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An Assessment of the Cod Stock in NAFO Divisions 3NO

by

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Nominal catch and catch at age

Between the years 1953-93, the highest catch of cod in NAFO Divisions 3NO occurred during 1967 with approximately 227,000 tonnes taken. The lowest catch of 9728 tonnes occurred during 1993 (Table 1, Figure 1). The next lowest catches had been in 1992 and 1978. Several times during the past 15 years the catches have been in excess of the TAC. However, the catch for 1992 and 1993 mark the first times since 1981 that the TAC has not been exceeded.

Canadian landings by month and division for 1993 are presented in Table 2. The Canadian fishery occurred throughout the year with peak landings during June and July. During 1993, 90% of the Canadian catch was taken from Division 3O. The catches by other countries, primarily Spain and Portugal, occur in the NAFO Regulatory Area, mainly in Division 3N.

Over the past several years, catches from the Regulatory Area have been those reported by contracting parties combined with estimates from Canadian surveillance authorities. Landings by Spain and Portugal are those reported by EC. These correspond closely with those estimated by Canadian surveillance. Other catches (Russian and non-contracting parties) are those estimated by Canadian surveillance.

Sampling data available for the Canadian fishery in 1993 (Table 3), obtained from Canadian port samplers and observers, were used to obtain monthly estimates of catch at age by Canada. In total, 18,192 cod were measured for length and 1,423 were aged during 1993. Catch, average weight and average length at age for the 1992 Canadian catch are presented in Table 4. Average weights at age were determined by applying a length weight relationship (log weight = 3.0879 x log length - 5.2106) to length frequencies and age length keys. The most abundant year-classes in the Canadian otter trawl fishery during 1993 were the 1989 (age 4) and the 1988 (age 5). The most abundant ages in the Canadian longline and gillnet fisheries were 7 (1986 year-class) and 12 (1981 year-class) respectively (Table 5). The 1981, 1985 and 1986 year-classes which had dominated catches in previous years have declined.

Catch-at-age data for the Spanish fleet fishing in the Regulatory Area obtained by Spanish authorities were provided by EC. There was no Division 3NO sampling data available from Portugal at the time this report was prepared. Portuguese otter trawl catches as well as other estimated otter trawl catches from the Regulatory Area were adjusted to catch-at-age using the sampling from the Spanish pair trawl fleet. Portuguese gill net catches were adjusted using the age composition estimated for the Canadian gillnet fleet. The catch-at-age data indicate that ages 3 and 4 (1989 and 1990 year-classes) were dominant in the otter trawl fisheries in the regulatory area (Table 5). (It is estimated that in excess of 3.7 million fish were taken in these fisheries. Since 1991, an estimated 14 million fish have been removed from these two year-classes.)

Catch-at-age, mean weights-at-age and catch biomass-at-age for the 1959-93 period are presented in Tables 6-8. During recent years, the 1981 and 1982 year-classes have been abundant in the Division 3NO cod catches. The 1981 (age 12) year-class is now dominant only in the Canadian gillnet catch. The most abundant year-classes in 1993 were the 1989 and 1990 or age 3 and 4. This is the third consecutive year where cod aged 4 and younger have dominated the catch. (These sexually immature, small fish were taken by all countries fishing in Division 3NO. In Div 3NO approximately 20% of age 5 fish are sexually mature. Therefore, there has been significant pre-recruit overfishing in these divisions over the past five years.) There does not appear to be any discernable trends in mean weights-at-age although those for most ages have shown an increase from 1992 to 1993.

Commercial catch and effort

Catch rates from the three main fleets prosecuting the fishery have not been used for quantitative calibrations of SPA in recent years. Previous analyses have not been updated at this time.

Research vessel survey data

Stratified-random research vessel surveys have been conducted in the spring by Canada in Divisions 3N and 3O since 1971 and 1973 respectively with the exceptions of 1983 in Div. 3N and 1974 and 1983 in Div. 3O. Surveys from 1971 to 1982 were conducted by the research vessel **A.T. CAMERON** and those since 1984 have been conducted by the sister ships **ALFRED NEEDLER** and **WILFRED TEMPLEMAN**. The stratification scheme used for these surveys is based on depth and is presented in Figure 2.

Biomass estimates for these surveys are presented in Tables 11-12 and in Figure 3. Biomass for Divisions 3N and 3O combined increased gradually from the early 1970's to the early 1980's with a sharp increase between 1982 and 1984. Since 1984 biomass has been declining steadily, with the exception of what appears to be an anomalously high 1987 estimate. The increase in 1987 was caused by a large increase in Division 3O. Estimates of the Division 3NO total biomass in 1993 increased to about 74,000 tonnes, up from 44000 and 58000 in 1992 and 1991 respectively.

Abundance estimates are shown in Tables 9-10 and Figure 4. Trends in Division 3NO cod abundance are similar to those observed for biomass with a large value again occurring in 1987, caused mainly by a high estimate for Division 3O. While the abundances estimated for the 1988 to 1992 period are all among the lowest observed in the Canadian time series of RV abundance for this stock, the 1993 estimate is up considerably. This results from increased estimates for the 1989 and 1990 year-classes.

Age composition data for 1971 to 1993 are presented in Table 13. The dominant ages in the 1993 survey were age 3 and age 4 (the 1989 and 1990 year-classes) with about 90% of the total abundance occurring at these ages. The year-classes from 1983 to 1988 (ages 5 to 10 in 1993) are among the lowest observed in the time series.

Stratified random surveys have been conducted by Canada during autumn from 1990 to 1993. The results of these surveys are presented in Tables 14-17. Biomass and abundance increased from 1990 91 but have since declined substantially especially from 1992 to 1993. The 1989 year-class was abundant in the 1991 and 1992 surveys but declined substantially in 1993 (Table 17).

Canada has also conducted stratified-random surveys during the August-September period in Div. 3NO since 1980 for the purpose of estimating abundance of juvenile as well as adult groundfish. This survey has been documented previously with respect to flatfish (Walsh, 1993). The surveys since 1988 have covered depths to 150 fathoms. The results in terms of biomass

and abundance by division as well as mean numbers at age per tow are presented in Tables 25 and 26. Biomass and abundance increased from 1989 to 1991 but have since decreased. The 1989 and 1990 year-classes were both strong in this series.

Survey Distribution

Figures 5 to 8 show distribution of survey sets as well as the mean number caught per tow, for the Canadian spring and autumn surveys. During the 1993 spring survey, cod were found mainly on the slope area of Div. 3O. Abundance from the autumn surveys has declined since 1991 with a substantial reduction in 1993. During 1992, abundance was greatest in the area of the S.E. Shoal (Stratum 376), although coverage was incomplete in the general area.

Surveys indicate that the stock is currently comprised mainly of individuals from the 1989 and 1990 year-classes, with their abundance being among the highest in the time series. Distribution plots are presented (Figures 7 and 8) for all survey years for ages 3 and 4 to provide some comparisons of distribution between year-classes. The distribution of relatively strong year-classes in the early 1980's (80, 81, 82) appears to have been more wide spread at ages 3 and 4 than that observed for the 1989 and 90 year-classes at age 3 and 4 in the 1993 spring survey.

During the autumn surveys, the 1989 year-class was strong at ages 2 and 3 but was much reduced at age 4 in 1993. The distribution at age 3 was mainly from a portion of the S.E. Shoal.

Estimation of stock parameters

ADAPT Calibration

The adaptive framework (Gavaris 1988) used in this assessment included catch per tow from both Canadian and Russian research vessel surveys, both disaggregated by age. The Russian data from 1977-92 was that presented in a document by Kuzmin (1992) while that for 1993 was provided by Russian scientists. The formulation used with ADAPT is described as follows:

Parameters estimated by ADAPT:

- Year-class estimates
  $N_{i,1990}$ i = 3 to 11

- Catchabilities for RV numbers at age
  $K(\text{Can Spring})_i$ i = 3 to 11
  $K(\text{USSR})_i$ i = 3 to 11
  $K(\text{Can Autumn})_i$ i = 3 to 11
  $K(\text{Can Juv})_i$ i = 3 to 11

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 (12) set at the mean weighted F for age group 7-10.
- Intercepts not fitted.

Input data

- $C_{i,t}$ i = 3 to 12 t = 1977-93
- $RV(\text{Can})_{i,t}$ i = 3 to 11 t = 1977-82, 1984-93

- $RV(USSR)_{i,t}$ i = 3 to 11 t = 1977-91, 1993
- $RV(Can\text{-}Autumn)_{i,t}$ i = 3 to 11 t = 1990-93
- $RV(Can\text{-}Juv.)_{i,t}$ i = 3 to 11 t = 1989-93

Objective function

- Minimize

$$\sum_{age}\sum_{year}\{obs(\ln RV(Can\text{-}spring)_{i,t})-pred(\ln RV(Can\text{-}spring)_{i,t})\}^2 +$$
$$\sum_{age}\sum_{year}\{obs(\ln RV(USSR)_{i,t})-pred(\ln RV(USSR)_{i,t})\}^2+$$
$$\sum_{age}\sum_{year}\{obs(\ln RV(Can\text{-}autumn)_{i,t})-pred(\ln RV(Can\text{-}autumn)_{i,t})\}^2$$
$$\sum_{age}\sum_{year}\{obs(\ln RV(Can\text{-}Juv.)_{i,t})-pred(\ln RV(Can\text{-}Juv.)_{i,t})\}^2$$

Summary

- Number of observations = 369
- Number of parameters estimated = 45

The coefficients of variation (CV's) on the age 4 to 11 abundance estimates were in the range of 30% to 37%, while that on age 3 was higher at 49% (Table 18). Estimated standard errors were highest with the Canadian autumn survey series and the T-statistic indicated that all ages were marginally significant. Bias estimates (Table 18) were highest for the latter series (10 to 14%) while those for the other RV indices ranged from 2.2 to 11%. Bias on the population parameter estimates were highest at ages 3 and 4 (13 and 8% respectively). All research vessel catchabilities were estimated with CV's between 23% and 50%. Residuals indicate no obvious trends but all survey indices contain several year effects, both negative and positive (Table 19). The high CV's on most abundance estimates and the patterns observed in the residuals suggest some uncertainty with the results of this analysis. This could be the result of highly variable survey indices as well as poorly estimated removals at age.

Laurec-Shepherd Calibration

An analysis using the Laurec-Shepherd (LS) technique was also conducted using Canadian spring RV data from 1984 to 1993 as well as Canadian autumn and juvenile groundfish data from 1990 to 1993. Most of the structure and data were the same as included in the ADAPT analysis. There were two differences: the fishing mortality on the oldest age group was set at the mean of the previous five ages 7-11 as opposed to ages 7-10 for ADAPT; and only the Canadian RV data were included. The catchabilities were similar at each age and no discernable trend was observed in the time series (Table 21). Standard errors of F were large at the younger ages for the Canadian spring and juvenile groundfish surveys. Those for the autumn survey were generally larger than the other survey indices. As with ADAPT, no trends were evident in log catchability residuals.

Estimation of Partial Recruitment (PR)

Assessments of this stock for the years 1990 to 1993 have included a formulation of ADAPT for which PR was estimated to dome shaped; the F on the oldest age group was estimated at 40% of the fully recruited F (mean of ages 7-10). During the 1993 assessment (Davis et al, 1993), analyses were presented indicating that different interpretations of stock status were produced depending on the option of PR that was considered most appropriate. It was recommended (NAFO Scs Doc. 93/17, p. 60) that additional analysis be conducted to assess the impact of PR on the interpretation of stock status and determine the most appropriate approach.

The basis for adoption of a 40% dome on the oldest age group was related to patterns observed in the ADAPT RV catchability estimates (K's). It was suggested (Bishop et al, 1990) that K's should be at least stable, if not declining, through older ages. Catchabilities obtained assuming a 'flat-topped' PR indicated increasing values at age for both Canadian and Russian RV indices. When fishing mortalities on oldest ages were set at 40% of those at fully recruited ages, more stable catchabilities for older ages in the RV indices were produced.

For the current assessment, similar analyses were conducted. A formulation of ADAPT was used assuming flat-topped PR and domes of both 40% and 70%. In this analysis, an additional index was included (Canadian autumn RV). The catchabilities produced (Figures 9-11) showed similar patterns with those in earlier analyses. As the dome level increased, K values for the Canadian spring RV index showed an increasing trend, mainly at ages 9 and older. Russian RV data showed a similar but less pronounced effect. With the exception of values for the oldest age in the calibration (age 11), the Canadian autumn K values decreased at all ages older than 6, with the effect becoming more pronounced with an increasing dome.

Biomass estimates were obtained from cohort analyses using the three options of PR described above (Figure 12) in ADAPT analyses. A 40% dome produced biomass estimates that were consistently higher (about 80% in the mid 80's) than at 70% dome or with a flat-topped PR. This would also imply that biomass in the mid 1980's was as large or larger than that in the late 1960's when landings were consistently in excess of 100,000t. RV biomass estimates peaked in the mid 1980's, but there were no survey estimates in the late 1960's for similar comparisons.

The data presented indicate that the procedure for estimation of an appropriate level of PR for the fully recruited ages is not clear and that the consequent influence on the interpretation of stock status could be substantial. It was decided that the previously used rationale for use of a 40% dome on PR was not well substantiated and that for the present assessment, PR was assumed to be flat-topped.

Assessment Results

The results from both the Laurec-Shepherd and ADAPT calibration techniques were similar with respect to fishing mortalities and population abundance (Tables 20, 22, 23). Population numbers declined from 1985 to 1991 but have since increased because of large RV estimates for the 1989 and 1990 year-classes (Table 20 and 21) Results from ADAPT indicated higher estimates for population abundance at younger ages in 1992 and 1993.

Results of a cohort analysis based on F's obtained from ADAPT are shown in Tables 24-26 and Figures 13-15. While population abundance and biomass are declining for ages 5 and older, totals for all ages increased in 1993 as a result of the relatively large estimates for the 1989 and 1990 year-classes. The analysis estimates the 1989 year-class at about 47 million in 1992 and the 1990 year-class at 33 million. In the 1993 assessment the accepted ADAPT formulation estimated the 1989 year-class at about 38 million. For projection purposes, at that time, the size of the year-class in 1992 was set at 20 million, the geometric-mean for recent years.

The increased abundance estimate for the 1989 year-class and the better than average value for the 1990 year-class results mainly from their strong appearance in the Canadian spring and Russian surveys during 1993. The confidence limits about the 1993 estimates were large for both of these surveys. In the Canadian survey, most cod were found in 2 strata in Division 3O. The Canadian autumn surveys in 1991 and 1992 also indicated a relatively strong 1989 year-class while the 1993 survey suggested a much smaller year-class size. Estimates from the juvenile groundfish survey in 1993 also indicated a decline in abundance for the 1989 and 1990 year classes. The stock in 1993 is represented mainly by the younger age groups (90% of the abundance and 60% of the biomass at ages 3 and 4). These yearclasses (1989 and 1990) have been in commercial catches since age 2 years and have dominated the catch numbers at age in

1991, 1992 and 1993. These year classes would not contribute significantly to the spawning stock until age 6 (50% mature between ages 5 and 6), ie. 1995 for the 1989 yearclass.

References

Bishop, C.A., J.W. Baird and E.F. Murphy. 1990. An assessment of the cod stock on NAFO Div. 3NO. NAFO SCR Doc. 90/73. Serial No. N1795. 35p.

Davis, M.B., D. Stansbury, E.F. Murphy and C.A. Bishop. 1993. An assessment of the cod stock in NAFO Div. 3NO. NAFO SCR Doc. 93/90. Serial No. N2276. 38p.

Gavaris, S. 1988. An adaptive framework for the estimation of population size. CAFSAC Res. Doc. 88/29: 12p.

Kuzmin, S.A. 1992. Stock assessment of cod from NAFO Subarea 3 by the data from the 1991 trawl-acoustic survey. NAFO SCR Doc. 92/13. Serial No. N2055. 18p.

Walsh, S.J. 1993. Dynamics of juvenile American plaice populations on the Grand Banks, NAFO Divisions 3LNO. Serial. No. N2255. 21p.

Table 1. Catch (tonnes) of cod in NAFO Divisions 3NO.

Year	Canada	Spain	Portugal	Russia	Others	Total	TAC
1953	39884	12633	7919		5761	66197	
1954	17392	88674	24045		4650	134761	
1955	6053	64987	27711		15605	114356	
1956	5363	42624	15505		1390	64882	
1957	9641	51990	21740		6819	90190	
1958	4812	29436	11608		2195	48051	
1959	3687	39994	17730	48	2911	64370	
1960	3408	33972	14347	24204	3746	79677	
1961	5428	32284	9059	22854	3099	72724	
1962	3235	17413	3653	7971	2712	34984	
1963	5079	37632	10004	10184	6843	69742	
1964	2882	37185	8095	9510	6789	64461	
1965	4229	64652	1692	17166	11448	99187	
1966	6501	52533	5070	39023	5792	108919	
1967	3446	77948	9703	118845	16842	226784	
1968	3287	69752	6752	78820	6900	165511	
1969	3664	71160	4940	29173	8768	117705	
1970	4771	67034	3185	28338	8233	111561	
1971	2311	89915	6589	19307	8174	126296	
1972	1736	76324	11537	12198	1579	103374	
1973	1832	42403	7759	27849	586	80429	103000
1974	1360	38338	6602	26911	178	73389	101000
1975	1189	16616	5560	20785	24	44174	88000
1976	2065	9880	2620	8992	726	24283	43000
1977	2532	8827	1742	4041	462	17604	30000
1978	6246	5813	641	1819	199	14718	15000
1979	9938	13782	1140	2446	545	27851	25000
1980	5589	8999	1145	3261	997	19991	26000
1981	6096	13299	1091	3187	671	24344	26000
1982	10185	14361	2466	3985	608	31605	17000
1983	11374	12320	1109	3238	778	28819	17000
1984	8705	13590	1071	3306	431	27103	26000
1985	18179	13682	608	3968	462	36899	33000
1986	18035	23395	6890	1181	1144	50645	33000
1987	18652	15788	4108	764	2307	41619	33000
1988	19727	15889	3927	2973	634	43150	40000
1989	13433	17904	913	108	857	33215	25000
1990*	10620	4678	2145	18	11385	28846	18600
1991*	12056	3976	1061	–	12296	29389	13600
1992*	7684	1927	448	51	2450	12561**	13600
1993*	5326	3031	521	150	700	9728**	10200

* Provisional

** Includes Surveillance Estimates and NAFO Scientific Council Estimates

Table 2. Cod landings (t) by month from NAFO Divisions 3NO by Canada in 1993.

3N	Can/N						Can/M				3O	Can/N				Can/m					
	OT	DS	SSc	GN	LL	HL	OT	DS	GN	LL	OT	DS	SS	GN	LL	OT	DS	SS	GN	LL	Totals
J											34			3		123				32	192
F											13									21	34
M											95			65		28				82	270
A					1						172			46	12	120	34			176	561
M	1		3					1		3			12	225	5	42	58			193	543
J							2			2	702	51	43	30		141	30			53	1054
J	94		11							1	603		27	15		14				69	834
A	76	17	13			1				3	281	1				16				10	418
S	53	10	20					5		1	116		2				3			15	225
O	3		6						91		35					1					136
N				5					52		179			38			3		63	1	341
D	1			10			4		62	1	536			14		30	29		31		718
Total	228	27	53	15	1	1	6	6	205	11	2766	52	84	436	17	515	157	0	94	652	5326

Table 3. Commercial sampling by Canada used to estimate catch at age for Divisions 3NO in 1993.

Gear	Month	Wt (t)	Number Measured	Number Aged	Weight Total (t)	Cumulative Total (t)
OT	Jan	157				
+Misc.	Feb	13	1194	271	293	
	Mar	123				
	Apr	326				
	May	117	786	270	1412	
	Jun	969				3894
	Jul	749				
	Aug	404	4078	283	1362	
	Sep	209				
	Oct	45				
	Nov	182	6362	599	827	
	Dec	600				
GN	Jan	3				
	Feb		271	a	68	
	Mar	65				
	Apr	46				
	May	225	2040	a	301	
	Jun	30				750
	Jul	15				
	Aug				15	
	Sep					
	Oct	91				
	Nov	158			366	
	Dec	117				
LL	Jan	32				
	Feb	21	1798	a	135	
	Mar	82				
	Apr	189				
	May	201	71	a	445	
	Jun	55				682
	Jul	70				
	Aug	14	1592	a	100	
	Sep	16				
	Oct					
	Nov	1			2	
	Dec	1				
Totals		5326	18192	1423	5326	5326

a – Otter trawl age–length key applied

Table 4. Catch, average weight and length at age for the cod fishery by Canada in Divisions 3NO during 1993.

Age	Average Wt (Kg)	L. (cm)	Catch Mean	Std. Err	C.V.
3	0.457	36.90	21	3.02	0.14
4	0.984	48.02	426	19.28	0.05
5	1.399	53.71	227	20.06	0.09
6	1.796	58.22	197	17.94	0.09
7	2.875	67.53	179	12.36	0.07
8	4.438	78.21	46	4.67	0.1
9	6.404	88.00	22	4.15	0.19
10	7.94	94.64	35	5.61	0.16
11	8.86	98.28	44	5.79	0.13
12	8.605	97.37	49	5.04	0.1
13	11.68	106.98	32	5.02	0.16
14	12.26	108.74	30	4.92	0.16
15	12.96	110.94	33	7.05	0.21
16	13.73	112.64	16	3.83	0.24
17	12.16	107.53	14	1.69	0.12
18	14.35	114.57	19	5.74	0.3
19	15.66	118.62	8	0.35	0.04
20	17.93	123.6	2	0.36	0.24

Table 5. Catch numbers (000's) and average weight at age of cod from the fisheries in NAFO Divisions 3NO during 1993.

Age	Canada OT		LL		GN		Spain Pair Trawl		Portugal GN		OT		Other		Total Number (000's)	Average Weight (Kg)
	Number	Wt (Kg)	Number	Wt (Kg)	Number	Wt (Kg)	Number	Wt (Kg)	Number	Wt (Kg)	Number	Wt (Kg)	Number	Wt (Kg)		
2							6	0.26			0	0.26	2	0.26	8	0.26
3	21	0.46					755	0.40			56	0.40	212	0.40	1044	0.40
4	422	0.99	3	0.97			2002	0.77			148	0.77	562	0.77	3137	0.80
5	225	1.40	2	1.47			306	1.34			23	1.34	86	1.34	642	1.36
6	187	1.80	9	1.74			215	1.88			16	1.88	60	1.88	487	1.84
7	163	2.87	15	2.93	1	3.40	99	2.80			7	2.80	28	2.80	313	2.79
8	38	4.46	7	4.18	1	5.21	16	3.62			1	3.62	4	3.62	67	4.05
9	16	6.24	4	6.70	2	7.08	1	4.20	1	8.64	0	4.20	0.28	4.20	24	5.95
10	23	7.82	4	7.24	8	8.64	1	5.43	3	9.40	0	5.43	0.28	5.43	39	7.91
11	30	8.80	5	8.23	9	9.40			3	8.72					47	8.74
12	32	8.55	7	8.69	10	8.72			4	12.08					53	8.81
13	20	11.77	3	9.66	9	12.08			4	12.64					36	11.69
14	17	12.37	4	11.00	8	12.64			3	12.84					32	12.14
15	20	13.13	4	12.33	9	12.84			3	12.67					36	12.79
16	10	13.80	2	16.03	4	12.67			2	16.13					18	13.65
17	10	11.02	3	14.14	1	16.13									14	12.46
18	12	13.55	5	16.40	2	13.38			1	15.59					20	13.78
19	5	15.57	3	15.82	1	15.59									9	15.84
20+			1	19.52											1	15.82
Number	1251		81		65		3401		24		252		955		6028	
Weight (t)	3895		681		750		3031		296		225		850		9728	
Av. Wt.	3.11		8.41		11.54		0.89		12.33		0.89		0.89		1.61	

TABLE 6. CATCH AT AGE FOR DIV. 3NO COD,1959 - 1993

	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972
3	1711	1846	812	1026	313	6202	1013	753	20086	16359	8154	2105	950	69
4	13036	6503	4400	3882	5757	15555	7611	18413	62442	56775	12924	19703	26900	19797
5	5068	22050	11696	2206	11210	19496	7619	19681	50317	48608	26949	10799	30300	12289
6	6025	3095	15258	1581	4849	7919	13258	11795	18517	18485	11191	9481	11700	13432
7	3935	2377	2014	3594	1935	2273	9861	8486	4774	6337	2089	3646	3500	5883
8	1392	2504	1672	773	3840	1109	4827	4467	4651	1592	1393	1635	2500	1686
9	757	583	847	668	1165	788	1081	1829	236	505	518	541	500	285
10	926	387	196	433	608	328	1248	1694	180	178	292	149	200	216
11	1220	898	25	226	322	37	163	122	71	90	134	227	100	78
12	103	242	245	216	208	112	141	57	45	45	202	90	50	74
13	1128	1409	392	846	473	56	276	183	335	51	574	1472	700	350
3+	35301	41894	37557	15451	30680	53875	47098	67480	161654	149025	64420	49848	77400	54159
4+	33590	40048	36745	14425	30367	47673	46085	66727	141568	132666	56266	47743	76450	54090
5+	20554	33545	32345	10543	24610	32118	38474	48314	79126	75891	43342	28040	49550	34293
6+	15486	11495	20649	8337	13400	12622	30855	28633	28809	27283	16393	17241	19250	22004

	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
3	10058	6425	671	4054	607	920	72	266	505	305	1179	58	57	153	516	277
4	27600	9501	8781	7534	2469	4337	3827	1055	1091	1978	647	1000	2953	2865	422	318
5	15098	10907	3528	5945	2531	2518	9208	3812	1262	1591	1893	1411	6203	6423	3491	1527
6	5989	10872	2505	1064	1500	818	2784	2275	2297	1012	1204	2324	3036	4370	3445	6347
7	1971	2247	3057	211	572	354	883	761	1902	1528	686	1220	2519	1512	1213	3955
8	972	2147	1059	238	177	102	265	222	574	1492	1152	720	797	948	653	1009
9	707	1015	921	44	209	58	58	92	192	595	774	918	459	558	845	567
10	243	676	461	37	65	51	17	31	94	211	238	551	533	373	494	425
11	137	428	252	13	41	8	12	8	41	162	81	106	261	349	398	249
12	116	257	152	9	25	5	7	13	13	27	41	42	97	135	404	142
13	173	881	396	17	36	21	16	2	32	52	36	70	71	86	188	298
3+	63064	45356	21783	19186	8232	9192	17149	8537	8003	8953	7931	8420	16986	17772	12069	15114
4+	53006	38931	21112	15132	7625	8272	17077	8271	7498	8648	6752	8362	16929	17619	11553	14837
5+	25406	29430	12331	7598	5156	3935	13250	7216	6407	6670	6105	7362	13976	14754	11131	14519
6+	10308	18523	8803	1653	2625	1417	4042	3404	5145	5079	4212	5951	7773	8331	7640	12992

	1989	1990	1991	1992	1993
3	1917	1064	1103	4508	1044
4	2182	4505	673	1769	3137
5	1502	4341	995	837	642
6	1260	895	544	612	487
7	1887	422	282	235	313
8	1284	721	368	64	67
9	485	581	568	99	24
10	233	439	502	128	39
11	168	150	383	153	47
12	100	93	202	100	53
13	285	106	337	217	166
3+	11303	13307	5957	8722	6019
4+	9356	12243	4854	4214	4975
5+	7204	7738	4181	2445	1838
6+	5702	3397	3196	1608	1196

TABLE 7. WEIGHT AT AGE FOR DIV. 3NO COD,1959 - 1993

	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973
3	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.48	0.48	0.48	0.48	0.48	0.48	0.54	0.57
4	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.90	0.90	0.90	0.90	0.90	0.90	0.97	1.00
5	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.35	1.35	1.35	1.35	1.35	1.35	1.44	1.43
6	1.95	1.95	1.95	1.95	1.95	1.95	1.95	2.14	2.14	2.14	2.14	2.14	2.14	2.08	2.19
7	2.82	2.82	2.82	2.82	2.82	2.82	2.82	3.16	3.16	3.16	3.16	3.16	3.16	2.89	3.63
8	3.39	3.39	3.39	3.39	3.39	3.39	3.39	4.21	4.21	4.21	4.21	4.21	4.21	3.56	4.63
9	3.98	3.98	3.98	3.98	3.98	3.98	3.98	6.34	6.34	6.34	6.34	6.34	6.34	5.95	6.25
10	4.68	4.68	4.68	4.68	4.68	4.68	4.68	7.69	7.69	7.69	7.69	7.69	7.69	7.95	9.56
11	5.25	5.25	5.25	5.25	5.25	5.25	5.25	8.46	8.46	8.46	8.46	8.46	8.46	8.32	11.17
12	6.17	6.17	6.17	6.17	6.17	6.17	6.17	10.24	10.24	10.24	10.24	10.24	10.24	10.14	13.99
13	13.50	13.50	13.50	13.50	13.50	13.50	13.50	13.50	13.50	13.50	13.50	13.50	13.50	13.50	13.50
3+	44.23	44.23	44.23	44.23	44.23	44.23	44.23	58.47	58.47	58.47	58.47	58.47	58.47	57.34	67.92
4+	43.81	43.81	43.81	43.81	43.81	43.81	43.81	57.99	57.99	57.99	57.99	57.99	57.99	56.80	67.35
5+	42.99	42.99	42.99	42.99	42.99	42.99	42.99	57.09	57.09	57.09	57.09	57.09	57.09	55.83	66.35
6+	41.74	41.74	41.74	41.74	41.74	41.74	41.74	55.74	55.74	55.74	55.74	55.74	55.74	54.39	64.92

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
3	0.42	0.38	0.50	0.57	0.72	0.65	0.71	0.90	0.94	0.85	0.79	0.48	0.39	0.49	0.74
4	0.73	0.89	0.91	1.00	1.05	0.98	1.04	1.27	1.17	1.17	1.15	0.86	1.01	0.82	1.00
5	1.20	1.28	1.41	1.48	1.55	1.39	1.69	1.84	1.50	1.87	1.51	1.37	1.52	1.30	1.39
6	1.96	2.13	2.33	2.48	2.25	2.09	2.50	2.69	2.20	2.63	2.28	2.05	2.16	1.93	1.79
7	2.86	3.14	3.25	3.51	3.74	2.87	3.69	3.55	3.83	3.80	3.04	3.25	3.49	2.89	2.23
8	4.67	4.16	4.03	4.74	4.61	3.70	5.49	5.33	5.26	5.20	4.05	4.65	5.41	4.76	3.77
9	7.32	5.53	6.67	7.17	6.19	4.75	7.98	7.13	7.49	6.27	5.76	6.62	7.95	7.26	5.12
10	5.46	6.74	8.74	8.81	7.23	7.15	9.22	9.10	8.80	8.08	7.22	8.32	9.82	8.95	6.88
11	8.40	5.27	9.14	11.70	9.48	7.98	10.60	9.01	9.82	8.99	8.92	9.15	9.94	9.85	9.37
12	7.51	7.09	12.49	11.47	12.87	10.11	12.61	10.15	12.28	11.01	12.61	11.13	9.98	12.59	11.07
13	13.50	13.50	13.50	13.50	13.50	13.50	13.50	13.50	13.50	13.50	13.50	13.50	13.50	13.50	13.50
3+	54.03	50.11	62.97	66.43	63.19	55.17	69.03	64.47	66.79	63.37	60.83	61.38	65.07	64.24	56.85
4+	53.61	49.73	62.47	65.86	62.47	54.52	68.32	63.57	65.85	62.52	60.04	60.90	64.68	63.75	56.11
5+	52.88	48.84	61.56	64.86	61.42	53.54	67.28	62.30	64.68	61.35	58.89	60.04	63.67	62.93	55.11
6+	51.68	47.56	60.15	63.38	59.87	52.15	65.59	60.46	63.18	59.48	57.38	58.67	62.15	61.63	53.73

	1989	1990	1991	1992	1993
3	0.51	0.55	0.55	0.33	0.40
4	0.97	1.01	0.85	0.65	0.80
5	1.60	1.46	1.59	1.06	1.36
6	2.24	2.51	2.30	1.80	1.84
7	3.27	2.73	3.83	2.82	2.79
8	4.61	4.14	5.56	4.85	4.05
9	7.08	5.02	7.53	5.56	5.95
10	8.31	8.37	9.04	7.43	7.91
11	9.47	9.29	11.98	8.64	9.74
12	12.25	11.25	13.98	10.65	9.91
13	13.50	11.91	13.60	14.11	12.79
3+	63.81	58.24	70.81	57.90	55.44
4+	63.30	57.69	70.26	57.57	55.04
5+	62.33	56.68	69.41	56.92	54.24
6+	60.73	55.22	67.82	55.86	52.55

TABLE 8. CATCH BIOMASS AT AGE FOR DIV. 3NO COD,1959 - 1993

	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972
3	719	775	341	431	131	2605	425	361	9641	7852	3914	1010	456	37
4	10690	5332	3605	3183	4721	12755	6241	16572	56199	51097	11632	17733	24210	19203
5	6335	27563	14620	2757	14013	24370	9524	26569	67928	65621	36351	14579	40905	17696
6	11749	6035	29753	3083	9456	15442	25953	25241	39626	39558	23949	20289	25038	27939
7	11097	6703	5679	10135	5457	6410	27805	26516	15086	20025	6601	11521	11060	17002
8	4719	8489	5665	2620	13018	3760	16364	18806	19581	6702	5865	6853	10525	6002
9	3013	2320	3371	2659	4637	3136	4302	11596	1496	3202	3284	3430	3170	1696
10	4334	1811	917	2026	2645	1535	5841	13027	1384	1369	2245	1146	1538	1717
11	6405	4714	131	1187	1690	194	856	1032	601	761	1134	1920	846	649
12	636	1493	1512	1333	1283	691	870	584	461	461	2068	922	512	750
13	15228	19021	5292	11421	6385	756	3726	2470	4522	689	7749	19872	9450	4725
3+	74923	84255	70693	40835	63636	71654	101810	143075	216524	197337	104822	99306	127710	97416
4+	74204	83483	70552	40405	63505	69049	101384	142713	206883	189485	100908	98295	127254	97379
5+	63514	78150	66944	37221	58784	56294	95143	126142	150685	138387	89276	80562	103044	78176
6+	57179	50558	52324	34464	44771	31924	85619	99572	82757	72766	52595	65984	62139	60480

	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
3	5733	2695	255	2027	346	662	47	189	455	287	1002	46	27	60	253
4	27600	6936	7815	6856	2469	4554	3750	1097	1386	2314	757	1150	2540	2894	346
5	21590	13088	4516	8382	3746	3903	12799	6442	2322	2387	3540	2131	8498	9763	4538
6	13116	21309	5336	2526	3720	1840	5819	5687	6179	2226	3167	5299	6224	9439	6304
7	7155	6426	9599	686	2008	1324	2534	2808	6752	5852	2607	3709	8187	5277	3506
8	4500	10026	4405	959	839	470	981	1219	3059	7848	5990	2916	3706	5129	3108
9	4419	7430	5093	293	1499	359	276	734	1369	4457	4853	5288	3039	4436	6135
10	2323	3691	3107	323	573	369	122	286	855	1857	1923	3978	4435	3663	4421
11	1530	3595	1328	119	480	76	96	85	369	1591	728	946	2388	3469	3920
12	1623	1930	1078	112	287	64	71	164	132	332	451	530	1080	1334	5086
13	2336	11893	5346	229	486	283	216	27	432	702	486	945	959	1161	2535
3+	91925	99024	47575	22514	16451	13905	26709	18738	23310	29852	25504	26936	41081	46624	40156
4+	86192	96326	47623	20487	16105	13243	26662	18550	22856	29565	24502	26890	41054	46564	39903
5+	58592	79390	39808	13631	13636	8689	22912	17452	21470	27251	23745	25740	38514	43671	39557
6+	37001	66302	35292	5248	9890	4786	10113	11010	19148	24864	20205	23610	30016	33908	35019

	1988	1989	1990	1991	1992	1993
3	205	975	585	607	1486	418
4	319	2117	4550	572	1150	2510
5	2107	2403	6338	1582	887	873
6	11361	2822	2246	1251	1102	596
7	9820	6170	1152	1080	663	873
8	3804	5919	2985	2046	310	271
9	2903	3434	2917	4277	550	143
10	2924	1936	3674	4538	951	308
11	2333	1591	1393	4585	1322	411
12	1572	1225	934	2824	1065	467
13	4023	3847	1262	4553	3062	2123
3+	40370	32443	28037	27949	12550	9293
4+	40165	31468	27452	27342	11062	9876
5+	39847	29349	22902	26770	9912	6366
6+	37740	26946	16564	25155	9025	5493

Table 9. Abundance (000's) from stratified random spring surveys in Division 3O. Numbers in brackets are estimates for non-sampled strata.

Depth range (fath)	Strata	Area	ATC 207/209 1973	ATC 233 1975	ATC 245 1976	ATC 263 1977	ATC 277 1978	ATC 289/291 1979	ATC 303 1980	ATC 318/319 1981	ATC 327/328 1982	AN 27 1984	AN 43 1985	WT 47 1986	WT 58 1987	WT 70 1988	WT 82 1989	WT 94/95 1990	WT 105/106 1991	WT* 119/120 1992	WT 136/137 1993
31–50	330	2089	2143	418	680	889	1072	3674	1411	941	358	1921	1461	824	3763	993	342	949	86	16	45
	331	456	34	49	624	(185)	240	205	1284	(134)	377	993	548	214	650	240	137	(186)	34	17	0
	338	1898	2451	4987	3229	9047	1311	2666	1681	(1797)	4103	10116	2390	2976	5303	1781	3818	1371	1382	855	356
	340	1716	(979)	215	4165	258	708	1730	386	859	2340	2898	2734	2576	55431	1178	615	873	186	26	64
	351	2520	2837	936	615	4843	2535	39982	1513	3689	8701	18538	4413	32509	28753	2913	1470	2033	315	151	63
	352	2580	3409	1289	1791	5965	4648	2292	2113	(2264)	3486	11814	4859	2988	12097	8821	3769	4320	1439	775	443
	353	1282	225	706	48	321	1732	4388	48	(207)	257	0	674	165	1700	1674	385	529	69	192	144
51–100	329	1721	129	(380)	3682	172	1731	1012	65	129	754	775	501	501	42933	2233	388	1200	1608	48	108
	332	1047	(1031)	1729	367	1729	7309	2613	118	(814)	5678	236	1839	458	2546	1297	393	1556	19059	1305	49906
	337	948	735	688	356	249	320	516	47	(234)	285	142	939	882	451	249	1281	285	939	1583	37573
	339	585	220	22	(109)	(129)	329	1361	(60)	198	2459	1054	88	29	278	102	15	132	44	44	22
	354	474	261	(105)	712	36	(230)	729	2076	107	107	142	261	178	1975	160	36	53	368	71	267
101–150	333	151	(19)	958	85	0	4	0	6	(14)	60	0	17	53	340	0	283	74	193	130	176
	336	121	9	0	0	141	5	2	95	(4)	27	0	9	45	9	5	5	59	27	763	132
	355	103	19	0	4	(18)	(24)	19	128	19	151	0	398	12	54	12	178	50	97	27	66
150–200	334	92	(11)	(7)	7	0	2	0	21	(8)	3	0	152	856	14	70	52	235	483	173	414
	335	58	7	(0)	1	(0)	0	0	3	(0)	4	0	0	40	4	7	4	26	4	131	234
	356	61	2	(1)	(2)	(3)	(4)	5	18	2	48	0	0	9	2	30	37	40	44	135	130
31–50		12541	12078	8600	11152	21508	12246	54937	8436	9891	19622	46280	17079	42252	107697	17600	10536	10261	3511	2032	1020
51–100		4775	2376	2934	5226	2315	9919	6231	2366	1482	9283	2349	3628	2048	48183	4041	2113	3226	22018	3051	87856
101–150		375	47	958	89	159	33	21	229	37	238	0	424	110	403	17	466	183	317	920	374
151–200		211	20	8	10	3	6	5	42	10	55	0	152	905	20	107	93	301	531	439	778
201–300		245	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2347	6369	752
301–400		309	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	4	102	46
Mean #/tow			10.80	9.30	12.26	17.85	16.52	45.54	8.24	8.50	21.73	36.19	15.84	33.72	116.31	16.20	9.83	10.40	19.63	9.32	65.65
Adjusted total			14518	12500	16476	23983	22204	61193	11073	11419	29199	48628	21283	45316	156302	21764	13204	13978	26375	12914	90953
Unadjusted total			12481	11996	16365	23648	21946	61195	11013	5943	29198	48628	21282	45315	156304	21764	13206	13786	26375	12914	90953
Upper limit			16978	72778	36380	38899	54753	115076	18404	11743	45492	63225	27522	101321	237824	28720	19586	17170	72880	92671	650816
Lower limit			7983	−48786	−3649	8397	−10861	7314	3621	144	12904	34031	15043	−10690	74784	14808	6827	10401	−20130	−66842	−468909

* 1992 data are not used to adjust for missing strata; strata > 200 fathoms are not included in means + totals.

Table 10. Cod abundance (000's) from stratified random spring surveys in Division 3N. Numbers in brackets are estimates for non-sampled strata.

Depth range (fath)	Strata	Area	ATC 199 1972	ATC 208-209 1973	ATC 222 1974	ATC 233 1975	ATC 245 1976	ATC 263 1977	ATC 277 1978	ATC 289+291 1979	ATC 304 1980	ATC 318-319 1981	ATC 328 1982	AN 27 1984	WT 29 AN 43 1985	WT 47 1986	WT 58+59 1987	WT 70 1988	WT 82 1989	WT 95-96 1990	WT 105-106 1991	WT* 119-120 1992	WT 136-137 1993
0-30	375	1593	3826	399	1435	6617	(811)	7474	4329	263	508	10583	1578	1746	3184	912	2167	1116	1674	1226	60	80	40
	376	1499	788	38	(128)	1294	113	3601	225	225	113	225	32	7933	48	177	2813	375	113	177	48	0	0
31-50	360	2992	1516	(420)	(544)	2302	3425	4211	1011	1273	2695	524	2118	5679	3004	553	1198	1422	165	569	56	112	20
	361	1853	5796	835	904	3624	723	5610	4764	1165	1808	(3111)	4961	3283	10293	3310	10484	2841	1904	2380	817	35	226
	362	2520	11823	984	1466	431	1021	5830	7440	757	1204	3859	1608	18970	4385	2392	43871	1702	2605	3443	170	32	63
	373	2520	3831	142	426	(1137)	76	946	5959	327	331	1892	1589	8161	769	676	4307	1097	822	227	52	0	0
	374	931	175	175	0	140	(101)	1607	1817	297	0	163	1677	2893	175	47	266	363	28	210	14	14	0
	383	674	1644	51	25	(80)	17	320	1493	34	0	118	25	34	0	0	422	51	84	25	34	0	0
51-100	359	421	822	622	(152)	(367)	4709	1359	(745)	561	2133	611	126	95	0	1264	332	269	95	47	32	47	190
	377	100	1066	143	613	413	(46)	2800	105	73	490	1146	278	56	105	23	758	0	19	0	0	0	4
	382	647	4347	16	130	(150)	24	2639	1943	243	255	146	194	0	134	12	16	24	81	130	0	0	0
101-150	358	225	861	4189	(260)	(604)	(280)	262	(1209)	439	1993	135	1343	380	448	760	1478	549	709	456	59	1478	709
	378	139	3673	459	1683	(409)	(190)	657	120	403	1445	193	1236	318	2181	433	151	157	198	172	122	172	89
	381	182	779	861	79	156	(173)	3267	364	155	379	779	1851	200	2391	1312	68	191	102	273	55	7	0
151-200	357	164	(254)	1157	(43)	(105)	(46)	12	(216)	49	336	37	382	0	2831	137	(253)	6	18	123	148	302	12
	379	106	(295)	1802	785	(124)	(56)	24	0	671	408	40	322	175	525	801	4	8	44	139	406	1126	56
	380	116	118	641	70	(122)	(55)	22	(246)	96	26	15	(121)	83	788	136	313	226	118	270	300	57	4119
0-30		3092	4614	437	1563	7911	924	11075	4554	488	621	10808	1610	9679	3232	1089	4980	1491	1787	1403	108	80	34
31-50		11490	24785	2607	3365	7714	5361	18524	22484	3853	6038	9667	11978	39020	18626	6978	60548	7476	5608	6854	1143	193	304
51-100		1168	6235	781	895	930	4779	6798	2793	877	2878	1903	598	151	239	1299	1106	293	195	177	32	47	198
101-150		546	5313	5509	2022	1169	643	4186	1693	997	3818	1107	4430	898	5020	2505	1697	897	1009	901	236	1657	796
151-200		386	667	3600	858	351	157	48	462	816	770	92	825	258	4144	1074	570	240	180	532	854	1485	4161
201-300		420	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	539	1982	138
301-400		352	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	14	14	5
Mean #/tow			33.23	10.33	6.98	14.43	9.48	32.45	25.54	5.60	11.28	18.82	15.53	40.02	24.97	10.34	55.02	8.30	7.01	7.88	1.90	3.94	4.33
Adjusted total			41612	12930	8741	18073	11867	40640	31985	7008	14124	23574	19444	50107	31262	12943	68902	10397	8772	9866	2372	5132	5675
Unadjusted total			41062	12511	7615	14976	10108	40641	29569	7030	14125	20464	19321	50006	31260	12943	68649	10399	8778	9867	2372	5132	5675
Upper limit			60525	19420	10765	25131	25080	58111	38156	9512	18899	38028	24878	72633	39382	18459	94509	12770	11226	11844	3550	11869	57178
Lower limit			21600	5602	4465	4821	-4864	23171	20982	4547	9351	2900	13765	27378	23139	7427	42788	8028	6330	7890	1193	-1604	-45826

*1992 data are not used to adjust for missing strata; strata > 200 fathoms are not included in means or totals.

Table 11. Biomass (MT) from random stratified cruises in Division 3O. Numbers in brackets are estimates for non-sampled strata.

Depth range (fath)	Strata	Area	ATC 207-209 1973	ATC 233 1975	ATC 245 1976	ATC 263 1977	ATC 277 1978	ATC 289/291 1979	ATC 303 1980	ATC 318/319 1981	ATC 327/328 1982	AN 27 1984	AN 43 1985	WT 47 1986	WT 58 1987	WT 70 1988	WT 82 1989	WT 94/95 1990	WT 105/106 1991	WT* 119/120 1992	WT 136/137 1993
31-50	330	2089	8986	474	287	592	2218	3753	470	3371	123	3626	4642	2136	5654	2767	1713	2262	90	2	11
	331	456	279	728	454	(183)	342	150	609	(410)	38	2630	3423	685	804	1224	183	(848)	98	97	0
	338	1898	4174	5558	1874	6947	1334	5729	1795	(5873)	5659	29905	7485	14405	9838	9124	14874	5475	6271	8466	2959
	340	1716	(2043)	2028	2688	298	966	3718	386	4294	2849	6827	5431	5796	77479	12421	2977	6338	70	4	979
	351	2520	3003	1561	2681	8134	4334	47954	5629	6621	4498	43255	23490	38217	66032	15852	11619	16567	3890	1128	696
	352	2580	2986	425	1428	6114	3961	6235	5625	(9618)	6236	34168	29692	15071	49765	57457	34373	28930	16762	9958	4879
	353	1282	3172	77	2	262	84	1573	2	(541)	472	0	6083	951	9610	626	2371	3544	688	972	2222
51-100	329	1721	205	(221)	6417	180	2008	357	19	517	396	594	840	304	45335	9436	682	1611	1627	10	17
	332	1047	(1579)	829	351	939	4525	2266	9	(2068)	3474	2358	13471	2499	9808	8681	1369	8728	4097	960	30014
	337	948	75	1904	32	629	614	23	133	(623)	610	434	1203	8497	2674	382	2787	1997	2373	17045	19121
	339	585	1086	40	(44)	(70)	249	1475	(31)	505	610	1087	359	29	354	233	146	103	3	7	3
	354	474	427	(35)	38	8	(83)	34	273	44	125	489	219	180	2179	530	25	317	2312	39	540
101-150	333	151	(36)	524	82	0	2	0	28	(49)	153	0	147	232	1057	0	1040	225	500	53	916
	336	121	28	0	0	136	3	1	286	(15)	70	0	34	45	17	18	23	191	40	438	147
	355	103	74	0	4	(9)	(12)	24	367	32	135	0	135	12	114	19	195	96	86	3	58
151-200	334	92	(21)	(6)	6	0	6	0	43	(28)	8	0	570	3481	59	248	136	425	776	514	781
	335	58	22	(0)	3	(0)	0	0	10	(2)	11	0	0	126	18	39	7	63	2	44	2088
	356	61	10	(0)	(0)	(2)	(3)	12	49	9	166	0	0	32	7	102	74	142	11	43	154
31-50			12541	24643	10851	9414	22530	13239	69112	14516	30728	19875	120411	80246	77261	219182	99471	68110	63964	27869	20627
51-100			4775	3372	3029	6882	1826	7479	4155	481	3757	5215	4962	16092	11509	60350	19262	5009	12756	10412	18061
101-150			375	138	524	86	145	16	25	681	96	358	0	316	289	1188	37	1258	512	626	494
151-200			211	53	6	9	2	9	12	102	31	185	0	570	3639	84	389	217	630	789	603
201-300			245	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11868	1516
301-400			309	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	41
Mean wt./tow			20.99	10.72	12.20	18.23	15.44	54.55	11.73	25.76	19.08	93.30	72.35	68.98	208.97	88.67	55.51	57.84	37.22	29.84	48.27
Adjusted total			28204	14411	16391	24502	20743	73302	15768	34619	25633	125375	97224	92698	280808	119156	74594	77863	39696	41342	66875
Unadjusted total			24527	14148	16346	24238	20647	73304	15735	15393	25632	125373	97223	92699	280807	119157	74595	77016	39697	41342	66875
Upper limit			35742	87352	89006	38369	35818	135612	24518	25204	33925	169977	126100	136099	382599	179304	134314	101143	55540	91139	353969
Lower limit			13312	-59055	-56313	10108	5477	10995	6951	5582	17338	80769	68346	49299	179014	59009	14876	52888	23854	-8454	-220218

*1992 data are not used to adjust for missing strata; strata > 200 fathoms are not included in totals or means.

Table 12. Cod biomass (MT) from stratified random spring surveys in Division 3N. Numbers in brackets are estimates for non-sampled strata.

Depth range (fath)	Strata	Area	ATC 199 1972	ATC 208-209 1973	ATC 222 1974	ATC 233 1975	ATC 245 1976	ATC 263 1977	ATC 277 1978	ATC 289+291 1979	ATC 304 1980	ATC 318-319 1981	ATC 328 1982	AN 27 1984	WT 29 AN 43 1985	WT 47 1986	WT 58+59 1987	WT 70 1988	WT 82 1989	WT 95-96 1990	WT 105-106 1991	WT* 119-120 1992	WT 136-137 1993
0-30	375	1593	9691	1012	955	10591	(2148)	5424	3598	369	3229	29835	5943	2404	18475	14585	8034	16512	20104	10230	1141	1391	678
	376	1499	1837	783	(174)	383	77	9663	102	868	855	2208	2	1049	391	1883	2876	4454	745	2745	751	0	0
31-50	360	2992	1910	(919)	(382)	305	1948	4037	2182	1416	1738	3743	1238	7877	9161	1945	1282	494	1202	9486	581	842	1
	361	1853	4395	2453	350	3243	2616	5889	8203	2666	4173	(12196)	8125	12838	29220	50957	27584	15887	12722	20240	11883	278	2232
	362	2520	9416	4101	2231	306	1664	6830	6621	1632	5847	8701	3708	40764	16509	19686	69852	12714	16464	24747	2361	446	873
	373	2520	3325	1802	2359	(758)	1030	1749	4300	1838	857	4578	6647	17916	2446	2897	6788	5959	6090	3441	392	0	0
	374	931	681	266	0	135	(227)	1247	1324	479	0	146	2369	8335	877	769	1058	4032	489	3296	361	3	0
	383	674	1572	1	17	(14)	46	338	1564	146	0	430	5	295	0	0	818	71	335	326	113	0	0
51-100	359	421	303	251	(6)	(7)	659	147	(76)	190	478	208	13	71	0	134	43	44	21	6	15	3	51
	377	100	535	14	83	283	(14)	1379	130	22	287	428	22	29	13	54	328	0	9	0	0	0	1
	382	647	2032	7	59	(10)	44	991	2215	220	285	182	36	0	16	61	12	7	419	40	0	0	0
101-150	358	225	1030	1721	(64)	(69)	(111)	383	(300)	483	1054	229	236	182	122	547	1803	229	486	159	56	284	450
	378	139	4028	393	631	(49)	(78)	686	90	281	939	104	303	133	470	256	73	96	81	62	82	62	68
	381	182	883	1475	228	128	(146)	2797	393	196	427	533	2186	319	1544	747	82	270	39	212	232	1	0
151-200	357	164	(104)	1343	(13)	(14)	(25)	29	(74)	52	332	135	92	0	2102	259	(142)	18	22	62	59	158	17
	379	106	(107)	1776	515	(16)	(27)	50	0	601	178	53	179	129	324	365	4	15	22	61	204	633	60
	380	116	273	1116	180	(30)	(49)	55	(135)	232	57	25	(86)	224	847	135	454	181	176	180	110	56	3061
0-30		3092	11528	1795	1127	10974	2225	15087	3700	1237	4084	32043	5945	3453	18866	16468	10910	20966	20849	12975	1892	1391	678
31-50		11490	21299	9542	5339	4761	7531	20090	24194	8177	12615	29784	22092	88025	58213	76254	107382	39157	37302	61536	15691	1569	2980
51-100		1168	2870	272	148	300	717	2517	2421	432	1050	818	71	100	29	249	383	51	449	46	15	3	52
101-150		546	5941	3589	923	246	335	3866	783	960	2420	866	2725	634	2136	1550	1958	595	606	433	370	347	518
151-200		386	484	4235	708	60	101	134	209	885	567	213	357	353	3273	759	600	214	220	303	373	847	3138
201-300		420	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	351	802	58
301-400		352	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6	5	4
Mean wt./tow			33.64	15.52	6.58	13.05	8.71	33.30	25.00	9.34	16.56	50.90	24.91	73.92	65.90	76.09	96.81	48.70	47.46	60.13	14.65	3.79	5.77
Adjusted total			42123	19433	8245	16340	10911	41698	31307	11694	20737	63734	31196	92564	82515	95278	121233	60981	59425	75294	18340	4940	7554
Unadjusted total			41912	18513	7607	15372	8084	41695	30722	11692	20736	51538	31104	92566	82515	95280	121091	60982	59425	75293	18342	4940	7554
Upper limit			57120	27613	13059	36966	13775	62035	38492	16493	28150	120670	46068	123679	108356	162514	159883	80483	81925	98258	33620	7761	48311
Lower limit			26704	9413	2155	-6222	2393	21355	22952	6891	13322	-17595	16141	61452	56675	28046	82300	41481	36925	52329	3064	2120	-33203

*1992 data are not used to adjust for missing strata; strata > 200 fathoms are not included in means + totals.

Table 13. Mean number per tow at age of cod from RV surveys conducted by Canada in Divisions 3NO.

	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
1	0	0.01	0.06	0.04	0.41	0.55	0.01	0.56	3	0.01	0.33
2	2.57	1.15	2.35	1.13	2.84	3.67	2.3	0.72	0.9	5.32	0.35
3	25.88	8.84	2.39	4.05	4.22	2.73	9.5	7.18	2.27	1.36	5.02
4	3.56	18.94	1.67	0.73	2.37	1.73	6.16	8.29	8.99	0.66	1.47
5	2.72	1.69	2.21	0.36	0.53	1.57	4.53	2.52	7.62	1.06	1.71
6	0.65	0.7	0.44	0.31	0.28	0.25	1.51	0.97	1.71	0.43	2.16
7	0.66	0.57	0.25	0.11	0.54	0.07	0.48	0.62	0.51	0.21	1.05
8	0.29	0.4	0.18	0.03	0.22	0.12	0.22	0.04	0.25	0.18	0.47
9	0.15	0.29	0.2	0.01	0.22	0.06	0.1	0.01	0.1	0.18	0.49
10	0.02	0.17	0.12	0.06	0.07	0.07	0.1	0.03	0.02	0.09	0.22
11	0.05	0.08	0.05	0.02	0.01	0.02	0.01	0.04	0.06	0.05	0.04
12	0.09	0.05	0.08	0	0.02	0	0.04	0	0	0.07	0.13
13	0	0	0.12	0	0.01	0	0.09	0.04	0.04	0.03	0.06
14	0.29	0.35	0.44	0.12	0.13	0.05	0.12	0.01	0.1	0.12	0.16
1+	36.93	33.24	10.56	6.97	11.87	10.89	25.17	21.03	25.57	9.77	13.66
2+	36.93	33.23	10.5	6.93	11.46	10.34	25.16	20.47	22.57	9.76	13.33
3+	34.36	32.08	8.15	5.8	8.62	6.67	22.86	19.75	21.67	4.44	12.98
4+	8.48	23.24	5.76	1.75	4.4	3.94	13.36	12.57	19.4	3.08	7.96
5+	4.92	4.3	4.09	1.02	2.03	2.21	7.2	4.28	10.41	2.42	6.49
6+	2.2	2.61	1.88	0.66	1.5	0.64	2.67	1.76	2.79	1.36	4.78

	1982	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
1	1.40	0.01	0.01	0.02	0.21	0.01	0.02	0.04	0.02	0	0
2	8.40	3.29	0.41	0.68	2.73	1.68	0.25	0.47	6.3	0.65	0.14
3	1.06	6.21	4.50	0.69	2.80	2.23	1.89	0.95	1.24	4.42	13.86
4	3.17	9.92	6.09	7.54	9.18	0.46	1.09	1.34	0.60	0.17	18.32
5	0.54	5.30	2.43	6.32	34.30	0.41	0.28	1.09	0.41	0.10	1.09
6	0.42	5.61	0.89	1.58	20.91	1.07	0.30	0.24	0.18	0.13	0.69
7	0.70	1.87	0.98	0.67	8.20	1.18	0.68	0.47	0.13	0.05	0.59
8	0.52	1.00	0.74	0.64	1.75	0.78	0.62	0.61	0.17	0.03	0.28
9	0.23	1.81	0.89	0.49	1.91	0.82	0.44	0.73	0.34	0.11	0.07
10	0.14	1.57	1.35	0.72	0.68	0.87	0.48	0.51	0.22	0.13	0.10
11	0.06	0.86	0.99	1.17	0.76	0.44	0.64	0.42	0.18	0.16	0.20
12	0.04	0.32	0.49	0.64	0.70	0.55	0.42	0.41	0.11	0.17	0.15
13	0.01	0.11	0.24	0.35	0.80	0.79	0.33	0.22	0.15	0.15	0.08
14	0.13	0.22	0.39	0.51	0.76	1.25	1.00	1.65	0.72	0.13	0.08
1+	16.82	38.10	20.40	22.02	85.69	12.54	8.44	9.15	10.77	6.40	35.65
2+	15.42	38.09	20.39	22.00	85.48	12.53	8.42	9.11	10.75	6.40	35.65
3+	7.02	34.80	19.98	21.32	82.75	10.85	8.17	8.64	4.45	5.75	35.51
4+	5.96	28.59	15.48	20.63	79.95	8.62	6.28	7.69	3.21	1.33	21.65
5+	2.79	18.67	9.39	13.09	70.77	8.16	5.19	6.35	2.61	1.16	3.33
6+	2.25	13.37	6.96	6.77	36.47	7.75	4.91	5.26	2.20	1.06	2.24

Table 14. Biomass (t) and Abundance (000's) of cod from autumn stratified random surveys in Division 3O.

Depth			Biomass				Abundance			
Range	Strata	Area	1990	1991	1992	1993	1990	1991	1992	1993
31–50	330	2089	2465	681	876	1668	1625	745	902	1542
	331	456	1	232	83	127	11	377	68	86
	338	1898	6639	3771	1533	1710	3437	1311	249	826
	340	1716	1697	3520	2839	474	644	1520	2222	464
	351	2520	7031	9922	1296	4276	4634	5334	662	3297
	352	2580	11930	18064	1960	2338	3060	4532	613	968
	353	1282	2666	7	0	0	674	24	0	0
51–100	329	1721	683	496	9	98	215	129	43	78
	332	1047	345	4	85	506	196	39	79	393
	337	948	1301	46	174	38	213	36	108	71
	339	585	618	0	40	162	73	0	22	176
	354	474	2	0	319	0	36	0	249	0
101–150	333	151	4	0	6	0	6	0	6	0
	336	121	16	0	0	48	3	0	0	27
	355	103	–	15	6	30	–	66	116	37
151–200	334	92	8	0	0	10	7	0	0	5
	335	58	5	4	0	0	4	2	0	0
	356	61	–	4	0	26	–	2	0	27
201–300	717	93	0	–	–	0	0	–	–	0
	719	76	0	0	–	0	0	0	–	0
	721	76	–	0	–	0	–	0	–	0
301–400	718	111	–	–	–	0	–	–	–	0
	720	105	–	–	–	0	–	–	–	0
	722	93	–	0	–	0	–	–	–	0
31–50		12541	32429	36197	8587	10593	14085	13843	4716	7183
51–100		4775	2949	546	627	804	733	204	501	718
101–150		375	20	15	12	78	9	66	122	64
151–200		211	13	8	0	36	11	4	0	32
Total			35411	36766	9226	11511	14838	14117	5339	7997
Upper			47985	51619	14078	20007	21022	19938	8452	13057
Lower			22833	21918	4376	3015	8657	8295	2014	2939

Table 15. Biomass (t) and Abundance ('000) of cod from autumn stratified random surveys in Division 3N.

Depth Range	Strata	Area	Biomass 1990	Biomass 1991	Biomass 1992	Biomass 1993	Abundance 1990	Abundance 1991	Abundance 1992	Abundance 1993
0–30	375	1593	21899	38662	–	1499	1814	11988	–	628
	376	1499	2089	14770	22566	66	1067	28265	47484	56
31–50	360	2992	3727	1611	1817	4550	1492	842	861	898
	361	1853	14530	8568	4456	7393	1913	2156	2956	1474
	362	2520	4180	21096	6986	659	2218	7623	7756	405
	373	2520	4897	16186	1660	40	447	3247	378	108
	374	931	1129	3356	–	418	196	2097	–	163
	383	674	40	34	–	0	84	67	–	0
51–100	359	421	1	0	35	7	16	0	63	16
	377	100	36	–	74	0	49	–	101	0
	382	647	47	10	27	28	49	32	49	73
101–150	358	225	130	95	607	18	127	160	988	17
	378	139	116	158	103	1	110	261	151	5
	381	182	–	0	–	31	–	0	–	48
151–200	357	164	128	64	37	143	111	68	43	277
	379	106	140	–	93	58	156	–	119	95
	380	116	–	13	–	8	–	48	–	13
201–300	723	155	–	–	–	21	–	–	–	23
	725	105	–	–	–	35	–	–	–	28
	727	160	–	–	–	104	–	–	–	204
301–400	724	124	–	–	–	4	–	–	–	5
	726	72	–	–	–	0	–	–	–	0
0–30		3092	23988	53432	22566	1565	2881	40253	47484	684
31–50		11490	28503	50851	14919	13060	6350	16032	11951	3048
51–100		1168	84	10	136	35	114	32	213	89
101–150		546	246	253	710	50	237	421	1139	70
151–200		386	268	77	130	209	167	116	162	385
201–300		420	–	–	–	160	–	–	–	255
301–400		196	–	–	–	4	–	–	–	5
Total			53089	104623	38461	15083	9749	56854	60949	4536
Upper			96410	164110	110465	25418	13724	113966	226427	6399
Lower			9760	45134	−33545	4750	5768	256	−104530	2675

Table 16. Mean No./Tow at age for Div. 3NO combined from Fall Research Vessel surveys

Age	1990	1991	1992	1993
1	0.81	0.51	0.01	0.05
2	1.05	14.98	5.71	0.12
3	1.06	1.92	17.89	1.13
4	2.23	1.47	2.40	2.20
5	1.46	2.55	0.95	0.27
6	0.37	1.36	0.60	0.24
7	0.29	0.41	0.18	0.18
8	0.40	0.40	0.04	0.10
9	0.42	0.68	0.05	0.02
10	0.27	0.46	0.06	0.02
11	0.23	0.51	0.00	0.07
12	0.10	0.37	0.05	0.05
13	0.17	0.31	0.11	0.04
14+	0.69	1.07	0.20	0.18
Mean	9.55	26.99	28.26	4.67
Upper	12.34	48.96	98.93	6.64
Lower	6.76	5.02	−42.42	2.70

Table 17. Comparison of Biomass and Abundance from Spring RV Surveys for 3NO Cod

	BIOMASS			ABUNDANCE		
YEAR	3N	3O	3NO	3N	3O	3NO
1972	42	–	–	42	–	–
1973	19	28	48	13	15	27
1974	8	–	–	9	–	–
1975	16	14	31	18	13	31
1976	11	16	27	12	17	28
1977	42	25	66	41	24	65
1978	31	21	52	32	22	54
1979	12	73	85	7	61	68
1980	21	16	37	14	11	25
1981	64	35	98	24	11	35
1982	31	26	57	19	29	49
1983	No Survey			No Survey		
1984	93	125	218	50	49	99
1985	83	97	180	31	22	53
1986	95	93	188	13	45	58
1987	121	281	402	69	156	225
1988	61	119	180	10	22	32
1989	59	75	134	9	13	22
1990	75	78	153	10	14	24
1991	18	40	58	2	26	29
1992	5	41	46	5	13	18
1993	8	67	75	6	91	97

Comparison of Biomass and Abundance for Fall RV Surveys

Year	3N	3O	3NO	3N	3O	3NO
1990	53	35	88	10	15	25
1991	105	37	142	57	14	71
1992	38	9	47	61	5	66
1993	15	12	27	5	8	13

Table 18. Results from ADAPT using Canadian Spring and Fall RV Surveys and Russian Surveys: Estimat... parameters with associated CVs.

APPROXIMATE STATISTICS ASSUMING LINEARITY NEAR SOLUTION

ORTHOGONALITY OFFSET..... 0.001260
MEAN SQUARE RESIDUALS 0.838035

PARAMETER	AGE	ESTIMATE	STD. ERR.	T-STAT	C.V.	BIAS
NUMBERS						
	3	32927	16084	2.047	0.488	13.10
	4	34548	12880	2.682	0.373	8.14
	5	3001	982	3.055	0.327	6.59
	6	1431	435	3.292	0.304	6.56
	7	1442	442	3.264	0.306	5.87
	8	580	193	3.009	0.332	6.05
	9	178	60	2.971	0.337	5.98
	10	241	82	2.953	0.339	5.68
	11	284	101	2.804	0.357	5.91
INDEX 1: RV1						
	3	1.55E-4	3.62E-5	4.282	0.234	2.19
	4	2.05E-4	4.74E-5	4.311	0.232	2.21
	5	2.13E-4	4.95E-5	4.307	0.232	2.26
	6	2.06E-4	4.79E-5	4.296	0.233	2.35
	7	2.38E-4	5.55E-5	4.290	0.233	2.43
	8	2.51E-4	5.87E-5	4.281	0.234	2.56
	9	3.44E-4	8.07E-5	4.268	0.234	2.71
	10	4.77E-4	1.12E-4	4.259	0.235	2.91
	11	6.44E-4	1.51E-4	4.261	0.235	3.09
INDEX 2: RV2						
	3	4.02E-4	9.33E-5	4.313	0.232	2.25
	4	3.91E-4	9.03E-5	4.330	0.231	2.29
	5	3.93E-4	9.09E-5	4.326	0.231	2.36
	6	3.99E-4	9.23E-5	4.319	0.232	2.41
	7	3.84E-4	8.89E-5	4.317	0.232	2.46
	8	3.88E-4	8.99E-5	4.312	0.232	2.57
	9	5.15E-4	1.20E-4	4.305	0.232	2.70
	10	7.22E-4	1.68E-4	4.303	0.232	2.87
	11	9.50E-4	2.21E-4	4.292	0.233	2.83
INDEX 3: RV3						
	3	1.54E-4	7.61E-5	2.030	0.493	10.83
	4	3.37E-4	1.63E-4	2.063	0.485	10.32
	5	4.68E-4	2.27E-4	2.058	0.486	10.56
	6	5.40E-4	2.65E-4	2.041	0.490	11.18
	7	3.80E-4	1.85E-4	2.051	0.488	11.10
	8	3.07E-4	1.50E-4	2.052	0.487	11.22
	9	2.80E-4	1.37E-4	2.034	0.492	12.25
	10	2.60E-4	1.29E-4	2.018	0.496	13.37
	11	7.20E-4	3.56E-4	2.021	0.495	14.03
INDEX 4: RV4						
	3	6.47E-4	2.82E-4	2.298	0.435	8.17
	4	6.34E-4	2.72E-4	2.334	0.428	7.89
	5	6.23E-4	2.67E-4	2.330	0.429	8.03
	6	4.67E-4	2.02E-4	2.312	0.432	8.42
	7	4.09E-4	1.76E-4	2.320	0.431	8.43
	8	3.11E-4	1.34E-4	2.312	0.432	8.94
	9	2.18E-4	9.50E-5	2.292	0.436	9.64
	10	1.99E-4	8.73E-5	2.274	0.440	10.44
	11	6.84E-4	3.00E-4	2.280	0.439	10.94

RV1 - Canada Spring
RV2 - Russia
RV3 - Canada Fall
RV4 - Canada Juvenile

Table 19. Results from ADAPT using Canadian Spring and Fall RV Surveys and Russian Surveys: Residuals.

LOG RESIDUALS FROM RV1 11/ 2/94

	1977	1978	1979	1980	1981	1982	1984	1985	1986	1987
3	0.405	0.243	-0.082	-0.715	0.263	-1.069	0.044	-0.038	-0.619	1.129
4	0.644	0.270	0.475	-1.345	-0.667	-0.210	0.654	-0.001	0.485	1.928
5	1.300	0.106	0.662	-1.337	-0.126	-1.398	0.733	-0.391	0.405	2.309
6	0.918	0.335	0.296	-1.613	-0.194	-1.141	1.065	-0.561	-0.159	2.143
7	0.876	0.441	0.076	-1.434	-0.427	-1.092	0.514	-0.274	-0.418	1.894
8	0.973	-0.996	-0.082	-0.507	-0.254	-0.661	0.275	-0.011	-0.169	1.001
9	-0.117	-1.759	-0.021	-0.368	0.618	-0.732	0.288	0.273	-0.246	1.230
10	0.926	-0.932	-0.988	-0.058	-0.112	-0.383	0.934	0.085	0.213	0.353
11	-0.994	0.434	-0.170	-0.029	-0.788	-1.127	0.955	0.760	0.048	0.619

	1988	1989	1990	1991	1992	1993
3	0.164	0.022	-0.693	0.173	-0.345	1.118
4	-0.670	-0.490	0.028	-0.599	-1.593	1.109
5	-0.809	-0.701	0.373	-0.482	-1.419	0.774
6	-0.429	-0.449	0.057	-0.384	-1.082	1.198
7	-0.222	-0.163	0.501	0.213	-1.268	0.785
8	-0.034	-0.193	0.379	0.090	-0.636	0.826
9	0.443	-0.457	0.254	0.246	0.029	0.318
10	0.850	0.079	-0.119	-0.606	-0.308	0.065
11	0.315	0.908	0.094	-0.763	-0.559	0.295

SUM OF RV RESIDUALS : 0.00001033432185 MEAN RESIDUAL : 7.176612393E-8

LOG RESIDUALS FROM RV2 11/ 2/94

	1977	1978	1979	1980	1981	1982	1983	1984	1985
3	0.337	0.232	-0.517	-0.696	-0.416	0.225	-0.037	0.773	1.669
4	0.751	0.328	-1.034	-0.704	-0.267	0.319	0.419	0.935	1.463
5	1.191	0.949	-0.758	-1.049	-0.631	0.931	0.342	0.978	1.806
6	1.154	1.086	-0.566	-0.653	-1.445	0.397	0.986	0.454	1.439
7	1.721	0.912	0.057	-0.156	-1.180	-0.296	0.648	0.662	1.173
8	1.852	1.264	-0.057	0.430	-0.840	-2.051	-0.145	0.428	0.893
9	0.601	0.820	0.298	-0.246	-0.688	0.504	0.468	-0.614	0.174
10	0.533	-0.158	0.928	0.339	-1.331	0.787	0.435	-0.157	-0.447
11	0.942	3.249	-0.020	0.289	-0.190	0.048	0.558	-0.894	-0.127

	1986	1987	1988	1989	1990	1991	1993
3	1.310	-0.113	0.382	-1.036	-2.512	-0.406	0.806
4	1.526	-0.938	-1.240	-1.228	-1.422	0.144	0.947
5	1.093	-1.839	-2.146	-1.645	-1.242	0.782	1.238
6	1.041	-1.559	-1.848	-1.510	-0.777	0.426	1.377
7	1.038	-0.911	-1.779	-1.166	-1.515	0.178	0.612
8	1.285	-0.216	-1.141	-0.836	-1.869	0.541	0.462
9	0.983	-0.042	-0.460	-1.642	-2.140	1.019	0.965
10	0.384	-0.031	-0.124	-1.899	-1.480	0.492	1.729
11	-1.012	-0.186	-0.462	-1.331	-1.720	-0.151	1.005

SUM OF RV RESIDUALS : 0.000007536941072 MEAN RESIDUAL : 5.233986856E-8

Table 19. (cont)

LOG RESIDUALS FROM RV3 11/ 2/94

	1990	1991	1992	1993
3	-0.594	0.737	1.161	-1.305
4	0.378	0.265	0.765	-1.408
5	0.271	0.724	0.256	-1.251
6	0.085	0.857	-0.342	-0.600
7	-0.188	1.184	-0.284	-0.712
8	-0.362	1.042	-0.388	-0.292
9	-0.470	1.456	-0.379	-0.606
10	0.100	0.998	-0.293	-0.805
11	-1.030	0.418	1.345	-0.733

SUM OF RV RESIDUALS : 0.00001209146174 MEAN RESIDUAL : 3.3587393728E-7

LOG RESIDUALS FROM RV4 11/ 2/94

	1989	1990	1991	1992	1993
3	0.580	-0.123	0.766	-0.625	-0.598
4	0.163	1.026	0.028	-0.444	-0.772
5	-0.114	0.842	0.130	-0.404	-0.454
6	-0.201	0.523	0.316	-0.384	-0.254
7	0.074	0.169	0.271	-0.200	-0.315
8	-0.001	0.349	0.107	-0.218	-0.237
9	-0.448	0.526	0.587	-0.683	0.019
10	0.035	0.287	0.318	-0.763	0.123
11	-0.155	-0.537	-0.395	1.350	-0.263

SUM OF RV RESIDUALS : 0.00001216555953 MEAN RESIDUAL : 2.703457673E-7

Table 20. Results from ADAPT using Canadian Spring and Fall RV Surveys and Russian Surveys: Population numbers and fishing mortality.

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
3	45464	40586	17554	19982	27767	22112	36000	42379	33333	9273
4	18879	36673	32396	14307	16119	22277	17828	28408	34644	27239
5	7956	13223	26101	23061	10759	12210	16449	14011	22354	25692
6	4169	4224	8548	13038	15432	7667	8557	11754	10195	12689
7	1295	2056	2718	4479	8616	10556	5361	5916	7521	5599
8	469	543	1363	1426	2979	5333	7260	3769	3740	3878
9	487	224	352	876	967	1919	3017	4901	2434	2341
10	133	210	131	236	634	618	1033	1769	3182	1578
11	73	50	125	92	165	434	315	630	950	2123
12	57	23	34	92	68	98	209	185	420	542
3+	78982	97811	89323	77589	83506	83225	96029	113723	118773	90954

	1987	1988	1989	1990	1991	1992	1993
3	6753	13652	14262	14146	8057	47035	32853
4	7453	5062	10926	9942	10619	5599	34430
5	19709	5720	3856	6971	4064	2656	2983
6	15223	12977	3302	1798	1780	2427	1417
7	6435	9347	4882	1563	663	965	1433
8	3216	4171	4074	2290	898	287	577
9	2318	2042	2502	2174	1222	402	177
10	1412	1133	1159	1609	1254	487	240
11	954	709	543	738	920	572	283
12	1423	421	355	292	469	407	330
3+	64895	55234	45861	41524	29945	60837	74723

FISHING MORTALITY 11/ 2/94

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
3	0.015	0.025	0.005	0.015	0.020	0.015	0.037	0.002	0.002	0.018	0.088	0.023
4	0.156	0.140	0.140	0.085	0.078	0.103	0.041	0.040	0.099	0.124	0.065	0.072
5	0.433	0.236	0.494	0.202	0.139	0.155	0.136	0.118	0.366	0.323	0.218	0.350
6	0.507	0.241	0.446	0.214	0.180	0.158	0.169	0.247	0.399	0.479	0.288	0.778
7	0.669	0.211	0.445	0.208	0.280	0.174	0.152	0.259	0.462	0.354	0.234	0.630
8	0.540	0.233	0.242	0.189	0.239	0.370	0.193	0.237	0.269	0.315	0.254	0.311
9	0.643	0.337	0.201	0.123	0.248	0.419	0.333	0.232	0.234	0.306	0.516	0.366
10	0.780	0.313	0.155	0.157	0.179	0.474	0.294	0.422	0.205	0.303	0.489	0.536
11	0.961	0.195	0.112	0.101	0.321	0.532	0.334	0.206	0.362	0.200	0.618	0.491
12	0.657	0.273	0.261	0.169	0.236	0.359	0.243	0.287	0.292	0.319	0.373	0.461

	1989	1990	1991	1992	1993
3	0.161	0.087	0.164	0.112	0.036
4	0.249	0.695	1.186	0.430	0.106
5	0.563	1.165	0.316	0.428	0.270
6	0.548	0.799	0.412	0.327	0.472
7	0.557	0.354	0.636	0.314	0.274
8	0.428	0.428	0.603	0.283	0.137
9	0.241	0.350	0.721	0.317	0.161
10	0.251	0.359	0.584	0.343	0.197
11	0.419	0.254	0.616	0.350	0.202
12	0.369	0.373	0.636	0.314	0.194

Table 21. Results of Laurec-Shepherd calibration analysis for cod in Div. 3NO.

VPA Version 3.0 (MSDOS)

At 11/02/1994 5:22

Cod in Divisions 3NO

CPUE data from file c3NO_rv.dat

Disaggregated Qs
Log transformation
The final F is the (reciprocal variance-weighted) mean of the raised fleet F's.
No trend in Q (mean used)

Terminal Fs estimated using Laurec-Shepherd

Tuning converged after 25 iterations

Total of the absolute F residuals for all ages in the
last year, between iterations 24 and 25 = .000

Regression weights
, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000

Oldest age F = 1.000*average of 5 younger ages.

Fishing mortalities

Age,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993
3,	.002,	.002,	.019,	.089,	.023,	.173,	.092,	.222,	.242,	.040
4,	.040,	.100,	.124,	.066,	.073,	.256,	.772,	1.293,	.660,	.265
5,	.118,	.368,	.326,	.217,	.355,	.567,	1.195,	.380,	.528,	.537
6,	.246,	.399,	.481,	.292,	.755,	.559,	.804,	.441,	.426,	.679
7,	.259,	.459,	.354,	.236,	.639,	.542,	.368,	.647,	.347,	.404
8,	.238,	.270,	.312,	.254,	.315,	.440,	.411,	.637,	.293,	.156
9,	.245,	.235,	.307,	.507,	.366,	.246,	.365,	.667,	.348,	.170
10,	.406,	.219,	.304,	.490,	.520,	.251,	.368,	.622,	.304,	.224
11,	.212,	.343,	.218,	.617,	.493,	.401,	.255,	.637,	.389,	.174
12,	.272,	.305,	.299,	.421,	.467,	.376,	.353,	.642,	.336,	.226

Log catchability residuals

Fleet : CANADIAN RV spring

Age ,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993
3 ,	-.18,	-.27,	-.84,	.90,	-.05,	-.14,	-.87,	.24,	.19,	1.01
4 ,	.43,	-.23,	.23,	1.71,	-.90,	-.71,	-.12,	-.80,	-1.41,	1.79
5 ,	.55,	-.57,	.23,	2.12,	-.99,	-.88,	.16,	-.49,	-1.40,	1.27
6 ,	.86,	-.77,	-.37,	1.95,	-.67,	-.64,	-.15,	-.54,	-1.02,	1.34
7 ,	.31,	-.49,	-.62,	1.70,	-.43,	-.40,	.34,	.02,	-1.38,	.96
8 ,	.10,	-.18,	-.35,	.83,	-.20,	-.34,	.15,	-.01,	-.78,	.78
9 ,	.09,	.03,	-.49,	.95,	.18,	-.68,	.04,	-.10,	-.13,	.11
10 ,	.73,	.00,	.05,	.19,	.65,	-.07,	-.27,	-.72,	-.59,	.03
11 ,	.72,	.44,	-.13,	.34,	.04,	.60,	-.16,	-1.03,	-.72,	-.12

Fleet : CANADIAN RV fall

Age ,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993
3 ,	,	,	,	,	,	,	-.76,	.68,	1.59,	-1.50
4 ,	,	,	,	,	,	,	.04,	-.25,	.89,	-.68
5 ,	,	,	,	,	,	,	-.18,	.71,	.22,	-.75
6 ,	,	,	,	,	,	,	-.36,	.84,	-.13,	-.35
7 ,	,	,	,	,	,	,	-.32,	.99,	-.27,	-.40
8 ,	,	,	,	,	,	,	-.23,	.88,	-.45,	-.20
9 ,	,	,	,	,	,	,	-.02,	1.09,	-.42,	-.64
10 ,	,	,	,	,	,	,	.05,	.98,	-.41,	-.62
11 ,	,	,	,	,	,	,	.82,	1.60,	-2.83,	.41

Fleet : Canadian Juv. Fall

Age ,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993
3 ,	,	,	,	,	,	.38,	-.32,	.79,	-.12,	-.72
4 ,	,	,	,	,	,	-.04,	.78,	-.40,	-.29,	-.05
5 ,	,	,	,	,	,	-.33,	.45,	.17,	-.38,	.09
6 ,	,	,	,	,	,	-.33,	.30,	.27,	-.21,	-.03
7 ,	,	,	,	,	,	-.11,	.20,	.11,	-.19,	-.01
8 ,	,	,	,	,	,	-.03,	.25,	.05,	-.20,	-.08
9 ,	,	,	,	,	,	-.42,	.55,	.38,	-.60,	.10
10 ,	,	,	,	,	,	.04,	.29,	.29,	-.90,	.27
11 ,	,	,	,	,	,	.82,	.53,	.60,	-2.62,	.67

Table 21. (Cont.)

SUMMARY STATISTICS FOR AGE 3

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	-13.14	.655	.0002	.0148	.842E-01	.666E-01	-13.142	.198
2	-13.14	1.556	.0002	.1815	-.131E+00	.756E+00	-13.140	.696
3	-11.76	.649	.0008	.0832	-.199E+00	.183E+00	-11.760	.265

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.040	.442	.665	.665	2.265

SUMMARY STATISTICS FOR AGE 4

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	-12.86	1.124	.0003	.0443	-.392E-01	.124E+00	-12.865	.339
2	-12.52	.743	.0004	.5230	-.102E+00	.357E+00	-12.516	.332
3	-11.86	.505	.0007	.2772	-.108E+00	.156E+00	-11.857	.206

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.265	.392	.509	.509	1.688

SUMMARY STATISTICS FOR AGE 5

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	-12.88	1.148	.0003	.1506	-.528E-01	.126E+00	-12.877	.346
2	-12.25	.692	.0005	1.1404	-.222E+00	.301E+00	-12.248	.310
3	-11.97	.383	.0006	.4907	.930E-03	.128E+00	-11.968	.156

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.537	.322	.357	.357	1.232

SUMMARY STATISTICS FOR AGE 6

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	-12.89	1.065	.0003	.1774	-.279E-01	.118E+00	-12.894	.321
2	-12.26	.638	.0005	.9656	-.950E-01	.305E+00	-12.256	.285
3	-12.32	.309	.0004	.7002	.958E-02	.103E+00	-12.321	.126

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.679	.269	.262	.269	.951

SUMMARY STATISTICS FOR AGE 7

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	-12.74	.917	.0003	.1550	-.724E-02	.102E+00	-12.743	.276
2	-12.57	.744	.0003	.6050	-.152E+00	.348E+00	-12.569	.333
3	-12.45	.173	.0004	.4085	-.194E-01	.566E-01	-12.451	.071

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.404	.166	.138	.166	.695

SUMMARY STATISTICS FOR AGE 8

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	-12.72	.523	.0003	.0715	.874E-02	.582E-01	-12.721	.158
2	-12.76	.669	.0003	.1920	-.126E+00	.316E+00	-12.763	.299
3	-12.79	.185	.0003	.1697	-.557E-01	.525E-01	-12.791	.075

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.156	.169	.189	.189	1.264

SUMMARY STATISTICS FOR AGE 9

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	-12.33	.456	.0004	.1514	-.155E-01	.505E-01	-12.331	.138
2	-12.83	.861	.0003	.3229	-.339E+00	.347E+00	-12.826	.385
3	-13.16	.545	.0002	.1542	-.120E-01	.182E+00	-13.159	.223

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.170	.324	.185	.324	.326

SUMMARY STATISTICS FOR AGE 10

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	-12.10	.485	.0006	.2175	-.989E-01	.412E-01	-12.097	.146
2	-13.05	.794	.0002	.4182	-.341E+00	.305E+00	-13.052	.355
3	-13.25	.563	.0002	.1711	-.736E-01	.183E+00	-13.253	.230

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.224	.334	.218	.334	.426

SUMMARY STATISTICS FOR AGE 11

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	-11.69	.587	.0008	.1963	-.128E+00	.473E-01	-11.693	.177
2	-13.27	2.178	.0002	.1155	-.565E+00	.989E+00	-13.273	.974
3	-13.08	1.608	.0002	.0896	-.346E+00	.497E+00	-13.075	.657

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.174	.535	.188	.535	.124

Table 21 (cont)
Run title: Cod in Divisions 3NO

Table 8 Fishing mortality (F) at age

YEAR / AGE	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	FBAR 91-93
3	0.0149	0.0259	0.0046	0.0149	0.0203	0.0154	0.0372	0.0015	0.0019	0.0187	0.0892	0.0233	0.1733	0.0922	0.2219	0.2419	0.0404	0.1681
4	0.1571	0.1399	0.143	0.0853	0.0781	0.1033	0.0411	0.04	0.1001	0.1236	0.0658	0.0729	0.2556	0.7721	1.2934	0.6601	0.2647	0.7394
5	0.4298	0.2377	0.4895	0.2069	0.1393	0.156	0.136	0.1184	0.368	0.3264	0.2175	0.3553	0.5665	1.1947	0.38	0.528	0.5366	0.4815
6	0.5117	0.239	0.448	0.2125	0.1854	0.1582	0.1697	0.246	0.3987	0.4814	0.2917	0.7649	0.5594	0.8042	0.4411	0.4262	0.6793	0.5155
7	0.6811	0.2151	0.4383	0.2101	0.2764	0.1809	0.153	0.2594	0.4587	0.3542	0.2364	0.6392	0.5424	0.3677	0.6471	0.3467	0.4035	0.4658
8	0.554	0.2409	0.2475	0.1859	0.2424	0.3632	0.2016	0.2379	0.2695	0.3122	0.2543	0.3155	0.4401	0.4107	0.6372	0.2927	0.1564	0.3621
9	0.6214	0.3527	0.2099	0.1271	0.2428	0.4249	0.3253	0.2449	0.2346	0.3071	0.507	0.3661	0.2459	0.3652	0.6668	0.3484	0.1697	0.3949
10	0.7304	0.2986	0.1648	0.1655	0.1851	0.4581	0.3001	0.4062	0.2192	0.304	0.4902	0.5201	0.2514	0.3675	0.6223	0.3044	0.2243	0.3837
11	0.9186	0.1782	0.1057	0.1087	0.3424	0.5539	0.319	0.2115	0.3428	0.2182	0.6173	0.4934	0.4006	0.2546	0.6372	0.3894	0.1743	0.4003
12	0.7011	0.2571	0.2335	0.1595	0.258	0.3977	0.2612	0.272	0.305	0.2991	0.421	0.4669	0.3761	0.3531	0.6421	0.3363	0.2256	0.4014
FBAR	0.5881	0.264	0.333	0.1846	0.2119	0.2902	0.2143	0.2521	0.3248	0.3476	0.3328	0.4935	0.4343	0.585	0.5657	0.3744	0.3616	

Traditional vpa Terminal Fs estimated using Laurec-Shepherd

Table 10 Stock number at age (start of year) Numbers*10**-3

YEAR / AGE	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	GMST 77-90	AMST 77-90
3	45344	39619	17441	19842	27665	21965	35604	41791	33211	9093	6659	13286	13252	13309	6093	23053	29106	0	20698	24149
4	18692	36576	31607	14215	16005	22194	17708	28086	34163	27139	7307	4987	10627	9123	9937	3996	14818	22888	17066	19888
5	7937	13079	26038	22428	10686	12119	16387	13914	22092	25307	19637	5601	3796	6738	3451	2232	1691	9311	12692	14697
6	4097	4228	8443	13067	14931	7612	8489	11711	10120	12518	14949	12935	3215	1764	1671	1932	1078	809	7784	9148
7	1264	2011	2726	4416	8650	10156	5320	5866	7497	5561	6333	9142	4929	1504	646	880	1033	447	4523	5384
8	455	524	1328	1440	2931	5372	6939	3738	3705	3880	3195	4093	3950	2346	853	277	509	565	2475	3135
9	493	214	337	849	979	1883	3059	4644	2412	2317	2325	2028	2445	2082	1274	369	169	357	1395	1862
10	137	217	123	224	612	629	1008	1809	2976	1562	1395	1146	1152	1565	1183	535	213	117	706	1040
11	74	54	132	86	155	416	326	611	987	1957	944	700	558	733	887	520	323	140	342	552
12	54	24	37	97	63	90	196	194	405	573	1288	417	350	306	465	384	288	222	167	292
TOTAL	78547	96546	88211	76663	82677	82437	95036	112363	117568	89908	64032	54336	44272	39471	26460	34178	49230	34856		

Table 22. Fishing mortality matrix for cod in Div. 3NO, 1959-1993.

AGE	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
3	0.036	0.039	0.011	0.011	0.004	0.063	0.007	0.004	0.129	0.198	0.073
4	0.166	0.185	0.124	0.067	0.076	0.312	0.102	0.167	0.516	0.646	0.238
5	0.340	0.468	0.592	0.084	0.278	0.393	0.248	0.416	0.936	1.027	0.747
6	0.520	0.359	0.702	0.143	0.270	0.324	0.510	0.759	0.899	1.187	0.702
7	0.457	0.399	0.421	0.347	0.261	0.195	0.871	0.735	0.824	0.940	0.377
8	0.472	0.597	0.546	0.281	0.779	0.234	0.817	1.464	1.297	0.736	0.543
9	0.351	0.369	0.412	0.438	0.911	0.350	0.378	0.880	0.241	0.435	0.565
10	0.350	0.304	0.203	0.383	0.944	0.715	1.667	2.107	0.186	0.290	0.485
11	0.879	0.685	0.028	0.380	0.552	0.124	1.005	0.720	0.462	0.133	0.370
12	0.403	0.413	0.393	0.360	0.719	0.372	0.928	1.286	0.633	0.596	0.489

AGE	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
3	0.029	0.013	0.001	0.384	0.217	0.033	0.178	0.015	0.025	0.005	0.015	0.020
4	0.253	0.626	0.387	0.917	0.779	0.520	0.619	0.156	0.140	0.140	0.085	0.078
5	0.320	0.780	0.665	0.579	1.289	0.765	0.829	0.433	0.236	0.494	0.202	0.139
6	0.649	0.692	1.022	0.825	1.170	1.338	0.564	0.507	0.241	0.446	0.214	0.180
7	0.519	0.531	0.950	0.384	0.885	1.441	0.341	0.669	0.211	0.445	0.208	0.280
8	0.577	0.843	0.532	0.386	0.975	1.714	0.366	0.540	0.233	0.242	0.189	0.239
9	0.419	0.345	0.204	0.446	0.917	2.000	0.262	0.643	0.337	0.201	0.123	0.248
10	0.311	0.268	0.245	0.268	1.067	1.791	0.376	0.780	0.313	0.155	0.157	0.179
11	0.900	0.355	0.158	0.242	1.083	2.028	0.189	0.962	0.196	0.112	0.101	0.321
12	0.452	0.492	0.480	0.369	0.957	1.736	0.336	0.658	0.274	0.261	0.169	0.236

AGE	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
3	0.015	0.037	0.002	0.002	0.018	0.088	0.023	0.161	0.216	0.164	0.112	0.036
4	0.103	0.041	0.040	0.099	0.124	0.065	0.072	0.249	0.694	0.206	0.430	0.106
5	0.155	0.136	0.118	0.366	0.323	0.218	0.350	0.563	1.166	0.315	0.428	0.270
6	0.158	0.169	0.247	0.399	0.479	0.288	0.778	0.548	0.798	0.413	0.326	0.472
7	0.174	0.152	0.259	0.462	0.354	0.234	0.630	0.557	0.354	0.635	0.314	0.274
8	0.370	0.193	0.237	0.268	0.315	0.254	0.311	0.427	0.428	0.603	0.282	0.137
9	0.419	0.333	0.232	0.234	0.306	0.516	0.366	0.241	0.349	0.721	0.317	0.161
10	0.474	0.294	0.422	0.204	0.303	0.489	0.535	0.251	0.359	0.581	0.344	0.197
11	0.532	0.334	0.205	0.361	0.200	0.617	0.491	0.418	0.254	0.616	0.347	0.202
12	0.359	0.243	0.287	0.292	0.319	0.372	0.460	0.369	0.372	0.636	0.314	0.194

Table 23. Beginning of year biomass (tonnes) for cod in Div. 3NO, 1959-1993.

AGE	1959	1960	1961	1962	1963	1964	1965	1966	1967
3	16183	15914	24731	32417	23621	33797	46624	73597	64236
4	62445	24959	24458	39101	51273	37591	50731	81235	112532
5	19466	65993	29296	30515	51672	67147	38845	67219	100876
6	26621	17703	52170	20465	35411	49403	57235	40103	58638
7	30517	18735	15202	31781	21812	33257	43950	44727	24451
8	12789	19027	13575	10776	24252	18132	29542	22127	25801
9	10378	7667	10184	7646	7913	10827	13950	16017	6282
10	15326	7035	5099	6489	4747	3062	7338	11791	8196
11	11162	9923	4880	3915	4160	1737	1408	1653	1712
12	1935	4457	4704	4458	2517	2252	1442	624	975
3+	206821	191412	184299	187565	227377	257205	291065	359095	403697
4+	190639	175498	159567	155147	203756	223407	244441	285498	339462
5+	128194	150539	135109	116046	152483	185817	193710	204263	226930
6+	108728	84546	105813	85531	100811	118670	154865	137044	126053

AGE	1968	1969	1970	1971	1972	1973	1974	1975	1976
3	35224	44806	28172	28502	24664	17540	10488	5594	9737
4	86664	44344	63933	41995	46570	37348	12521	14642	10611
5	92234	62368	47997	68133	31844	44713	18226	7052	13064
6	49970	41688	37293	43987	38860	20923	29167	6000	4802
7	29881	19098	25886	24404	26364	18775	10579	10981	2121
8	12322	13400	15036	17694	15149	12278	15690	4924	3052
9	8178	6848	9028	9794	8556	10247	10878	5982	1110
10	5460	5859	4305	6571	7807	8612	6653	4295	907
11	6437	3865	3410	2984	4716	6643	6407	1720	655
12	1019	5324	2523	1310	1967	4446	4151	1529	280
3+	327390	247599	237582	245374	206497	181524	124759	62720	46340
4+	292166	202793	209410	216872	181833	163984	114271	57126	36602
5+	205502	158449	145477	174877	135263	126636	101750	42484	25991
6+	113268	96081	97480	106744	103420	81923	83524	35432	12927

AGE	1977	1978	1979	1980	1981	1982	1983	1984	1985
3	19095	25057	9023	10609	21919	18632	26308	32102	11030
4	13351	28374	27224	11766	15308	22861	18697	28086	28569
5	9234	16464	31536	29692	14888	16854	24332	18624	28058
6	7796	7709	15387	24309	32922	15431	16999	24273	17937
7	3705	6262	6908	12442	25674	33906	15508	16732	20475
8	1841	2185	5070	5663	13213	23054	32426	14792	14065
9	2618	1213	1649	4761	6052	12131	17331	26852	12611
10	1017	1509	870	1562	5404	4897	8041	11912	22058
11	742	455	953	799	1505	4104	2804	5356	7730
12	580	282	328	922	704	1032	2172	1967	4191
3+	59978	89510	98950	102525	137589	152901	164616	180697	166723
4+	40883	64452	89926	91916	115670	134269	138309	148595	155694
5+	27532	36078	62702	80150	100362	111408	119611	120509	127125
6+	18298	19614	31166	50457	85474	94554	95279	101885	99067

AGE	1986	1987	1988	1989	1990	1991	1992	1993
3	2494	2317	8821	5170	2675	4074	9949	8364
4	18965	4215	3544	9255	7137	2726	3345	17651
5	29389	22583	6086	4879	8293	5152	2521	2802
6	21828	25407	19796	5806	3605	3258	4108	1979
7	14979	16076	18899	11811	3866	2056	2453	3214
8	16265	13111	13766	13084	8424	3499	1240	1947
9	14238	14527	10085	12924	10484	6823	2237	954
10	12729	11913	8009	7563	12388	8478	3640	1591
11	19338	9393	6496	4385	6488	9216	5092	2277
12	5158	15944	4405	3808	3022	5343	4597	2908
3+	155383	135486	99905	78684	66382	50626	39182	43686
4+	152889	133170	91084	73514	63707	46551	29233	35322
5+	133923	128955	87540	64259	56570	43825	25888	17672
6+	104534	106372	81455	59380	48276	38673	23367	14870

Table 24. Population numbers at the beginning of the year (000s) for cod in Div. 3NO, 1959-1993.

AGE	1959	1960	1961	1962	1963	1964	1965	1966	1967
3	53837	52944	82277	107847	78582	112438	162502	209951	183246
4	94022	42530	41677	66628	87369	64054	86445	132128	171212
5	19450	65183	28936	30141	51038	66323	38369	63888	91517
6	16417	11339	33416	13108	22681	31643	36660	24520	34499
7	11865	7989	6483	13553	9301	14182	18742	18018	9402
8	4088	6154	4390	3485	7844	5864	9555	6422	7074
9	2828	2087	2773	2082	2154	2947	3798	3455	1216
10	3468	1630	1181	1504	1100	710	1700	2131	1174
11	2305	2002	984	790	839	350	284	263	212
12	340	783	826	783	442	396	253	85	105
3+	208620	192641	202944	239920	261351	298908	358307	460862	499657
4+	154783	139697	120667	132073	182769	186470	195805	250911	316411
5+	60761	97167	78990	65445	95400	122416	109361	118782	145199
6+	41311	31984	50054	35304	44362	56093	70992	54894	53682

AGE	1968	1969	1970	1971	1972	1973	1974	1975	1976
3	100484	127819	80367	84410	62153	34824	36352	22782	27542
4	131855	67467	97271	63894	68249	50825	19410	23949	18045
5	83677	56582	43544	61811	27972	37965	16638	7295	11662
6	29399	24526	21941	25879	23190	11782	17422	3753	2780
7	11491	7344	9955	9385	10601	6833	4227	4426	806
8	3378	3674	4122	4851	4517	3357	3811	1428	858
9	1583	1325	1747	1896	1710	2172	1869	1177	211
10	782	839	616	941	1100	1142	1139	611	130
11	798	479	423	370	590	705	715	321	84
12	110	572	271	141	212	412	453	198	35
3+	363557	290628	260257	253577	200294	150015	102035	65940	62152
4+	263072	162809	179890	169167	138141	115192	65683	43158	34611
5+	131217	95341	82619	105273	69891	64367	46273	19209	16566
6+	47540	38760	39075	43462	41919	26402	29635	11915	4904

AGE	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
3	45468	40602	17559	19984	27769	22113	36000	42398	33332	9273
4	18881	36677	32410	14311	16121	22278	17829	28408	34660	27238
5	7957	13224	26104	23072	10762	12211	16450	14012	22353	25705
6	4169	4224	8549	13041	15441	7669	8558	11755	10195	12689
7	1295	2056	2718	4480	8618	10563	5364	5918	7522	5600
8	469	543	1363	1427	2979	5335	7266	3771	3741	3879
9	487	224	352	876	967	1920	3018	4906	2436	2342
10	133	210	131	236	634	618	1034	1771	3186	1579
11	73	50	125	92	165	434	315	631	951	2127
12	57	23	34	92	68	98	209	185	421	542
3+	78989	97833	89346	77610	83524	83241	96042	113753	118796	90973
4+	33521	57231	71787	57626	55756	61128	60042	71355	85464	81700
5+	14640	20554	39377	43315	39635	38850	42213	42948	50805	54462
6+	6683	7330	13273	20243	28873	26638	25763	28936	28451	28757

AGE	1987	1988	1989	1990	1991	1992	1993
3	6754	13648	14265	6046	8053	46941	32556
4	7454	5063	10923	9945	3988	5595	34353
5	19708	5721	3857	6969	4066	2656	2980
6	15234	12977	3302	1799	1778	2428	1417
7	6434	9355	4882	1563	663	963	1434
8	3217	4171	4081	2289	898	288	576
9	2318	2043	2502	2179	1222	402	178
10	1412	1133	1159	1609	1259	487	240
11	955	709	543	738	920	576	283
12	1425	422	355	293	469	407	333
3+	64912	55241	45870	33431	23315	60743	74350
4+	58158	41593	31605	27385	15262	13802	41794
5+	50704	36531	20681	17440	11274	8207	7441
6+	30996	30810	16824	10471	7209	5551	4461

Table 25. Abundance (000's) and biomass (t) of cod from autumn juvenile RV Surveys

3N

Depth Range	Abundance Strata	1989	1990	1991	1992	1993	Biomass Strata	1989	1990	1991	1992	1993
0-30	375	3238	14501	146399	27641	8575	375	4250	6211	19242	7913	5984
	376	3523	18802	56932	8405	9454	376	823	1173	7337	3245	7340
31-50	360	1582	9163	54155	5526	572	360	320	1952	8749	1722	723
	361	32938	40768	66058	14576	9051	361	5588	23257	27572	4661	6086
	362	9643	19958	28717	11742	19822	362	6419	14672	10539	7491	10569
	373	23706	23245	1401	6536	-	373	18148	28119	1293	4631	-
	374	891	1806	6915	1946	1287	374	2688	3110	18313	2278	735
	383	2125	2460	227	179	-	383	2209	3487	100	81	-
51-100	359	201	53	34	15	0	359	13	86	29	16	0
	377	-	-	-	-	11	377	-	-	-	-	10
	382	516	183	83	275	-	382	224	68	27	174	-
101-150	358	-	-	-	3707		358	-	-	-	982	-
0-30		6761	33303	203331	36046	18029		5073	7384	26579	11158	13324
31-50		70885	97400	157473	40505	30732		35372	74597	66566	20864	18113
51-100		717	236	117	290	11		237	154	56	190	10
101-150		-	-	-	3707	0		-	-	-	982	-
Total		78363	130939	360921	80548	48772		40682	82135	93201	33194	31447
Upper		142761	167732	547326	108201	78517		54446	112156	188123	41763	49429
Lower		13967	94144	174516	52894	19024		26921	52112	-1722	24624	13464

	30 Strata	Abundance 1989	1990	1991	1992	1993	Biomass Strata	1989	1990	1991	1992	1993
31-50	330	3937	11008	5551	2309	3286	330	3079	3631	1623	1081	2591
	331	654	582	355	315	1018	331	557	90	222	45	1295
	338	14123	75304	14661	1160	7263	338	2503	5901	2211	709	12360
	340	8664	16208	8135	2098	2250	340	6095	8457	2898	836	1949
	351	10413	11234	15857	10586	8605	351	8773	10913	9837	9463	10231
	352	10480	29118	18949	3333	5696	352	26622	11662	19250	4063	6291
	353	4860	1840	845	170	136	353	273	44	63	48	43
	354	831	1125	924	365	252	354	139	128	302	126	111
51-100	329	3251	-	1372	2479	1207	329	9943	-	575	1934	772
	332	2226	32164	12020	278	3255	332	78	651	303	211	177
	337	3124	5408	504	176	1386	337	40	171	58	45	320
	339	124	104	466	202	47	339	653	280	164	84	13
	333	-	-	-	-	0	333	-	-	-	-	0
	336	-	-	-	-	0	336	-	-	-	-	0
31-50		53962	146419	65277	20336	28506		48041	40826	36406	16371	34871
56-100		8725	37676	14362	3135	5895		10714	1102	1100	2274	1282
Total		62687	184095	79639	23471	34401	Total	58755	41928	37506	18645	36153
Upper		93613	319061	115132	31178	46757	Upper	87452	55455	54511	26134	59941
Lower		31763	49126	44147	15766	22046	Lower	30056	28401	20502	11158	12363

Table 26. Mean number per tow at age of cod from Juvenile Survey conducted by Canada in Divisions 3NO during August and September.

age	1989	1990	1991	1992	1993
1	1.40	60.88	36.33	0.84	2.25
2	14.16	11.62	74.04	12.28	4.32
3	12.58	6.53	8.54	12.89	9.80
4	5.82	8.99	2.45	1.42	8.02
5	1.21	3.62	1.96	0.69	0.83
6	0.72	0.67	0.72	0.52	0.31
7	1.22	0.50	0.19	0.22	0.30
8	0.79	0.63	0.17	0.05	0.11
9	0.25	0.53	0.24	0.03	0.03
10	0.17	0.28	0.19	0.03	0.04
11	0.20	0.21	0.23	0.00	0.11
12	0.11	0.04	0.18	0.02	0.09
13	0.09	0.08	0.17	0.10	0.06
14	0.16	0.27	0.48	0.13	0.26
1+	38.88	94.85	125.89	29.22	26.53
2+	37.48	33.97	89.56	28.38	24.28
3+	23.32	22.35	15.52	16.10	19.96
4+	10.74	15.82	6.98	3.21	10.16
5+	4.92	6.83	4.53	1.79	2.14
6+	3.71	3.21	2.57	1.10	1.31

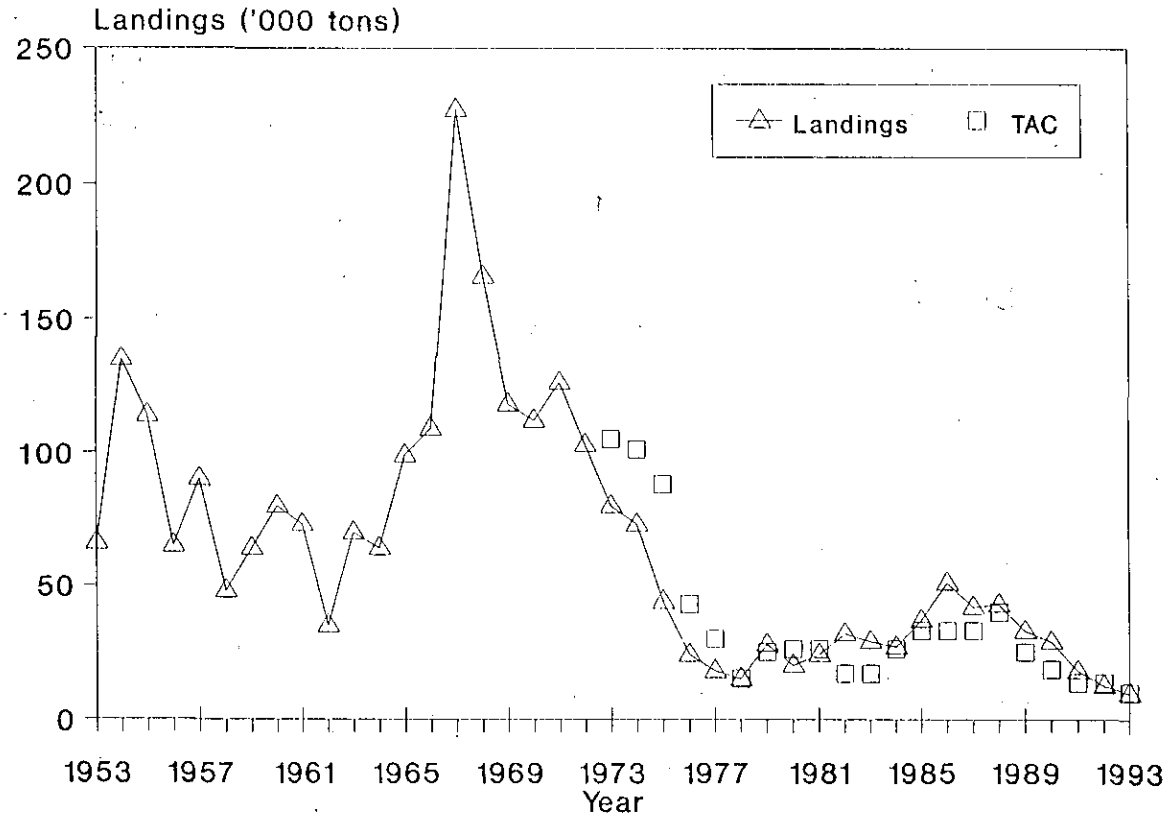


Figure 1. Landings of cod in NAFO Divisions 3NO for the period 1953-93.

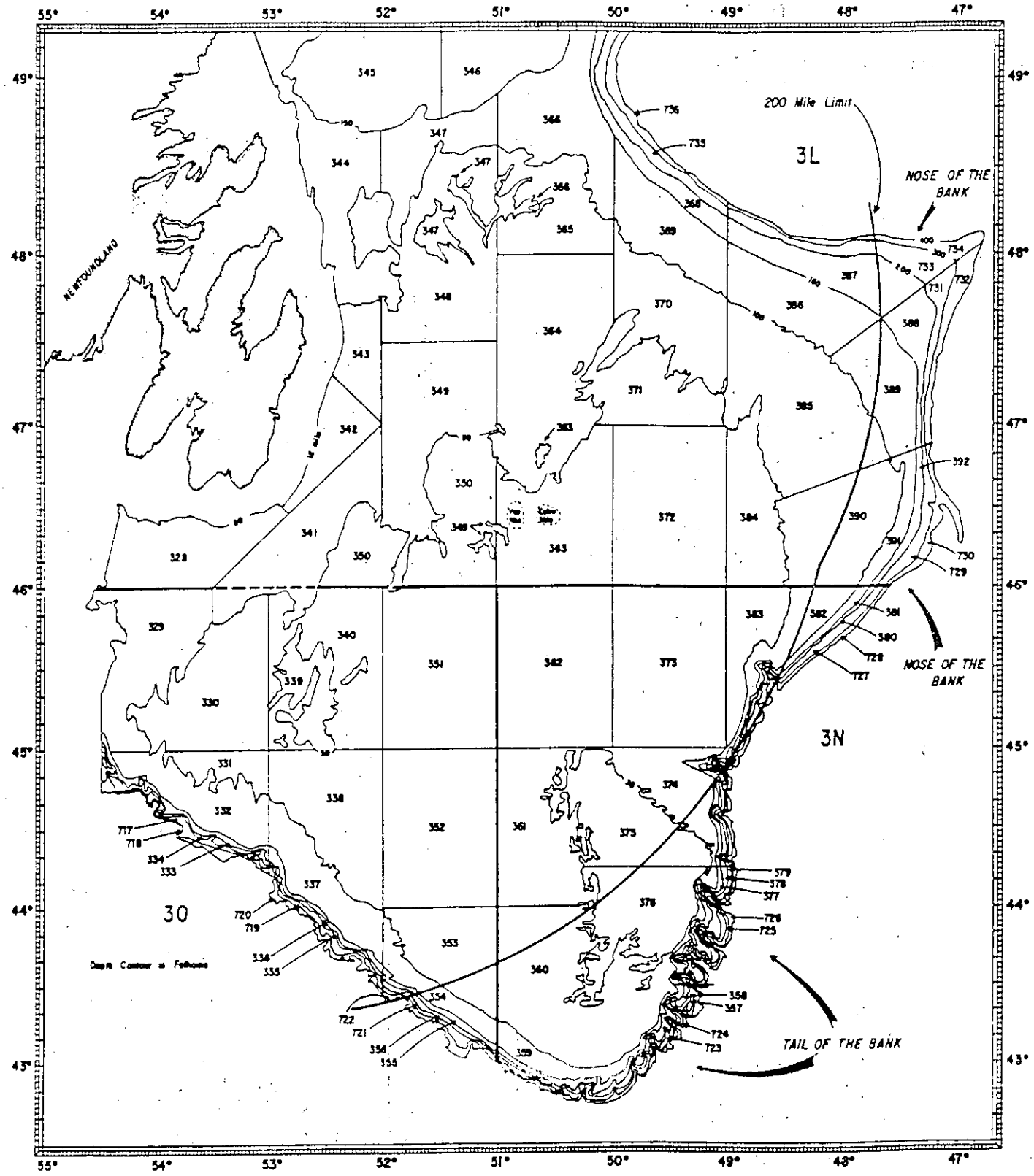


Figure 2. Stratification scheme for NAFO Divisions 3LNO showing the Canadian 200-mile limit.

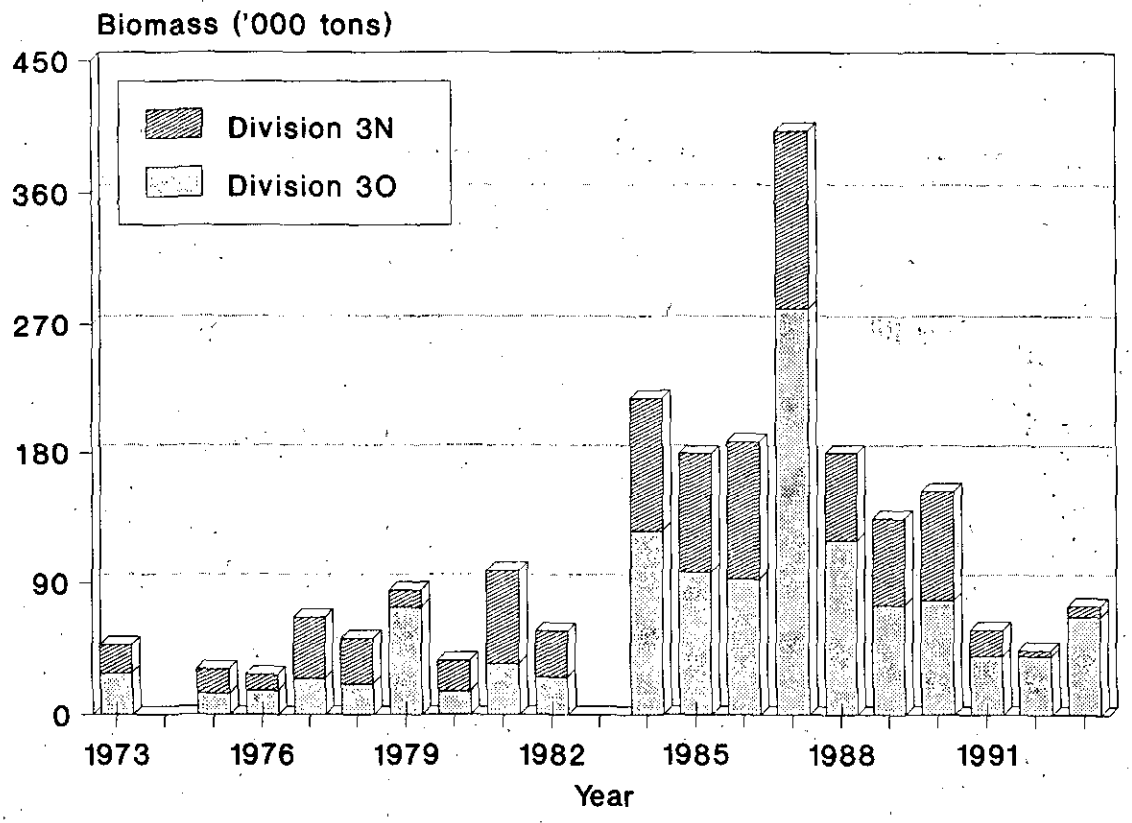


Figure 3. Cod in Divisions 3NO:
RV biomass from Canadian spring surveys.

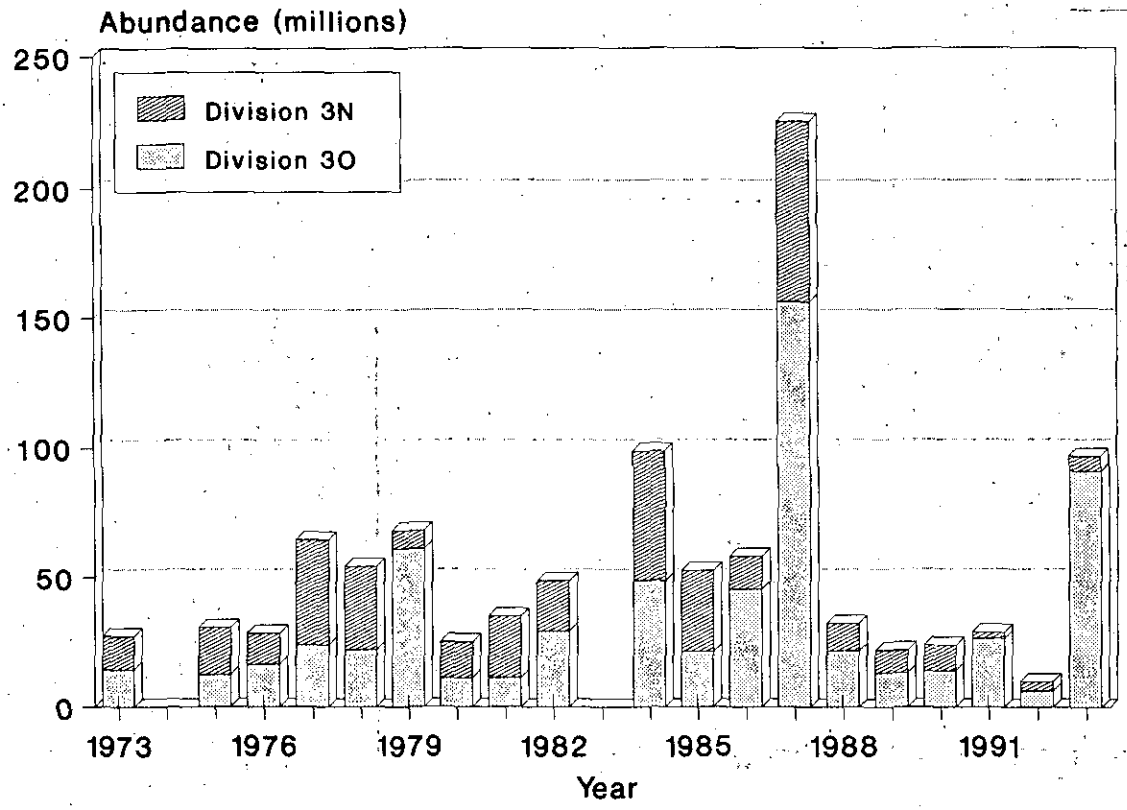


Figure 4. Cod in Divisions 3NO:
RV abundance from Can. spring surveys.

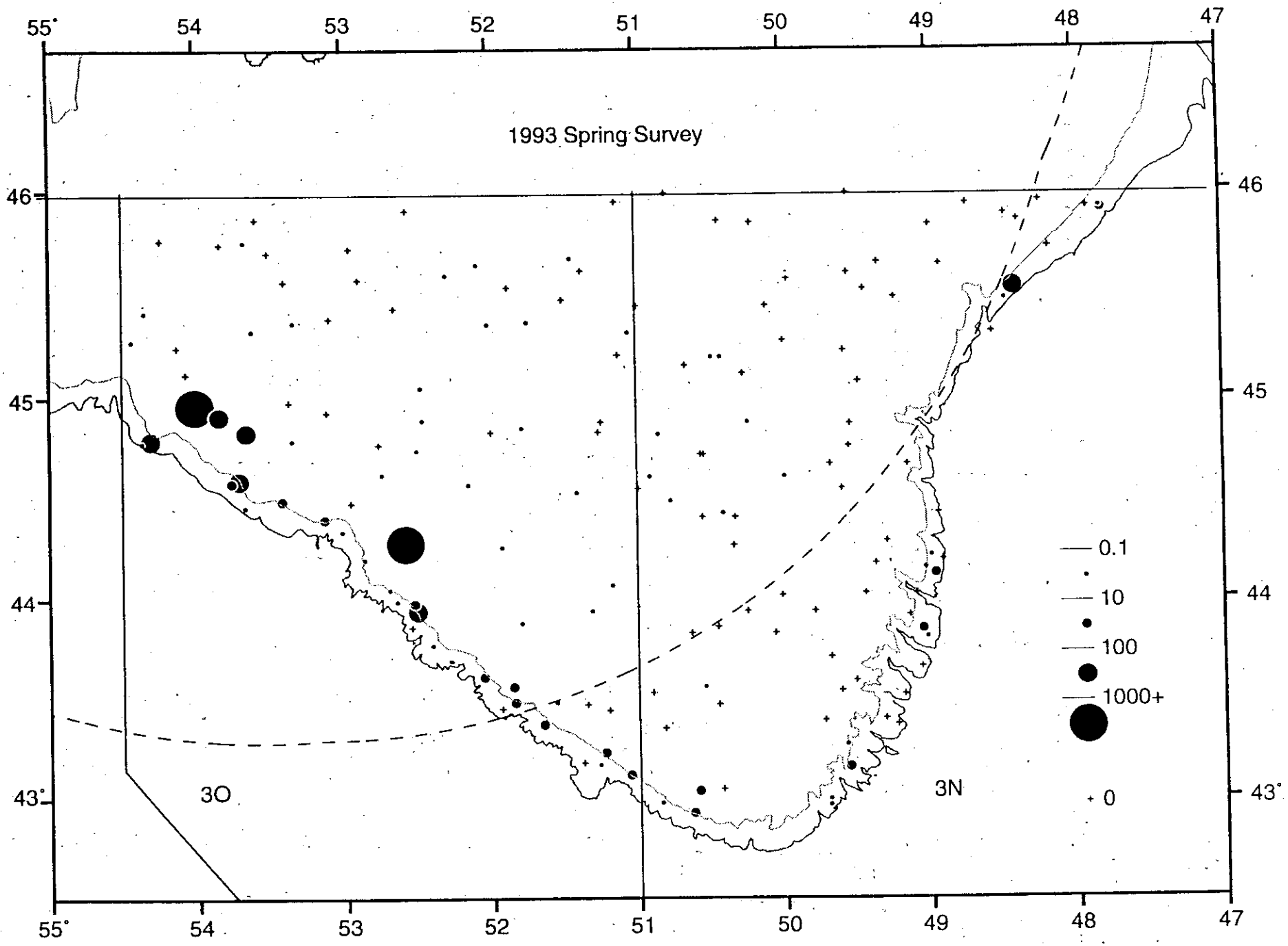


Figure 5. Cod distribution (numbers per tow) from the Canadian spring survey in Div. 3NO during 1993.

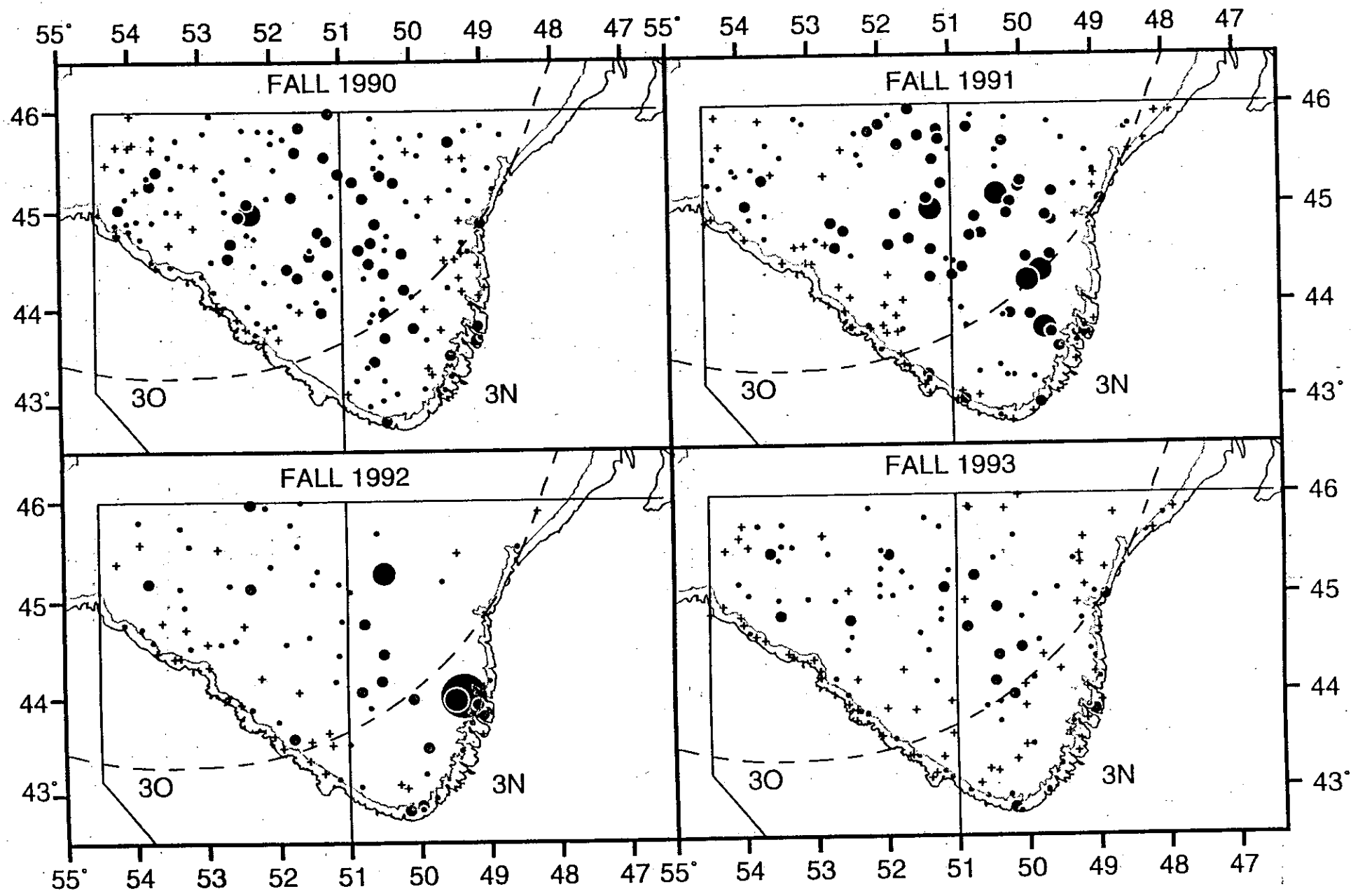


Figure 6. Cod distribution (numbers per tow) from the Canadian autumn surveys in Div. 3NO from 1990 to 1993.

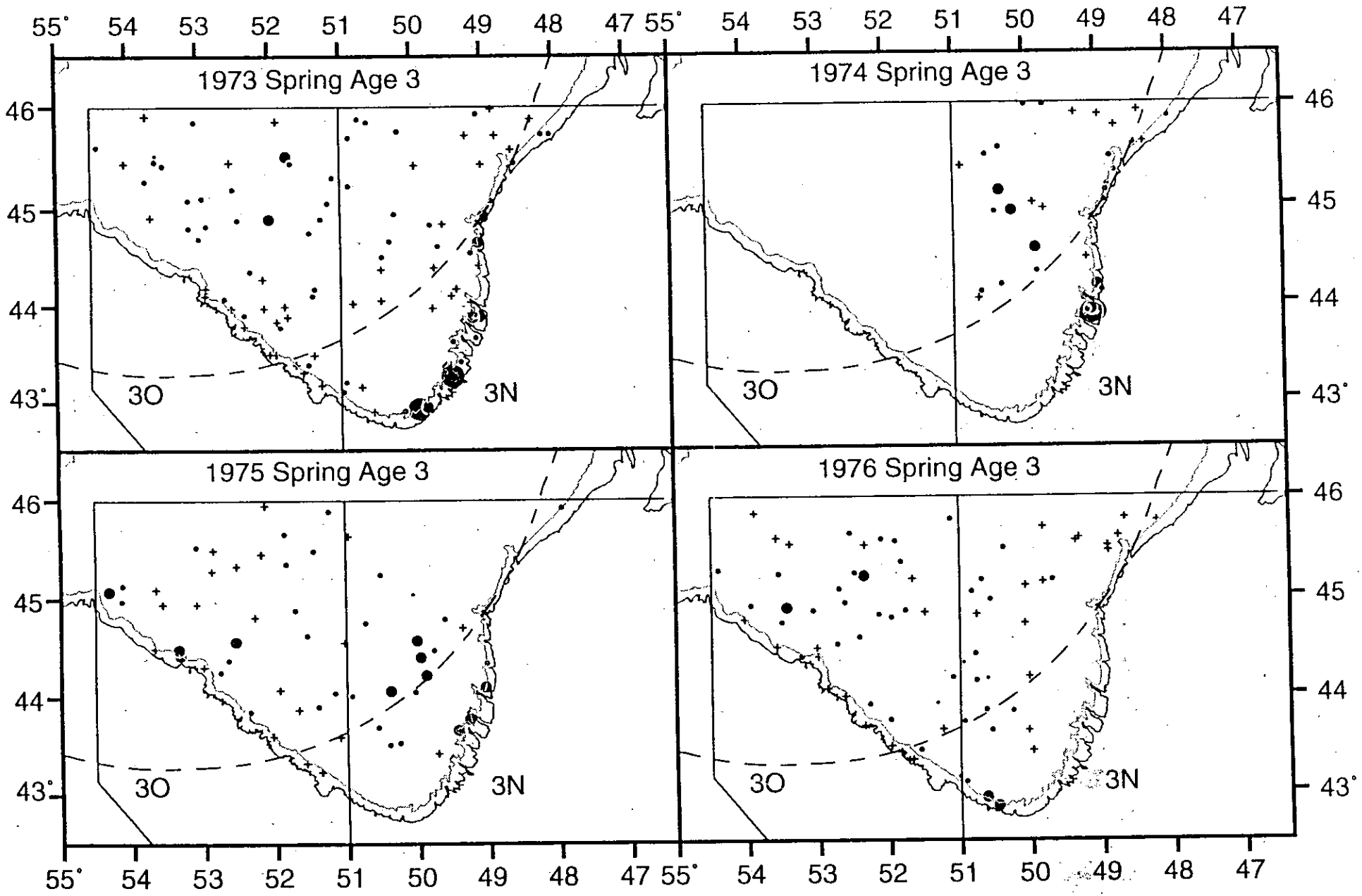


Figure 7. Cod distribution (numbers per tow) at age 3 from Canadian spring (1973-93) and autumn (1990-93) surveys in Div. 3NO.

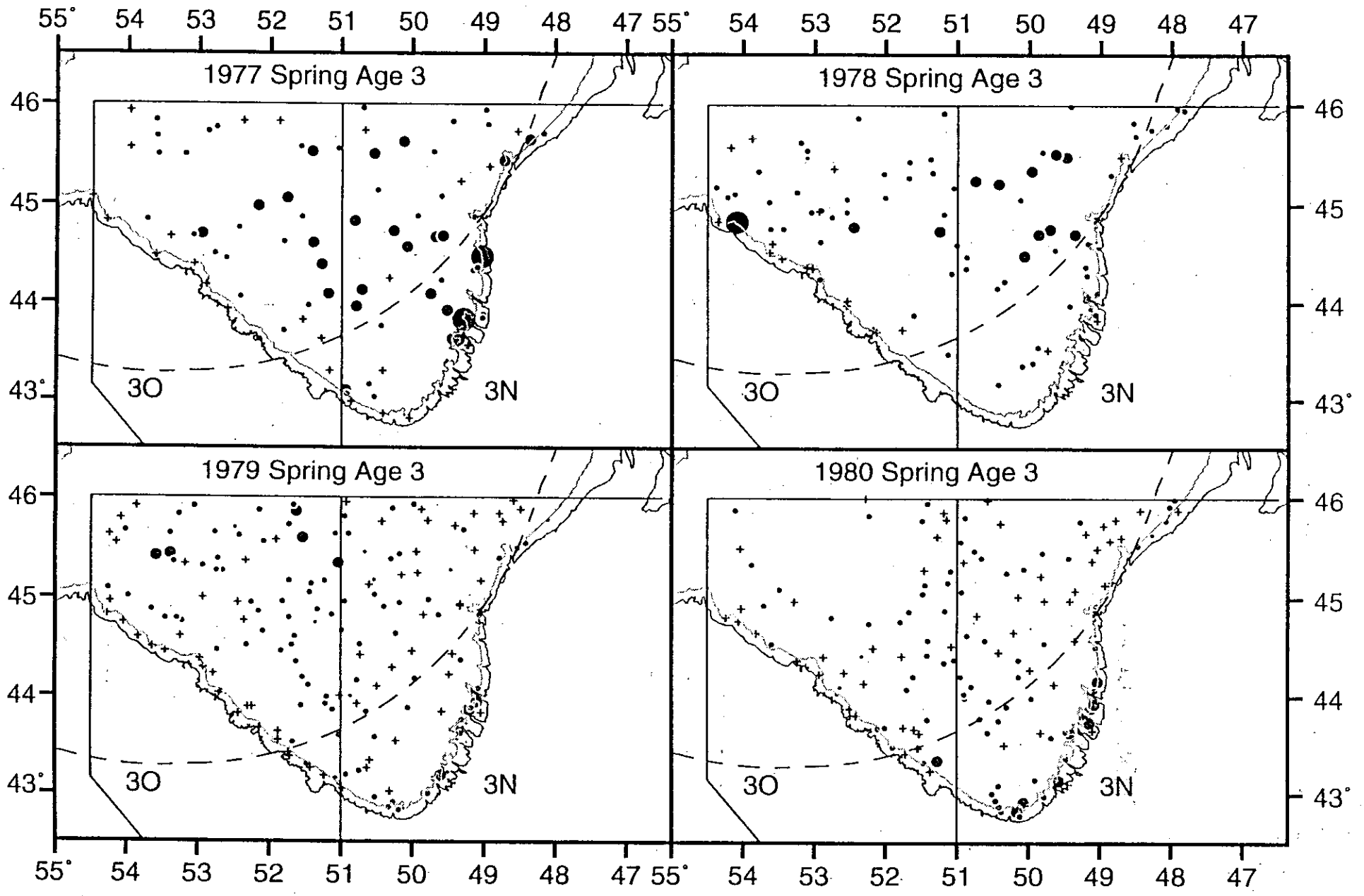


Figure 7. (cont)

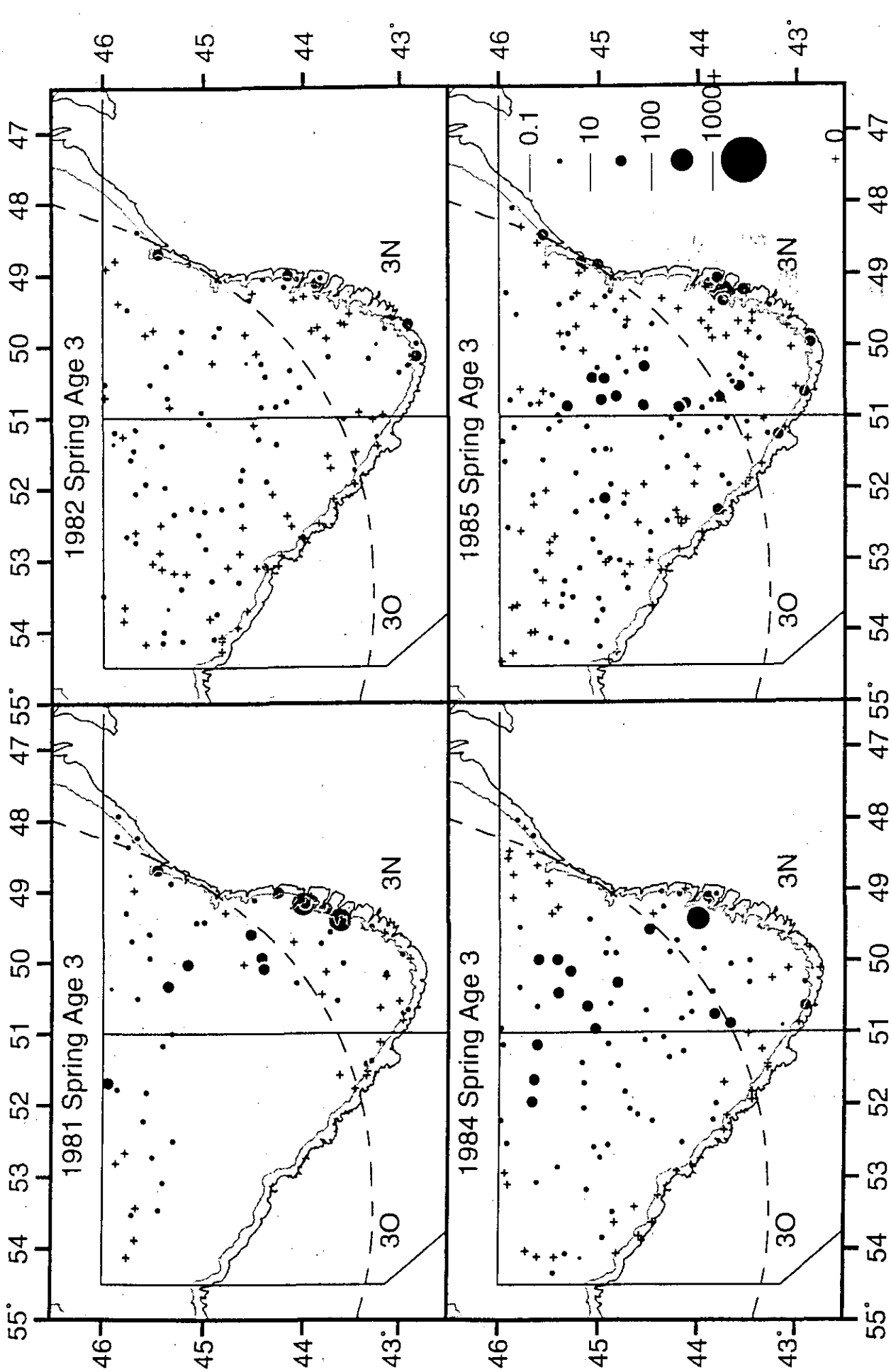


Figure 7. (cont)

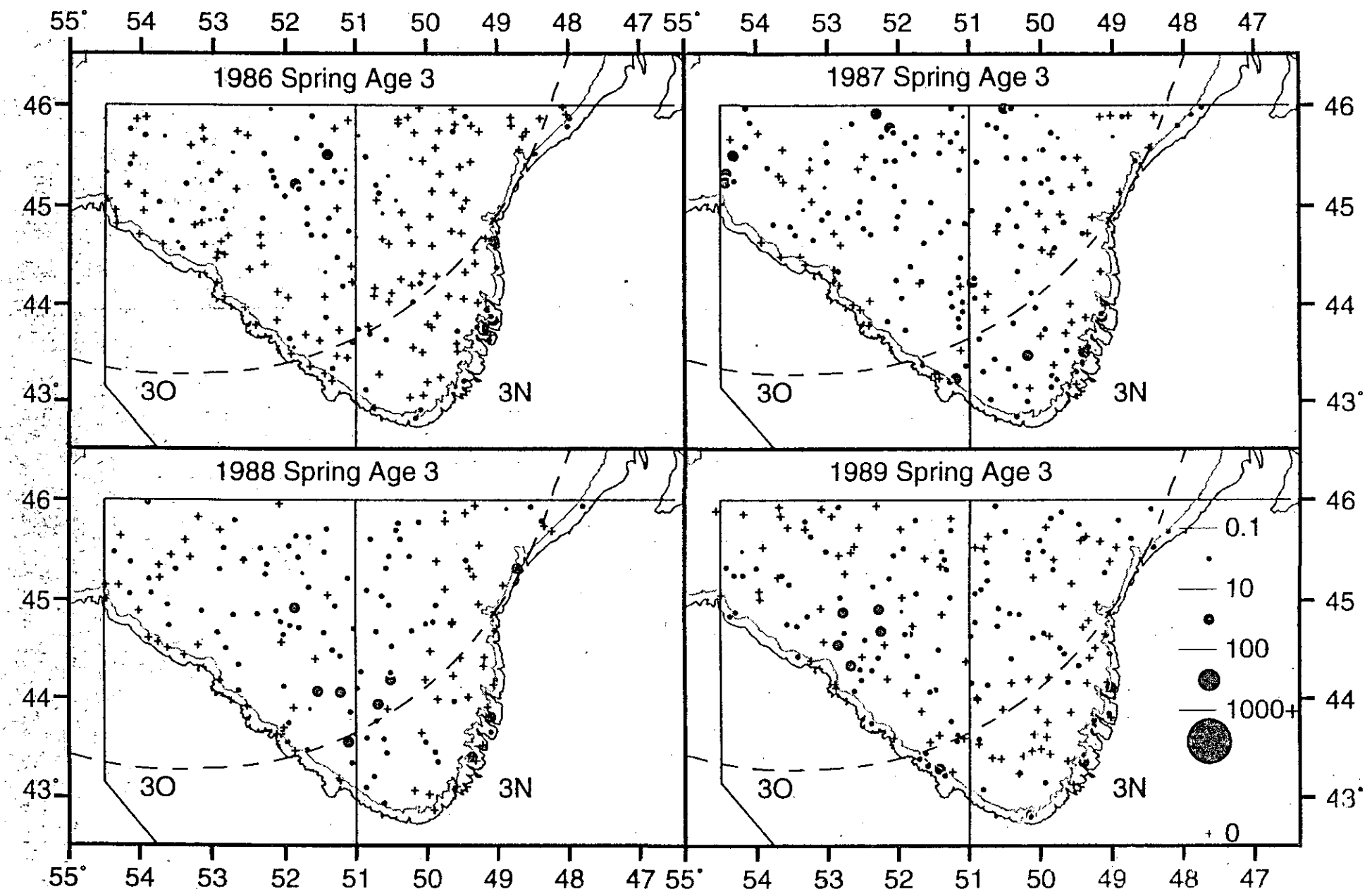


Figure 7. (cont)

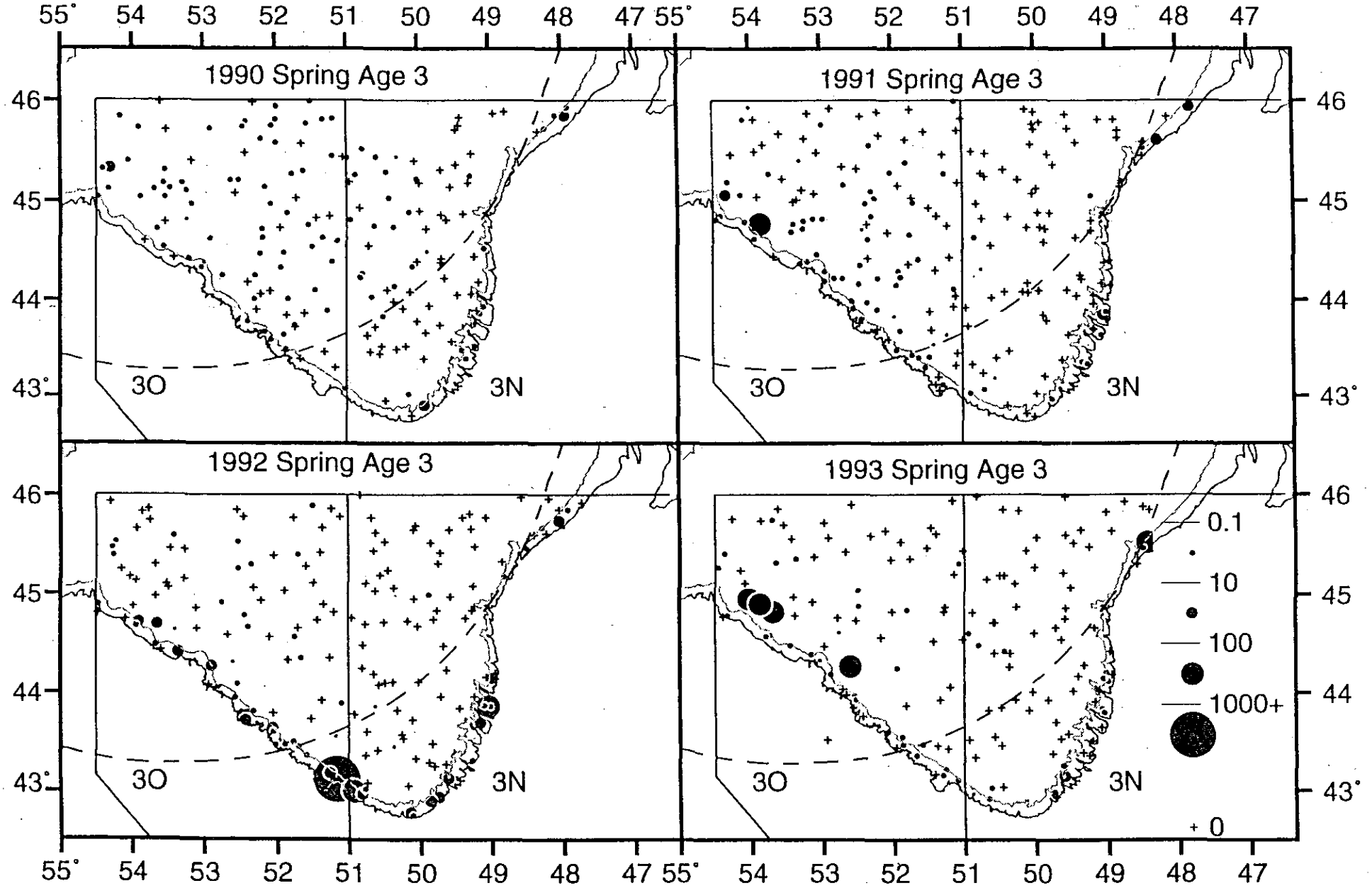


Figure 7. (cont)

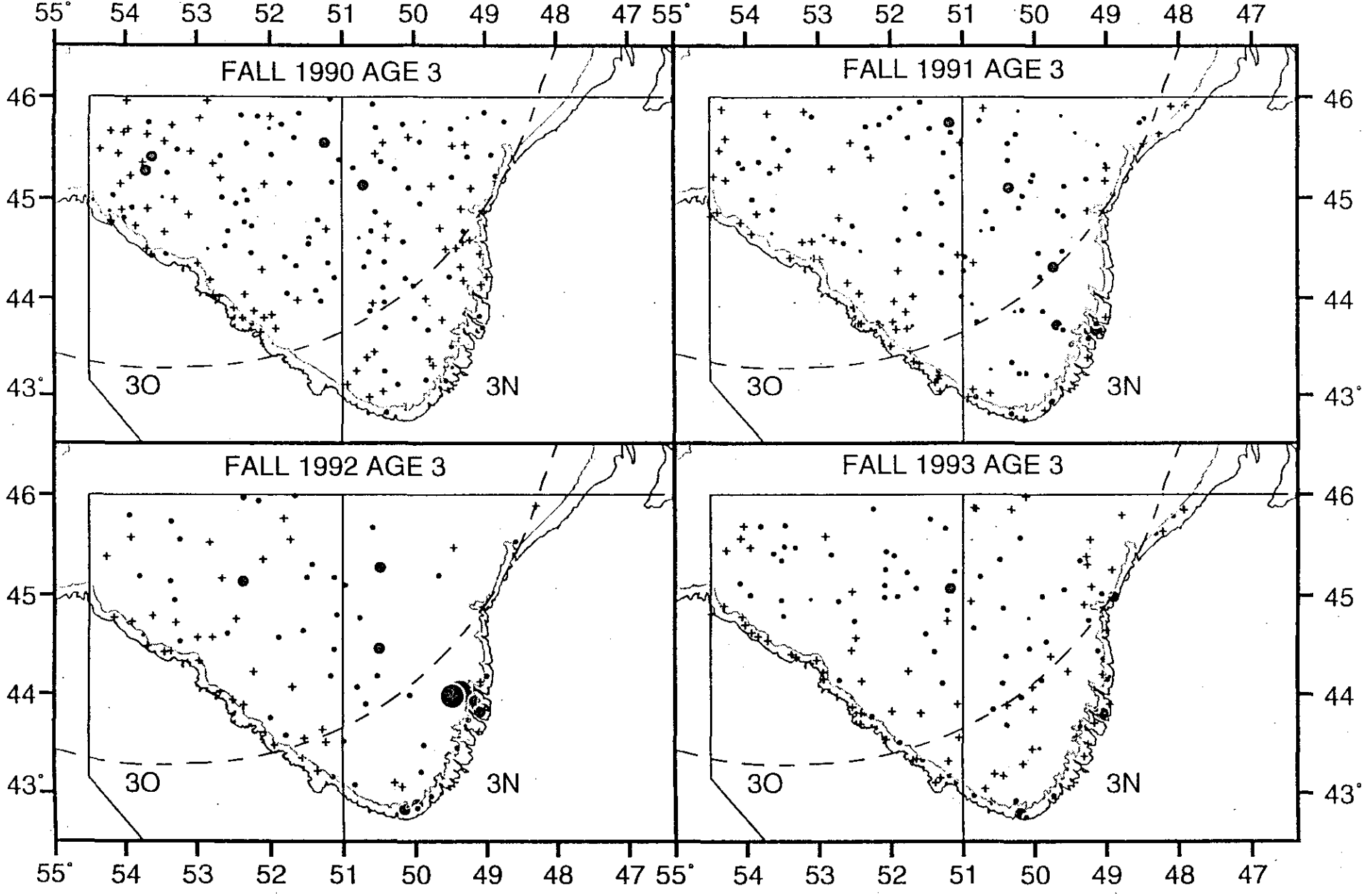


Figure 7. (cont)

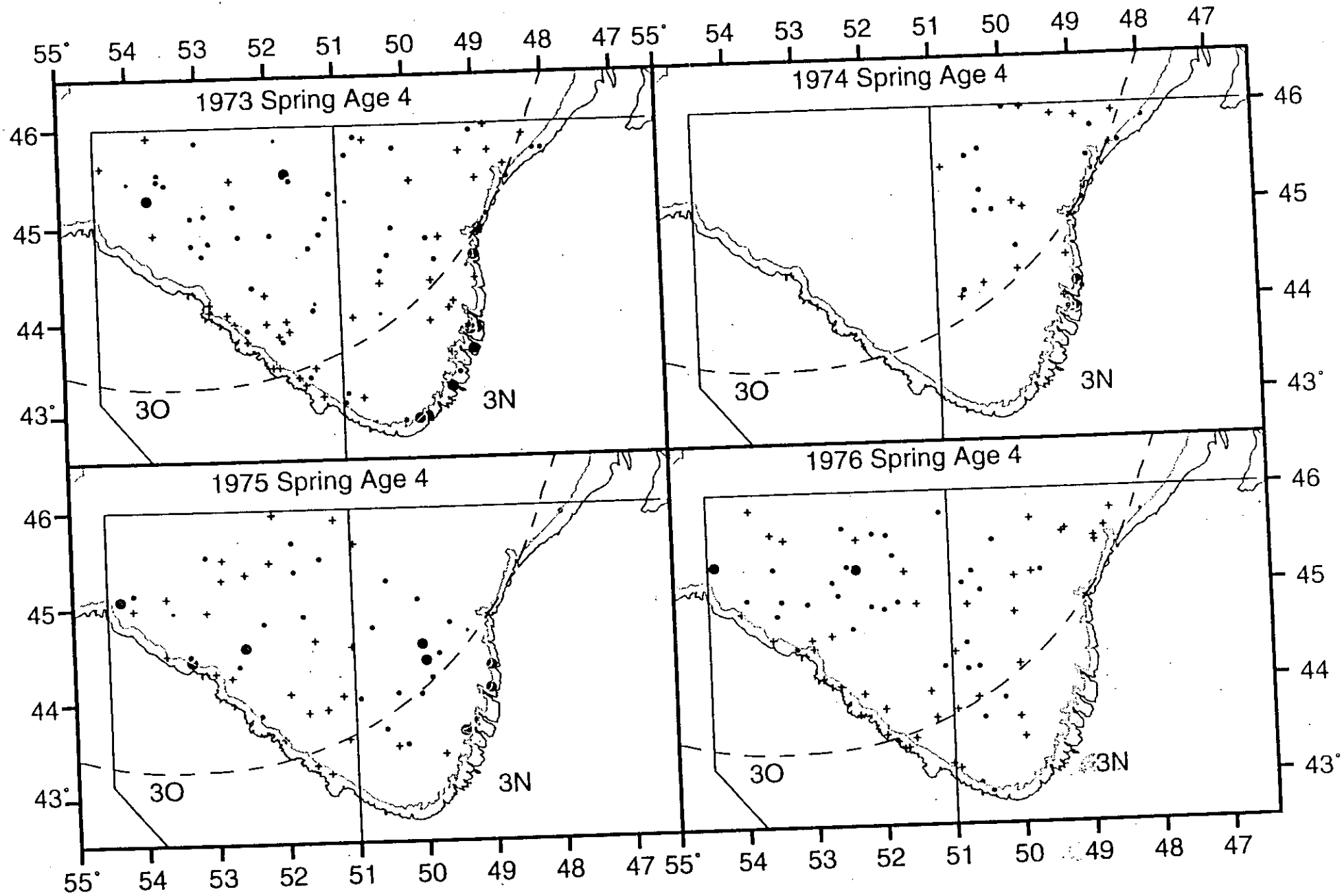


Figure 8. Cod distribution (numbers per tow) at age 4 from Canadian spring (1973-93) and autumn (1990-93) surveys in Div. 3NO.

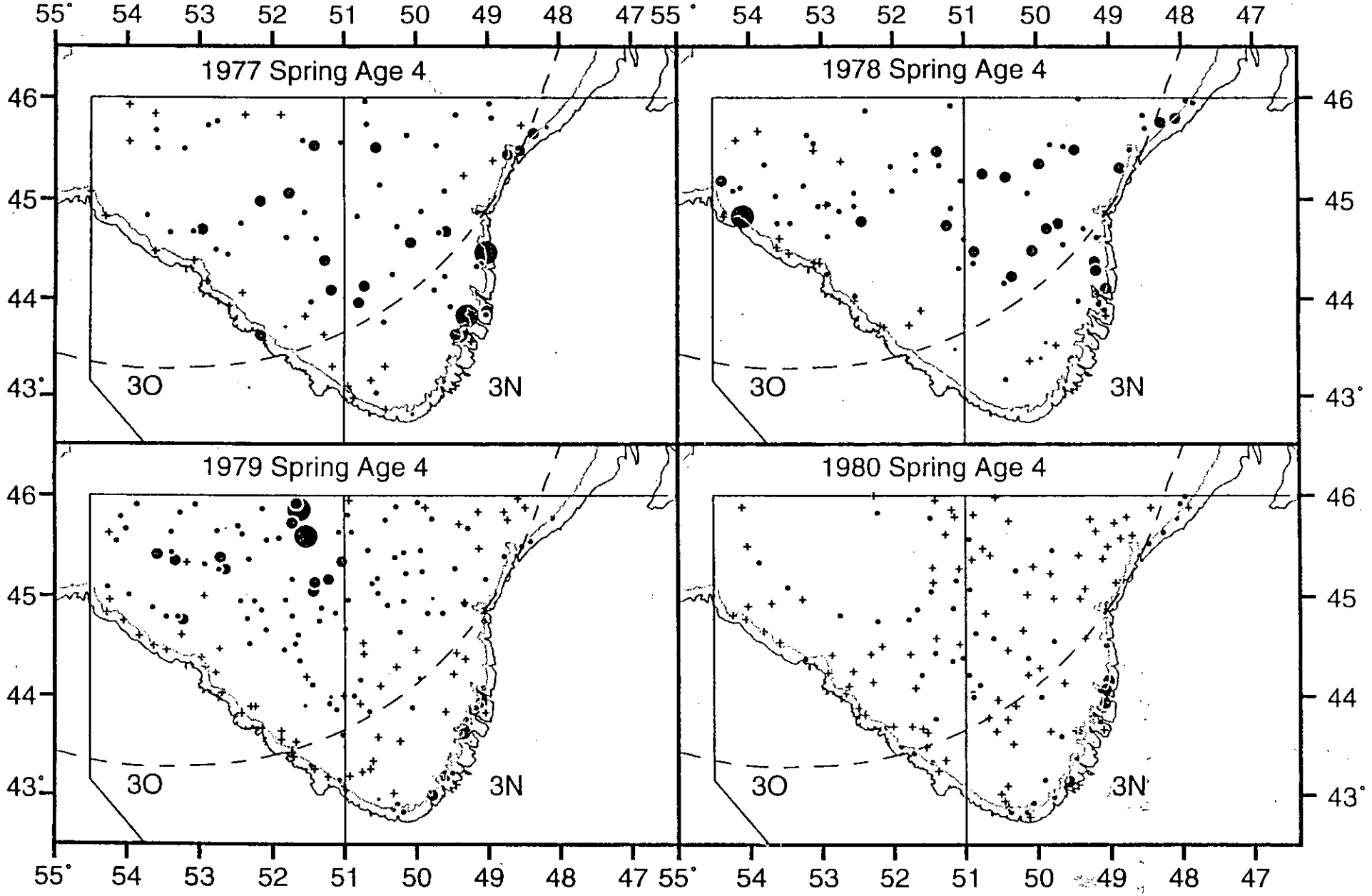
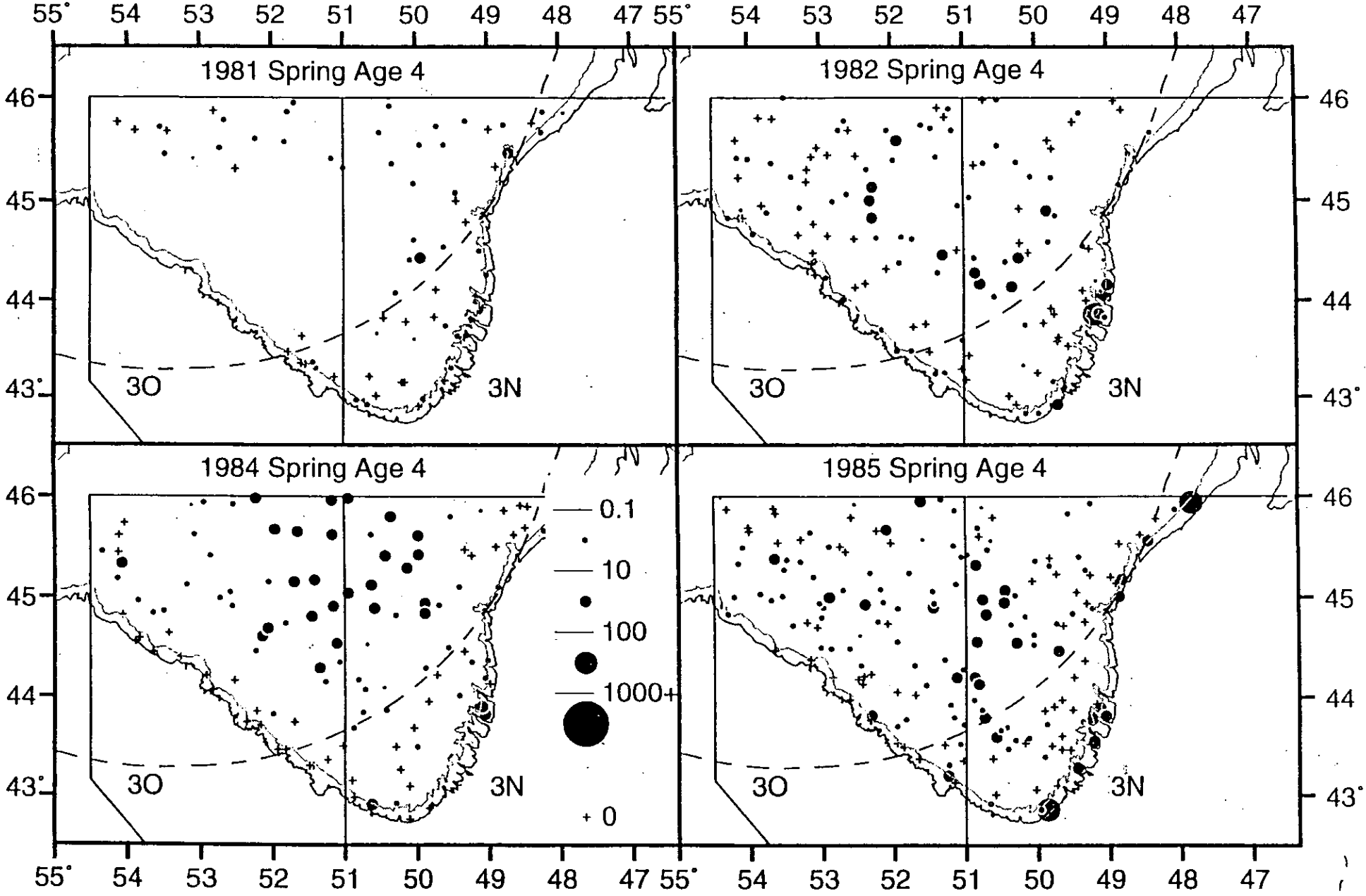


Figure 8. (cont)



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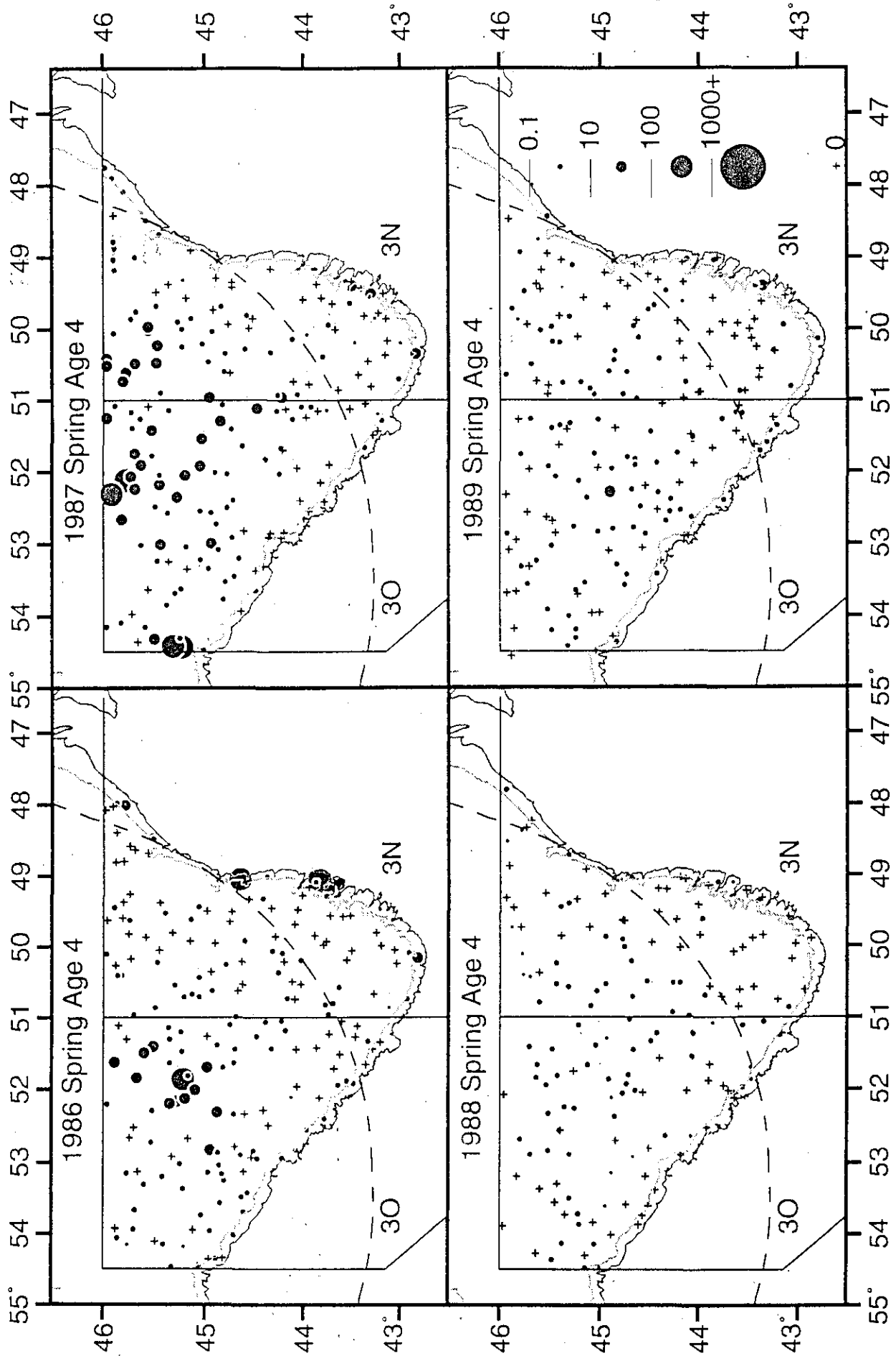


Figure 8. (cont)

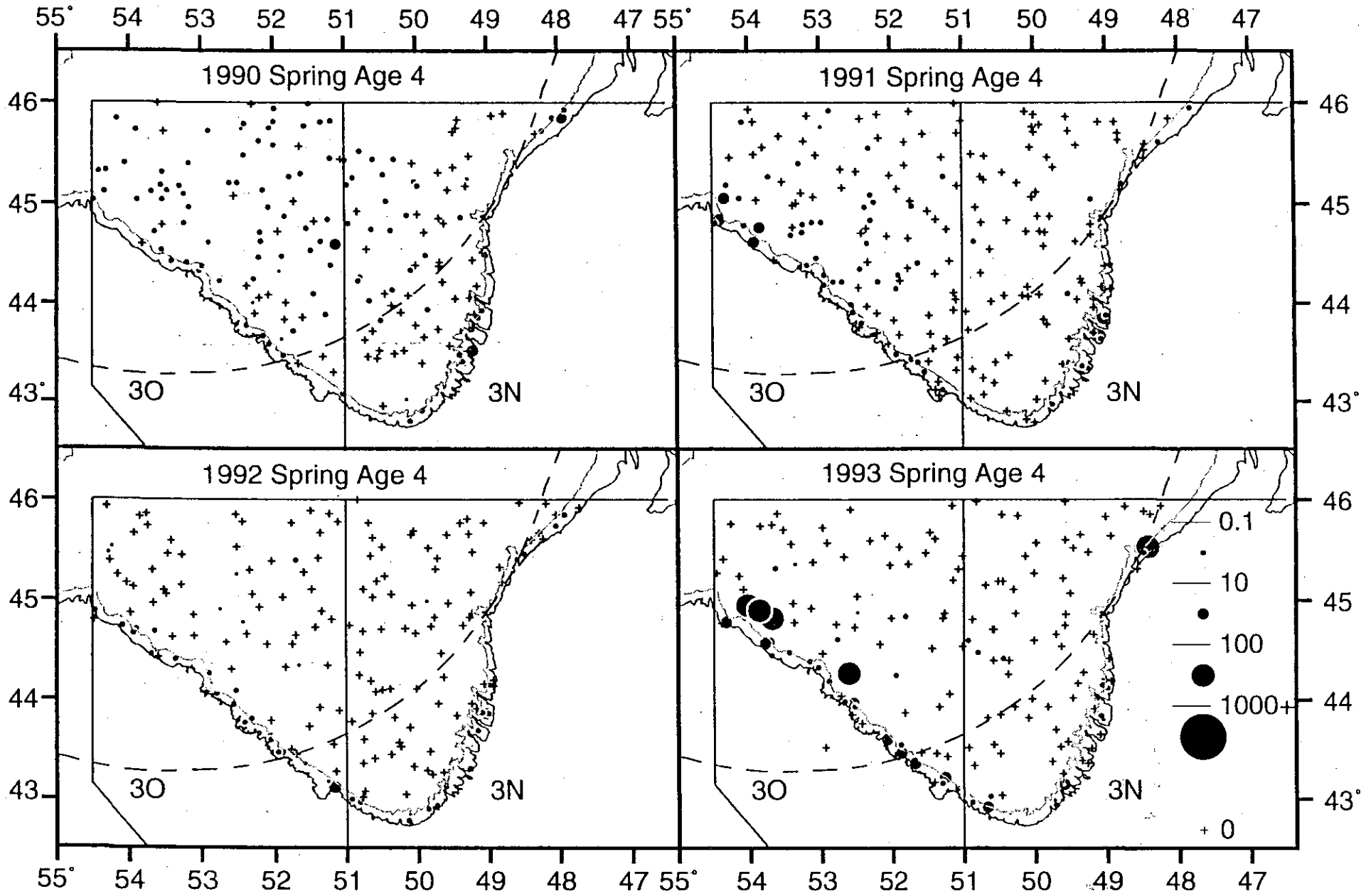


Figure 8. (cont)

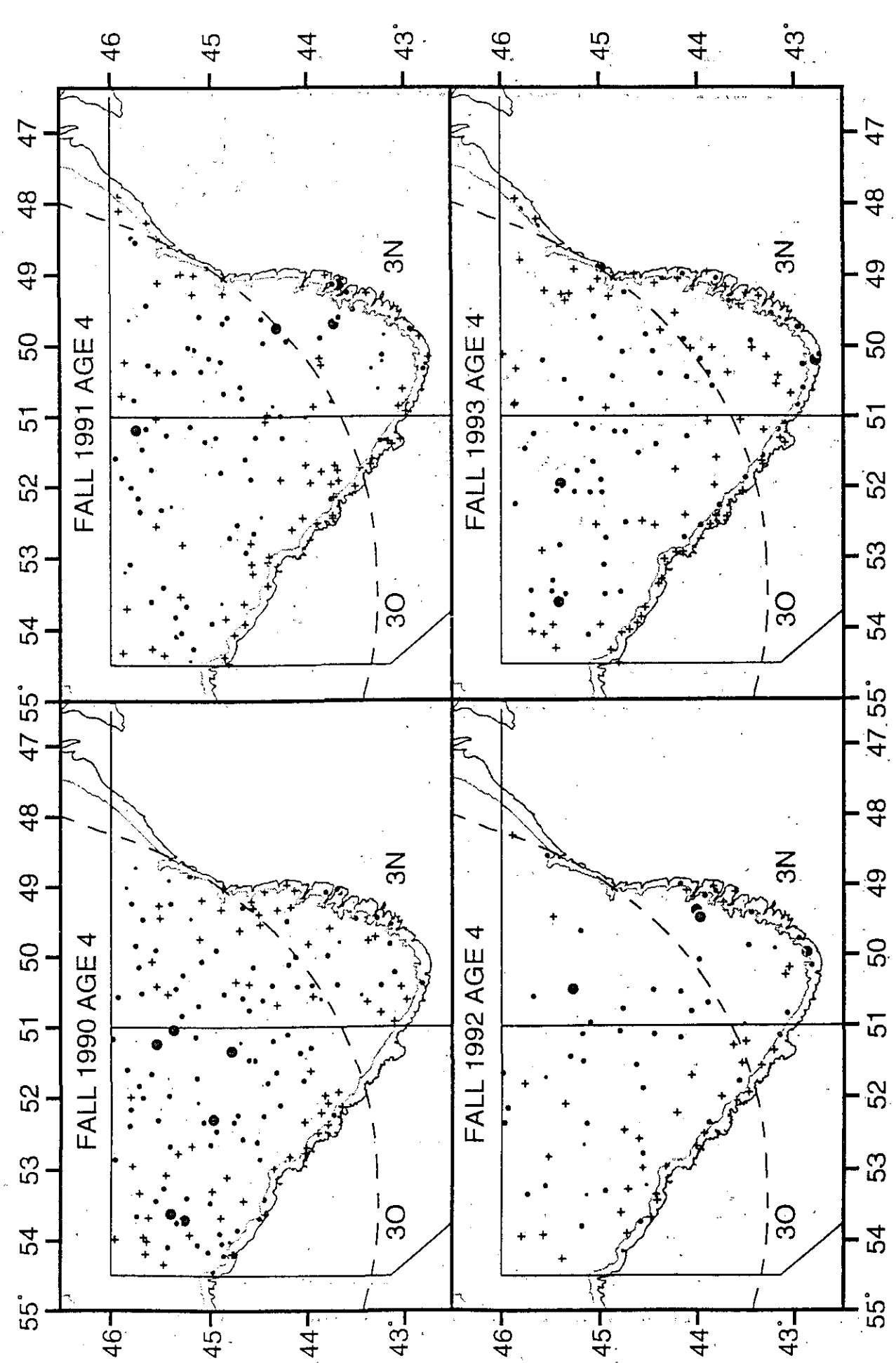


Figure 8. (cont)

Figure 9. ADAPT K estimates - 3NO cod at different levels of domed PR

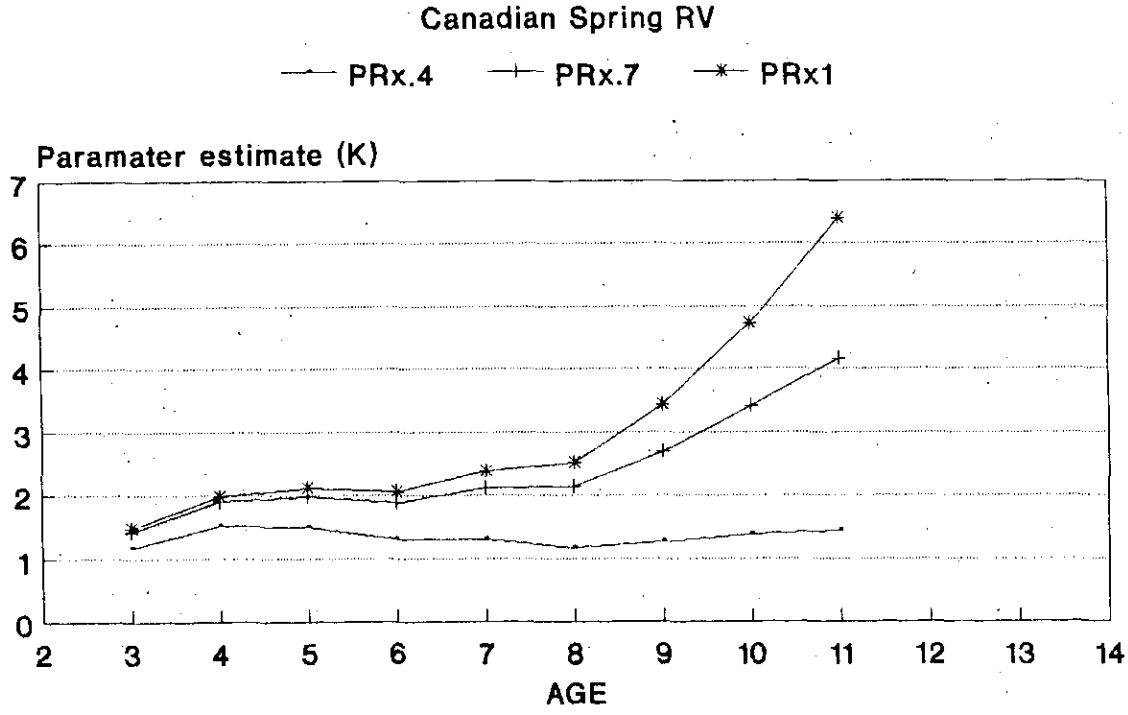


Figure 10. ADAPT K estimates - 3NO cod at different levels of domed PR

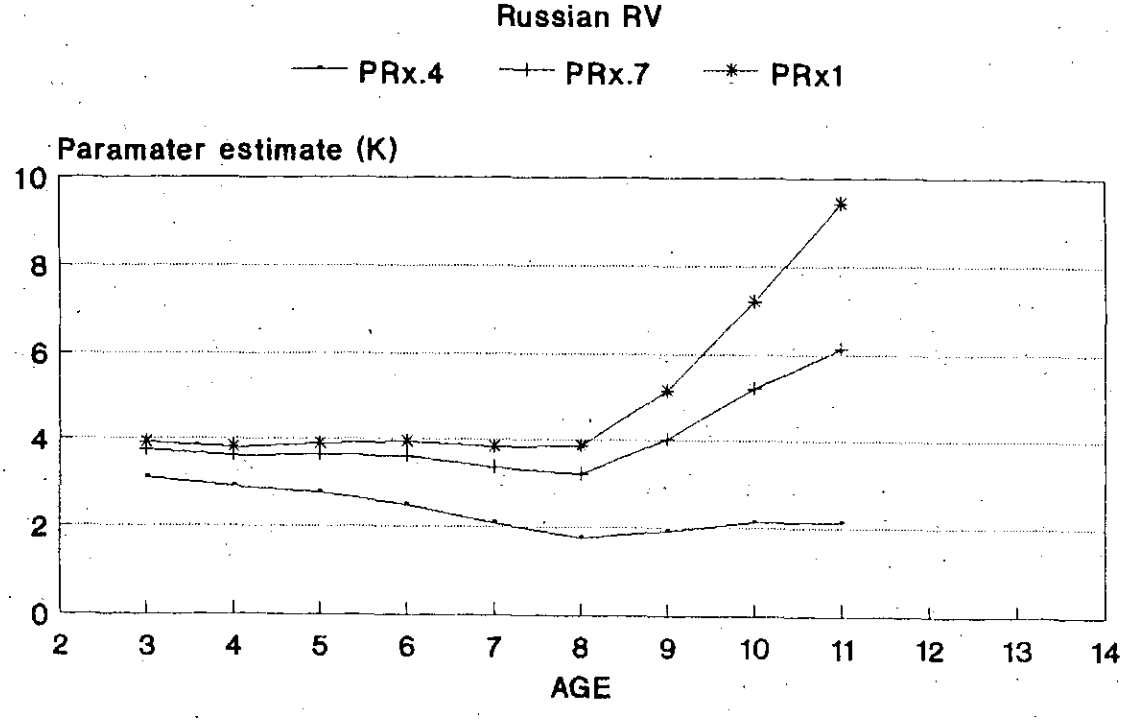


Figure 11. ADAPT K estimates - 3NO cod at different levels of domed PR

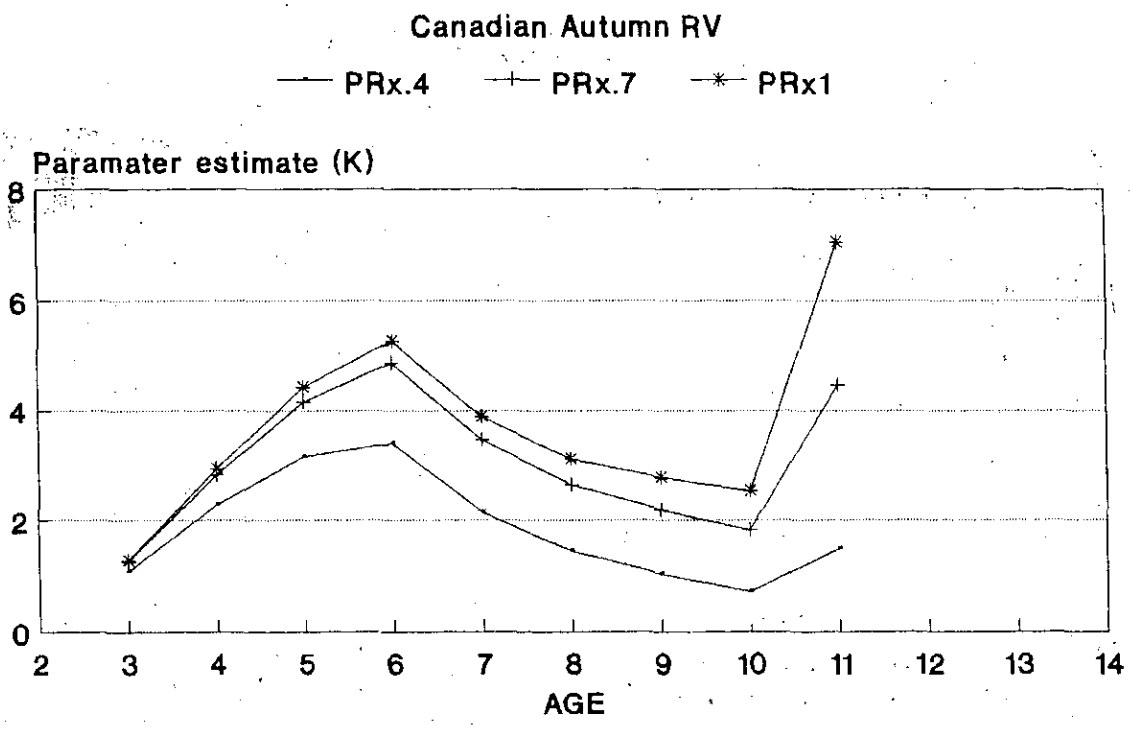
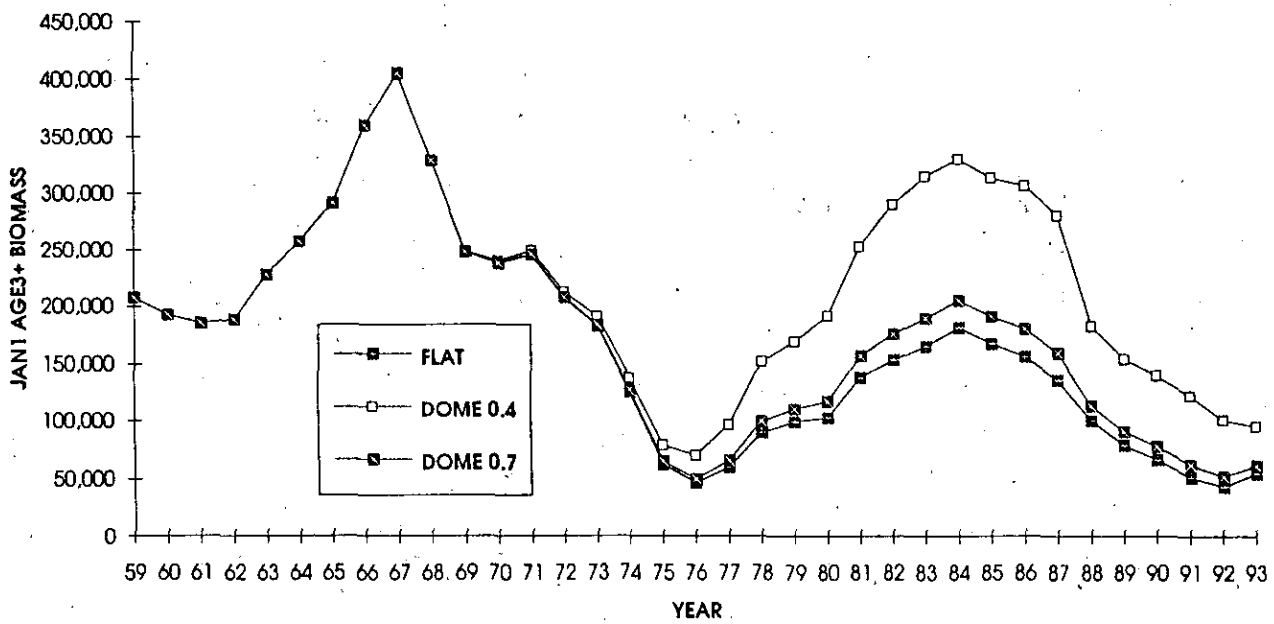


Figure 12. BEGINNING OF THE YEAR BIOMASS FOR DIV. 3NO COD CALIBRATED FOR CANADA (SPRING AND FALL) AND RUSSIAN SURVEYS



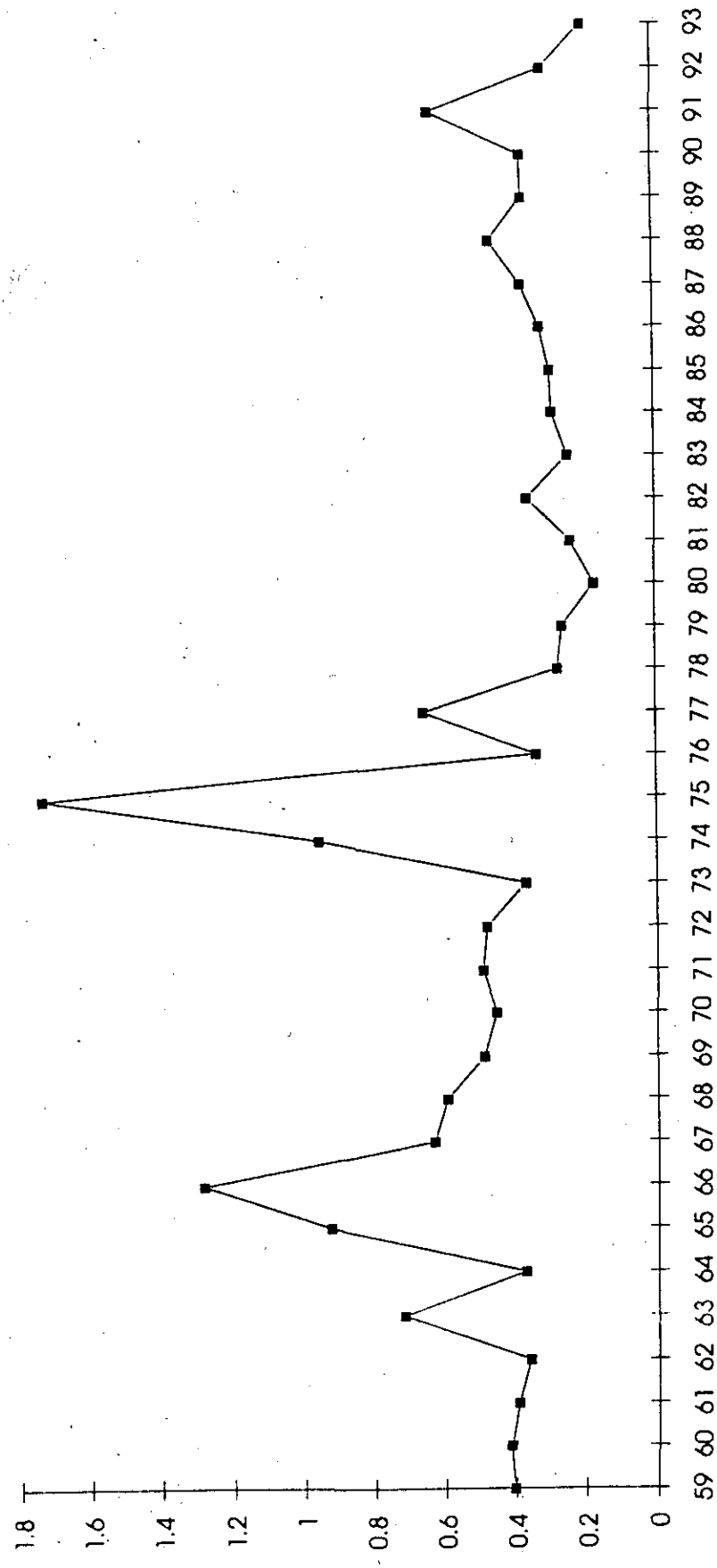


Figure 13. Trends in fishing mortality (ages 7-9) for cod in Div. 3NO.

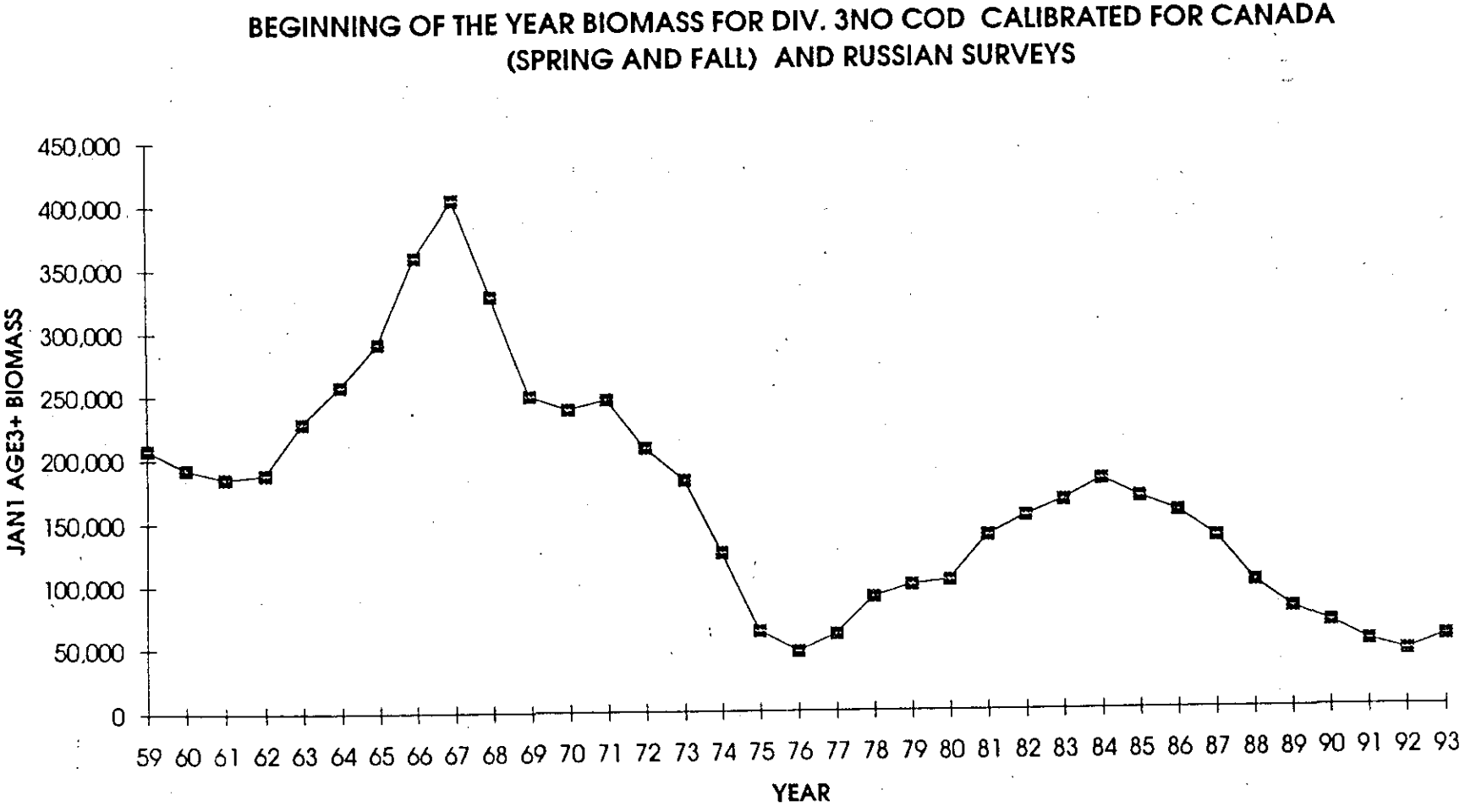


Figure 14. January 1 population biomass for cod in Div. 3NO.

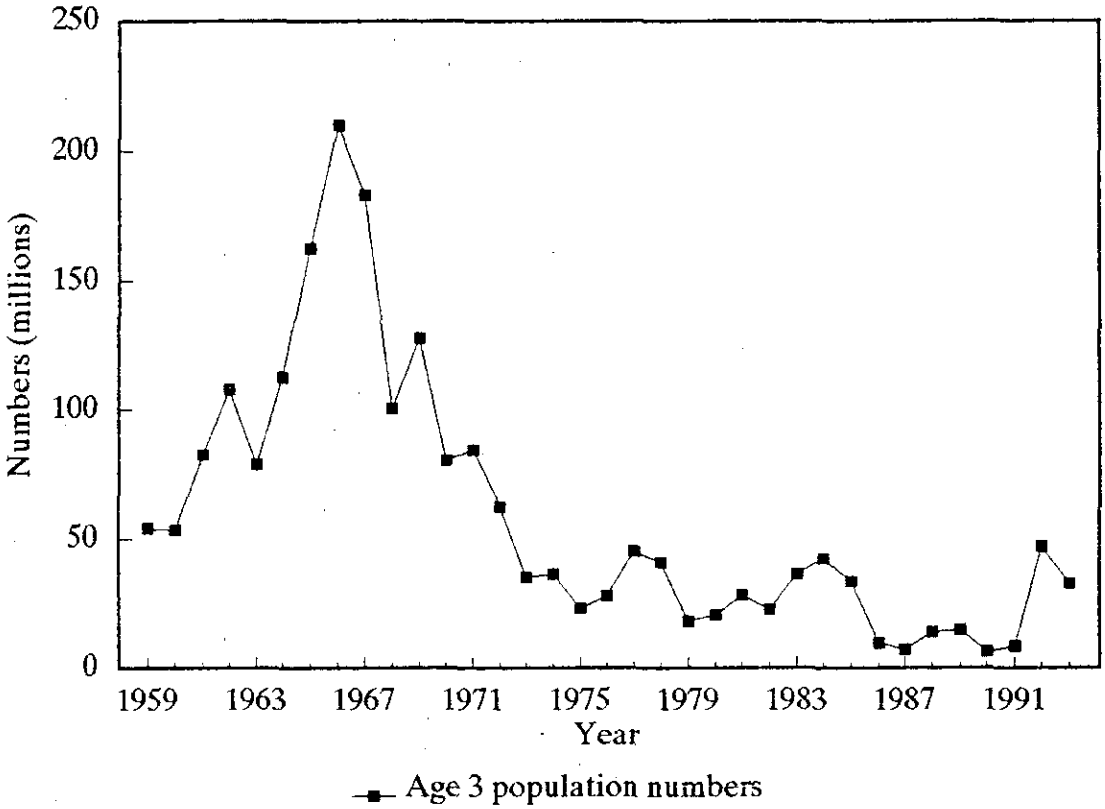


Figure 15. Age 3 population numbers for cod in Div. 3NO, 1959–93.