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Cod in Divisions 2J+3KL - Estimates of Biomass and Age Composition for the Portion of the Stock Beyond the Canadian 200-mile Fishery Zone

by

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Introduction

This document provides an update of information in response to the following Fisheries Commission request:

> "The Fisheries Commission, with the concurrence of the coastal state, requests that the Scientific Council continue to provide information, if available, on the stock separation in Div. 2J+3KL and the proportion of the biomass of the cod stock in Div. 3L in the 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 occurring in the Regulatory Area."

Data on stock separation has been presented and discussed at previous Scientific Council meetings (Lear 1985, 1986a, 1986b, 1986c). The general conclusion drawn from these discussions was that it was advisable to assess Div. 2J+3KL cod as a single stock complex as has been done in the past (NAFO Council reports, 1986). Analyses on the structure of the 2J+3KL cod stock complex and the potential for assessing the management unit in smaller areas is ongoing. This document provides an update of estimates of: the biomass in the Regulatory Area, and the age composition of this portion of the stock complex.

Results and Discussion

Survey coverage

The area of NAFO Div. 3L, in depths to 400 fathoms, is 42,265 square nautical miles, of which about 3700 or 9% occurs in the Regulatory Area (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 square nautical miles (Table 2); therefore, the area to this depth in the Regulatory Area in Div. 2J3KL is about 3.5% of the total.

Stratified-random research vessel surveys have been conducted in Div. 2J, 3K, and 3L during autumn since 1977, 1978, and 1981 respectively. Stratified-random surveys have also been conducted in Div. 3L 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. The research vessel A. T. CAMERON was used to conduct Div. 3L surveys for the 1971-82 period while the sister ships, research vessels WILFRED TEMPLEMAN and ALFRED NEEDLER have been used since that time. Surveys in Div. 2J and 3K have been conducted by the research vessel GADUS ATLANTICA.

Biomass estimates

Information on the proportion of the cod biomass occurring in Div. 3L in the Regulatory Area has been presented previously (Baird and Bowering 1986, Baird 1987, Wells et al. 1988, Baird and Bishop 1989, and Baird et al. 1990). This update adds information from the 1990 Canadian spring and fall research surveys.

For the spring surveys conducted during the 1977-90 period, the portion of the 3L cod biomass in the Regulatory Area has ranged from 0.4% to 6.1%. In 1990, the percentage was about 5.6% (Table 3).

Autumn survey results for the years 1981-90 indicated that from 0.5% to 7.7% of the 3L biomass occurred in the Regulatory Area. The 1990 percentage was about 2.9% (Table 4).

The 1985-86 winter survey results (Table 5) indicated that, in winter, about 25% of the 3L biomass occurred in the Regulatory Area. No new information is available on the portion of the biomass in the Regulatory Area during the winter months.

Surveys conducted during the autumn 1981-90 in Div. 2J+3KL indicate that only a small portion, less than 1%, of the total 2J+3KL biomass occurs in the Regulatory Area at that time (Table 6). The average divisional biomass, as derived from fall research vessel surveys is presented in Table 7. If these proportions are similar throughout the year, on average, less than 5% of the 2J+3KL biomass occurs in the Regulatory Area.

Age composition

The age compositions from research vessel surveys conducted in Div. 3L in the spring and autumn of 1990 are included with those previously presented (Baird et al. 1990) in Tables 8-9 and Figures 2-3.

The 1985 and 1986 winter survey results (Table 5 and Fig. 4) show that during this season, when the portion of the 3L biomass in the Regulatory Area is at its highest, the age composition is similar inside and outside the Regulatory Area.

As in previous years, the 1990 spring and autumn survey results indicate a higher proportion of young fish in the Regulatory Area.

Age compositions for the entire 2J3KL cod biomass estimated from research vessel surveys are presented in Tables 11 and 12. Age compositions for the entire management unit are similar to those which occur in Div. 3L inside the 200-mile fishing zone.

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Wells, R., J. W. Baird, and C. A. Bishop. 1988. The proportion of cod biomass in the Regulatory Area of Div. 3L in relation to the whole of Div. 3L. NAFO SCR Doc. 88/95. Ser. No. N1547, 15 p.

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

Depth (fm)	Depth (m)	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 nautical miles in Div. 2J, 3K, and 3L.

Division	Survey area (mi^2) (0-750 m)	Percentage
2J	27,633	26
3K	36,545	34
3L	42,265	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 surveys conducted in the spring over the period 1977–90. The number of successful sets is in parenthesis.

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	WT 70–71 (154) 1988	WT 83 (194) 1989	WT 96 (156) 1990
385	51–100	5	21	4	56	314	21	0	104	21	53	107	154	40
390	"	55	278	437	1,169	1,539	275	119	144	223	277	0	109	35
389	101–150	62	833	659	681	4,292	296	1,031	3,825	558	401	429	382	318
391	"	100	634	356	1,048	2,064	1,212	95	429	826	201	41	95	621
387	151–200	37	45	68	170	95	90	871	7,952	2,425	72	192	927	10,557
388	"	99	1,169	179	346	107	188	1,308	343	1,556	10	177	121	1,162
392	"	100	30	66	189	0	128	256	2,237	435	3	98	57	
729	201–300	100							35					
731	"	100							36					
733	"	50			not surveyed				158	not surveyed				
730	301–400	100			beyond 200 fathoms				0	beyond 200 fathoms				
732	"	100							0					
734	"	67							0					
Biomass outside 200 miles			3,010	1,769	3,659	8,411	2,210	3,680	15,263	6,044	1,017	1,044	2,845	12,733
Total 3L biomass			70,877	78,118	129,116	139,030	218,214	140,578	267,515	239,857	257,564	259,080	193,713	228,865
Outside 200 miles			4.3	2.3	2.8	6.1	1.0	2.6	5.7	2.5	0.4	0.4	1.5	5.6

Table 4. Estimates of cod biomass outside the 200 mile fishery zone in Division 3L by strata and depth zone from surveys conducted during autumn for 1981–90. The number of successful sets is in parenthesis.

Strata	Depth zone (fath)	% Area outside 200-mi. zone	ATC 323–325 (96) 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	WT 87 (174) 1989	WT 101 (161) 1990
385	51–100	5	2	2	51	94	5	55	48	16	3	36
390	"	55	5	32	469	622	5	19	152	112	59	36
389	101–150	62	–	2,125	–	1,697	1,563	1,068	1,074	436	1,246	1,162
391	"	100	–	487	159	79	325	370	70	6	23	165
387	151–200	37	494	3,410	–	2,762	1,501	7,483	1,014	477	176	3,198
388	"	99	–	456	–	610	1,892	–	114	362	1,348	1,056
392	"	100	–	220	109	68	106	11	8	41	22	120
729	201–300	100	–	–	–	59	0	0	–	–	–	57
731	"	100	–	–	–	49	146	–	–	–	–	11
733	"	50	–	–	–	483	150	–	–	–	–	227
730	301–400	100	–	–	–	0	0	–	–	–	–	–
732	"	100	–	–	–	0	0	–	–	–	–	0
734	"	67	–	–	–	0	0	–	–	–	–	0
Biomass outside 200 miles			501	6,732	788	6,523	5,693	9,006	2,480	1,450	2,877	6,068
Total 3L biomass			109,706	87,997	131,267	191,701	165,417	190,731	151,936	139,726	73,514	210,725
% Outside 200 miles			0.5	7.7	0.6	3.4	3.4	4.7	1.6	1.0	3.9	2.9

Table 5. Estimates of cod biomass outside the 200 mile fishery zone in Division 3L by strata and depth zone from surveys conducted during winter for 1985-86. The number of successful sets is in parenthesis.

Strata	Depth zone (fath.)	% Area outside 200 mi. zone	WT 22-24 (182) 1985	WT 42-44 (206) 1986
385	51-100	5	566	21
390	"	55	2,941	21
389	101-150	62	22,223	1,055
391	"	100	2,710	92
387	151-200	37	20,034	8,592
388	"	99	21,940	2,133
392	"	100	2,182	902
729	201-300	100	0	178
731	"	100	546	-
733	"	50	2,629	728
730	301-400	100	0	-
732	"	100	0	-
734	"	67	20	-
Biomass outside 200 miles			75,800	13,722
Total 3L biomass			318,563	51,164
% Outside 200 miles			23.8	26.8

Table 6. Cod biomass distribution in NAFO Division 2J3KL derived from fall surveys in relation to the 200-mile fishery zone from Canadian research vessel surveys.

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	Average
Biomass outside 200 mi.	501	6,732	788	6,523	5,693	9,006	2,480	1,450	2,877	6,068	
Total 2J3KL	528,300	447,800	607,800	554,100	387,400	952,200	450,000	468,800	505,138	437,838	
% Outside	0.1	1.5	0.1	1.2	1.5	0.9	0.6	0.3	0.6	1.4	0.82

Table 7. Biomass estimates (000 t) of cod from autumn research vessel surveys in NAFO Divisions 2J, 3K, and 3L.

Division	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	
2J	228.8	216.5	267.1	181.7	136.7	404.6	174.8	252.9	141.1	33.9	
3K	185.4	142.2	183.7	181.9	86.0	356.4	123.3	75.4	290.5	193.1	
3L	114.5	89.1	157.0	190.5	164.7	191.2	151.9	139.7	73.5	210.7	
Total	528.7	447.8	607.8	554.1	387.4	952.2	450.0	468.0	505.1	437.7	
Percentage											Average
2J	43	48	44	33	35	43	39	54	28	8	38
3K	35	32	30	33	22	37	27	16	57	44	33
3L	22	20	26	34	43	20	34	30	15	48	29
Total	100	100	100	100	100	100	100	100	100	100	

Table 8. Percent age compositions Division 3L inside and outside the 200-mile limit as derived from the 1986-90 spring RV surveys.

Age	1986 WT 48		1987 WT 59-60		1988 WT 70-71		1989 WT 83		1990 WT 96	
	Inside	Outside	Inside	Outside	Inside	Outside	Inside	Outside	Inside	Outside
1	-	-	-	-	-	-	-	-	0	0
2	-	1	1	6	-	5	1	2	1	1
3	6	19	5	40	10	57	10	39	10	22
4	24	42	11	30	9	20	20	43	29	36
5	26	20	29	13	15	5	9	6	21	25
6	19	10	27	5	33	6	9	2	8	6
7	9	4	14	3	16	3	23	2	8	4
8	7	3	5	1	8	2	17	2	11	3
9	2	1	4	1	3	1	5	2	6	2
10	1	-	1	1	2	1	2	1	3	1
11	2	1	1	-	1	-	2	1	1	0
12	1	-	1	1	1	-	-	-	-	0

Table 9. Percent age compositions for Division 3L inside and outside the 200-mile limit as derived from the 1986-90 fall RV surveys.

Age	1986 AN 72		1987 WT 65		1988 WT 78		1989 WT 87		1990 WT 101	
	Inside	Outside	Inside	Outside	Inside	Outside	Inside	Outside	Inside	Outside
1	-	-	-	17	-	4	-	1	0	1
2	3	4	7	62	5	37	3	20	1	4
3	6	4	6	18	16	36	22	40	13	18
4	27	20	13	2	8	6	21	15	30	31
5	23	23	31	3	18	2	11	3	21	12
6	24	26	23	1	22	2	15	2	12	4
7	7	8	11	1	16	3	15	3	8	3
8	6	6	4	1	8	3	6	2	7	5
9	2	3	3	2	4	2	4	4	4	7
10	1	1	-	-	2	1	1	3	1	4
11	1	2	-	1	-	1	-	2	1	3
12	1	1	1	1	-	1	-	1	-	3

Table 10. Percent age compositions from Division 3L inside and outside the 200-mile limit as derived from the 1985-86 winter RV surveys.

Age	1985 WT 22-24		1986 WT 42-44	
	Inside	Outside	Inside	Outside
1	-	-	-	-
2	1	-	1	-
3	10	13	8	8
4	17	25	35	38
5	30	27	31	28
6	18	14	17	17
7	14	11	4	4
8	5	5	2	3
9	2	2	-	1
10	1	2	-	-
11	1	1	-	-
12	-	-	-	-

TABLE 11. MEAN NUMBERS PER TOW OF COD AT AGE FROM AUTUMN RESEARCH SURVEYS CONDUCTED IN DIVISIONS 2J3KL.

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
1	0.16	0.51	1.00	0.36	0.02	0.14	0.21	0.59	0.66	0.40
2	1.59	2.49	5.87	5.56	1.10	1.85	1.57	2.14	8.25	1.91
3	5.12	5.88	11.43	10.78	7.27	4.77	2.04	3.93	8.98	10.93
4	2.75	5.94	10.32	15.22	12.35	20.70	4.03	3.20	8.30	12.95
5	3.27	3.84	10.41	11.34	10.02	31.29	13.23	5.30	6.20	8.62
6	9.70	2.80	3.80	9.59	7.28	21.29	11.62	10.58	6.52	5.64
7	8.81	5.84	2.35	2.30	4.24	10.14	4.38	10.14	8.23	3.90
8	3.67	5.33	5.21	1.37	0.92	5.26	2.67	2.58	4.84	3.98
9	0.74	2.59	2.86	2.09	0.78	1.37	1.38	1.55	1.62	1.68
10	0.23	0.57	1.39	1.30	0.67	0.58	0.34	0.79	0.98	0.55
11	0.10	0.16	0.35	0.54	0.41	0.68	0.17	0.15	0.43	0.23
12	0.11	0.09	0.13	0.28	0.15	0.42	0.19	0.11	0.16	0.12
13	0.10	0.07	0.12	0.12	0.06	0.19	0.13	0.08	0.10	0.04
1+	36.34	36.10	55.26	60.85	45.26	98.69	41.96	41.14	55.29	50.95
2+	36.18	35.59	54.26	60.49	45.24	98.54	41.75	40.55	54.62	50.54
3+	34.59	33.10	48.39	54.92	44.14	96.69	40.18	38.41	46.37	48.64
4+	29.47	27.22	36.95	44.14	36.87	91.93	38.14	34.48	37.39	37.71
5+	26.72	21.29	26.63	28.92	24.52	71.22	34.11	31.28	29.09	24.76

TABLE 12. PROPORTION AT AGE FROM AUTUMN RESEARCH VESSEL SURVEYS CONDUCTED IN DIVISIONS 2J3KL.

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
1	0.00	0.01	0.02	0.01	0.00	0.00	0.01	0.01	0.01	0.01
2	0.04	0.07	0.11	0.09	0.02	0.02	0.04	0.05	0.15	0.04
3	0.14	0.16	0.21	0.18	0.16	0.05	0.05	0.10	0.16	0.21
4	0.08	0.16	0.19	0.25	0.27	0.21	0.10	0.08	0.15	0.25
5	0.09	0.11	0.19	0.19	0.22	0.32	0.32	0.13	0.11	0.17
6	0.27	0.08	0.07	0.16	0.16	0.22	0.28	0.26	0.12	0.11
7	0.24	0.16	0.04	0.04	0.09	0.10	0.10	0.25	0.15	0.08
8	0.10	0.15	0.09	0.02	0.02	0.05	0.06	0.06	0.09	0.08
9	0.02	0.07	0.05	0.03	0.02	0.01	0.03	0.04	0.03	0.03
10	0.01	0.02	0.03	0.02	0.01	0.01	0.01	0.02	0.02	0.01
11	0.00	0.00	0.01	0.01	0.01	0.01	0.00	0.00	0.01	0.00
12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

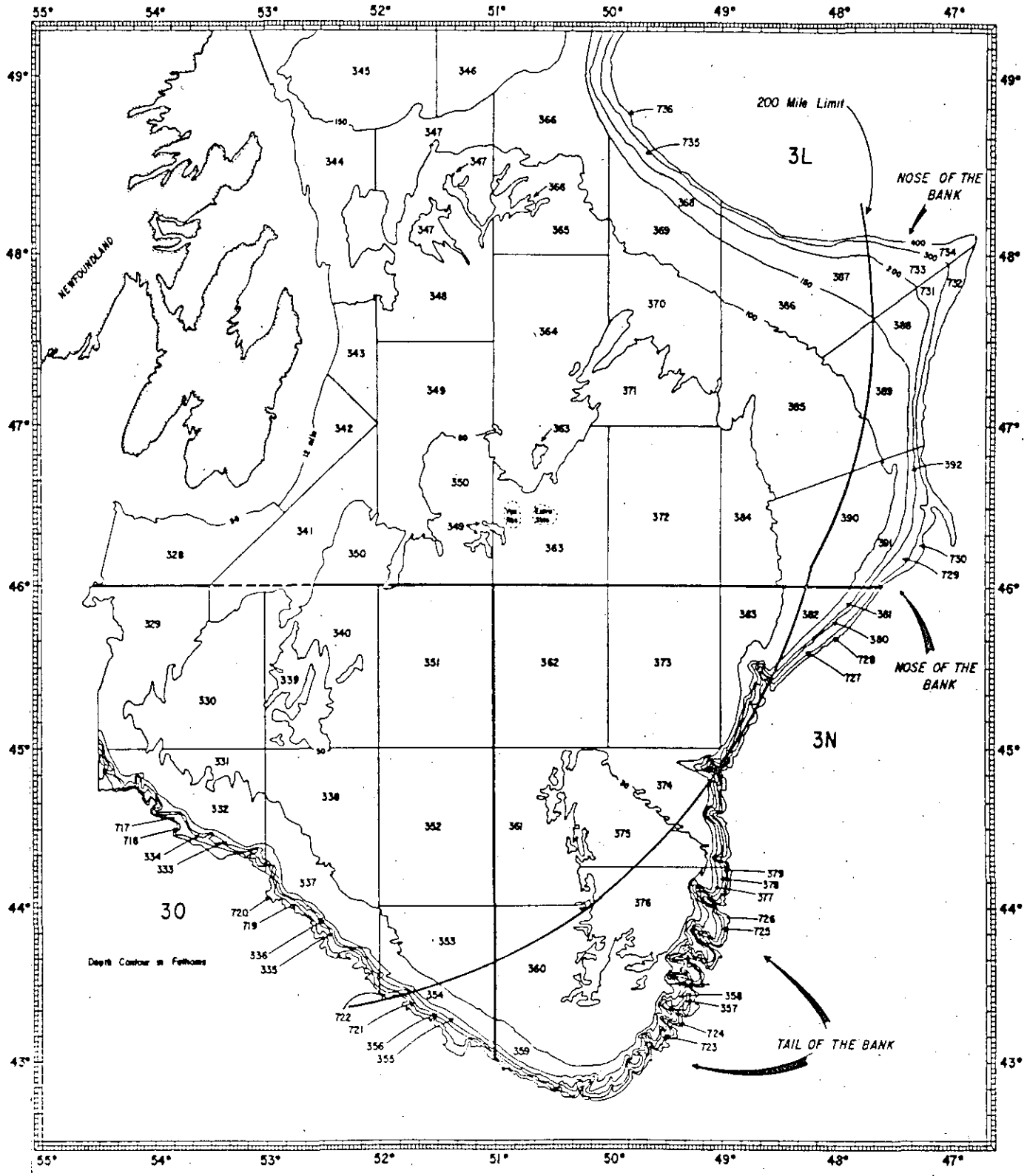

Figure 1. Stratification scheme for NAFO Divisions 3LNO showing the Canadian 200-mile limit.

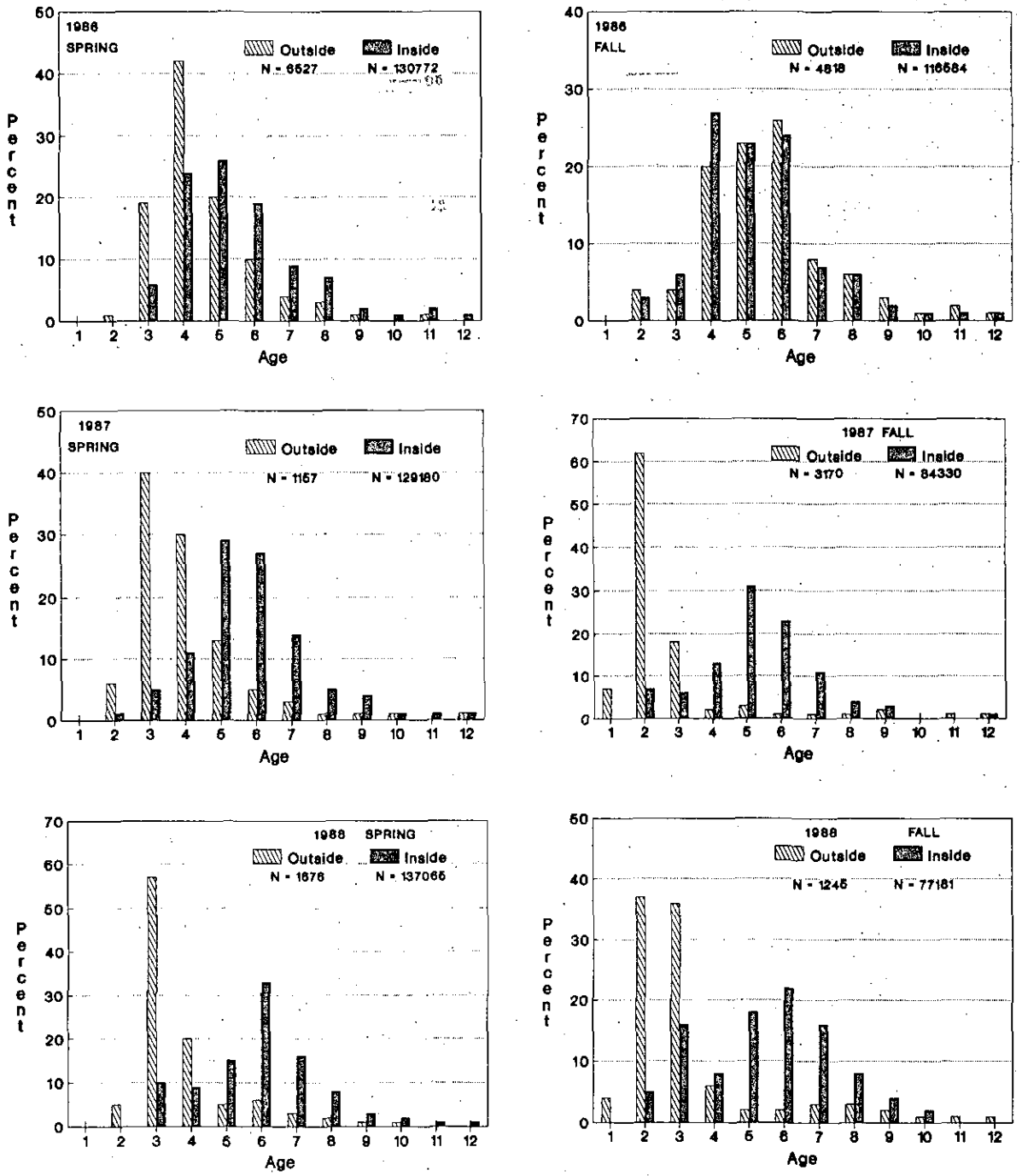

Fig 2. Percent age composition for Division 3L inside and outside the 200-mile limit derived from 1986-88 spring and autumn Canadian RV surveys.

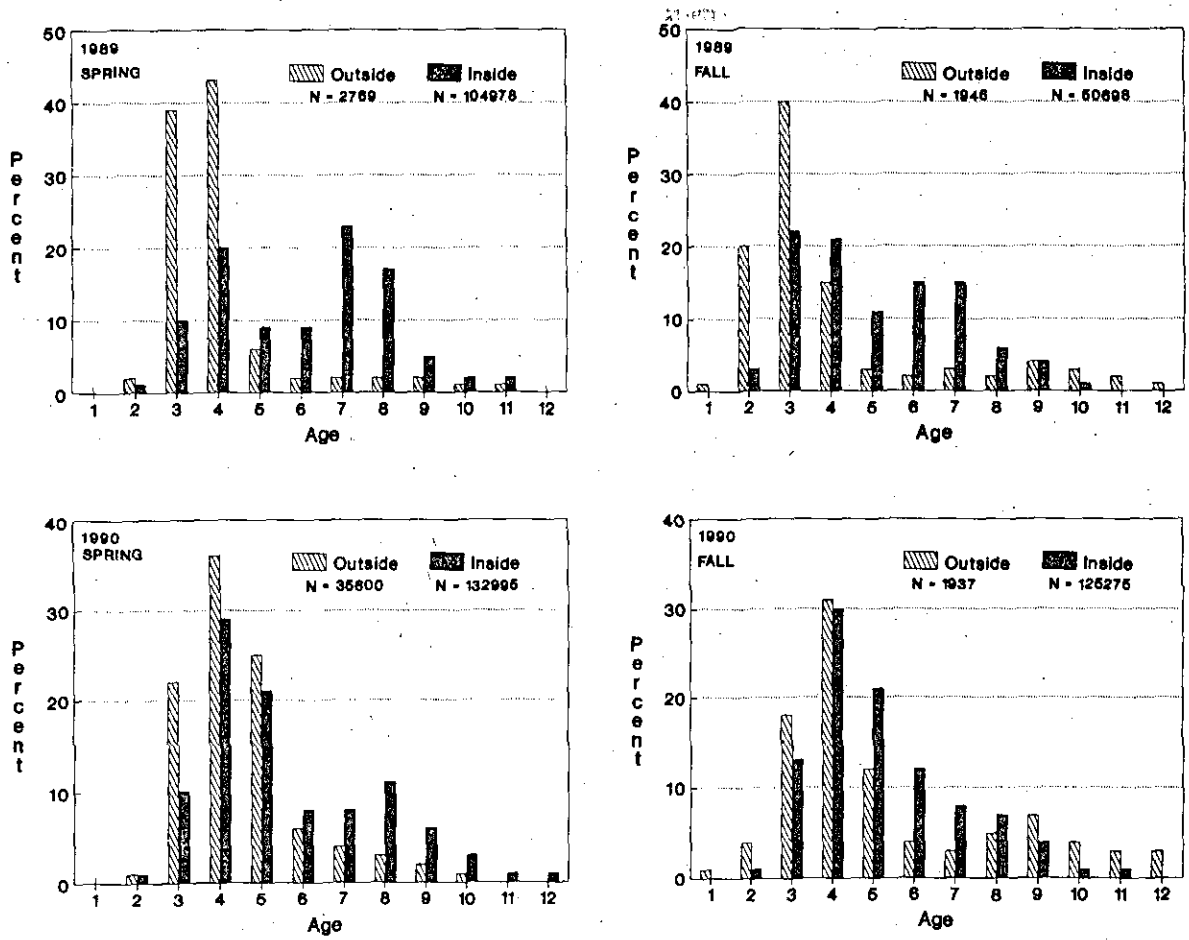

Fig 3. Percent age composition for Division 3L inside and outside the 200-mile limit derived from 1989-90 spring and autumn Canadian RV surveys.

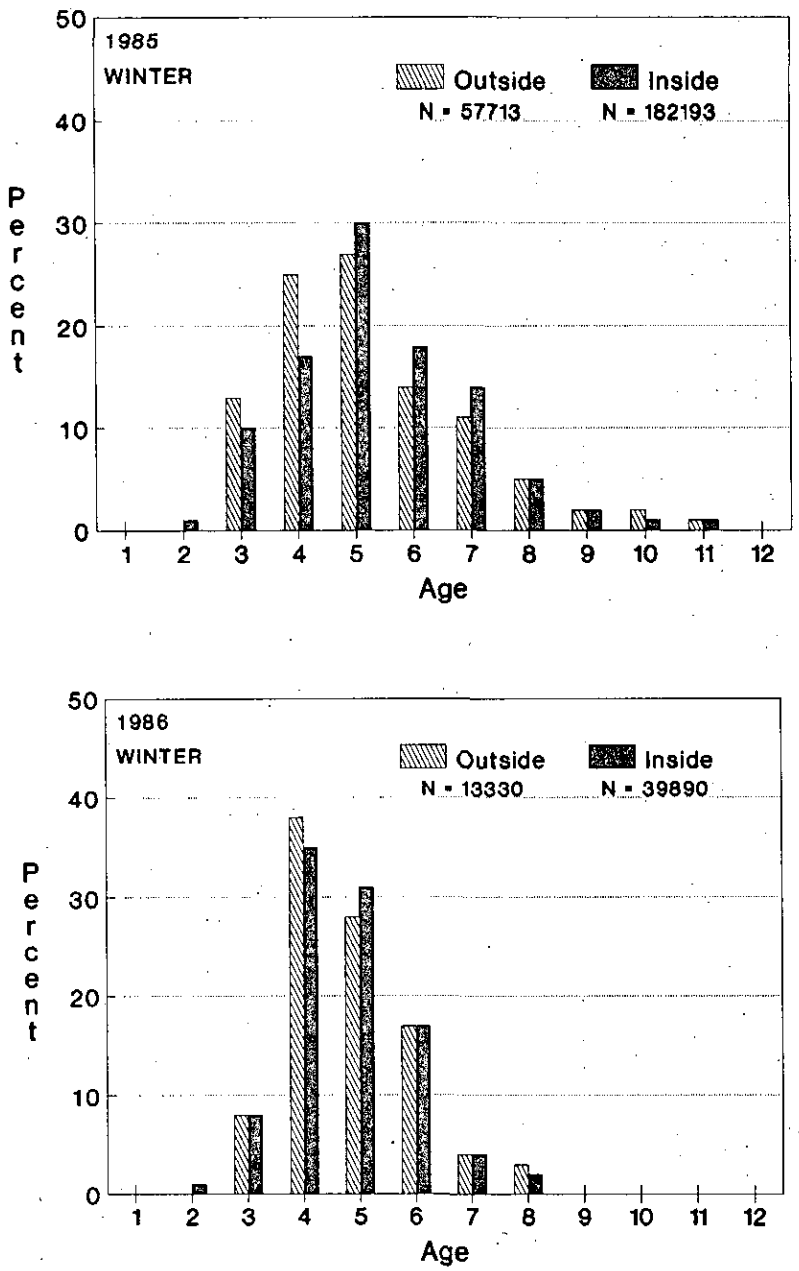

Fig 4. Percent age composition for Division 3L inside and outside the 200-mile limit derived from 1985-86 winter Canadian RV surveys.