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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

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 et al., 1991) on the proportion of biomass occurring in the NAFO Regulatory Area (NRA) and the age composition of this biomass using data from the Canadian 1991 research surveys in the area. 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 recommending that the stock be managed as a single complex (2J+3KL) are still valid.

Results and Discussion

Survey coverage

The area of NAFO Div. 3L, in depths to 400 fathoms, is 42,265 sq. naut. miles, of which about 37,000 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

For the spring surveys conducted during the 1977-91 period, the portion of total 3L biomass in the NRA has ranged from 0.4% to 10.8%. In 1991, the percentage was 10.8% (Table 3), the highest in this time series. Values for recent years may be underestimated as there has been evidence (winter hydroacoustic surveys and the commercial fisheries) to suggest that cod have moved to deeper waters and some may have been outside of the normal survey depth range (400 fathom).

Autumn survey results for the years 1981-91 indicated that from 0.5% to 7.7% of the 3L biomass occurred in the NRA with the 1991 value being about 2.9% (Table 4).

The 1985-86 winter survey results indicated that, in winter, about 25% of the 3L biomass occurred in the NRA. No stratified-random surveys have been conducted during winter since that time.

Surveys conducted during autumn for the years 1981-91 in Div 2J3KL indicated that only a small portion, less than 1%, of the total 2J3KL biomass occurs in the NRA at that time (Table 5). The average Divisional biomass from these surveys (Table 6) would suggest that, on average, less than 5% of the 2J3KL biomass occurs in the NRA throughout the year.

Age composition

The age compositions from spring and autumn research vessel surveys in Div. 3L since 1986 (Tables 7-8; Figures 2-3) 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 occurred in Div. 3L inside the 200-mile fishing zone.

Reference

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 (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 1977-91. The number of successful sets is in parenthesis.

| Strata (fath) | Depth zone | % Area outside 200-mi. zone | ATC | | | | | WT | | | | WT | | WT | |
|---------------------------|------------|-----------------------------|--------------------|-------------------|---------------------------------|------------------------|-----------------------|--------------------|---------------------|------------------|---------------------------------|---------------------|------------------|------------------|-----------------------|
| | | | 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 86 (156) 1990 | WT 106-107 (138) 1991 |
| 385 | 51-100 | 5 | 21 | 4 | 56 | 314 | 21 | 0 | 104 | 21 | 53 | 107 | 154 | 40 | 325 |
| 390 | " | 55 | 278 | 437 | 1,169 | 1,539 | 275 | 119 | 144 | 223 | 277 | 0 | 109 | 35 | 202 |
| 389 | 101-150 | 62 | 833 | 659 | 681 | 4,292 | 296 | 1,031 | 3,825 | 558 | 401 | 429 | 382 | 318 | 140 |
| 391 | " | 100 | 634 | 356 | 1,048 | 2,064 | 1,212 | 95 | 429 | 826 | 201 | 41 | 95 | 621 | 283 |
| 387 | 151-200 | 37 | 45 | 68 | 170 | 95 | 90 | 871 | 7,952 | 2,425 | 72 | 192 | 927 | 10,557 | 3,422 |
| 388 | " | 99 | 1,169 | 179 | 346 | 107 | 188 | 1,308 | 343 | 1,556 | 10 | 177 | 121 | 1,162 | 995 |
| 392 | " | 100 | 30 | 66 | 189 | 0 | 128 | 256 | 2,237 | 435 | 3 | 98 | 57 | 179 | 170 |
| 729 | 201-300 | 100 | | | | | | | 35 | | | | | 670 | 670 |
| 731 | " | 100 | | | | | | | 36 | | | | | | |
| 733 | " | 50 | | | not surveyed beyond 200 fathoms | | | | 158 | | not surveyed beyond 200 fathoms | | | | 1,290 |
| 730 | 301-400 | 100 | | | | | | | 0 | | | | | 0 | 0 |
| 732 | " | 100 | | | | | | | 0 | | | | | 0 | 0 |
| 734 | " | 67 | | | | | | | 0 | | | | | 173 | 173 |
| 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 | 7,856 |
| 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 | 72,416 |
| 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 | 10.8 |

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 1981-91. The number of successful sets is in parenthesis.

| Strata (fath) | Depth zone | % Area outside 200-mi. zone | ATC | | WT | | WT | | WT | | WT | | WT |
|---------------------------|------------|-----------------------------|-----------------------|------------------------|-------------------|---------------------|---------------------|---------------------|------------------|------------------|------------------|-------------------|-----------------------|
| | | | 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 | WT AN 72 (142) 1986 | WT 65 (165) 1987 | WT 78 (189) 1988 | WT 87 (174) 1989 | WT 101 (161) 1990 | WT 114-115 (219) 1991 |
| 385 | 51-100 | 5 | 2 | 2 | 51 | 94 | 5 | 55 | 48 | 16 | 3 | 36 | 6 |
| 390 | " | 55 | 5 | 32 | 469 | 622 | 5 | 19 | 152 | 112 | 39 | 36 | 0 |
| 389 | 101-150 | 62 | - | 2,125 | - | 1,697 | 1,563 | 1,068 | 1,074 | 436 | 1,246 | 1,162 | 563 |
| 391 | " | 100 | - | 487 | 159 | 79 | 325 | 370 | 70 | 6 | 23 | 165 | 15 |
| 387 | 151-200 | 37 | 494 | 3,410 | - | 2,762 | 1,501 | 7,483 | 1,014 | 477 | 176 | 3,198 | 641 |
| 388 | " | 99 | - | 456 | - | 610 | 1,892 | - | 114 | 362 | 1,348 | 1,056 | 255 |
| 392 | " | 100 | - | 220 | 109 | 68 | 106 | 11 | 8 | 41 | 22 | 120 | 30 |
| 729 | 201-300 | 100 | - | - | - | 59 | 0 | 0 | - | - | - | 57 | 0 |
| 731 | " | 100 | - | - | - | 49 | 146 | - | - | - | - | 11 | 25 |
| 733 | " | 50 | - | - | - | 483 | 150 | - | - | - | - | 227 | 7 |
| 730 | 301-400 | 100 | - | - | - | 0 | 0 | - | - | - | - | 0 | 0 |
| 732 | " | 100 | - | - | - | 0 | 0 | - | - | - | - | 0 | 0 |
| 734 | " | 67 | - | - | - | 0 | 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 | 1,542 |
| Total 3L biomass | | | 109,706 | 87,997 | 131,267 | 191,701 | 165,417 | 190,731 | 151,936 | 139,726 | 73,514 | 210,725 | 52,750 |
| % Outside 200 miles | | | 0.5 | 7.7 | 0.6 | 3.4 | 3.4 | 4.7 | 1.6 | 1.0 | 3.9 | 2.9 | 2.9 |

Table 5. 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 | 1991 | Average |
|-------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| Biomass outside 200 mi. | 501 | 6,732 | 788 | 6,523 | 5,693 | 9,006 | 2,480 | 1,450 | 2,877 | 6,068 | 1542 | |
| Total 2J3KL | 528,300 | 447,800 | 607,800 | 554,100 | 387,400 | 952,200 | 450,000 | 468,800 | 505,138 | 437,838 | 210,702 | |
| % Outside | 0.1 | 1.5 | 0.1 | 1.2 | 1.5 | 0.9 | 0.6 | 0.3 | 0.6 | 1.4 | 0.01 | 0.75 |

Table 6. Biomass estimates (ooo t) of cod from autumn research vessel surveys in NAFO Division 2J, 3K and 3L.

| Division | Biomass | | | | | | | | | | | Ave. |
|----------|------------|------|------|------|------|------|------|------|------|------|------|------|
| | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 | |
| 2J | 229 | 217 | 267 | 182 | 137 | 405 | 176 | 249 | 141 | 314 | 32 | |
| 3K | 179 | 136 | 176 | 180 | 86 | 356 | 123 | 75 | 291 | 193 | 126 | |
| 3L | 112 | 89 | 152 | 191 | 165 | 191 | 152 | 140 | 74 | 211 | 53 | |
| Total | 520 | 442 | 595 | 553 | 388 | 952 | 451 | 464 | 506 | 438 | 211 | |
| | Percentage | | | | | | | | | | | |
| 2J | 44 | 49 | 45 | 33 | 35 | 43 | 39 | 54 | 28 | 8 | 15 | |
| 3K | 34 | 31 | 30 | 33 | 22 | 37 | 27 | 16 | 58 | 44 | 60 | |
| 3L | 22 | 20 | 25 | 34 | 43 | 20 | 34 | 30 | 14 | 48 | 25 | |
| Total | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | |

Table 7. Percent age compositions Division 3L inside and outside the 200-mile limit as derived from the 1986-91 spring RV surveys.

| Age | 1986 WT 48 | | 1987 WT 59-60 | | 1988 WT 70-71 | | 1989 WT 83 | | 1990 WT 96 | | 1991 WT 106-107 | |
|-----|---------------|---------|------------------|---------|------------------|---------|---------------|---------|---------------|---------|--------------------|---------|
| | Inside | Outside | Inside | Outside | Inside | Outside | Inside | Outside | Inside | Outside | Inside | Outside |
| 1 | - | - | - | - | - | - | - | - | 0 | 0 | 0 | 0 |
| 2 | - | 1 | 1 | 6 | - | 5 | 1 | 2 | 1 | 1 | 1 | 2 |
| 3 | 6 | 19 | 5 | 40 | 10 | 57 | 10 | 39 | 10 | 22 | 7 | 19 |
| 4 | 24 | 42 | 11 | 30 | 9 | 20 | 20 | 43 | 29 | 36 | 24 | 46 |
| 5 | 26 | 20 | 29 | 13 | 15 | 5 | 9 | 6 | 21 | 25 | 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 | 5 | 1 |
| 10 | 1 | - | 1 | 1 | 2 | 1 | 2 | 1 | 3 | 1 | 2 | 0 |
| 11 | 2 | 1 | 1 | - | 1 | - | 2 | 1 | 1 | 0 | 2 | 1 |
| 12 | 1 | - | 1 | 1 | 1 | - | - | - | - | 0 | 0 | 0 |

Table 8. Percent age compositions for Division 3L inside and outside the 200-mile limit as derived from the 1986-91 fall RV surveys.

| Age | 1986 AN 72 | | 1987 WT 65 | | 1988 WT 78 | | 1989 WT 87 | | 1990 WT 101 | | 1991 WT 114-115 | |
|-----|---------------|---------|---------------|---------|---------------|---------|---------------|---------|----------------|---------|--------------------|---------|
| | Inside | Outside | Inside | Outside | Inside | Outside | Inside | Outside | Inside | Outside | Inside | Outside |
| 1 | - | - | - | 17 | - | 4 | - | 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 | 22 | 40 | 13 | 18 | 10 | 18 |
| 4 | 27 | 20 | 13 | 2 | 8 | 6 | 21 | 15 | 30 | 31 | 29 | 26 |
| 5 | 23 | 23 | 31 | 3 | 18 | 2 | 11 | 3 | 21 | 12 | 30 | 20 |
| 6 | 24 | 26 | 23 | 1 | 22 | 2 | 15 | 2 | 12 | 4 | 17 | 10 |
| 7 | 7 | 8 | 11 | 1 | 16 | 3 | 15 | 3 | 6 | 3 | 3 | 2 |
| 8 | 6 | 6 | 4 | 1 | 8 | 3 | 6 | 2 | 7 | 5 | 2 | 1 |
| 9 | 2 | 3 | 3 | 2 | 4 | 2 | 4 | 4 | 4 | 7 | 2 | 1 |
| 10 | 1 | 1 | - | - | 2 | 1 | 1 | 3 | 1 | 4 | 1 | 1 |
| 11 | 1 | 2 | - | 1 | - | 1 | - | 2 | 1 | 3 | - | - |
| 12 | 1 | 1 | 1 | 1 | - | 1 | - | 1 | - | 3 | - | - |

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

| Age | MEAN NUMBERS PER TOW | | | | | | | | | | | | | | |
|-----|----------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|--|
| | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 | |
| 1 | 0.02 | 0.41 | 0.27 | 0.18 | 0.51 | 1.04 | 0.38 | 0.02 | 0.14 | 0.21 | 0.59 | 0.68 | 0.40 | 0.03 | |
| 2 | 0.40 | 0.32 | 3.00 | 1.59 | 2.48 | 6.07 | 5.57 | 1.10 | 1.85 | 1.56 | 2.14 | 8.25 | 1.91 | 1.34 | |
| 3 | 5.39 | 1.94 | 2.48 | 5.12 | 5.87 | 12.22 | 10.79 | 7.27 | 4.77 | 2.04 | 3.93 | 8.98 | 10.93 | 3.35 | |
| 4 | 11.51 | 11.78 | 3.83 | 2.74 | 5.92 | 10.82 | 15.23 | 12.35 | 20.70 | 4.03 | 3.20 | 8.30 | 12.95 | 13.97 | |
| 5 | 13.95 | 16.79 | 13.23 | 3.26 | 3.83 | 10.83 | 11.34 | 10.01 | 31.29 | 13.23 | 5.28 | 6.20 | 8.61 | 9.00 | |
| 6 | 5.51 | 10.53 | 13.31 | 9.87 | 2.79 | 3.87 | 9.59 | 7.28 | 21.28 | 11.61 | 10.57 | 6.52 | 5.64 | 3.31 | |
| 7 | 1.62 | 2.27 | 4.99 | 8.79 | 5.82 | 2.43 | 2.30 | 4.24 | 10.14 | 4.38 | 10.13 | 8.23 | 3.90 | 1.10 | |
| 8 | 0.63 | 0.92 | 1.19 | 3.66 | 5.31 | 5.33 | 1.37 | 0.92 | 5.28 | 2.67 | 2.58 | 4.84 | 3.98 | 0.50 | |
| 9 | 0.47 | 0.31 | 0.37 | 0.74 | 2.59 | 2.93 | 2.09 | 0.78 | 1.37 | 1.38 | 1.55 | 1.62 | 1.68 | 0.35 | |
| 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 | |
| 11 | 0.12 | 0.19 | 0.11 | 0.10 | 0.18 | 0.38 | 0.54 | 0.41 | 0.68 | 0.17 | 0.15 | 0.43 | 0.23 | 0.04 | |
| 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 | |
| 13 | 0.08 | 0.04 | 0.05 | 0.10 | 0.07 | 0.13 | 0.12 | 0.08 | 0.19 | 0.13 | 0.08 | 0.10 | 0.04 | 0.01 | |
| 1+ | 40.11 | 45.80 | 43.21 | 38.26 | 36.01 | 57.38 | 60.87 | 45.25 | 98.67 | 41.96 | 41.11 | 55.29 | 50.93 | 33.18 | |
| 2+ | 40.09 | 45.39 | 42.94 | 38.10 | 35.50 | 58.34 | 60.51 | 45.23 | 98.53 | 41.74 | 40.53 | 54.62 | 50.53 | 33.15 | |
| 3+ | 39.69 | 45.07 | 39.94 | 34.51 | 33.02 | 50.27 | 54.94 | 44.13 | 96.68 | 40.18 | 38.38 | 46.37 | 48.62 | 31.81 | |
| 4+ | 34.30 | 43.13 | 37.47 | 29.40 | 27.14 | 38.05 | 44.15 | 36.86 | 91.91 | 38.14 | 34.48 | 37.39 | 37.70 | 28.46 | |
| 5+ | 22.79 | 31.35 | 33.64 | 26.66 | 21.22 | 27.43 | 28.93 | 24.52 | 71.21 | 34.11 | 31.26 | 29.09 | 24.75 | 14.49 | |
| 6+ | 8.84 | 14.57 | 20.41 | 23.39 | 17.39 | 16.61 | 17.59 | 14.50 | 39.93 | 20.88 | 25.97 | 22.89 | 16.14 | 5.49 | |

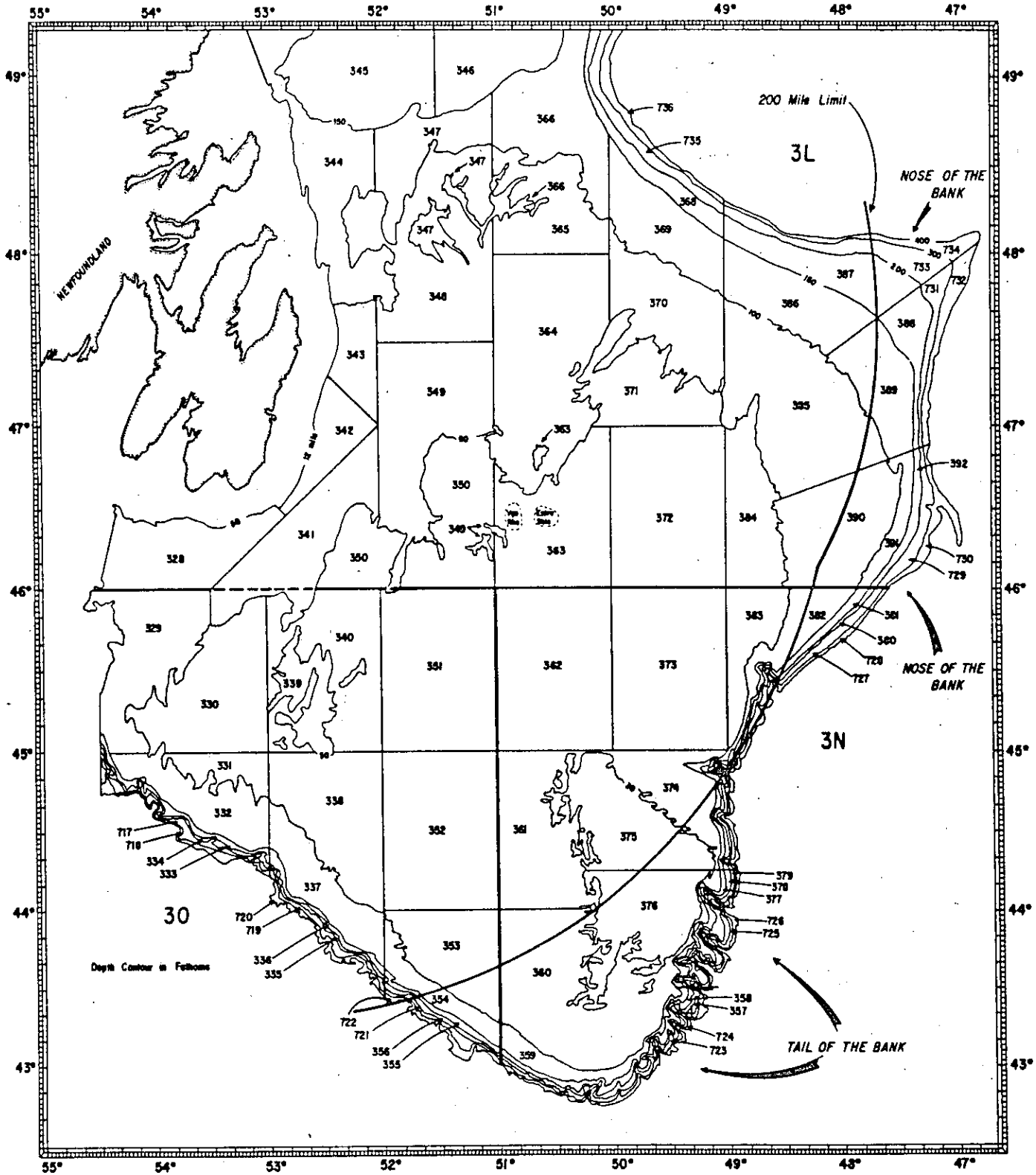


Figure 1. Stratification scheme for NAFO Divisions 3LNO showing the Canadian 200-mile limit.

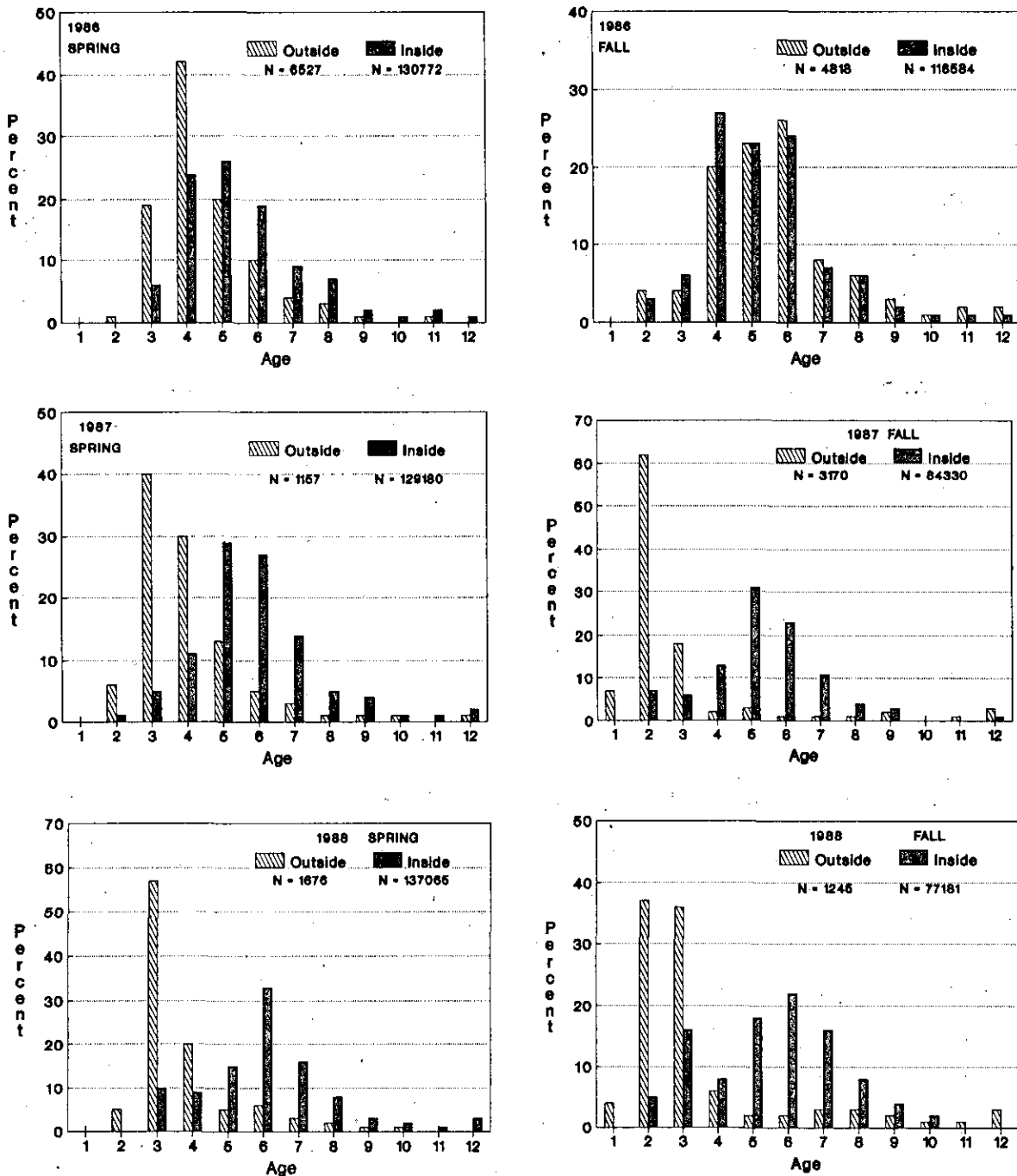


Fig 2. Percent age composition for Division 3L inside and outside the 200-mile limit derived from 1986-88 spring and autumn Canadian RV surveys.

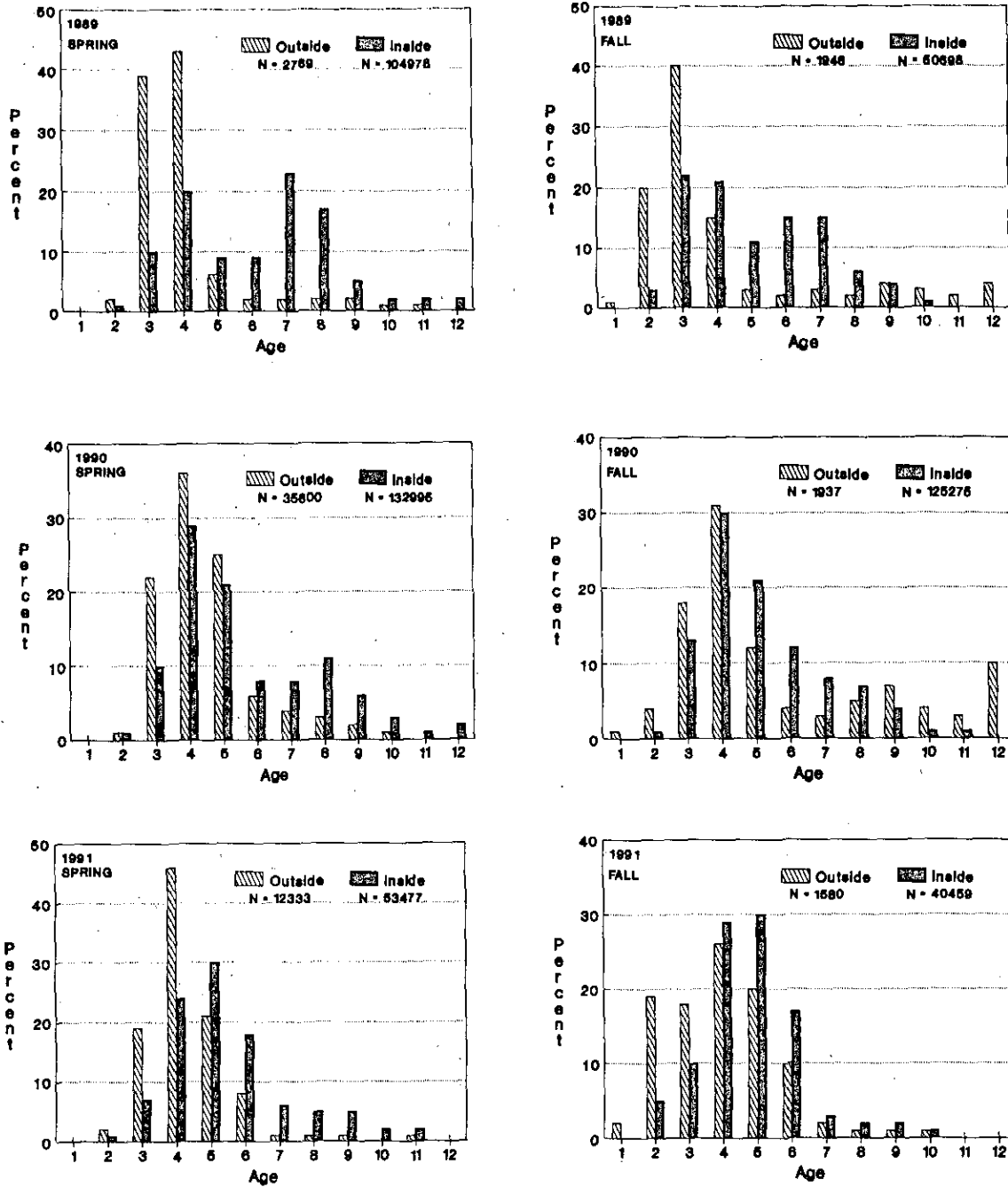


Fig 3. Percent age composition for Division 3L inside and outside the 200-mile limit derived from 1989-1991 spring and autumn Canadian RV surveys.