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Cod in Divisions 2J+3KL - Estimates of Biomass and Age Composition for the Portion of the Stock in the NAFO Regulatory Area from Canadian Research Vessel Surveys

by

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Introduction

The Fisheries Commission has annually requested information on " the stock separation in Div. 2J+3KL and the cod stock in Div. 3L in the NAFO Regulatory Area and a projection, if possible, of the proportion likely to be available in the Regulatory area in future years ". Information is also requested on "the age composition of that portion of the stock in the Regulatory Area". This document updates information presented previously (Murphy and Bishop.,1993) on the proportion of biomass occurring in the NAFO Regulatory Area (NRA) and the age composition of this biomass using data from the Canadian 1993 research surveys in the area.

Results and Discussion

Stock separation

The issue of stock separation has been addressed in some detail by the Scientific Council in recent years (NAFO Scientific Council Reports,1986) and the general conclusions have been that the stock be managed as a single complex (2J+3KL). The general issue of stock definition is being addressed using a suite of recently developed genetic techniques (nuclear DNA gene probes). It is hoped that ongoing comparative genetic studies will lead to a better understanding of the 2J+3KL stock complex.

Survey coverage

The area of NAFO Div. 3L, in depths to 400 fathoms, is 42,265 sq. naut. miles, of which about 3700 or 9% occurs in the NRA (Table 1,Fig. 1). All areas within this depth zone in both Div. 2J and 3K are on the shoreward side of the Canadian 200-mile fishery zone. The total area in Div. 2J3KL to 400 fathoms is about 106,000 sq. naut. miles (Table 2); therefore, the area to this depth in the NRA in Div. 2J3KL is about 3.5% of the total.

Stratified-random research vessel surveys have been conducted by Canada in Div. 2J, 3K, and 3L during autumn since 1977, 1978, and 1981 respectively. Stratified-random surveys have also been conducted during spring since 1971 (excluding 1983-84) and during winter in 1985 and 1986. Surveys during spring for the 1971-76 period were incomplete with regard to strata coverage and have been excluded from analysis for this document.

Biomass estimates

Winter surveys are not regularly conducted in Division 3L .Results of surveys in the winters of 1985 and 1986 indicated that, in winter, about 25% of the 3L biomass occurred in the NRA (Murphy et al.,1991). No stratified-random surveys have been conducted during winter since that time.

Spring surveys conducted during the 1977-90 period show the portion of total 3L biomass in the NRA has ranged from 0.4% to 6.0% with a mean of 2.9. In 1991, the percentage increased to 10.8% and increased to 16.1% in 1992 and to 40.1 % in 1993 (Table 3).
Figure 2 shows the cod distribution from spring surveys 1986-1993, the decline seen in the 2J3KL stock is evident.

Autumn survey results for the years 1981-93 indicated that from 0.5% to 7.7% of the 3L biomass occurred in the NRA with the 1993 value being about 6.0% the highest observed since 1982. (Table 4).

Surveys conducted during autumn for the years 1981-92 in Div 2J3KL indicated that only a small portion, less than 1%, of the total 2J3KL biomass occurs in the NRA at that time. In 1993 this portion has increased to 5 % (Table 5).

The average Divisional biomass from the autumn surveys (Table 6) has been variable in recent years. Biomass has declined substantially since 1990 and is currently (1993) at an extremely low level.

Age composition

The age compositions from spring and autumn research vessel surveys in Div. 3L since 1986 (Tables 7-8; Figures 3-4) indicate for most years a higher proportion of younger cod in the NRA.

The 1985 and 1986 winter survey results, which indicated the highest seasonal proportion of 3L biomass in the NRA, also showed that the age compositions were similar in both areas.

Age compositions for the entire 2J3KL cod research vessel survey biomass (Table 9) were similar to those which occur in Div. 3L inside the 200-mile fishing zone.

Reference

Murphy, E.F, and C.A.Bishop. Cod in Divisions 2J+3KL - Estimates of biomass and age composition for the portion of the stock in the NAFO Regulatory Area. NAFO SCR Doc. 93/47. Ser.No. N2228 8 p.

Murphy, E.F, C.A. Bishop, and J.W.Baird. 1991. Cod in Divisions 2J+3KL - Estimates of biomass and age composition for the portion of the stock beyond the Canadian 200-mile fishery zone. NAFO SCR Doc. 91/51. Ser.No. N1934. 12 p.

Table 1. Proportion of area (square nautical miles) outside the 200 mile fishery zone in NAFO Div. 3L by depth range.

Depth fathoms	Depth meters	Area total	Area outside	% outside
31-50	56-91	8,552	0	0
51-100	92-183	17,452	933	5
101-150	184-274	6,918	791	11
151-200	275-366	3,855	768	20
201-300	367-549	1,142	636	56
301-400	550-732	804	554	69
unstratified shoreward		3,542	0	0
total		42,265	3,682	9

Table 2. Area in square nuatical miles in Div 2J, 3K and 3L.

Division	Survey area (mi . sq.) (0-750 m)	%
2J	27,633	26
3K	36,545	34
3L	42,262	40
Total	106,443	100

Table 3. Estimates of cod biomass outside the 200 mile fishery zone in Division 3L by strata and depth zone from Canadian RV surveys conducted in the spring over the period 1977-93. The number of successful set are in parentesis.

		% Area	ATC	ATC	ATC	ATC	ATC	ATC	WT	WT	WT	WT	WT	WT	WT	WT	WT
	Depth	outside	262	276	290	304-305	317-318	329	28-30	48	59-60	70-71	83	96	106-107	119-122	137-138
	zone	200 mi.	(102)	(94)	(141)	(115)	(77)	(103)	(221)	(211)	(181)	(154)	(194)	(156)	(138)	(178)	(181)
Strata	fath.	zone	1977	1978	1979	1980	1981	1982	1985	1986	1987	1988	1989	1990	1991	1992	1993
385	51-100	5	21	4	56	314	21	0	104	21	53	107	154	40	325	2	5
390	"	55	278	437	1169	1539	275	119	144	223	277	0	109	35	202	20	16
389	101-150	62	833	659	681	4292	296	1031	3825	558	401	429	382	318	140	39	0
391	"	100	634	356	1048	2064	1212	95	429	826	201	41	95	621	283	0	0
387	151-200	37	45	68	170	95	90	871	7952	2425	72	192	927	10557	3422	3005	241
388	"	99	1169	179	346	107	188	1308	343	1556	10	177	121	1162	995	239	481
392	"	100	30	66	189	0	128	256	2237	435	3	98	57		179	10	5
729	201-300	100							35						170	552	15
731	"	100							36						670	253	84
733	"	50		not surveyed					158		not surveyed				1290	384	55
730	301-400	100							0						0	0	0
732	"	100							0						0	0	0
734	"	67							0						173	0	0
biomass outside 200 mi. limit			3010	1769	3659	8411	2210	3680	15263	6044	1017	1044	1845	12733	7849	4505	901
total 3L biomass			70815	78212	129117	139030	220979	140578	267516	239857	257564	259080	192713	228865	72416	27919	2248
% outside			4.3%	2.3%	2.8%	6.0%	1.0%	2.6%	5.7%	2.5%	0.4%	0.4%	1.0%	5.6%	10.8%	16.1%	40.1%

Table 4. Estimates of cod biomass outside the 200 mile fishery zone in Division 3L by strata and depth zone from Canadian RV surveys conducted in the autumn over the period 1981-93. The number of successful set are in parentesis.

		% Area	ATC	ATC	WT	WT	WT	AN	WT	WT	WT	WT	WT	WT	WT
	Depth	outside	323-325	333-334	7-9	16-18	37-39	72	65	78	87	101	114-115	129-130	145-146
	zone	200 mi.	(99)	(120)	(125)	(208)	(231)	(142)	(165)	(189)	(174)	(161)	(219)	(215)	(153)
Strata	fath.	zone	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
385	51-100	5	2	2	51	94	5	55	48	16	3	36	6	14	0
390	"	55	5	32	469	622	5	19	152	112	59	36	0	14	0
389	101-150	62		2125		1697	1563	1068	1074	436	1246	1162	563	0	0
391	"	100		487	159	79	325	370	70	6	23	165	15	1	10
387	151-200	37	494	3410		2762	1501	7483	1014	477	176	3198	641	303	267
388	"	99		456		610	1892		114	362	1348	1056	255	124	90
392	"	100		220	109	68	106	11	8	41	22	120	30	2	6.0
729	201-300	100				59	0	0				57	0	27	83
731	"	100				49	146					11	25	35	54
733	"	50	not surveyed			483	150					227	7	64	138
730	301-400	100				0	0		not surveyed				0	0	0
732	"	100				0	0					0	0	0	0
734	"	67				0	0					0	0	0	4
biomass outside 200 mi. limit			501	6732	788	6523	5693	9006	2480	1450	2877	6068	1542	584	651
total 3L biomass			109819	87997	131267	191702	165169	190732	151936	139726	73514	210725	52750	50506	10808
% outside			0.5%	7.7%	0.6%	3.4%	3.4%	4.7%	1.6%	1.0%	3.9%	2.9%	2.9%	1.2%	6.0%

Table 5. Cod biomass distribution in NAFO Divisions 2J3KL derived from fall surveys in relation to the 200 mile fishery zone.

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
biomass outside													
200 mi. limit	501	6732	788	6523	5693	9006	2480	1450	2877	6068	1542	584	651
Total 2J3KL	518793	441702	598492	551626	387172	952231	450687	464295	504932	436175	206156	62260	12593
% OUTSIDE	0.10%	1.52%	0.13%	1.18%	1.47%	0.95%	0.55%	0.31%	0.57%	1.39%	0.75%	0.94%	5.17%

Table 6. Biomass estimates (000 t) of cod from autumn research vessel surveys in NAFO Div. 2J3KL.

		Biomass												
Divisions	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	
2J	229	217	267	182	137	405	175	249	141	33	29	2	1	
3K	178	136	176	179	86	356	123	75	291	193	126	9	3	
3L	112	89	155	190	164	191	152	140	74	210	52	51	9	
Total	519	442	598	551	387	952	450	464	506	436	207	62	13	
														AVERAGE
2J	44%	49%	45%	33%	35%	43%	39%	54%	28%	8%	14%	3%	8%	31%
3K	34%	31%	29%	32%	22%	37%	27%	16%	58%	44%	61%	15%	23%	33%
3L	22%	20%	26%	34%	42%	20%	34%	30%	15%	48%	25%	82%	69%	36%
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Table 7. Percent age compositions Divisions 3L inside and outside the 200 mile limit as derived from the 1986-93 spring RV surveys.

	1986		1987		1988		1989		1990		1991		1992		1993	
	WT	48	WT 59-60		WT 70 -71		WT 83		WT 96		WT 106 -107		WT 119 -122		WT137 -138	
Age	Inside	Outside	Inside	Outside	Inside	Outside	Inside	Outside	Inside	Outside	Inside	Outside	Inside	Outside	Inside	Outside
1									0	0	0	0			0	0
2		1	1	6		5	1	2	1	1	1	2	1	1	0	0
3	6	19	5	40	10	57	10	39	10	22	7	19	8	6	27	16
4	24	42	11	30	9	20	20	43	29	36	24	46	34	17	25	40
5	24	20	29	13	15	5	9	6	21	25	30	21	46	39	17	27
6	19	10	27	5	33	6	9	2	8	6	18	8	9	24	20	10
7	9	4	14	3	16	3	23	2	8	4	6	1	2	9	7	5
8	7	3	5	1	8	2	17	2	11	3	5	1	0	1	4	2
9	2	1	4	1	3	1	5	2	6	2	5	1	0	0	1	0
10	1		1	1	2	1	2	1	3	1	2	0	0	1	0	0
11	2	1	1		1		2	1	1	0	2	1	0	0	0	0
12	1		1	1	1											

Table 8. Percent age compositions Divisions 3L inside and outside the 200 mile limit as derived from the 1986-93 autumn RV surveys.

	1986		1987		1988		1989		1990		1991		1992		1993	
	AN	72	WT 65		WT 78		WT 87		WT 101		WT 114 -115		WT 129-130		WT 145 -146	
Age	Inside	Outside	Inside	Outside	Inside	Outside	Inside	Outside	Inside	Outside	Inside	Outside	Inside	Outside	Inside	Outside
1				7		4		1	0	1	0	2	0	0	0	0
2	3	4	7	62	5	37	3	20	1	4	5	19	2	7	9	5
3	6	4	6	18	16	36	22	40	13	18	10	18	18	33	26	27
4	27	20	13	2	8	6	21	15	30	31	29	26	29	22	38	44
5	23	23	31	3	18	2	11	3	21	12	30	20	28	15	17	15
6	24	26	23	1	22	2	15	2	12	4	17	10	17	15	8	7
7	7	8	11	1	16	3	15	3	8	3	3	2	5	5	2	2
8	6	6	4	1	8	3	6	2	7	5	2	1	0	1	0	0
9	2	3	3	2	4	2	4	4	4	7	2	1	0	0	0	0
10	1	1			2	1	1	3	1	4	1	1	0	1	0	0
11	1	2		1		1		2	1	3			0	0	0	0
12	1	1	1	1		1		1		3			0	0	0	0

Table 9. MEAN NUMBERS OF COD PER TOW AT AGE FROM AUTUMN RV SURVEYS IN DIVISIONS 2J3KL.

Age	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
1	0.02	0.41	0.27	0.16	0.51	1.04	0.36	0.02	0.14	0.21	0.59	0.66	0.40	0.03	0.01	0.00
2	0.40	0.32	3.00	1.59	2.49	6.09	5.57	1.10	1.85	1.56	2.14	8.25	1.91	1.34	0.29	0.37
3	5.39	1.94	2.48	5.11	5.88	12.31	10.79	7.27	4.77	2.04	3.93	8.98	10.93	3.35	1.78	0.60
4	11.51	11.78	3.83	2.74	5.93	10.65	15.23	12.35	20.70	4.03	3.20	8.30	12.95	13.97	2.30	0.83
5	13.95	16.79	13.23	3.26	3.83	10.88	11.34	10.01	31.29	13.23	5.29	6.20	8.61	9.00	2.72	0.34
6	5.51	10.53	13.31	9.67	2.79	3.88	9.59	7.28	21.29	11.61	10.57	6.52	5.64	3.31	1.42	0.22
7	1.62	2.27	4.99	8.78	5.82	2.44	2.30	4.24	10.14	4.38	10.13	8.23	3.90	1.10	0.35	0.04
8	0.63	0.92	1.19	3.66	5.31	5.35	1.37	0.92	5.26	2.67	2.58	4.84	3.98	0.50	0.04	0.01
9	0.47	0.31	0.37	0.74	2.59	2.94	2.09	0.78	1.37	1.38	1.55	1.62	1.68	0.35	0.02	0.00
10	0.33	0.26	0.23	0.23	0.57	1.42	1.30	0.67	0.58	0.34	0.79	0.98	0.55	0.16	0.01	0.00
11	0.12	0.19	0.11	0.10	0.16	0.36	0.54	0.41	0.68	0.17	0.15	0.43	0.23	0.04	0.00	0.00
12	0.09	0.06	0.16	0.11	0.09	0.14	0.28	0.15	0.42	0.19	0.11	0.16	0.12	0.02	0.01	0.00
13	0.06	0.04	0.05	0.10	0.07	0.13	0.12	0.06	0.19	0.13	0.08	0.10	0.04	0.01	0.00	0.00
1+	40.11	45.80	43.21	36.23	36.03	57.63	60.87	45.25	98.68	41.96	41.11	55.29	50.93	33.18	8.96	2.41
2+	40.09	45.39	42.94	36.08	35.52	56.58	60.51	45.23	98.54	41.74	40.53	54.62	50.53	33.15	8.94	2.41
3+	39.69	45.07	39.94	34.49	33.03	50.49	54.94	44.13	96.69	40.18	38.38	46.37	48.62	31.81	8.65	2.03
4+	34.30	43.13	37.47	29.38	27.16	38.18	44.15	36.86	91.92	38.14	34.46	37.39	37.70	28.46	6.87	1.43
5+	22.79	31.35	33.64	26.64	21.23	27.53	23.93	24.52	71.22	34.11	31.26	29.09	24.75	14.49	4.57	0.61
6+	8.84	14.57	20.41	23.38	17.40	16.66	17.59	14.50	39.93	20.88	25.97	22.89	16.14	5.49	1.85	0.27

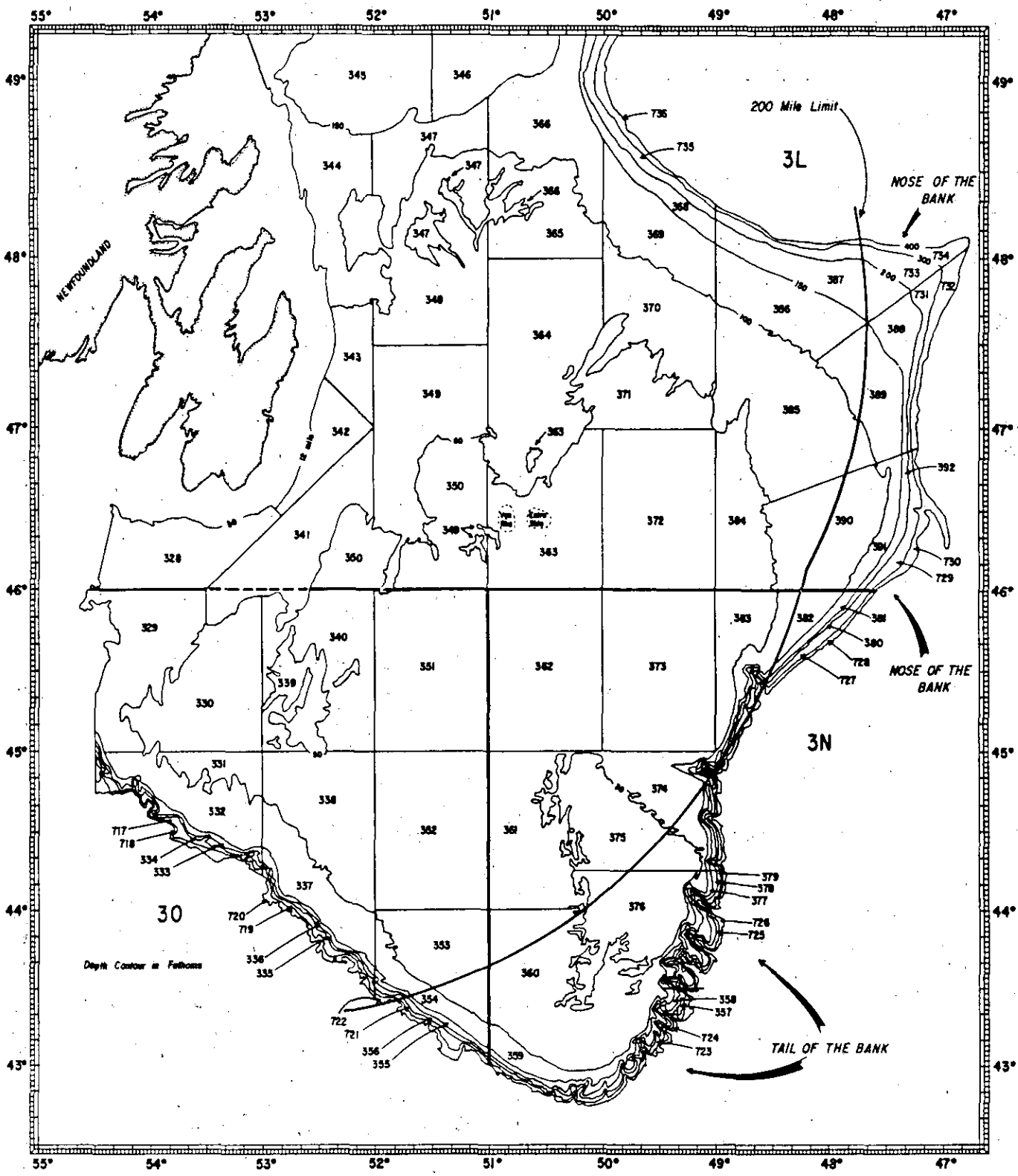

Figure 1. Stratification scheme for NAFO Divisions 3LNO showing the Canadian 200-mile limit.

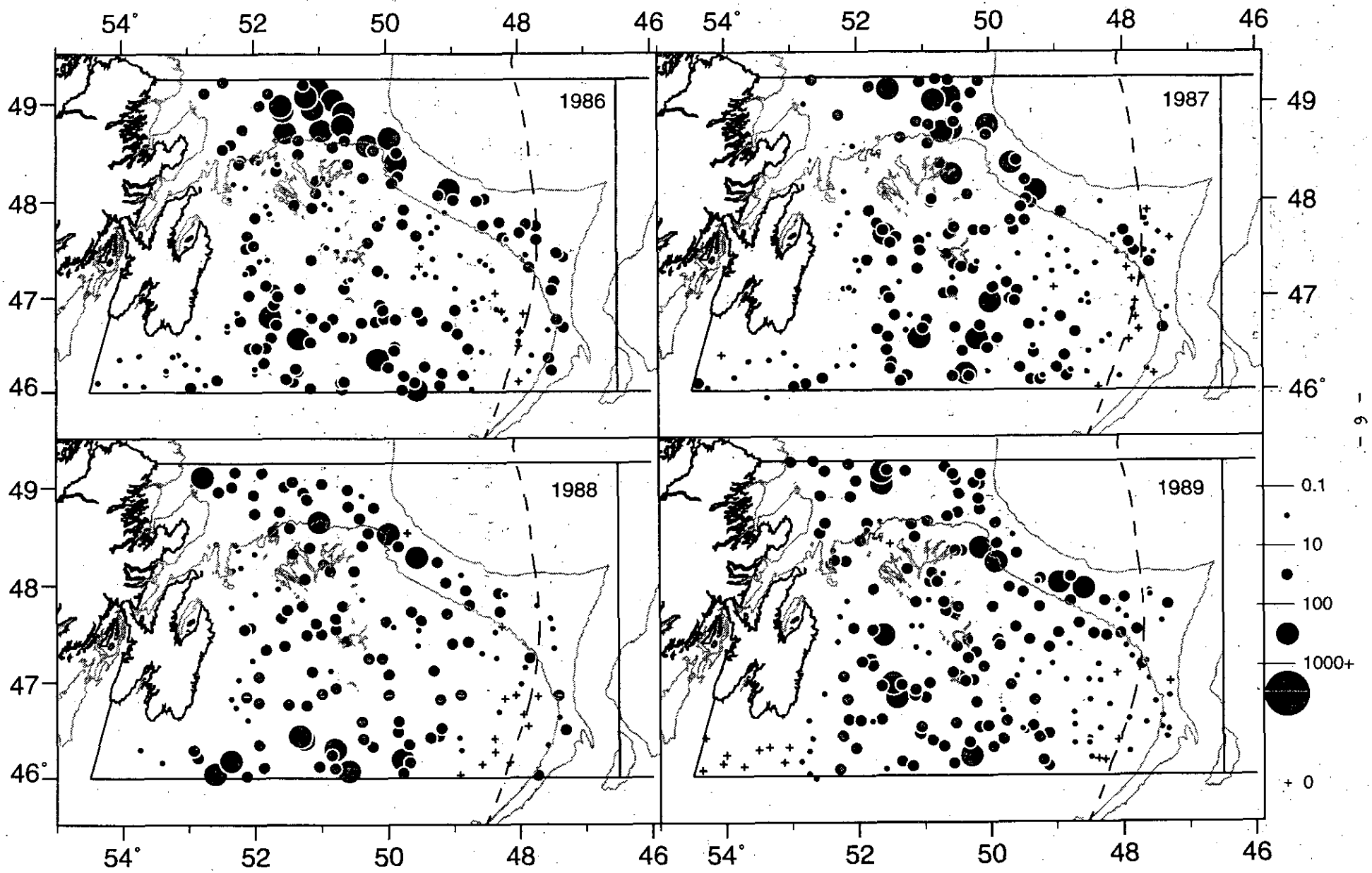

Fig 2. Numbers of Cod per tow from Canadian Research Vessel Surveys 1986 -1989 (Spring).

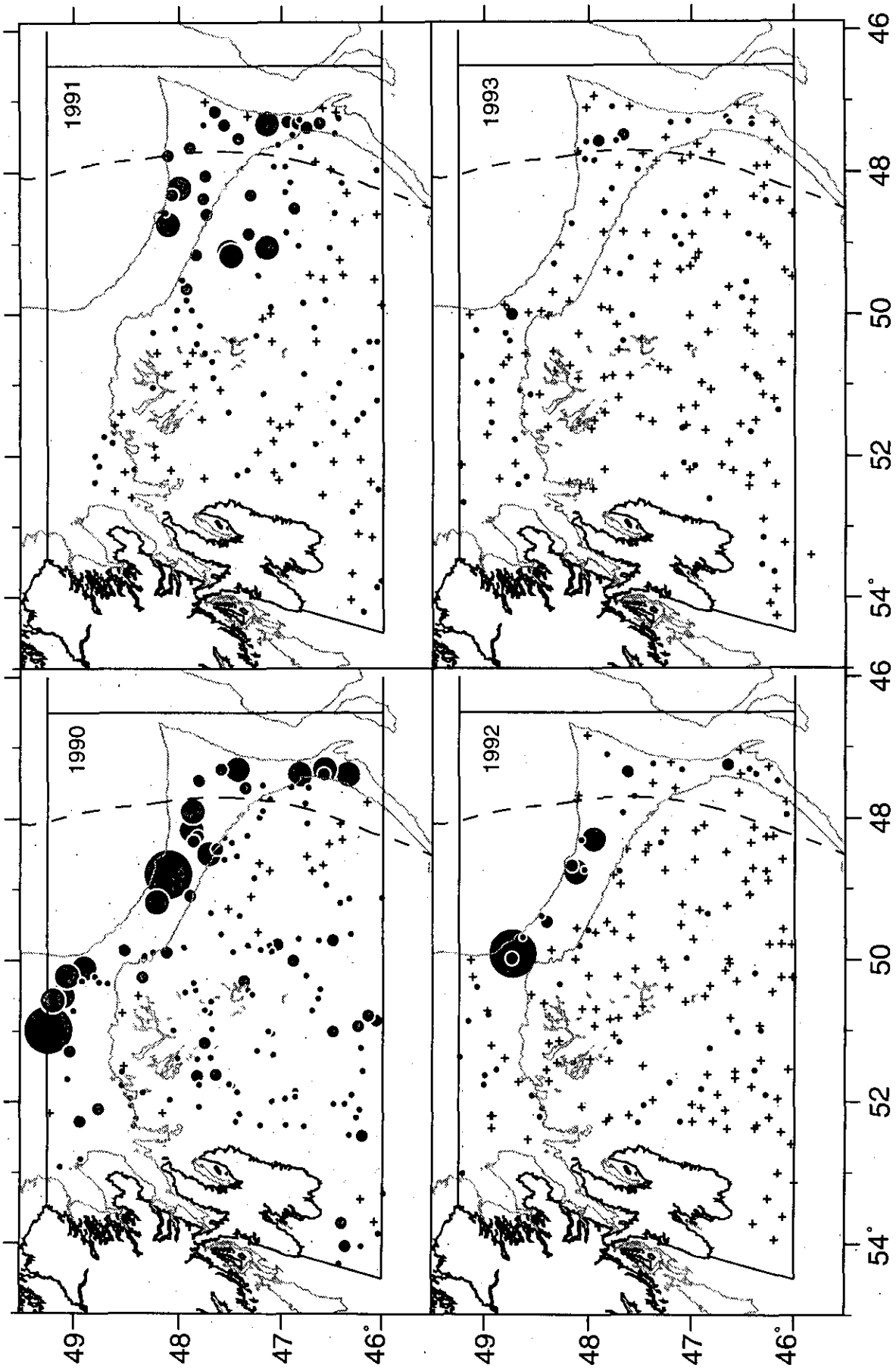

Fig 2. Numbers of Cod per tow from Canadian Research Vessel Surveys 1990 - 1993 (Spring).

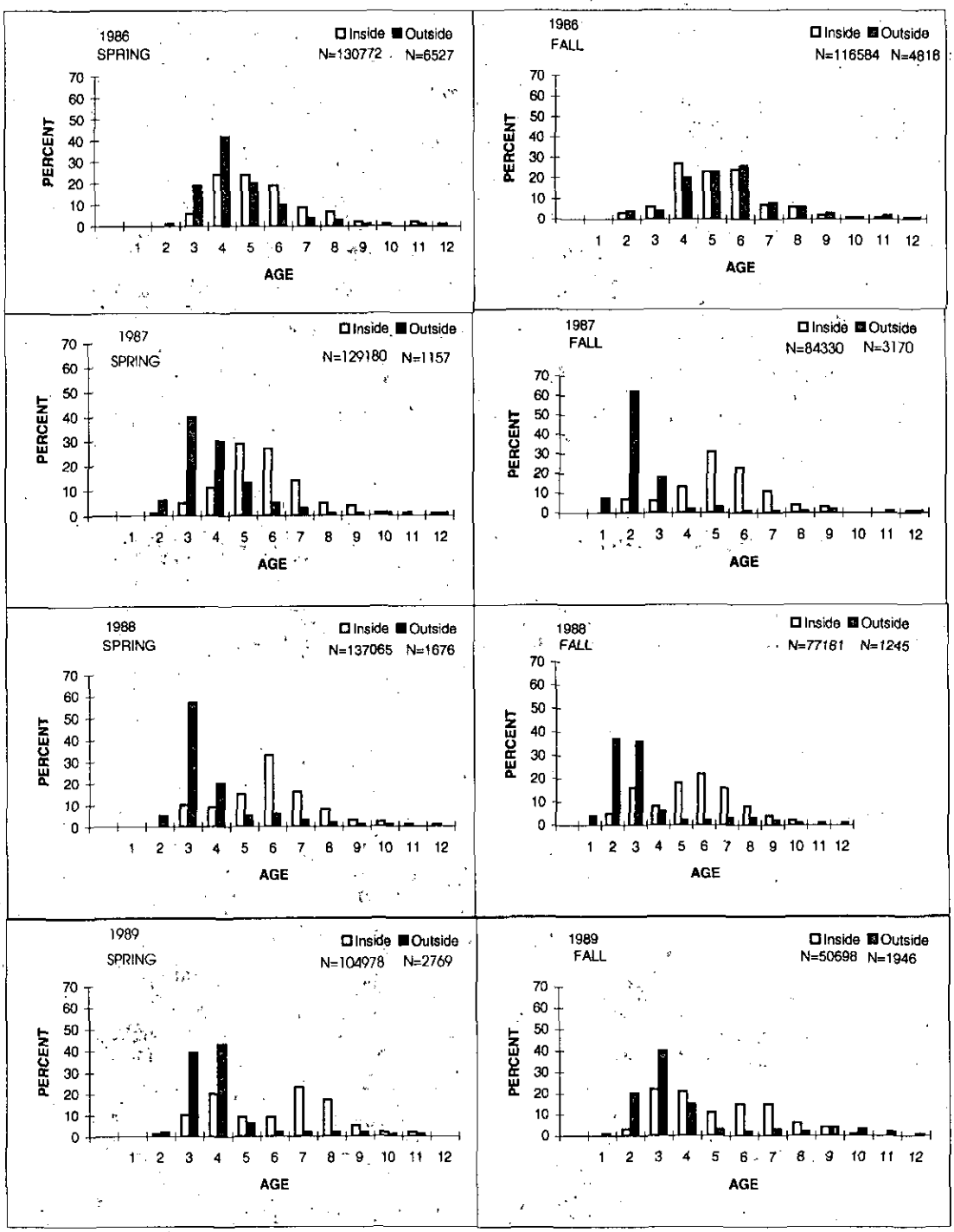

Fig 3. Percent age composition for Division 3L inside and outside the 200-mile limit derived from 1986-1989 spring and autumn Canadian RV surveys.

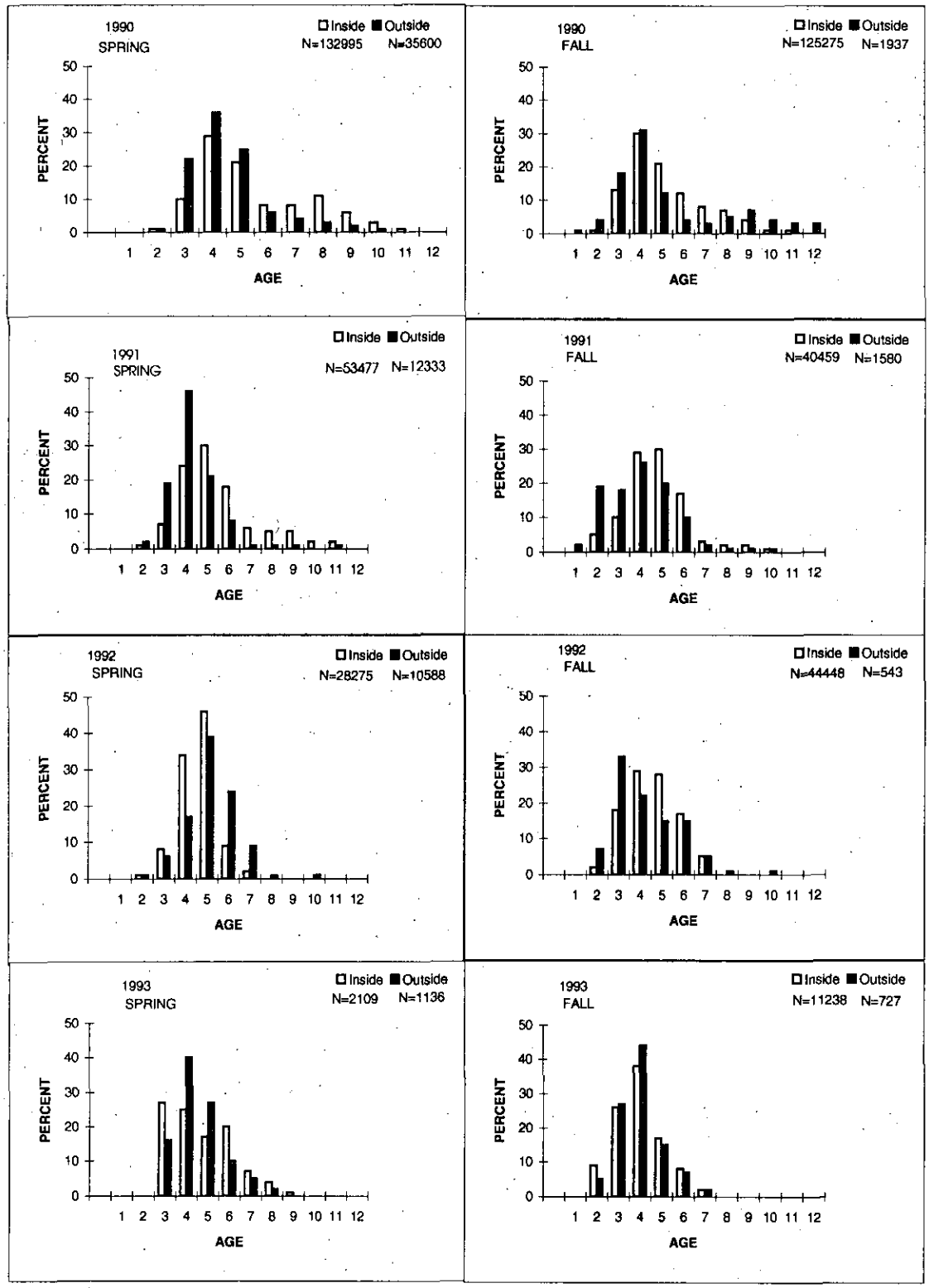

Fig 4. Percent age composition for Division 3L Inside and outside the 200-mile limit derived from 1990-1993 spring and autumn Canadian RV surveys.