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# Update of the Assessment of the Cod Stock in NAFO Divisions 3NO

by

M. B. Davis, C. A. Bishop, D. E. Stansbury, and E. F. Murphy

Department of Fisheries and Oceans, Science Branch
P. O. Box 5667, St. John's, Newfoundland, Canada A1C 5X1

An assessment for cod in Divisions 3NO was completed in February 1994 (Davis *et al.* 1994). This paper is an update of that assessment and incorporates Portuguese sampling data made available since February and presents preliminary results from the 1994 Canadian spring research vessel survey.

Provisional landings data for 1993 have not changed since the last assessment (Table 1). 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 the EU. Other catches (Russian and non-contracting parties) are those estimated by Canadian surveillance.

Between the years 1953-93, the highest catch of cod occurred during 1967 with approximately 227,000 tonnes taken. The lowest catch of 9728 tonnes occurred during 1993. The next lowest catches had been in 1992 and 1978 (Table 1). The fishery has been closed for the remainder of 1994.

Sampling data available for the 1993 Canadian fishery, obtained from Canadian port samplers and observers, were used to generate estimates of catch-at-age by Canada. Catch-at-age data for the Spanish fleet fishing in the Regulatory Area and obtained by Spanish authorities were provided by the EU. Since the February 1994 assessment, sampling data for the Portuguese otter trawl and gill net fleets have become available and have been incorporated in the catch-at-age matrix. The previous assessment had applied catch-at-age data from the Spanish pair trawl fleet to adjust the Portuguese otter trawl catches. The previous assessment also adjusted the Portuguese gill net catches using the age composition estimated for the Canadian gillnet fleet. Catch-at-age data from the Spanish pair trawl fleet continues to be used to adjust the estimated otter trawl catches from other fleets fishing in the Regulatory Area. The impact of the Portuguese data was to increase the total number of fish caught mostly from ages 2-4 years.

Catch-at-age, mean weights-at-age and catch biomass-at-age for the 1959-93 period are presented in Tables 3-5. 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.

The inclusion of the additional sampling data in the ADAPT formulation only slightly increases the fishing mortalities (Fs) on all ages with the exception of age 6 which decreases slightly.

The log residual patterns for the Canadian spring and Russian surveys are positive while the Canadian autumn and juvenile groundfish surveys are mostly negative. This lack of coherence in the residual patterns suggests a cautious interpretation of the results. In addition, the population estimate has wide confidence limits given that most fish caught in the 1993 Canadian Spring survey came from two strata in Division 3O.

Preliminary survey abundance and biomass estimates from the 1994 Canadian Spring survey in Div. 3NO are presented in Tables 6-9. Abundance and biomass have dropped dramatically since the 1993 survey and suggests that the 1993 estimates may have been optimistic.

Summary

The report from the Special Meeting of Scientific Council in February 1994 (NAFO SCS Doc. 94/2) indicated that the 1993 cod population in Div. 3NO was comprised mainly of the 1989 and 1990 year classes and concluded that any fishery would concentrate on these ages. It was also noted that there was some uncertainty as to the strength of the year classes. The 1993 Canadian and Russian spring survey indices suggest a high abundance of young fish. However, the Canadian autumn and juvenile groundfish surveys gave less optimistic views.

Preliminary results from the 1994 Canadian spring survey now suggest that cod population numbers are in fact quite low. Since the 1989 and 1990 year classes are the only fish available to provide significant stock rebuilding potential in the coming years, and these year classes may now be present in lower numbers than previously considered.

M.B. Davis, C.A. Bishop, D.E. Stansbury, and E.F. Murphy. An assessment of the Cod Stock in NAFO Divisions 3NO. NAFO SCR Doc 94/3.

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 | 8527 | 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. Catch numbers (000's) and average weight at age of cod from the fisheries in NAFO Divisions 3NO during 1993.

| Age | Canada OT | | Canada LL | | Canada GN | | Spain Pair Trawl | | Portugal GN | | Portugal OT | | Other | | Total Number | Mean Weight |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Number | t (Kg | Number | t (Kg | Number | t (Kg | Number | t (Kg | Number | t (Kg | Number | Wt(Kg) | Number | Wt (Kg | (000's | (Kg) |
| 2 | | | | | | | 6 | 0.26 | | | 25 | 0.12 | 2 | 0.26 | 33 | 0.16 |
| 3 | 21 | 0.46 | | | | | 755 | 0.40 | 0 | 0.32 | 326 | 0.24 | 212 | 0.40 | 1314 | 0.36 |
| 4 | 422 | 0.99 | 3 | 0.97 | | | 2002 | 0.77 | 1 | 0.99 | 219 | 0.50 | 562 | 0.77 | 3209 | 0.78 |
| 5 | 225 | 1.40 | 2 | 1.47 | | | 306 | 1.34 | 1 | 2.16 | 17 | 1.00 | 86 | 1.34 | 637 | 1.35 |
| 6 | 187 | 1.80 | 9 | 1.74 | | | 215 | 1.88 | 1 | 2.88 | 6 | 1.37 | 60 | 1.88 | 479 | 1.84 |
| 7 | 163 | 2.87 | 15 | 2.93 | 1 | 3.40 | 99 | 2.80 | 12 | 3.92 | 3 | 1.66 | 28 | 2.80 | 321 | 2.82 |
| 8 | 38 | 4.46 | 7 | 4.18 | 1 | 5.21 | 16 | 3.62 | 8 | 4.63 | 0 | 2.96 | 4 | 3.62 | 74 | 4.11 |
| 9 | 16 | 6.24 | 4 | 6.70 | 2 | 7.08 | 1 | 4.20 | 2 | 6.16 | 0 | | 0.28 | 4.20 | 25 | 5.87 |
| 10 | 23 | 7.82 | 4 | 7.24 | 8 | 8.64 | 1 | 5.43 | 2 | 7.46 | 0 | 4.40 | 0.28 | 5.43 | 39 | 7.76 |
| 11 | 30 | 8.80 | 5 | 8.23 | 9 | 9.40 | | | 5 | 9.21 | 0 | 5.51 | | | 49 | 8.79 |
| 12 | 32 | 8.55 | 7 | 8.69 | 10 | 8.72 | | | 4 | 10.5 | 0 | | | | 53 | 8.67 |
| 13 | 20 | 11.8 | 3 | 9.66 | 9 | 12.1 | | | 2 | 11.04 | 0 | 6.14 | | | 34 | 11.5 |
| 14 | 17 | 12.4 | 4 | 11.0 | 8 | 12.6 | | | 1 | 11.87 | | | | | 30 | 12.1 |
| 15 | 20 | 13.1 | 4 | 12.3 | 9 | 12.8 | | | 1 | 12.93 | | | | | 34 | 12.8 |
| 16 | 10 | 13.8 | 2 | 16.0 | 4 | 12.7 | | | 1 | 14.77 | | | | | 17 | 13.4 |
| 17 | 10 | 11.0 | 3 | 14.1 | 1 | 16.1 | | | 1 | 15.05 | | | | | 15 | 12.6 |
| 18 | 12 | 13.6 | 5 | 16.4 | 2 | 13.4 | | | 1 | 15.12 | | | | | 20 | 13.7 |
| 19 | 5 | 15.6 | 3 | 15.8 | 1 | 15.6 | | | 0 | 19.03 | | | | | 9 | 15.9 |
| 20+ | | | 1 | 19.5 | | | | | 0 | 17.16 | | | | | 1 | 16.0 |
| Number | 1251 | | 81 | | 65 | | 3401 | | 43 | | 597 | | 955 | | 6393 | |
| Weight ( | 3895 | | 681 | | 750 | | 3031 | | 296 | | 225 | | 850 | | 9728 | |
| Av. Wt. | 3.11 | | 8.41 | | 11.5 | | 0.89 | | 6.88 | | 0.38 | | 0.89 | | 1.52 | |

Table 3. CATCH AT AGE FOR DIV. 3NO COD,1959 - 1993 (000s)

| | 1959 | 1960 | 1961 | 1962 | 1963 | 1964 | 1965 | 1966 | 1967 | 1968 | 1969 | 1970 | 1971 | 1972 | 1973 | 1974 | 1975 | 1976 | 1977 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3 | 1711 | 1846 | 812 | 1026 | 313 | 6202 | 1013 | 753 | 20086 | 16359 | 8154 | 2105 | 950 | 69 | 10058 | 6425 | 671 | 4054 | 607 |
| 4 | 13036 | 6503 | 4400 | 3882 | 5757 | 15555 | 7611 | 18413 | 62442 | 56775 | 12924 | 19703 | 26900 | 19797 | 27600 | 9501 | 8781 | 7534 | 2469 |
| 5 | 5068 | 22050 | 11696 | 2206 | 11210 | 19496 | 7619 | 19681 | 50317 | 48608 | 26949 | 10799 | 30300 | 12289 | 15098 | 10907 | 3528 | 5945 | 2531 |
| 6 | 6025 | 3095 | 15258 | 1581 | 4849 | 7919 | 13258 | 11795 | 18517 | 18485 | 11191 | 9481 | 11700 | 13432 | 5989 | 10872 | 2505 | 1084 | 1500 |
| 7 | 3935 | 2377 | 2014 | 3594 | 1935 | 2273 | 9861 | 8486 | 4774 | 6337 | 2089 | 3646 | 3500 | 5883 | 1971 | 2247 | 3057 | 211 | 572 |
| 8 | 1392 | 2504 | 1672 | 773 | 3840 | 1109 | 4827 | 4467 | 4651 | 1592 | 1393 | 1635 | 2500 | 1686 | 972 | 2147 | 1059 | 238 | 177 |
| 9 | 757 | 583 | 847 | 668 | 1165 | 788 | 1081 | 1829 | 236 | 505 | 518 | 541 | 500 | 285 | 707 | 1015 | 921 | 44 | 209 |
| 10 | 926 | 387 | 196 | 433 | 608 | 328 | 1248 | 1694 | 180 | 178 | 292 | 149 | 200 | 216 | 243 | 676 | 461 | 37 | 65 |
| 11 | 1220 | 898 | 25 | 226 | 322 | 37 | 163 | 122 | 71 | 90 | 134 | 227 | 100 | 78 | 137 | 428 | 252 | 13 | 41 |
| 12 | 103 | 242 | 245 | 216 | 208 | 112 | 141 | 57 | 45 | 45 | 202 | 90 | 50 | 74 | 116 | 257 | 152 | 9 | 25 |
| 13 | 1128 | 1409 | 392 | 846 | 473 | 56 | 276 | 183 | 335 | 51 | 574 | 1472 | 700 | 350 | 173 | 881 | 396 | 17 | 36 |
| 3+ | 35301 | 41894 | 37557 | 15451 | 30680 | 53875 | 47098 | 67480 | 161654 | 149025 | 64420 | 49848 | 77400 | 54159 | 63064 | 45356 | 21783 | 19186 | 8232 |
| 4+ | 33590 | 40048 | 36745 | 14425 | 30367 | 47673 | 46085 | 66727 | 141568 | 132666 | 56266 | 47743 | 76450 | 54090 | 53006 | 38931 | 21112 | 15132 | 7625 |
| 5+ | 20554 | 33545 | 32345 | 10543 | 24610 | 32118 | 38474 | 48314 | 79126 | 75891 | 43342 | 28040 | 49550 | 34293 | 25406 | 29430 | 12331 | 7598 | 5156 |
| 6+ | 15486 | 11495 | 20649 | 8337 | 13400 | 12622 | 30855 | 28633 | 28809 | 27283 | 16393 | 17241 | 19250 | 22004 | 10308 | 18523 | 8803 | 1653 | 2625 |

| | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3 | 920 | 72 | 266 | 505 | 305 | 1179 | 58 | 57 | 153 | 516 | 277 | 1917 | 1064 | 1103 | 4508 | 1314 |
| 4 | 4337 | 3827 | 1055 | 1091 | 1978 | 647 | 1080 | 2953 | 2865 | 422 | 318 | 2182 | 4505 | 673 | 1769 | 3209 |
| 5 | 2518 | 9208 | 3812 | 1262 | 1591 | 1893 | 1411 | 6203 | 6423 | 3491 | 1527 | 1502 | 4341 | 995 | 837 | 637 |
| 6 | 818 | 2784 | 2275 | 2297 | 1012 | 1204 | 2324 | 3036 | 4370 | 3445 | 6347 | 1260 | 895 | 544 | 612 | 479 |
| 7 | 354 | 883 | 761 | 1902 | 1528 | 686 | 1220 | 2519 | 1512 | 1213 | 3955 | 1887 | 422 | 282 | 235 | 321 |
| 8 | 102 | 265 | 222 | 574 | 1492 | 1152 | 720 | 797 | 948 | 653 | 1009 | 1284 | 721 | 368 | 64 | 74 |
| 9 | 58 | 58 | 92 | 192 | 595 | 774 | 918 | 459 | 558 | 845 | 567 | 485 | 581 | 568 | 99 | 25 |
| 10 | 51 | 17 | 31 | 94 | 211 | 238 | 551 | 533 | 373 | 494 | 425 | 233 | 439 | 502 | 128 | 39 |
| 11 | 8 | 12 | 8 | 41 | 162 | 81 | 106 | 261 | 349 | 398 | 249 | 168 | 150 | 383 | 153 | 49 |
| 12 | 5 | 7 | 13 | 13 | 27 | 41 | 42 | 97 | 135 | 404 | 142 | 100 | 93 | 202 | 100 | 53 |
| 13 | 21 | 16 | 2 | 32 | 52 | 36 | 70 | 71 | 86 | 188 | 298 | 285 | 106 | 337 | 217 | 160 |
| 3+ | 9192 | 17149 | 8537 | 8003 | 8953 | 7931 | 8420 | 16986 | 17772 | 12069 | 15114 | 11303 | 13307 | 5957 | 8722 | 6360 |
| 4+ | 8272 | 17077 | 8271 | 7498 | 8648 | 6752 | 8362 | 16929 | 17619 | 11553 | 14837 | 9386 | 12243 | 4854 | 4214 | 5046 |
| 5+ | 3935 | 13250 | 7216 | 6407 | 6670 | 6105 | 7362 | 13976 | 14754 | 11131 | 14519 | 7204 | 7738 | 4181 | 2445 | 1837 |
| 6+ | 1417 | 4042 | 3404 | 5145 | 5079 | 4212 | 5951 | 7773 | 8331 | 7640 | 12992 | 5702 | 3397 | 3186 | 1608 | 1200 |

Table 4. WEIGHT AT AGE FOR DIV. 3NO COD,1959 - 1993

| | 1959 | 1960 | 1961 | 1962 | 1963 | 1964 | 1965 | 1966 | 1967 | 1968 | 1969 | 1970 | 1971 | 1972 | 1973 | 1974 | 1975 | 1976 | 1977 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 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 | 0.42 | 0.38 | 0.50 | 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 | 0.73 | 0.89 | 0.91 | 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 | 1.20 | 1.28 | 1.41 | 1.48 |
| 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 | 1.96 | 2.13 | 2.33 | 2.48 |
| 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 | 2.86 | 3.14 | 3.25 | 3.51 |
| 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 | 4.67 | 4.16 | 4.03 | 4.74 |
| 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 | 7.32 | 5.53 | 6.67 | 7.17 |
| 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 | 5.46 | 6.74 | 8.74 | 8.81 |
| 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 | 8.40 | 5.27 | 9.14 | 11.70 |
| 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 | 7.51 | 7.09 | 12.49 | 11.47 |
| 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 | 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 | 54.03 | 50.11 | 62.97 | 66.43 |
| 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 | 53.61 | 49.73 | 62.47 | 65.86 |
| 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 | 52.88 | 48.84 | 61.56 | 64.86 |
| 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 | 51.68 | 47.56 | 60.15 | 63.38 |

| | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3 | 0.72 | 0.65 | 0.71 | 0.90 | 0.94 | 0.85 | 0.79 | 0.48 | 0.39 | 0.49 | 0.74 | 0.51 | 0.55 | 0.55 | 0.33 | 0.36 |
| 4 | 1.05 | 0.98 | 1.04 | 1.27 | 1.17 | 1.17 | 1.15 | 0.86 | 1.01 | 0.82 | 1.00 | 0.97 | 1.01 | 0.85 | 0.65 | 0.78 |
| 5 | 1.55 | 1.39 | 1.69 | 1.84 | 1.50 | 1.87 | 1.51 | 1.37 | 1.52 | 1.30 | 1.38 | 1.60 | 1.46 | 1.59 | 1.06 | 1.35 |
| 6 | 2.25 | 2.09 | 2.50 | 2.69 | 2.20 | 2.63 | 2.28 | 2.05 | 2.16 | 1.83 | 1.79 | 2.24 | 2.51 | 2.30 | 1.80 | 1.84 |
| 7 | 3.74 | 2.87 | 3.69 | 3.55 | 3.83 | 3.80 | 3.04 | 3.25 | 3.49 | 2.89 | 2.23 | 3.27 | 2.73 | 3.83 | 2.82 | 2.82 |
| 8 | 4.61 | 3.70 | 5.49 | 5.33 | 5.26 | 5.20 | 4.05 | 4.65 | 5.41 | 4.76 | 3.77 | 4.61 | 4.14 | 5.56 | 4.85 | 4.11 |
| 9 | 6.19 | 4.75 | 7.98 | 7.13 | 7.49 | 6.27 | 5.76 | 6.62 | 7.95 | 7.26 | 5.12 | 7.08 | 5.02 | 7.53 | 5.56 | 5.87 |
| 10 | 7.23 | 7.15 | 9.22 | 9.10 | 8.80 | 8.08 | 7.22 | 8.32 | 9.82 | 8.95 | 6.88 | 8.31 | 8.37 | 9.04 | 7.43 | 7.76 |
| 11 | 9.48 | 7.98 | 10.60 | 9.01 | 9.82 | 8.99 | 8.92 | 9.15 | 9.94 | 9.85 | 9.37 | 9.47 | 9.29 | 11.98 | 8.64 | 8.79 |
| 12 | 12.87 | 10.11 | 12.61 | 10.15 | 12.28 | 11.01 | 12.61 | 11.13 | 9.88 | 12.59 | 11.07 | 12.25 | 11.25 | 13.98 | 10.65 | 8.67 |
| 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 | 11.91 | 13.60 | 14.11 | 12.74 |
| 3+ | 63.19 | 55.17 | 69.03 | 64.47 | 66.79 | 63.37 | 60.83 | 61.38 | 65.07 | 64.24 | 56.85 | 63.81 | 58.24 | 70.81 | 57.90 | 55.09 |
| 4+ | 62.47 | 54.52 | 68.32 | 63.57 | 65.85 | 62.52 | 60.04 | 60.90 | 64.68 | 63.75 | 56.11 | 63.30 | 57.69 | 70.26 | 57.57 | 54.73 |
| 5+ | 61.42 | 53.54 | 67.28 | 62.30 | 64.68 | 61.35 | 58.89 | 60.04 | 63.67 | 62.93 | 55.11 | 62.33 | 56.68 | 69.41 | 56.92 | 53.95 |
| 6+ | 59.87 | 52.15 | 65.59 | 60.46 | 63.18 | 59.48 | 57.38 | 58.67 | 62.15 | 61.63 | 53.73 | 60.73 | 55.22 | 67.82 | 55.86 | 52.60 |

Table 5. CATCH BIOMASS AT AGE FOR DIV. 3NO COD,1959 - 1993

| | 1959 | 1960 | 1961 | 1962 | 1963 | 1964 | 1965 | 1966 | 1967 | 1968 | 1969 | 1970 | 1971 | 1972 | 1973 | 1974 | 1975 | 1976 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3 | 719 | 775 | 341 | 431 | 131 | 2605 | 425 | 361 | 9641 | 7852 | 3914 | 1010 | 456 | 37 | 5733 | 2699 | 255 | 2027 |
| 4 | 10690 | 5332 | 3608 | 3183 | 4721 | 12755 | 6241 | 16572 | 56198 | 51098 | 11632 | 17733 | 24210 | 19203 | 27600 | 6936 | 7815 | 6856 |
| 5 | 6335 | 27563 | 14620 | 2758 | 14013 | 24370 | 9524 | 26569 | 67928 | 65621 | 36381 | 14579 | 40905 | 17696 | 21590 | 13088 | 4516 | 8382 |
| 6 | 11749 | 6035 | 29753 | 3083 | 9456 | 15442 | 25853 | 25241 | 39626 | 39558 | 23949 | 20289 | 25038 | 27939 | 13116 | 21309 | 5336 | 2526 |
| 7 | 11097 | 6703 | 5679 | 10135 | 5457 | 6410 | 27808 | 26816 | 15086 | 20025 | 6601 | 11521 | 11060 | 17002 | 7155 | 6426 | 9599 | 686 |
| 8 | 4719 | 8489 | 5668 | 2620 | 13018 | 3760 | 16364 | 18806 | 19581 | 6702 | 5865 | 6883 | 10525 | 6002 | 4500 | 10026 | 4405 | 959 |
| 9 | 3013 | 2320 | 3371 | 2659 | 4637 | 3136 | 4302 | 11596 | 1496 | 3202 | 3284 | 3430 | 3170 | 1696 | 4419 | 7430 | 5093 | 293 |
| 10 | 4334 | 1811 | 917 | 2026 | 2845 | 1535 | 5841 | 13027 | 1384 | 1369 | 2245 | 1146 | 1538 | 1717 | 2323 | 3691 | 3107 | 323 |
| 11 | 6405 | 4715 | 131 | 1187 | 1691 | 194 | 856 | 1032 | 601 | 761 | 1134 | 1920 | 846 | 649 | 1530 | 3595 | 1328 | 119 |
| 12 | 636 | 1493 | 1512 | 1333 | 1283 | 691 | 870 | 584 | 461 | 461 | 2068 | 922 | 512 | 750 | 1623 | 1930 | 1078 | 112 |
| 13 | 15228 | 19022 | 5292 | 11421 | 6386 | 756 | 3726 | 2471 | 4523 | 689 | 7749 | 19872 | 9450 | 4725 | 2336 | 11894 | 5346 | 230 |
| 3+ | 74923 | 84258 | 70893 | 40835 | 63636 | 71654 | 101810 | 143075 | 216524 | 197337 | 104822 | 99306 | 127710 | 97416 | 91925 | 89024 | 47878 | 22514 |
| 4+ | 74204 | 83483 | 70552 | 40405 | 63505 | 69049 | 101384 | 142713 | 206883 | 189485 | 100908 | 98295 | 127254 | 97379 | 86192 | 86326 | 47623 | 20487 |
| 5+ | 63514 | 78150 | 66944 | 37221 | 58784 | 56294 | 95143 | 126142 | 150685 | 138387 | 89276 | 80562 | 103044 | 78176 | 58592 | 79390 | 39808 | 13631 |
| 6+ | 57179 | 50588 | 52324 | 34464 | 44771 | 31924 | 85619 | 99572 | 82757 | 72766 | 52895 | 65984 | 62139 | 60480 | 37001 | 66302 | 35292 | 5248 |

| | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3 | 346 | 662 | 47 | 189 | 455 | 287 | 1002 | 46 | 27 | 60 | 253 | 205 | 978 | 585 | 607 | 1488 | 473 |
| 4 | 2469 | 4554 | 3750 | 1097 | 1386 | 2314 | 757 | 1150 | 2540 | 2894 | 346 | 318 | 2117 | 4550 | 572 | 1150 | 2503 |
| 5 | 3746 | 3903 | 12799 | 6442 | 2322 | 2387 | 3540 | 2131 | 8498 | 9763 | 4538 | 2107 | 2403 | 6338 | 1582 | 887 | 860 |
| 6 | 3720 | 1841 | 5819 | 5688 | 6179 | 2226 | 3167 | 5299 | 6224 | 9439 | 6304 | 11361 | 2822 | 2246 | 1251 | 1102 | 881 |
| 7 | 2008 | 1324 | 2534 | 2808 | 6752 | 5852 | 2607 | 3709 | 8187 | 5277 | 3506 | 8820 | 6170 | 1152 | 1080 | 663 | 905 |
| 8 | 839 | 470 | 981 | 1219 | 3059 | 7848 | 5990 | 2916 | 3706 | 5129 | 3108 | 3804 | 5919 | 2985 | 2046 | 310 | 304 |
| 9 | 1499 | 359 | 276 | 734 | 1369 | 4457 | 4853 | 5288 | 3039 | 4436 | 6135 | 2903 | 3434 | 2917 | 4277 | 550 | 147 |
| 10 | 573 | 369 | 122 | 286 | 855 | 1857 | 1923 | 3978 | 4435 | 3663 | 4421 | 2924 | 1936 | 3674 | 4538 | 951 | 303 |
| 11 | 480 | 76 | 96 | 85 | 369 | 1591 | 728 | 946 | 2388 | 3469 | 3920 | 2333 | 1591 | 1393 | 4588 | 1322 | 431 |
| 12 | 287 | 64 | 71 | 164 | 132 | 332 | 451 | 530 | 1080 | 1334 | 5086 | 1572 | 1225 | 934 | 2824 | 1065 | 460 |
| 13 | 486 | 284 | 216 | 27 | 432 | 702 | 486 | 945 | 959 | 1161 | 2538 | 4023 | 3848 | 1262 | 4583 | 3062 | 2038 |
| 3+ | 16451 | 13905 | 26709 | 18738 | 23310 | 29852 | 25504 | 26936 | 41081 | 46624 | 40156 | 40370 | 32443 | 28037 | 27949 | 12550 | 9305 |
| 4+ | 16105 | 13243 | 26662 | 18550 | 22856 | 29565 | 24502 | 26890 | 41054 | 46564 | 39903 | 40165 | 31465 | 27452 | 27342 | 11062 | 8832 |
| 5+ | 13636 | 8689 | 22912 | 17452 | 21470 | 27251 | 23745 | 25740 | 38514 | 43671 | 39557 | 39847 | 29349 | 22902 | 26770 | 9912 | 6329 |
| 6+ | 9890 | 4786 | 10113 | 11010 | 19148 | 24864 | 20205 | 23610 | 30016 | 33908 | 35019 | 37740 | 26946 | 16564 | 25188 | 9025 | 5469 |

Table 6. Cod biomass (t) from Canadian (Spring) RV Surveys in Division 3O.
Numbers in italics are estimates for non-sampled strata.

| Depth range (fath) | Strata | Vessel Area Sq. mi | WT 82 1989 | WT 94/95 1990 | WT 105/106 1991 | WT 119/120 1992 | WT 136/137 1993 | WT 152/153 1994 |
|---|---|---|---|---|---|---|---|---|
| 31-50 | 330 | 2089 | 1713 | 2262 | 90 | 2 | 11 | 0 |
| | 331 | 456 | 183 | *848* | 98 | 97 | 0 | 0 |
| | 338 | 1898 | 14874 | 5475 | 6271 | 8466 | 2959 | 1009 |
| | 340 | 1716 | 2977 | 6338 | 70 | 4 | 979 | 45 |
| | 351 | 2520 | 11619 | 16567 | 3890 | 1128 | 696 | 30 |
| | 352 | 2580 | 34373 | 28930 | 16762 | 9958 | 4879 | 944 |
| | 353 | 1282 | 2371 | 3544 | 688 | 972 | 2222 | 0 |
| 51-100 | 329 | 1721 | 682 | 1611 | 1627 | 10 | 17 | 4456 |
| | 332 | 1047 | 1369 | 8728 | 4097 | 960 | 30014 | 0 |
| | 337 | 948 | 2787 | 1997 | 2373 | 17045 | 19121 | 370 |
| | 339 | 585 | 146 | 103 | 3 | 7 | 3 | 0 |
| | 354 | 474 | 25 | 317 | 2312 | 39 | 540 | 0 |
| 101-150 | 333 | 151 | 1040 | 225 | 500 | 53 | 916 | 7242 |
| | 336 | 121 | 23 | 191 | 40 | 438 | 147 | 298 |
| | 355 | 103 | 195 | 96 | 86 | 3 | 58 | 11 |
| 151-200 | 334 | 92 | 136 | 425 | 776 | 514 | 781 | 467 |
| | 335 | 58 | 7 | 63 | 2 | 44 | 2088 | 248 |
| | 356 | 61 | 74 | 142 | 11 | 45 | 154 | 79 |
| 31-50 | | 12541 | 68110 | 63964 | 27869 | 20627 | 11746 | 2028 |
| 51-100 | | 4775 | 5009 | 12756 | 10412 | 18061 | 49695 | 4826 |
| 101-150 | | 375 | 1258 | 512 | 626 | 494 | 1121 | 7551 |
| 151-200 | | 211 | 217 | 630 | 789 | 603 | 3023 | 794 |
| 201-300 | | 245 | - | - | - | 1516 | 1212 | 896 |
| 301-400 | | 309 | - | - | - | 41 | 78 | 499 |
| Mean wt./tow | | | 55.51 | 57.84 | 37.22 | 29.84 | 48.27 | |
| Adjusted total | | | 74594 | 77862 | 39696 | 39785 | 65585 | 15199 |
| Unadjusted total | | | 74595 | 77016 | 39697 | 41342 | 66875 | 16594 |
| Upper limit | | | 134314 | 101143 | 55540 | 91139 | 353969 | |
| Lower limit | | | 14876 | 52888 | 23854 | -8454 | -220218 | |

* Adjusted totals are for strata to 200 fathoms, a multiplicative model is used to fill missing strata.

** Unadjusted total is for all strata fished.

Table 7. Cod abundance (1000's) from Canadian (Spring) RV Surveys in Division 3O
Numbers in italics are estimates for non-sampled strata.

| Depth range (fath) | Strata | Vessel Area Sq. mi. | WT 82 1989 | WT 94/95 1990 | WT 105/106 1991 | WT 119/120 1992 | WT 136/137 1993 | WT 152/153 1994 |
|---|---|---|---|---|---|---|---|---|
| 31-50 | 330 | 2089 | 342 | 949 | 86 | 16 | 45 | 0 |
| | 331 | 456 | 137 | *186* | 34 | 17 | 0 | 0 |
| | 338 | 1898 | 3818 | 1371 | 1382 | 855 | 356 | 71 |
| | 340 | 1716 | 615 | 873 | 186 | 26 | 64 | 77 |
| | 351 | 2520 | 1470 | 2033 | 315 | 151 | 63 | 54 |
| | 352 | 2580 | 3769 | 4320 | 1439 | 775 | 443 | 121 |
| | 353 | 1282 | 385 | 529 | 69 | 192 | 144 | 0 |
| 51-100 | 329 | 1721 | 388 | 1200 | 1608 | 48 | 108 | 3385 |
| | 332 | 1047 | 393 | 1556 | 19059 | 1305 | 49906 | 0 |
| | 337 | 948 | 1281 | 285 | 939 | 1583 | 37573 | 47 |
| | 339 | 585 | 15 | 132 | 44 | 44 | 22 | 0 |
| | 354 | 474 | 36 | 53 | 368 | 71 | 267 | 0 |
| 101-150 | 333 | 151 | 283 | 74 | 193 | 130 | 176 | 986 |
| | 336 | 121 | 5 | 59 | 27 | 763 | 132 | 195 |
| | 355 | 103 | 178 | 50 | 97 | 27 | 66 | 12 |
| 151-200 | 334 | 92 | 52 | 235 | 483 | 173 | 414 | 193 |
| | 335 | 58 | 4 | 26 | 4 | 131 | 234 | 72 |
| | 356 | 61 | 37 | 40 | 44 | 135 | 130 | 124 |
| 31-50 | | 12541 | 10536 | 10261 | 3511 | 2032 | 1115 | 323 |
| 51-100 | | 4775 | 2113 | 3226 | 22018 | 3051 | 87876 | 3432 |
| 101-150 | | 375 | 466 | 183 | 317 | 920 | 374 | 1193 |
| 151-200 | | 211 | 93 | 301 | 531 | 439 | 778 | 389 |
| 201-300 | | 245 | - | - | 2347 | 6369 | 752 | 539 |
| 301-400 | | 309 | - | - | 4 | 102 | 46 | 270 |
| Mean wt./tow | | | 9.83 | 10.4 | 19.63 | 9.32 | 65.65 | |
| Adjusted total* | | | 13208 | 13971 | 26377 | 6442 | 90143 | 5337 |
| Unadjusted total ** | | | 13206 | 13786 | 26375 | 12914 | 90953 | 6146 |
| Upper limit | | | 19586 | 17170 | 72880 | 92671 | 650816 | |
| Lower limit | | | 6827 | 10401 | -20130 | -66842 | -46909 | |

* Adjusted totals are for strata to 200 fathoms, a multiplicative model is used to fillmissing strata.

** Unadjusted total is for all strata fished.

Table 8. Cod biomass (t) from Canadian (Spring) RV Surveys in Division 3N.

| Depth range (fath) | Strata | Vessel Area Sq. mi. | WT 82 1989 | WT 94/95 1990 | WT 105/106 1991 | WT 119/120 1992 | WT 136/137 1993 | WT 152/153 1994 |
|---|---|---|---|---|---|---|---|---|
| 0-30 | 375 | 1593 | 20104 | 10230 | 1141 | 1391 | 678 | 0 |
| | 376 | 1499 | 745 | 2745 | 751 | 0 | 0 | 0 |
| 31-50 | 360 | 2992 | 1202 | 9486 | 581 | 842 | 1 | 0 |
| | 361 | 1853 | 12722 | 20240 | 11883 | 278 | 2232 | 21 |
| | 362 | 2520 | 16464 | 24747 | 2361 | 446 | 873 | 0 |
| | 373 | 2520 | 6090 | 3441 | 392 | 0 | 0 | 0 |
| | 374 | 931 | 489 | 3296 | 361 | 3 | 0 | 0 |
| | 383 | 674 | 335 | 326 | 113 | 0 | 0 | 0 |
| 51-100 | 359 | 421 | 21 | 6 | 15 | 3 | 51 | 0 |
| | 377 | 100 | 9 | 0 | 0 | 0 | 1 | 1 |
| | 382 | 647 | 419 | 40 | 0 | 0 | 0 | 0 |
| 101-150 | 358 | 225 | 486 | 159 | 56 | 284 | 450 | 87 |
| | 378 | 139 | 81 | 62 | 82 | 62 | 68 | 11 |
| | 381 | 182 | 39 | 212 | 232 | 1 | 0 | 37 |
| 151-200 | 357 | 164 | 22 | 62 | 59 | 158 | 17 | 68 |
| | 379 | 106 | 22 | 61 | 204 | 633 | 60 | 42 |
| | 380 | 116 | 176 | 180 | 110 | 56 | 3061 | 0 |
| 0-30 | | 3092 | 20849 | 12975 | 1892 | 1391 | 678 | 0 |
| 31-50 | | 11490 | 37302 | 61536 | 15691 | 1569 | 3106 | 21 |
| 51-100 | | 1168 | 449 | 46 | 15 | 3 | 52 | 1 |
| 101-150 | | 546 | 606 | 433 | 370 | 347 | 518 | 135 |
| 151-200 | | 386 | 220 | 303 | 373 | 847 | 3138 | 110 |
| 201-300 | | 420 | - | - | 351 | 802 | 58 | 34 |
| 301-400 | | 196 | - | - | 6 | 5 | 4 | 4 |
| Mean wt./tow | | | 47.46 | 60.13 | 14.65 | 3.79 | 5.77 | |
| Adjusted total * | | | 59426 | 75293 | 18341 | 4157 | 7492 | 267 |
| Unadjusted total ** | | | 59426 | 75293 | 18698 | 4964 | 7554 | 305 |
| Upper limit | | | 81925 | 98258 | 33620 | 7761 | 48311 | |
| Lower limit | | | 36925 | 52329 | 3064 | 2120 | -33203 | |

* Adjusted totals are for strata to 200 fathoms, a multiplicative model is used to fill missing strata.

** Unadjusted total is for all strata fished.

Table 9. Cod abundance (1000's) from Canadian (Spring) RV Surveys in Division 3N

| Depth range (fath) | Strata | Vessel Area Sq mi. | WT 82 1989 | WT 94/95 1990 | WT 105/106 1991 | WT 119/120 1992 | WT 136/137 1993 | WT 152/153 1994 |
|---|---|---|---|---|---|---|---|---|
| 0-30 | 375 | 1593 | 1674 | 1226 | 60 | 80 | 40 | 0 |
| | 376 | 1499 | 113 | 177 | 48 | 0 | 0 | 0 |
| 31-50 | 360 | 2992 | 165 | 569 | 56 | 112 | 20 | 0 |
| | 361 | 1853 | 1904 | 2380 | 817 | 35 | 226 | 28 |
| | 362 | 2520 | 2605 | 3443 | 170 | 32 | 63 | 0 |
| | 373 | 2520 | 822 | 227 | 52 | 0 | 0 | 0 |
| | 374 | 931 | 28 | 210 | 14 | 14 | 0 | 0 |
| | 383 | 674 | 84 | 25 | 34 | 0 | 0 | 0 |
| 51-100 | 359 | 421 | 95 | 47 | 32 | 47 | 190 | 0 |
| | 377 | 100 | 19 | 0 | 0 | 0 | 4 | 4 |
| | 382 | 647 | 81 | 130 | 0 | 0 | 0 | 0 |
| 101-150 | 358 | 225 | 709 | 456 | 59 | 1478 | 709 | 34 |
| | 378 | 139 | 198 | 172 | 122 | 172 | 89 | 31 |
| | 381 | 182 | 102 | 273 | 55 | 7 | 0 | 7 |
| 151-200 | 357 | 164 | 18 | 123 | 148 | 302 | 12 | 105 |
| | 379 | 106 | 44 | 139 | 406 | 1126 | 56 | 44 |
| | 380 | 116 | 118 | 270 | 300 | 57 | 4119 | 0 |
| 0-30 | | 3092 | 1787 | 1403 | 108 | 80 | 40 | 0 |
| 31-50 | | 11490 | 5608 | 6854 | 1143 | 193 | 309 | 28 |
| 51-100 | | 1168 | 195 | 177 | 32 | 47 | 194 | 4 |
| 101-150 | | 546 | 1009 | 901 | 236 | 1657 | 798 | 72 |
| 151-200 | | 386 | 180 | 532 | 854 | 1485 | 4187 | 149 |
| 201-300 | | 420 | - | - | 539 | 1982 | 138 | 67 |
| 301-400 | | 196 | - | - | 14 | 14 | 5 | 4 |
| Mean wt./tow | | | 7.01 | 7.88 | 1.90 | 3.94 | 4.33 | |
| Adjusted total* | | | 8779 | 9867 | 2373 | 3462 | 5528 | 253 |
| Unadjusted total** | | | 8779 | 9867 | 2926 | 5458 | 5671 | 324 |
| Upper limit | | | 11226 | 17170 | 3550 | 92671 | 650816 | |
| Lower limit | | | 6330 | 10401 | 1193 | -66842 | -46909 | |

* Adjusted totals are for strata to 200 fathoms, a multiplicative model is used to fill missing strata.

** Unadjusted total is for all strata fished.

**Table 10. Results from ADAPT using Canadian Spring and Fall RV Surveys and Russian Surveys: Estimated Parameters with associated CVs.**

APPROXIMATE STATISTICS ASSUMING LINEARITY NEAR SOLUTION

ORTHOGONALITY OFFSET..... 0.000256
MEAN SQUARE RESIDUALS ..... 0.824870

| PARAMETER | AGE | ESTIMATE | STD. ERR. | T-STAT | C.V. |
|---|---|---|---|---|---|
| NUMBERS | | | | | |
| | 3 | 27816 | 13348 | 2.084 | 0.480 |
| | 4 | 30720 | 11330 | 2.711 | 0.369 |
| | 5 | 2808 | 912 | 3.081 | 0.325 |
| | 6 | 1546 | 450 | 3.438 | 0.291 |
| | 7 | 1428 | 433 | 3.300 | 0.303 |
| | 8 | 583 | 191 | 3.053 | 0.328 |
| | 9 | 178 | 59 | 3.004 | 0.333 |
| | 10 | 239 | 80 | 2.978 | 0.336 |
| | 11 | 283 | 100 | 2.839 | 0.352 |
| INDEX 1: RV1 | | | | | |
| | 3 | 1.67Ee4 | 3.88Ee5 | 4.310 | 0.232 |
| | 4 | 2.13Ee4 | 4.90Ee5 | 4.340 | 0.230 |
| | 5 | 2.13Ee4 | 4.91Ee5 | 4.341 | 0.230 |
| | 6 | 2.04Ee4 | 4.72Ee5 | 4.335 | 0.231 |
| | 7 | 2.38Ee4 | 5.51Ee5 | 4.325 | 0.231 |
| | 8 | 2.52Ee4 | 5.83Ee5 | 4.315 | 0.232 |
| | 9 | 3.45Ee4 | 8.02Ee5 | 4.303 | 0.232 |
| | 10 | 4.78Ee4 | 1.11Ee4 | 4.294 | 0.233 |
| | 11 | 6.46Ee4 | 1.50Ee4 | 4.296 | 0.233 |
| INDEX 2: RV2 | | | | | |
| | 3 | 4.31Ee4 | 9.93Ee5 | 4.341 | 0.230 |
| | 4 | 4.06Ee4 | 9.30Ee5 | 4.360 | 0.229 |
| | 5 | 3.95Ee4 | 9.07Ee5 | 4.360 | 0.229 |
| | 6 | 3.96Ee4 | 9.09Ee5 | 4.357 | 0.230 |
| | 7 | 3.85Ee4 | 8.84Ee5 | 4.352 | 0.230 |
| | 8 | 3.88Ee4 | 8.93Ee5 | 4.347 | 0.230 |
| | 9 | 5.16Ee4 | 1.19Ee4 | 4.340 | 0.230 |
| | 10 | 7.24Ee4 | 1.67Ee4 | 4.338 | 0.231 |
| | 11 | 9.51Ee4 | 2.20Ee4 | 4.327 | 0.231 |
| INDEX 3: RV3 | | | | | |
| | 3 | 2.11Ee4 | 1.04Ee4 | 2.033 | 0.492 |
| | 4 | 3.64Ee4 | 1.76Ee4 | 2.073 | 0.482 |
| | 5 | 4.69Ee4 | 2.26Ee4 | 2.074 | 0.482 |
| | 6 | 5.25Ee4 | 2.54Ee4 | 2.068 | 0.483 |
| | 7 | 3.82Ee4 | 1.85Ee4 | 2.068 | 0.484 |
| | 8 | 3.08Ee4 | 1.49Ee4 | 2.068 | 0.484 |
| | 9 | 2.82Ee4 | 1.37Ee4 | 2.051 | 0.488 |
| | 10 | 2.63Ee4 | 1.29Ee4 | 2.035 | 0.491 |
| | 11 | 7.31Ee4 | 3.59Ee4 | 2.037 | 0.491 |
| INDEX 4: RV4 | | | | | |
| | 3 | 8.31Ee4 | 3.60Ee4 | 2.304 | 0.434 |
| | 4 | 6.86Ee4 | 2.92Ee4 | 2.346 | 0.426 |
| | 5 | 6.25Ee4 | 2.66Ee4 | 2.348 | 0.426 |
| | 6 | 4.57Ee4 | 1.95Ee4 | 2.340 | 0.427 |
| | 7 | 4.11Ee4 | 1.76Ee4 | 2.339 | 0.428 |
| | 8 | 3.12Ee4 | 1.34Ee4 | 2.331 | 0.429 |
| | 9 | 2.19Ee4 | 9.48Ee5 | 2.312 | 0.433 |
| | 10 | 2.00Ee4 | 8.73Ee5 | 2.294 | 0.436 |
| | 11 | 6.93Ee4 | 3.01Ee4 | 2.299 | 0.435 |

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

**Table 11. Results from ADAPT using Canadian Spring and Fall RV Surveys and Russian Surveys: Residuals.**

LOG RESIDUALS FROM RV1 2/ 6/94

| f | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3 f | 0.330 | 0.168 | e0.157 | e0.791 | 0.188 | e1.144 | e0.030 | e0.113 | e0.694 | 1.053 | 0.088 | e0.051 | 0.107 | 0.137 | e0.310 | 1.220 |
| 4 f | 0.605 | 0.231 | 0.436 | e1.384 | e0.706 | e0.249 | 0.615 | e0.039 | 0.425 | 1.389 | e0.709 | e0.530 | e0.008 | e0.196 | e1.577 | 1.196 |
| 5 f | 1.299 | 0.104 | 0.861 | e1.338 | e0.127 | e1.399 | 0.732 | e0.392 | 0.407 | 2.308 | e0.809 | e0.702 | 0.370 | e0.477 | e1.485 | 0.849 |
| 6 f | 0.923 | 0.341 | 0.502 | e1.608 | e0.188 | e1.134 | 1.071 | e0.555 | e0.153 | 2.152 | e0.423 | e0.442 | 0.063 | e0.381 | e1.067 | 1.099 |
| 7 f | 0.875 | 0.439 | 0.074 | e1.436 | e0.428 | e1.093 | 0.513 | e0.275 | e0.418 | 1.893 | e0.218 | e0.164 | 0.502 | 0.212 | e1.274 | 0.799 |
| 8 f | 0.971 | e0.397 | e0.084 | e0.509 | e0.255 | e0.663 | 0.274 | e0.011 | e0.170 | 1.001 | e0.035 | e0.185 | 0.379 | 0.093 | e0.637 | 0.827 |
| 9 f | e0.119 | e1.761 | e0.023 | e0.370 | 0.616 | e0.734 | 0.286 | 0.272 | e0.248 | 1.229 | 0.443 | e0.459 | 0.266 | 0.247 | 0.033 | 0.320 |
| 10 f | 0.924 | e0.335 | e0.391 | e0.061 | e0.114 | e0.385 | 0.931 | 0.083 | 0.211 | 0.352 | 0.849 | 0.079 | e0.122 | e0.586 | e0.307 | 0.070 |
| 11 f | e0.397 | 0.450 | e0.173 | e0.032 | e0.791 | e1.131 | 0.952 | 0.757 | 0.045 | 0.617 | 0.314 | 0.907 | 0.094 | e0.766 | e0.527 | 0.302 |

SUM OF RV RESIDUALS : 7.08599871Ee8 MEAN RESIDUAL : 4.920832444Ee10

LOG RESIDUALS FROM RV2 2/ 6/94

| f | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 | 1993 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3 f | 0.268 | 0.164 | e0.586 | e0.764 | e0.485 | 0.157 | e0.106 | 0.706 | 1.600 | 1.242 | e0.182 | 0.313 | e1.102 | e1.704 | e0.435 | 0.915 |
| 4 f | 0.715 | 0.292 | e1.070 | e0.740 | e0.303 | 0.283 | 0.384 | 0.899 | 1.429 | 1.490 | e0.973 | e1.276 | e1.265 | e1.454 | 0.551 | 1.037 |
| 5 f | 1.185 | 0.944 | e0.763 | e1.054 | e0.636 | 0.926 | 0.337 | 0.973 | 1.800 | 1.090 | e1.844 | e2.150 | e1.650 | e1.249 | 0.783 | 1.309 |
| 6 f | 1.160 | 1.092 | e0.560 | e0.646 | e1.438 | 0.403 | 0.992 | 0.460 | 1.446 | 1.047 | e1.550 | e1.841 | e1.503 | e0.771 | 0.429 | 1.279 |
| 7 f | 1.719 | 0.911 | 0.055 | e0.157 | e1.181 | e0.297 | 0.647 | 0.661 | 1.172 | 1.038 | e0.912 | e1.775 | e1.167 | e1.514 | 0.176 | 0.626 |
| 8 f | 1.350 | 1.263 | e0.058 | 0.429 | e0.841 | e2.052 | e0.146 | 0.427 | 0.892 | 1.284 | e0.216 | e1.142 | e0.828 | e1.869 | 0.544 | 0.462 |
| 9 f | 0.599 | 0.818 | 0.297 | e0.248 | e0.690 | 0.503 | 0.467 | e0.615 | 0.173 | 0.982 | e0.042 | e0.459 | e1.643 | e2.128 | 1.020 | 0.968 |
| 10 f | 0.531 | e0.160 | 0.926 | 0.337 | e1.334 | 0.785 | 0.433 | e0.159 | e0.449 | 0.382 | e0.032 | e0.125 | e1.898 | e1.482 | 0.512 | 1.735 |
| 11 f | 0.940 | 3.248 | e0.021 | 0.287 | e0.191 | 0.047 | 0.556 | e0.895 | e0.128 | e1.013 | e0.185 | e0.462 | e1.330 | e1.718 | e0.151 | 1.014 |

SUM OF RV RESIDUALS : 5.690755&Ee8 MEAN RESIDUAL : 3.351913805Ee10

LOG RESIDUALS FROM RV3 2/ 6/94

| f | 1990 | 1991 | 1992 | 1993 |
|---|---|---|---|---|
| 3 f | 0.009 | 0.465 | 0.962 | e1.436 |
| 4 f | 0.305 | 0.300 | 0.750 | e1.354 |
| 5 f | 0.265 | 0.727 | 0.179 | e1.171 |
| 6 f | 0.114 | 0.883 | e0.304 | e0.693 |
| 7 f | e0.190 | 1.180 | e0.293 | e0.697 |
| 8 f | e0.364 | 1.043 | e0.391 | e0.288 |
| 9 f | e0.463 | 1.451 | e0.380 | e0.608 |
| 10 f | 0.090 | 1.015 | e0.299 | e0.807 |
| 11 f | e1.040 | 0.404 | 1.369 | e0.734 |

SUM OF RV RESIDUALS : 7.179214574Ee8 MEAN RESIDUAL : 1.994226273Ee9

LOG RESIDUALS FROM RV4 2/ 6/94

| f | 1989 | 1990 | 1991 | 1992 | 1993 |
|---|---|---|---|---|---|
| 3 f | 0.333 | 0.534 | 0.558 | e0.761 | e0.665 |
| 4 f | 0.084 | 0.952 | 0.146 | e0.462 | e0.720 |
| 5 f | e0.117 | 0.837 | 0.134 | e0.478 | e0.376 |
| 6 f | e0.177 | 0.545 | 0.334 | e0.353 | e0.350 |
| 7 f | 0.072 | 0.168 | 0.268 | e0.208 | e0.300 |
| 8 f | 0.005 | 0.346 | 0.107 | e0.222 | e0.236 |
| 9 f | e0.454 | 0.534 | 0.584 | e0.683 | 0.019 |
| 10 f | 0.030 | 0.279 | 0.335 | e0.767 | 0.123 |
| 11 f | e0.164 | e0.544 | e0.406 | 1.377 | e0.262 |

**Table 12. Results from ADAPT using Canadian Spring and Fall RV Surveys and Russian Surveys: Population numbers and Fishing Mortalities.**

POPULATION NUMBERS (000S) 2/ 6/94

| | F | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3 | f | 45461 | 40577 | 17548 | 19975 | 27761 | 22098 | 35997 | 42297 | 33326 | 9265 | 6752 | 13660 | 14230 | 6256 | 7769 | 42365 | 27745 |
| 4 | f | 18878 | 36671 | 32389 | 14302 | 16114 | 22272 | 17817 | 28405 | 34578 | 27233 | 7447 | 5061 | 10933 | 9916 | 4160 | 5363 | 30607 |
| 5 | f | 7956 | 13222 | 26099 | 23055 | 10755 | 12205 | 16445 | 14002 | 22351 | 25638 | 19704 | 5716 | 3856 | 6977 | 4042 | 2797 | 2790 |
| 6 | f | 4168 | 4224 | 8547 | 13037 | 15427 | 7664 | 8553 | 11751 | 10187 | 12687 | 15179 | 12974 | 3298 | 1798 | 1784 | 2409 | 1532 |
| 7 | f | 1295 | 2056 | 2718 | 4478 | 8615 | 10552 | 5359 | 5914 | 7518 | 5593 | 6433 | 9310 | 4879 | 1560 | 662 | 969 | 1419 |
| 8 | f | 469 | 543 | 1363 | 1426 | 2978 | 5332 | 7257 | 3767 | 3738 | 3876 | 3211 | 4169 | 4044 | 2287 | 895 | 287 | 580 |
| 9 | f | 487 | 224 | 352 | 876 | 967 | 1919 | 3016 | 4899 | 2432 | 2339 | 2316 | 2038 | 2501 | 2149 | 1220 | 400 | 177 |
| 10 | f | 133 | 210 | 131 | 236 | 634 | 618 | 1033 | 1769 | 3180 | 1576 | 1410 | 1131 | 1156 | 1608 | 1234 | 485 | 238 |
| 11 | f | 73 | 50 | 125 | 92 | 165 | 434 | 315 | 630 | 950 | 2121 | 953 | 708 | 542 | 735 | 920 | 556 | 281 |
| 12 | f | 57 | 23 | 34 | 92 | 68 | 98 | 209 | 185 | 420 | 541 | 1421 | 420 | 354 | 291 | 466 | 406 | 317 |
| 3+ | f | 78977 | 97798 | 99306 | 77569 | 83483 | 93192 | 95999 | 113617 | 118679 | 90870 | 64827 | 55187 | 45792 | 33579 | 23153 | 56037 | 65686 |

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FISHING MORTALITY 2/ 6/94

| | F | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3 | f | 0.015 | 0.025 | 0.005 | 0.015 | 0.020 | 0.015 | 0.037 | 0.002 | 0.002 | 0.018 | 0.088 | 0.023 | 0.161 | 0.208 | 0.171 | 0.125 | 0.054 |
| 4 | f | 0.156 | 0.140 | 0.140 | 0.085 | 0.078 | 0.103 | 0.041 | 0.040 | 0.099 | 0.124 | 0.065 | 0.072 | 0.249 | 0.697 | 0.197 | 0.453 | 0.123 |
| 5 | f | 0.433 | 0.236 | 0.494 | 0.202 | 0.139 | 0.156 | 0.136 | 0.118 | 0.366 | 0.324 | 0.218 | 0.350 | 0.563 | 1.164 | 0.318 | 0.402 | 0.289 |
| 6 | f | 0.507 | 0.241 | 0.446 | 0.214 | 0.180 | 0.158 | 0.169 | 0.247 | 0.400 | 0.479 | 0.289 | 0.778 | 0.549 | 0.799 | 0.411 | 0.330 | 0.419 |
| 7 | f | 0.669 | 0.211 | 0.445 | 0.208 | 0.280 | 0.174 | 0.153 | 0.259 | 0.463 | 0.355 | 0.234 | 0.634 | 0.558 | 0.355 | 0.636 | 0.312 | 0.286 |
| 8 | f | 0.540 | 0.233 | 0.242 | 0.189 | 0.240 | 0.370 | 0.193 | 0.237 | 0.269 | 0.315 | 0.255 | 0.311 | 0.432 | 0.428 | 0.606 | 0.283 | 0.151 |
| 9 | f | 0.643 | 0.337 | 0.201 | 0.123 | 0.348 | 0.420 | 0.334 | 0.332 | 0.234 | 0.306 | 0.516 | 0.367 | 0.241 | 0.355 | 0.722 | 0.319 | 0.169 |
| 10 | f | 0.780 | 0.313 | 0.155 | 0.157 | 0.179 | 0.474 | 0.294 | 0.422 | 0.205 | 0.303 | 0.490 | 0.536 | 0.252 | 0.359 | 0.597 | 0.345 | 0.199 |
| 11 | f | 0.961 | 0.196 | 0.112 | 0.101 | 0.321 | 0.532 | 0.334 | 0.206 | 0.362 | 0.201 | 0.619 | 0.493 | 0.420 | 0.255 | 0.617 | 0.363 | 0.213 |
| 12 | f | 0.657 | 0.273 | 0.261 | 0.169 | 0.236 | 0.359 | 0.243 | 0.288 | 0.292 | 0.320 | 0.374 | 0.462 | 0.371 | 0.374 | 0.640 | 0.315 | 0.203 |

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