Northwest Atlantic Fisheries Organization

Serial No. N2891

NAFO SCR Doc. 97/57
CORRIGENDUM

SCIENTIFIC COUNCIL MEETING - JUNE 1997

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

E. F. Murphy

Correction to Table 6

Average Divisional percentages should be as follows:

2J 29%, 3K 33% and 3L 38%

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E.F. Murphy

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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 portion 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 , 1996) on the proportion of the biomass occurring in the NAFO Regulatory Area (NRA) and the age composition of this biomass using data from the Canadian 1996 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 the past (NAFO Scientific Council Reports, 1986) and the general conclusions have been that the stock be managed as a single stock complex (2J3KL). Recent work (Bentzen et al. 1996) has shown that within the northern cod complex , two pooled samples , NORTH (Hamilton , Funk and Belle Isle Banks) and SOUTH (the northern Grand Bank area) are distinguishable using microsatellite DNA techniques. This lends support to tagging work (Lear 1984, and Taggart et al. 1995) which showed that cod tagged in spawning aggregations on offshore banks show fidelity to these banks. Genetic work is continuing with the goals of identifying inshore or bay stocks and other distinct population in the offshore if they exist. The ability of being able to identify distinct elements of the stock complex may have implications on how this stock is managed in the future.

Survey coverage

The area of NAFO Div 3L, in depths to 400 fathoms is 42,265 sq. naut. miles , of which 3,700 or 9% is 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 the Div. 2J3KL to 400 fathoms is about 106,000 sq. naut. miles (Table 2.); therefore , the area to this depth in the NRA is about 3.5% of the total.

Stratified -random surveys have been conducted by Canada in Div. 2J, 3K and 3L during the autumn since 1977, 1978 and 1981 respectively . Stratified-random surveys have also been conducted during the spring since 1971

(excluding 1983-84) and during the winter in 1985 and 1986 . Surveys during the spring for 1971-1976 period were incomplete with regards to strata coverage and have been excluded from analysis in this document.

Changes to surveys

It should be noted that in the fall of 1995 the survey trawl used changed from the Engles 145 to the Campelen 1800 shrimp trawl. No attempt has been made to convert biomass estimates presented to a common unit. The change in gear should result in an increase in the percentage of smaller cod.

In the fall of 1996 strata shoreward of the scheme used previously were surveyed, however data from these strata are not included in the calculations of biomass inside and outside the limit or the percentage at age.

Biomass estimates

Winter surveys are not regularly conducted in Division 3L. Results of winter surveys in 1985 and 1986 indicated that 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 %. Since 1991 this percentage increased from 10.8% to a high of 63% in 1994 and was 2.4 % in 1996 (Table 3).

Autumn survey results for the years 1981-94 indicated that on average 3.5% of the 3L biomass occurs in the NRA with the 1994 value of 9.7% being the highest observed. The 1996 value was about 0.2 % the lowest observed. (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 increased to 5 % in the NRA and was
< 1 % in 1995 and 1996 (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 (1996) 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 2-5) indicate for most years a higher proportion of younger cod are found in the NRA.

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

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

REFERENCES

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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. 96/65. Ser.No. N2741 11 p.

Table 1. Proportion of ares (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 1977-96. The number of successful set are in parentesis.

Strata	Depth zone fath.	% Area outside 200 mi. zone	ATC 262 (102) 1977	ATC 276 (94) 1978	ATC 290 (141) 1979	ATC 304-305 (115) 1980	ATC 317-318 (77) 1981	ATC 329 (103) 1982	WT 28-30 (221) 1985	WT 48 (211) 1986	WT 59-60 (181) 1987
385	51-100	5	21	4	56	314	21	0	104	21	53
390	"	55	278	437	1169	1539	275	119	144	223	277
389	101-150	62	833	659	681	4292	296	1031	3825	558	401
391	"	100	634	356	1048	2064	1212	95	429	826	201
387	151-200	37	45	68	170	95	90	871	7952	2425	72
388	"	99	1169	179	346	107	188	1308	343	1556	10
392	"	100	30	66	189	0	128	256	2237	435	3
729	201-300	100							35		
731	"	100							36		
733	"	50		not surveyed					158	not surveyed	
730	301-400	100							0		
732	"	100							0		
734	"	67							0		
biomass outside 200 mi. limit			3010	1769	3659	8411	2210	3680	15263	6044	1017
total 3L biomass			70815	78212	129117	139030	220979	140578	267516	239857	257564
% outside			4.3%	2.3%	2.8%	6.0%	1.0%	2.6%	5.7%	2.5%	0.4%

Table 3 cont . 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 1977-96. The number of successful set are in parentesis.

Strata	Depth zone fath.	% Area outside 200 mi. zone	WT 70-71 (154) 1988	WT 83 (194) 1989	WT 96 (156) 1990	WT 106-107 (138) 1991	WT 119-122 (178) 1992	WT 137-138 (181) 1993	WT 152-154 (160) 1994	WT 168-170 (151) 1995	WT 189-91 (188) 1996
385	51-100	5	107	154	40	325	2	5	0	0	0
390	"	55	0	109	35	202	20	16	0	0	17
389	101-150	62	429	382	318	140	39	0	0	6	0
391	"	100	41	95	621	283	0	0	0	0	0
387	151-200	37	192	927	10557	3422	3005	241	0	20	31
388	"	99	177	121	1162	995	239	481	0	9	12
392	"	100	98	57		179	10	5	0	9	18
729	201-300	100				170	552	15	6	0	13
731	"	100				670	253	84	2094	0	152
733	"	50		not surveyed		1290	384	55	62	46	21
730	301-400	100				0	0	0	0	0	0
732	"	100				0	0	0	0	0	0
734	"	67				173	0	0	0	0	0
biomass outside 200 mi. limit			1044	1845	12733	7849	4505	901	2162	90	264
total 3L biomass			259080	192713	228865	72416	27919	2248	3429	343	10884
% outside			0.4%	1.0%	5.6%	10.8%	16.1%	40.1%	63.1%	26.2%	2.4%

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

Strata	Depth zone fath.	% Area outside 200 mi. zone	ATC 323-325 (99) 1981	ATC 333-334 (120) 1982	WT 7-9 (125) 1983	WT 16-18 (208) 1984	WT 37-39 (231) 1985	AN 72 (142) 1986	WT 65 (165) 1987	WT 78 (189) 1988
385	51-100	5	2	2	51	94	5	55	48	16
390	"	55	5	32	469	622	5	19	152	112
389	101-150	62		2125		1697	1563	1068	1074	436
391	"	100		487	159	79	325	370	70	6
387	151-200	37	494	3410		2762	1501	7483	1014	477
388	"	99		456		610	1892		114	362
392	"	100		220	109	68	106	11	8	41
729	201-300	100				59	0	0		
731	"	100				49	146			
733	"	50	not surveyed			483	150			
730	301-400	100				0	0		not surveyed	
732	"	100				0	0			
734	"	67				0	0			
biomass outside 200 mi. limit			501	6732	788	6523	5693	9006	2480	1450
total 3L biomass			109819	87997	131267	191702	165169	190732	151936	139726
% outside			0.5%	7.7%	0.6%	3.4%	3.4%	4.7%	1.6%	1.0%

Table 4 cont. 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.

Strata	Depth zone fath.	% Area outside 200 mi. zone	WT 87 (174) 1989	WT 101 (161) 1990	WT 114-115 (219) 1991	WT 129-130 (215) 1992	WT 145-146 (153) 1993	WT 160-162 (200) 1994	WT 176-181 (166) 1995	Tel 41 WT 196-198 (179) 1996
385	51-100	5	3	36	6	14	0	0	0	1
390	"	55	59	36	0	14	0	0	7	0
389	101-150	62	1246	1162	563	0	0	0	8	0
391	"	100	23	165	15	1	10	0	0	0
387	151-200	37	176	3198	641	303	267	34	9	7
388	"	99	1348	1056	255	124	90	43	34	0
392	"	100	22	120	30	2	6.0	0	15	7
729	201-300	100		57	0	27	83	0	0	0
731	"	100		11	25	35	54	8	5	nf
733	"	50		227	7	64	138	17	7	0
730	301-400	100			0	0	0	5	0	0
732	"	100		0	0	0	0	0	0	0
734	"	67		0	0	0	4	12	0	0
biomass outside 200 mi. limit			2877	6068	1542	584	651	119	85	15
total 3L biomass			73514	210725	52750	50506	10808	1232	5275	7066
% outside			3.9%	2.9%	2.9%	1.2%	6.0%	9.7%	1.6%	0.2%

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
biomass outside 200 mi. limit	501	6732	788	6523	5693	9006	2480	1450
Total 2J3KL	518793	441702	598492	551626	387172	952231	450687	464295
% OUTSIDE	0.10%	1.52%	0.13%	1.18%	1.47%	0.95%	0.55%	0.31%

	1989	1990	1991	1992	1993	1994	1995	1996
biomass outside 200 mi. limit	2877	6068	1542	583.6503	651	119	85	15
Total 2J3KL	504932	436175	206156	62260	12593	2704	13344	24381
% OUTSIDE	0.57%	1.39%	0.75%	0.94%	5.17%	4.40%	0.64%	0.06%

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
2J	229	217	267	182	137	405	175	249
3K	178	136	176	179	86	356	123	75
3L	112	89	155	190	164	191	152	140
Total	519	442	598	551	387	952	450	464
2J	44%	49%	45%	33%	35%	43%	39%	54%
3K	34%	31%	29%	32%	22%	37%	27%	16%
3L	22%	20%	26%	34%	42%	20%	34%	30%
Total	100%	100%	100%	100%	100%	100%	100%	100%

					Biomass				
Divisions	1989	1990	1991	1992	1993	1994	1995	1996	
2J	141	33	29	2	1	0.5	3	4	
3K	291	193	126	9	3	1	5	6	
3L	74	210	52	51	9	1	5	14	
Total	506	436	207	62	13	2.5	13	24	
									AVERAGE
2J	28%	8%	14%	3%	8%	20%	23%	17%	43%
3K	58%	44%	61%	15%	23%	40%	38%	25%	29%
3L	15%	48%	25%	82%	69%	40%	38%	58%	29%
Total	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 1986-95 spring RV surveys.

	1986		1987		1988		1989		1990		1991	
	WT48		WT 59-60		WT 70 -71		WT 83		WT 96		WT 106 -107	
Age	Inside	Outside	Inside	Outside	Inside	Outside	Inside	Outside	Inside	Outside	Inside	Outside
1	0	0	0	0	0	0	0	0	0	0	0	0
2	0	1	1	6	0	5	1	2	1	1	1	2
3	6	19	5	40	10	57	10	39	10	22	8	19
4	24	42	11	30	9	19	20	43	29	36	25	46
5	26	20	29	13	15	5	9	6	21	24	30	21
6	19	10	27	5	33	6	9	2	8	6	18	8
7	9	4	14	3	16	3	23	2	8	4	6	1
8	7	3	5	1	8	2	17	2	11	3	5	1
9	2	1	4	1	3	1	5	2	6	2	4	1
10	1	0	1	1	2	1	2	1	3	1	2	0
11	2	1	1	0	1	0	2	1	1	0	2	0
12	1	0	1	1	1	0	0	0	1	0	0	0

	1992		1993		1994		1995		1996	
	WT 119-122		WT137 -138		WT152-154		WT168-170		WT189-191	
Age	Inside	Outside	Inside	Outside	Inside	Outside	Inside	Outside	Inside	Outside
1	0	0	0	0	0	0	0	0	4	0
2	1	1	0	0	1	0	15	5	23	25
3	7	10	29	14	15	7	14	11	17	24
4	31	20	28	34	35	36	31	36	32	32
5	46	37	16	26	37	38	25	25	15	16
6	12	22	15	19	8	12	12	14	8	3
7	3	8	8	4	3	7	2	2	1	0
8	1	1	3	3	0	1	2	6	0	0
9	0	1	1	0	0	0	0	0	0	0
10	0	1	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0

Table 8. Percent age compositions Divisions 3L inside and outside the 200 mile limit as derived from the 1986-96 autumn RV surveys.

	1986		1987		1988		1989		1990		1991	
	AN 72		WT65		WT 78		WT 87		WT 101		WT 114 -115	
Age	Inside	Outside	Inside	Outside	Inside	Outside	Inside	Outside	Inside	Outside	Inside	Outside
1	0	0	0	7	0	4	0	1	0	1	0	2
2	3	4	7	62	5	37	3	20	1	4	5	19
3	6	4	6	18	16	36	24	40	13	18	10	18
4	27	20	13	2	8	6	23	15	30	31	29	26
5	23	23	31	3	18	2	11	3	21	11	30	20
6	24	26	23	1	22	2	14	2	12	4	17	10
7	7	8	11	1	16	3	14	3	8	3	3	2
8	6	6	4	1	8	3	5	2	7	5	2	1
9	2	3	3	2	4	2	4	4	4	7	2	1
10	1	1	0	0	2	1	1	3	1	4	1	1
11	1	2	0	1	0	1	0	2	1	3	0	0
12	1	1	1	1	0	1	0	1	0	3	0	0

	1992		1993		1994		1995		1996	
	WT 129-130		WT 145-146		WT 160 - 160		WT176-181		Tel 41 WT176-181	
Age	Inside	Outside	Inside	Outside	Inside	Outside	Inside	Outside	Inside	Outside
1	0	0	0	0	0	0	7	1	3	0
2	2	8	9	5	6	6	21	32	15	23
3	18	27	26	27	19	15	34	50	26	58
4	29	19	38	44	35	54	18	13	31	18
5	28	18	17	15	23	22	10	4	14	0
6	17	21	8	7	11	3	8	0	7	0
7	5	6	2	2	6	1	2	0	3	0
8	0	1	0	0	0	0	0	0	1	0
9	0	0	0	0	0	0	0	0	1	0
10	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0

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

Age	1981	1982	1983	1984	1985	1986	1987	1988
1	0.16	0.51	1.04	0.36	0.02	0.14	0.21	0.59
2	1.59	2.49	6.09	5.57	1.10	1.85	1.56	2.14
3	5.11	5.88	12.31	10.79	7.27	4.77	2.04	3.93
4	2.74	5.93	10.65	15.23	12.35	20.70	4.03	3.20
5	3.26	3.83	10.88	11.34	10.01	31.29	13.23	5.29
6	9.67	2.79	3.88	9.59	7.28	21.29	11.61	10.57
7	8.78	5.82	2.44	2.30	4.24	10.14	4.38	10.13
8	3.66	5.31	5.35	1.37	0.92	5.26	2.67	2.58
9	0.74	2.59	2.94	2.09	0.78	1.37	1.38	1.55
10	0.23	0.57	1.42	1.30	0.67	0.58	0.34	0.79
11	0.10	0.16	0.36	0.54	0.41	0.68	0.17	0.15
12	0.11	0.09	0.14	0.28	0.15	0.42	0.19	0.11
13	0.10	0.07	0.13	0.12	0.06	0.19	0.13	0.08
1+	36.23	36.03	57.63	60.87	45.25	98.68	41.96	41.11
2+	36.08	35.52	56.58	60.51	45.23	98.54	41.74	40.53
3+	34.49	33.03	50.49	54.94	44.13	96.69	40.18	38.38
4+	29.38	27.16	38.18	44.15	36.86	91.92	38.14	34.46
5+	26.64	21.23	27.53	23.93	24.52	71.22	34.11	31.26
6+	23.38	17.40	16.66	17.59	14.50	39.93	20.88	25.97

Age	1989	1990	1991	1992	1993	1994	1995	1996
1	0.66	0.40	0.03	0.01	0.00	0.01	1.58	0.38
2	8.25	1.91	1.34	0.29	0.37	0.05	0.97	1.37
3	8.98	10.93	3.35	1.78	0.60	0.16	0.74	0.85
4	8.30	12.95	13.97	2.30	0.83	0.13	0.30	0.41
5	6.20	8.61	9.00	2.72	0.34	0.08	0.12	0.15
6	6.52	5.64	3.31	1.42	0.22	0.02	0.06	0.04
7	8.23	3.90	1.10	0.35	0.04	0.02	0.01	0.03
8	4.84	3.98	0.50	0.04	0.01	0.01	0.00	0.00
9	1.62	1.68	0.35	0.02	0.00	0.00	0.00	0.00
10	0.98	0.55	0.16	0.01	0.00	0.00	0.00	0.00
11	0.43	0.23	0.04	0.00	0.00	0.00	0.00	0.00
12	0.16	0.12	0.02	0.01	0.00	0.00	0.00	0.00
13	0.10	0.04	0.01	0.00	0.00	0.00	0.00	0.00
1+	55.29	50.93	33.18	8.96	2.41	0.48	3.79	3.24
2+	54.62	50.53	33.15	8.94	2.41	0.47	2.21	2.85
3+	46.37	48.62	31.81	8.65	2.03	0.42	1.24	1.48
4+	37.39	37.70	28.46	6.87	1.43	0.26	0.50	0.63
5+	29.09	24.75	14.49	4.57	0.61	0.13	0.20	0.22
6+	22.89	16.14	5.49	1.85	0.27	0.05	0.08	0.07

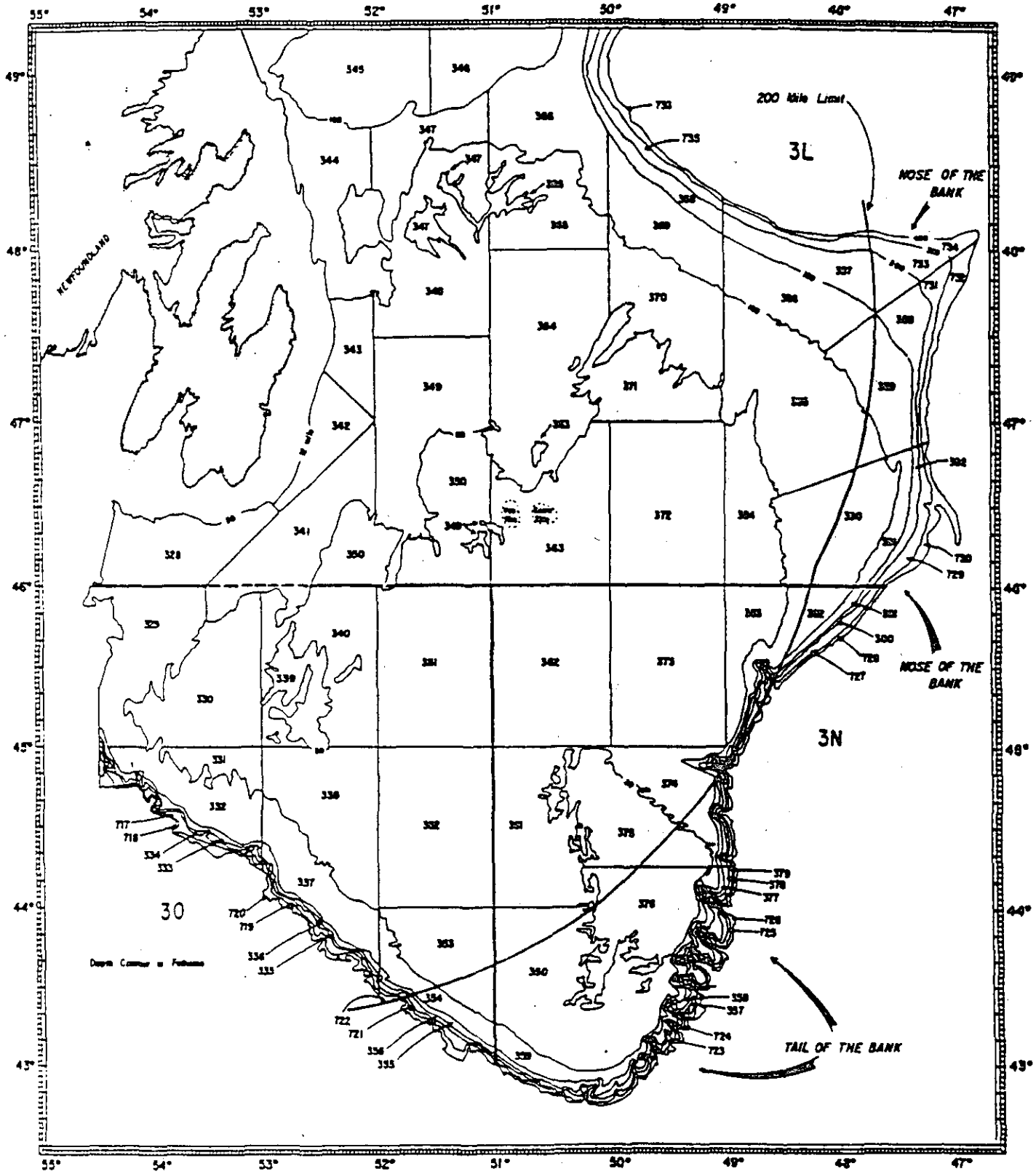

Figure 1. Stratification scheme for NAFO Divisions 3LNO showing the Canadian 200-mile limit.

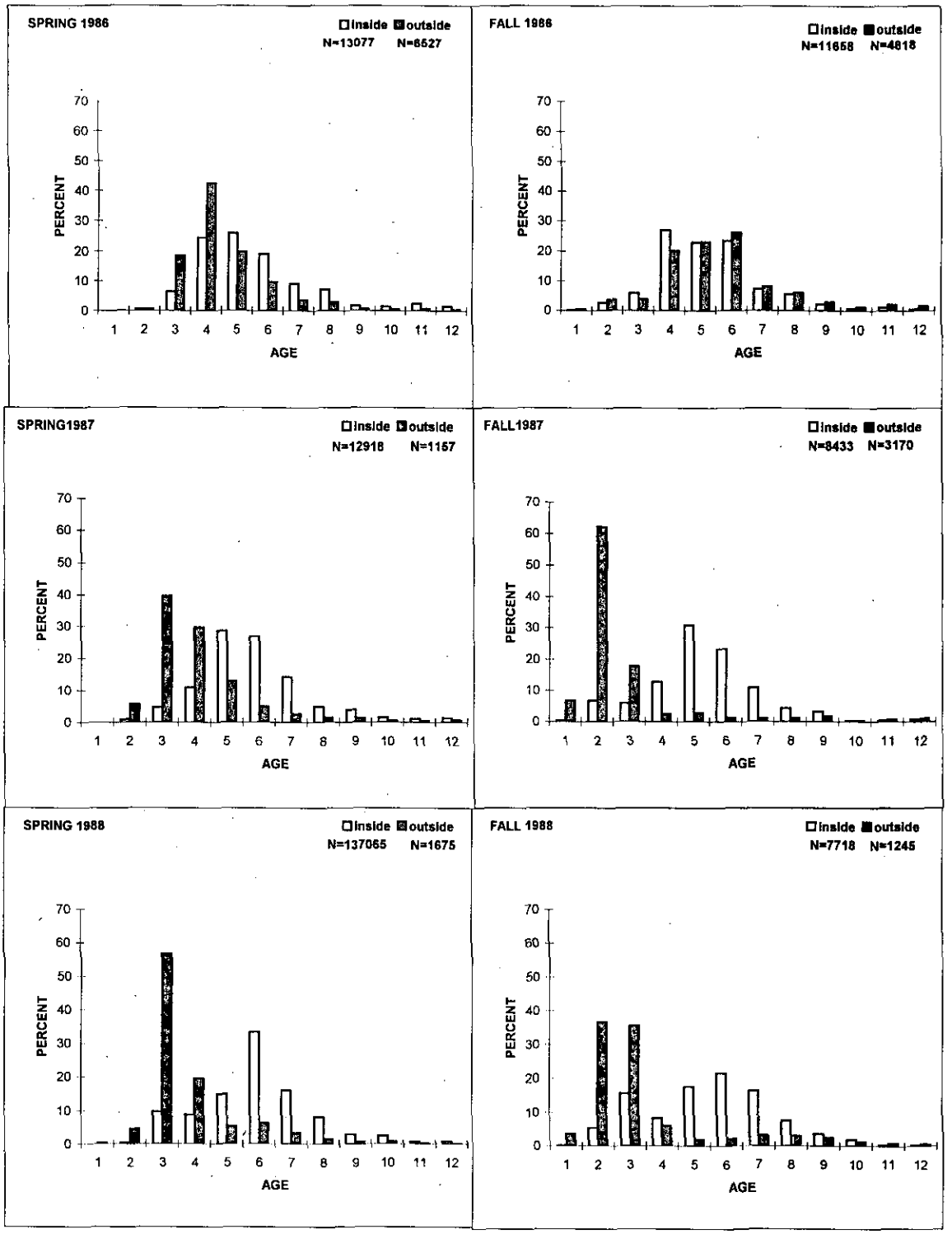

Fig 2. Percent at age composition for Division 3L inside and outside the 200-mile limit derived from 1986-1988 spring and fall Canadian RV surveys.

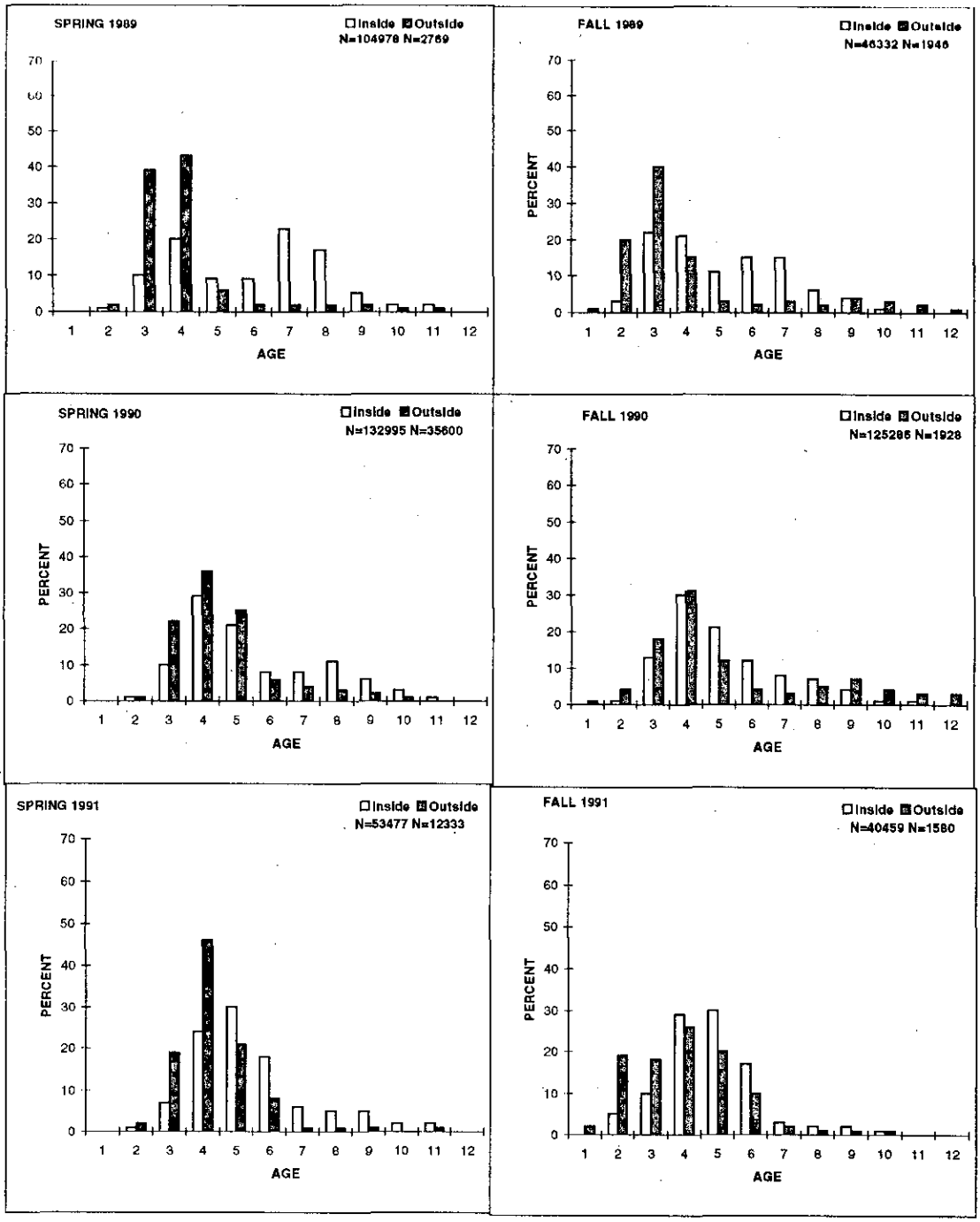

Fig 3. Percent age composition for Division 3L inside and outside the 200-mile limit derived from 1989 -1991 spring and autumn Canadian RV surveys.

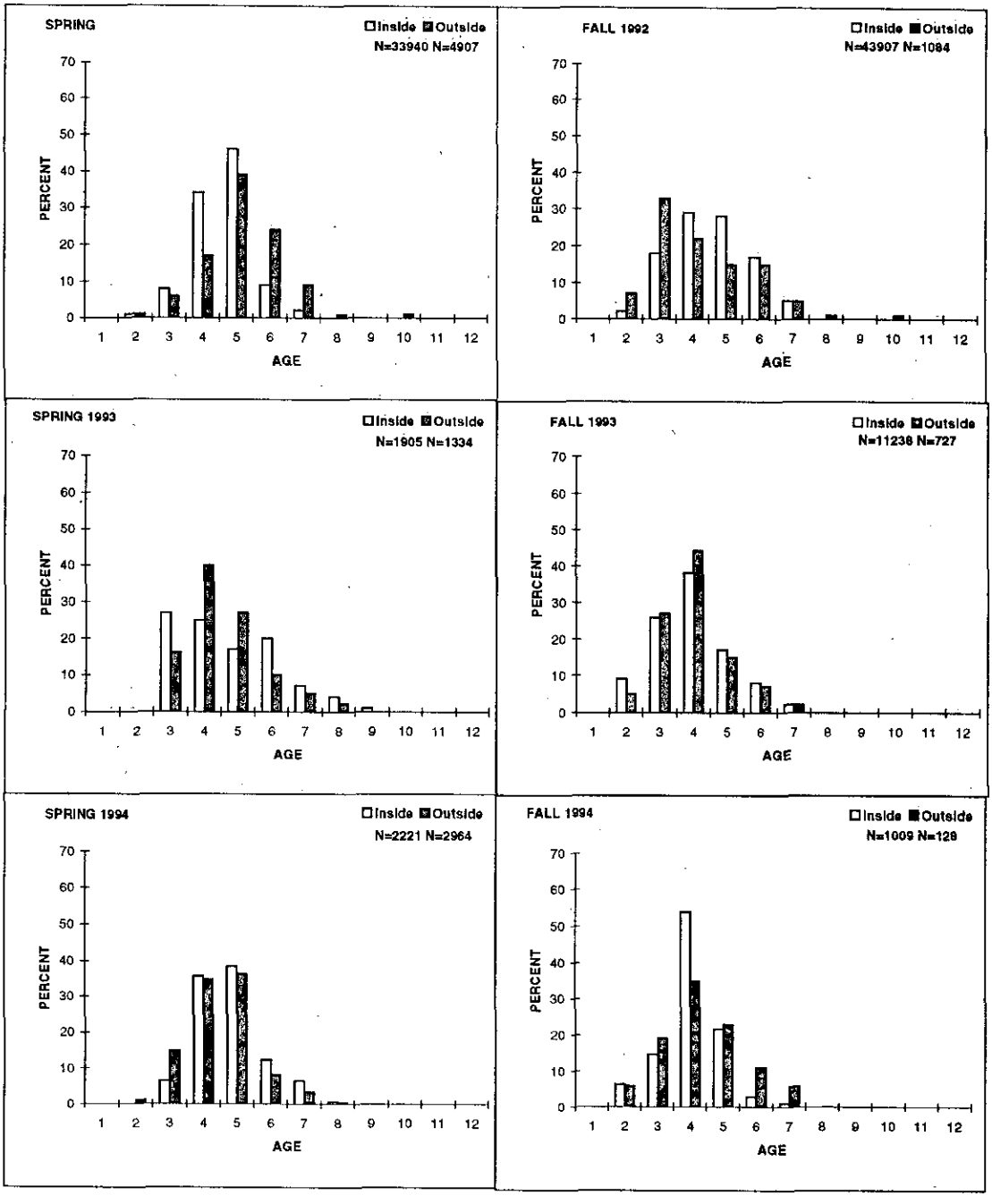

Fig 4. Percent age composition for Division 3L inside and outside the 200-mile limit derived from 1992 -1994 spring and autumn Canadian RV surveys.

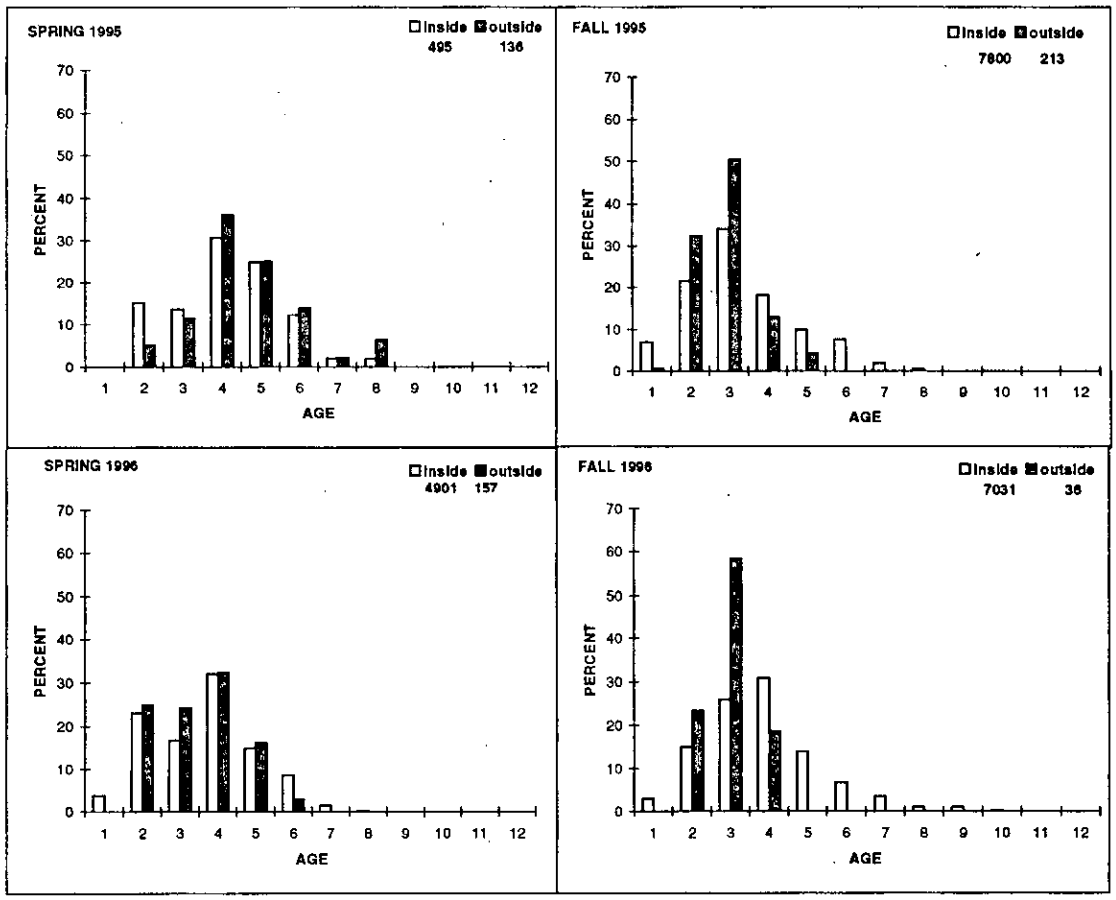

Fig 5. Percent at age composition for 3L inside and outside the 200 mile limit derived from the the 1995 and1996 spring and fall Canadian RV surveys