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AN ASSESSMENT OF THE COD STOCK IN NAFO SUBDIVISION 3Ps

by

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Abstract

Catches of cod from NAFO Subdiv. 3Ps have ranged from a high of 84,000t in 1961 to a low of 27,000t in 1978. Since 1976 catches have been obtained only by Canada and France and, in recent years, total catches have been relatively stable at about 42,000t. Research vessel indices of abundance from Canadian and French surveys were used on a disaggregated basis in a single ADAPT calibration analysis to estimate fishing mortality and stock size for 1991. The assessment indicated that the fully recruited (ages 7-9) fishing mortality in 1991 was about 0.30. The age 3+ biomass at the beginning of 1991 was estimated to be about 300,000t, among the highest observed in the time series. Surveys by both Canada and France in the winter of 1992 suggested a substantial decline in cod biomass and abundance. It has not been determined whether this decline was due to distributional changes or represents an actual stock decline.

Résumé

Les prises de morue dans la subdivision 3Ps de l'OPANO se sont échelonnées entre un maximum de 84 000 t en 1961 et un minimum de 27 000 t en 1978. Depuis 1976, ces prises proviennent exclusivement de navires canadiens et français. Ces dernières années, les prises totales ont été relativement stables, se situant autour de 42 000 t. On a utilisé les indices d'abondance obtenus lors des campagnes d'évaluation effectuées par les navires scientifiques canadiens et français, sous forme désagrégée, dans une seule analyse d'étalonnage ADAPT afin d'estimer la mortalité due à la pêche et la grosseur du stock pour 1991. L'évaluation a révélé que la mortalité due à la pêche dans le stock pleinement recruté (âges 7-9) était d'environ 0,30 en 1991. On a chiffré à environ 300 000 t la biomasse d'âge 3 + au début de 1991, ce qui représente le plus haut niveau de la série chronologique. Les campagnes d'évaluation réalisées par le Canada et par la France en hiver 1992 dénotent un fléchissement important de la biomasse et de l'abondance de la morue. On n'a pas déterminé si celui-ci était dû à des changements dans la distribution ou s'il correspondait à une baisse réelle du stock.

Introduction

Nominal catches have ranged from a high of 84,000t in 1961 to a low of 27,000t in 1978 (Table 1, Fig. 1). Catches were highest from 1959 to 1974 (Ave. 62,000t) but declined to about 35,000t in 1975, a general level that persisted until 1984. From 1985 to 1987, catches averaged 55,000t mainly due to increased catches by France. Catches have been relatively stable at about 42,000t since 1987.

Since 1976 only Canada and France have participated in the fishery. Catches by inshore gears (trap, gillnet, longline and handline) have traditionally accounted for the largest portion of the total Canadian catches and these have ranged between 20,000t and 29,000t since 1976. The 1991 inshore landings were slightly higher than those for 1990 (Table 1). The longline fishery obtains the largest portion of the total inshore catch followed by gillnet, trap and handline (Figure 2). Both longline and trap catches increased slightly in 1991 while both gillnet and handline declined. French catches since 1959 have been taken by a metropolitan France freezer fleet (METRO) and by inshore and offshore fleets based in St. Pierre and Miquelon (SPM). From 1959 to 1977, most of the SPM catch was obtained by the inshore fleet, with the largest catch (3800t) occurring in 1961. Catches by this gear has been generally less than 500t in recent years. Offshore catches by SPM trawlers increased from about 200t in 1975-76 to between 10,000t and 16,000t since 1985. Metro catches were highest in 1986 at about 12,000t because of the diversion of fishing effort from the Gulf of St. Lawrence, but the fleet has not fished in Subdiv. 3Ps since 1989.

Nominal catches reported for 1991 (Table 2) were obtained from the Department of Fisheries and Oceans (Canada) and from French scientists at the IFREMER laboratory at St. Pierre (France).

Preliminary information available for the Canadian and French otter trawl fisheries relative to areas fished indicate that, in recent years, an increasing portion of the catch has been obtained from deeper waters. In the first quarter 1992 Canadian catch, a higher than normal catch was obtained from depths deeper than 250 fathoms and mainly from the area south of Halibut Channel. French catches from this area were also reported at depths greater than 500 fathoms.

Catch and average weight-at-age

A summary of the sampling used to derive the Canadian catch-at-age in 1991 is given in Table 3. The following relationship was applied in deriving the average weights-at-age; $\log \text{ weight} = 3.0879 \log \text{ length} = 5.2106$. The discrepancy between reported and calculated catch from these average weights in 1991 was approximately 2%. Catch numbers and average weights at age are shown in Tables 4 and 5. The 1986 and 1987 year classes were most abundant in the total catch. Similar data for the French catch were provided by the St. Pierre laboratory and indicated a predominance of the 1985 to 1987 year classes. (Table 6; Figure 3). Average weights at age from the French catches were somewhat higher at the earlier ages (2-5) and lower at ages 6 and older.

Tables 7 and 8 show catch and average weights-at-age for the 1959-91 period. Although average weights-at-age for most ages were slightly lower in 1991 than 1990, they were not greatly different from those of recent years and there was no evident trend.

Research vessel surveys

Stratified-random surveys have been conducted in Subdivision 3Ps by Canada since 1972 and France since 1978. The two survey series are similar with regard to the stratification scheme used, method of sampling, and analysis of results but differ in the type of fishing gear used and the daily timing of the survey (daylight hr only for French survey). Canadian surveys were conducted by the research vessels A. T. Cameron (1972-82), the A. Needler (1983-84) and the W. Templeman (1985-92). From the limited amount of comparable fishing data available it has been concluded that the three had similar fishing power and that no adjustments were necessary. The French survey has been conducted by the research vessels Cryos (1978-91) and Thalassa (1992). Comparable fishing data between these two vessels is not available although the same fishing gear and survey design were used.

Canadian surveys have covered strata in depth ranges to 300 fathoms since 1980 while similar coverage by French surveys occurred only in 1981, 1983, and 1990-92. To account for incomplete coverage of strata in certain years for both surveys, estimates of biomass and abundance for non sampled strata were obtained using a multiplicative model. Results from both survey series are highly variable.

Biomass estimates from Canadian surveys (Table 9; Fig. 5) showed an increasing trend in the mid 1980's peaking at 85,000t in 1988. This was followed by a decline in 1989, increases in both 1990 and 91, and a substantial decline in 1992 to about 16,000t, the lowest level observed in the 1978-92 time series. Abundance estimates (Table 10) showed a similar pattern.

French surveys (Tables 13, 14; Fig. 5) showed an increasing trend from 1978 to 1986 followed by declines to the late 1980's. Increases in both 1990 and 91 were followed by a substantial decline in 1992 to the lowest values observed in the time series.

Mean number-per-tow estimates from the Canadian surveys (Table 11) indicated that in 1992 the 1986 and 87 year-classes were most abundant. Results from the French surveys (Tables 15 and 16) indicated that the 1989 and 1990 year-classes were most abundant in 1992.

French surveys have only covered depths from 200 fath. to 300 fath. in 5 of the 15 surveys. The surveys in 1990 and 1991 indicated that a considerable portion of the total biomass occurred in the deeper waters, particularly in strata bordering the Laurentian Channel (711-714). This pattern was similar to that observed in the Canadian surveys. Mean number-per-tow estimates previously provided by French scientists have not included data from the deeper waters (with the exception of stratum 708). For the current assessment, age compositions for the deeper strata were provided for surveys since 1990 and are included

in Table 15. Because information was not available for previous years, it was assumed that either (1) there was no catch in the deeper water strata in the earlier years (Table 15) or (2) that the proportion of numbers in the unsurveyed area was the same as that observed in the Canadian surveys when there had been coverage (Table 16). The latter was considered a more reasonable assumption and the results were used as an index for assessment purposes.

Both survey series have indicated that in recent years biomass has declined in shallow water strata while increasing in the deeper water strata. Because both surveys have only been conducted to depths up to 300 fathoms, it is possible that some of the stock may have been at depths outside the survey area. This problem may have been more acute in 1992 considering the distribution of the commercial first quarter otter trawl fishery.

Bottom temperatures from Canadian surveys in 1992 have indicated the persistence of temperatures < 0.0 C. at depths of 100 fathoms and less in recent years while those at depths > 100 fathoms have been substantially higher (Table 12). Bottom temperatures, particularly at shallower depths, were higher when surveys were conducted later in the spring.

Data from the commercial fishery as well as research vessel surveys suggest that changes in the stock distribution have occurred in recent years. (Figure 6 and 7). There has been a tendency for survey catches to be larger in deeper waters; i.e. the Laurentian Channel and Southern Halibut Channel. Catches in depths < 100 fm have been very low since 1990. Commercial catches in 1992 have been reported from greater depths than those included in the survey. This is generally an area that is difficult to survey because of rough bottom conditions.

Commercial catch and effort data

In previous assessments of this stock, problems were encountered with interpretation of the results from the analysis of Canadian catch rate data. Catch rate at age data indicated that there were substantial fluctuations in the age structure of the catch. These problems have not been resolved and consequently further analysis incorporating the 1991 data was not conducted.

Catch rate data (t/h) for the French (SPM) fleet during the 1978-91 period was included in a multiplicative analysis. Data for the French fishery was provided by the French (SPM) laboratory. To reduce the possible effects of rounding and truncation errors, data with less than 10 t catch or 10 h effort were excluded in both analyses.

The model explained 64% of the variation in the data (Table 17) for French catch rates and all categories were significant. Catch rates were also best in the winter months. French catch rates (Table 18) increased from 1981 to 1984, declined from 1985 to 1988, and have since shown a general increase, with similar values for 1990 and 1991. The low catch rates in 1988 and 1989 may have been due to areal restrictions of this fleet within 3Ps. If index values for these years are discounted, the time series shows a general declining trend since 1984. Using effort data from the C/E analysis (Table 18) and the otter trawl catch at age (Table 19), catch rate at age indices (Table 20) were obtained.

There are some difficulties with the interpretation of the trends observed in this catch rate index. The fishery developed from relatively low catch levels (1600t) at the beginning of the series and increased to about 15,000t by the late 1980s. During this period increases in fishing power could have influenced catch rates. The fleet has also been influenced by areal restrictions as the result of the boundary dispute between Canada and France. These factors are difficult to quantify and consequently their influence on the catch rate index are not known. For these reasons this index was not included in the current analysis to estimate stock size.

Estimation of stock size

Stock size was estimated using a formulation of the adaptive framework using Canadian and French research vessel indices. The catch rate indices were not included for reasons previously stated.

Canadian survey data prior to 1980 were not used for calibration mainly because strata coverage was incomplete in the earlier years.

Cod distribution observed from surveys prior to 1992 indicated a progressive movement of cod to deeper water on the shelf edge. In addition, Canadian and French offshore fishing fleets encountered concentrations of cod in deep water outside the area covered by the surveys during the early months of 1992. It is probable that the large decline in the RV estimates was in part due to changes in distribution and any concomitant change in abundance could not be determined. Therefore the inclusion of the 1992 RV data in the assessment calculations was not considered appropriate and they were not included in the formulation of ADAPT presented below.

The formulation of ADAPT used is described as follows:

Parameters estimated by ADAPT:

- Yearclass estimates
 $N_{i,1991}$ $i = 3$ to 12

- Catchabilities for RV and C/E numbers
 K_{1i} $i = 3$ to 12 (Canadian RV)
 K_{2i} $i = 3$ to 12 (French RV)

Additional structure imposed:

- Natural mortality was assumed to be 0.20.
- Error in the catch at age was assumed negligible.
- F on oldest age group (13) set at 20% of the unweighted mean F for age groups 7-9.
- Intercepts not fitted.

Input data:

- $C_{i,t}$ i = 3 to 13 t = 1978-91
- $RV1_{i,t}$ (Canada) i = 3 to 12 t = 1980-91
- $RV2_{i,t}$ (France) i = 3 to 12 t = 1978-91
- Winter RVs related to population at beginning of year.

Objective function:

- Minimize

$$\sum_{age} \sum_{year} \{obs(\ln RV1_{i,t}) - pred(\ln RV1_{i,t})\}^2 +$$

$$\sum_{age} \sum_{year} \{obs(\ln RV2_{i,t}) - pred(\ln RV2_{i,t})\}^2$$

Summary:

- Number of observations = 260
- Number of parameters estimated = 30

Population numbers at the beginning of 1991 estimated by ADAPT for age 4-12 were associated with coefficients of variation between 32% and 38%. The age 3 population was estimated with a somewhat higher CV of about 53% (Table 21). All RV catchabilities at age were estimated with CVs of 19% to 24%. As noted in previous assessments of this stock, residual patterns (Table 21) indicate several year effects in both indices used in the calibration.

Two approaches were considered in the determination of cod stock size at the beginning of 1992. In the first the large decline in RV estimates from 1991 to 1992 was assumed to be due solely to a temporary change in distribution and not a decline in abundance, and the population in 1992 was determined by simply using the 1991 catch at age to determine the survivors at the beginning of 1992. In the second the RV decline was considered to represent permanent emigration from the area or that higher than expected natural mortality occurred in 1991. The 1992 stock size was then determined by the

application of the RV catchabilities, from the calibration, using data to 1991, to the survey estimates from 1992.

Assessment results

The results of the analysis using the above formulation shows the age 3+ population at the beginning of 1991 to be about 300 million fish (Table 22). This population was dominated by the very strong 1986 and 1987 yearclasses (ages 4 and 5 in 1991). These two yearclasses at age 3 in 1989 and 1990 were estimated to be 122 and 134 million fish respectively, by far the highest in the 33 year SPA time series for this stock (Figure 8).

Fishing mortalities on fully recruited ages were estimated to be about 0.26-0.29 for 1989-1991, similar to levels observed during the early 1980s. Fs for the 1986 to 1988 period were substantially higher at about 0.42 (Figure 9).

The age 3+ population biomass at the beginning of the year was at its lowest level in the mid-1970s at about 80,000t (Figure 10). A regular increase occurred until about 1985 to about 270,000t with a subsequent decline to just under 200,000t in 1988. With the strong recruitment of the 1986 and 1987 yearclasses the biomass rapidly increased to about 300,000t in 1991, the highest level of biomass in the time series.

If the large decline in RV estimates was due mainly to fish being temporarily distributed outside the range of the survey, but still being available in 1992, then the stock biomass (age 3+ at the beginning of 1992) was estimated to be slightly less than that of 1991. However if the RV estimates actually reflect a permanent decline in abundance then this biomass in 1992 could be as low as 90,000t, approaching the all time low for this stock.

The age 6+ biomass (Figure 11) increased from the low levels of the mid-1970's (about 35,000t) and peaked at about 140,000t in 1986. A subsequent decline to 1989 was caused mainly by the weak 1983 and 84 year-classes. The 1991 6+ biomass is approximately 120,000t. For the scenarios discussed above the two values for age 6+ biomass in 1992 are 164,000t and 26,000t, the highest and lowest values observed in the 1959-91 time series.

The data currently available are insufficient to determine which of the two stock status scenarios is most representative.

Table 1. Cod catches (MT) from Subdivision 3Ps, 1959-91.

Year	Can(N)		Can(M)	France			Spain	Portugal	Other	Total
	Offshore (Mobile)	Inshore (fixed gear)		STPM M						
				Ins.	Off.	Metro				
1959	2,726	32,718	4,784	3,078	-	4,952	7,794	3,647	471	60,170
1960	1,780	40,059	5,095	3,424	210	2,460	17,223	262	2,123	72,636
1961	2,167	32,506	3,883	3,793	347	11,490	21,015	4,985	3,434	83,620
1962	1,176	29,888	1,474	2,171	70	4,138	10,289	1,873	1,560	52,639
1963	1,099	30,447	331	1,112	645	324	10,826	209	6,828	51,821
1964	2,161	23,897	370	1,002	1,095	2,777	15,216	169	9,880	56,567
1965	2,459	25,902	1,203	1,863	707	1,781	13,404	-	4,535	51,854
1966	5,473	23,785	583	1,157	2,050	4,607	23,678	519	4,355	66,207
1967	3,861	26,331	1,259	-	2,244	3,204	20,851	980	4,044	62,774
1968	6,538	22,938	585	-	880	1,126	26,868	8	18,611	77,556
1969	4,269	20,009	849	1,415	1,062	15	28,141	57	7,982	63,799
1970	4,650	23,410	2,166	1,307	663	35	35,750	143	8,734	76,858
1971	8,657	26,651	731	1,196	455	2,730	19,169	81	2,778	62,448
1972	3,323	19,276	252	990	446	-	18,550	109	1,267	44,213
1973	3,107	21,349	181	976	189	-	19,952	1,180	5,707	52,641
1974	3,770	15,999	657	600	348	5,366	14,937	1,246	3,789	46,712
1975	741	14,332	122	586	189	3,549	12,234	1,350	2,270	35,373
1976	2,013	20,978	317	722	182	1,501	9,236	177	2,007	37,133
1977	3,333	23,755	2,171	845	407	1,734	-	-	-	32,245
1978	2,082	19,560	700	360	1,614	2,860	-	-	45	27,221
1979	2,381	23,413	863	495	3,794	2,060	-	-	-	33,006
1980	2,809	29,427	715	214	1,722	2,681	-	-	-	37,568
1981	2,696	26,068	2,321	333	3,768	3,706	-	-	-	38,892
1982	2,639	21,351	2,948	1,009	3,771	2,184	-	-	-	33,902
1983	2,100	23,915	2,580	843	4,775	4,238	-	-	-	38,451
1984	895	22,865	1,969	777	6,773	3,671	-	-	-	36,950
1985	4,529	24,854	3,476	642	9,422	8,444	-	-	-	51,367
1986	4,981	24,208	2,120	389	13,653	11,939	-	-	-	57,290
1987	3,693	26,589	2,517	551	15,214	8,737	-	-	-	57,301
1988	3,662	19,742	2,303	282	10,011	7,373	-	-	4	43,377
1989 ^a	2,716	22,962	2,361	333	9,646	892	-	-	-	38,910
1990 ^a	2,990	20,047	3,289	158	14,769	-	-	-	-	41,253
1991	3,395	21,297	2,596	204	15,583	-	-	-	-	43,075

^aProvisional.

Table 2. Cod landings (t) by Canada in 1991 from NAFO Subdivision 3Ps by month and gear.

Month	Can(N)							Can(SF)					Can(G)				Total
	OT	MWT	ST	GN	LL	HL	Trap	OT	MWT	SSC	GN	LL	OT	DS	GN	LL	
Jan.	468			125	609	19		266				33					1520
Feb.	877	10		73	459	7		263	23			80	3				1795
Mar.	977	1		124	440	5		196	8			211	120				2082
Apr.	564	23		470	448	64		4				330	48				1951
May	94			502	315	160	203	89				96	1				1460
June	186		1	889	516	414	668				7	2	2	2			2687
July	48		3	2171	1064	391	2961				93	15	2	8	49		6805
Aug.	61		2	1082	902	291	208				54	85	3	6	51	1	2746
Sept.	39		5	386	1241	214	3	2				98	5	9	49		2051
Oct.	12		2	201	1568	155	4	3			14	37	1	7	17		2021
Nov.	2			167	749	73		72	2			25		4			1094
Dec.	20			264	671	21		51				35	14				1076
Total	3348	34	13	6454	8982	1814	4047	946	31	2	168	1047	199	36	166	1	27288

Catch by month for France

	<u>OT</u>	<u>Inshore</u>	<u>Total</u>
Jan.	2743	1	2744
Feb.	2917	-	2917
Mar.	2927	2	2929
Apr.	453	4	457
May	771	15	786
June	484	46	530
July	60	59	119
Aug.	-	45	45
Sept.	8	8	16
Oct.	464	12	476
Nov.	2351	11	2362
Dec.	2405	1	2406
	<u>15583</u>	<u>204</u>	<u>15787</u>

Table 3. Commercial cod sampling by Can(N) in NAFO Subdivision 3Ps in 1991.

Qtr.	Gear	No. aged	Month	No. meas.	Month	Total
1	OT	648	Jan.	1457	468	734
			Feb.	568	887	1176
			Mar.	5920	978	1302
				<u>648</u>	<u>7945</u>	<u>3212</u>
2	OT	^a	Apr.	257	639	1014
1	Longline	439	Jan.	1595	609	609
	"		Feb.	2952	459	459
	Gillnet		Feb.	146	73	198
		<u>439</u>	<u>4693</u>		<u>1226</u>	
2	Longline	302	Mar.	2051	440	1203
	"		Apr.	1325	448	
	Cod trap		May	412	203	203
		<u>302</u>			<u>1406</u>	
3	Longline	518	Aug.	2115	988	2482
	Cod trap		June	1425	668	3844
	"		July	4036	2961	
	Gillnet		June	993	896	896
	"		July	476	2313	2313
	"		Aug.	593	1187	1187
	Handline		July	1472	291	1096
	"		Aug.	226	214	
		<u>518</u>			<u>11818</u>	
4	Longline	653	Sept.	2012	1241	4229
	"		Oct.	2599	1568	
	"		Nov.	2077	749	
	Handline		Sept.	240	214	463
		<u>653</u>	<u>6928</u>		<u>4692</u>	
1-4	OT					4609
	Cod trap					4047
	Gillnet					6788
	Longline					10030
	Handline					1814
	All	<u>2560</u>		<u>34947</u>		<u>27288</u>

^aQtr. 1 OT A/L key was used.

Table 4. Cod catch and average weight at age by gear from the Canadian fishery in NAFO Subdivision 3Ps during 1991.

Age	Mobile gear	Cod trap	Gillnet	Handline	Longline	Total
<u>Numbers (x 10⁻³)</u>						
2					5	5
3		244	1	5	127	377
4	67	3020	22	338	2392	5839
5	578	1807	476	552	2637	6051
6	625	245	980	244	1389	3483
7	167	35	675	88	446	1410
8	114	3	188	23	136	464
9	152	2	110	15	84	363
10	114		55	5	46	221
11	34		30	2	21	86
12	19		9	2	7	38
13	19		17	1	4	42
14	13		7		1	22
15	6		2	1	1	10
16	6					8
17	5		1			5
18	3					3
19	1		2			4
20+	2					2
wt.	4609	4047	6788	1814	10030	27288
<u>Ave. wt. - kg</u>						
2					0.26	0.26
3		0.42	0.40	0.50	0.46	0.43
4	0.79	0.61	0.72	0.79	0.78	0.69
5	1.16	0.86	1.77	1.23	1.18	1.13
6	1.62	1.19	2.31	1.84	1.72	1.84
7	2.16	1.74	2.75	2.48	2.33	2.51
8	2.70	2.05	3.40	3.20	2.92	3.07
9	3.60	1.72	4.67	3.45	3.30	3.84
10	4.06		5.49	4.27	4.55	4.53
11	6.93		5.56	4.55	5.49	6.05
12	8.10		7.41	11.89	6.06	7.81
13	8.78		8.17	7.34	7.63	8.37
14	11.18		7.60		6.17	9.72
15	12.30		7.42	13.10	9.12	11.22
16	12.94				11.14	12.37
17	14.46		10.11			13.83
18	15.68					15.70
19	16.33		12.70			14.20
20+	16.38					16.38

Table 5. Catch, average weight and length at age of cod from the Canadian commercial fishery in Subdivision 3Ps in 1991.

Age	Average		Mean	Catch		C. V.
	Weight	Length		STD. ERR.		
2	0.264	31.458	5	1.54	0.34	
3	0.434	36.972	377	79.71	0.21	
4	0.690	42.788	5839	219.09	0.04	
5	1.134	49.969	6051	226.38	0.04	
6	1.838	58.549	3483	138.25	0.04	
7	2.506	64.910	1410	88.67	0.06	
8	3.070	68.821	464	47.59	0.10	
9	3.840	73.680	363	28.51	0.08	
10	4.525	77.338	221	18.78	0.09	
11	6.053	86.150	86	9.91	0.12	
12	7.806	93.088	38	4.93	0.13	
13	8.373	95.343	42	5.86	0.14	
14	9.718	99.854	22	4.44	0.20	
15	11.219	105.456	10	2.24	0.22	
16	12.366	108.640	8	1.59	0.21	
17	13.833	113.410	5	1.18	0.22	
18	15.702	118.293	3	0.97	0.29	
19	14.201	114.586	4	1.77	0.50	
20	16.380	118.939	2	0.70	0.42	
21	23.854	136.000		0.00	0.01	
22	13.097	112.000		0.32	1.01	

Table 6. Catch and average weight at age of cod in NAFO Subdivision 3Ps from the fisheries by Canada and France in 1991.

Age	Canada		France		Total	
	Number	Average weight	Number	Average weight	Number	Average weight
2	5	0.26	8	0.54	13	0.43
3	377	0.43	435	0.75	812	0.60
4	5839	0.69	2142	0.91	7981	0.75
5	6051	1.13	3977	1.23	10028	1.17
6	3483	1.84	2424	1.60	5907	1.74
7	1410	2.51	754	2.10	2164	2.37
8	464	3.07	343	2.69	807	2.91
9	363	3.84	257	3.49	620	3.69
10	221	4.53	207	3.91	428	4.23
11	86	6.05	22	7.46	108	6.34
12	38	7.81	38	7.55	76	7.68
13	42	8.37	8	10.07	50	8.64
14	22	9.72			22	9.72
15	10	11.22			10	11.22
16	8	12.37			8	12.37
17	5	13.83			5	13.83
18	3	15.70			3	15.70
19	4	14.20			4	14.20
20+	2	16.38			2	16.38
No.	18433		10615		29048	
Wt.	27288		15787		43075	

TABLE 7. CATCH NUMBERS AT AGE (000S) OF COD IN SUBDIVISION 3Ps.

	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
3	1001	567	450	1245	961	1906	2314	949	2871	1143	774	756	2884	731	945	1887	1840
4	13940	5496	5586	6749	4499	5785	9636	13662	10913	12602	7098	8114	6444	4944	4707	6042	7329
5	7525	23704	10357	9003	7091	5635	5799	13065	12900	13135	11585	12916	8574	4591	11386	9987	5397
6	7265	6714	15960	4533	5275	5179	3609	4621	6392	5853	7178	9763	7266	3552	4010	6365	4541
7	4875	3476	3616	5715	2527	2945	3254	5119	2349	3572	4554	6374	8218	4603	4022	2540	5867
8	942	3484	4680	1367	3030	1881	2055	1586	1364	1308	1757	2456	3131	2636	2201	1857	723
9	1252	1020	1849	791	898	1891	1218	1833	604	549	792	730	1275	833	2019	1149	1196
10	1260	827	1376	571	292	652	1033	1039	316	425	717	214	541	463	515	538	105
11	631	406	446	187	143	339	327	517	380	222	61	178	85	205	172	249	174
12	545	407	265	140	99	329	68	389	95	111	120	77	125	117	110	80	52
13	44	283	560	135	107	54	122	32	149	5	67	121	62	48	14	32	6
14	0	27	58	241	92	27	36	22	3	107	110	14	57	45	29	17	2
3+	39280	46411	45203	30677	25014	26623	29471	42834	38336	39032	34813	41713	38662	22768	30130	30743	27232
4+	38279	45844	44753	29432	24053	24717	27157	41885	35465	37889	34039	40957	35778	22037	29185	28856	25392
5+	24339	40348	39167	22683	19554	18932	17521	28223	24552	25287	26941	32843	29334	17093	24478	22814	18063
6+	16814	16644	28810	13680	12463	13297	11722	15158	11652	12152	15356	19927	20760	12502	13092	12827	12666
	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	
3	4110	935	502	135	368	1022	130	760	203	206	306	585	935	1071	2006	812	
4	12139	9156	5146	3072	1625	2888	5092	2682	4521	4718	5103	2956	4951	8995	8622	7981	
5	7923	8326	6096	10321	5054	3136	4430	9174	4538	11473	10253	11023	4971	7842	8195	10028	
6	2875	3209	4006	5066	8156	4652	2348	4080	7018	6118	11228	9763	6471	2863	3329	5907	
7	1305	920	1753	2353	3379	5855	2861	1752	2221	5072	4283	5453	5046	2549	1483	2164	
8	495	395	653	721	1254	1622	2939	1150	584	1496	2167	1416	1793	1112	1237	807	
9	140	265	235	233	327	539	640	1041	542	417	650	1107	630	600	692	620	
10	53	117	178	84	114	175	243	244	338	377	224	341	284	223	350	428	
11	17	57	72	53	56	67	83	91	134	333	171	149	123	141	142	108	
12	21	43	27	24	45	35	30	37	35	131	143	78	75	57	104	76	
13	4	31	17	13	21	18	11	18	8	24	79	135	53	29	47	50	
14	3	11	10	10	25	2	7	8	8	12	23	50	31	26	22	22	
3+	29085	23465	18695	22085	20424	20011	18814	21037	20150	30377	34630	33056	25363	25508	26229	29003	
4+	24975	22530	18193	21950	20056	18989	18684	20277	19947	30171	34324	32471	24428	24437	24223	28191	
5+	12836	13374	13047	18878	18431	16101	13592	17595	15426	25453	29221	29515	19477	15442	15601	20210	
6+	4913	5048	6951	8557	13377	12965	9162	8421	10888	13980	18968	18492	14506	7600	7406	10182	

TABLE 8. MEAN WEIGHT AT AGE (kg) OF COD IN SUBDIVISION 3Ps.

	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
3	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.55	0.45
4	0.69	0.69	0.69	0.69	0.69	0.69	0.69	0.69	0.69	0.69	0.69	0.69	0.69	0.69	0.69	0.69	0.69	0.69	0.68	0.70
5	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.30	1.08
6	1.68	1.68	1.68	1.68	1.68	1.68	1.68	1.68	1.68	1.68	1.68	1.68	1.68	1.68	1.68	1.68	1.68	1.68	1.86	1.75
7	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.67	2.45
8	3.21	3.21	3.21	3.21	3.21	3.21	3.21	3.21	3.21	3.21	3.21	3.21	3.21	3.21	3.21	3.21	3.21	3.21	3.42	2.99
9	4.10	4.10	4.10	4.10	4.10	4.10	4.10	4.10	4.10	4.10	4.10	4.10	4.10	4.10	4.10	4.10	4.10	4.10	4.19	4.10
10	5.08	5.08	5.08	5.08	5.08	5.08	5.08	5.08	5.08	5.08	5.08	5.08	5.08	5.08	5.08	5.08	5.08	5.08	4.94	5.16
11	6.03	6.03	6.03	6.03	6.03	6.03	6.03	6.03	6.03	6.03	6.03	6.03	6.03	6.03	6.03	6.03	6.03	6.03	5.92	5.17
12	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	6.76	7.20
13	8.05	8.05	8.05	8.05	8.05	8.05	8.05	8.05	8.05	8.05	8.05	8.05	8.05	8.05	8.05	8.05	8.05	8.05	8.78	7.75
14	9.16	9.16	9.16	9.16	9.16	9.16	9.16	9.16	9.16	9.16	9.16	9.16	9.16	9.16	9.16	9.16	9.16	9.16	10.90	8.72

	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
3	0.41	0.52	0.48	0.45	0.58	0.66	0.64	0.54	0.56	0.63	0.63	0.58	0.60
4	0.65	0.72	0.79	0.77	0.84	1.04	0.98	0.75	0.77	0.82	0.81	0.86	0.75
5	1.01	1.13	1.32	1.17	1.33	1.40	1.36	1.18	1.21	1.09	1.16	1.27	1.17
6	1.65	1.66	1.80	1.78	1.99	1.97	1.93	1.84	1.63	1.67	1.63	1.85	1.74
7	2.55	2.48	2.30	2.36	2.58	2.64	2.51	2.43	2.31	2.17	2.25	2.45	2.37
8	3.68	3.60	3.27	2.88	3.26	3.77	3.43	3.15	3.02	2.92	3.37	3.00	2.91
9	4.30	5.40	4.36	3.91	3.77	4.75	4.35	4.30	4.33	3.58	4.11	4.22	3.69
10	6.49	6.95	5.68	5.28	5.04	5.56	5.06	5.50	5.11	4.98	5.18	5.09	4.23
11	7.00	7.29	7.41	6.18	6.56	6.01	5.42	6.19	6.20	5.61	6.29	6.35	6.34
12	8.20	8.64	9.04	8.62	8.45	9.04	9.37	8.72	6.98	6.60	7.30	7.60	7.68
13	9.53	9.33	8.39	8.64	10.06	11.20	11.95	8.05	7.08	7.46	7.75	8.31	8.64
14	10.84	9.58	9.56	11.41	11.82	10.40	10.85	11.91	8.34	8.92	8.73	10.37	9.72

Table 9 . Cod biomass estimates (T) from research vessel surveys in NAFO Division 3Ps. Numbers in brackets are estimates for non-sampled strata.

Depth range (fath)	Strata	Area	ATC	ATC	ATC	ATC	ATC	ATC	ATC	ATC	ATC	AN	AN	WT	WT	WT	WT	WT	WT	WT	WT	
			207	221	234	247	261	273	287	302	316	330	9	26	26	45	55+56	68	81	91	103	118
			1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
0-30	314	974	(9)	1326	(17)	2355	249	0	(241)	432	369	2028	13103	567	25	0	0	24	8	139	0	0
	320	1320	707	(829)	(279)	1333	(640)	(1036)	(1650)	2946	23087	1920	5618	5456	5259	284	495	1729	1026	0	121	25
31-50	308	112	175	278	205	193	311	38	125	240	305	490	766	681	1024	0	3	4	2	2	1	6
	312	272	(18)	243	334	456	1047	343	151	(105)	165	766	524	674	1016	61	33	3	3	0	4	0
	315	827	0	591	(141)	1746	1549	(537)	1836	235	0	528	2451	1893	329	2762	885	1247	1641	523	367	19
	321	1189	0	(355)	(105)	1741	(269)	2035	(730)	1880	1419	2845	2419	1183	89	335	723	1738	367	2	59	0
	325	944	(0)	(53)	(0)	2	(34)	180	820	28	1240	95	329	502	0	35	130	31	7	26	57	13
	326	166	(0)	(2)	(0)	(8)	(0)	0	2	3	0	53	322	0	(7)	0	16	28	0	3	16	0
51-100	307	395	5955	3916	883	1126	2095	3219	4105	1763	13723	3028	892	771	5189	12339	2688	13936	3138	340	20	9
	311	317	573	2430	763	627	410	154	1106	3792	761	1943	3256	863	4870	399	4331	593	361	18	24	2
	317	193	278	589	164	550	491	(298)	368	536	268	1582	3685	30	14064	2180	886	109	243	0	552	15
	319	984	643	477	481	3099	2490	(2486)	10637	1652	15068	3548	3799	3995	1282	10189	7784	12609	10170	(1499)	650	39
	322	1567	(73)	(360)	(98)	5178	(270)	490	14	2599	26	3705	4932	2597	1073	2004	1503	369	52	38	35	6
	323	696	(87)	(335)	(109)	367	63	1651	(673)	775	491	1215	858	2247	1263	2881	18047	143	281	3	24	22
324	494	(4)	(55)	(9)	8	(39)	(72)	29	0	(100)	430	618	136	10756	230	187	125	0	6	22	7	
101-150	306	419	(113)	433	1077	214	161	416	710	457	2652	1211	1250	236	590	755	11032	3589	267	779	24	16
	309	296	437	204	311	178	192	103	1558	863	2983	1178	926	156	1611	3216	2539	2722	1900	1415	299	10
	310	170	(21)	83	2181	(149)	0	154	119	0	817	608	134	134	268	332	198	417	147	194	32	4
	313	165	25	144	242	142	41	50	1036	127	446	283	74	130	250	0	279	69	570	105	26	13
	316	189	441	63	(19)	77	17	(78)	65	61	25	(93)	207	170	85	71	71	25	2847	4707	79	15
	318	123	6	4	0	0	6	(48)	36	790	(64)	136	11	0	(65)	81	782	106	13266	(27)	874	357
151-200	705	195	0	66	0	0	60	1	91	674	1310	22	27	0	542	611	121	501	18	123	1	17
	706	476	0	23	(39)	(255)	76	(171)	356	827	304	30	32	0	2068	447	8319	1134	130	69	100	197
	707	93	(15)	5	0	0	227	(67)	326	190	(89)	(80)	7	0	(90)	3124	1529	6667	370	(40)	799	397
	715	132	(47)	153	1	1	31	142	352	499	168	154	338	54	(264)	1523	810	4575	220	298	7435	845
	716	539	(71)	147	(88)	(498)	92	780	303	248	1608	168	147	15	344	3464	1544	2379	384	570	115	189
201-300	708	117	(28)	(100)	0	(183)	11	(125)	177	4633	(164)	(147)	0	0	(166)	327	8816	27852	57	(74)	555	1264
	711	961	(44)	(218)	(59)	(420)	(164)	(279)	(457)	1113	0	0	7	87	109	6949	477	502	361	303	21714	156
	712	973	(65)	(288)	(85)	(544)	(218)	(364)	9077	282	259	353	0	(509)	993	300	128	692	184	748	626	545
	713	950	(54)	(250)	0	(476)	(188)	(317)	(517)	0	850	0	36	(445)	87	271	1339	332	535	17075	3009	810
	714	1195	(184)	(683)	(227)	(1260)	(526)	(855)	(1364)	0	161	0	163	(1181)	(1144)	1857	258	700	4090	19821	17344	11081
0-30	2294	716	2155	296	3688	889	1036	1891	3378	23456	3948	18721	6023	5284	284	495	1753	1034	139	121	25	
31-50	3510	193	1522	785	4146	3210	3133	3664	2491	3129	4777	6811	4933	2465	3193	1290	3051	2020	556	504	38	
51-100	4646	7613	8162	2507	10955	5858	8370	16932	11117	30437	15451	18040	10639	38497	30222	35426	27884	14245	1904	1327	100	
101-150	1362	1043	931	3830	760	417	849	3524	2298	6987	3509	2602	826	2871	4455	14901	6928	18997	7227	1334	415	
151-200	1435	133	394	128	754	486	1161	1428	2438	3479	454	551	69	3308	9169	12323	15256	1122	1100	8450	1645	
201-300	4196	375	1539	371	2883	1107	1940	11592	6028	1434	500	206	2222	2499	9704	11018	30078	5227	38021	43248	13793	
Mean wt/tow			7.70	11.23	6.05	17.71	9.14	12.59	29.81	21.20	52.64	21.87	35.84	18.87	41.94	43.56	57.63	64.88	32.57	37.38	41.99	12.23
Total all depths			10075	14703	7918	23189	11967	16489	39036	27754	68924	28638	46931	24709	54920	57029	75452	84949	42642	48948	54983	16014
Unadjusted total			9242	11175	6643	19394	9619	9756	33402	27647	68507	28317	46929	22574	53184	57028	75451	84967	42662	47308	54997	16015
Upper limit			17506	14468	9171	29677	12282	15852	187818	52461	182556	35969	75189	30739	109270	85725	122747	447584	67528	90622	107637	23812
Lower limit			978	7883	4116	9112	6957	3660	-121014	2832	-45541	20666	18670	14408	-2903	28332	28156	-277649	17797	3993	2357	8217

Table 10. Cod abundance estimates (No. X 10⁻³) from research vessel surveys in NAFO Division 3Ps. Numbers in brackets are estimates for non-sampled strata.

Depth range (fath)	Strata	Area	ATC	ATC	ATC	ATC	ATC	ATC	ATC	ATC	ATC	AN	AN	WT	WT	WT	WT	WT	WT	WT	WT	
			207 1973	221 1974	234 1975	247 1976	261 1977	273 1978	287 1979	302 1980	316 1981	330 1982	9 1983	26 1984	26 1985	45 1986	55+56 1987	68 1988	81 1989	91 1990	103 1991	118 1992
0-30	314	974	(27)	1170	(11)	1060	73	0	(254)	279	307	2237	1859	91	21	0	0	42	8	24	0	0
	320	1320	545	(329)	(113)	941	(245)	(429)	(942)	528	10354	1362	1589	1870	476	99	129	180	238	0	83	11
31-50	308	112	34	122	65	34	166	21	74	59	46	235	238	395	563	0	13	13	4	8	4	8
	312	272	(40)	225	221	257	628	378	157	(95)	92	296	347	153	1644	31	51	20	7	0	10	0
	315	827	0	62	(39)	745	1304	(175)	621	171	0	145	489	410	177	786	147	103	133	217	35	18
	321	1189	0	(100)	(17)	312	(67)	179	(333)	196	402	1227	785	342	77	27	54	162	20	11	57	0
	325	944	(12)	(48)	(0)	35	(29)	567	850	35	213	85	124	71	0	27	47	24	18	35	102	21
	326	166	(0)	(3)	(0)	(9)	(1)	0	12	6	0	69	62	0	(5)	0	19	19	0	6	19	0
51-100	307	395	2645	2622	431	778	1090	1186	2090	949	5505	2372	569	193	2006	5802	1433	4700	1710	395	79	59
	311	317	822	2861	433	666	125	309	1124	3105	690	1888	1348	381	3692	127	2427	898	103	119	56	12
	317	193	354	761	127	971	199	(255)	309	1391	623	913	2062	14	1427	420	420	101	101	7	80	36
	319	984	872	1182	638	4136	2945	(2221)	15068	2733	13000	3176	2058	1637	111	3241	6968	6795	2401	(1781)	936	214
	322	1567	(219)	(430)	(150)	2294	(321)	706	118	2641	471	2632	1882	509	860	1382	1082	206	260	154	210	15
	323	696	(109)	(212)	(76)	78	138	1097	(597)	261	78	392	383	901	871	2069	3466	199	112	13	70	9
	324	494	(41)	(87)	(27)	37	(63)	(115)	93	0	(152)	352	593	321	10476	178	111	185	0	15	111	15
101-150	306	419	(153)	173	472	110	65	115	440	204	2810	692	763	47	267	577	6172	1329	231	1342	86	94
	309	296	141	111	152	89	63	67	870	289	1811	700	496	56	933	1700	1067	1355	833	733	467	22
	310	170	(51)	64	2039	(161)	0	183	121	0	651	434	72	57	102	179	115	315	351	421	376	19
	313	165	111	89	215	54	26	17	1018	81	266	217	37	12	111	0	173	43	508	81	211	124
	316	189	880	76	(19)	110	14	(70)	85	35	21	(82)	128	78	38	14	38	24	634	5881	85	21
	318	123	9	5	0	0	5	(42)	503	379	(55)	92	3	0	(40)	14	374	9	3241	(33)	776	677
151-200	705	195	0	55	0	0	48	7	66	432	988	15	5	0	285	366	102	271	22	29	7	29
	706	476	0	5	(23)	(141)	46	(102)	202	518	250	9	7	0	697	241	5041	411	27	27	27	150
	707	93	(19)	3	0	0	171	(46)	91	122	(59)	(53)	2	0	(44)	565	565	1714	93	(36)	562	373
	715	132	(65)	42	10	30	20	149	221	248	84	45	106	25	(145)	817	367	2145	74	456	7124	694
	716	539	(105)	40	(74)	(350)	20	587	334	223	1123	81	91	13	170	3004	1119	1432	212	162	113	391
201-300	708	117	(43)	(78)	0	(134)	9	(100)	92	3636	(129)	(115)	0	0	(96)	202	6148	9274	26	(80)	215	615
	711	961	(68)	(146)	(42)	(269)	(106)	(194)	(441)	649	0	0	9	14	54	4857	258	206	93	240	7033	159
	712	973	(75)	(160)	(47)	(292)	(116)	(211)	8180	146	73	97	0	(140)	426	162	37	313	82	555	530	285
	713	950	(75)	(159)	0	(290)	(116)	(210)	(474)	0	214	0	20	(140)	62	57	713	153	312	9352	2585	513
	714	1195	(207)	(397)	(144)	(696)	(299)	(514)	(1114)	0	56	0	27	(354)	(495)	466	157	379	1749	11123	13488	7240
0-30	2294	572	1499	124	2001	318	429	1196	807	10661	3599	3448	1961	497	99	129	222	246	24	83	11	
31-50	3510	86	560	342	1392	2195	1320	2047	562	753	2057	2045	1371	2466	871	331	341	182	277	227	47	
51-100	4646	5062	8155	1882	8960	4881	5889	19399	11080	20519	11725	8895	3956	19443	13219	15907	13084	4687	2484	1542	360	
101-150	1362	1355	518	2897	524	173	494	3037	988	5614	2217	1499	250	1491	2484	7939	3075	5798	8491	2001	957	
151-200	1435	189	145	107	521	305	891	914	1543	2504	203	211	38	1341	4993	7194	5973	428	710	7833	1637	
201-300	4196	468	940	233	1681	479	1229	10301	4431	472	212	56	648	1133	5744	7313	10325	2262	21350	23851	8812	
Mean #/tow		5.90	9.02	4.27	11.52	6.51	7.82	28.18	14.82	30.95	15.28	12.34	6.28	20.14	20.93	29.64	25.22	10.39	25.46	27.14	9.03	
Total all depths		7720	11816	5593	15081	8519	10248	36896	19410	40523	20012	16158	8225	26373	27410	38812	33021	13603	33337	35536	11826	
Unadjusted total		6412	9668	4802	12738	7155	5566	32741	19316	40128	19763	16156	7592	25546	27410	38812	33025	13606	31408	35551	11826	
Upper limit		10984	12638	6798	18812	9898	8367	236480	72479	108562	25828	21863	10760	165628	43048	63376	157954	22271	58781	68441	17177	
Lower limit		1841	6697	2805	6665	4412	2766	-170999	-33847	-28307	13698	10449	4425	-114537	11772	14248	-91904	4942	4036	2660	6473	

TABLE 11. MEAN NUMBERS PER TOW AT AGE ADJUSTED FOR MISSING STRATA FOR COD IN SUBDIVISION 3PS FOR THE YEARS 1972-92.

	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
1	0.02	0.01	0.52	0.17	0.18	0.01	0.00	0.85	0.16	0.03	0.51
2	0.62	0.66	1.60	0.34	2.52	0.15	0.49	0.35	4.52	0.53	1.95
3	1.09	0.77	1.58	0.97	1.65	1.98	0.76	0.53	1.37	3.02	0.99
4	2.24	1.17	1.13	0.88	3.03	1.73	2.76	5.47	0.97	4.97	4.91
5	1.50	1.31	1.53	0.54	1.89	1.33	1.18	16.15	3.29	5.46	2.25
6	1.00	0.37	1.42	0.50	0.86	0.68	0.85	3.39	2.91	7.05	1.05
7	1.33	0.73	0.39	0.45	0.52	0.22	0.61	0.76	0.53	6.63	1.42
8	0.78	0.29	0.32	0.17	0.48	0.11	0.42	0.37	0.49	1.33	1.48
9	0.33	0.38	0.25	0.11	0.11	0.16	0.25	0.13	0.14	1.31	0.40
10	0.20	0.09	0.13	0.07	0.09	0.06	0.24	0.11	0.13	0.31	0.11
11	0.08	0.02	0.04	0.02	0.06	0.01	0.08	0.03	0.10	0.06	0.08
12	0.05	0.02	0.03	0.01	0.06	0.03	0.03	0.01	0.11	0.08	0.03
13	0.03	0.00	0.02	0.01	0.00	0.03	0.03	0.01	0.04	0.08	0.02
14	0.05	0.01	0.02	0.00	0.00	0.01	0.00	0.01	0.00	0.05	0.02
15	0.03	0.00	0.00	0.01	0.02	0.01	0.03	0.00	0.02	0.01	0.03
16	0.09	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.03	0.02	0.02
1+	9.45	5.85	9.00	4.26	11.48	6.49	7.73	28.18	14.81	30.92	15.28
2+	9.42	5.84	8.48	4.09	11.30	6.49	7.73	27.33	14.65	30.89	14.77
3+	8.80	5.18	6.87	3.74	8.78	6.34	7.24	26.97	10.13	30.37	12.82
4+	7.72	4.41	5.29	2.77	7.13	4.36	6.48	26.45	8.76	27.34	11.82
	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	
1	0.25	0.01	0.01	0.01	0.04	0.02	0.02	0.00	0.05	0.00	
2	0.47	0.21	0.27	0.26	0.37	0.42	0.28	0.06	1.18	0.11	
3	1.02	0.32	1.71	0.54	0.83	0.78	0.68	1.31	0.73	1.13	
4	0.55	0.58	4.37	2.54	2.01	1.18	1.33	4.98	3.87	0.89	
5	3.05	0.44	5.66	5.40	10.26	1.79	0.97	6.22	7.33	2.74	
6	1.56	1.88	2.61	5.83	8.01	5.90	1.01	4.16	5.26	1.82	
7	0.54	0.75	2.44	2.28	3.82	6.14	2.29	3.13	2.88	1.05	
8	1.06	0.39	0.77	1.71	1.60	4.13	1.42	2.89	1.78	0.55	
9	1.99	0.48	0.45	0.99	0.97	1.85	0.82	1.24	1.53	0.29	
10	0.92	0.75	0.44	0.34	0.39	1.04	0.46	0.67	1.06	0.26	
11	0.45	0.18	0.44	0.28	0.31	0.90	0.51	0.36	0.78	0.08	
12	0.17	0.13	0.49	0.32	0.24	0.44	0.15	0.16	0.30	0.05	
13	0.07	0.05	0.20	0.18	0.24	0.18	0.13	0.12	0.15	0.01	
14	0.06	0.03	0.11	0.11	0.24	0.18	0.06	0.08	0.10	0.01	
15	0.05	0.00	0.03	0.07	0.09	0.11	0.11	0.01	0.05	0.03	
16	0.04	0.04	0.04	0.03	0.06	0.11	0.06	0.04	0.04	0.00	
1+	12.26	6.24	20.05	20.90	29.48	25.18	10.30	25.43	27.09	9.03	
2+	12.01	6.24	20.04	20.89	29.44	25.16	10.28	25.43	27.04	9.03	
3+	11.54	6.03	19.77	20.63	29.07	24.74	10.00	25.37	25.86	8.92	
4+	10.52	5.71	18.06	20.09	28.24	23.96	9.31	24.06	25.14	7.79	

Table 12. Mean bottom temperature (°C) by stratum from Canadian research vessel surveys in NAFO Subdivision 3Ps over the period 1978-92.

Depth range	Strata	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	
0-30	314	0.20		-0.20	1.52	1.64	1.96	1.40	-1.23	-0.79	-0.52	0.14	-0.74	-0.84	-0.16	-1.08	
	320		-0.70	-0.22	1.60	1.72	2.53	1.88	-1.09	-0.74	-1.12	0.20	-0.35	-0.88	-0.33	-0.73	
Average		0.20	-0.70	-0.21	1.55	1.68	2.34	1.72	-1.17	-0.76	-0.85	0.17	-0.52	-0.90	-0.24	-0.91	
31-50	308	1.75	1.65	0.00	1.00	0.40	0.73	2.40	-0.25	-0.50	0.85	1.45	0.35	-0.50	-0.07	0.45	
	312	0.75	0.13	0.00	1.30	1.45	1.60	2.80	-0.85	-0.80	-0.45	1.23	-0.37	-0.97	-0.13	-0.50	
	315		-0.80	-0.60	1.90	-0.67	1.14	1.44	-1.37	-0.80	-1.07	0.43	0.01	-0.85	-0.53	-0.54	
	321	0.53		-0.42	1.50	0.35	0.83	0.52	-1.21	-0.82	-0.73	0.19	-0.63	-0.70	-0.39	-0.80	
	325	0.55	-0.85	-0.95	2.05	0.7	-0.12	0.14	-1.50	-1.18	-0.79	-0.08	-0.56	-1.37	-0.68	-0.88	
	326	-0.50	-0.85	-1.05	-0.20	-0.90	-0.97	-1.00	-1.45	-0.90	-0.90	-0.35	-0.70	-1.00	-0.93	-1.10	
	Average		.61	0.08	-0.58	1.19	-0.06	0.59	0.88	-1.15	-0.93	-0.73	0.37	-0.37	-0.81	-0.46	-0.42
51-100	307	1.20	3.92	3.30	2.73	2.05	2.15	4.70	2.33	2.23	3.83	2.47	2.13	1.87	1.20	1.35	
	311	1.32	1.48	1.60	4.35	0.07	1.50	1.20	-0.35	1.50	1.47	1.16	.80	-0.56	0.53	0.85	
	317		-0.43	-0.35	2.40	-0.30	1.97	5.80	-0.15	-0.55	-0.40	0.40	0.20	0.20	-0.40	2.05	
	319		5.20	0.45	2.70	0.74	0.60	3.27	2.90	2.40	0.17	1.59	0.88		0.31	0.75	
	322	0.60		-0.32	-0.05	-0.46	-0.22	0.04	-1.32	-0.42	-0.47	0.18	-0.49	-0.48	-0.42	-0.65	
	323	0.27		-0.67	0.00	-0.70	-0.40	0.20	1.97	0.54	-0.65	-0.26	-0.60	-0.64	-0.55	-0.83	
	324		-0.50	-0.70	-0.95	-0.65	-1.03	-1.03	-1.05	-1.40	-0.75	-0.05	-0.78	-0.70	-0.82	-0.92	
	Average		0.91	1.98	0.21	2.08	0.22	0.40	1.52	0.02	0.55	0.11	0.71	0.03	-0.25	-0.02	0.37
101-150	306	2.90	6.06	6.05	6.15	5.30	4.60	5.95	7.15	7.10	6.25	6.02	5.10	4.40	3.95	4.75	
	309	2.07	5.67	5.75	4.70	4.05	5.00	5.80	5.53	6.45	5.65	5.37	4.15	3.65	4.10	3.90	
	310	3.83	5.27	6.20	6.50	4.70	5.47	6.10	7.27	7.50	6.40	5.67	2.30	3.77	3.25	5.10	
	313	2.60	5.22	5.30	7.25	3.00	5.00	6.90	6.05	8.10	7.00	6.60	5.10	2.95	3.65	5.50	
	316		6.60	6.70	7.95	5.40	5.15	5.60	4.80	8.15	5.03	6.93	5.20	4.40	4.20	6.50	
	318		-7.45	6.20	5.60	5.53	7.95	5.60	6.90	4.70	5.00	2.90			5.30	5.70	
	Average		2.85	5.81	6.03	6.71	4.67	5.10	6.38	6.09	7.35	5.84	5.95	4.20	3.89	4.08	5.24
151-200	705	5.90	6.52	5.35	6.40	4.60	5.33	5.15	7.30	6.75	6.30	5.65	5.70	5.67	5.80	4.95	
	706		6.10	5.50	6.30	4.72	5.28	6.60	7.40	7.10	4.96	5.90	5.38	6.03	5.80	5.32	
	707		7.40	6.05			5.17	6.20		5.20	4.60	3.70	3.80		5.70	6.70	
	715	5.30	6.00	5.80	6.30	4.45	5.03	6.25	6.30	7.00	6.25	5.60	5.75	5.55	2.85	5.05	
	716	4.20	6.35	6.00	6.05	5.10	5.32	6.20	7.26	6.65	6.13	5.88	5.48	5.52	5.50	5.27	
Average		5.13	6.41	5.74	6.21	4.72	5.24	6.08	7.23	6.64	5.54	5.66	5.28	5.68	5.13	5.46	
201-300	708		5.60	4.95			4.95	5.95		4.75	4.20	3.85	4.60		5.0	5.55	
	711			4.95	5.40	4.70	4.81	5.12		6.12	4.99	4.53	5.16	5.20	5.31	4.93	
	712		5.40	4.85	5.50	4.20	4.99			5.65	5.62	4.90	4.76	5.15	4.88	4.62	
	713			5.00	5.80	4.30	4.76			5.38	5.66	5.12	4.82	5.15	4.66	4.79	4.63
	714		5.20	4.95	5.15	4.50	4.71			6.30	5.62	5.28	4.84	5.12	4.69	4.72	4.68
Average			5.44	4.94	5.44	4.43	4.82	5.36	5.75	5.61	4.98	4.70	5.11	4.78	4.93	4.88	
0-30		0.20	-0.70	-0.21	1.55	1.68	2.34	1.72	-1.17	-0.76	-0.85	0.17	-0.52	-0.90	-0.24	-0.91	
31-50		0.61	0.08	-0.58	1.19	-0.06	0.59	0.88	-1.15	-0.93	-0.73	0.37	-0.37	-0.81	-0.46	-0.42	
51-100		0.91	1.98	0.21	2.08	0.22	0.40	1.52	0.02	0.55	0.11	0.71	0.03	-0.25	-0.02	0.37	
101-150		2.85	5.81	6.03	6.71	4.67	5.10	6.38	6.09	7.35	5.84	5.95	4.20	3.89	4.08	5.25	
151-200		5.13	6.41	5.74	6.21	4.72	5.24	6.08	7.23	6.64	5.54	5.66	5.28	5.68	5.13	5.46	
201-300			5.44	4.94	5.44	4.43	4.82	5.36	5.75	5.61	4.98	4.70	5.11	4.78	4.93	4.88	

Table 13. Cod abundance (000's) from stratified-random cruises conducted by France in Subdivision 3Ps. Numbers in brackets are estimates for non-sampled strata.

Depth (m)	Strata	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
< 55	314	33	0	(73)	267	22	133	0	33	33	67	(354)	33	0	0	0
	320	36	241	(256)	784	90	572	663	136	45	(785)	0	90	181	0	45
	TOTAL	69	241	329	1051	112	705	663	169	78	352	354	123	181	0	45
56-90	308	189	12	35	35	161	46	157	50	134	31	38	65	0	12	23
	312	605	99	28	677	456	99	6837	155	298	0	75	56	5	360	0
	315	368	57	0	269	113	85	3597	28	321	868	265	28	28	0	28
	321	20	896	326	502	387	221	147	16	55	(628)	1222	0	0	0	0
	325	(108)	(152)	(138)	129	(567)	275	647	65	226	0	485	0	0	0	65
TOTAL	1290	1216	527	1612	1684	726	11385	314	1034	1527	2085	149	33	372	116	
91-180	307	1948	1154	3084	640	4662	2958	2624	785	21238	4694	1136	8852	1144	419	189
	311	402	1628	1158	4357	3995	4147	15162	1954	18038	9503	16231	5973	1040	265	275
	317	0	119	(697)	724	4940	1696	16436	989	1182	8457	5410	7993	859	2260	2344
	319	1051	4583	1146	3262	3516	7666	5473	3909	2887	5695	3639	9413	13319	2186	1427
	322	939	617	5742	1149	4916	5720	2603	4239	4883	11270	4776	6735	912	134	54
	323	349	226	318	1156	572	3671	3683	2670	4576	1907	1668	1621	95	24	72
	324	(479)	(611)	(570)	0	(1845)	2605	3147	1607	727	237	3164	1878	85	34	118
TOTAL	5168	8938	12715	11288	24446	28463	49128	16153	53531	41763	36024	42465	17454	5322	4479	
181-270	306	765	870	698	9691	2841	6333	947	278	14560	2956	2589	3935	2759	535	273
	309	355	1642	264	1453	595	1500	1588	872	4906	831	2859	5852	13611	476	811
	310	396	186	15	489	1095	935	105	9513	175	382	2276	146	553	279	303
	313	130	328	11	859	814	678	83	2359	138	1432	23	1639	995	305	28
	316	65	95	39	165	423	30	173	4088	826	215	667	4871	6236	1458	2637
	318	21	8	(191)	247	34	1182	604	576	5810	101	2786	1097	1936	1692	166
TOTAL	1732	3129	1218	12904	5802	10658	3500	17686	26415	5917	11200	17540	26090	4745	4218	
271-365	705	254	982	27	423	3286	672	908	69	224	220	274	267	87	73	0
	706	22	0	98	672	3054	179	532	163	1981	8977	791	157	717	378	98
	707	(140)	586	(166)	13	2603	183	19	827	1172	81	80	51	73	105	1940
	715	922	597	895	628	2473	588	1636	917	1132	961	882	276	2048	1311	45
	716	123	357	923	455	1772	1196	1058	25	2258	5353	4836	406	1707	1329	222
TOTAL	1461	2522	2109	2191	13188	2818	4153	2001	6767	15592	6863	1157	4632	3196	2305	
366-545	708	(52)	(68)	(63)	45	353	8	4	315	381	1543	88	172	297	2472	357
	711				0		33						0	823	702	22
	712				0		133						0	2466	2666	34
	713				21								0	1854	2017	22
	714				137		0						0	9877	47664	1054
TOTAL	52	68	63	203	353	174	4	315	381	1543	88	172	15317	55521	1489	
0-545	TOTAL	9775	16115	16960	29249	45585	43544	68833	36638	88206	67194	56614	61608	63707	69156	12652
Confidence Interval		12225	22211	19582	41387	59497	52592	113553	49004	136843	91756	77558	82570			
		7325	10019	14338	16795	31673	34164	24113	24272	39571	42632	35670	40648			

Table 14. Cod biomass (MT) from stratified-random cruises conducted by France in Subdivision 3Ps.

Depth (m)	Strata	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
< 55	314	17	0		1390	111	30	0	7	13	133		17	0	0	0
	320	108	814		3797	513	2803	3526	104	14	0	0	316	222	0	5
	TOTAL	125	814		5187	624	2833	3526	111	27	133	0	333	222	0	5
56-90	308	371	9	150	88	299	151	111	65	100	29	6	25	0	1	3
	312	820	270	112	2304	454	636	1403	145	343	0	28	55	2	11	0
	315	771	850	0	1076	821	326	16918	8	1813	2058	2134	198	41	0	510
	321	183	4785	3746	2199	3746	1362	1026	3	543	0	649	0	0	0	0
	325				2101		1332	1466	81	259	0	453	0	0	0	65
TOTAL	2145	5914	4008	7768	5320	3807	20924	302	3058	2087	3270	278	43	12	578	
91-180	307	3598	2714	4428	1876	9009	6269	5384	2976	23172	8089	565	6168	215	37	24
	311	87	3199	1136	5797	8202	3572	19599	1276	20627	1356	4815	675	267	8	13
	317	0	260		813	454	421	21353	1502	2562	1049	815	973	226	183	243
	319	997	5810	1303	4435	4078	11349	8101	2831	3179	5746	5434	5889	3067	1907	89
	322	605	1945	3381	1793	2404	967	1122	2388	5944	2734	215	864	172	11	5
	323	91	572	858	822	54	794	803	512	2399	953	311	60	10	19	14
	324				0		815	964	594	288	99	171	90	44	8	34
TOTAL	5378	14500	11106	15536	24201	24187	57326	12079	58171	20026	12326	14719	4001	2173	422	
181-270	306	3080	2660	2162	12197	3716	11967	2296	804	23131	8294	4041	4691	663	69	33
	309	167	2743	804	2176	1122	3318	3852	1581	7434	1901	4827	7947	6726	151	172
	310	411	190	19	481	1683	739	229	4675	169	503	739	164	93	33	32
	313	113	331	1	1099	1279	840	170	1753	142	562	26	373	240	18	5
	316	91	121	39	282	544	36	332	38395	695	334	320	2324	4464	481	1265
	318	42	25		593	34	5282	786	1828	28349	259	4558	941	2096	2109	304
TOTAL	3904	6070	3025	16828	8378	22182	7665	49036	59920	11853	14511	16440	14282	2861	1811	
271-365	705	321	1115	13	574	4550	984	1661	99	414	354	394	325	49	46	0
	706	11	0	293	952	4010	375	1141	333	3896	13845	1413	296	768	422	334
	707		1303		13	10980	652	49	2314	3338	134	102	118	193	125	1476
	715	836	832	1564	827	4159	1261	3806	2282	2613	1908	1772	542	1759	783	42
	716	178	455	1169	554	2104	1934	2326	86	2775	5685	6264	439	1096	842	89
TOTAL	1346	3705	3039	2920	25803	5206	8983	5114	13036	21926	9945	1720	3865	2218	1941	
365-545	708				85	373	44	8	593	849	6136	264	429	899	1771	286
	711				0		296					0	1058	954	64	
	712				0		300					0	2926	3584	49	
	713				108							0	2268	1789	7	
	714				354		0					0	9607	58529	911	
TOTAL				547	373	640	8	593	849	6136	264	429	16758	66627	1317	
0-545	TOTAL	12899	31002	21178	48787	64699	58856	98433	67235	135061	62164	40316	33918	39169	73891	6074

TABLE 15. MEAN NUMBERS PER TOW AT AGE FROM SURVEYS CONDUCTED BY FRANCE.
ZERO CATCHES ASSUMED FOR UNSURVEYED DEEP WATER STRATA.

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
1	0.00	0.05	0.00	0.05	0.79	3.56	0.02	0.10	0.06	2.52	4.02	1.43	0.29	0.81	0.08
2	0.57	0.33	5.25	0.14	9.16	8.31	8.87	4.25	5.55	15.80	11.34	18.89	2.39	12.14	3.35
3	1.22	0.30	1.22	3.78	1.50	4.16	5.85	11.21	3.23	8.82	11.36	12.25	18.26	7.08	4.20
4	2.39	1.61	0.36	3.81	6.35	2.29	11.54	5.78	11.64	2.17	7.03	6.27	20.11	12.96	1.40
5	1.59	5.65	1.90	3.96	6.08	5.55	6.69	3.04	20.28	6.36	2.76	4.44	7.66	12.68	0.84
6	0.93	2.53	3.21	5.74	4.63	4.70	14.53	0.82	16.59	9.57	4.98	2.66	2.46	7.56	0.51
7	0.69	1.41	1.18	4.35	3.47	3.50	4.28	1.51	6.99	6.38	3.58	3.39	0.73	2.42	0.19
8	0.40	0.74	0.48	1.23	4.05	2.13	1.63	0.88	5.34	2.26	1.22	1.55	1.00	1.07	0.05
9	0.23	0.29	0.21	0.92	1.21	1.60	2.37	0.60	2.95	1.49	0.60	0.77	0.44	0.91	0.02
10	0.17	0.17	0.16	0.36	0.66	0.58	1.69	0.67	0.61	0.73	0.27	0.21	0.26	0.62	0.01
11	0.02	0.22	0.13	0.12	0.32	0.19	0.47	0.84	0.45	0.15	0.27	0.10	0.11	0.06	0.01
12	0.03	0.07	0.08	0.11	0.11	0.15	0.12	1.02	0.55	0.28	0.12	0.05	0.09	0.15	0.01
13	0.01	0.08	0.06	0.05	0.16	0.06	0.10	0.09	0.17	0.11	0.11	0.05	0.03	0.03	0.03
14	0.02	0.17	0.13	0.10	0.08	0.05	0.09	0.18	0.25	0.22	0.25	0.06	0.06	0.03	0.03
1+	8.27	13.64	14.35	24.71	38.57	36.84	58.25	31.00	74.64	56.86	47.91	52.13	53.89	58.52	10.72
2+	8.27	13.59	14.35	24.66	37.78	33.28	58.23	30.90	74.58	54.34	43.89	50.70	53.60	57.71	10.64
3+	7.70	13.25	9.10	24.53	28.62	24.97	49.36	26.65	69.03	38.54	32.55	31.81	51.21	45.57	7.28
4+	6.49	12.95	7.88	20.74	27.13	20.81	43.51	15.44	65.81	29.72	21.19	19.56	32.95	38.49	3.09

TABLE 16. MEAN NUMBERS PER TOW AT AGE FROM SURVEYS CONDUCTED BY FRANCE. CATCHES FOR UNSURVEYED DEEP WATER STRATA ASSUMED SAME PROPORTION AS CANADIAN RV.

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
1	0.00	0.07	0.00	0.05	0.79	3.56	0.02	0.10	0.08	2.60	4.14	1.43	0.29	0.81	0.08
2	0.62	0.46	5.47	0.14	9.21	8.31	9.43	4.38	6.93	16.29	11.69	18.89	2.39	12.14	3.35
3	1.32	0.41	1.27	3.78	1.50	4.16	6.22	11.56	4.03	9.09	11.71	12.25	18.26	7.08	4.20
4	2.60	2.21	0.37	3.81	6.38	2.29	12.27	5.96	14.55	2.24	7.25	6.27	20.11	12.96	1.40
5	1.73	7.73	1.98	3.96	6.12	5.55	7.12	3.14	25.35	6.56	2.85	4.44	7.66	12.68	0.84
6	1.01	3.47	3.35	5.74	4.65	4.70	15.45	0.85	20.74	9.87	5.14	2.66	2.46	7.56	0.51
7	0.75	1.93	1.23	4.35	3.49	3.50	4.55	1.56	8.73	6.57	3.69	3.39	0.73	2.42	0.19
8	0.44	1.02	0.50	1.23	4.07	2.13	1.73	0.91	6.67	2.33	1.26	1.55	1.00	1.07	0.05
9	0.25	0.40	0.21	0.92	1.21	1.60	2.52	0.62	3.69	1.53	0.61	0.77	0.44	0.91	0.02
10	0.19	0.23	0.16	0.36	0.67	0.58	1.80	0.69	0.76	0.75	0.28	0.21	0.26	0.62	0.01
11	0.02	0.31	0.13	0.12	0.32	0.19	0.50	0.87	0.56	0.16	0.28	0.10	0.11	0.06	0.01
12	0.03	0.10	0.08	0.11	0.12	0.15	0.13	1.05	0.69	0.28	0.13	0.05	0.09	0.15	0.01
13	0.01	0.11	0.06	0.05	0.16	0.06	0.11	0.10	0.21	0.12	0.12	0.05	0.03	0.03	0.03
14	0.03	0.23	0.13	0.10	0.08	0.05	0.10	0.18	0.31	0.23	0.26	0.06	0.06	0.03	0.03
1+	8.99	18.68	14.95	24.71	38.77	36.84	61.96	31.96	93.30	58.62	49.39	52.13	53.89	58.52	10.72
2+	8.99	18.61	14.95	24.66	37.98	33.28	61.94	31.86	93.22	56.02	45.25	50.70	53.60	57.71	10.64
3+	8.37	18.15	9.48	24.53	28.77	24.97	52.50	27.48	86.29	39.73	33.56	31.81	51.21	45.57	7.28
4+	7.05	17.74	8.21	20.74	27.27	20.81	46.28	15.92	82.26	30.64	21.85	19.56	32.95	38.49	3.09

TABLE 17. ANALYSIS OF VARIANCE AND REGRESSION COEFFICIENTS FROM THE REGRESSION OF LN C/E FOR COD IN SUBDIVISION 3Ps.

MULTIPLE R..... 0.798
 MULTIPLE R SQUARED..... 0.637

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DF	SUMS OF SQUARES	MEAN SQUARES	F-VALUE
INTERCEPT	1	1.356E-5	1.356E-5	
REGRESSION	23	9.211E0	4.005E-1	7.645
TYPE 1	10	7.317E0	7.317E-1	13.968
TYPE 2	13	2.222E0	1.709E-1	3.262
RESIDUALS	100	5.238E0	5.238E-2	
TOTAL	124	1.445E1		

CATEGORY	CODE	VARIABLE	COEFFICIENT	STD. ERROR	NO. OBS.
3	1	INTERCEPT	1.126	0.304	124
4	78				
3	2	1	-0.571	0.229	9
	3	2	-0.776	0.220	10
	4	3	-0.678	0.205	13
	5	4	-1.165	0.200	13
	6	5	-1.829	0.217	11
	7	6	-1.905	0.263	7
	9	7	-1.735	0.303	6
	10	8	-1.344	0.199	14
	11	9	-0.483	0.194	14
	12	10	-0.526	0.196	14
4	79	11	-0.173	0.334	7
	80	12	-0.016	0.361	7
	81	13	-0.551	0.334	8
	82	14	-0.381	0.326	8
	83	15	-0.195	0.325	8
	84	16	0.150	0.318	8
	85	17	0.148	0.302	11
	86	18	0.090	0.301	11
	87	19	-0.125	0.308	10
	88	20	-0.764	0.307	10
	89	21	-0.713	0.304	11
	90	22	-0.265	0.307	9
	91	23	-0.299	0.305	10

TABLE 18. ST. PIERRE OTTER TRAWL CATCH RATE INDEX FOR COD
IN SUBDIVISION 3Ps.

YEAR	LN TRANSFORM		RETRANSFORMED		CATCH	EFFORT
	MEAN	S.E.	MEAN	S.E.		
1978	1.1262	0.0924	3.022	0.902	1614	534
1979	0.9528	0.0621	2.580	0.636	3794	1470
1980	1.1103	0.0789	2.995	0.829	1722	575
1981	0.5749	0.0583	1.772	0.424	3768	2127
1982	0.7455	0.0562	2.103	0.494	3771	1793
1983	0.9308	0.0560	2.532	0.594	4775	1886
1984	1.2763	0.0486	3.590	0.786	6773	1887
1985	1.2738	0.0409	3.595	0.724	9422	2621
1986	1.2159	0.0403	3.394	0.678	13653	4023
1987	1.0010	0.0439	2.733	0.569	15214	5568
1988	0.3626	0.0440	1.443	0.301	10011	6937
1989	0.4131	0.0418	1.520	0.309	9646	6348
1990	0.8615	0.0439	2.377	0.495	14769	6214
1991	0.8269	0.0427	2.297	0.472	15583	6783

AVERAGE C.V. FOR THE RETRANSFORMED MEAN: 0.227

TABLE 20. CATCH RATE INDEX AT AGE OF COD TAKEN BY ST PIERRE
 OTTER TRAWLERS IN SUBDIV. 3Ps FOR THE PERIOD 1978-91.

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
3	1.97	0.11	0.78	0.18	0.08	0.28	0.17	0.19	0.05	0.14	0.16	0.91	0.89	0.64
4	7.53	4.22	1.20	0.74	2.38	1.28	3.67	4.30	2.61	0.93	1.96	5.04	5.35	3.12
5	9.91	9.49	4.38	1.36	2.85	6.07	3.57	9.26	7.84	5.89	2.03	3.92	5.39	5.79
6	6.29	5.27	8.03	2.21	2.21	3.56	5.87	4.30	7.51	5.82	1.68	1.55	1.85	3.52
7	2.25	1.73	2.71	2.93	1.89	1.57	2.94	3.17	2.62	2.44	1.92	0.89	0.68	1.10
8	0.58	0.53	0.82	0.52	1.61	0.75	0.83	0.90	0.93	0.71	0.76	0.19	1.00	0.50
9	0.11	0.13	0.17	0.09	0.21	0.43	0.81	0.24	0.27	0.48	0.29	0.11	0.44	0.37
10	0.07	0.08	0.03	0.02	0.02	0.06	0.36	0.24	0.08	0.11	0.07	0.06	0.19	0.30
11	0.04	0.02	0.00	0.00	0.00	0.02	0.13	0.25	0.05	0.06	0.02	0.02	0.06	0.03
12	0.02	0.02	0.00	0.00	0.00	0.00	0.04	0.12	0.05	0.01	0.02	0.01	0.03	0.05
13	0.00	0.01	0.00	0.00	0.00	0.00	0.01	0.02	0.03	0.02	0.01	0.01	0.00	0.01
14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.01	0.01	0.00
3+	28.76	21.61	18.14	8.08	11.24	14.03	18.38	23.01	22.04	16.62	8.92	12.71	15.89	15.44

TABLE 21. RESULTS OF ADAPT USING CANADIAN AND FRENCH RV WITH NO 1992 DATA.
 APPROXIMATE STATISTICS ASSUMING LINEARITY NEAR SOLUTION

PARAMETER	AGE	ESTIMATE	STD. ERR.	T-STAT	C.V.
ORTHOGONALITY OFFSET..... 0.006896					
MEAN SQUARE RESIDUALS 0.512104					

NUMBERS					
	3	72419	38341	1.889	0.529
	4	120368	45403	2.651	0.377
	5	81265	26380	3.081	0.325
	6	31974	10393	3.076	0.325
	7	8462	2842	2.977	0.336
	8	3301	1110	2.975	0.336
	9	5204	1753	2.968	0.337
	10	2809	1010	2.782	0.360
	11	1343	506	2.655	0.377
	12	844	296	2.855	0.350
INDEX 1: RV11					
	3	1.42E-5	3.14E-6	4.540	0.220
	4	4.12E-5	8.87E-6	4.648	0.215
	5	1.00E-4	2.14E-5	4.680	0.214
	6	1.65E-4	3.55E-5	4.649	0.215
	7	1.97E-4	4.32E-5	4.564	0.219
	8	2.33E-4	5.27E-5	4.422	0.226
	9	2.48E-4	5.73E-5	4.327	0.231
	10	2.31E-4	5.46E-5	4.236	0.236
	11	2.34E-4	5.52E-5	4.244	0.236
	12	2.18E-4	5.06E-5	4.309	0.232
INDEX 2: RV22					
	3	7.15E-5	1.45E-5	4.936	0.203
	4	9.72E-5	1.93E-5	5.041	0.198
	5	1.61E-4	3.18E-5	5.069	0.197
	6	2.35E-4	4.67E-5	5.037	0.199
	7	2.78E-4	5.62E-5	4.955	0.202
	8	2.85E-4	5.93E-5	4.807	0.208
	9	2.91E-4	6.19E-5	4.704	0.213
	10	2.56E-4	5.54E-5	4.616	0.217
	11	1.70E-4	3.67E-5	4.623	0.216
	12	1.98E-4	4.23E-5	4.692	0.213

TABLE 21. CONTINUED.

LOG RESIDUALS FROM RV11											25/ 2/93	
	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
3	0.83	1.08	0.40	-0.06	-1.15	0.62	0.23	0.26	-0.42	-1.00	-0.46	-0.33
4	0.08	1.27	0.72	-1.04	-1.47	0.60	0.17	0.70	-0.22	-0.72	0.13	-0.22
5	0.27	1.22	-0.10	-0.33	-1.87	0.22	0.23	1.01	0.05	-0.93	0.29	-0.07
6	-0.61	0.99	-0.49	-0.55	-0.85	-0.18	0.28	0.64	0.53	-0.45	0.64	0.04
7	-1.47	0.56	-0.22	-0.85	-0.95	-0.23	0.14	0.46	0.91	-0.02	1.08	0.60
8	-0.58	-0.16	-0.53	-0.08	-0.83	-0.62	-0.14	0.38	1.17	-0.00	0.51	0.89
9	-0.77	0.94	-0.93	0.24	-0.47	-0.35	0.06	-0.26	1.03	0.08	0.22	0.20
10	-0.51	0.62	-0.96	0.34	-0.28	-0.08	-0.19	-0.40	0.34	0.20	0.40	0.52
11	0.06	-0.98	-0.25	0.88	-1.01	-0.53	-0.12	0.06	0.77	-0.09	0.28	0.93
12	0.19	0.24	-1.26	1.02	0.07	0.34	-0.47	0.14	0.81	-0.67	-0.93	0.53
SUM OF RV RESIDUALS : 0.0004489419313 MEAN RESIDUAL : 0.000003741182761												

LOG RESIDUALS FROM RV22											25/ 2/93			
	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
3	-0.84	-1.53	-0.86	-0.31	-0.80	-0.27	0.20	0.92	0.62	1.04	0.68	0.27	0.56	0.33
4	-0.94	-0.41	-1.74	0.15	0.13	-0.47	0.72	0.06	1.06	-0.05	0.74	-0.03	0.67	0.13
5	-1.05	-0.05	-0.71	0.42	0.42	-0.21	0.44	-0.85	1.31	0.09	0.04	0.12	0.03	0.00
6	-1.10	-0.29	-0.82	0.43	0.64	0.20	0.91	-1.66	1.20	0.50	0.04	0.17	-0.25	0.05
7	-0.52	-0.03	-0.98	-0.21	0.33	0.67	0.50	-1.02	1.13	0.66	0.06	0.03	-0.72	0.08
8	-0.42	0.47	-0.78	-0.44	0.28	0.41	0.47	-0.66	1.02	0.55	-0.22	-0.12	-0.75	0.18
9	-0.08	0.01	-0.49	0.43	0.01	-0.14	1.04	-0.20	1.21	0.04	-0.23	-0.13	-0.98	-0.48
10	-0.18	0.46	-0.37	0.69	0.76	-0.23	0.49	0.28	0.51	0.15	-1.10	-0.71	-0.65	-0.11
11	-1.75	1.17	0.68	0.04	1.48	0.35	0.33	0.46	0.91	-0.30	-0.09	-1.41	-0.57	-1.31
12	-0.51	0.16	-0.00	0.67	0.19	0.96	0.13	1.19	0.39	0.41	-0.35	-1.76	-1.40	-0.08
SUM OF RV RESIDUALS : 0.0004597153985 MEAN RESIDUAL : 0.000003283681418														

TABLE 21. CONTINUED.

		POPULATION NUMBERS (000S)													25/ 2/93
		1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
3	1	43425	27227	42695	73692	47531	77669	72785	65515	30848	45661	84629	133558	148804	72283
4	1	69889	35099	22169	34623	59410	38797	62902	59407	53453	24979	36855	68442	108379	120015
5	1	31895	52564	25957	16680	25734	44033	29338	47409	44370	39146	17777	25694	47897	80932
6	1	13586	20597	33697	16679	10819	17061	27750	19913	28434	27050	22076	10056	13941	31799
7	1	4796	7499	12280	20209	9446	6733	10276	16370	10768	13121	13312	12219	5643	8402
8	1	2452	2340	4010	6996	11248	5145	3928	6404	8813	4941	5808	6333	7698	3278
9	1	985	1416	1264	2149	4261	6550	3172	2687	3889	5255	2764	3133	4179	5183
10	1	899	594	949	739	1271	2909	4421	2106	1823	2596	3301	1693	2022	2795
11	1	590	575	410	674	447	821	2161	3313	1384	1290	1817	2445	1184	1339
12	1	290	418	423	285	491	291	590	1648	2411	978	921	1376	1874	841
13	1	249	213	321	306	202	375	204	451	1231	1845	730	686	1075	1441
3+		169057	148544	144175	173032	170858	200384	217527	225225	187424	166860	189989	265637	342696	328308

		FISHING MORTALITY													25/ 2/93
		1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
3	1	0.013	0.005	0.010	0.015	0.003	0.011	0.003	0.003	0.011	0.014	0.012	0.009	0.015	0.012
4	1	0.085	0.102	0.084	0.097	0.100	0.079	0.083	0.092	0.111	0.140	0.161	0.157	0.092	0.076
5	1	0.237	0.245	0.242	0.233	0.211	0.262	0.187	0.311	0.295	0.373	0.370	0.411	0.210	0.147
6	1	0.394	0.317	0.311	0.369	0.274	0.307	0.328	0.415	0.573	0.509	0.391	0.378	0.306	0.228
7	1	0.517	0.426	0.363	0.386	0.408	0.339	0.273	0.419	0.579	0.615	0.543	0.262	0.343	0.332
8	1	0.349	0.416	0.424	0.296	0.341	0.284	0.180	0.299	0.317	0.381	0.417	0.216	0.196	0.315
9	1	0.306	0.201	0.337	0.325	0.182	0.193	0.209	0.188	0.204	0.265	0.290	0.238	0.202	0.141
10	1	0.247	0.170	0.142	0.304	0.237	0.097	0.088	0.220	0.146	0.157	0.100	0.157	0.212	0.184
11	1	0.145	0.107	0.164	0.116	0.230	0.131	0.071	0.118	0.147	0.137	0.078	0.066	0.142	0.093
12	1	0.108	0.066	0.125	0.146	0.070	0.152	0.068	0.092	0.068	0.092	0.094	0.047	0.063	0.105
13	1	0.078	0.070	0.075	0.067	0.062	0.054	0.044	0.060	0.073	0.084	0.083	0.048	0.049	0.039

TABLE 22. SUMMARY OF VPA RESULTS FOR SUBDIVISION 3PS COD

YEAR	FISHING MORTALITY	RECRUITMENT (x 10 ⁻⁶)	BIOMASS (x 10 ⁻³)	
			3+	6+
1959	0.34	59	246	145
1960	0.42	59	232	135
1961	0.73	51	211	151
1962	0.41	49	170	114
1963	0.32	43	157	108
1964	0.4	71	157	105
1965	0.46	81	157	98
1966	0.69	84	165	89
1967	0.43	100	159	76
1968	0.45	71	170	83
1969	0.61	57	175	94
1970	0.58	36	170	109
1971	0.77	61	153	104
1972	0.54	41	127	84
1973	0.71	32	121	72
1974	0.8	43	103	65
1975	0.92	57	89	51
1976	0.39	62	83	34
1977	0.31	78	124	41
1978	0.39	44	134	52
1979	0.35	27	132	65
1980	0.37	41	144	92
1981	0.39	72	160	95
1982	0.38	47	160	85
1983	0.32	77	189	89
1984	0.23	72	238	120
1985	0.3	64	272	131
1986	0.39	30	236	139
1987	0.44	44	210	129
1988	0.44	79	197	113
1989	0.26	122	232	96
1990	0.27	134	285	99
1991	0.29	61	297	120
1992 (a)			293	164
1992 (b)			89	26

a. 1992 survey results not considered

b. Using 1992 survey results with catchabilities from the ADAPT analysis

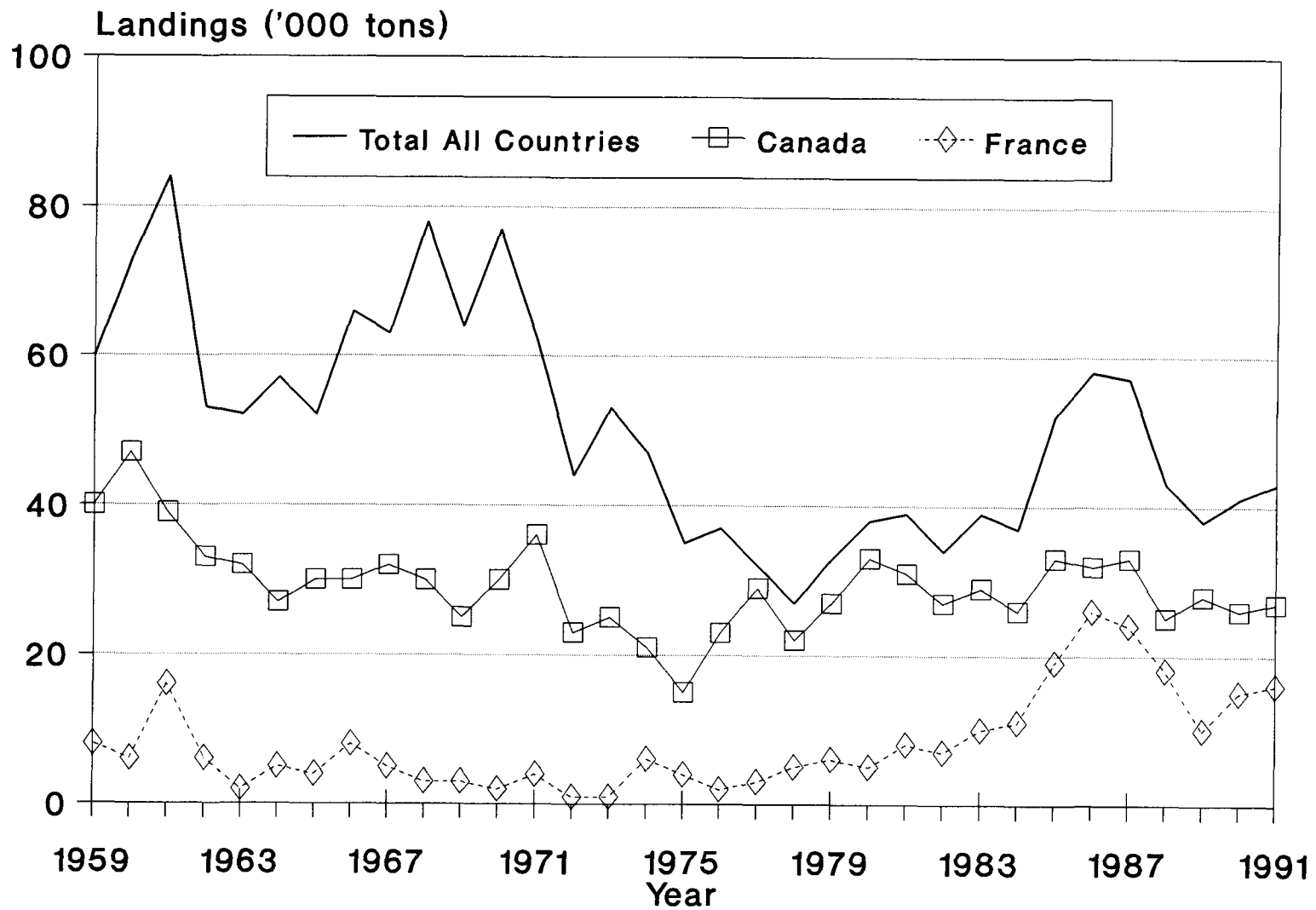


Figure 1. Cod landings from Subdivision 3Ps for the period 1959-91.

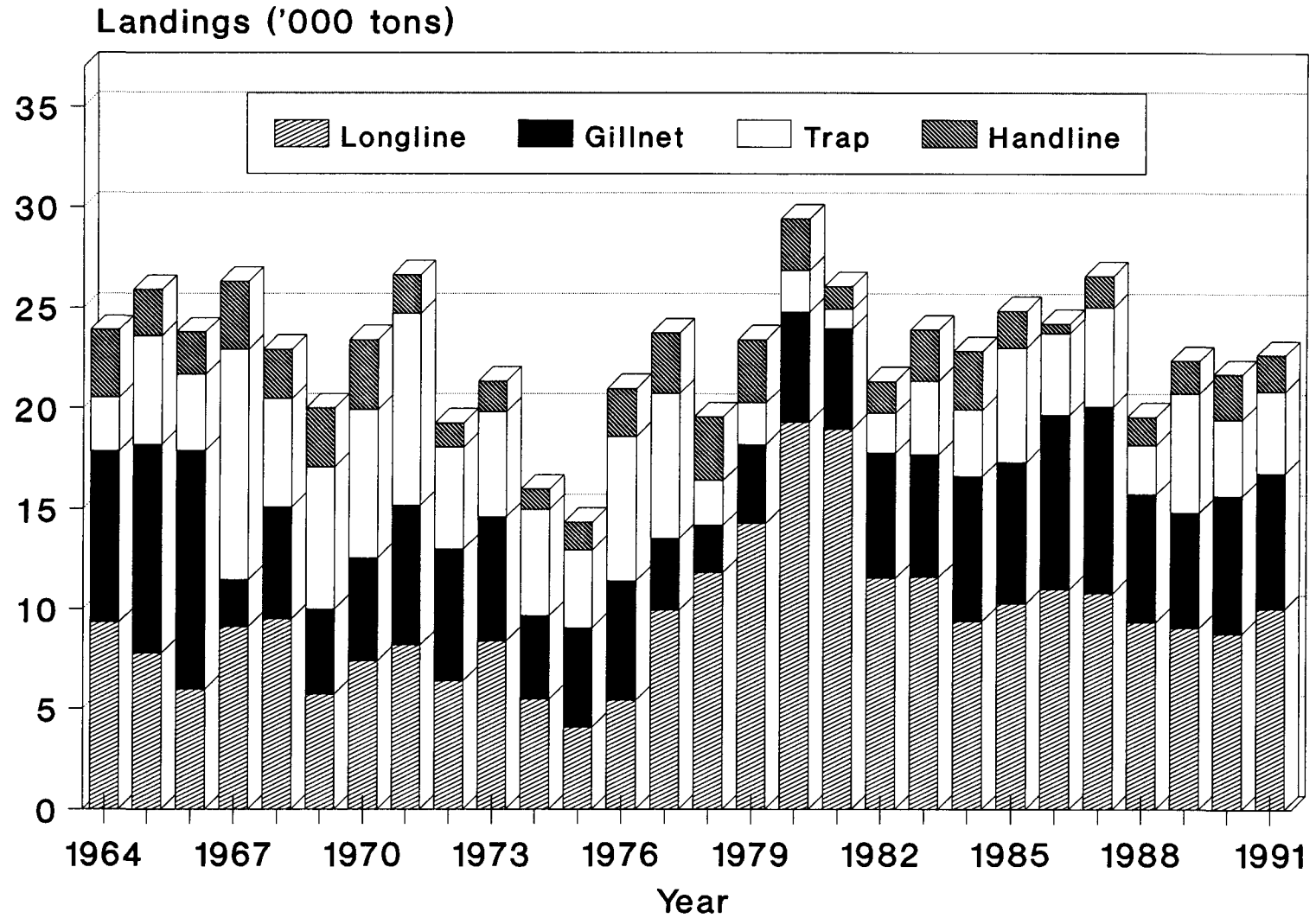


Figure 2. Fixed gear cod landings by Canada in Subdivision 3Ps.

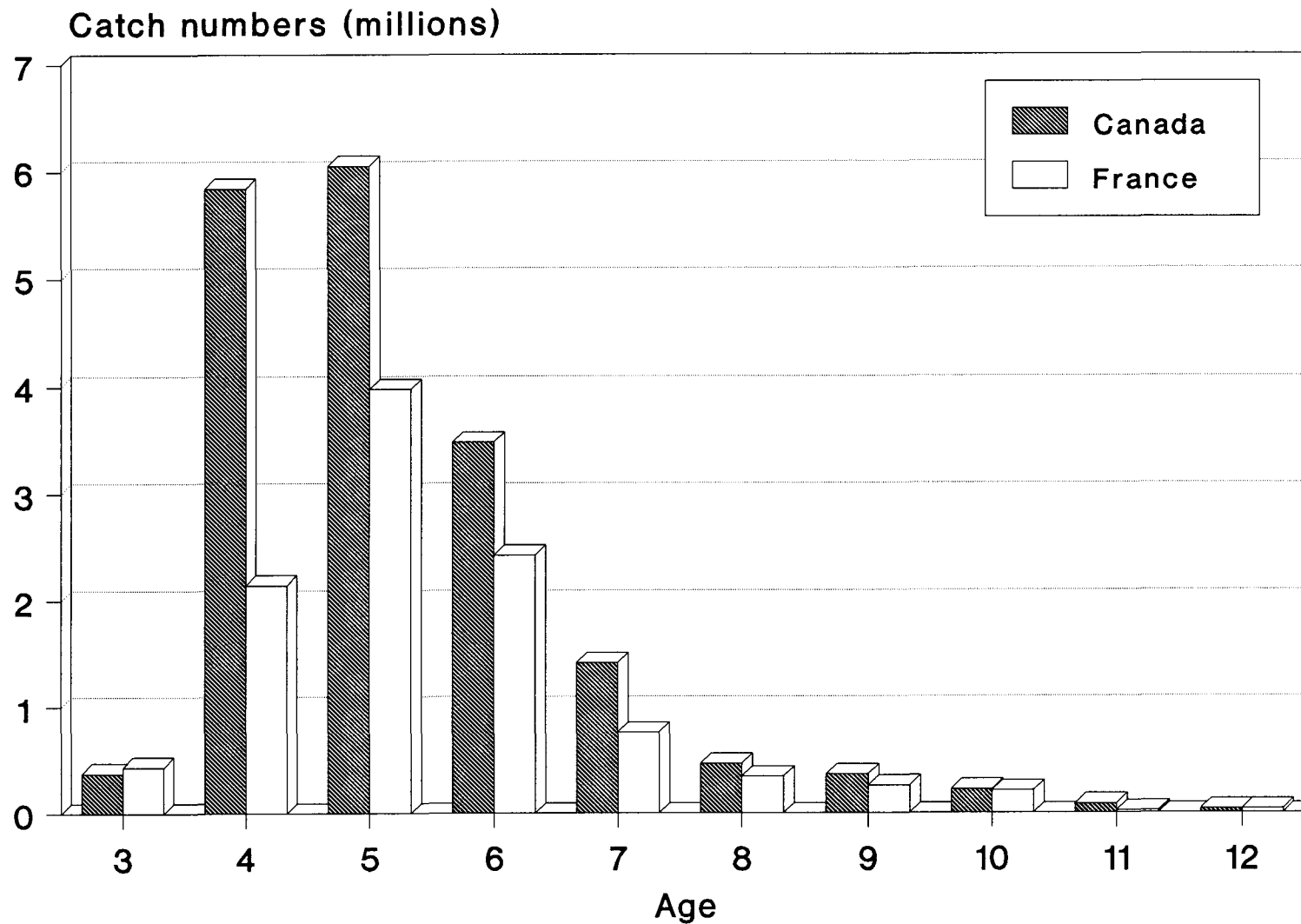


Fig 3. Canadian and French commercial age compositions for 1991.

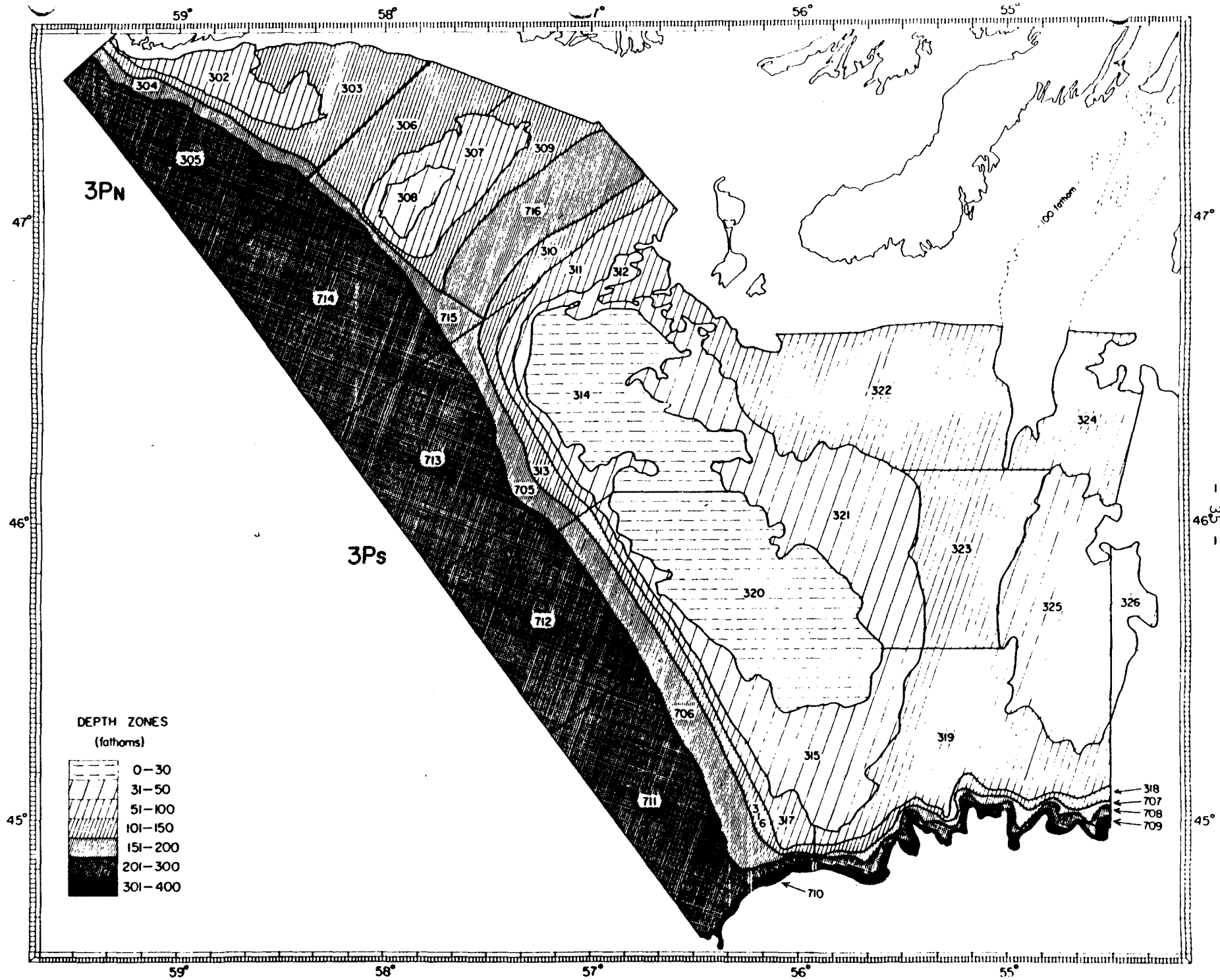


FIGURE 4. STRATIFICATION SCHEME USED FOR RANDOM-STRATIFIED RESEARCH VESSEL SURVEYS IN SUBDIVISION 3PS.

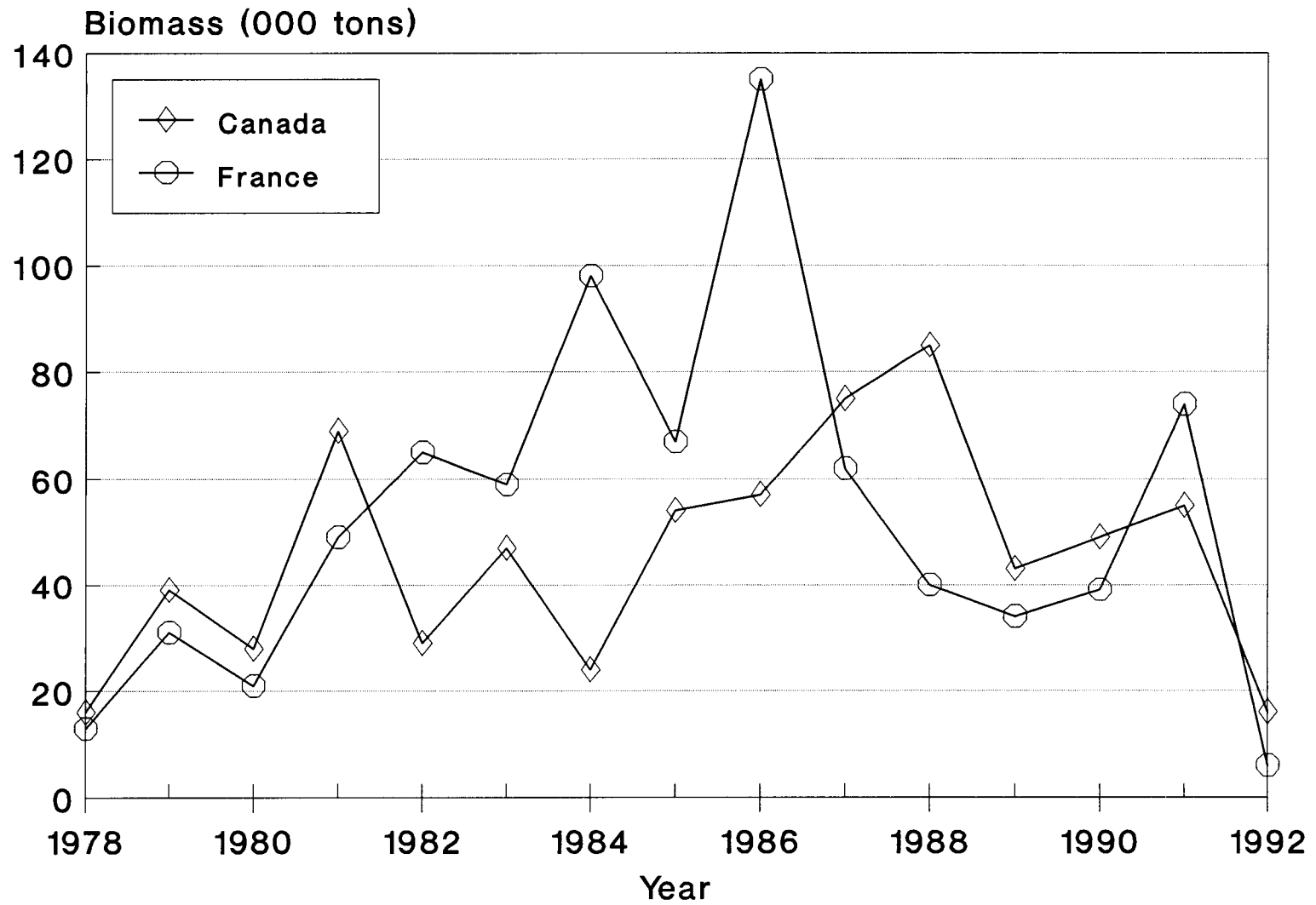


Fig 5. Biomass of cod in Subdiv. 3Ps estimated from Canadian and French RV.

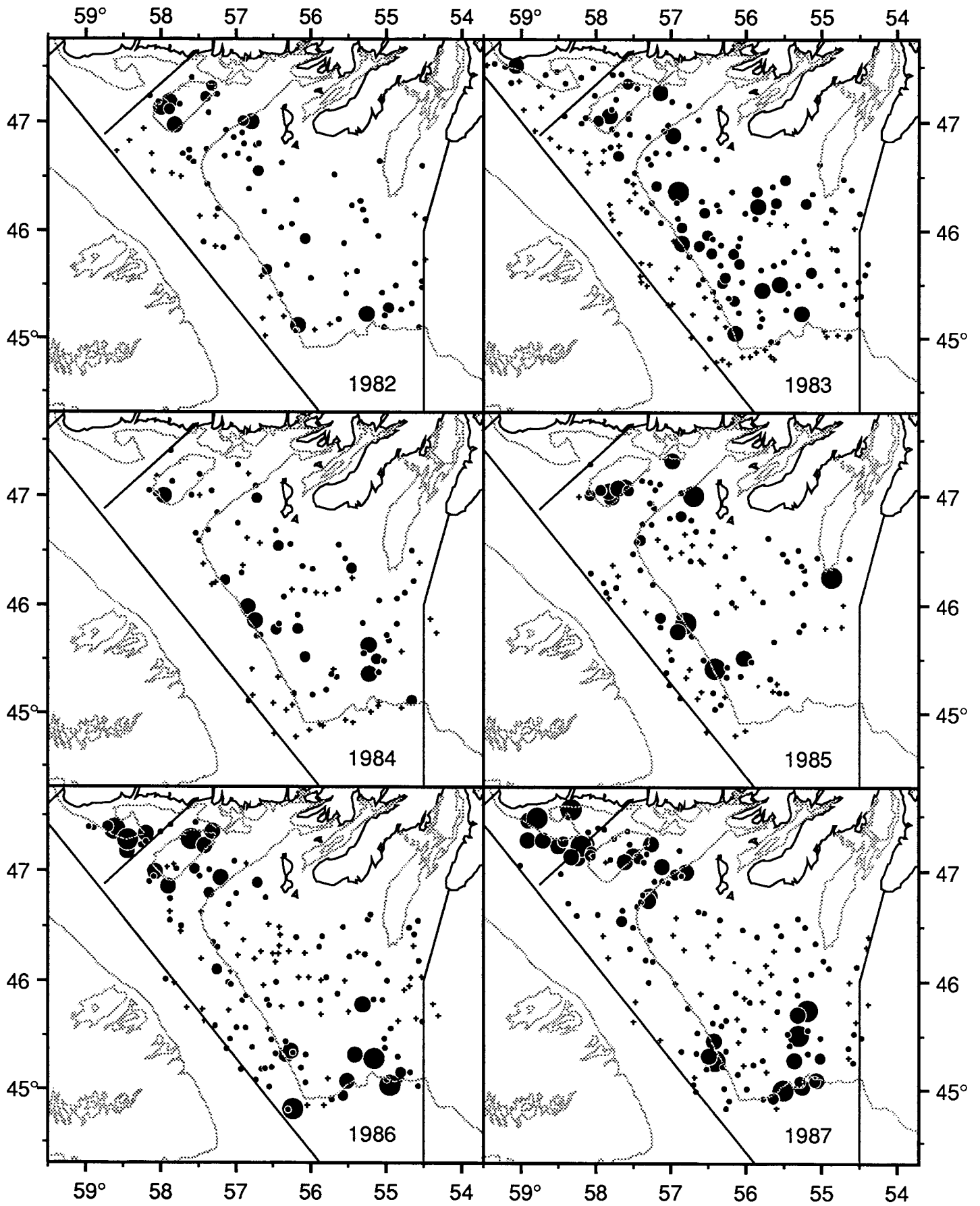


Fig. 6 : Distribution of cod catches during Canadian research surveys to 3Ps.

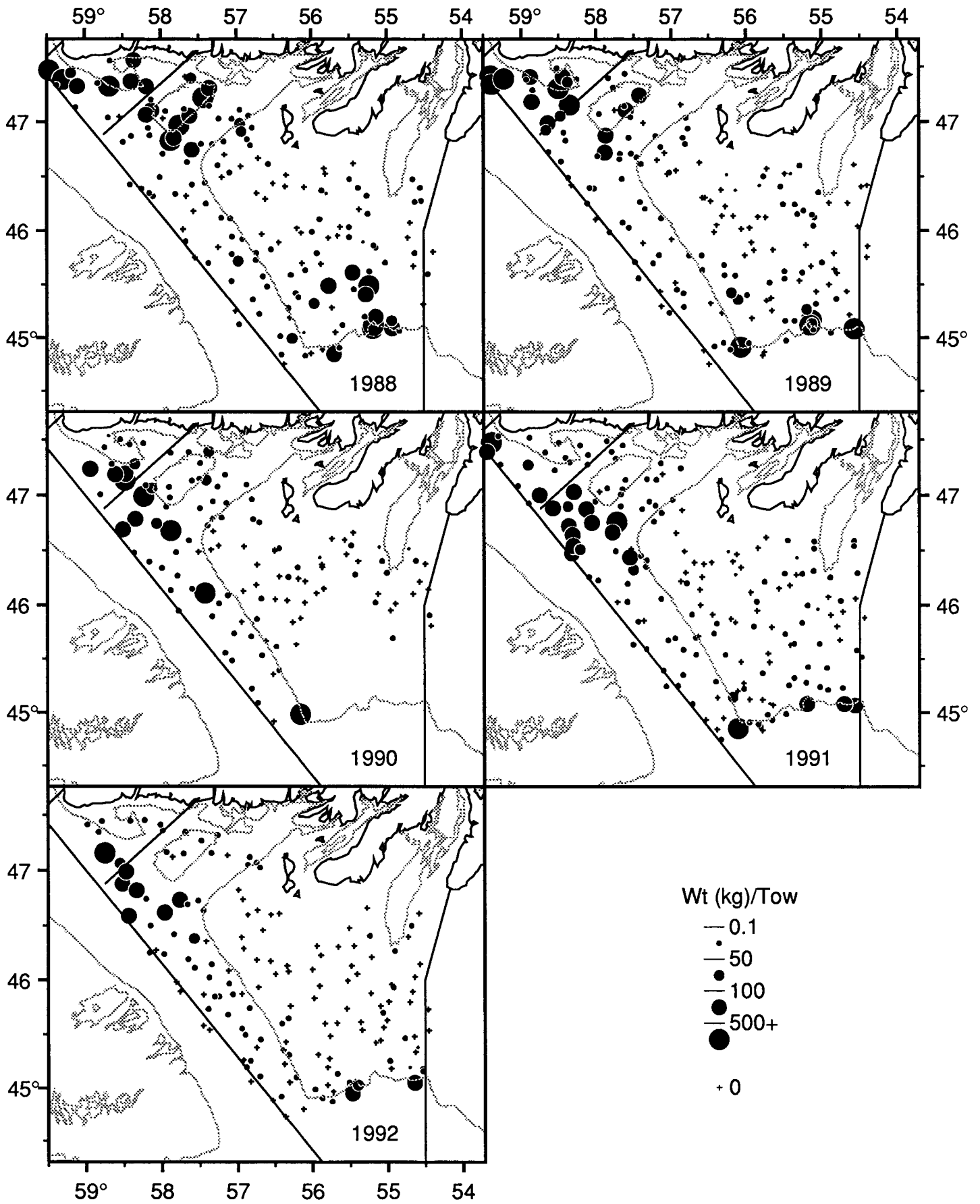


Fig. 6: Continued.

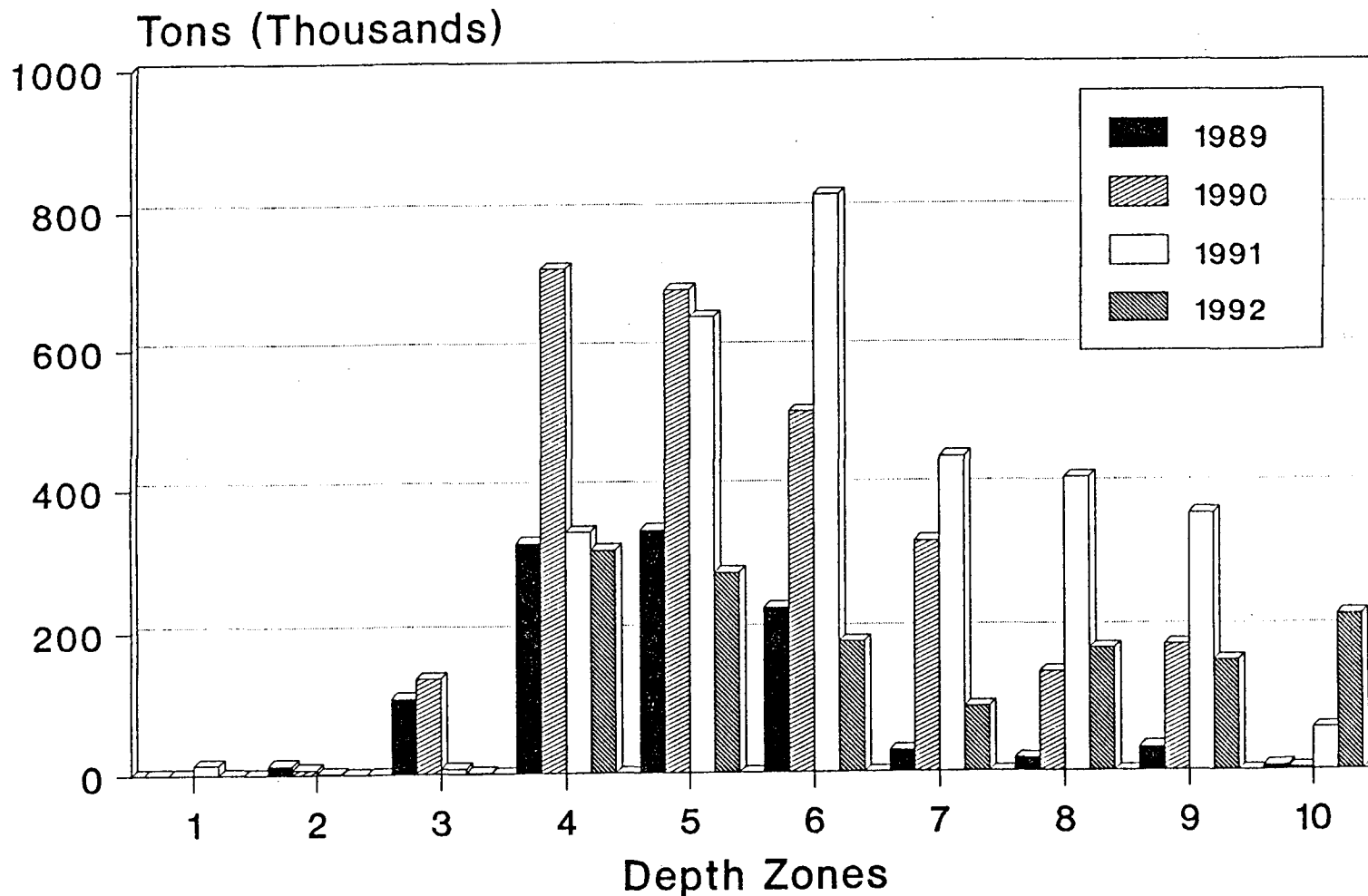
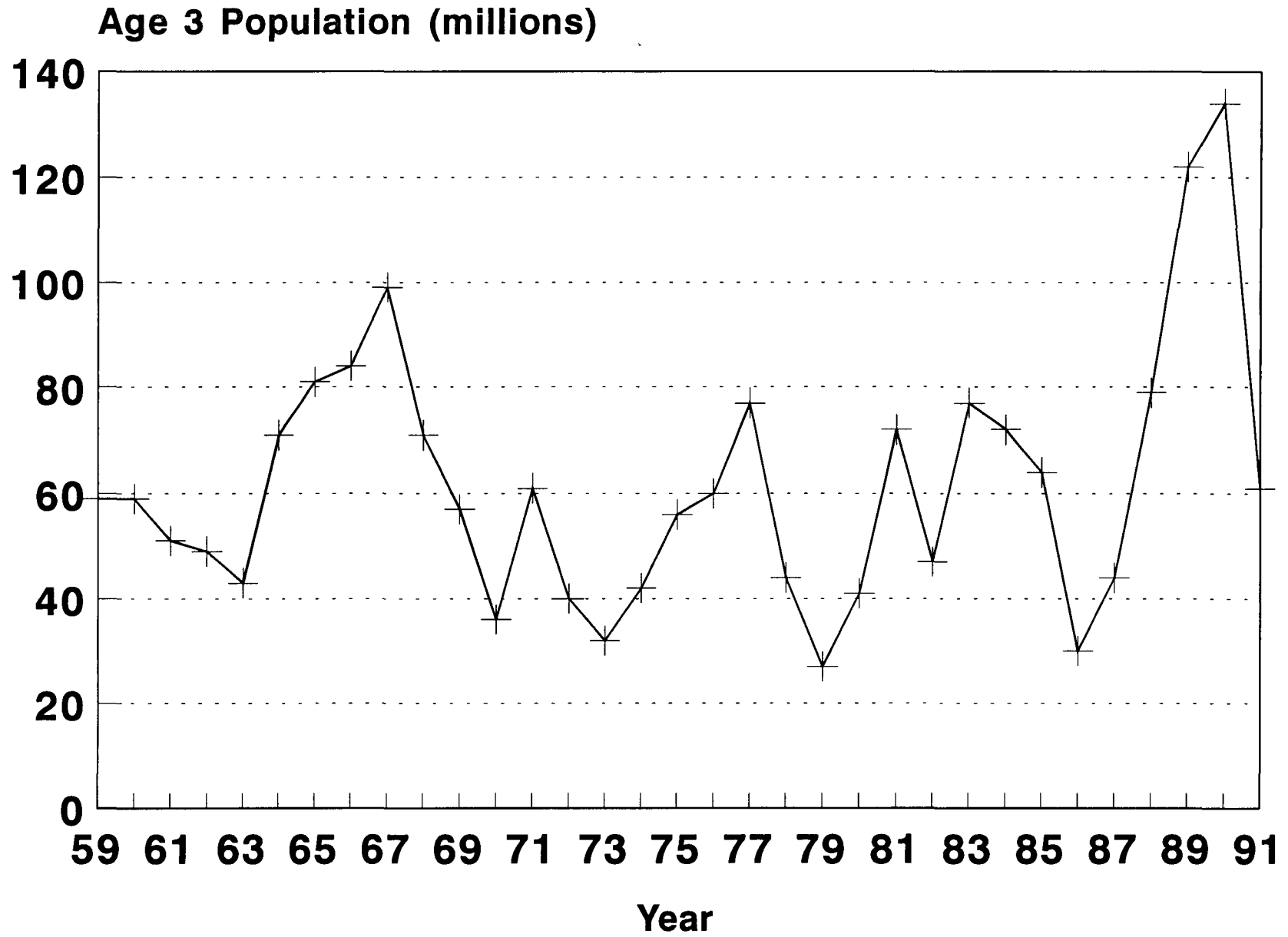


Fig. 7. Cod landings by depth zone for Subdivision 3Ps.

Depth Zone	Code
0 - 25 Fathoms	1
26 - 50 Fathoms	2
51 - 75 Fathoms	3
76 - 100 Fathoms	4
101 - 125 Fathoms	5
126 - 150 Fathoms	6
151 - 175 Fathoms	7
176 - 200 Fathoms	8
201 - 250 Fathoms	9
251 & Over	0



**Figure 8. Age 3 population numbers:
Cod in Subdivision 3Ps.**

Fig. 9. Cod in Subdivision 3Ps: Fishing Mortality

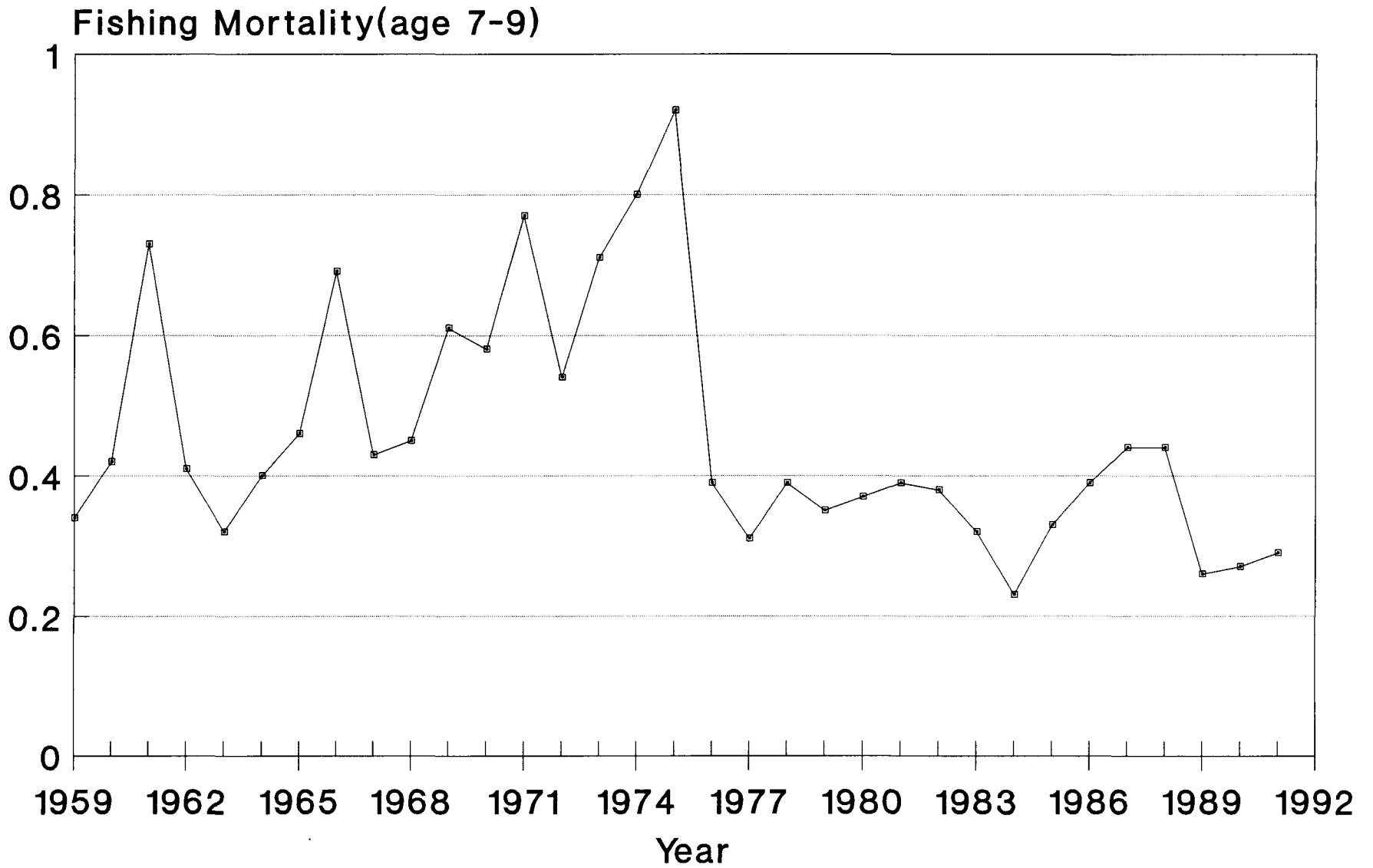


Fig. 10. Cod in Subdivision 3Ps:
Age 3+ January 1 SPA biomass

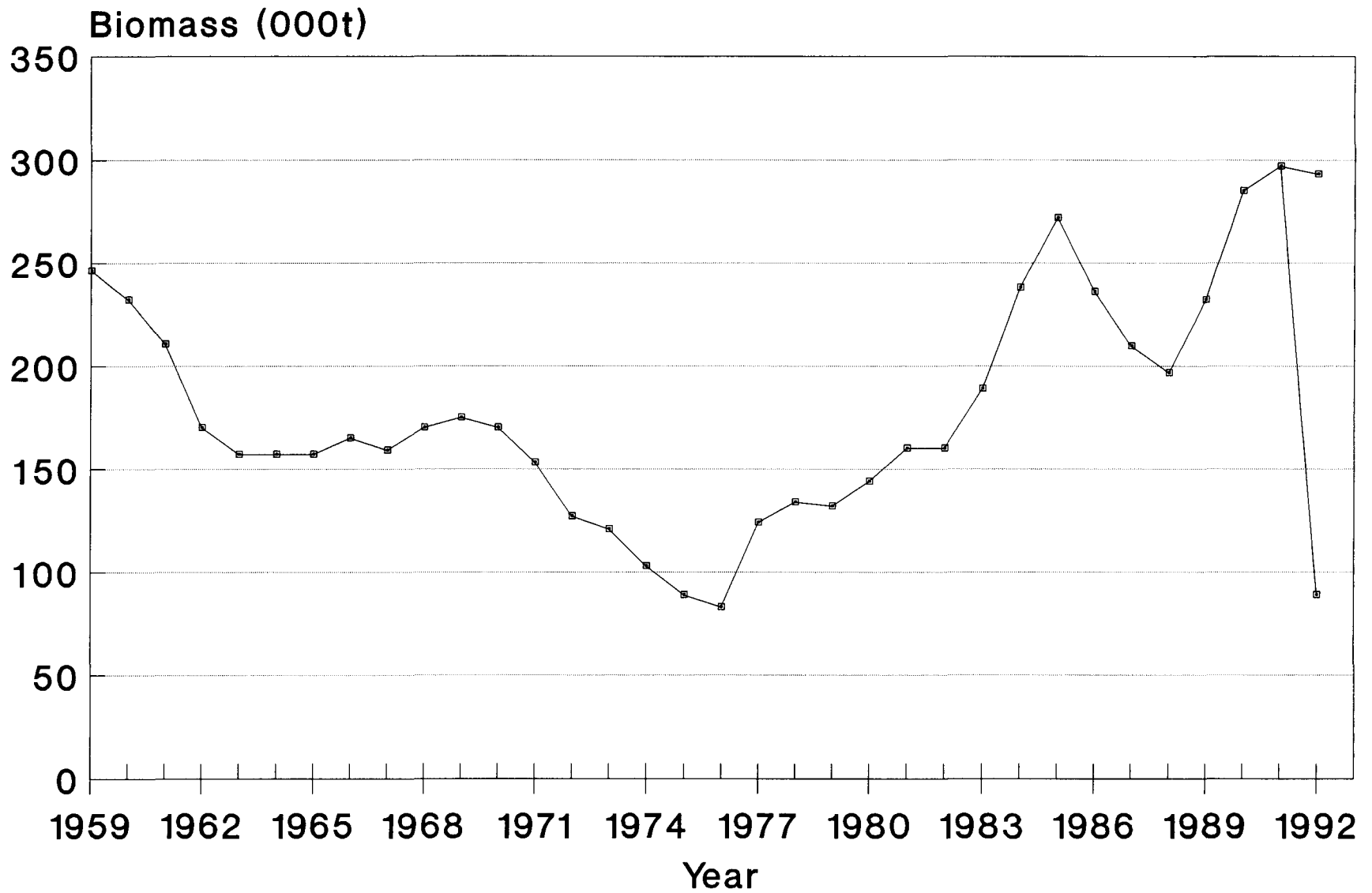


Fig. 11. Cod in Subdivision 3Ps:
Age 6+ January 1 SPA biomass

