Northwest Atlantic Fisheries Organization

Serial No. N1904 NAFO SCR Doc. 91/24

SCIENTIFIC COUNCIL MEETING - JUNE 1991

Yearly variations in water temperature in NAFO Subdivision 3Ps from 1978 to 1990.

by

Ph. Moguedet and J. C. Mahé

Institut Français de Recherche pour l'Exploitation de la Mer
B.P. 4240 - F-97500 Saint-Pierre et Miquelon

1. Introduction.

Since 1978 french groundfish surveys are carried out each late winter in NAFO Subdivision 3 Ps (Fig. 1). During each of these surveys water temperature is recorded at the end of each trawling set, and moreover one hydrological transect is systematically done (Fig. 2) from the southwestern slope of Saint-Pierre Bank to the north of Green Bank.

Year to year variations in water temperatures are estimated from average water temperatures by depth range on the transect and by the mean bottom temperatures on locations of trawling sets. Yearly mean profile and hydrological section on the transect are realised.

2. Material and methods.

Water temperature is recorded at the end of each trawling set by mean of an XBT cast, for surface, five meters depth and for each ten meters depth interval down to the bottom.

The selection of the transect has been described by Forest et al. (1981). From 1978 to 1984, the hydrographic section was made by using temperatures recordings obtained from the XBT casts made after trawling sets located the closest as possible to this transect and in the shortest time interval (Battaglia et al., 1987). Since 1985 fourteen XBT stations are yearly occupied on this transect. No data were available for 1980.

Yearly mean temperatures obtained by 100 meters depth range are compared to the average temperatures observed in these ranges over the studied period.

For each year, average temperatures are calculated by depth level using all stations along the transect to obtain a mean vertical profile of temperature.

An hydrological section on the transect has also been plot for each year.

3. Results and discussion.

Since 1978, french groundfish surveys are carried out between middle of February and middle of March (Tabl. 1). The transects have been realised in most cases at the middle of March, except for years 1983 and 1986 (each at the end of February) (Tabl. 1).

Anomalies analysis by 100 meters depth range shows that largest temperature fluctuations are generally found in the two upper ranges (0-99 m and 100-199 m) except for years 1982, 1984 and 1989 where importants fluctuations were encountered for the depth range 200-299 m (Fig. 3, Tabl. 2, 3). At the deeper range (> 300 m) variations are low (1 to 1.5° C).

Yearly mean vertical profiles of temperature (Fig. 4) can be classified in two groups depending on whether surface layer temperatures (0-150 m) are above (years 1981, 1983, 1984), or below (years 1982, 1985, 1986, 1987, 1989, 1990) 0° C.

The year 1978 with surface layer temperatures about 0° C (Fig. 4) appears to look like the mean temperature profile for the 1978-1987 period (Battaglia et al., 1987).

During colder winters, hydrological sections from the transect analysis show water masses with temperatures below 0° C extending from the east and lying on Green Bank and Saint-Pierre Bank (Fig. 5 to 8, Tabl. 4, 5). A small warm water mass always stands close to the southwestern slope of Saint-Pierre Bank. The colder are the winter, the deeper and more reduced is the warm water mass. This is in accordance with results of Drinkwater et al. (1986) and Battaglia et al. (1987).

Hydrological section of year 1984 shows (Fig. 6), as an exception, positive surface temperatures. This winter is considered like one of the warmest winter on the studied period.

4. Conclusion.

The 1982, 1985, 1986, 1987, 1989 and 1990 winters appear as cold winters while the three winters 1981, 1983 and 1984 are warm.

The largest temperature fluctuations occured in the 100-199 meters depth range, temperatures at these depths being greatly influenced by the importance of the Labrador cold water current (Battaglia et al., 1987).

Hydrographic sections on the transects confirm this, showing the cold water masses coming from the northeast of NAFO Subdivision 3 Ps (Green Bank).

5. References

Battaglia A., J.C. Poulard, 1987. Year to year variations in water temperature in NAFO Subdivision 3 Ps. *NAFO SCR.Doc.* 87/26 : 16 p.

Bertrand J., 1988. Water temperature in NAFO Subdivision 3 Ps for winter 1988. Rapport interne IFREMER DRV/RH Saint-Pierre et Miquelon : 8 p.

Drinkwater K.F., R.W. Trites, 1986. Overview of environmental conditions in the Northwest Atlantic in 1985. *NAFO SCR.Doc.* 86/72 : 31 p.

Forest A., J.C. Poulard, 1981. Water temperature distributions in NAFO Subdivision 3Ps in Autumn 1980 and late winter 1981. *NAFO SCR.Doc.* 81/VI/45 : 9 p.

Year	Dates of surveys		Dates of transects	
	beginning	end	beginning	end
1978	02/21	03/25	03/14	03/19
1979	02/21	03/20	03/07	03/08
1980	03/03	03/12	-	-
1981	02/24	03/31	03/11	03/21
1982	03/05	04/02	03/12	03/19
1983	02/10	03/19	02/26	03/02
1984	02/15	03/19	03/15	03/18
1985	02/09	03/10	03/13	03/14
1986	02/09	03/10	02/21	02/22
1987	02/04	03/06	03/05	03/06
1988	02/09	03/11	03/07	03/08
1989	02/14	03/19	03/09	03/10
1990	02/26	03/28	03/12	03/13

Table 1 - Dates of the french groundfish surveys and transects in NAFO Subdivision 3 Ps from 1978 to 1990 (ERHAPS surveys on R/V Cryos).

Year / Depth	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
< 100 m	23	19	11	27	20	27	29	5	17	13	14	22	17
100-199 m	19	24	11	33	30	32	28	2	31	25	36	46	48
200-299 m	10	14	12	19	20	24	15	3	25	30	20	27	25
> 300 m	7	9	6	29	12	24	15	4	21	14	13	18	32
Total	59	66	40	108	82	107	87	14	94	82	83	113	122

Table 2 - Number of temperature observations near the bottom on locations of trawling sets from 1978 to 1990.

Year / Depth	1978	1979	1980	1981	1982	1983
< 100 m	0.3 ± 3.0	-0.4 ± 0.5	-0.1 ± 1.6	1.2 ± 1.4	-0.4 ± 1.0	0.3 ± 1.0
100-199 m	1.3 ± 5.2	2.0 ± 5.8	1.3 ± 3.6	1.6 ± 4.8	1.1 ± 2.3	1.0 ± 3.5
200-299 m	5.9 ± 2.7	6.8 ± 2.2	5.9 ± 3.2	6.4 ± 2.3	4.5 ± 2.9	4.7 ± 1.7
> 300 m	5.3 ± 1.0	6.6 ± 0.9	6.1 ± 0.9	5.4 ± 1.1	4.8 ± 1.9	5.0 ± 0.6

Year / Depth	1984	1985	1986	1987	1988	1989	1990
< 100 m	1.5 ± 2.2	-1.1 ± 0.7	-0.1 ± 1.3	-0.2 ± 1.7	0.3 ± 1.0	-0.7 ± 1.4	-1.3 ± 0.6
100-199 m	4.4 ± 6.9	-0.9 ± 0.3	1.0 ± 5.1	1.5 ± 5.4	1.6 ± 6.6	0.8 ± 3.2	0.6 ± 3.8
200-299 m	7.0 ± 2.4	5.6 ± 5.7	6.8 ± 2.8	6.2 ± 1.9	3.9 ± 9.0	5.0 ± 2.4	4.5 ± 2.9
> 300 m	6.4 ± 1.3	7.2 ± 0.6	6.2 ± 1.4	5.7 ± 1.2	1.8 ± 12.4	5.2 ± 1.3	5.0 ± 2.5

Table 3 - Mean temperatures observed near the bottom on locations of trawling sets by depth zones from 1978 to 1990.

Years	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Number of transect stations	8	8	-	13	10	9	14	14	14	11	14	14	13
Duration of transect in days	5	2	-	11	8	5	4	1	1	1	1	1	1

Table 4 - Number of Sippican XBT stations occupied each year on the transect from the Southwestern slope of Saint-Pierre Bank to the North of Green Bank.

Depth (m)		1978	1979	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
0 to 99	Min.	-0.6	-1.1	-0.3	-1.0	-0.3	-0.5	-1.6	-1.3	-1.5	-0.6	-1.80	-1.70
	Max.	6.0	-0.1	4.7	1.1	3.2	7.3	1.1	1.5	0.0	1.9	0.50	0.10
	Aver.	-0.02	-0.51	1.97	-0.63	1.06	1.67	-1.00	-0.66	-1.05	0.31	-1.10	-1.43
	St. dev.	1.18	0.78	3.14	0.97	1.85	2.74	1.50	1.03	1.52	0.61	1.61	2.05
100 to 199	Min.	-0.6	-0.6	-0.6	-1.0	-0.5	-0.9	-1.4	-1.2	-1.4	-0.7	-1.20	-1.50
	Max.	8.2	8.6	9.1	7.8	6.6	10.0	7.4	6.7	4.4	9.7	4.30	5.90
	Aver.	4.17	2.14	3.10	1.32	3.06	5.54	0.19	0.75	-0.25	3.5	0.12	-0.11
	St. dev.	6.97	4.68	5.64	3.56	5.12	8.80	2.26	2.23	1.13	5.79	1.27	1.65
200 to 299	Min.	6.8	7.1	5.9	2.9	2.4	7.0	-0.9	4.3	1.5	3.7	1.30	2.00
	Max.	8.1	7.9	8.5	5.5	5.7	9.4	7.7	8.3	7.2	9.1	5.30	7.50
	Aver.	7.78	7.51	7.31	3.82	5.55	8.45	6.00	7.05	6.33	5.55	3.81	5.61
	St. dev.	11.56	11.48	10.60	5.56	8.24	12.22	8.96	10.16	9.23	8.11	5.55	8.38
300 to 399	Min.	4.7	-	5.7	3.4	-	5.4	5.7	6.0	5.4	3.6	4.00	5.70
	Max.	6.1	-	6.4	4.6	-	7.7	7.8	7.5	6.1	5.1	4.80	6.60
	Aver.	5.27	-	5.86	4.17	-	6.45	7.18	6.70	5.61	4.22	4.25	6.17
	St. dev.	8.07	-	8.61	6.23	-	9.49	10.42	9.70	8.26	6.15	6.15	9.11
0 to 399	Min.	-0.6	-1.1	-0.6	-1.0	-0.5	-0.9	-1.6	-1.3	-1.5	-0.70	4.10	-1.70
	Max.	8.2	8.6	9.1	7.8	6.6	10.0	7.8	7.5	6.33	9.70	4.10	7.50
	Aver.	1.81	0.95	3.09	0.80	2.01	3.52	0.87	1.28	0.52	2.00	4.10	0.03
	St. dev.	15.77	12.65	13.41	9.12	9.87	14.29	11.42	19.31	11.57	3.80	8.20	2.79

Table 5 - Yearly temperatures by depth ranges observed in late winter (minimum, maximum, average and standard deviation) on the transect.

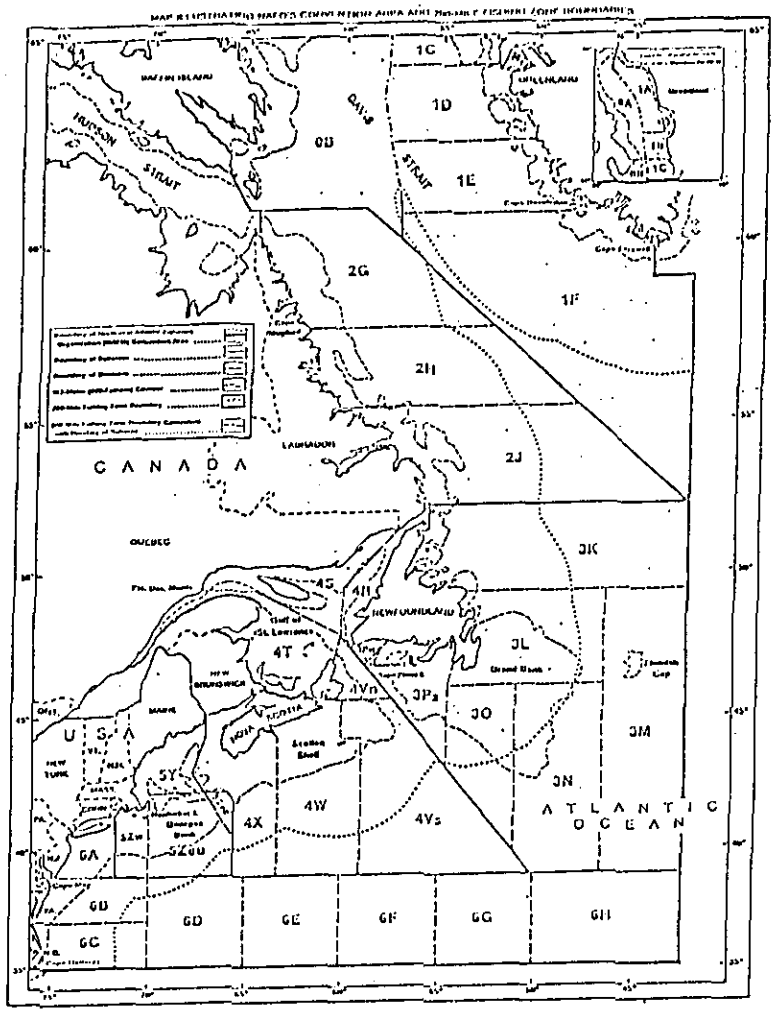

Figure 1 - Location of NAFO Subdivision 3 Ps.

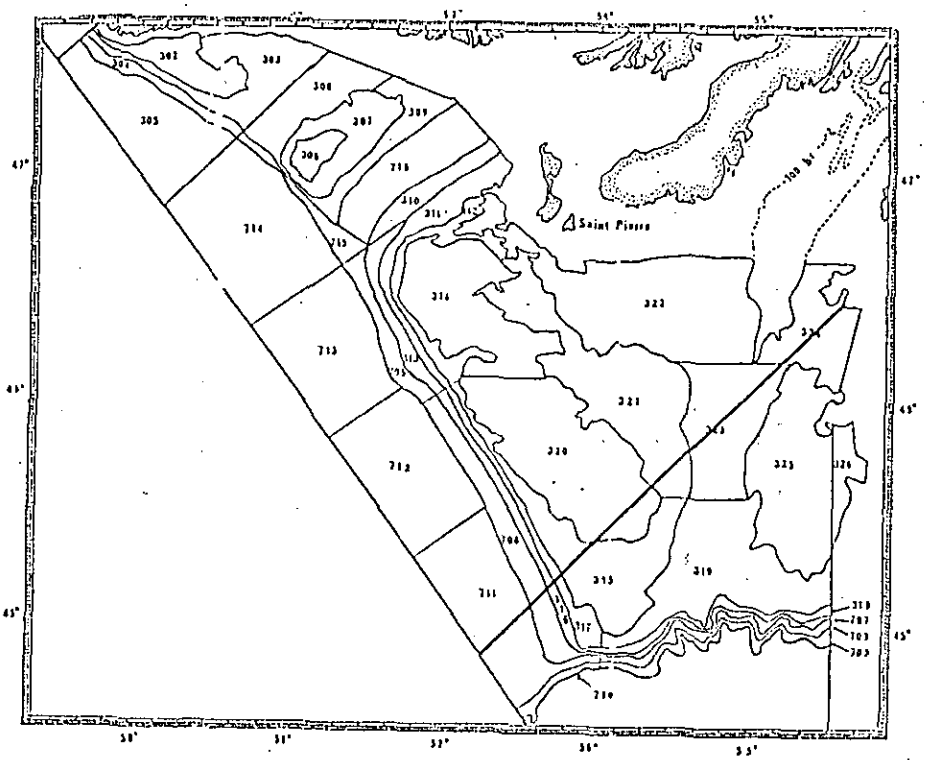

Figure 2 - Location of the transect carried out during french groundfish survey in late winter on the period 1978-1990.

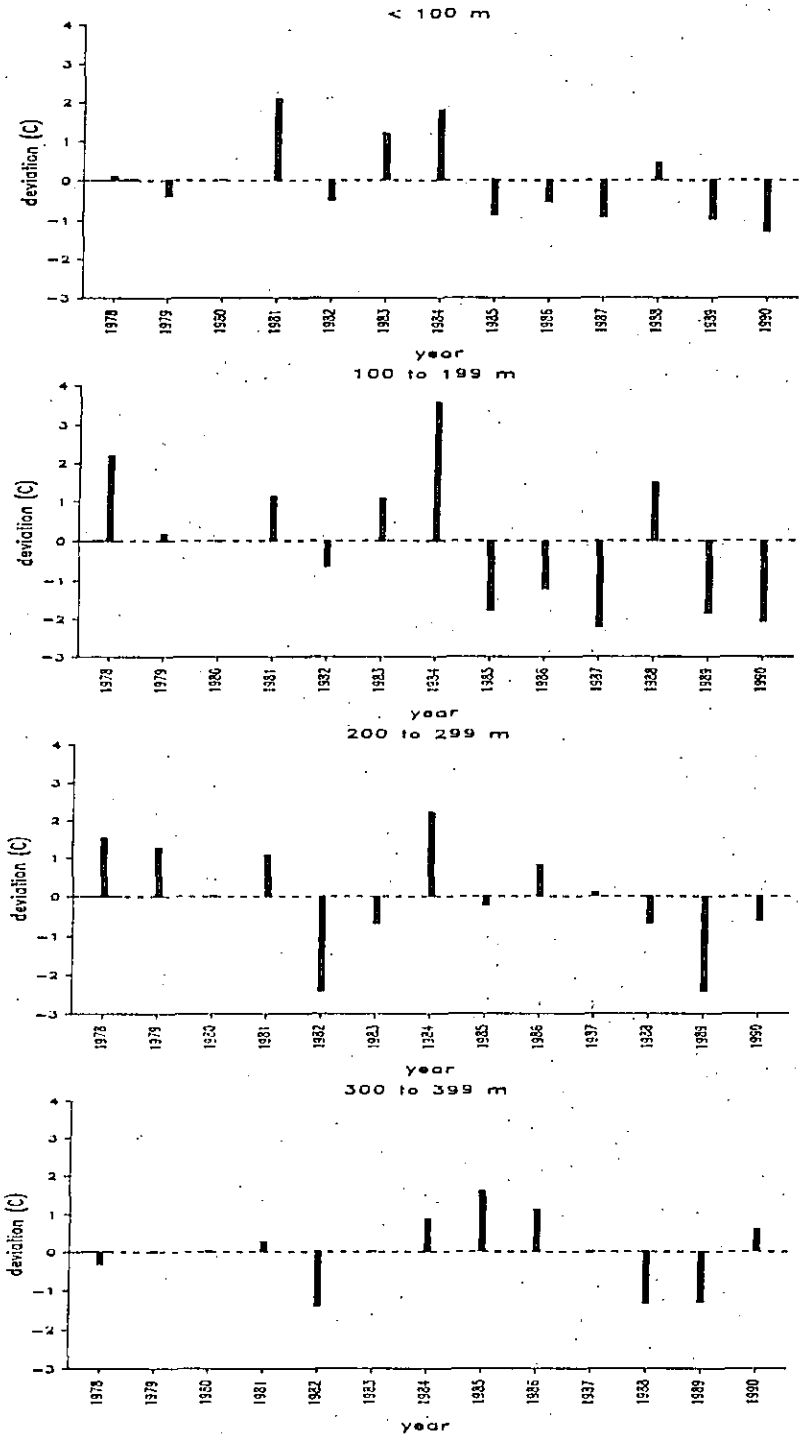

Figure 3 - Yearly deviations to the 1978-1990 mean temperatures in different depth ranges from the hydrographic transects.

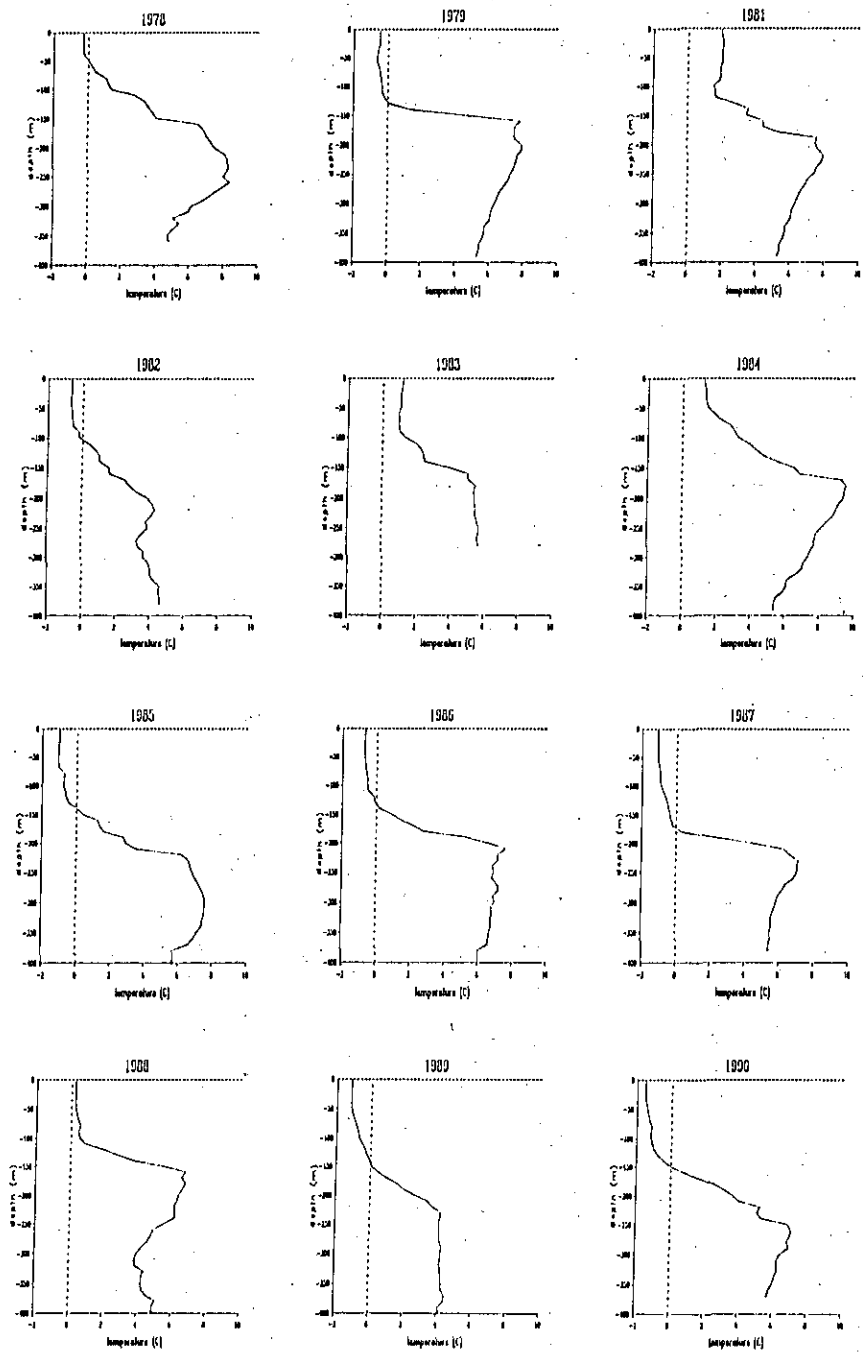

Figure 4 - Yearly profile of mean temperature at depth from hydrographic transects (1978-1990).

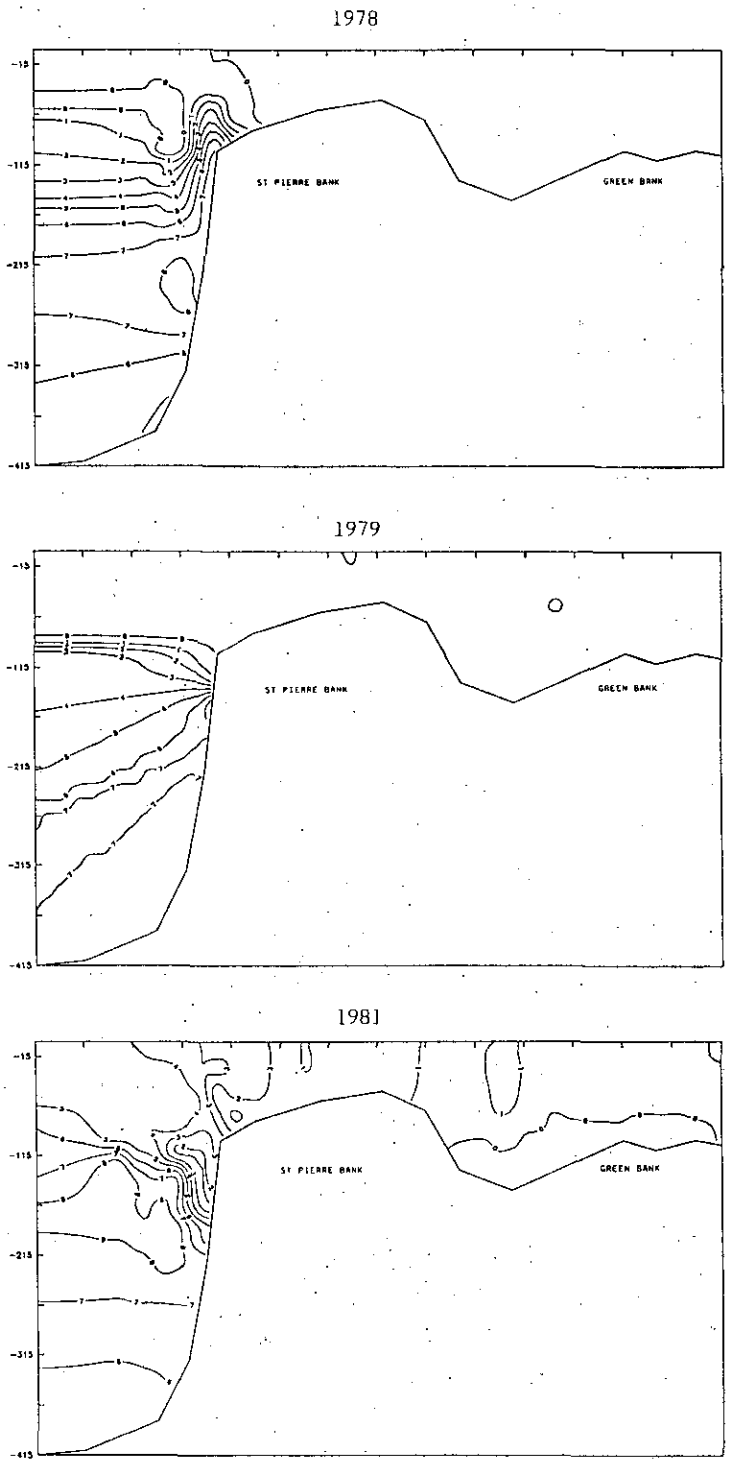

Figure 5 - Hydrological sections from the transect analysis (1978-1979-1981).

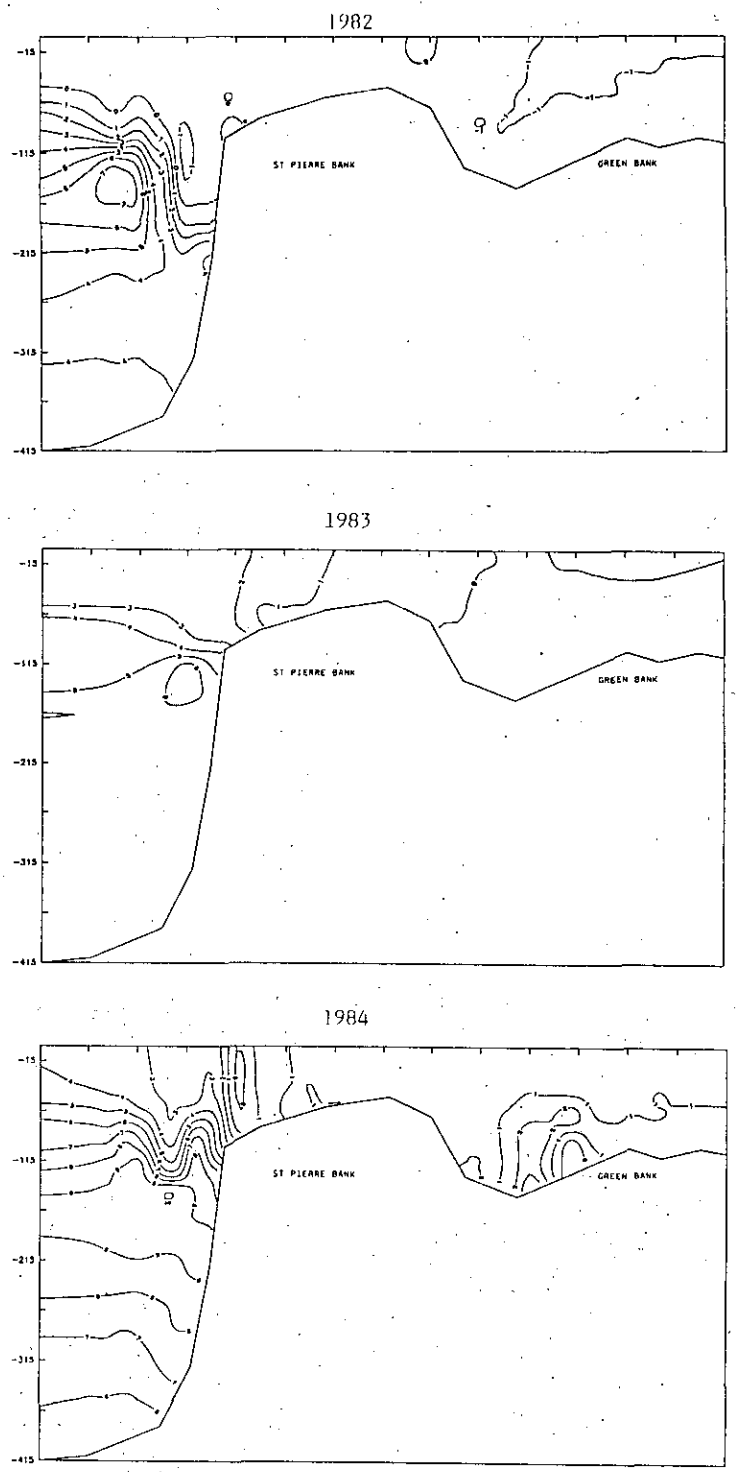

Figure 6 - Hydrological sections from the transect analysis (1982-1983-1984).

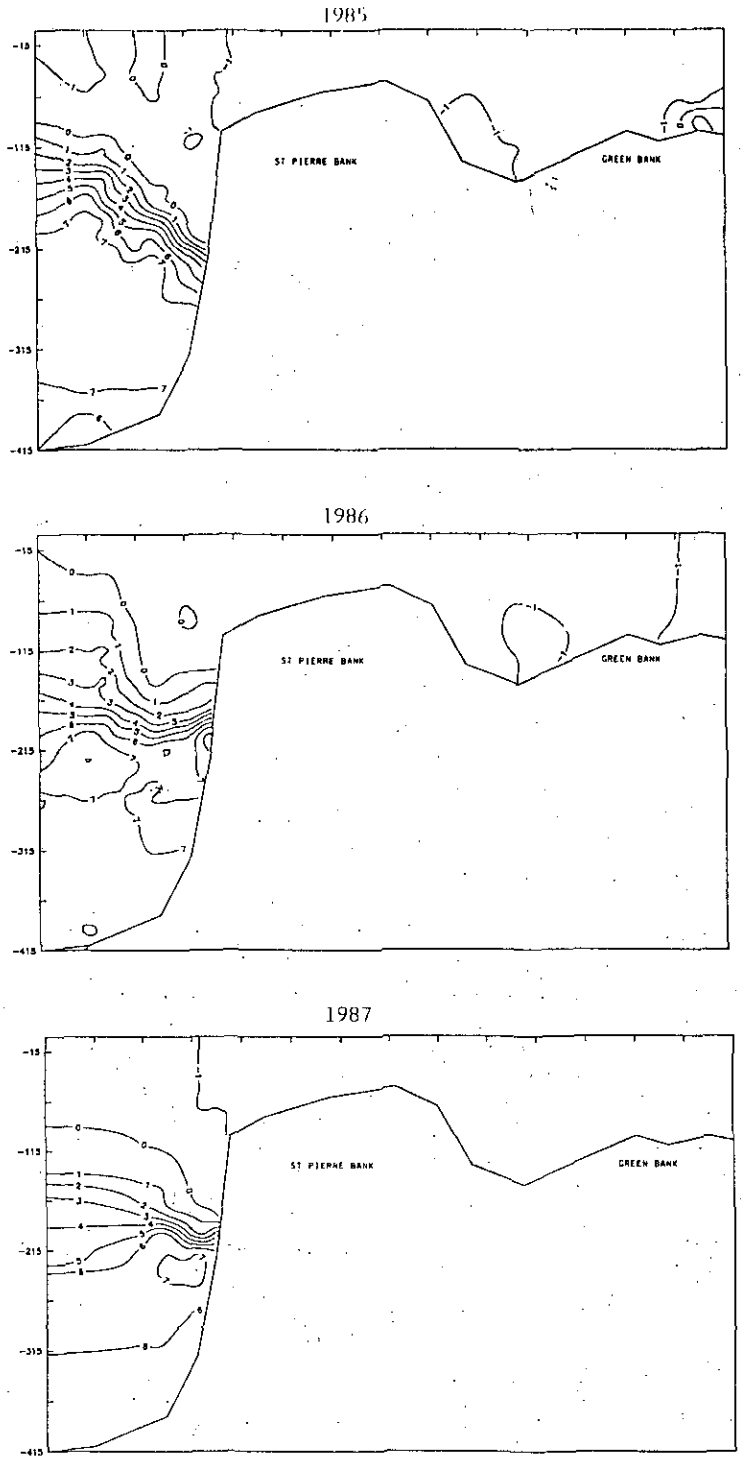

Figure 7 - Hydrological sections from the transect analysis (1985-1986-1987).

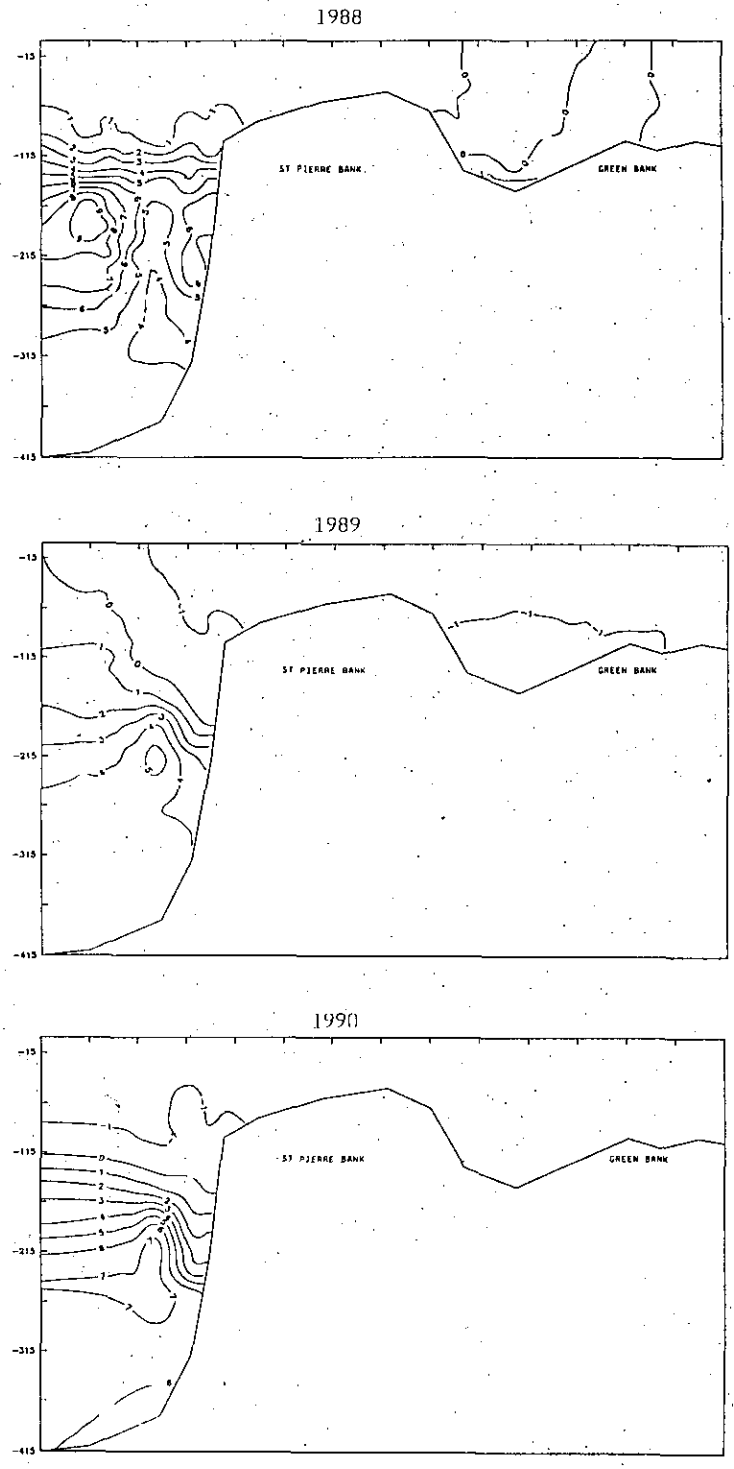

Figure 8 - Hydrological sections from the transect analysis (1988-1989-1990).