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Status of the Cod Stock in NAFO Subdivision 3Ps

by

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<sup>1</sup>La présente série documente les bases scientifiques des évaluations des ressources halieutiques sur la côte atlantique du Canada. Elle traite des problèmes courants selon les échéanciers dictés. Les documents qu'elle contient ne doivent pas être considérés comme des énoncés définitifs sur les sujets traités, mais plutôt comme des rapports d'étape sur les études en cours.

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## Abstract

Catches averaged slightly over 30,000 t from 1977 to the mid 1980's when there was an increase to about 57,000 t in 1986 and 1987. Since that time there has been a decline in catches to about 32,000 t in 1992 and further to only 15,000 t in 1993, the lowest level in the time series. The research vessel data suggest that population numbers and biomass have been declining since the late 1980's. Research survey biomass was low in 1994 but increased substantially in 1995. However, this was based on the results from one survey tow. In response to questions regarding stock structure identification and possible stock overlap with adjoining divisions, research survey coverage in recent years has been increased and the timing of the survey has been changed. Research vessel data suggested some improvement in the stock in 1995 although this was based on a single large survey catch. (There are no indications of good recruitment after the relatively strong year-class of 1989.)

## Résumé

Les prises se chiffraient en moyenne à un peu plus de 30 000 t, entre 1977 et le milieu des années 80, puis ont grimpé à environ 57 000 t en 1986 et 1987. Cependant, on a assisté depuis à une baisse, avec 32 000 t en 1992, et 15 000 t seulement en 1993, le plus bas niveau enregistré dans les séries chronologiques. Les données obtenues par navire de recherche semblent indiquer que le nombre de poissons et la biomasse diminuent depuis la fin des années 80. La biomasse observée au cours des relevés était faible en 1994, mais a connu une hausse substantielle en 1995. Toutefois, cette conclusion est basée sur les résultats d'un seul trait de chalut. On a élargi le champ d'application du relevé et modifié le moment de sa réalisation, afin de répondre aux questions concernant la structure du stock et les chevauchements possibles de stocks de divisions adjacentes. Les données tirées des relevés révèlent une certaine amélioration du stock en 1995, bien que cette conclusion soit basée sur les prises d'un seul relevé. (Il n'y a eu aucun signe de bon recrutement après la classe relativement forte de 1989.)

## Introduction

Nominal catches in Subdiv. 3Ps averaged 62,000 t from 1959 to 1974 peaking at 84,000 t in 1961 (Table 1; Fig. 1). Catches were stable at about 35,000 t from 1975 to 1984 but increased to 57,000 t in 1986-87, mainly as a result of increased offshore catch by France. Fishing area restrictions due to the boundary dispute have led to fluctuations in the French catch since the late 1980's. The 1993 TAC was reduced and access by French vessels to Canadian waters was restricted. There was no offshore French fishery in 1993. The total 1993 catch was 15,000 t, the lowest in the time series to that time, with the majority being obtained in the Canadian inshore fixed gear fishery. Based on the recommendations of the FRCC, the fishery was closed by the Canadian government in August 1993. A recreational food fishery was permitted for a total of 8 days in 1994. About 480 t of cod were taken before the fishery was closed while a further 165 t was taken as by-catch in other fisheries.

Catches by inshore gears (trap, gillnet, longline and handline) have traditionally accounted for the largest portion of the total Canadian catches. These have ranged between 20,000 t and 29,000 t since 1976 with a decline to 15,000 t in 1993 (Fig. 1). The catch in 1994 was mainly by jigger (Table 2).

### Catch and average weight-at-age

A summary of the sampling used to derive the catch-at-age in 1994 is given in Table 3. The following relationship was applied in deriving the average weights-at-age;  $\log \text{ weight} = 3.0879 \times \log \text{ length} - 5.2106$ . Catch numbers and average weights at age obtained using this catch and sampling data are shown in Table 4. The 1989 year-class (age 5) was most abundant in the total catch.

Tables 5-7 show catch (numbers and biomass) and average weights-at-age for the 1959-94 period. Average weight at age generally increased from 1993 to 1994 although comparability might not be realistic considering the very restricted fishery in 1994.

### Research vessel surveys

Stratified-random surveys have been conducted in Subdiv. 3Ps during winter-spring by Canada since 1972 and by France for the 1978-92 period. The two survey series were similar with regard to the stratification scheme used (Fig. 3), method of sampling, and analysis of results but differ in the type of fishing gear used and the daily timing of the survey (daylight hours only for French survey). Canadian surveys were conducted by the research vessels A. T. CAMERON (1972-82), the ALFRED NEEDLER (1983-84) and the WILFRED TEMPLEMAN (1985-95). 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 surveys have been conducted by the research vessels CRYOS (1978-91) and THALASSA (1992). Results from the French surveys have been presented previously (Bishop et al. 1994) and are not included in this paper.

Canadian surveys have covered strata in depth ranges to 300 fath since 1980. Since the 1993 survey, new strata were added to those already surveyed, covering the outside part of Placentia Bay (5 strata). Four of these new strata were fished in the 1995 survey.

Results from both survey series have been highly variable. Biomass estimates from Canadian surveys (Tables 8 and 10; Fig. 2) showed an increasing trend in the mid-1980's peaking at 85,000 t in 1988. This was followed by a decline in 1989, increases in both 1990 and 1991, and a substantial decline to about 8,000 t in April 1993, the lowest levels observed in the 1978-94 time series. The 1994 survey results indicated an increase in biomass to approximately 15,000 t. Abundance estimates (Tables 9 and 10) followed a similar pattern.

In recent years cod have been found mainly in the deeper strata (200-300 fath) (Fig. 4).

Biomass and abundance from the 1995 survey were substantially higher than those of recent years (Table 10; Fig. 2). However, this resulted from the occurrence of one large cod catch in a relatively small stratum (#318) (Fig. 3 and 5). The two tows conducted in this stratum obtained catches of 19.5 kg and 14,699 kg respectively. The variance about the mean estimate for this stratum were very high (Table 10). The biomass estimated for this stratum was 71,260 t, 91% of the total for the whole survey area.

Mean number-per-tow estimates from the Canadian surveys (Table 11) indicated that in 1994, the 1989 year-class was most abundant.

Since 1991, bottom water temperatures from surveys have generally increased from the lows experienced during the mid-1980's and in 1990 but large spatial areas with negative temperature anomalies have continued into the spring of 1994, particularly on the eastern portion of St. Pierre Bank, on the continental slope areas and in Placentia Bay (Colbourne 1995). Possible impacts of these changes have not been determined.

## Discussion

With the exception of that for 1995, surveys since 1991 have suggested that there has been a decline in the resource from levels estimated for the late 1980's. Although there were some questions concerning the reliability of the research surveys as indicators of stock abundance, they suggested that the resource was at a low level. This was consistent with declining length at age, increased total mortality from catch curve analyses and a loss of older age groups. Similar to stocks in adjoining divisions, 3Ps cod appeared to have declined since the mid-1980's.

Results from the 1995 survey suggest that the stock has improved dramatically. However, a very cautious approach to interpretation of these results is necessary considering the basis for the survey estimate. The stock is very likely closer to that estimated for 1994. If the very large catch is replaced by a similar value to that in the only other tow on the stratum, biomass estimated might have been lower than that in 1994. Unless there is further corroborating data, the 1995 estimate should be treated as a large, though interesting, outlier.

## References

- Bishop, C. A., E. F. Murphy and M. B. Davis. 1994. An assessment of the cod stock in NAFO Subdivision 3Ps. DFO Atlantic Fisheries Research Document 94/33, 33 p.
- Colbourne, E. 1995. Oceanographic conditions and climate change in the Newfoundland Region during 1994. DFO Atlantic Fisheries Research Document 95/3, 36 p.

Table 1. Cod catches (MT) from Subdivision 3Ps, 1959-93.

Year	Can (N)		Can(M)	France			Spain	Portugal	Other	Total
	Offshore (Mobile)	Inshore (fixed gear)		STPM M		Metro				
				Inshore	Offshore					
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	5,538	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	1,617	2,860	-	-	45	27,221
1979	2,381	23,413	863	495	3,794	2,060	-	-	-	33,006
1980	1,809	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	3,663	19,742	2,303	282	10,011	7,373	-	-	4	43,377
1989	3,098	23,208	2,361	335	9,646	892	-	-	-	39,540
1990*	2,990	20,047	3,289	158	14,769	-	-	-	-	41,253
1991*	3,395	21,297	2,596	204	15,583	-	-	-	-	43,075
1992*	3,905	17,940	2,628	2	7,050	-	-	-	-	31,525
1993*	1987	11,533	1,351	40	-	-	-	-	-	14,911
1994	81	481	84	-	-	-	-	-	-	646

\*Provisional.

Table 2. Cod landings (t) by the food and subsistence as well as by-catch fisheries by Canada in Subdivision 3Ps during 1994.

Month	Mobile gear				Fixed gear			Total	
	OT	MWT	DS	GN	LL	Jig.	HL		Other
J	10	27			2	10	1		50
F		15			1	1			17
M	13	14			1	1			29
A	10	11	8	3	5			15	52
M	12			15	1			7	35
J	6			36	1				43
J			2	15	2	2	1		22
A	1		1	4	3	94	26		129
S					1	192	51		244
O		1	3	3					7
N	4		1	6	1				12
D	6								6
Total	62	68	15	82	18	300	79	22	646 <sup>a</sup>

<sup>a</sup>Includes 84 t reported from Scotia-Fundy Region.

Table 3. Sampling used to estimate catch at age for cod in Subdivision 3Ps in 1994.

Gear	Month	No. measured	No. aged	Total weight (t)	Cumulative total (t)
OT+Seine	Jan	1719		37	
+MWT+LL(off)	Feb	54	316	15	
	Apr	1027	196	10	
	Jun	127		6	
	Nov	273	43	5	163
GN	May	164	62	15	
	Jun	154	104	36	82
Jigger+	Sept	5193	492	243	401
HL+other					
Totals		8711	1213		646

Table 4. Catch, average weight, and average length of cod from fisheries in Subdivision 3Ps during 1994.

AGE	AVERAGE		CATCH		
	WEIGHT (Kg.)	LENGTH (cm.)	MEAN (000's)	STD. ERR.	C. V.
2	0.261	31.320		0.20	0.56
3	0.615	41.182	8	1.88	0.22
4	0.816	45.226	72	4.86	0.07
5	1.350	53.059	147	6.59	0.04
6	1.943	59.511	61	4.65	0.08
7	2.095	60.801	49	3.86	0.08
8	3.007	67.914	22	2.03	0.09
9	3.807	73.673	11	1.26	0.12
10	4.400	77.213	3	0.59	0.21
11	6.435	86.626	2	0.44	0.27
12	7.442	92.104		0.15	0.35
13	7.590	93.124		0.14	0.34
14	6.171	87.226	1	0.52	0.67
15	12.044	109.000		0.02	0.75
16	8.540	97.010		0.02	0.86
17					
18					
19					
20	10.112	103.000		0.02	1.05
21	17.934	124.000		0.00	0.01

TABLE 5 . CATCH NUMBERS AT AGE (THOUSANDS) FROM THE COMMERCIAL COD FISHERY IN NAFO SUBDIVISION 3PS FOR THE YEARS 1959-94.

	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971
3	1001	567	450	1245	961	1906	2314	949	2871	1143	774	756	2884
4	13940	5496	5586	6749	4499	5785	9636	13662	10913	12602	7098	8114	6444
5	7525	23704	10357	9003	7091	5635	5799	13065	12900	13135	11585	12916	8574
6	7265	6714	15960	4533	5275	5179	3609	4621	6392	5853	7178	9763	7266
7	4875	3476	3616	5715	2527	2945	3254	5119	2349	3572	4554	6374	8218
8	942	3484	4680	1367	3030	1881	2055	1586	1364	1308	1757	2456	3131
9	1252	1020	1849	791	898	1891	1218	1833	604	549	792	730	1275
10	1260	827	1376	571	292	652	1033	1039	316	425	717	214	541
11	631	406	446	187	143	339	327	517	380	222	61	178	85
12	545	407	265	140	99	329	68	389	95	111	120	77	125
13	44	283	560	135	107	54	122	32	149	5	67	121	62
14	0	27	58	241	92	27	36	22	3	107	110	14	57
3+	39280	46411	45203	30677	25014	26623	29471	42834	38336	39032	34813	41713	38662
4+	38279	45844	44753	29432	24053	24717	27157	41885	35465	37889	34039	40957	35778
5+	24339	40348	39167	22683	19554	18932	17521	28223	24552	25287	26941	32843	29334
6+	16814	16644	28810	13680	12463	13297	11722	15158	11652	12152	15356	19927	20760
	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
3	731	945	1887	1840	4110	935	502	135	368	1022	130	760	203
4	4944	4707	6042	7329	12139	9156	5146	3072	1625	2888	5092	2682	4521
5	4591	11386	9987	5397	7923	8326	6096	10321	5054	3136	4430	9174	4538
6	3552	4010	6365	4541	2875	3209	4006	5066	8156	4652	2348	4080	7018
7	4603	4022	2540	5867	1305	920	1753	2353	3379	5855	2861	1752	2221
8	2636	2201	1857	723	495	395	653	721	1254	1622	2939	1150	584
9	833	2019	1149	1196	140	265	235	233	327	539	640	1041	542
10	463	515	538	105	53	117	178	84	114	175	243	244	338
11	205	172	249	174	17	57	72	53	56	67	83	91	134
12	117	110	80	52	21	43	27	24	45	35	30	37	35
13	48	14	32	6	4	31	17	13	21	18	11	18	8
14	45	29	17	2	3	11	10	10	25	2	7	8	8
3+	22768	30130	30743	27232	29085	23465	18695	22085	20424	20011	18814	21037	20150
4+	22037	29185	28856	25392	24975	22530	18193	21950	20056	18989	18684	20277	19947
5+	17093	24478	22814	18063	12836	13374	13047	18878	18431	16101	13592	17595	15426
6+	12502	13092	12827	12666	4913	5048	6951	8557	13377	12965	9162	8421	10888
	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994			
3	206	306	585	935	1071	2006	812	1233	278	8			
4	4718	5103	2956	4951	8995	8622	7981	3393	3712	72			
5	11473	10253	11023	4971	7842	8195	10028	6960	2035	147			
6	6118	11228	9763	6471	2863	3329	5907	5590	3156	61			
7	5072	4283	5453	5046	2549	1483	2164	1989	1334	49			
8	1496	2167	1416	1793	1112	1237	807	635	401	22			
9	417	650	1107	630	600	692	620	270	89	11			
10	377	224	341	284	223	350	428	193	38	3			
11	333	171	149	123	141	142	108	173	52	2			
12	131	143	78	75	57	104	76	81	13	0			
13	24	79	135	53	29	47	50	43	14	0			
14	12	23	50	31	26	22	22	42	5	1			
3+	30377	34630	33056	25363	25508	26229	29003	20602	11127	376			
4+	30171	34324	32471	24428	24437	24223	28191	19369	10849	368			
5+	25453	29221	29515	19477	15442	15601	20210	15976	7137	296			
6+	13980	18968	18492	14506	7600	7406	10182	9016	5102	149			





TABLE 7. CATCH BIOMASS AT AGE (t) FROM THE COMMERCIAL COD FISHERY IN NAFO SUBDIVISION 3PS FOR THE YEARS 1959-94.

	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971
3	280	159	126	349	269	534	648	266	804	320	217	212	808
4	9619	3792	3854	4657	3104	3992	6649	9427	7530	8695	4898	5599	4446
5	8127	25600	11186	9723	7658	6086	6263	14110	13932	14186	12512	13949	9260
6	12205	11280	26813	7615	8862	8701	6063	7763	10739	9833	12059	16402	12207
7	11700	8342	8678	13716	6065	7068	7810	12286	5638	8573	10930	15298	19723
8	3024	11184	15023	4388	9726	6038	6597	5091	4378	4199	5640	7884	10051
9	5133	4182	7581	3243	3682	7753	4994	7515	2476	2251	3247	2993	5228
10	6401	4201	6990	2901	1483	3312	5248	5278	1605	2159	3642	1087	2748
11	3805	2448	2689	1128	862	2044	1972	3118	2291	1339	368	1073	513
12	3815	2849	1855	980	693	2303	476	2723	665	777	840	539	875
13	354	2278	4508	1087	861	435	982	258	1199	40	539	974	499
14	0	247	531	2208	843	247	330	202	27	980	1008	128	522
3+	64463	76563	89835	51994	44109	48512	48030	68036	51285	53352	55899	66138	66879
4+	64183	76404	89709	51645	43840	47979	47382	67770	50482	53032	55682	65926	66071
5+	54564	72612	85854	46988	40736	43987	40733	58343	42952	44336	50785	60327	61625
6+	46437	47011	74669	37265	33078	37901	34470	44233	29020	30150	38273	46378	52365
	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
3	205	265	528	515	1151	514	226	55	191	491	59	441	134
4	3411	3248	4169	5057	8376	6226	3602	1997	1170	2282	3921	2253	4702
5	4958	12297	10786	5829	8557	10824	6584	10424	5711	4140	5183	12201	6353
6	5967	6737	10693	7629	4830	5969	7011	8359	13539	8374	4179	8119	13825
7	11047	9653	6096	14081	3132	2456	4295	6000	8380	13466	6752	4520	5863
8	8462	7065	5961	2321	1589	1351	1952	2653	4514	5304	8464	3749	2202
9	3415	8278	4711	4904	574	1110	963	1002	1766	2350	2502	3925	2575
10	2352	2616	2733	533	269	578	918	545	792	994	1283	1230	1879
11	1236	1037	1501	1049	103	337	372	371	408	496	513	597	805
12	819	770	560	364	147	291	194	197	389	316	259	313	316
13	386	113	258	48	32	272	132	124	196	151	95	181	90
14	412	266	156	18	27	120	87	108	240	19	80	95	83
3+	42672	52344	48152	42348	28787	30049	26337	31836	37296	38383	33290	37623	38828
4+	42467	52079	47624	41833	27636	29534	26111	31780	37105	37892	33232	37182	38694
5+	39055	48831	43455	36776	19260	23308	22509	29784	35935	35611	29311	34929	33992
6+	34097	36534	32669	30947	10703	12485	15925	19359	30224	31471	24128	22728	27639
	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994			
3	132	165	328	589	675	1163	487	567	99	5			
4	4624	3827	2276	4060	7286	7415	5986	2307	2524	59			
5	15603	12099	13338	5418	9097	10408	11733	7238	2192	198			
6	11808	20660	15914	10807	4667	6159	10278	8888	4671	118			
7	12731	10408	12596	10950	5735	3633	5129	4475	2837	103			
8	5131	6826	4276	5236	3747	3711	2348	1842	1132	66			
9	1814	2795	4793	2255	2466	2920	2288	1094	386	42			
10	1908	1232	1743	1414	1155	1782	1810	1071	163	13			
11	1805	1058	924	690	887	902	685	1157	244	13			
12	1227	1247	544	495	416	790	584	650	97	0			
13	287	636	956	395	225	391	432	400	96	0			
14	130	274	417	277	227	228	214	487	41	6			
3+	57199	61227	58105	42586	36583	39502	41973	30176	14483	624			
4+	57068	61061	57777	41997	35908	38338	41486	29609	14384	619			
5+	52444	57234	55501	37937	28622	30923	35500	27302	11860	560			
6+	36841	45136	42163	32519	19525	20516	23768	20064	9669	362			

Table 8. Cod biomass estimates (t) from research vessel surveys in NAFO Division 3Ps.

DEPTH range (fath)	Stratum number	Stratum Area sq. mi.	ATC		ATC		ATC		ATC		ATC		AN		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	135	
			Mar 20-30	Mar 16-23	Apr 19-30	Jun 2-13	Apr 14-26	Feb 21-28	16-Feb	19-Mar	Mar 7-26	28-May	22-Apr	Apr 9-18	Mar 7-26	Mar 6-23	13-Feb	27-Jan	Feb 1-16	31-Jan	Feb 2-20	Feb 5-25	Apr 1-21	
			22-Mar		14-Feb		20-Feb																	
0-30	314	974	9	1326	17	2355	249	0	241	432	369	2028	13103	567	25	0	0	24	8	139	0	0	0	
	320	1320	707	829	279	1333	640	1036	1650	2946	23087	1920	5618	5456	5259	284	495	1729	1026	0	121	25	0	
31-50	308	112	175	278	205	193	311	38	125	240	305	490	766	681	1024	0	3	4	2	2	1	6	22	
	312	272	18	243	334	456	1047	343	151	105	165	766	524	674	1016	61	33	3	3	0	4	0	0	
	315	827	0	591	141	1746	1549	537	1836	235	0	528	2451	1893	329	2762	885	1247	1641	523	367	19	0	
	321	1189	0	355	105	1741	269	2035	730	1880	1419	2845	2419	1183	89	335	723	1738	367	2	59	0	19	
	325	944	0	53	0	2	34	180	820	28	1240	95	329	502	0	35	130	31	7	26	57	13	0	
	326	166	0	2	0	8	0	0	2	3	0	53	322	0	7	0	16	28	0	3	16	0	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	608	
	311	317	573	2430	763	627	410	154	1106	3792	761	1943	3256	863	4870	399	4331	593	361	18	24	2	21	
	317	193	278	589	164	550	491	298	368	536	268	1582	3685	30	14064	2180	886	109	243	0	552	15	122	
	319	984	643	477	481	3099	2490	2486	10637	1652	15068	3548	3799	3995	1282	10189	7784	12609	10170	1499	650	39	50	
	322	1567	73	360	98	5178	270	490	14	2599	26	3705	4932	2597	1073	2004	1503	369	52	38	35	6	0	
	323	696	87	336	109	367	63	1651	673	775	491	1215	858	2247	1263	2881	18047	143	281	3	24	22	0	
101-150	324	494	4	55	9	8	39	72	29	0	100	430	618	136	10756	230	187	125	0	6	22	7	0	
	306	419	113	433	1077	214	161	416	710	457	2652	1211	1250	236	590	755	11032	3589	267	779	24	16	849	
	309	296	437	204	311	178	192	103	1558	863	2983	1178	926	156	1611	3216	2539	2722	1900	1415	299	10	958	
	310	170	21	83	2181	149	0	154	119	0	817	608	134	134	268	332	198	417	147	194	32	4	127	
	313	165	25	144	242	142	41	50	1036	127	446	283	74	130	250	0	279	69	570	105	26	13	57	
	316	189	441	63	19	77	17	78	65	61	25	93	207	170	85	71	71	25	2847	4707	79	15	67	
151-200	318	123	6	4	0	6	46	36	790	64	136	11	0	65	81	782	106	13266	27	874	357	649		
	705	195	0	66	0	0	60	1	91	674	1310	22	27	0	542	611	121	501	18	123	1	17	553	
	706	476	0	23	39	255	76	171	356	827	304	30	32	0	2068	447	8319	1134	130	69	100	197	106	
	707	93	15	5	0	0	227	47	326	190	69	80	7	0	90	3124	1529	6667	370	40	799	397	433	
	715	132	47	153	1	1	31	142	352	499	168	154	338	54	264	1523	810	4575	220	298	7435	845	828	
	716	539	71	147	68	498	92	780	303	248	1608	168	147	15	344	3464	1544	2379	384	570	115	189	119	
201-300	708	117	28	100	0	183	11	125	177	4633	164	147	0	0	166	327	8816	27852	57	74	555	1264	412	
	711	961	44	218	59	420	164	279	457	1113	0	0	7	87	109	6949	477	502	361	303	21714	156	176	
	712	973	65	288	85	644	218	344	9077	282	259	353	0	509	993	300	128	692	184	748	626	545	103	
	713	950	54	280	0	476	188	317	517	0	850	0	36	445	87	271	1339	332	535	17075	3009	810	187	
	714	1195	184	683	227	1260	526	855	1364	0	161	0	163	1181	1144	1857	258	700	4090	19821	17344	11018	975	
	0-30	2294	716	2155	296	3688	889	1036	1891	3378	23456	3948	18721	6023	5284	284	495	1753	1034	139	121	25	0	
31-50	3510	193	1522	785	4146	3210	3133	3664	2491	3129	4777	6811	4933	2465	3193	1790	3051	2020	556	504	38	41		
51-100	4646	7613	8162	2507	10955	5858	8370	16932	11117	30437	15451	18040	10639	38497	30222	35426	27884	14245	1904	1327	100	801		
101-150	1362	1043	931	3830	760	417	849	3524	2298	6987	3509	2602	826	2869	4455	14901	6928	18997	7227	1334	415	2707		
151-200	1435	133	394	128	754	486	1161	1428	2438	3479	454	551	69	3308	9169	12323	15256	1122	1100	8450	1645	2039		
201-300	4196	375	1539	371	2883	1107	1940	11592	6028	1434	500	206	2222	2499	9704	11018	30078	5227	38021	43248	13793	1853		
301-400	132	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	0*	nf	18*	20*	nf	14	nf	189		
Total **			10075	14703	7918	23189	11967	16489	39036	27754	68924	28638	46931	24709	54920	57029	75452	84949	42642	48948	54983	16014	7742	
Mean wt/tow			7.7	11.23	6.05	17.71	9.14	12.59	29.81	21.2	52.64	21.87	35.84	18.87	41.94	43.56	57.63	64.88	32.57	37.38	41.99	12.23	5.68	
Unadjusted total			9242	11175	6643	19394	9619	9756	33402	27647	68507	28317	46929	22574	53184	57028	75451	84967	42662	47308	54997	16015	7808	
Upper limit			17506	14468	9171	29677	12282	15852	187818	52461	182556	35969	75189	30739	109270	85725	122747	447584	67528	90622	107637	23812	10528	
Lower limit			978	7883	4116	9112	6957	3660	-121014	2832	-45541	20666	18670	14408	-2903	28332	28156	-277649	17797	3993	2357	8217	5088	

Note: numbers in brackets are estimates for non sampled strata and only 0-300 fathom strata are used in deriving these estimates.

nf = not fished

\* estimated using one tow

\*\* total and mean wt. per tow. Include sampled and estimated values for depths to 300 fathom. Estimates were derived from a multiplicative model using survey data to 1992.



Table 10. Cod abundance and biomass from Canadian Research Vessel Surveys

DEPTH range (fath)	Stratum number	Stratum Area sq. mi.	abundance		biomass	
			WT	WT	WT	WT
			150-151 1994 April 5-27	166-167 1995 April 5-29	150-151 1994 April 5-27	166-167 1995 April 5-29
0-30	314	974	24	0	113	0
	320	1320	0	0	0	0
31-50	308	112	118	21	42	11
	312	272	0	7	0	1
	315	827	0	0	0	0
	321	1189	0	0	0	0
	325	944	0	0	0	0
	326	166	0	6	0	1
	783*	229	0	-	0	-
51-100	307	395	4047	123	3468	51
	311	317	184	16	233	13
	317	193	0	22	0	11
	319	984	16	83	4	68
	322	1567	18	0	6	0
	323	696	0	0	0	0
	324	494	12	9	0	2
	781*	446	0	22	0	4
	782*	183	7	0	0	0
101-150	306	419	495	91	424	62
	309	296	111	104	171	112
	310	170	145	70	165	120
	313	165	19	415	17	656
	316	189	57	21	137	6
	318*	129	0	48077	0	71260
	779*	422	8	0	1	0
	780*	403	0	0	0	0
151-200	705	195	224	578	321	1089
	706	476	116	161	118	166
	707*	74	11	178	2	286
	715	132	1003	168	1514	280
	716	539	227	251	327	423
201-300	708*	126	4701	1480	3798	370
	711	961	72	9	82	12
	712	973	209	118	568	164
	713	950	550	431	919	938
	714	1195	1065	1281	1471	2163
0-30		2294	24	0	113	0
31-50		3739	118	34	42	13
51-100		5275	4284	275	3711	149
101-150		2193	835	48778	915	72216
151-200		1416	1581	1336	2282	2244
201-300		4205	6597	3319	6838	3647
total 0-300		19122	13439	53742	13901	78269
301-400	709	158	806	39	647	54
401-500	710	176	10	a	7	a
501-600	776	173		a		a
601-700	777	208		a		a
701-800	778	194		a		a
Total all sampled strata		20031	14255	53781	14555	78323
Mean #/tow			9.76	39.53	9.97	60.09
upper limit			24549	663996	24053	984981
lower limit			3964	-556434	5059	-821496

\* strata have been added or area has changed in 1994.

a depth range not fished

TABLE 11. MEAN NUMBERS PER TOW AT AGE ADJUSTED FOR MISSING STRATA  
FOR COD IN SUBDIVISION 3PS FOR THE YEARS 1972-95.

I	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
1 I	0.02	0.01	0.52	0.17	0.18	0.01	0.00	0.85	0.16	0.03	0.51	0.25	0.01
2 I	0.62	0.66	1.60	0.34	2.52	0.15	0.49	0.35	4.52	0.53	1.95	0.47	0.21
3 I	1.09	0.77	1.58	0.97	1.65	1.98	0.76	0.53	1.37	3.02	0.99	1.02	0.32
4 I	2.24	1.17	1.13	0.88	3.03	1.73	2.76	5.47	0.97	4.97	4.91	0.55	0.58
5 I	1.50	1.31	1.53	0.54	1.89	1.33	1.18	16.15	3.29	5.46	2.25	3.05	0.44
6 I	1.00	0.37	1.42	0.50	0.86	0.68	0.85	3.39	2.91	7.05	1.05	1.56	1.88
7 I	1.33	0.73	0.39	0.45	0.52	0.22	0.61	0.76	0.53	6.63	1.42	0.54	0.75
8 I	0.78	0.29	0.32	0.17	0.48	0.11	0.42	0.37	0.49	1.33	1.48	1.06	0.39
9 I	0.33	0.38	0.25	0.11	0.11	0.16	0.25	0.13	0.14	1.31	0.40	1.99	0.48
10 I	0.20	0.09	0.13	0.07	0.09	0.06	0.24	0.11	0.13	0.31	0.11	0.92	0.75
11 I	0.08	0.02	0.04	0.02	0.06	0.01	0.08	0.03	0.10	0.06	0.08	0.45	0.18
12 I	0.05	0.02	0.03	0.01	0.06	0.03	0.03	0.01	0.11	0.08	0.03	0.17	0.13
13 I	0.03	0.00	0.02	0.01	0.00	0.03	0.03	0.01	0.04	0.08	0.02	0.07	0.05
14 I	0.05	0.01	0.02	0.00	0.00	0.01	0.00	0.01	0.00	0.05	0.02	0.06	0.03
15 I	0.03	0.00	0.00	0.01	0.02	0.01	0.03	0.00	0.02	0.01	0.03	0.05	0.00
16 I	0.09	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.03	0.02	0.02	0.04	0.04
1+I	9.45	5.85	9.00	4.26	11.48	6.49	7.73	28.18	14.81	30.92	15.28	12.26	6.24
2+I	9.42	5.84	8.48	4.09	11.30	6.49	7.73	27.33	14.65	30.89	14.77	12.01	6.24
3+I	8.80	5.18	6.87	3.74	8.78	6.34	7.24	26.97	10.13	30.37	12.82	11.54	6.03
4+I	7.72	4.41	5.29	2.77	7.13	4.36	6.48	26.45	8.76	27.34	11.82	10.52	5.71
I	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995		
1 I	0.01	0.01	0.04	0.02	0.02	0.00	0.05	0.00	0.00	0.00	0.00		
2 I	0.27	0.26	0.37	0.42	0.28	0.06	1.18	0.11	0.00	0.07	0.01		
3 I	1.71	0.54	0.83	0.78	0.68	1.31	0.73	1.13	0.41	0.29	0.19		
4 I	4.37	2.54	2.01	1.18	1.33	4.98	3.87	0.89	2.79	1.78	0.74		
5 I	5.66	5.40	10.26	1.79	0.97	6.22	7.33	2.74	0.69	4.20	9.21		
6 I	2.61	5.83	8.01	5.90	1.01	4.16	5.26	1.82	2.65	1.30	17.14		
7 I	2.44	2.28	3.82	6.14	2.29	3.13	2.88	1.05	0.72	1.40	4.12		
8 I	0.77	1.71	1.60	4.13	1.42	2.89	1.78	0.55	0.36	0.48	5.21		
9 I	0.45	0.99	0.97	1.85	0.82	1.24	1.53	0.29	0.15	0.09	2.28		
10 I	0.44	0.34	0.39	1.04	0.46	0.67	1.06	0.26	0.10	0.04	0.28		
11 I	0.44	0.28	0.31	0.90	0.51	0.36	0.78	0.08	0.12	0.03	0.22		
12 I	0.49	0.32	0.24	0.44	0.15	0.16	0.30	0.05	0.03	0.02	0.01		
13 I	0.20	0.18	0.24	0.18	0.13	0.12	0.15	0.01	0.04	0.01	0.07		
14 I	0.11	0.11	0.24	0.18	0.06	0.08	0.10	0.01	0.01	0.02	0.04		
15 I	0.03	0.07	0.09	0.11	0.11	0.01	0.05	0.03	0.00	0.00	0.01		
16 I	0.04	0.03	0.06	0.11	0.06	0.04	0.04	0.00	0.00	0.01	0.00		
1+I	20.05	20.90	29.48	25.18	10.30	25.43	27.09	9.03	8.07	9.74	39.53		
2+I	20.04	20.89	29.44	25.16	10.28	25.43	27.04	9.03	8.07	9.74	39.53		
3+I	19.77	20.63	29.07	24.74	10.00	25.37	25.86	8.92	8.07	9.67	39.52		
4+I	18.06	20.09	28.24	23.96	9.31	24.06	25.14	7.79	7.66	9.38	39.33		

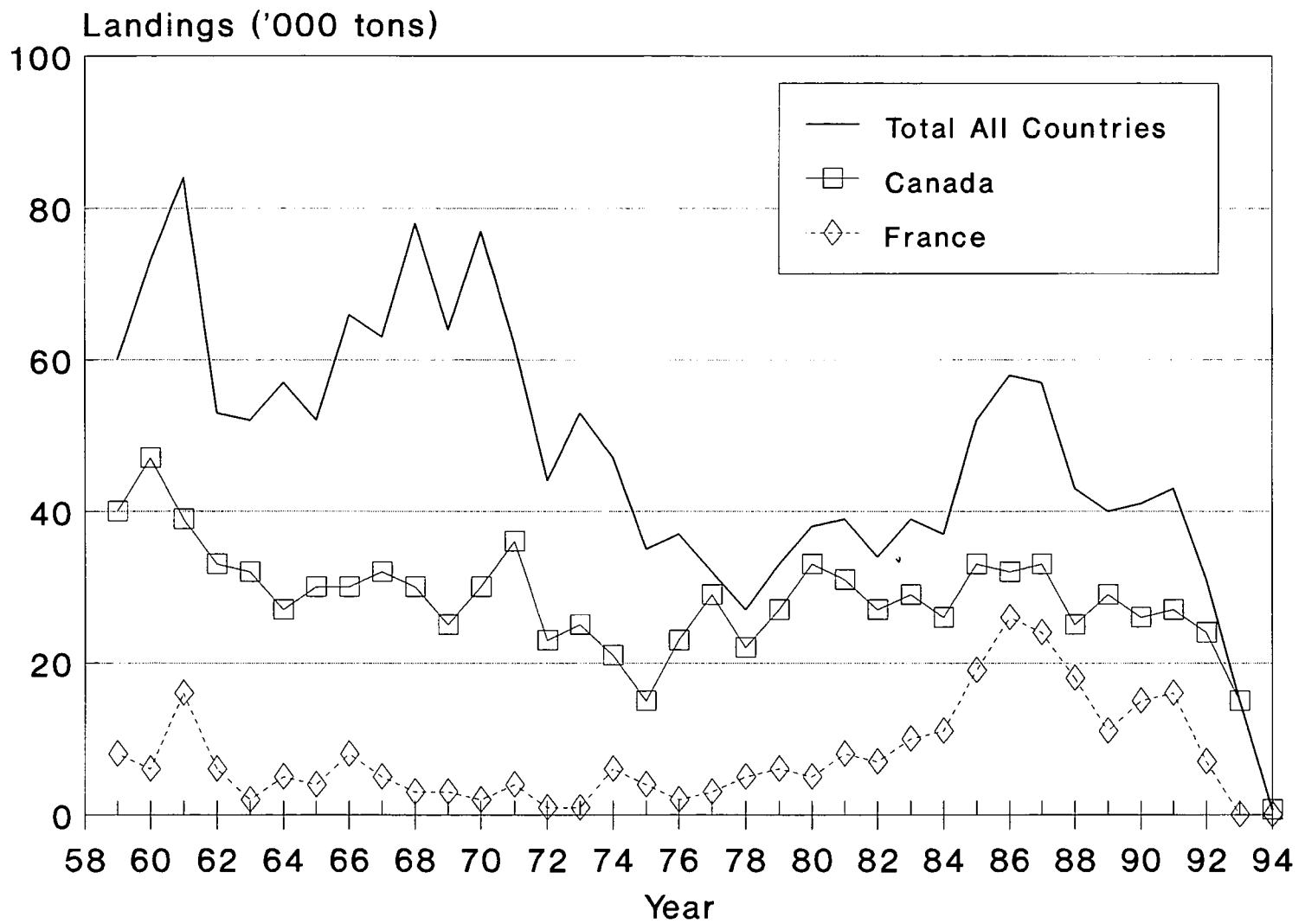
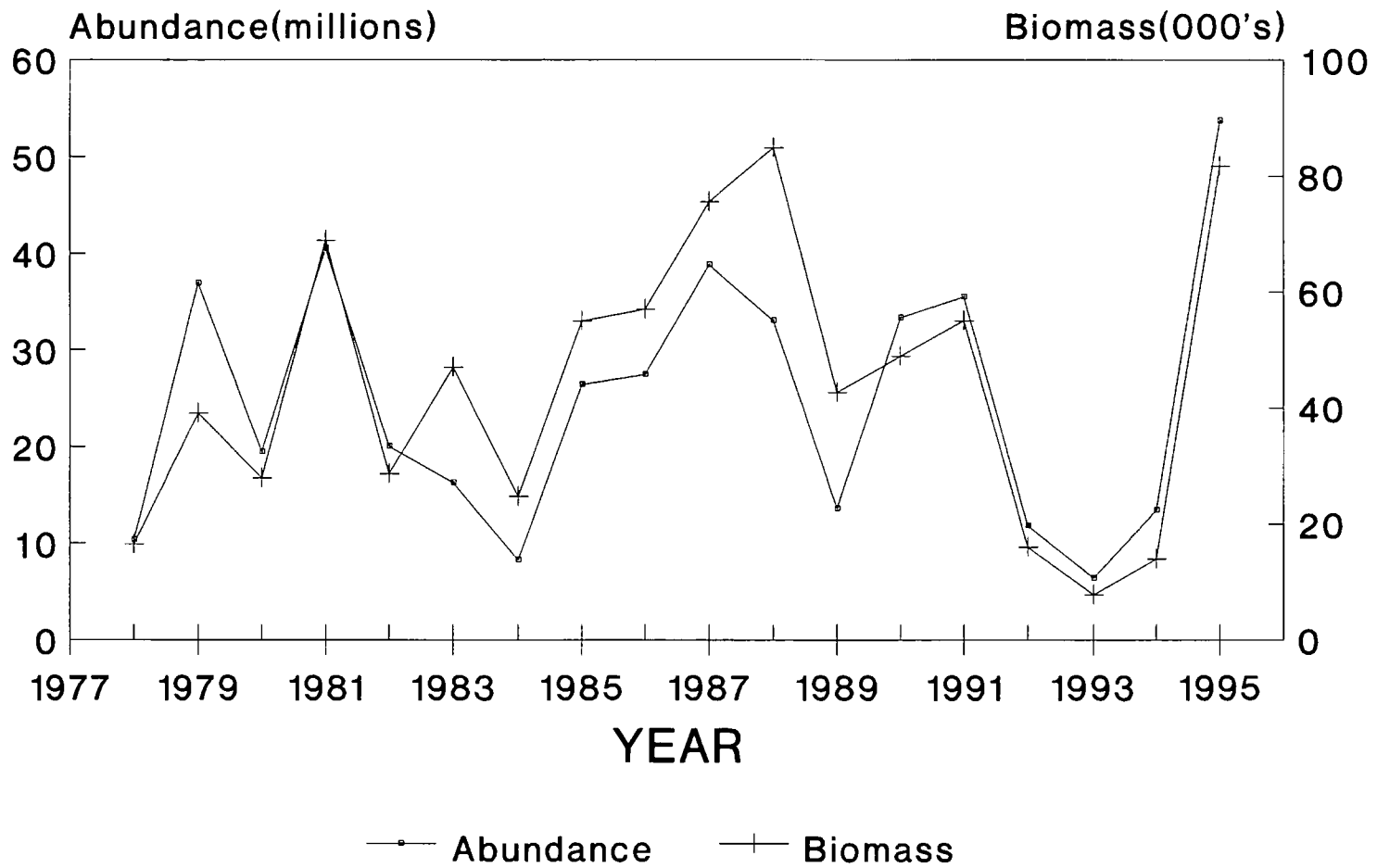


Figure 1. Cod landings from Subdivision 3Ps for the period 1959-94.

Fig.2 Abundance and Biomass  
Canadian 3Ps Surveys





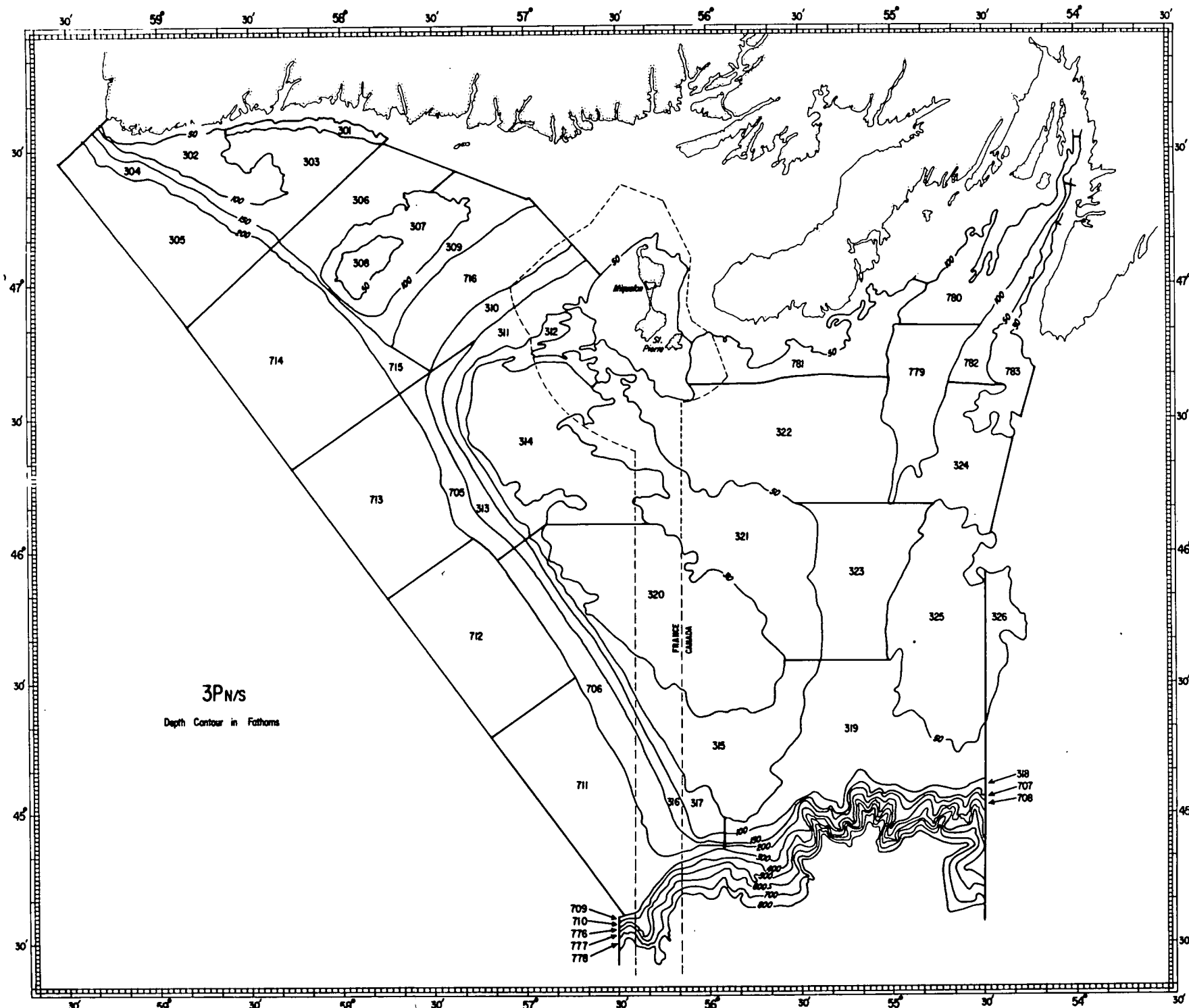


Figure 3. Stratification scheme used for random-stratified surveys in NAFO Subdivision 3Ps.

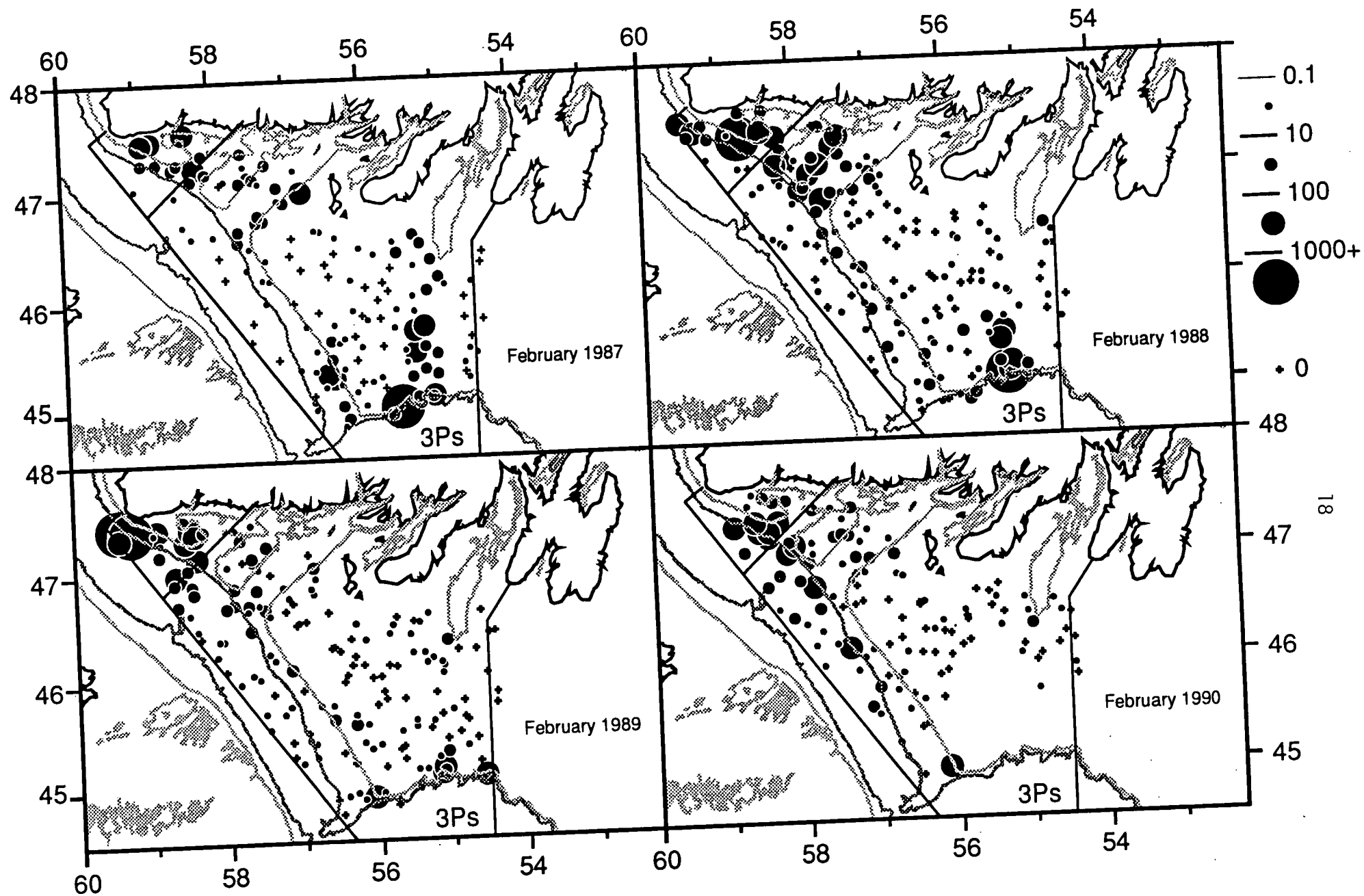


Figure 4. Cod distribution (numbers per tow) from the Canadian winter-spring surveys in Subdiv. 3Ps for the 1987-93 period.

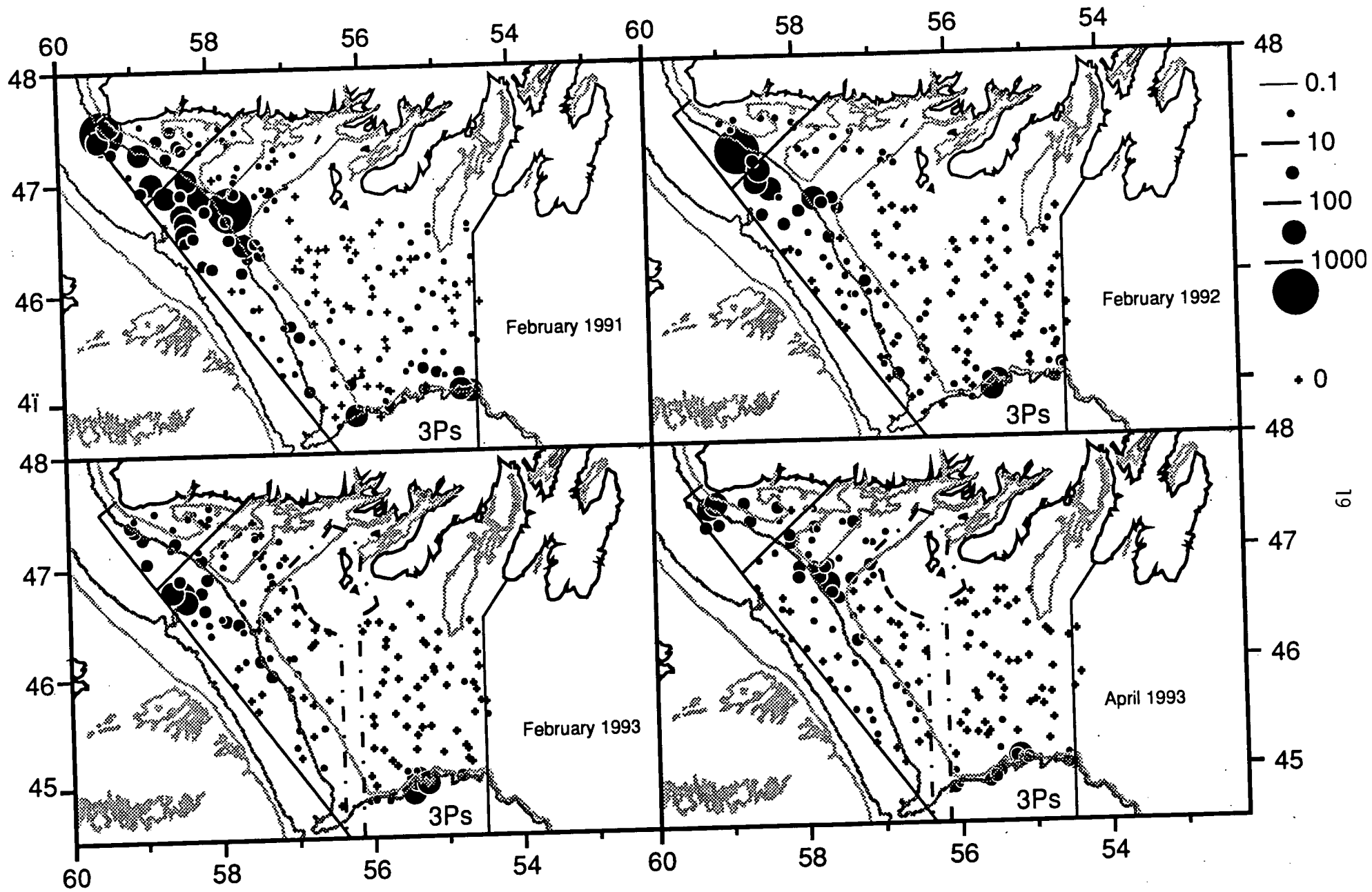


Figure 4(cont'd)

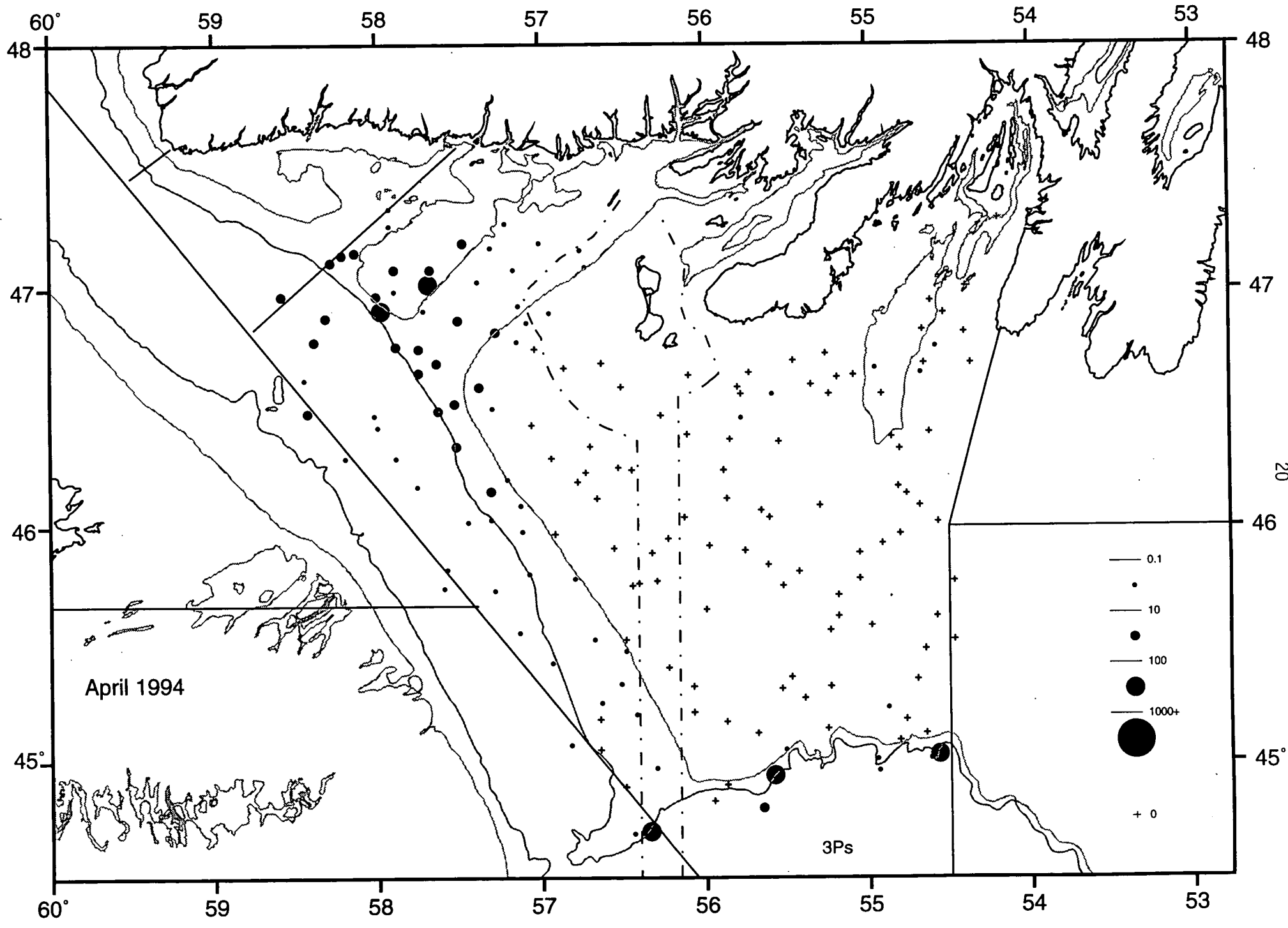


Fig 5. Cod catch numbers per tow from Canadian Research Vessel Survey April 1994.

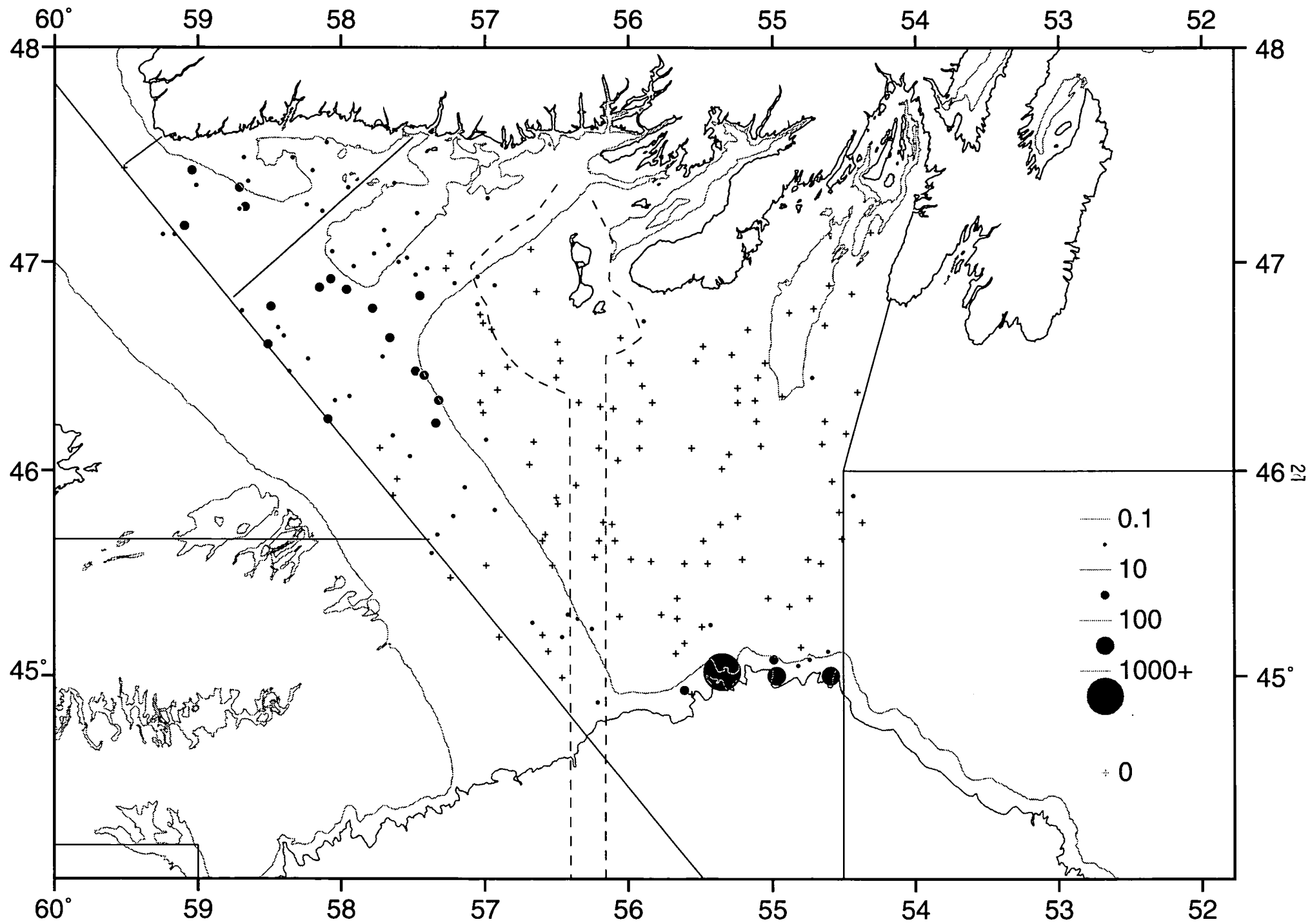


Figure . Distribution of cod catches 1995 3P survey (April)