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Median Length at 50% Maturity of Atlantic Cod in Subdivision 3Ps: Year to Year Variations and Comparison of Samples From Burgeo Bank, St. Pierre Bank and South Slope

by

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Introduction

The determination of size and age at sexual maturity is of major importance in conducting stock assessment being the link between individual growth and reproductive potential of a population. The median length at 50 % maturity (L50) of a particular stock is dependent on environmental condition and rate of exploitation. The evolution of this parameter over the years can be of interest in evaluating the level of exploitation of a population by fisheries but also, in areas of probable intermingling of two different populations, a fine analysis of the parameter could help in determining the extent of the mixing, conditionwise that the individual stocks show significantly different values of median length at maturity. Data collected on cod maturity during the french research surveys conducted annually from 1978 to 1992 in Subdivision 3Ps were analysed first to identify a trend over the period and second to compare the values of the parameter in two areas of possible intermixing : the Burgeo Bank (mixing with cod stock from the Gulf of St-Lawrence - Divisions 4RS) and the South Slope of the Halibut Channel (possible mixing with cod stock from the Gand Bank -Division 3O).

Materials and Methods

Data analysed in this paper were collected during the french winter research surveys in Subdivision 3Ps from 1978 to 1992 (no sufficient data were available for the years 1980 and 1990). The standard process in conducting french groundfish surveys has been describred by Forest and Minet (1981). All the measured cods are grouped in maturity classes using the scale described by Homans and Vladykov (1954). The median length at sexual maturity (L50) was calculated by probit analysis following the method described by Leslie *et al.* (1945). The area sampled was divided in three zones (Fig.1), two of them grouping samples taken from strata where intermingling with neighbouring stocks could occur, further referenced in the publication as follows :

Burgeo : strata 306, 307, 308, 309,714, 715, possible mixing with cod stock from the Gulf of St-Lawrence,

South Slope : strata 318, 707, 708, possible mixing with cod stock from the Grand Bank.

St-Pierre Bank : remaining strata from the rest of the Subdivision 3Ps.

Results and discussion

Year to year evolution of the median length at 50 % maturity

Mean length at maturity computed annually for each of the areas above referenced are given in table 1 provided that sufficient data where available to give significant figures. The values obtained from strata of the St-Pierre Bank are plotted against the year of survey (Fig. 2) to

show the evolution of the parameter in an area where the possibility of intermixing with other population is low, and could therefore be considered as an intrinsic component of the 3Ps cod stock. The mean date of survey is also plotted with scale inversed.

After a drop from 1978 to 1981, the mean length at maturity has somewhat increased from 1982 to 1988 to decrease again from 1989 to 1992. However if we take into account the mean date of observation, it seems obvious that the time of the year has an effect on the determination of the L50. The surveys were all carried out at a period of the year where maturation is in process and the younger individuals being about to reach their first maturity could fall into the mature category from one week to another with no substantial growth.

In order to have a better estimation of the year to year variation of the median length at maturity, observation should be made later in the spring, at a time when the process of maturation has been achieved most completely.

Median length at 50 % maturity per area

Provided that a sufficient number of individuals has been examined in each of the three areas defined previously and presented in figure 1, the L50 for each sex, area and year were computed and the results are presented in table 1 and figure 3 with their 95% confidence limits.

Considering both males and females data, differences between the South slope and the St-Pierre Bank values were not identified except for the year 1991. The continuity of the South slopes between Subdivision 3Ps and Division 3O and the presence of good catches located just at the border of the two areas (Fig. 14), could lead us to think that some of the cod sampled this year in this area was coming from the stock of Division 3O.

Comparison between Burgeo Bank and St-Pierre Bank values shows significant differences for the years 1984, 1986 to 1991 (1990 excluded, no data being available). As it has already been assumed by Mabeau *et al.*,(1986), this could be due to the presence on the Burgeo Bank of cod migrated from the Gulf of St-Lawrence where the length at 50 % maturity is lower than the values observed on the St-Pierre Bank.

A more detailed analysis of the Burgeo Bank area and neighbouring strata was carried out for the years where sufficient individuals have been sampled. Mean length at maturity per stratum or group of strata were calculated for each sex for the years 1981 to 1984 (Fig. 4a to 4h) and the years 1986 to 1989 (Fig. 5a to 5h). No detailed analysis was carried out for the year 1991 since about all of the cod was sampled in stratum 714. Weight per set were plotted to show the distribution of cod estimated for these years from the french groundfish surveys (Fig 6 to 14).

In the years 1981 to 1983, where no significant differences were noted in the values computed for the Burgeo Bank strata and the St-Pierre Bank, the detailed figures show that the values estimated for the northwest strata of the Burgeo Bank (306 and 307) are somewhat lower than the ones estimated for the remaining strata. This could indicate that mixing with cod from the Gulf of St-Lawrence occured, but at a low level.

The values estimated for the years 1984, 1986 to 1989 and 1991 where significantly different for the Burgeo Bank and the St-Pierre Bank. The detailed analysis for the years 1984 (Fig. 4g and 4h), 1986 to 1989 (Fig. 5a to 5h) shows that the lowest values are again found in the strata 306 and 307. The mean length at maturity increases as we look at the values for the strata located closer to the Hermitage channel (stratum 716).

The years 1986 and 1988 were particularly interesting since concentrations of cod were found on Burgeo Bank and on the northwest slope of the St-Pierre Bank (Fig. 10 and 12). One could assume that cod from the Gulf of St-Lawrence would have entered Burgeo Bank down to the nothwest slope of the St-Pierre Bank. However, the median lengths at 50 % maturity calculated for each stratum of these areas show that the Northwest Slope values (strata 310 and 311) are similar to the one computed for the St-Pierre Bank and significantly different from the ones of the northwest part of the Burgeo Bank (strata 306 and 307). In 1986, the values estimated for the strata 309 and 715 lied in between the values of strata 306-307 and the ones estimated for the strata 310-311 and St-Pierre Bank. In 1988, the L50 computed for the stratum 309 is similar to the stratum 306 value and the cod sampled in the Hermitage Channel (stratum 716) showed a L50 similar to the one estimated for St-Pierre Bank. These results could lead us to think that whenever cod from the Gulf of St-Lawrence migrates to the Burgeo Bank, its favoured areas are mostly restricted to the Northwest part of it (strata 306-309 and northern parts of strata 714-715).

Conclusion

The analysis of mean length at 50 % maturity of the cod sampled during the late winter french research surveys showed that if the year to year evolution could not be pointed out due to the period of observation, years of intermingling with neighbouring stocks were identified, especially on Burgeo Bank.

The comparison between the samples from St-Pierre Bank and the South Slope did not show significant differences except for the year 1991.

The detailed analysis of the Burgeo Bank samples showed that the method of comparing the L50 parameter in area of intermingling gives a fair indication of the importance of migration from a neighbouring stock, provided that the two stock's intrinsic values are significantly different.

An annual comparison with samples from all the neighbouring stocks would be of most interest in order to achieve a better analysis.

References

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MABEAU S., J. C. POULARD and J. C. MAHE. 1986. Research survey abundance indices for the cod stock in NAFO Subdivision 3Ps; their reliability and compatibility with results of a cohort analysis. *I.C.E.S.* CM/1986-G: 38, 21 p.

Males	Burgeo		St-Pierre Bank		South slope	
Year	L 50	Nb.	L 50	Nb.	L 50	Nb.
1978	53.26 (51.67-54.85)	257	54.52 (52.00-57.04)	247		
1979	52.39 (51.31-53.47)	258	49.80 (49.00-50.60)	485	53.73 (51.50-55.96)	89
1981	47.87 (46.22-49.52)	566	48.62 (46.73-50.51)	1039		
1982	50.63 (49.74-51.52)	630	51.56 (50.70-52.42)	2023	55.32 (53.57-57.07)	222
1983	51.46 (50.39-52.53)	653	53.50 (52.36-54.64)	1901	55.12 (43.08-67.16)	127
1984	50.94 (49.00-52.88)	553	56.65 (55.21-58.09)	1848		
1985	55.42 (53.02-57.82)	364	55.11 (53.85-56.37)	1557	59.65 (58.36-60.94)	455
1986	46.38 (44.59-46.38)	1220	56.26 (55.19-57.33)	2126	59.83 (56.96-62.70)	471
1987	52.50 (51.51-53.49)	733	57.72 (56.72-58.72)	1973	56.05 (54.54-57.56)	216
1988	51.89 (49.72-54.06)	541	57.28 (55.25-59.31)	3181	58.50 (56.17-60.83)	380
1989	48.59 (47.27-49.91)	1634	54.10 (51.59-56.61)	2710	58.70 (54.71-62.69)	286
1991	43.94 (42.59-45.29)	1230	49.08 (46.56-51.60)	758	62.29 (58.22-66.36)	700
1992	37.30 (33.83-40.77)	290	53.01 (48.89-5713)	558	56.48 (54.05-58.91)	305

Females	Burgeo		St-Pierre Bank		South slope	
Year	L 50	Nb.	L 50	Nb.	L 50	Nb.
1978	59.87 (58.26-61.48)	315	61.97 (58.89-65.05)	235		
1979	56.04 (54.43-57.65)	339	54.69 (53.49-55.89)	549	54.73 (52.60-56.86)	97
1981	50.43 (49.74-51.12)	682	52.46 (50.79-54.13)	1135		
1982	53.67 (52.29-55.05)	763	52.62 (51.68-53.56)	2110	53.24 (51.21-55.27)	227
1983	53.57 (52.76-54.38)	827	56.64 (50.43-62.85)	2008	58.86 (56.77-60.95)	126
1984	56.46 (55.04-57.88)	656	60.55 (59.24-61.86)	1804		
1985	53.00 (51.60-54.40)	401	55.55 (54.39-56.71)	1694	55.52 (54.07-56.97)	517
1986	50.05 (48.69-51.41)	1309	57.31 (56.26-53.86)	2247	57.74 (56.30-59.18)	442
1987	54.38 (53.52-55.24)	859	57.91 (57.15-58.67)	1845	55.23 (53.33-57.13)	217
1988	56.84 (55.59-58.09)	647	61.31 (59.27-63.35)	3989	59.57 (58.73-60.41)	335
1989	54.74 (53.39-56.09)	1813	61.81 (60.25-63.37)	2902	64.66 (61.90-67.42)	294
1991	51.24 (49.94-52.54)	1341	56.10 (54.15-58.05)	769	62.88 (60.18-65.58)	727
1992	56.83 (48.32-65.34)	197	57.15 (50.63-63.67)	562	57.71 (53.55-61.87)	290

Table 1 - Median length at 50 % maturity of Atlantic cod per sex and area of Subdivision 3Ps from french research survey from 1978 to 1992 (no data available for the years 1980 and 1990, numbers in parenthesis indicate 95 % confidence limits).

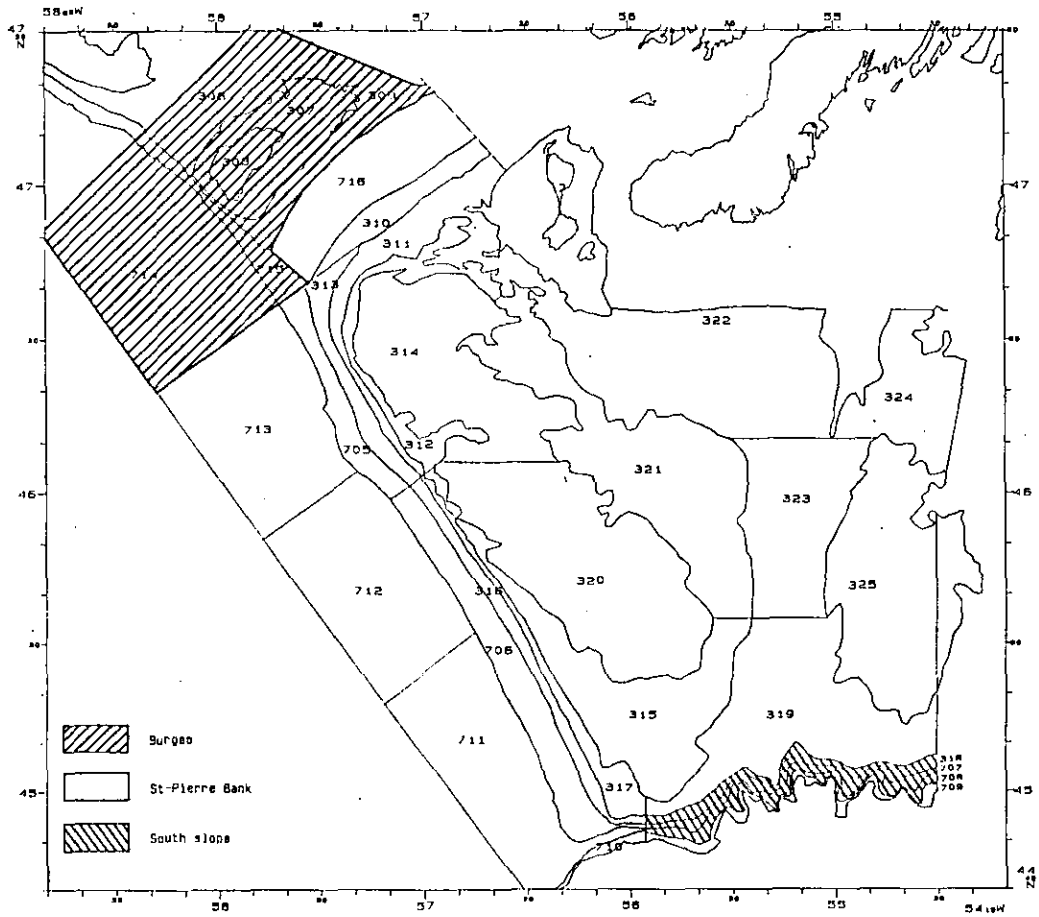


Figure 1 - Map of the area covered by the french research surveys in NAFO subdivision 3Ps showing the location of the cod sampling areas.

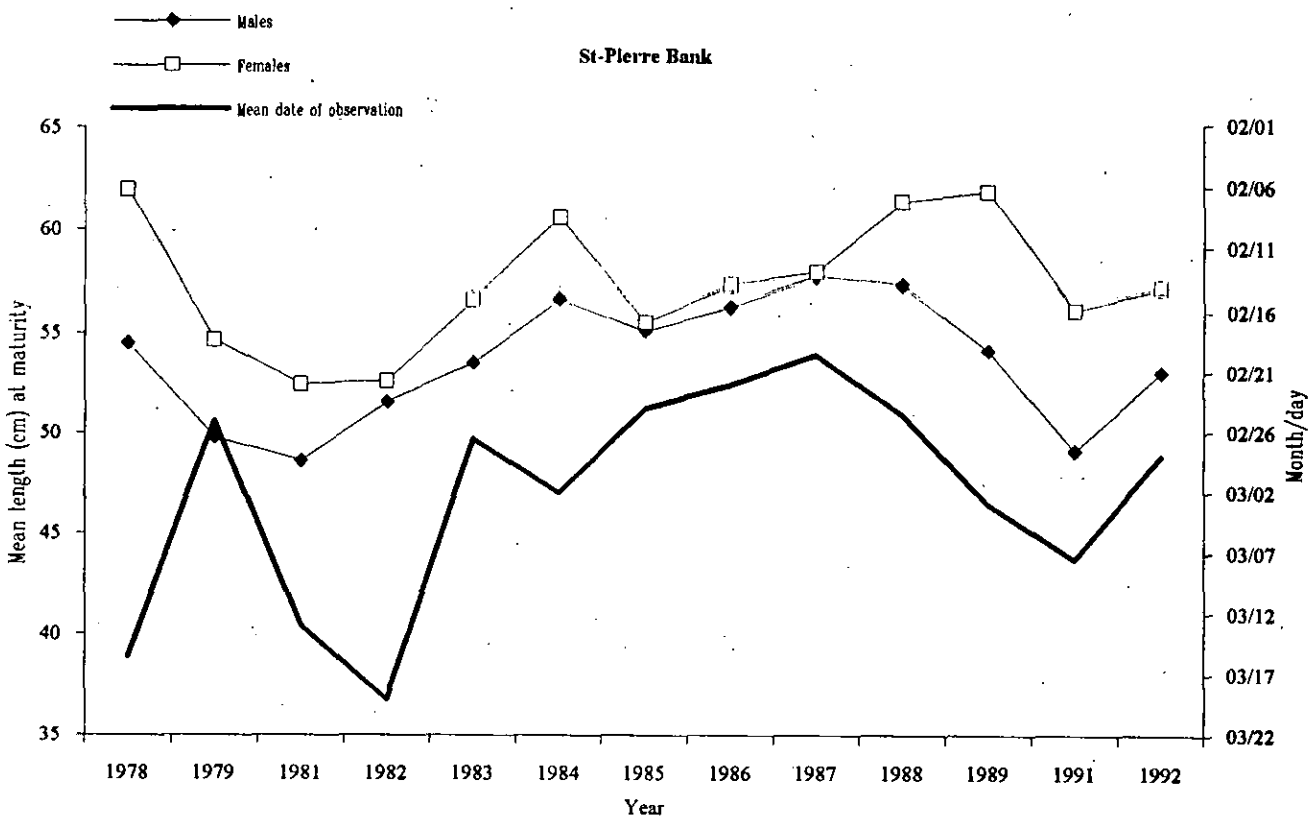
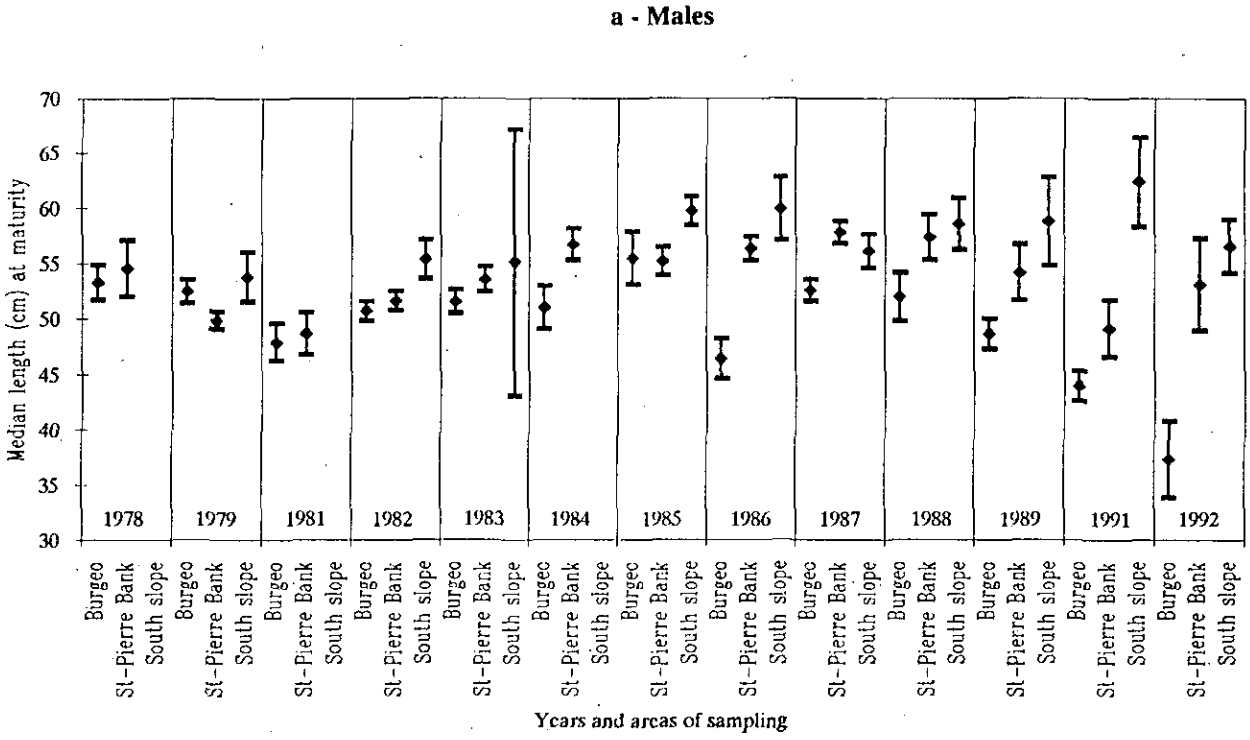


Figure 2 - Evolution of the median length at maturity (cm) for cod sampled in the St-Pierre Bank area from 1978 to 1992 (1980 and 1990 excluded) in relation with the mean date of observation.



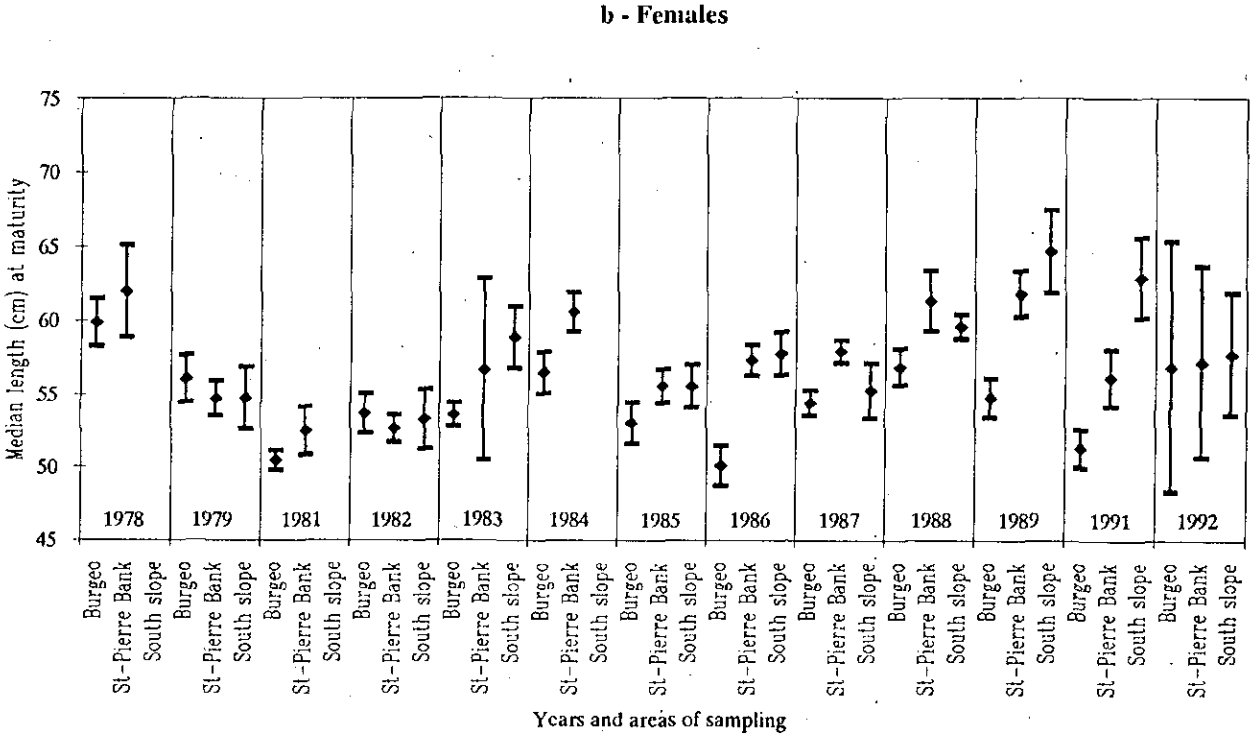


Figure 3 - Median length at maturity for Atlantic cod in Subdivision 3Ps per sex, year and area of sampling for the years 1978 to 1992 (no data available for the years 1980 and 1990). Vertical bars indicate 95 % confidence limits.

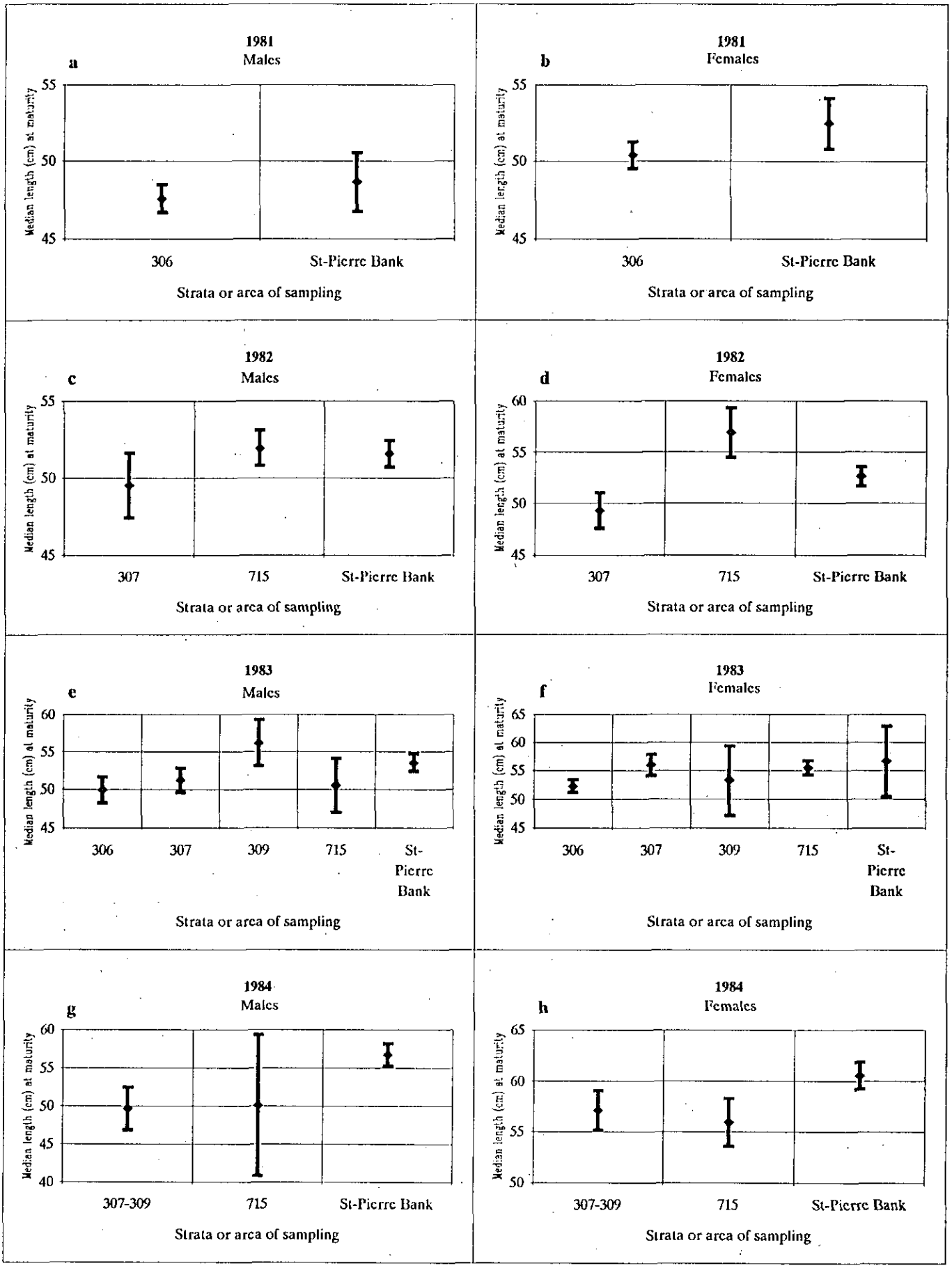


Figure 4 - Median length at maturity for Atlantic cod in Subdivision 3Ps per sex, stratum or area of sampling for the years 1981 to 1984. Vertical bars indicate 95 % confidence limits.

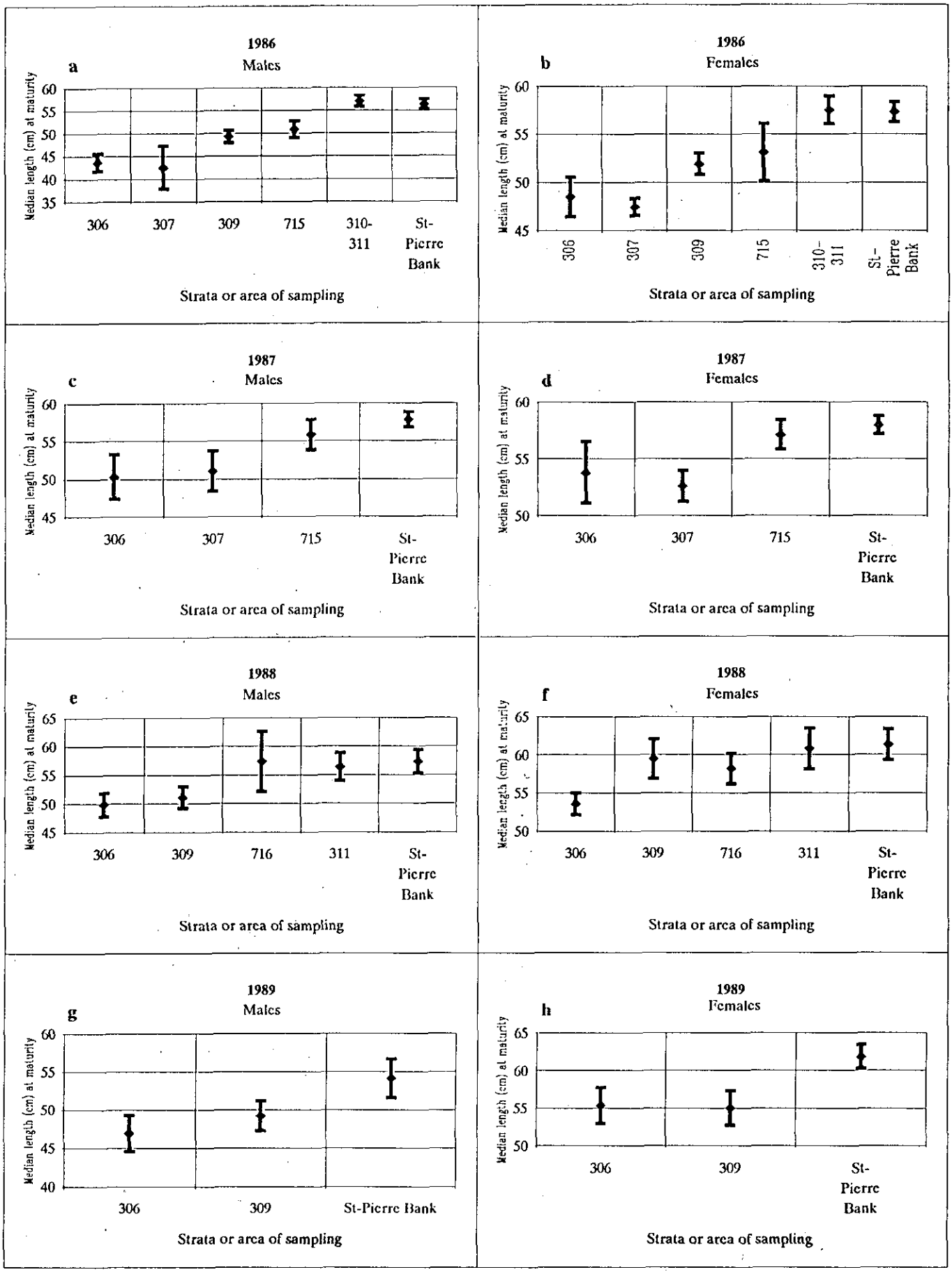


Figure 5 - Median length at maturity for Atlantic cod in Subdivision 3Ps per sex, stratum or area of sampling for the years 1986 to 1989. Vertical bars indicate 95 % confidence limits.

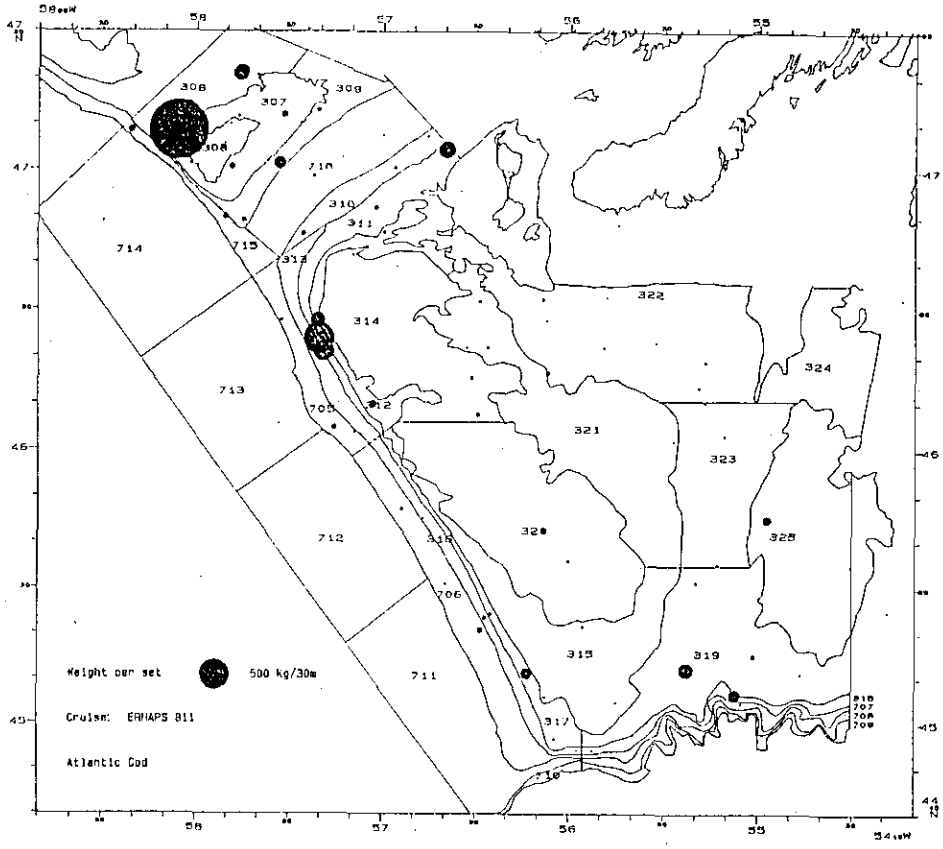


Figure 6 - Distribution of Atlantic cod in Subdivision 3Ps from french research survey in late winter 1981.

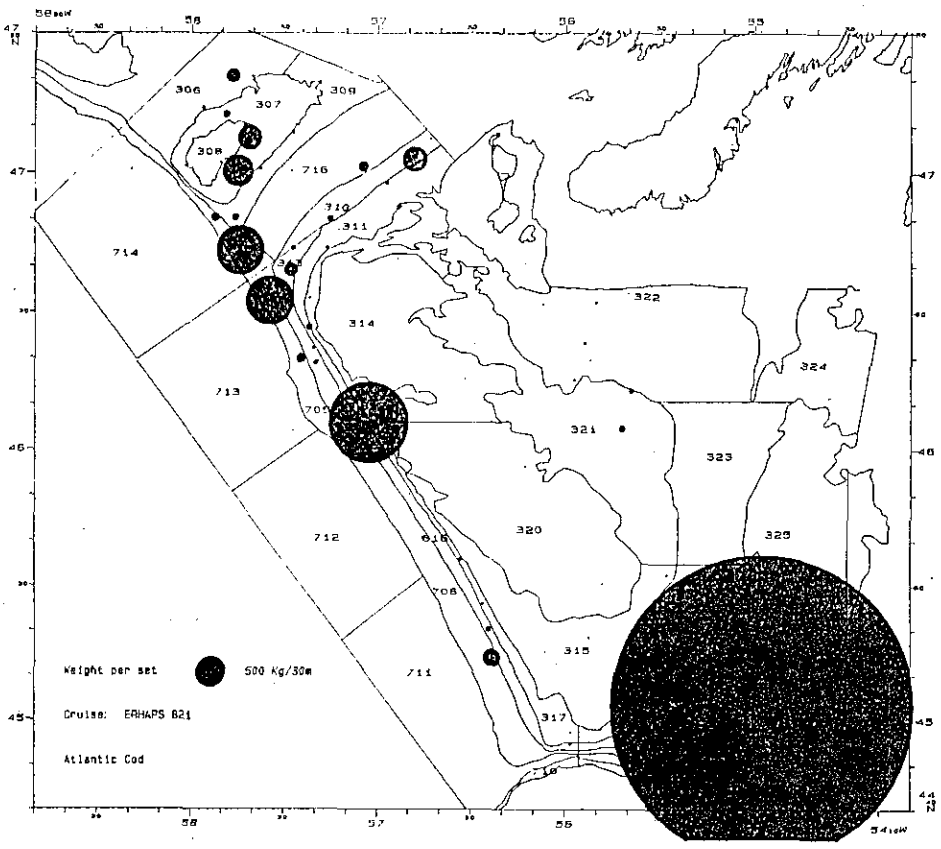


Figure 7 - Distribution of Atlantic cod in Subdivision 3Ps from french research survey in late winter 1982.

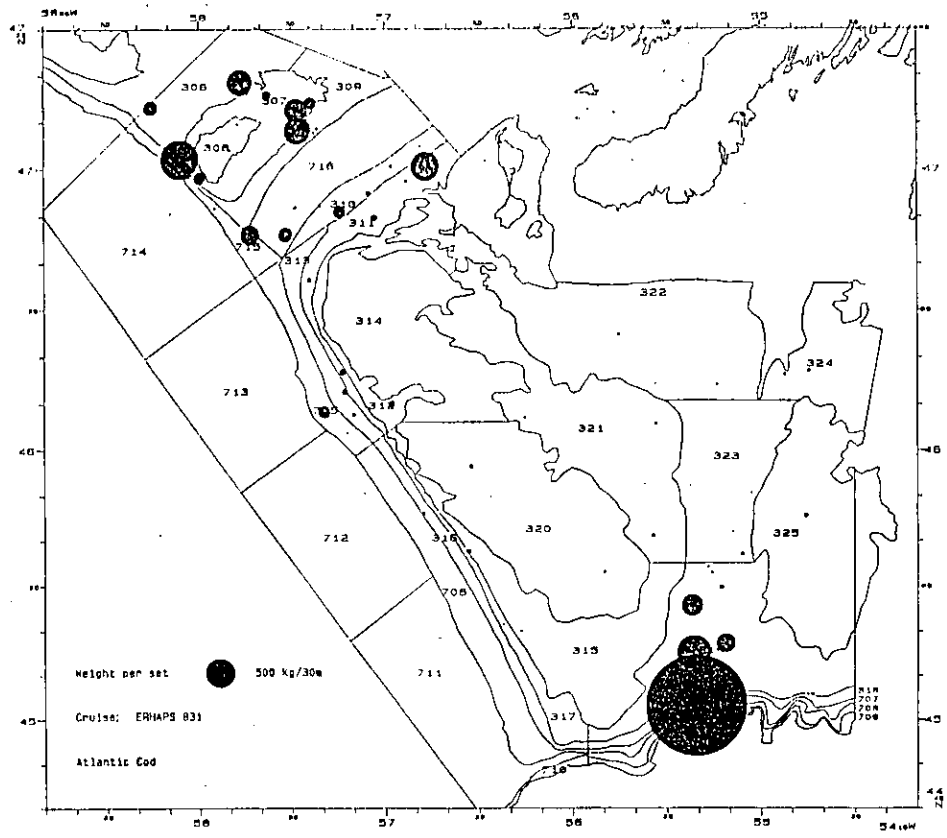


Figure 8 - Distribution of Atlantic cod in Subdivision 3Ps from french research survey in late winter 1983.

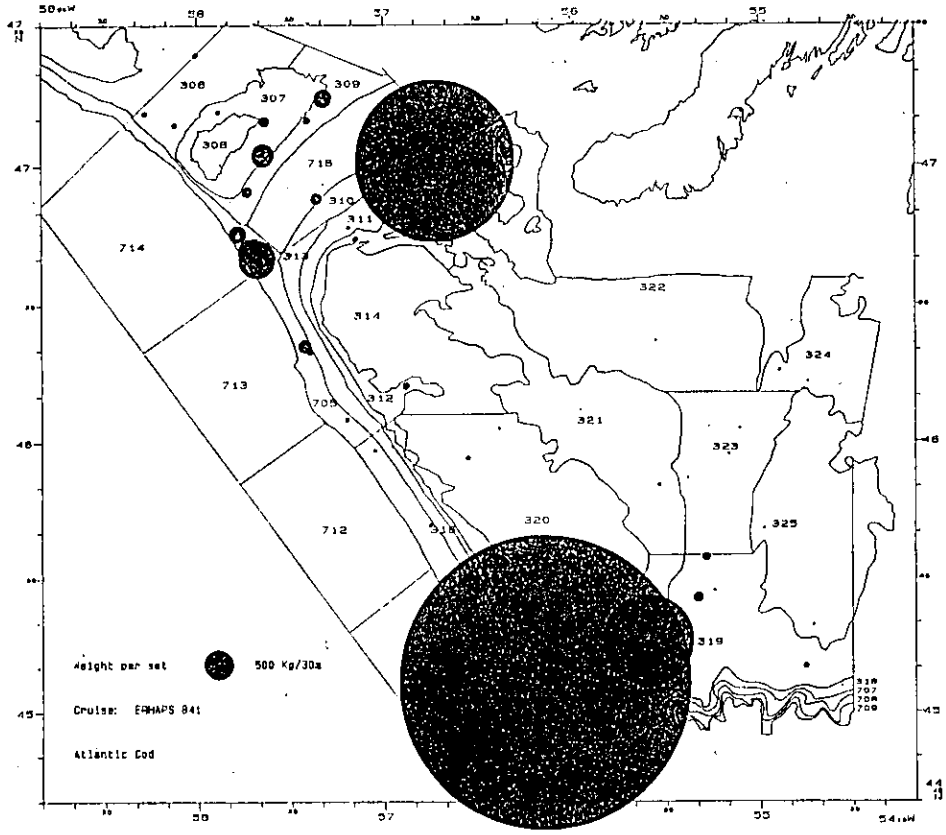


Figure 9 - Distribution of Atlantic cod in Subdivision 3Ps from french research survey in late winter 1984.

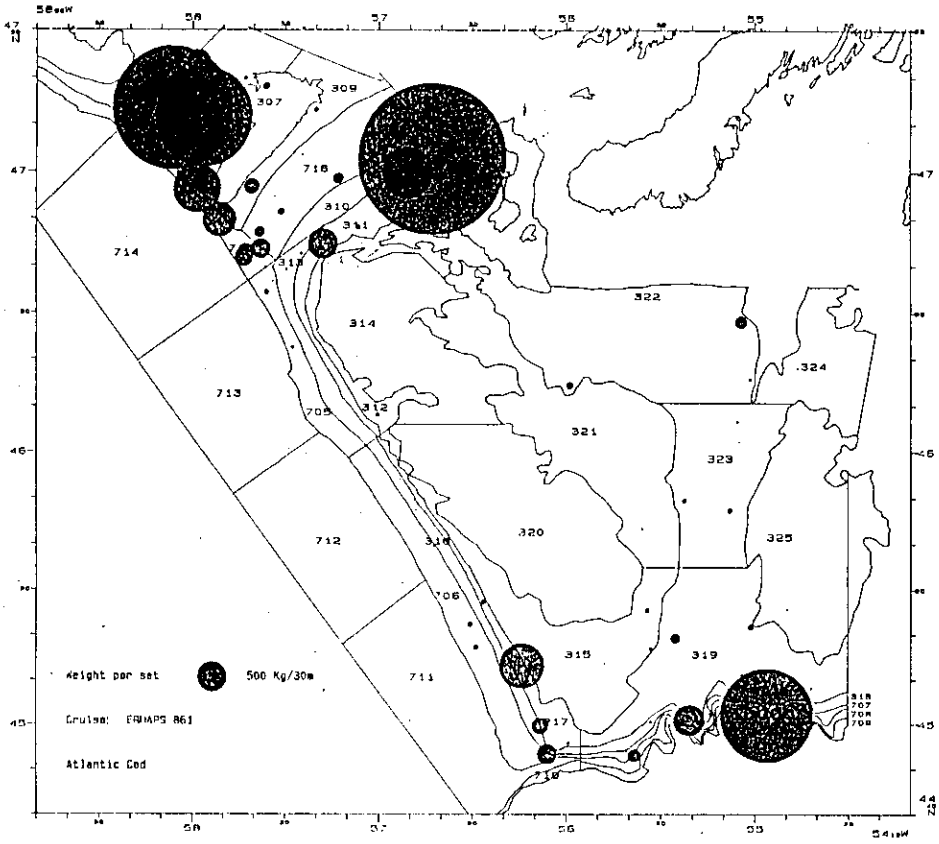


Figure 10 - Distribution of Atlantic cod in Subdivision 3Ps from french research survey in late winter 1986.

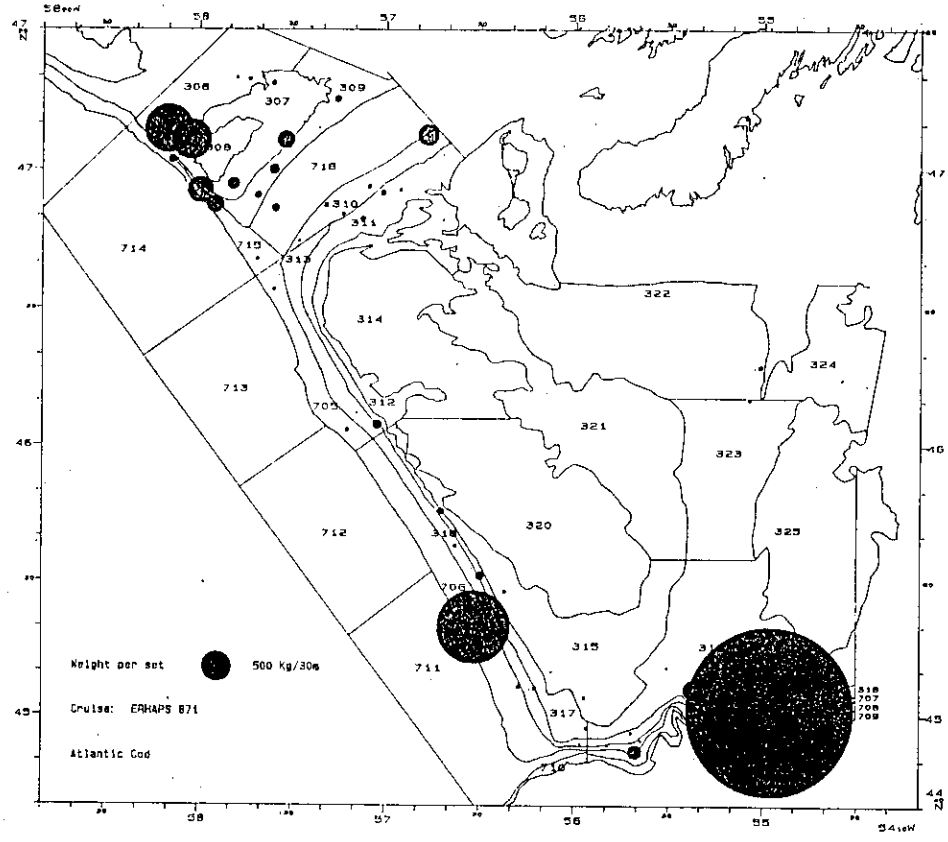


Figure 11 - Distribution of Atlantic cod in Subdivision 3Ps from french research survey in late winter 1987.

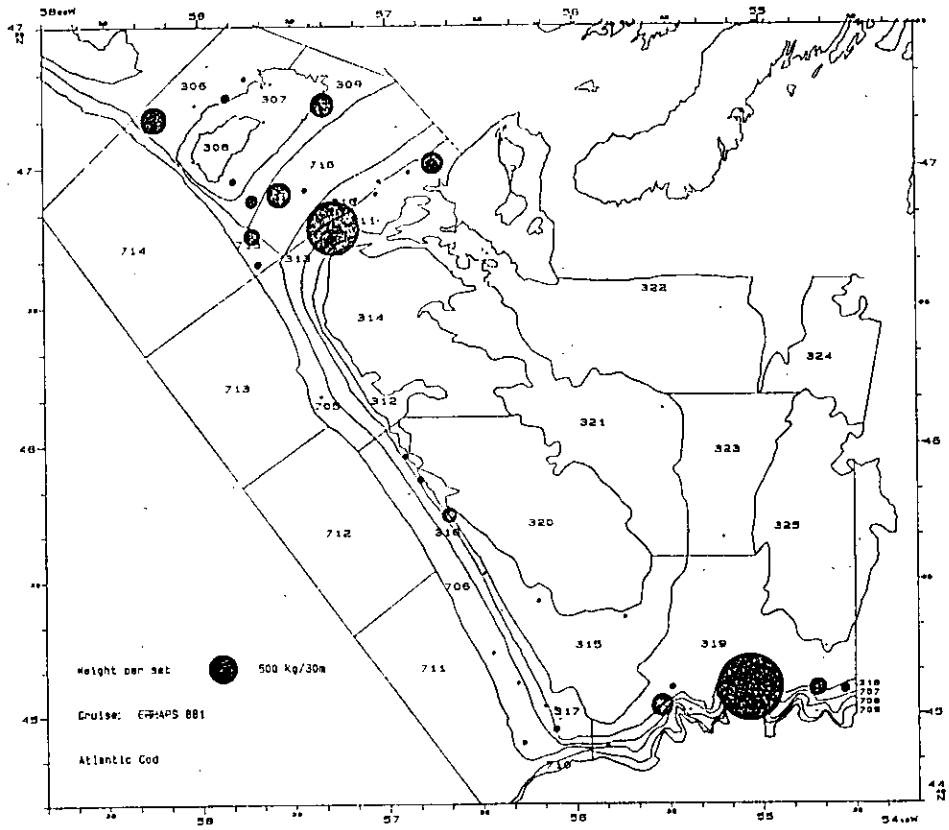


Figure 12 - Distribution of Atlantic cod in Subdivision 3Ps from french research survey in late winter 1988.

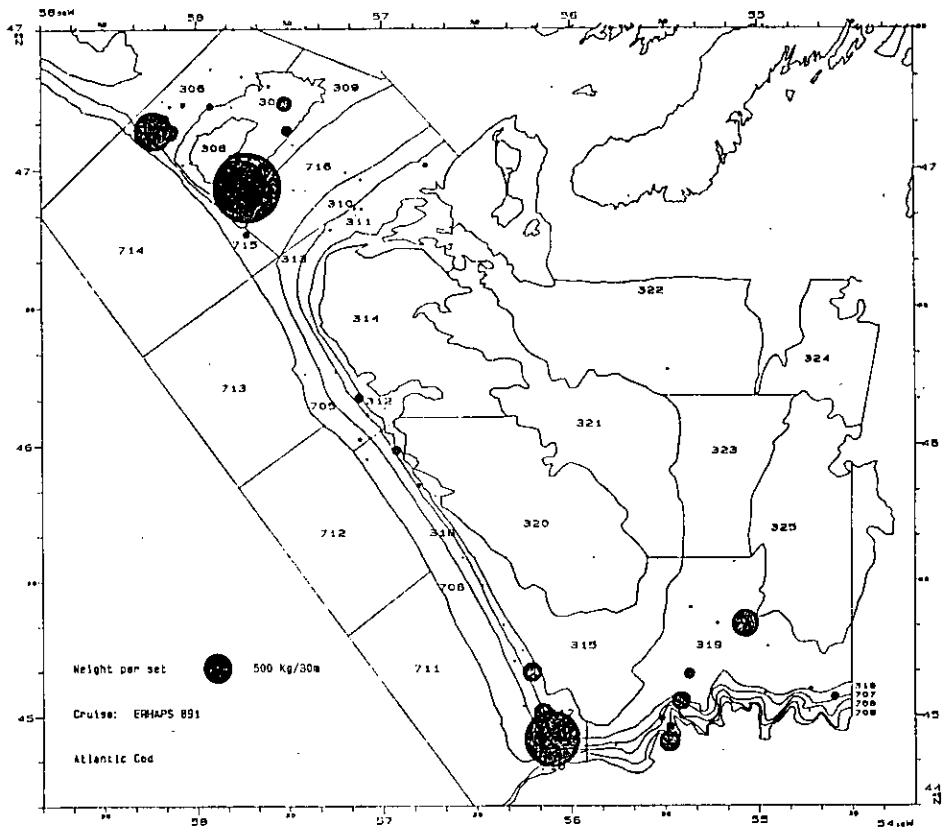


Figure 13 - Distribution of Atlantic cod in Subdivision 3Ps from french research survey in late winter 1989.

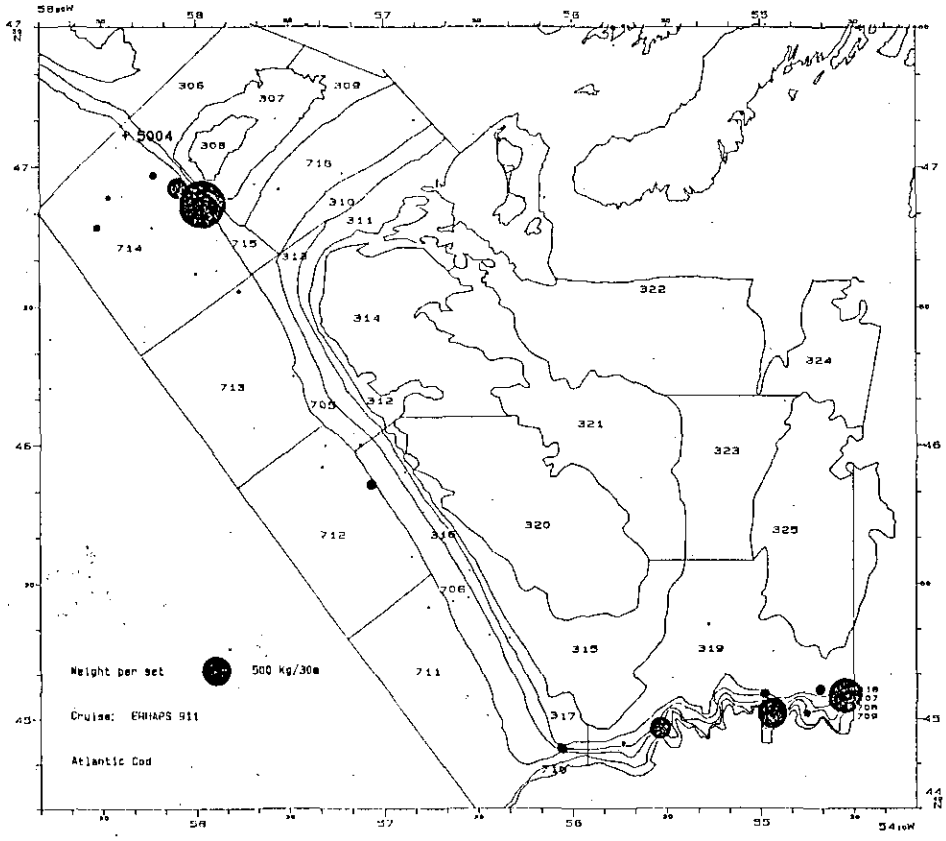


Figure 14 - Distribution of Atlantic cod in Subdivision 3Ps from french research survey in late winter 1991.