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Yearly distribution of American plaice (*Hippoglossides platessoides*) in late winter in Subdivision 3Ps in the period 1978-1990

by

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1. Introduction.

Groundfish surveys have been yearly conducted in late winter (February-March, Table 1) in NAFO Subdivision 3 Ps since 1978 by french scientists. For each trawling set operation abundance in biomass for American plaice have been estimated.

The objective of this paper is to analyse the yearly distribution of this species on the period 1978-1990 and to relate it with year to year fluctuations in temperatures observed in this area in winter.

2. Material and methods.

The standard process, which is yearly conducted, is described by Forest *et al.* (1981). The sampling design consist in a random selections of trawling stations, their number being proportional to the variance observed in the Cod abundance (main species sought) in each stratum of the stratified area (Fig. 1). Trawling operations are constants (30 minutes, 4 knots).

Abundance estimates, in biomass and number per 30 minutes, are made for each trawling set for the main commercial species (Cod, American plaice, Redfish...), and the average values by stratum are calculated. On the other hand, water temperature is recorded at the end of each trawling operation by mean of an XBT cast, for surface, bottom and every angular point.

From an hydrological transect carried every year and crossing the Saint-Pierre Bank from the southwestern slope to the north of Green Bank, 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, abundance estimate in biomass (kg/30 mn) for American plaice at each trawling set have been plot on the map of the Subdivision 3 Ps. The abundance is represented by circle with radius proportional to it.

For some strata (316, 317, 319, 322, 323, 324) where American plaice is frequently distributed, relation between bottom temperature (average on temperatures

observed for all trawling operations in the stratum) and abundance in biomass (average of abundance biomass estimate for all trawling set in the stratum) is studied for the period 1978-1990.

No data were available for 1980.

3. Results and discussion.

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

According to Moguedet *et al.* (1991) 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 occuring in the two upper depth ranges are due to the great influence of the Labrador cold water current (Battaglia *et al.*, 1987). This is confirmed by hydrographic sections on the transects done during the surveys (Moguedet *et al.*, 1991) showing the cold water masses coming from the northeast of NAFO Subdivision 3 Ps.

Average abundance in American plaice's biomass (kg/30 mn) estimated by stratum for each year is presented in table 4. When strata have not been sampled, values have been recalculated using a multiplicative model (data left justified).

Analysis of maps showing abundance of American plaice distribution in Subdivision 3 Ps (Fig. 3 to 8) reveals two things. Generally this species is well represented in the Halibut Channel (strata 322, 324, 323, 319). On the coldest late winters (1982, 1985 to 1987 and 1989, 1990) highest concentration have been observed on the southwest slope of Saint-Pierre Bank (strata 316, 317).

This phenomen can be related to the movement of cold water masses, in Subdivision 3 Ps, inducted by the Labrador current, from northeast to southwest (Moguedet *et al.*, 1991). American plaice follows this cold water current and on coldest winters, when water masses arrive until the slope of Saint-Pierre Bank the species is encountered in these areas in largest abundances.

Analysis of the relation between bottom temperature and abundance (Fig. 9) for strata of Halibut Channel (319, 323, 322, 324) and strata of southwest slope of Saint-Pierre Bank (316, 317) don't show significatives correlations (except for stratum 317). This due to the fact that data used are average data of all the samples in the stratum (for abundance and temperature) and because most of the time, the cold water masses lie just on a part of the stratum.

4. References

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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.

YEAR		1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	AVERAGE
STRATA	Max.depth (meters)	Kg/30mn	Kg/30mn	Kg/30mn	Kg/30mn	Kg/30mn	Kg/30mn	Kg/30mn	Kg/30mn	Kg/30mn	Kg/30mn	Kg/30mn	Kg/30mn	Kg/30mn	Kg/30mn
314	0-55	.00	.00	3.65	5.67	8.67	.10	1.67	.75	2.50	3.00	3.15	.00	.00	2.24
320	0-55	2.80	.33	5.55	2.67	5.67	4.70	3.33	.10	8.50	5.46	10.00	.00	.00	3.78
308	55-91	2.67	.00	.00	2.50	2.50	.00	.00	.00	.00	.00	.00	.00	.00	.59
312	55-91	72.00	.33	.05	1.00	2.80	6.33	9.33	.67	11.83	.37	.00	.65	1.45	8.22
315	55-91	7.02	15.37	7.00	8.25	5.25	8.25	5.50	1.75	23.33	11.00	26.07	8.75	25.05	11.74
321	55-91	1.25	3.25	3.00	7.50	3.00	6.93	40.00	.80	5.00	7.00	1.87	2.75	7.55	6.92
325	55-91	6.74	6.67	6.70	8.75	8.53	3.30	5.67	.77	8.00	11.00	3.00	3.15	7.00	6.10
307	91-182	.20	.33	1.70	.13	.00	.40	.43	1.00	1.60	.18	.50	.37	.11	.53
311	91-182	30.50	22.00	29.67	21.67	112.50	7.50	12.67	13.25	54.50	30.67	37.01	48.27	12.91	33.32
317	91-182	138.00	229.67	210.88	15.25	680.00	75.67	37.17	1,643.46	440.40	746.00	80.27	332.33	342.47	382.43
319	91-182	40.00	9.00	50.67	178.20	133.03	32.50	21.40	2,004.17	117.68	18.25	50.62	119.30	53.35	217.55
322	91-182	27.50	127.50	514.50	107.57	36.20	307.60	46.00	296.55	66.53	7.73	3.25	28.42	17.30	122.05
323	91-182	267.00	642.25	95.67	406.50	502.33	299.32	447.25	203.00	329.67	128.00	101.40	71.50	163.70	281.28
324	91-182	62.55	62.05	62.27	47.00	77.31	205.00	432.00	173.00	40.50	3.23	44.50	19.20	28.30	96.69
306	182-273	.73	.37	.40	2.33	.25	.73	1.07	.87	1.17	.83	1.18	.44	.70	.85
309	182-273	6.00	7.00	.83	2.00	.37	2.47	.77	2.03	5.07	.90	.17	.20	2.30	2.32
310	182-273	41.67	6.67	5.67	4.77	12.92	9.57	4.67	19.50	.45	1.50	21.75	3.00	6.35	10.65
313	182-273	4.50	3.00	1.00	7.00	27.70	7.67	1.63	21.00	20.90	596.00	14.55	289.55	15.70	77.71
316	182-273	1.00	18.33	9.00	72.75	68.33	6.33	4.33	216.50	53.17	96.50	36.52	33.30	26.17	49.40
318	182-273	13.00	7.00	23.06	430.00	4.00	14.33	266.00	41.00	2.67	48.00	14.90	44.70	36.80	72.73
705	273-364	3.50	5.50	.00	3.67	4.00	4.00	2.70	2.50	1.80	1.27	1.60	7.00	6.60	3.40
706	273-364	2.00	2.00	6.00	4.80	8.67	6.00	3.73	3.00	6.05	11.67	7.77	8.58	8.63	6.07
707	273-364	5.18	.15	5.15	10.00	.00	.47	1.33	272.80	1.90	36.00	1.00	8.50	22.10	28.04
715	273-364	.50	.05	.20	.55	.30	.50	.33	2.58	.18	.65	1.55	.10	1.85	.72
716	273-364	1.17	2.83	5.07	3.33	2.43	2.62	8.43	6.97	9.27	2.80	3.07	3.62	7.60	4.55
708	364-546	5.97	5.91	5.94	2.00	32.00	.05	6.50	.33	2.25	1.10	35.20	.15	4.55	7.84
711	364-546				1.50		2.00								1.75
712	364-546				1.50		.00								.75
713	364-546				.67										.67
714	364-546				.03		.10								.07

Table 4 - Yearly average abundance estimates in biomass (kg/30 mn) for American plaice by stratum in Subdivision 3 Ps.

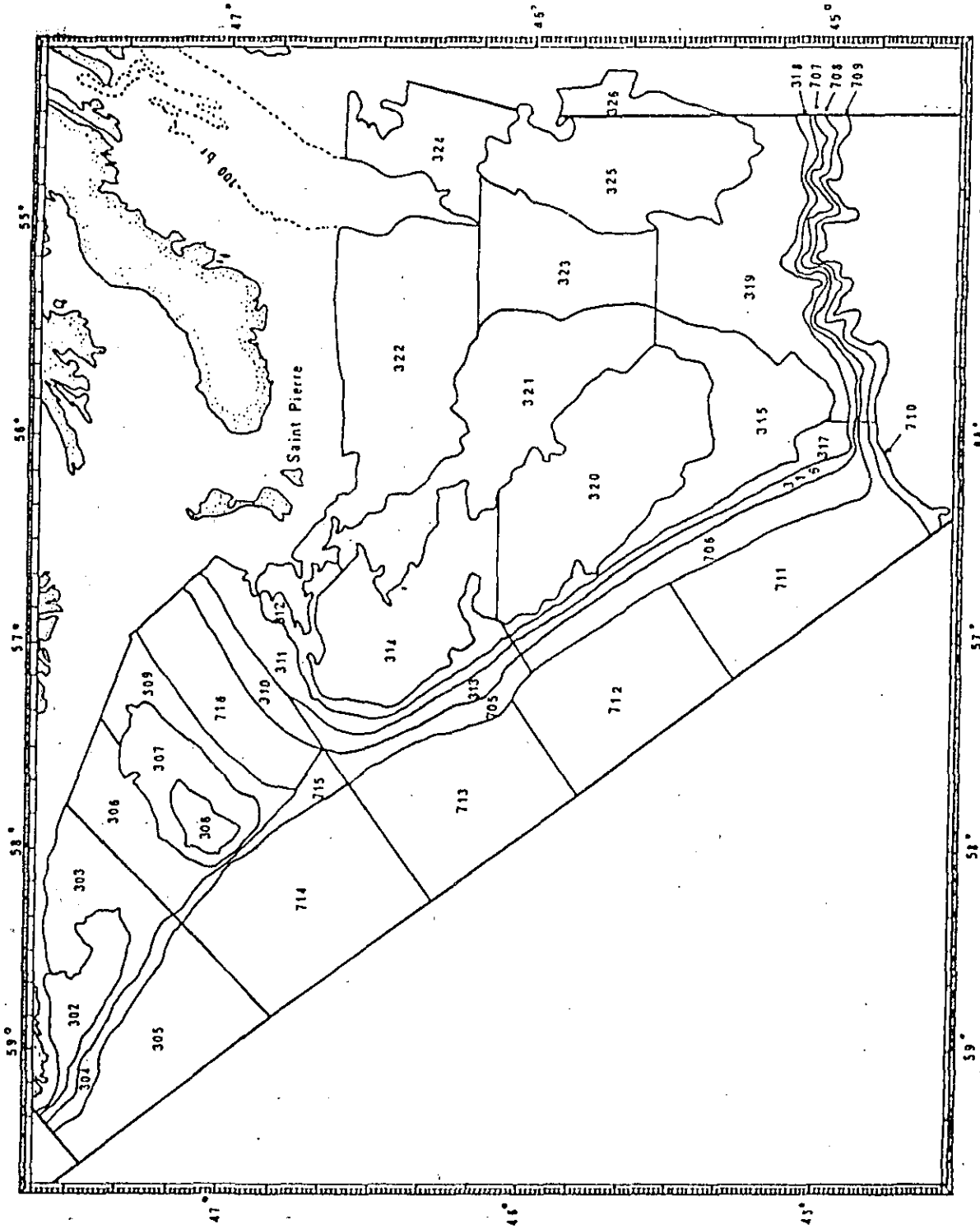


Figure 1 - Stratification scheme for NAFO Subdivision 3 Pn and 3 Ps.

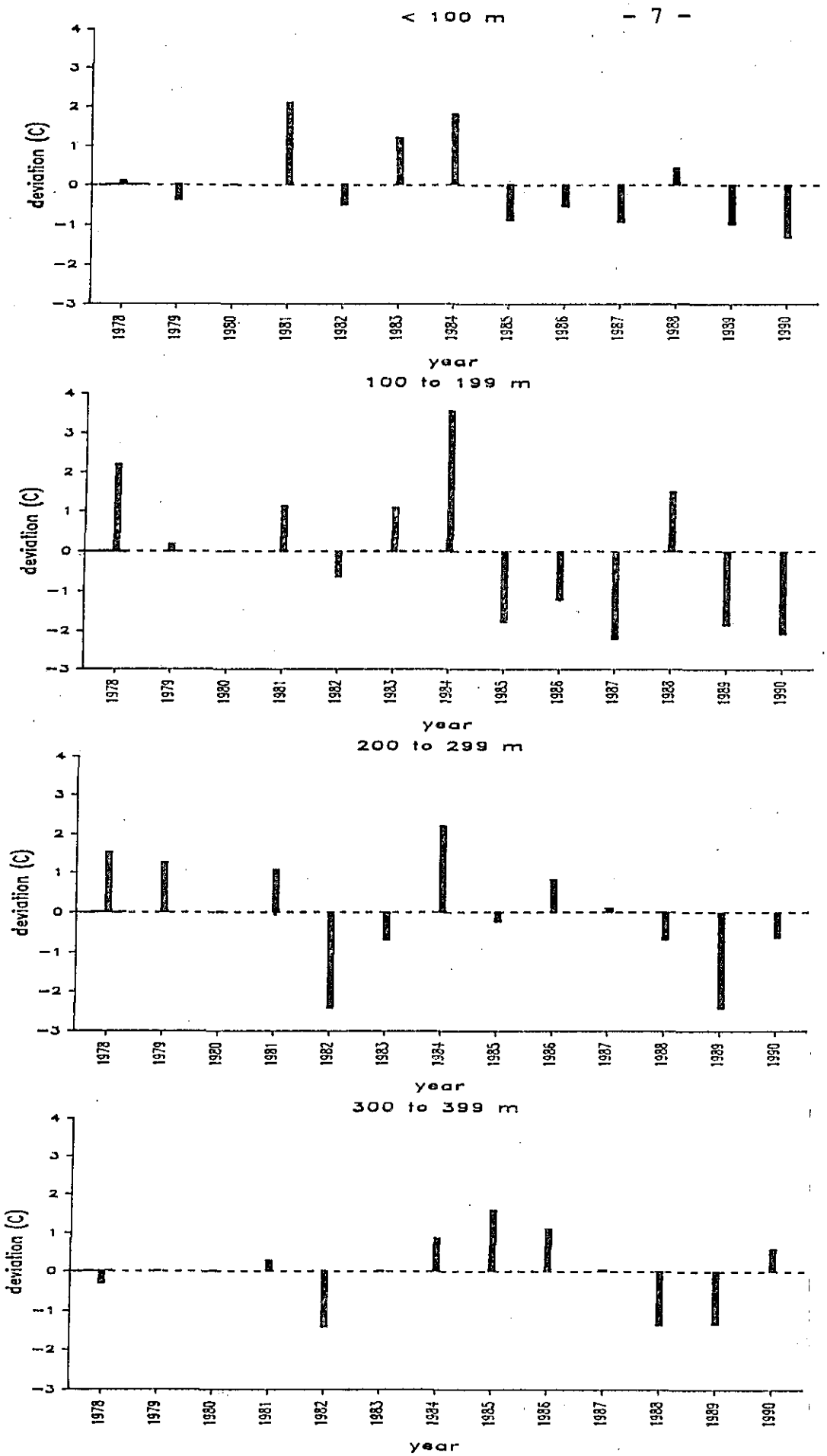
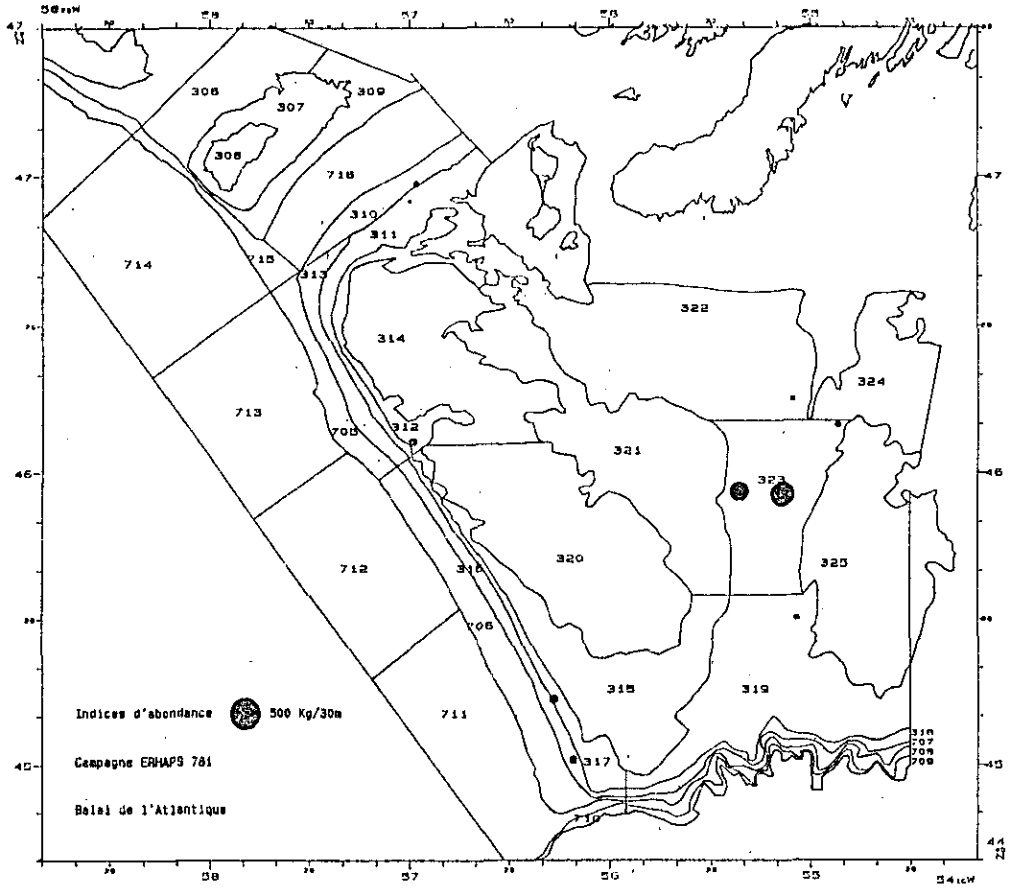


Figure 2 - Yearly deviations to the 1978-1990 mean temperature in different depth ranges from the hydrographic transects.



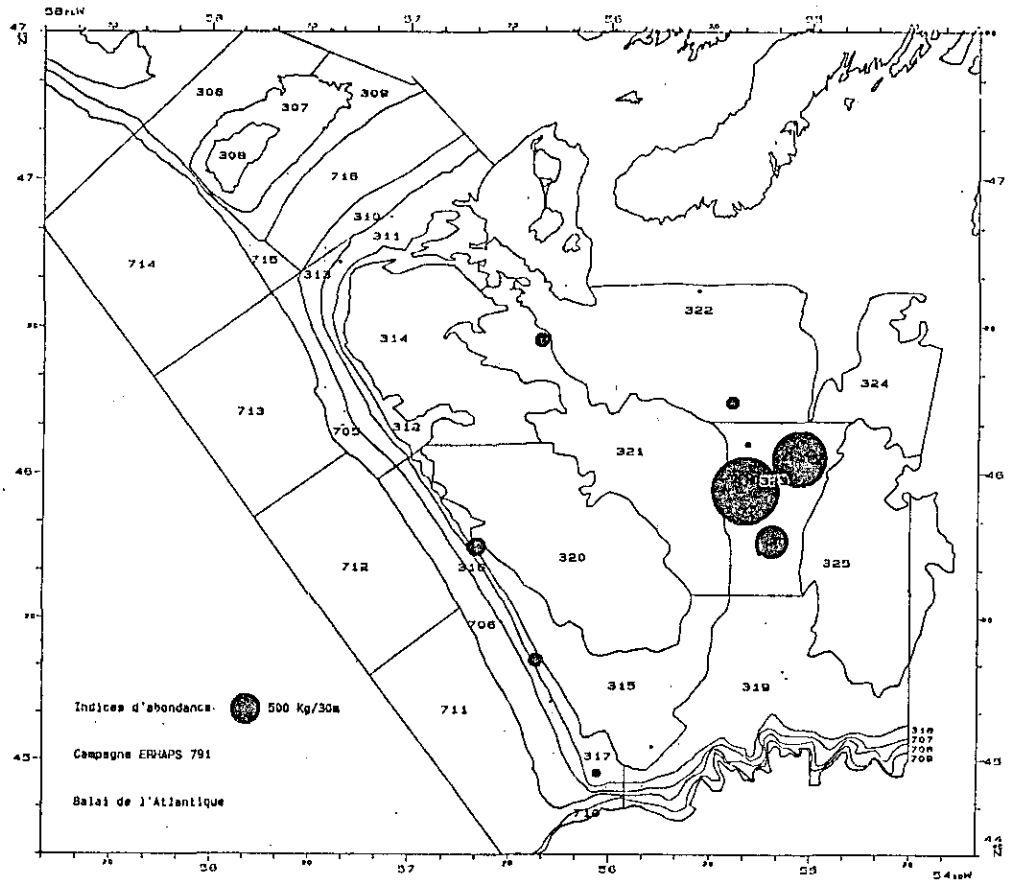
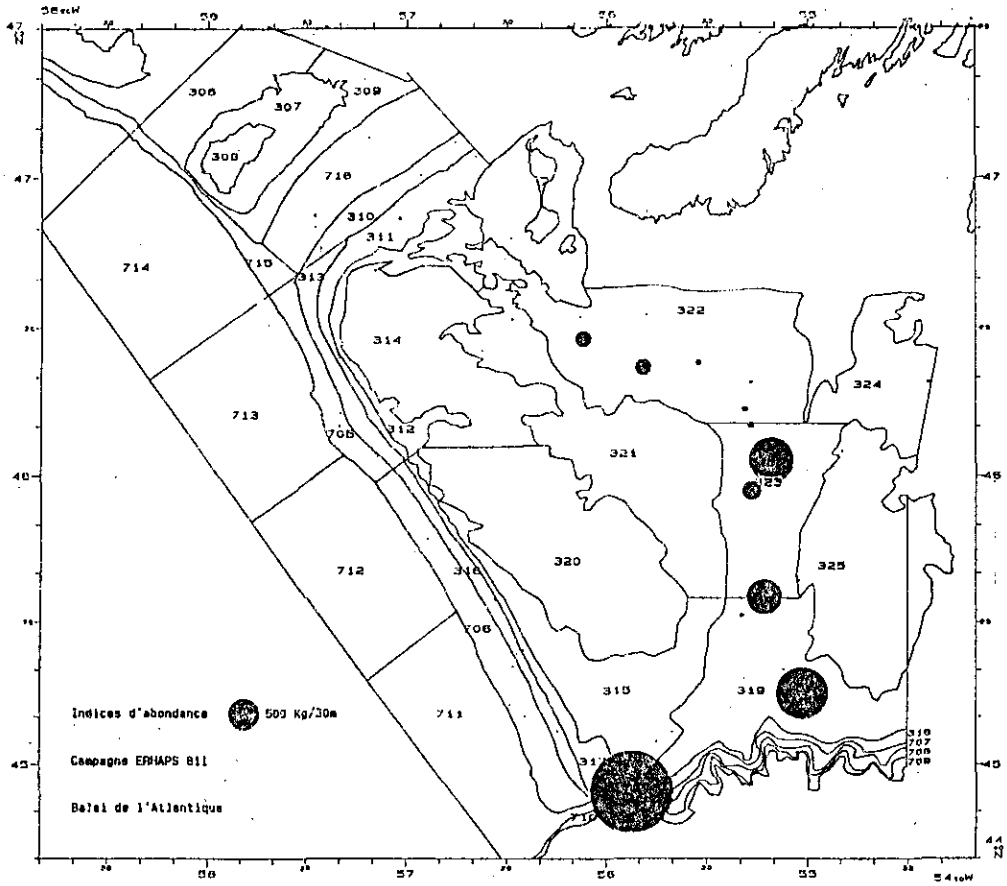


Figure 3 - Cartography of abundance estimate in biomass (kg/30 mn) by trawling set for American plaice in Subdivision 3 Ps for 1978 and 1979.



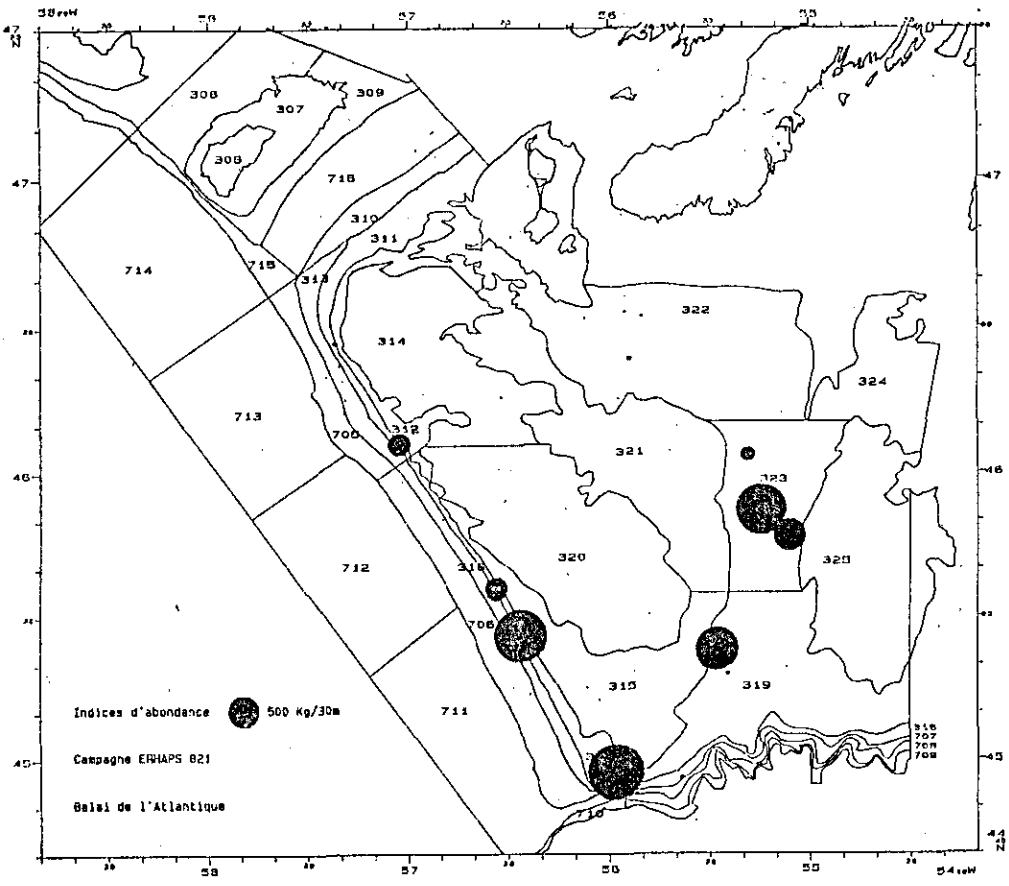
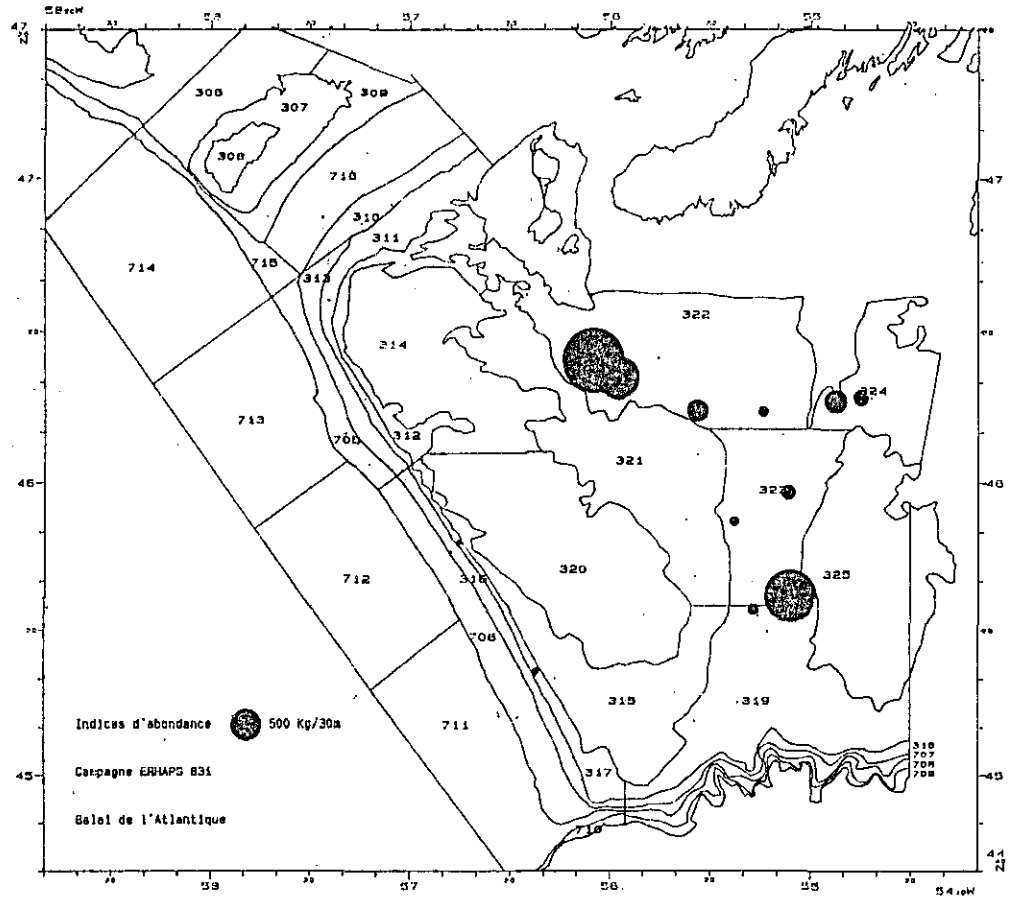


Figure 4 - Cartography of abundance estimate in biomass (kg/30 mn) by trawling set for American plaice in Subdivision 3 Ps for 1981 and 1982.



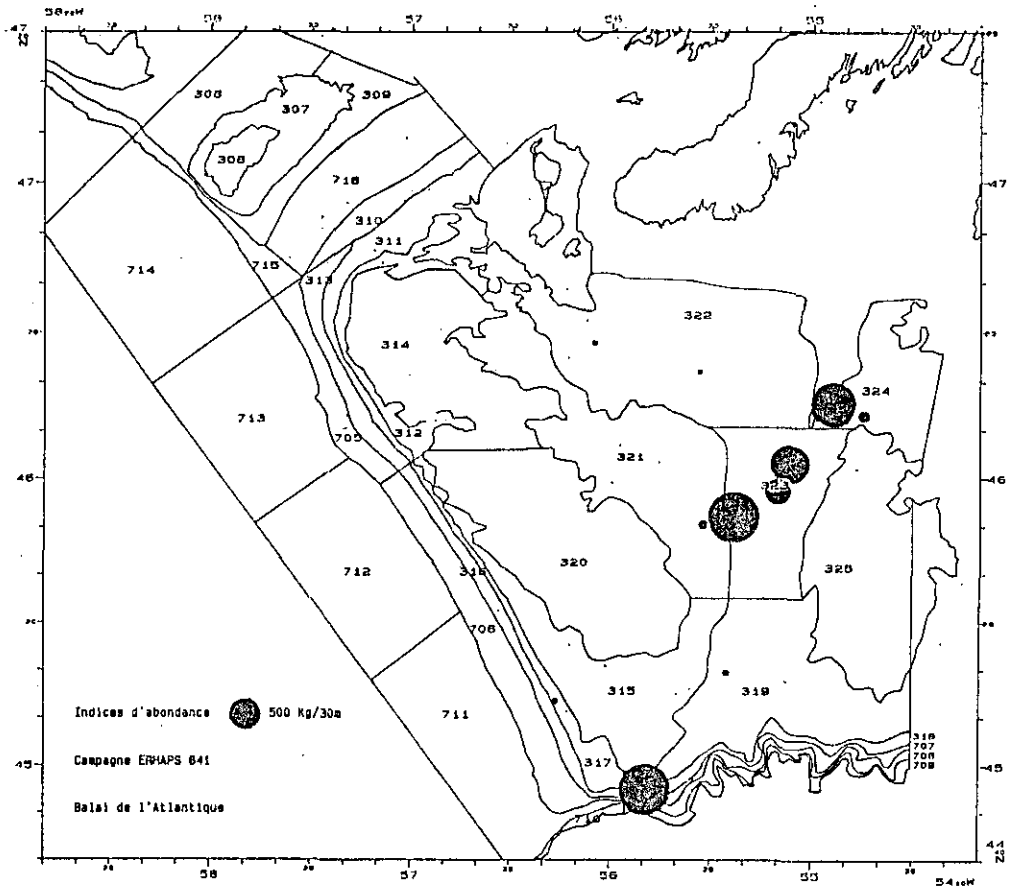
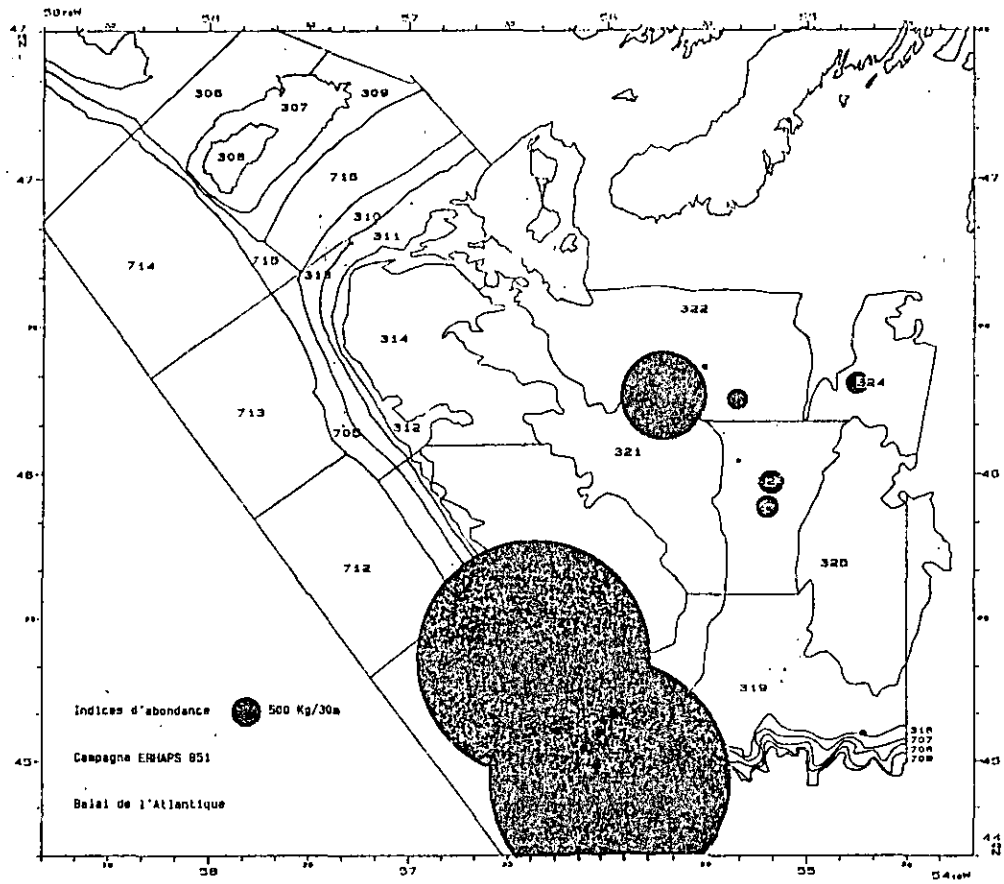


Figure 5 - Cartography of abundance estimate in biomass (kg/30 mn) by trawling set for American plaice in Subdivision 3 Ps for 1983 and 1984.



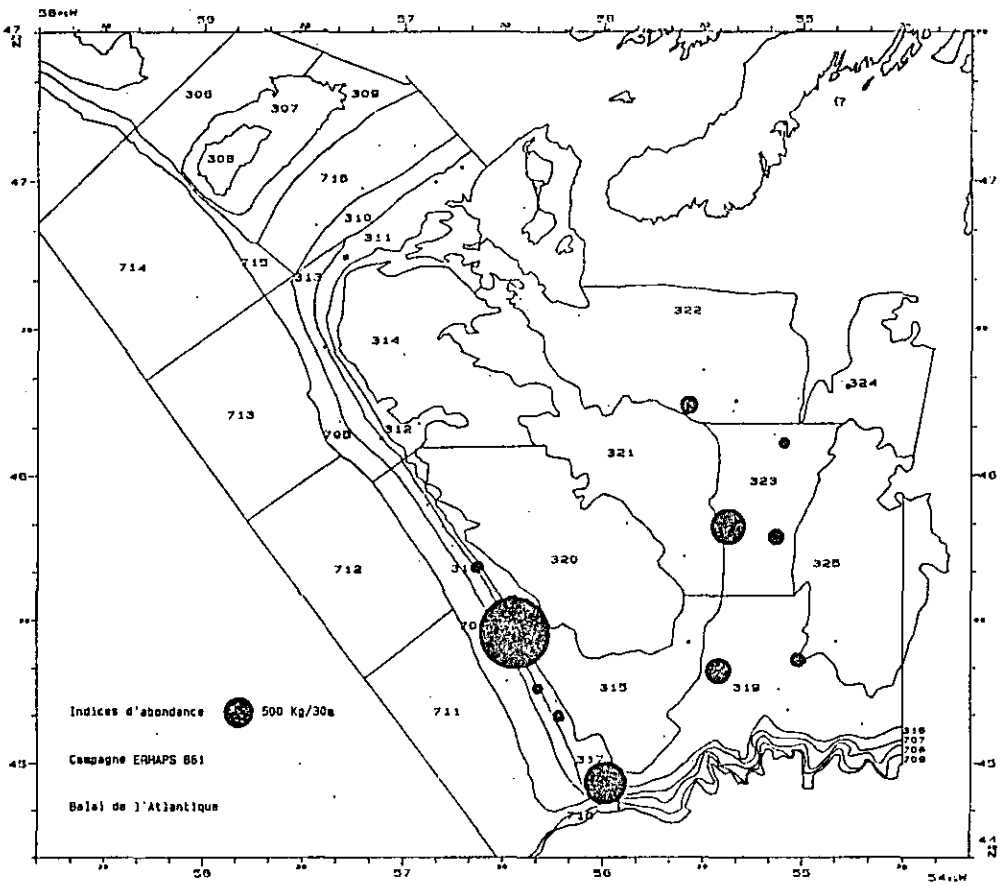
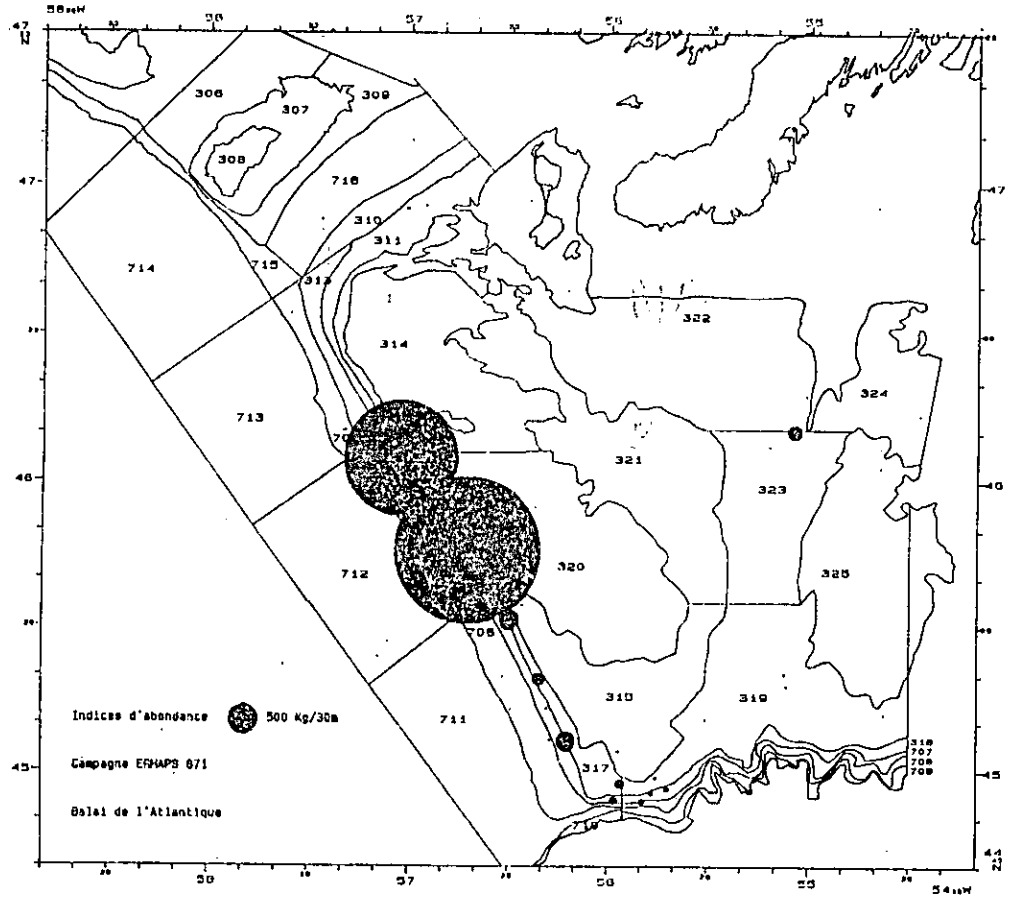


Figure 6 - Cartography of abundance estimate in biomass (kg/30 mn) by trawling set for American plaice in Subdivision 3 Ps for 1985 and 1986.



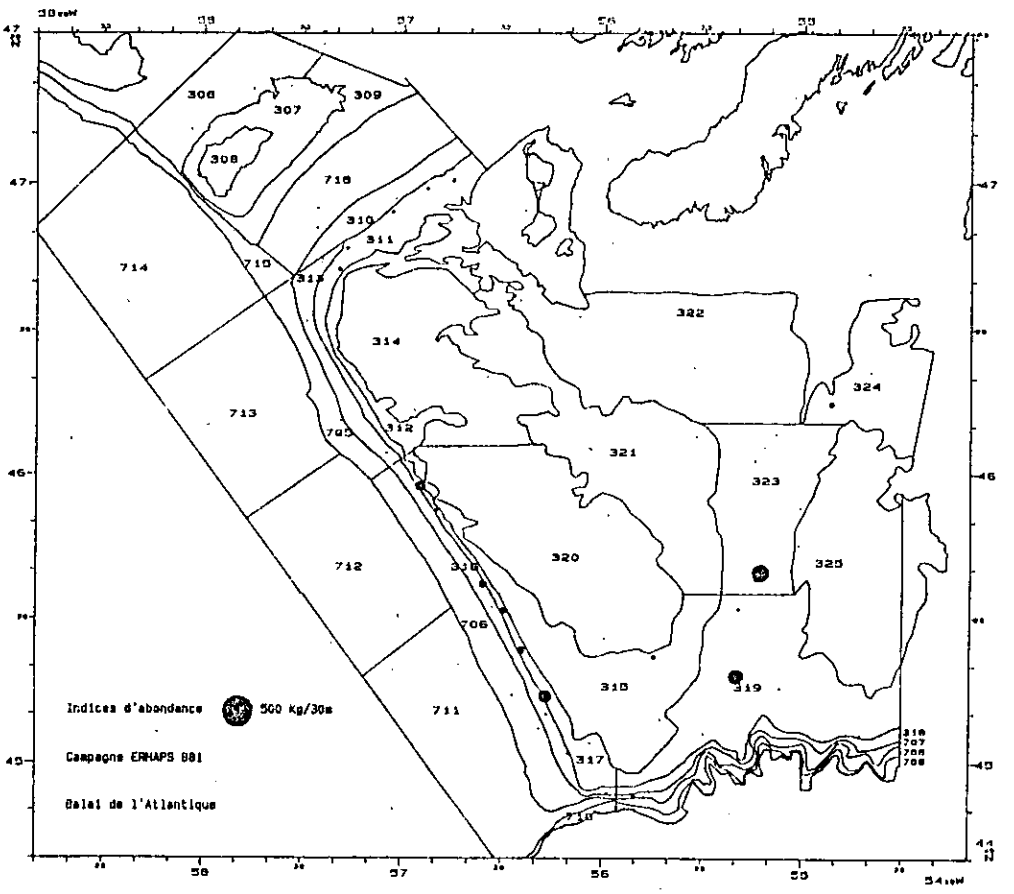
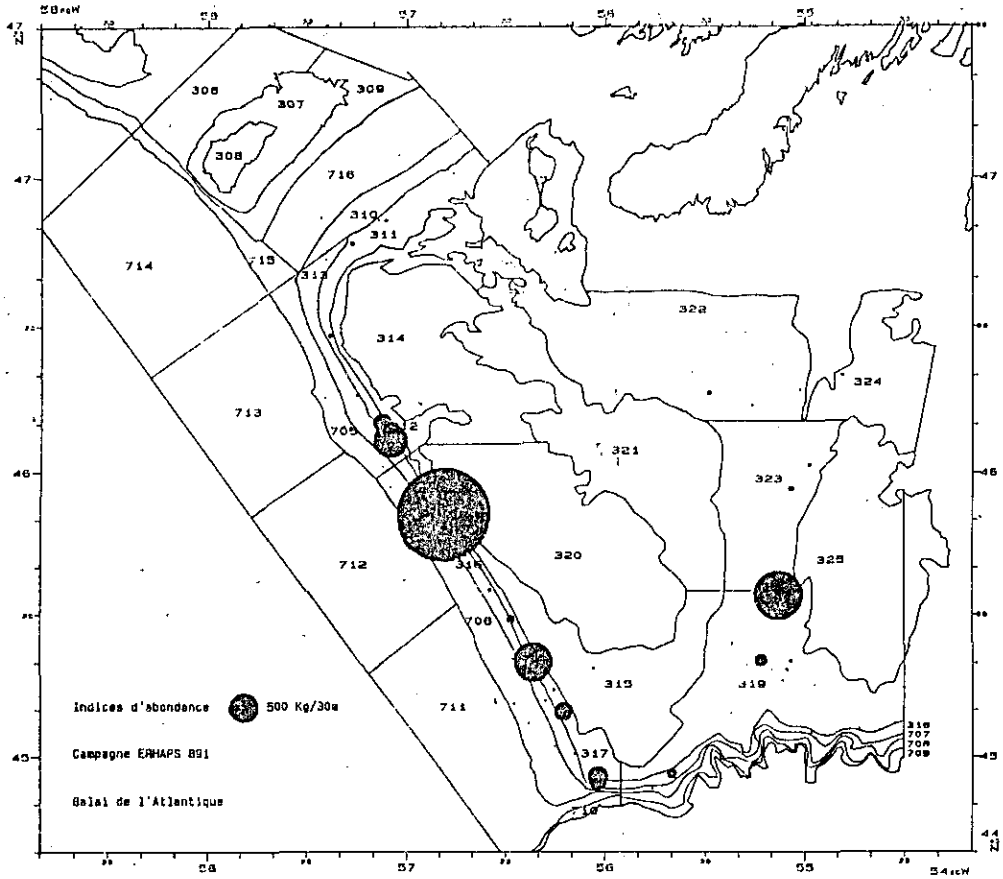


Figure 7 - Cartography of abundance estimate in biomass (kg/30 mn) by trawling set for American plaice in Subdivision 3 Ps for 1987 and 1988.



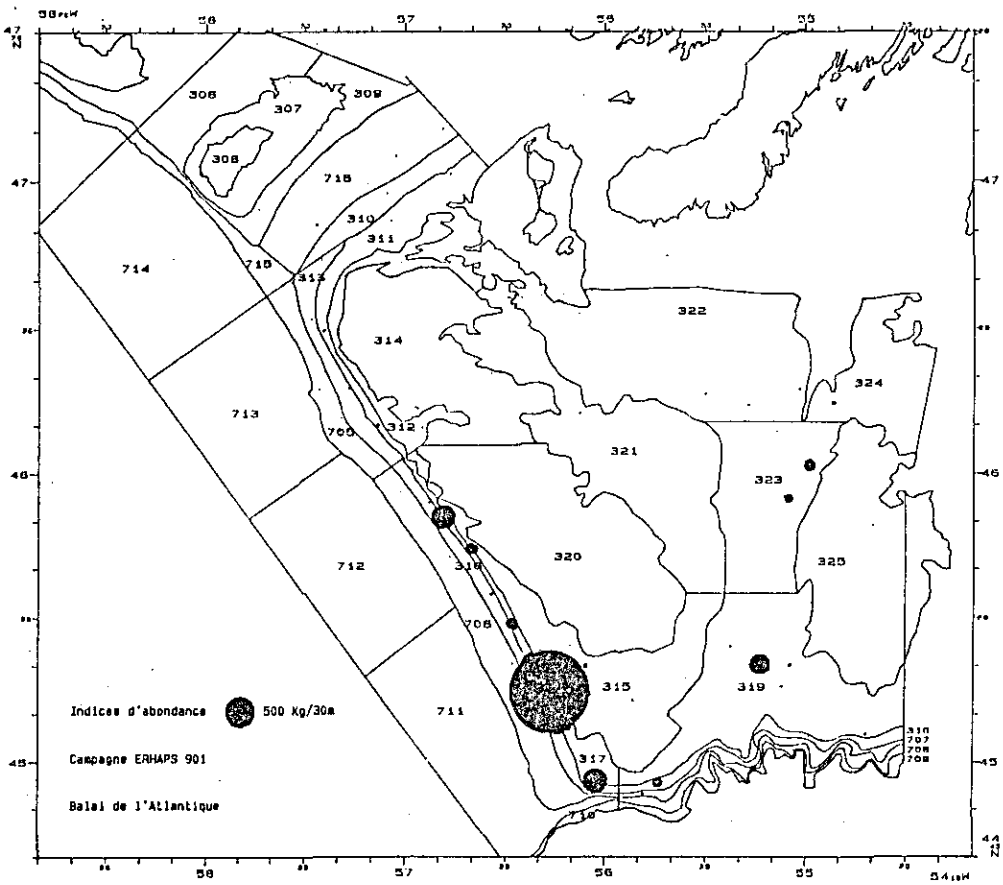


Figure 8 - Cartography of abundance estimate in biomass (kg/30 mn) by trawling set for American plaice in Subdivision 3 Ps for 1989 and 1990.

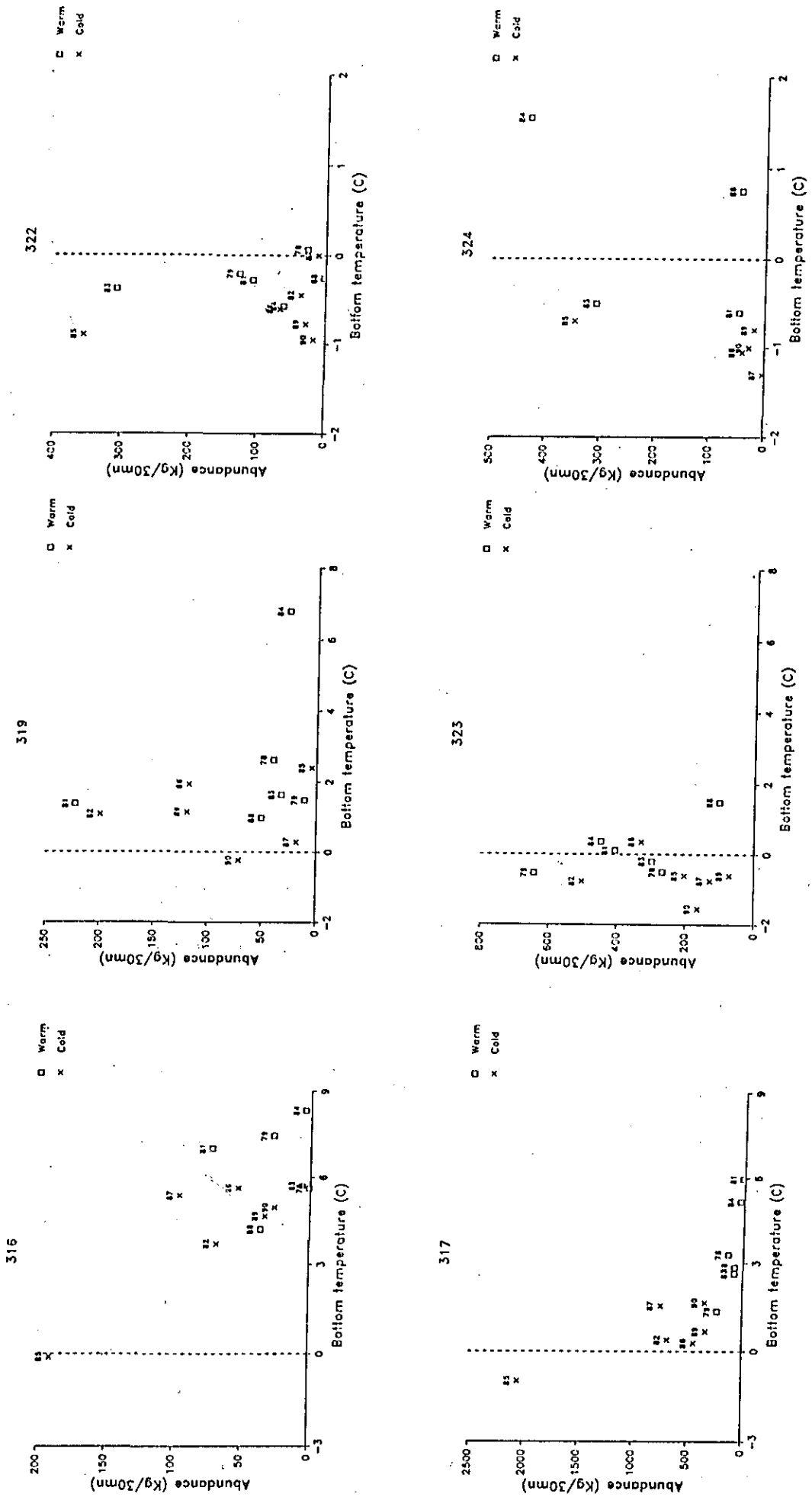


Figure 9 - Relation between bottom temperature (average for the stratum) and average abundance estimate in biomass (kg/30 mn) for American plaice in strata 316, 317, 319, 323, 322 and 324 from 1978 to 1990.