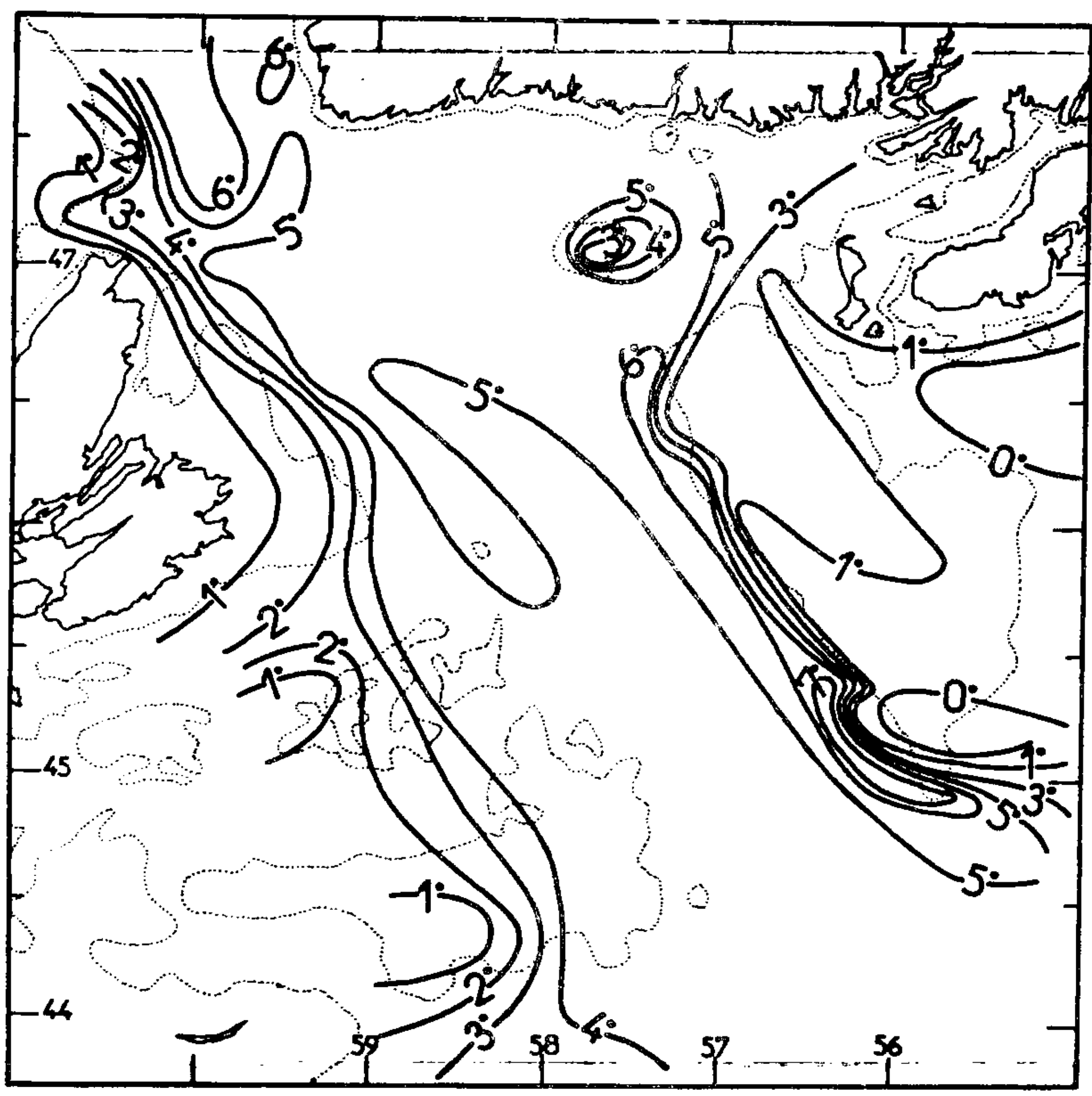

Fig. 2. Distribution of near bottom temperature.

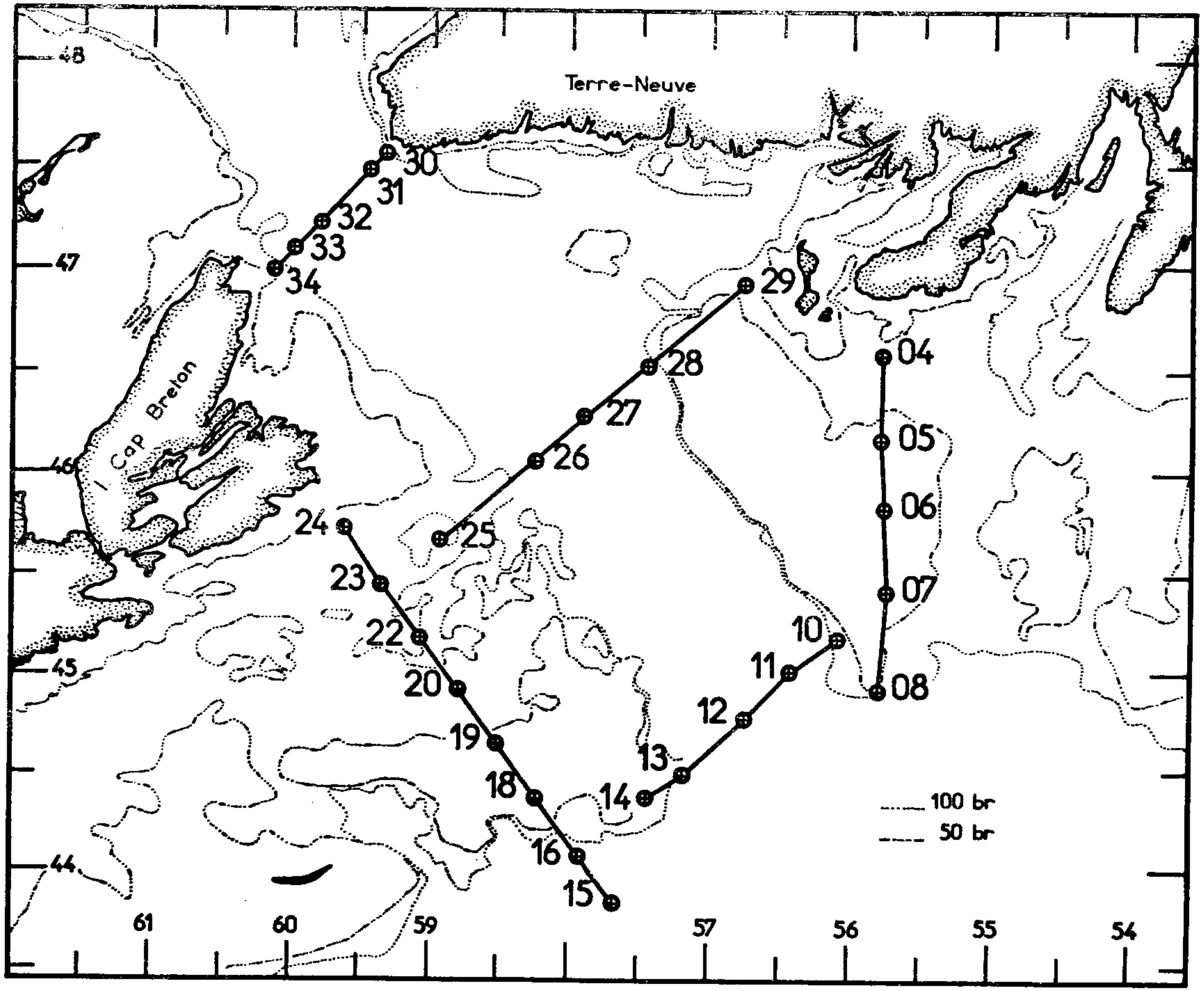

Fig. 3. Plottin; ıart showing locations of hydrographic tions.

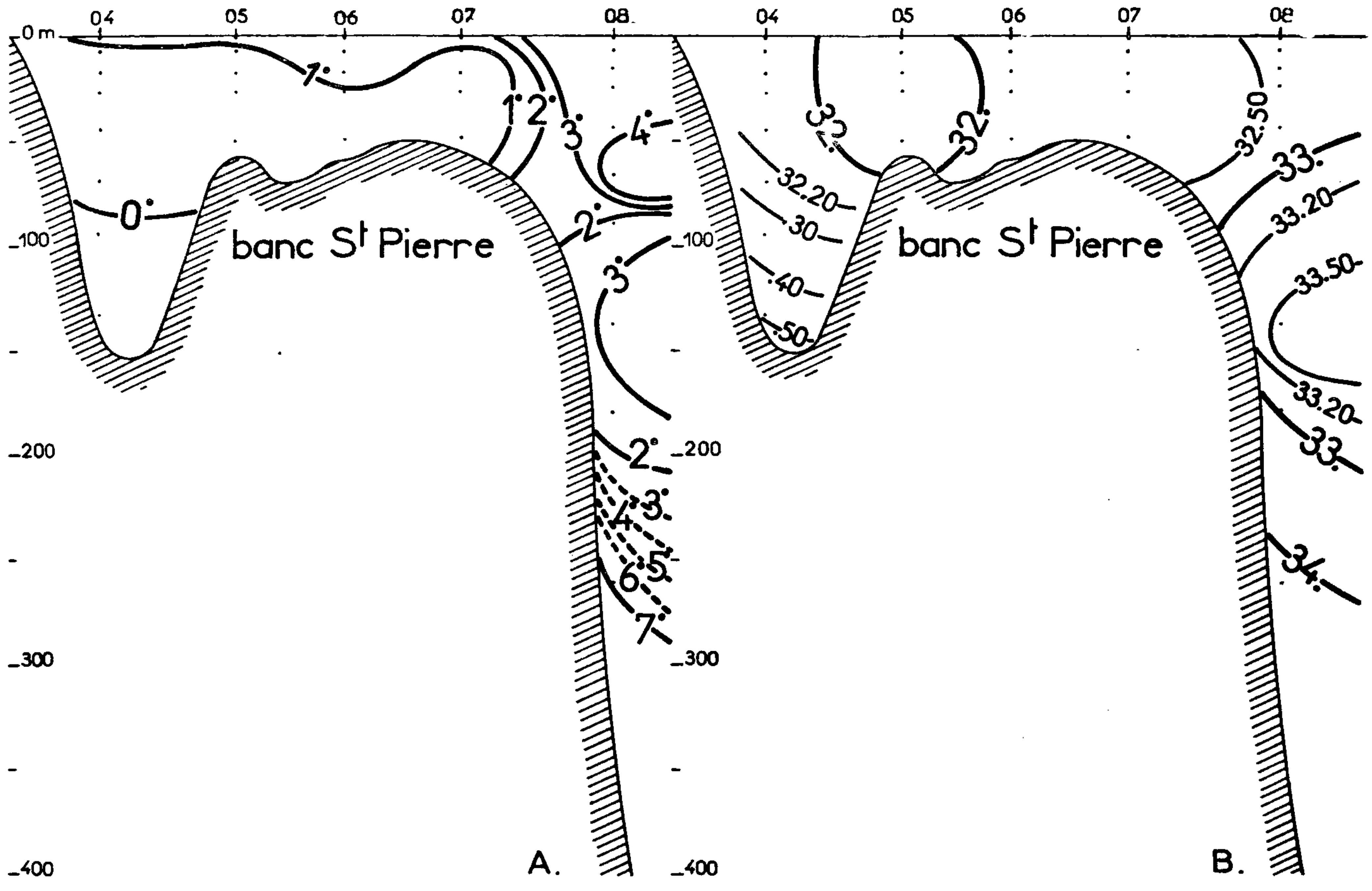

Fig. 4. Section I - Burin Peninsula/south of Saint Pierre Bank.
A. Temperatures B. Salinities

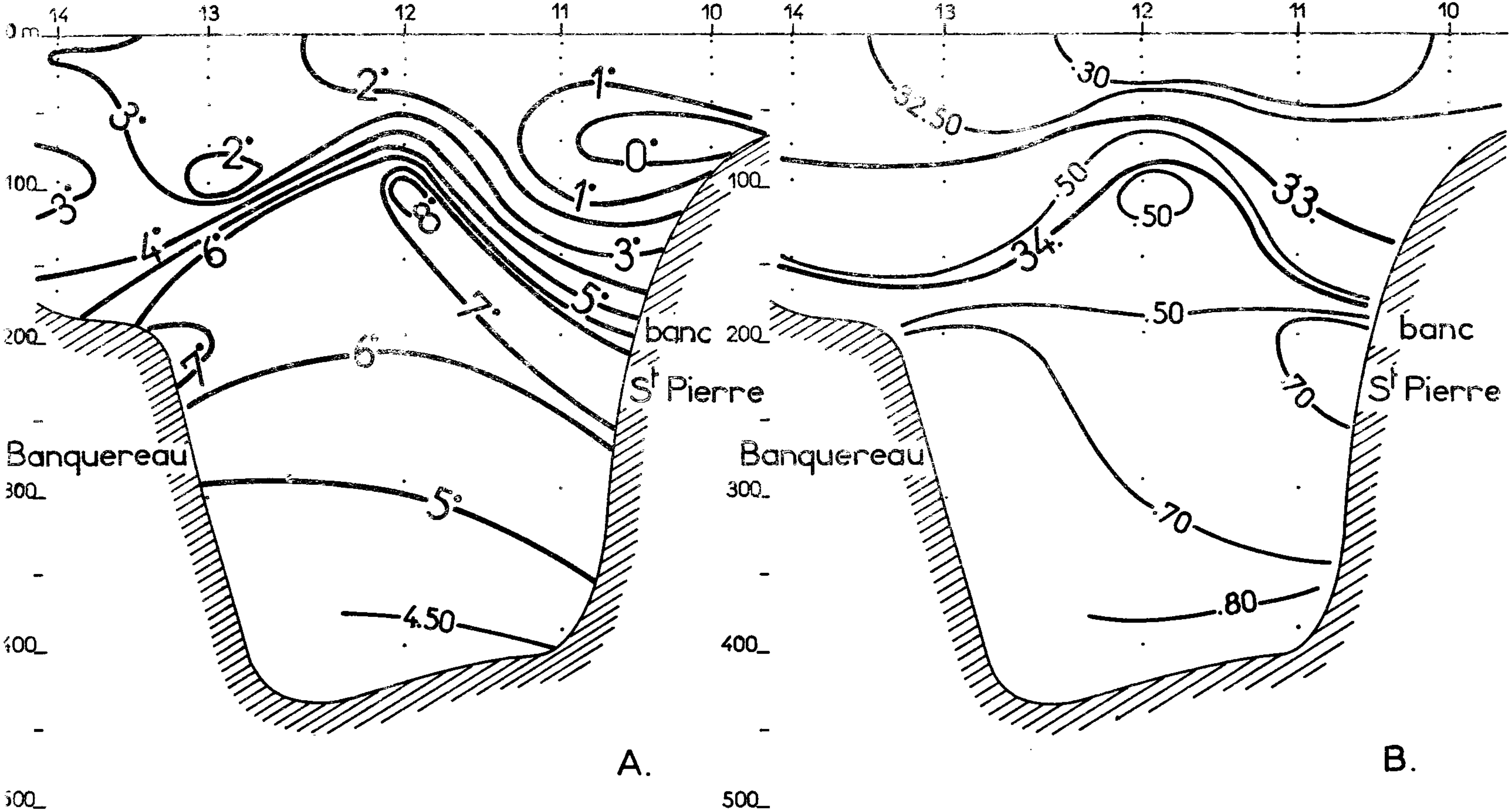

Fig. 5. Section II - Sou'' of Banquereau/South of Saint Pierre Bar'
A. Temperatures B. Salinities

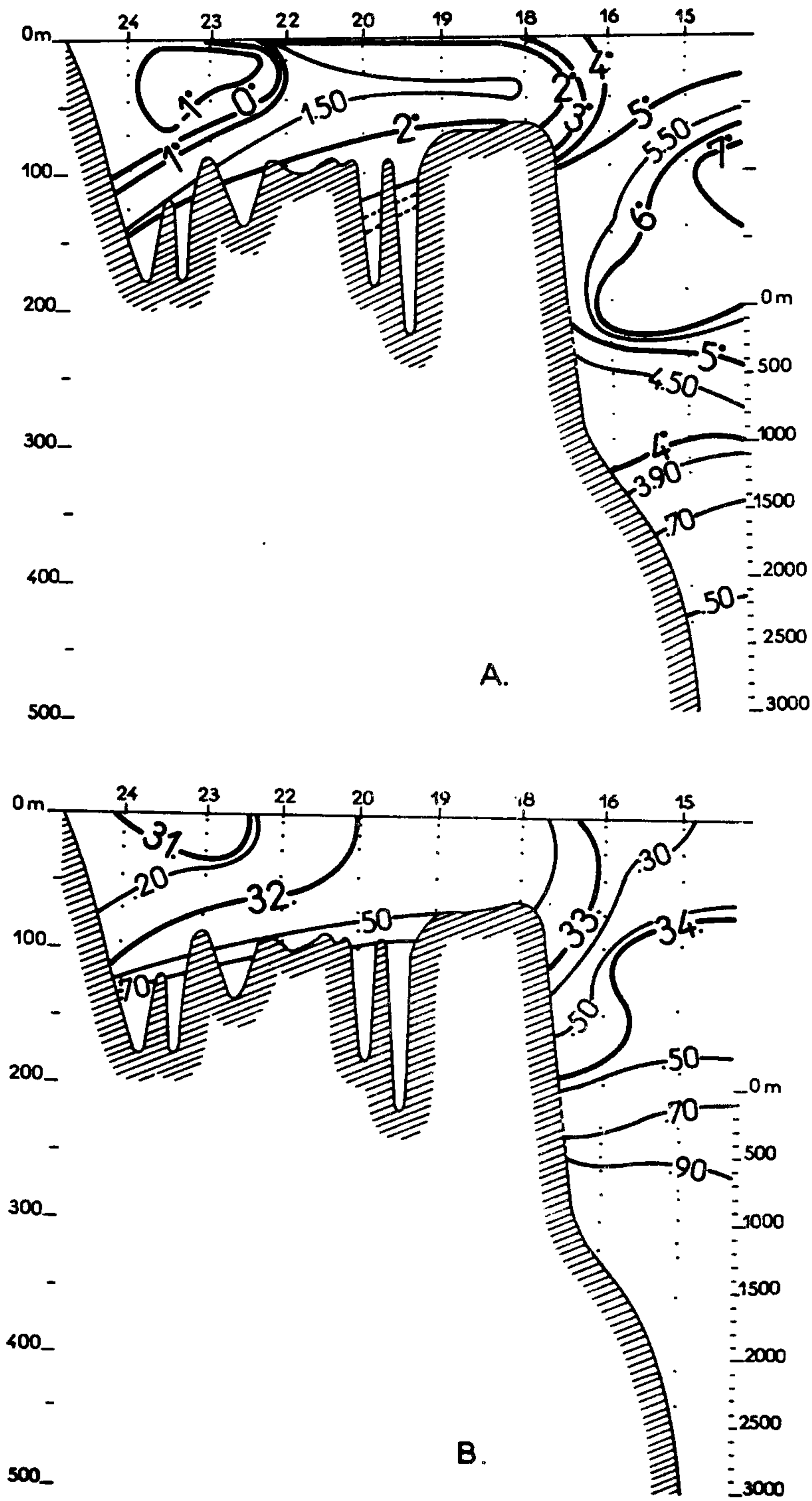

Fig. 6. Section III - Cape Breton/South of Banquereau.
A. Temperatures B. Salinities

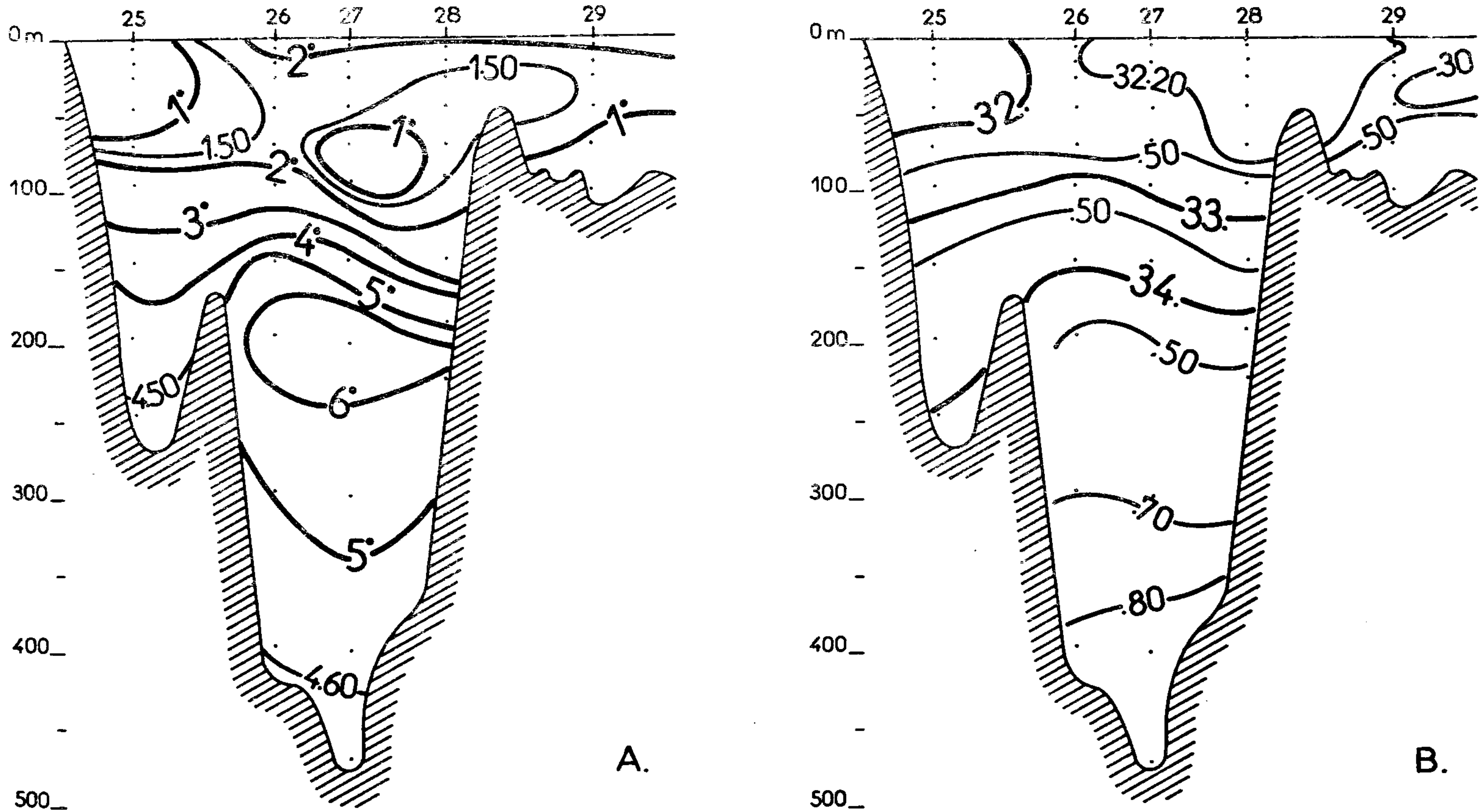

Fig. 7. Section IV - North of Misaine Bank/North of Saint Pierre Bank.
A. Temper-tures B. Salinities

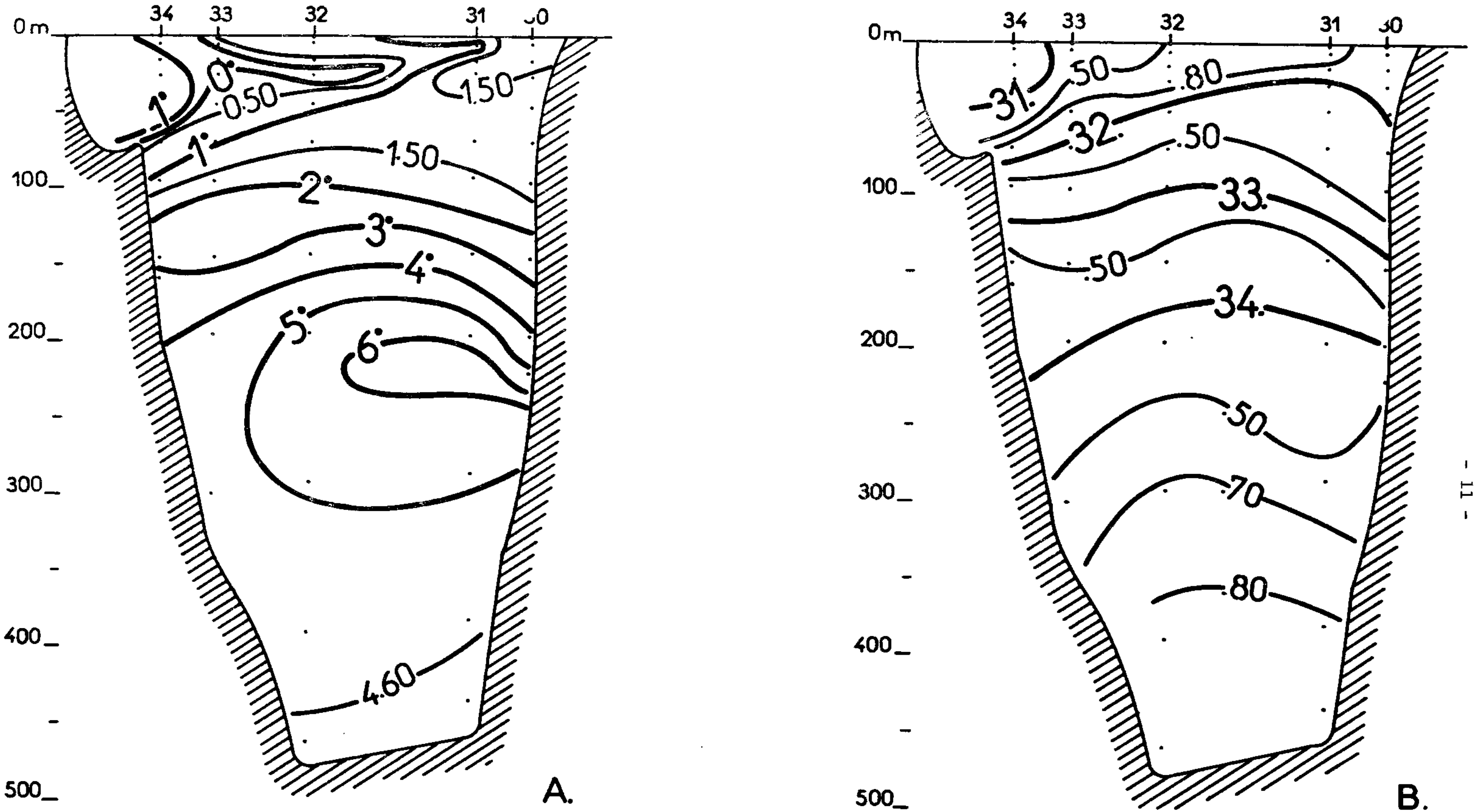

Fig. 8. Section V - Cabot Strait.
A. Temperatures B. Salinities

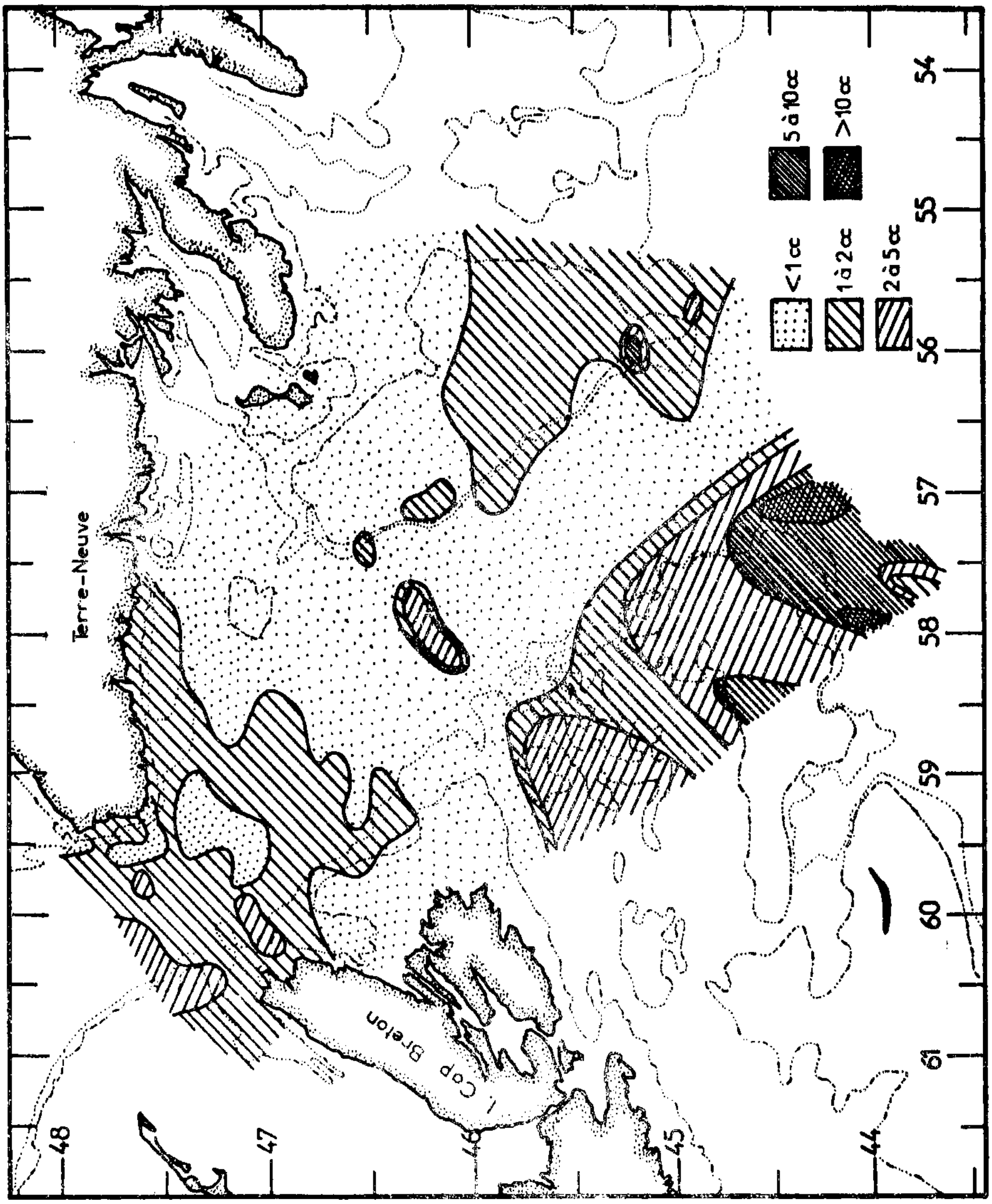

Fig. 9. Zooplankton distribution.

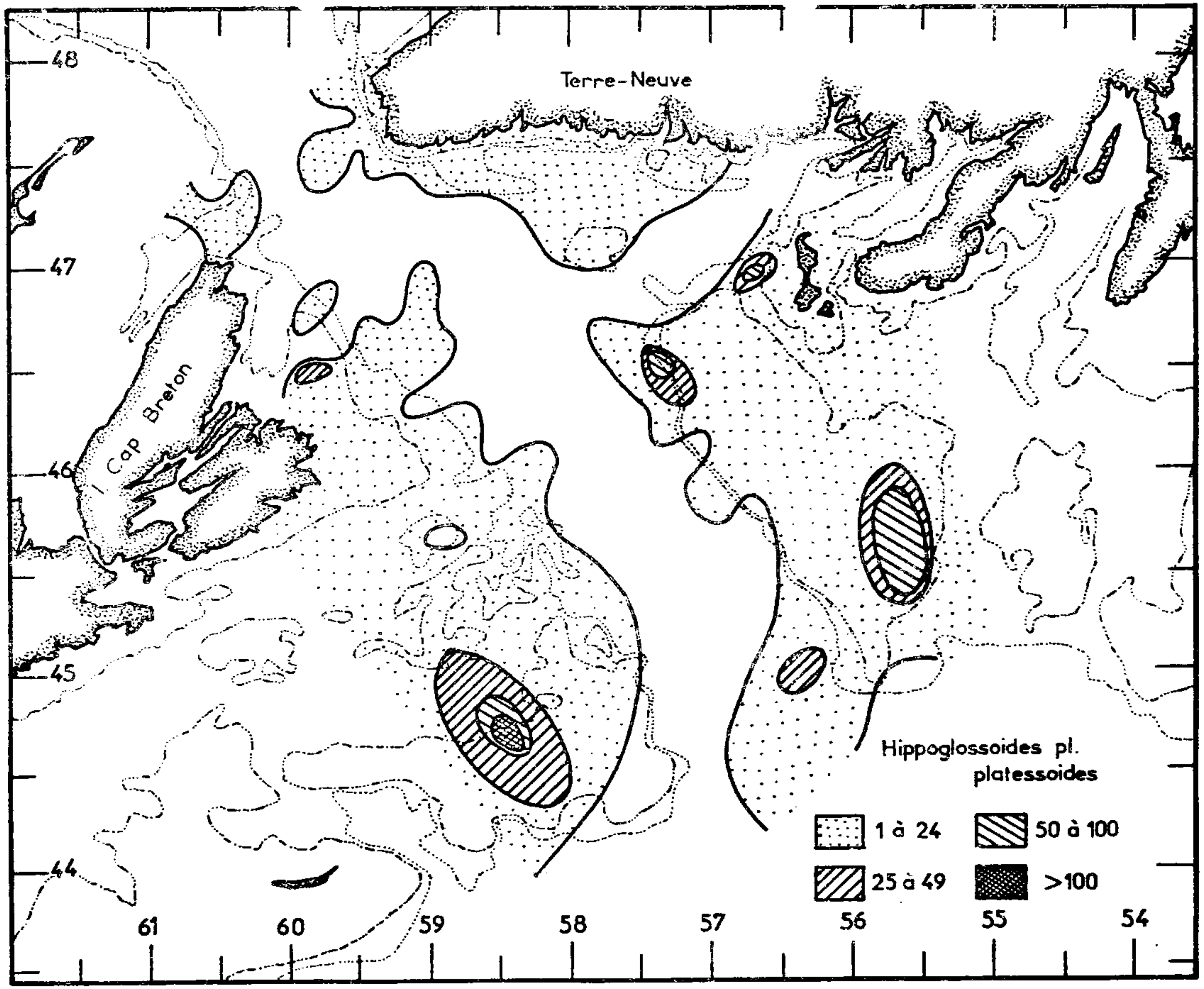

Fig. 10. Distribution of american plaice eggs: <u>Hippoglossoides pl. platessoides.</u>
(No. of eggs/m^2 of surface).