Northeast Fisheries Science Center Reference Document 08-16

# Appendix to the Report of the 3rd Groundfish Assessment Review Meeting (GARM III)

*Assessment of 19 Northeast Groundfish Stocks through 2007*
*Northeast Fisheries Science Center, Woods Hole, Massachusetts,*
*August 4-8, 2008*

by Northeast Fisheries Science Center

September 2008

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*NOAA's National Marine Fisheries Serv., 166 Water St., Woods Hole MA 02543-1026*

**U.S. DEPARTMENT OF COMMERCE**
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Northeast Fisheries Science Center
Woods Hole, Massachusetts

September 2008

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# Table of Contents

Panel Summary Reports from Individual GARM III Meetings

# Appendix A. Georges Bank Atlantic cod

## by Loretta O'Brien , Nina Shepherd, Michele Traver, Jiashen Tang, and Betty Holmes

Appendix A. Table A1a. USA Western GB commercial landings at age (thousands of fish; metric tons) and mean weight (kg) and mean length (cm) at age of of Atlantic cod, 1978-2007.

| | Age | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | Total |
| USA Western Georges Bank Commercial Landings in Numbers (000's) at Age | | | | | | | | | | | | | | | | | |
| 1978 | 0 | 2420 | 44757 | 12479 | 4832 | 119 | 1085 | 0 | 167 | 0 | 0 | 0 | 0 | 0 | 0 | | 65858 |
| 1979 | 446 | 11762 | 3927 | 29906 | 6053 | 2600 | 795 | 2389 | 0 | 199 | 76 | 0 | 0 | 0 | 0 | | 58153 |
| 1980 | 991 | 27575 | 40830 | 2202 | 15313 | 6194 | 3112 | 463 | 1016 | 0 | 0 | 0 | 0 | 0 | 0 | | 97696 |
| 1981 | 280 | 22100 | 26729 | 12750 | 725 | 6858 | 2012 | 349 | 1004 | 208 | 69 | 0 | 0 | 0 | 0 | | 73083 |
| 1982 | 4189 | 60994 | 22453 | 13481 | 8064 | 861 | 2730 | 425 | 301 | 168 | 175 | 41 | 6 | 11 | 0 | | 113899 |
| 1983 | 811 | 30197 | 44466 | 9118 | 5905 | 4651 | 548 | 964 | 220 | 115 | 71 | 82 | 65 | 13 | 0 | | 97227 |
| 1984 | 610 | 11025 | 25222 | 18232 | 2683 | 1921 | 1814 | 177 | 865 | 127 | 92 | 126 | 56 | 7 | 0 | | 62957 |
| 1985 | 1218 | 33734 | 11473 | 7479 | 8751 | 1904 | 1216 | 899 | 71 | 371 | 62 | 24 | 20 | 8 | 0 | | 67231 |
| 1986 | 1300 | 9266 | 22568 | 2697 | 1852 | 1713 | 256 | 243 | 274 | 25 | 75 | 26 | 15 | 5 | 0 | | 40315 |
| 1987 | 187 | 37643 | 5653 | 9809 | 1365 | 1111 | 940 | 182 | 122 | 112 | 4 | 11 | 4 | 0 | 0 | | 57144 |
| 1988 | 0 | 16050 | 39917 | 3542 | 6069 | 803 | 422 | 367 | 82 | 86 | 51 | 0 | 0 | 0 | 0 | | 67388 |
| 1989 | 0 | 14326 | 21689 | 22508 | 1635 | 1812 | 282 | 147 | 58 | 0 | 0 | 0 | 0 | 0 | 0 | | 62457 |
| 1990 | 0 | 43914 | 23420 | 9495 | 8676 | 697 | 627 | 105 | 60 | 29 | 0 | 13 | 0 | 0 | 0 | | 87035 |
| 1991 | 376 | 9564 | 24991 | 12324 | 5115 | 2981 | 273 | 222 | 71 | 13 | 6 | 7 | 0 | 0 | 0 | | 55943 |
| 1992 | 0 | 16627 | 8835 | 5993 | 6030 | 1481 | 793 | 120 | 88 | 5 | 7 | 0 | 8 | 0 | 0 | | 39986 |
| 1993 | 0 | 5878 | 24097 | 3255 | 1822 | 1725 | 482 | 482 | 99 | 4 | 0 | 0 | 0 | 0 | 0 | | 37844 |
| 1994 | 0 | 2022 | 9831 | 11956 | 1598 | 522 | 855 | 238 | 107 | 0 | 29 | 0 | 0 | 0 | 0 | | 27158 |
| 1995 | 0 | 3231 | 9293 | 5353 | 2604 | 212 | 166 | 174 | 38 | 6 | 6 | 0 | 0 | 0 | 0 | | 21083 |
| 1996 | 0 | 1986 | 6884 | 8310 | 1675 | 1148 | 53 | 81 | 88 | 0 | 0 | 0 | 0 | 0 | 0 | | 20225 |
| 1997 | 0 | 3849 | 5120 | 6328 | 4922 | 601 | 511 | 79 | 55 | 17 | 5 | 0 | 0 | 0 | 0 | | 21488 |
| 1998 | 81 | 6770 | 9287 | 3094 | 2122 | 1449 | 186 | 41 | 8 | 0 | 0 | 0 | 0 | 0 | 0 | | 23037 |
| 1999 | 0 | 2369 | 15126 | 4815 | 1600 | 581 | 842 | 85 | 9 | 0 | 0 | 0 | 0 | 0 | 0 | | 25427 |
| 2000 | 88 | 7013 | 5831 | 7303 | 1530 | 449 | 221 | 251 | 16 | 0 | 0 | 0 | 0 | 0 | 0 | | 22702 |
| 2001 | 5 | 4961 | 20580 | 5200 | 2809 | 702 | 214 | 74 | 73 | 4 | 1 | 0 | 0 | 0 | 0 | | 34623 |
| 2002 | 0 | 290 | 9032 | 9958 | 2432 | 2059 | 517 | 90 | 51 | 26 | 8 | 1 | 0 | 0 | 0 | | 24464 |
| 2003 | 0 | 723 | 2186 | 5058 | 4635 | 671 | 480 | 82 | 24 | 12 | 1 | 0 | 0 | 0 | 0 | | 13872 |
| 2004 | 0 | 284 | 2383 | 834 | 1469 | 1003 | 178 | 156 | 42 | 13 | 5 | 4 | 2 | 0 | 0 | | 6374 |
| 2005 | 0 | 223 | 943 | 3425 | 866 | 714 | 442 | 66 | 36 | 11 | 9 | 1 | 0 | 0 | 0 | | 6735 |
| 2006 | 0 | 117 | 4343 | 1232 | 1679 | 216 | 121 | 112 | 13 | 11 | 3 | 1 | 0 | 1 | 0 | | 7850 |
| 2007 | 0 | 1289 | 1652 | 7207 | 410 | 484 | 50 | 33 | 22 | 2 | 4 | 0 | 0 | 0 | 0 | | 11152 |

Appendix A. Table A1a.continued. USA Western GB commercial landings at age (thousands of fish; metric tons) and mean weight (kg) and mean length (cm) at age of of Atlantic cod, 1978-2007.

| | | | | | Age | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | Total |
| USA Western Georges Bank Commercial Landings in Weight (Tons) at Age | | | | | | | | | | | | | | | | | |
| 1978 | 0 | 313 | 11740 | 4838 | 1968 | 71 | 817 | 0 | 210 | 0 | 0 | 0 | 0 | 0 | 0 | | 19954 |
| 1979 | 38 | 1686 | 926 | 13959 | 3141 | 1928 | 781 | 2508 | 0 | 287 | 83 | 0 | 0 | 0 | 0 | | 25348 |
| 1980 | 82 | 4174 | 10210 | 895 | 8980 | 4309 | 2676 | 431 | 897 | 0 | 0 | 0 | 0 | 0 | 0 | | 32610 |
| 1981 | 31 | 3448 | 6843 | 4830 | 434 | 5130 | 1795 | 374 | 1513 | 403 | 155 | 0 | 0 | 0 | 0 | | 24937 |
| 1982 | 277 | 8798 | 6338 | 5152 | 4514 | 563 | 2811 | 451 | 421 | 245 | 253 | 62 | 15 | 25 | 0 | | 29878 |
| 1983 | 87 | 4420 | 10967 | 3343 | 3023 | 3102 | 504 | 1068 | 256 | 165 | 128 | 139 | 139 | 27 | 0 | | 27362 |
| 1984 | 61 | 1762 | 6358 | 7000 | 1486 | 1410 | 1655 | 199 | 953 | 149 | 139 | 200 | 100 | 15 | 0 | | 21486 |
| 1985 | 114 | 4802 | 2593 | 3154 | 4745 | 1274 | 1002 | 967 | 99 | 485 | 105 | 38 | 41 | 20 | 0 | | 19454 |
| 1986 | 123 | 1387 | 5382 | 1072 | 1172 | 1339 | 253 | 262 | 374 | 34 | 108 | 42 | 35 | 12 | 0 | | 11579 |
| 1987 | 16 | 5334 | 1465 | 4070 | 806 | 913 | 806 | 192 | 152 | 171 | 9 | 24 | 9 | 0 | 0 | | 13961 |
| 1988 | 0 | 2432 | 9522 | 1358 | 3353 | 615 | 394 | 381 | 110 | 127 | 100 | 0 | 0 | 0 | 0 | | 18388 |
| 1989 | 0 | 2403 | 4958 | 8808 | 889 | 1323 | 273 | 136 | 75 | 0 | 0 | 0 | 0 | 0 | 0 | | 18873 |
| 1990 | 0 | 6731 | 5755 | 3545 | 4416 | 448 | 551 | 130 | 72 | 39 | 0 | 20 | 0 | 0 | 0 | | 21696 |
| 1991 | 44 | 1471 | 6203 | 4777 | 2849 | 1960 | 215 | 209 | 95 | 24 | 13 | 17 | 0 | 0 | 0 | | 17867 |
| 1992 | 0 | 2489 | 2122 | 2465 | 2861 | 1001 | 626 | 120 | 102 | 8 | 14 | 0 | 18 | 0 | 0 | | 11819 |
| 1993 | 0 | 909 | 5347 | 1242 | 1068 | 1055 | 392 | 454 | 92 | 12 | 0 | 0 | 0 | 0 | 0 | | 10563 |
| 1994 | 0 | 273 | 2070 | 4155 | 811 | 387 | 598 | 221 | 110 | 0 | 55 | 0 | 0 | 0 | 0 | | 8668 |
| 1995 | 0 | 487 | 1862 | 2035 | 1395 | 190 | 152 | 217 | 49 | 9 | 15 | 0 | 0 | 0 | 0 | | 6406 |
| 1996 | 0 | 303 | 1687 | 2690 | 810 | 773 | 63 | 84 | 99 | 0 | 0 | 0 | 0 | 0 | 0 | | 6508 |
| 1997 | 0 | 609 | 1212 | 2269 | 1939 | 355 | 392 | 64 | 62 | 20 | 7 | 0 | 0 | 0 | 0 | | 6926 |
| 1998 | 4 | 998 | 2105 | 1117 | 1052 | 829 | 154 | 32 | 13 | 0 | 0 | 0 | 0 | 0 | 0 | | 6300 |
| 1999 | 0 | 369 | 3260 | 1624 | 780 | 360 | 593 | 86 | 13 | 0 | 0 | 0 | 0 | 0 | 0 | | 7083 |
| 2000 | 10 | 1198 | 1450 | 2663 | 778 | 281 | 183 | 218 | 14 | 0 | 0 | 0 | 0 | 0 | 0 | | 6788 |
| 2001 | 0 | 766 | 4769 | 1577 | 1368 | 414 | 153 | 67 | 72 | 5 | 3 | 0 | 0 | 0 | 0 | | 9191 |
| 2002 | 0 | 55 | 1980 | 3028 | 969 | 1112 | 343 | 72 | 55 | 33 | 10 | 1 | 0 | 0 | 0 | | 7652 |
| 2003 | 0 | 149 | 535 | 1553 | 1945 | 357 | 311 | 62 | 23 | 14 | 2 | 0 | 0 | 0 | 0 | | 4951 |
| 2004 | 0 | 58 | 677 | 310 | 631 | 520 | 112 | 124 | 38 | 15 | 8 | 5 | 3 | 0 | 0 | | 2500 |
| 2005 | 0 | 40 | 243 | 1182 | 366 | 365 | 265 | 56 | 36 | 12 | 13 | 1 | 0 | 0 | 0 | | 2580 |
| 2006 | 0 | 24 | 1097 | 448 | 691 | 113 | 76 | 82 | 12 | 12 | 3 | 1 | 1 | 1 | 0 | | 2559 |
| 2007 | 0 | 262 | 418 | 2330 | 166 | 219 | 26 | 23 | 15 | 2 | 3 | 0 | 0 | 0 | 0 | | 3462 |

Appendix A. Table A1a.continued. USA Western GB commercial landings at age (thousands of fish; metric tons) and mean weight (kg) and mean length (cm) at age of of Atlantic cod, 1978-2007.

| | Age | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | Average |
| | USA Western Georges Bank Commercial Landings Mean Weight (kg) at Age | | | | | | | | | | | | | | | | |
| 1978 | 0 | 1.296 | 2.623 | 3.877 | 4.071 | 5.998 | 7.533 | 0 | 12.614 | 0 | 0 | 0 | 0 | 0 | 0 | | 3.03 |
| 1979 | 0.861 | 1.434 | 2.357 | 4.668 | 5.19 | 7.416 | 9.823 | 10.498 | 0 | 14.414 | 10.939 | 0 | 0 | 0 | 0 | | 4.359 |
| 1980 | 0.824 | 1.514 | 2.501 | 4.068 | 5.864 | 6.956 | 8.601 | 9.295 | 8.827 | 0 | 0 | 0 | 0 | 0 | 0 | | 3.338 |
| 1981 | 1.091 | 1.56 | 2.56 | 3.788 | 5.988 | 7.481 | 8.925 | 10.718 | 15.072 | 19.393 | 22.4 | 0 | 0 | 0 | 0 | | 3.412 |
| 1982 | 0.661 | 1.442 | 2.823 | 3.821 | 5.598 | 6.535 | 10.299 | 10.607 | 14.013 | 14.641 | 14.449 | 15.268 | 24.028 | 22.4 | 0 | | 2.623 |
| 1983 | 1.069 | 1.464 | 2.466 | 3.666 | 5.119 | 6.669 | 9.207 | 11.076 | 11.668 | 14.33 | 17.884 | 17.004 | 21.173 | 20.494 | 0 | | 2.814 |
| 1984 | 1.003 | 1.598 | 2.521 | 3.839 | 5.54 | 7.339 | 9.122 | 11.287 | 11.019 | 11.737 | 15.143 | 15.831 | 17.803 | 22.4 | 0 | | 3.413 |
| 1985 | 0.935 | 1.423 | 2.26 | 4.216 | 5.423 | 6.689 | 8.244 | 10.755 | 13.879 | 13.065 | 17.14 | 15.654 | 20.181 | 23.879 | 0 | | 2.894 |
| 1986 | 0.946 | 1.497 | 2.385 | 3.974 | 6.325 | 7.816 | 9.893 | 10.785 | 13.615 | 13.844 | 14.34 | 15.939 | 24.183 | 23.344 | 0 | | 2.872 |
| 1987 | 0.857 | 1.417 | 2.591 | 4.15 | 5.91 | 8.217 | 8.58 | 10.528 | 12.424 | 15.203 | 22.4 | 21.887 | 20.847 | 0 | 0 | | 2.443 |
| 1988 | 0 | 1.515 | 2.385 | 3.835 | 5.524 | 7.661 | 9.332 | 10.398 | 13.492 | 14.734 | 19.77 | 0 | 0 | 0 | 0 | | 2.729 |
| 1989 | 0 | 1.677 | 2.286 | 3.913 | 5.438 | 7.3 | 9.669 | 9.271 | 12.956 | 0 | 0 | 0 | 0 | 0 | 0 | | 3.022 |
| 1990 | 0 | 1.533 | 2.457 | 3.733 | 5.09 | 6.431 | 8.785 | 12.371 | 12.173 | 13.391 | 0 | 15.36 | 0 | 0 | 0 | | 2.493 |
| 1991 | 1.158 | 1.538 | 2.482 | 3.876 | 5.569 | 6.573 | 7.868 | 9.418 | 13.346 | 18.597 | 22.4 | 24.028 | 0 | 0 | 0 | | 3.194 |
| 1992 | 0 | 1.497 | 2.402 | 4.113 | 4.745 | 6.758 | 7.9 | 9.999 | 11.612 | 15.398 | 19.272 | 0 | 22.191 | 0 | 0 | | 2.956 |
| 1993 | 0 | 1.546 | 2.219 | 3.816 | 5.861 | 6.117 | 8.127 | 9.417 | 9.302 | 31.885 | 0 | 0 | 0 | 0 | 0 | | 2.791 |
| 1994 | 0 | 1.351 | 2.105 | 3.475 | 5.071 | 7.425 | 7.001 | 9.28 | 10.207 | 0 | 18.723 | 0 | 0 | 0 | 0 | | 3.192 |
| 1995 | 0 | 1.507 | 2.004 | 3.802 | 5.358 | 8.96 | 9.132 | 12.483 | 12.777 | 14.233 | 24.154 | 0 | 0 | 0 | 0 | | 3.039 |
| 1996 | 0 | 1.524 | 2.45 | 3.237 | 4.836 | 6.735 | 11.876 | 10.313 | 11.241 | 0 | 0 | 0 | 0 | 0 | 0 | | 3.218 |
| 1997 | 0 | 1.583 | 2.366 | 3.586 | 3.939 | 5.901 | 7.667 | 8.026 | 11.301 | 11.277 | 15.43 | 0 | 0 | 0 | 0 | | 3.223 |
| 1998 | 0.536 | 1.475 | 2.266 | 3.611 | 4.96 | 5.721 | 8.285 | 7.8 | 15.398 | 0 | 0 | 0 | 0 | 0 | 0 | | 2.735 |
| 1999 | 0 | 1.558 | 2.155 | 3.373 | 4.874 | 6.188 | 7.04 | 10.056 | 14.816 | 0 | 0 | 0 | 0 | 0 | 0 | | 2.786 |
| 2000 | 1.177 | 1.708 | 2.486 | 3.646 | 5.088 | 6.265 | 8.27 | 8.684 | 8.457 | 0 | 0 | 0 | 0 | 0 | 0 | | 2.99 |
| 2001 | 0.727 | 1.544 | 2.317 | 3.032 | 4.869 | 5.891 | 7.187 | 9.126 | 9.854 | 12.176 | 17.917 | 0 | 0 | 0 | 0 | | 2.655 |
| 2002 | 0 | 1.883 | 2.192 | 3.04 | 3.982 | 5.403 | 6.632 | 7.948 | 10.68 | 12.768 | 12.144 | 13.129 | 0 | 0 | 0 | | 3.128 |
| 2003 | 0 | 2.057 | 2.449 | 3.07 | 4.197 | 5.325 | 6.485 | 7.527 | 9.576 | 11.72 | 15.108 | 0 | 0 | 0 | 0 | | 3.569 |
| 2004 | 0 | 2.034 | 2.842 | 3.713 | 4.292 | 5.187 | 6.298 | 7.952 | 9.23 | 11.451 | 14.713 | 11.8 | 16.086 | 0 | 0 | | 3.922 |
| 2005 | 0 | 1.811 | 2.58 | 3.453 | 4.224 | 5.107 | 5.993 | 8.586 | 9.902 | 11.798 | 13.905 | 19.274 | 0 | 0 | 0 | | 3.832 |
| 2006 | 0 | 2.08 | 2.527 | 3.638 | 4.119 | 5.21 | 6.319 | 7.303 | 8.931 | 10.118 | 8.935 | 10.505 | 16.568 | 18.822 | 0 | | 3.259 |
| 2007 | 0 | 2.035 | 2.532 | 3.233 | 4.046 | 4.521 | 5.312 | 7.001 | 6.802 | 11.497 | 7.057 | 0 | 0 | 0 | 0 | | 3.104 |

Appendix A. Table A1a.continued. USA Western GB commercial landings at age (thousands of fish; metric tons) and mean weight (kg) and mean length (cm) at age of of Atlantic cod, 1978-2007.

USA Western Georges Bank Commercial Landings Mean Length (cm) at Age

| | Age | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | Average |
| 1978 | 0.0 | 50.2 | 62.7 | 71.0 | 71.2 | 79.8 | 89.4 | 0.0 | 106.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | 65.0 |
| 1979 | 44.2 | 52.0 | 60.4 | 75.7 | 78.6 | 88.7 | 98.2 | 100.3 | 0.0 | 110.9 | 102.0 | 0.0 | 0.0 | 0.0 | 0.0 | | 72.0 |
| 1980 | 43.3 | 52.8 | 61.7 | 72.9 | 82.2 | 87.3 | 93.2 | 94.0 | 94.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | 65.6 |
| 1981 | 47.6 | 53.1 | 62.4 | 70.9 | 83.1 | 89.3 | 95.1 | 100.6 | 113.2 | 123.0 | 129.0 | 0.0 | 0.0 | 0.0 | 0.0 | | 65.8 |
| 1982 | 39.7 | 52.0 | 64.2 | 70.5 | 80.6 | 84.6 | 99.3 | 100.0 | 110.0 | 111.7 | 110.5 | 111.7 | 132.0 | 129.0 | 0.0 | | 60.1 |
| 1983 | 47.5 | 52.4 | 61.5 | 69.5 | 78.3 | 85.6 | 95.7 | 101.6 | 102.8 | 110.8 | 119.2 | 117.4 | 126.1 | 124.5 | 0.0 | | 62.4 |
| 1984 | 46.5 | 53.6 | 62.0 | 71.3 | 80.3 | 88.9 | 95.2 | 102.4 | 101.6 | 103.4 | 112.0 | 114.7 | 118.4 | 129.0 | 0.0 | | 66.6 |
| 1985 | 45.5 | 51.8 | 59.5 | 73.8 | 80.1 | 85.9 | 92.0 | 100.8 | 109.6 | 107.3 | 117.9 | 114.2 | 124.5 | 131.6 | 0.0 | | 62.0 |
| 1986 | 45.6 | 52.5 | 61.0 | 72.1 | 84.6 | 90.8 | 98.3 | 101.1 | 108.8 | 109.8 | 110.8 | 115.2 | 132.0 | 130.2 | 0.0 | | 62.6 |
| 1987 | 44.2 | 51.8 | 62.6 | 73.3 | 82.6 | 92.5 | 93.2 | 99.9 | 105.8 | 113.2 | 129.0 | 127.8 | 126.0 | 0.0 | 0.0 | | 59.1 |
| 1988 | 0.0 | 53.1 | 61.0 | 70.9 | 80.2 | 90.1 | 95.8 | 99.5 | 108.4 | 112.0 | 123.8 | 0.0 | 0.0 | 0.0 | 0.0 | | 62.3 |
| 1989 | 0.0 | 54.8 | 60.3 | 71.7 | 80.0 | 88.2 | 97.5 | 96.3 | 107.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | 64.8 |
| 1990 | 0.0 | 53.3 | 61.5 | 70.3 | 78.0 | 84.2 | 93.6 | 105.7 | 105.1 | 108.7 | 0.0 | 114.0 | 0.0 | 0.0 | 0.0 | | 60.5 |
| 1991 | 48.8 | 53.2 | 61.8 | 71.1 | 80.5 | 84.9 | 89.7 | 93.2 | 108.6 | 121.4 | 129.0 | 132.0 | 0.0 | 0.0 | 0.0 | | 65.6 |
| 1992 | 0.0 | 52.7 | 61.4 | 73.4 | 76.9 | 85.6 | 92.2 | 98.2 | 104.9 | 117.0 | 120.0 | 0.0 | 132.0 | 0.0 | 0.0 | | 63.7 |
| 1993 | 0.0 | 53.1 | 59.9 | 71.7 | 82.7 | 83.5 | 93.5 | 98.0 | 97.8 | 141.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | 63.1 |
| 1994 | 0.0 | 51.3 | 58.8 | 69.4 | 79.4 | 89.9 | 89.1 | 98.1 | 101.1 | 0.0 | 122.8 | 0.0 | 0.0 | 0.0 | 0.0 | | 66.2 |
| 1995 | 0.0 | 52.8 | 57.9 | 71.1 | 81.3 | 95.1 | 97.1 | 106.9 | 108.6 | 114.0 | 129.0 | 0.0 | 0.0 | 0.0 | 0.0 | | 64.6 |
| 1996 | 0.0 | 53.2 | 61.7 | 67.7 | 77.2 | 88.0 | 102.6 | 101.5 | 103.3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | 66.6 |
| 1997 | 0.0 | 53.6 | 61.2 | 70.0 | 72.1 | 84.2 | 92.0 | 93.1 | 104.8 | 105.3 | 117.0 | 0.0 | 0.0 | 0.0 | 0.0 | | 66.6 |
| 1998 | 38.1 | 52.4 | 60.4 | 71.1 | 79.4 | 83.5 | 94.8 | 93.1 | 117.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | 63.0 |
| 1999 | 0.0 | 53.5 | 59.6 | 69.4 | 79.1 | 85.4 | 89.6 | 100.5 | 115.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | 63.9 |
| 2000 | 48.9 | 54.9 | 62.4 | 71.1 | 79.3 | 85.6 | 94.1 | 96.4 | 96.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | 65.1 |
| 2001 | 42.0 | 53.2 | 60.8 | 66.5 | 78.3 | 83.7 | 90.0 | 96.7 | 100.2 | 107.5 | 123.0 | 0.0 | 0.0 | 0.0 | 0.0 | | 62.8 |
| 2002 | 0.0 | 56.9 | 59.6 | 66.8 | 72.8 | 80.8 | 86.8 | 91.7 | 101.8 | 109.2 | 107.0 | 111.0 | 0.0 | 0.0 | 0.0 | | 66.4 |
| 2003 | 0.0 | 58.3 | 61.8 | 66.8 | 74.4 | 80.4 | 86.6 | 90.8 | 97.9 | 106.0 | 111.0 | 0.0 | 0.0 | 0.0 | 0.0 | | 69.7 |
| 2004 | 0.0 | 58.2 | 64.7 | 71.1 | 75.2 | 80.3 | 85.8 | 93.1 | 97.5 | 105.5 | 114.5 | 106.1 | 118.3 | 0.0 | 0.0 | | 71.8 |
| 2005 | 0.0 | 56.1 | 63.1 | 69.7 | 75.3 | 80.1 | 84.3 | 95.8 | 99.9 | 104.9 | 112.9 | 126.0 | 0.0 | 0.0 | 0.0 | | 71.6 |
| 2006 | 0.0 | 58.7 | 62.3 | 70.9 | 74.2 | 80.2 | 85.8 | 90.2 | 94.2 | 100.6 | 96.8 | 99.3 | 119.0 | 125.0 | 0.0 | | 67.5 |
| 2007 | 0.0 | 58.2 | 62.8 | 68.1 | 73.1 | 75.8 | 80.0 | 87.6 | 86.6 | 104.8 | 85.3 | 0.0 | 0.0 | 0.0 | 0.0 | | 66.8 |

Appendix A. Table A1b. USA Eastern GB commercial landings at age (thousands of fish; metric tons) and mean weight (kg) and mean length (cm) at age of of Atlantic cod, 1978-2007.

| | Age | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | Total |
| | | | | USA Eastern Georges Bank Commercial Landings in Numbers (000's) at Age | | | | | | | | | | | | | |
| 1978 | 0.34 | 367 | 12834 | 4446 | 1752 | 862 | 685 | 102 | 121 | 24 | 7 | 2 | 0 | 0.47 | 2 | | 21204 |
| 1979 | 21 | 3231 | 2011 | 7127 | 2723 | 1238 | 581 | 480 | 87 | 18 | 9 | 5 | 0 | 4 | 0 | | 17536 |
| 1980 | 0 | 2596 | 5626 | 1002 | 4639 | 2179 | 656 | 117 | 201 | 34 | 7 | 0 | 0 | 0 | 0 | | 17056 |
| 1981 | 96 | 5731 | 9602 | 6916 | 942 | 1937 | 869 | 533 | 308 | 114 | 20 | 10 | 0 | 0 | 0 | | 27077 |
| 1982 | 0 | 13029 | 5110 | 3644 | 3953 | 415 | 1642 | 503 | 191 | 63 | 48 | 31 | 25 | 5 | 0 | | 28659 |
| 1983 | 50 | 3650 | 10674 | 4323 | 2709 | 1786 | 279 | 549 | 325 | 136 | 161 | 100 | 14 | 35 | 6 | | 24797 |
| 1984 | 75 | 2041 | 6661 | 9655 | 2877 | 2188 | 1830 | 205 | 542 | 231 | 100 | 41 | 21 | 9 | 0 | 4 | 26481 |
| 1985 | 10 | 6670 | 4425 | 2544 | 4294 | 1143 | 638 | 596 | 80 | 176 | 24 | 29 | 8 | 5 | 0 | | 20640 |
| 1986 | 23 | 2021 | 9006 | 1918 | 1852 | 2147 | 301 | 256 | 165 | 15 | 61 | 12 | 0 | 0 | 0 | | 17777 |
| 1987 | 0 | 10379 | 2367 | 3787 | 641 | 496 | 577 | 154 | 81 | 41 | 6 | 4 | 0 | 0 | 0 | | 18533 |
| 1988 | 0 | 574 | 14450 | 3337 | 4418 | 672 | 447 | 525 | 91 | 60 | 29 | 5 | 1 | 0 | 1 | | 24609 |
| 1989 | 0 | 2151 | 4624 | 10375 | 906 | 1709 | 209 | 133 | 169 | 24 | 8 | 1 | 0 | 0 | 0 | | 20310 |
| 1990 | 0 | 2573 | 9722 | 3301 | 5338 | 564 | 591 | 51 | 28 | 37 | 0 | 3 | 0 | 0 | 0 | | 22208 |
| 1991 | 53 | 2080 | 3437 | 6090 | 3186 | 2638 | 377 | 199 | 54 | 20 | 3 | 8 | 0 | 0 | 3 | | 18148 |
| 1992 | 13 | 6451 | 4502 | 1618 | 3361 | 1084 | 977 | 66 | 65 | 5 | 9 | 0 | 0 | 0 | 0 | | 18150 |
| 1993 | 3 | 1812 | 7087 | 2825 | 1055 | 1107 | 349 | 232 | 58 | 20 | 4 | 0 | 0 | 0 | 0 | | 14553 |
| 1994 | 0 | 224 | 1184 | 1411 | 396 | 61 | 100 | 46 | 32 | 3 | 3 | 0 | 1 | 0 | 0 | | 3461 |
| 1995 | 0 | 140 | 663 | 288 | 461 | 60 | 20 | 14 | 15 | 1 | 1 | 0 | 0 | 0 | 0 | | 1664 |
| 1996 | 0 | 99 | 567 | 1056 | 219 | 211 | 24 | 10 | 12 | 2 | 0 | 0 | 0 | 0 | 0 | | 2201 |
| 1997 | 0 | 100 | 220 | 348 | 687 | 141 | 82 | 26 | 5 | 3 | 3 | 0 | 0 | 0 | 0 | | 1615 |
| 1998 | 0 | 100 | 424 | 364 | 441 | 433 | 55 | 34 | 10 | 2 | 0 | 0 | 0 | 0 | 0 | | 1864 |
| 1999 | 0 | 175 | 1428 | 1222 | 497 | 275 | 278 | 60 | 11 | 2 | 0 | 0 | 0 | 0 | 0 | | 3948 |
| 2000 | 0 | 165 | 410 | 1307 | 516 | 129 | 78 | 40 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2652 |
| 2001 | 0 | 80 | 2270 | 915 | 1730 | 398 | 123 | 76 | 34 | 4 | 1 | 1 | 0 | 0 | 0 | | 5633 |
| 2002 | 0 | 29 | 793 | 2740 | 615 | 735 | 146 | 37 | 32 | 11 | 3 | 2 | 0 | 0 | 0 | | 5143 |
| 2003 | 0 | 14 | 574 | 1379 | 2368 | 485 | 456 | 90 | 18 | 5 | 1 | 0 | 0 | 0 | 0 | | 5390 |
| 2004 | 0 | 18 | 339 | 700 | 815 | 579 | 166 | 101 | 23 | 3 | 2 | 0 | 0 | 0 | 0 | | 2746 |
| 2005 | 0 | 0 | 13 | 152 | 130 | 52 | 104 | 14 | 8 | 3 | 0 | 0 | 0 | 0 | 0 | | 475 |
| 2006 | 0 | 0 | 58 | 59 | 170 | 78 | 24 | 15 | 4 | 0 | 0 | 1 | 0 | 0 | 0 | | 409 |
| 2007 | 0 | 3 | 29 | 509 | 28 | 133 | 5 | 6 | 3 | 1 | 0 | 0 | 0 | 0 | 0 | | 718 |

Appendix A. Table A1b continued. USA Eastern GB commercial landings at age (thousands of fish; metric tons) and mean weight (kg) and mean length (cm) at age of of Atlantic cod, 1978-2007.

| | Age | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | Total |
| USA Eastern Georges Bank Commercial Landings in Weight (Tons) at Age | | | | | | | | | | | | | | | | | |
| 1978 | 0 | 48 | 2484 | 1250 | 718 | 452 | 360 | 72 | 82 | 22 | 11 | 3 | 0 | 1 | 3 | | 5502 |
| 1979 | 2 | 454 | 301 | 2342 | 1282 | 877 | 554 | 450 | 86 | 26 | 11 | 9 | 0 | 7 | 0 | | 6408 |
| 1980 | 0 | 324 | 1168 | 311 | 2399 | 1375 | 490 | 122 | 188 | 43 | 10 | 0 | 0 | 0 | 0 | | 6418 |
| 1981 | 10 | 731 | 1833 | 2032 | 392 | 1243 | 699 | 497 | 398 | 165 | 38 | 20 | 0 | 0 | 0 | | 8092 |
| 1982 | 0 | 1591 | 1095 | 1251 | 1948 | 283 | 1396 | 488 | 231 | 91 | 73 | 61 | 47 | 11 | 0 | | 8565 |
| 1983 | 5 | 586 | 2502 | 1344 | 1194 | 1086 | 202 | 563 | 375 | 182 | 260 | 163 | 31 | 70 | 17 | | 8572 |
| 1984 | 9 | 332 | 1509 | 3159 | 1324 | 1338 | 1537 | 186 | 618 | 282 | 128 | 68 | 39 | 20 | 0 | 7 | 10550 |
| 1985 | 1 | 888 | 783 | 782 | 1968 | 678 | 516 | 591 | 89 | 223 | 38 | 44 | 16 | 8 | 0 | | 6641 |
| 1986 | 2 | 231 | 1859 | 516 | 841 | 1425 | 249 | 242 | 213 | 23 | 72 | 21 | 0 | 0 | 0 | | 5696 |
| 1987 | 0 | 1415 | 520 | 1405 | 324 | 358 | 484 | 141 | 85 | 43 | 8 | 7 | 0 | 0 | 0 | | 4793 |
| 1988 | 0 | 75 | 3105 | 931 | 2148 | 396 | 332 | 461 | 89 | 71 | 33 | 10 | 2 | 0 | 2 | | 7645 |
| 1989 | 0 | 345 | 898 | 3120 | 398 | 950 | 133 | 125 | 166 | 25 | 10 | 2 | 0 | 0 | 0 | | 6182 |
| 1990 | 0 | 359 | 1886 | 945 | 2310 | 334 | 462 | 45 | 29 | 41 | 1 | 3 | 0 | 0 | 0 | | 6414 |
| 1991 | 7 | 329 | 790 | 1841 | 1399 | 1454 | 283 | 174 | 43 | 20 | 4 | 8 | 0 | 0 | 3 | | 6353 |
| 1992 | 1 | 936 | 973 | 498 | 1343 | 571 | 625 | 53 | 63 | 7 | 12 | 0 | 0 | 0 | 0 | | 5080 |
| 1993 | 0 | 263 | 1441 | 778 | 458 | 571 | 246 | 175 | 58 | 22 | 10 | 0 | 0 | 0 | 0 | | 4019 |
| 1994 | 0 | 31 | 223 | 411 | 149 | 37 | 68 | 39 | 30 | 3 | 5 | 0 | 3 | 0 | 0 | | 997 |
| 1995 | 0 | 18 | 121 | 94 | 215 | 39 | 21 | 14 | 16 | 1 | 1 | 0 | 0 | 0 | 0 | | 540 |
| 1996 | 0 | 14 | 115 | 300 | 91 | 118 | 15 | 9 | 13 | 2 | 0 | 0 | 0 | 0 | 0 | | 674 |
| 1997 | 0 | 13 | 36 | 87 | 259 | 70 | 51 | 19 | 6 | 3 | 3 | 0 | 0 | 0 | 0 | | 549 |
| 1998 | 0 | 14 | 80 | 113 | 178 | 222 | 36 | 25 | 10 | 2 | 0 | 0 | 0 | 0 | 0 | | 678 |
| 1999 | 0 | 23 | 249 | 362 | 203 | 141 | 162 | 40 | 8 | 2 | 0 | 0 | 0 | 0 | 0 | | 1193 |
| 2000 | 0 | 22 | 78 | 354 | 194 | 57 | 41 | 23 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 771 |
| 2001 | 0 | 10 | 391 | 220 | 527 | 181 | 65 | 50 | 28 | 3 | 1 | 1 | 0 | 0 | 0 | | 1479 |
| 2002 | 0 | 4 | 148 | 749 | 235 | 346 | 89 | 31 | 24 | 11 | 5 | 2 | 0 | 0 | 0 | | 1641 |
| 2003 | 0 | 2 | 121 | 373 | 811 | 207 | 243 | 60 | 13 | 4 | 1 | 0 | 0 | 0 | 0 | | 1838 |
| 2004 | 0 | 3 | 67 | 198 | 291 | 271 | 83 | 73 | 18 | 2 | 2 | 0 | 0 | 0 | 0 | | 1007 |
| 2005 | 0 | 0 | 2 | 43 | 44 | 21 | 48 | 9 | 5 | 2 | 0 | 0 | 0 | 0 | 0 | | 174 |
| 2006 | 0 | 0 | 13 | 16 | 57 | 26 | 12 | 7 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | | 134 |
| 2007 | 0 | 1 | 5 | 141 | 9 | 50 | 3 | 4 | 2 | 1 | 0 | 0 | 0 | 0 | 0 | | 216 |

Appendix A. Table A1b continued. USA Eastern GB commercial landings at age (thousands of fish; metric tons) and mean weight (kg) and mean length (cm) at age of of Atlantic cod, 1978-2007.

USA Eastern Georges Bank Commercial Landings Mean Weight (kg) at Age

| | Age | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | Average |
| 1978 | 0.582 | 1.307 | 1.935 | 2.812 | 4.099 | 5.239 | 5.255 | 7.086 | 6.723 | 9.172 | 15.742 | 15.59 | 0 | 11.95 | 16.63 | | 2.595 |
| 1979 | 1.025 | 1.406 | 1.496 | 3.286 | 4.71 | 7.083 | 9.537 | 9.377 | 9.874 | 13.923 | 11.951 | 16.28 | 0 | 20.11 | 0 | | 3.654 |
| 1980 | 0 | 1.25 | 2.076 | 3.102 | 5.171 | 6.314 | 7.466 | 10.394 | 9.379 | 12.696 | 14.159 | 0 | 0 | 0 | 0 | | 3.763 |
| 1981 | 1.013 | 1.276 | 1.909 | 2.938 | 4.166 | 6.418 | 8.052 | 9.333 | 12.944 | 14.483 | 19.369 | 20.85 | 0 | 0 | 0 | | 2.988 |
| 1982 | 0 | 1.221 | 2.143 | 3.432 | 4.928 | 6.808 | 8.504 | 9.686 | 12.057 | 14.48 | 15.121 | 19.32 | 18.76 | 24.36 | 0 | | 2.989 |
| 1983 | 1.015 | 1.605 | 2.344 | 3.109 | 4.406 | 6.08 | 7.243 | 10.243 | 11.531 | 13.35 | 16.085 | 16.25 | 22.4 | 20.22 | 27.52 | | 3.457 |
| 1984 | 1.217 | 1.628 | 2.265 | 3.272 | 4.604 | 6.118 | 8.399 | 9.074 | 11.406 | 12.172 | 12.865 | 16.45 | 18.57 | 22.23 | 0 | 20.85 | 3.984 |
| 1985 | 0.9 | 1.331 | 1.771 | 3.075 | 4.585 | 5.935 | 8.087 | 9.923 | 11.199 | 12.656 | 15.774 | 15.3 | 20.85 | 17.96 | 0 | | 3.218 |
| 1986 | 0.877 | 1.146 | 2.064 | 2.689 | 4.542 | 6.636 | 8.277 | 9.448 | 12.903 | 15.224 | 11.914 | 17.28 | 0 | 0 | 0 | | 3.204 |
| 1987 | 0 | 1.364 | 2.196 | 3.71 | 5.047 | 7.221 | 8.389 | 9.131 | 10.535 | 10.628 | 12.888 | 17.3 | 0 | 0 | 0 | | 2.586 |
| 1988 | 0 | 1.315 | 2.149 | 2.791 | 4.861 | 5.888 | 7.422 | 8.79 | 9.783 | 11.822 | 11.209 | 18.78 | 20.11 | 0 | 14.16 | | 3.107 |
| 1989 | 0 | 1.606 | 1.943 | 3.007 | 4.396 | 5.556 | 6.358 | 9.434 | 9.845 | 10.329 | 11.891 | 13.75 | 0 | 0 | 0 | | 3.044 |
| 1990 | 0 | 1.396 | 1.94 | 2.863 | 4.327 | 5.914 | 7.821 | 8.956 | 10.205 | 11.078 | 13.024 | 11.24 | 0 | 0 | 0 | | 2.888 |
| 1991 | 1.29 | 1.583 | 2.298 | 3.024 | 4.39 | 5.509 | 7.521 | 8.702 | 7.928 | 10.382 | 12.344 | 9.503 | 0 | 0 | 11.23 | | 3.5 |
| 1992 | 1.016 | 1.451 | 2.162 | 3.077 | 3.995 | 5.265 | 6.396 | 8.094 | 9.742 | 13.175 | 13.74 | 0 | 0 | 0 | 0 | | 2.799 |
| 1993 | 0.866 | 1.45 | 2.034 | 2.755 | 4.338 | 5.156 | 7.042 | 7.558 | 10.156 | 10.633 | 22.191 | 0 | 0 | 0 | 0 | | 2.762 |
| 1994 | 0 | 1.382 | 1.88 | 2.909 | 3.754 | 6.037 | 6.832 | 8.623 | 9.188 | 13.136 | 14.95 | 0 | 22.19 | 0 | 0 | | 2.881 |
| 1995 | 0 | 1.306 | 1.831 | 3.242 | 4.657 | 6.409 | 10.4 | 10.069 | 10.57 | 16.626 | 20.698 | 0 | 0 | 0 | 0 | | 3.248 |
| 1996 | 0.902 | 1.377 | 2.023 | 2.839 | 4.137 | 5.576 | 6.078 | 8.978 | 10.182 | 9.283 | 12.702 | 0 | 0 | 0 | 0 | | 3.062 |
| 1997 | 0 | 1.34 | 1.656 | 2.488 | 3.776 | 4.983 | 6.261 | 7.34 | 10.579 | 9.804 | 12.635 | 16.63 | 0 | 0 | 0 | | 3.398 |
| 1998 | 0 | 1.35 | 1.894 | 3.105 | 4.026 | 5.113 | 6.529 | 7.33 | 9.97 | 10.299 | 11.095 | 10.16 | 0 | 0 | 0 | | 3.637 |
| 1999 | 0 | 1.323 | 1.743 | 2.966 | 4.079 | 5.139 | 5.826 | 6.778 | 7.499 | 10.671 | 0 | 0 | 0 | 0 | 0 | | 3.023 |
| 2000 | 0 | 1.329 | 1.894 | 2.708 | 3.768 | 4.42 | 5.273 | 5.681 | 6.378 | 0 | 7.682 | 0 | 0 | 0 | 0 | 0 | 2.908 |
| 2001 | 0 | 1.252 | 1.721 | 2.402 | 3.046 | 4.552 | 5.248 | 6.479 | 8.218 | 9.063 | 7.824 | 9.283 | 0 | 0 | 0 | | 2.625 |
| 2002 | 0 | 1.349 | 1.863 | 2.732 | 3.816 | 4.711 | 6.079 | 8.387 | 7.426 | 10.332 | 13.567 | 11.94 | 0 | 0 | 0 | | 3.19 |
| 2003 | 0 | 1.591 | 2.108 | 2.704 | 3.427 | 4.263 | 5.34 | 6.671 | 7.55 | 8.41 | 11.08 | 0 | 0 | 0 | 0 | | 3.41 |
| 2004 | 0 | 1.801 | 1.986 | 2.821 | 3.576 | 4.671 | 5.003 | 7.195 | 7.641 | 7.686 | 9.057 | 11.1 | 0 | 0 | 0 | | 3.665 |
| 2005 | 0 | 1.327 | 1.781 | 2.807 | 3.412 | 4.024 | 4.648 | 6.229 | 5.981 | 6.681 | 0 | 0 | 8.457 | 0 | 0 | | 3.661 |
| 2006 | 0 | 0 | 2.298 | 2.667 | 3.35 | 3.31 | 5.172 | 5.069 | 5.029 | 6.277 | 9.283 | 5.911 | 0 | 0 | 0 | | 3.275 |
| 2007 | 0 | 1.48 | 1.744 | 2.765 | 3.259 | 3.773 | 6.481 | 6.189 | 6.067 | 7.865 | 8.457 | 0 | 0 | 0 | 0 | | 3.011 |

Appendix A. Table A1b continued. USA Eastern GB commercial landings at age (thousands of fish; metric tons) and mean weight (kg) and mean length (cm) at age of of Atlantic cod, 1978-2007.

USA Eastern Georges Bank Commercial Landings Mean Length (cm) at Age

| | Age | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | Average |
| 1978 | 39.0 | 50.4 | 57.4 | 64.1 | 72.7 | 78.6 | 78.8 | 87.7 | 85.6 | 94.0 | 114.8 | 114.3 | 0.0 | 105.0 | 117.0 | | 61.8 |
| 1979 | 46.9 | 51.7 | 52.6 | 67.9 | 76.3 | 87.2 | 97.2 | 96.5 | 98.5 | 110.3 | 105.0 | 116.1 | 0.0 | 124.5 | 0.0 | | 67.8 |
| 1980 | 0.0 | 49.8 | 58.4 | 66.5 | 78.9 | 84.5 | 89.0 | 99.5 | 96.3 | 107.0 | 111.0 | 0.0 | 0.0 | 0.0 | 0.0 | | 68.5 |
| 1981 | 46.7 | 49.6 | 56.5 | 65.5 | 73.6 | 85.1 | 91.6 | 96.2 | 106.8 | 110.8 | 123.0 | 126.0 | 0.0 | 0.0 | 0.0 | | 62.7 |
| 1982 | 0.0 | 49.5 | 58.8 | 68.8 | 77.7 | 86.8 | 93.3 | 97.2 | 104.6 | 111.4 | 113.0 | 122.5 | 120.9 | 132.0 | 0.0 | | 62.1 |
| 1983 | 46.7 | 54.0 | 60.8 | 66.7 | 74.6 | 83.2 | 88.1 | 98.7 | 103.1 | 108.3 | 115.6 | 115.4 | 129.0 | 124.6 | 138.0 | | 66.6 |
| 1984 | 49.6 | 54.2 | 60.3 | 67.8 | 75.9 | 83.5 | 92.8 | 95.4 | 102.7 | 104.9 | 105.8 | 115.5 | 120.7 | 127.9 | 0.0 | 126.0 | 70.3 |
| 1985 | 45.0 | 50.9 | 55.7 | 66.6 | 75.8 | 82.7 | 91.5 | 97.9 | 102.0 | 106.1 | 114.5 | 113.7 | 126.0 | 120.0 | 0.0 | | 64.3 |
| 1986 | 44.5 | 48.3 | 58.3 | 62.4 | 74.6 | 85.8 | 92.2 | 96.3 | 106.9 | 113.3 | 104.2 | 118.0 | 0.0 | 0.0 | 0.0 | | 64.4 |
| 1987 | 0.0 | 51.2 | 59.4 | 70.5 | 78.6 | 88.6 | 93.0 | 95.6 | 99.8 | 100.2 | 106.7 | 118.5 | 0.0 | 0.0 | 0.0 | | 60.2 |
| 1988 | 0.0 | 50.7 | 59.2 | 63.8 | 77.2 | 82.2 | 89.2 | 94.3 | 97.8 | 103.8 | 101.0 | 121.3 | 124.5 | 0.0 | 111.0 | | 65.1 |
| 1989 | 0.0 | 54.1 | 57.5 | 66.0 | 74.2 | 79.9 | 82.8 | 96.8 | 98.3 | 99.8 | 104.8 | 109.9 | 0.0 | 0.0 | 0.0 | | 65.0 |
| 1990 | 0.0 | 51.6 | 57.2 | 64.8 | 73.9 | 81.8 | 90.0 | 95.1 | 99.4 | 102.3 | 108.0 | 102.9 | 0.0 | 0.0 | 0.0 | | 63.4 |
| 1991 | 50.5 | 53.9 | 60.6 | 65.7 | 74.3 | 79.8 | 89.4 | 93.4 | 90.5 | 99.9 | 105.8 | 97.0 | 0.0 | 0.0 | 102.7 | | 67.8 |
| 1992 | 46.8 | 52.7 | 60.0 | 67.2 | 73.1 | 80.6 | 85.8 | 92.9 | 99.9 | 111.0 | 112.5 | 0.0 | 0.0 | 0.0 | 0.0 | | 63.4 |
| 1993 | 45.0 | 52.8 | 58.9 | 64.9 | 75.2 | 79.8 | 89.3 | 90.9 | 99.7 | 102.5 | 132.0 | 0.0 | 0.0 | 0.0 | 0.0 | | 63.6 |
| 1994 | 0.0 | 51.5 | 57.5 | 65.7 | 71.1 | 83.6 | 87.9 | 94.6 | 96.4 | 110.4 | 115.1 | 0.0 | 132.0 | 0.0 | 0.0 | | 64.3 |
| 1995 | 0.0 | 51.3 | 57.1 | 68.7 | 78.1 | 86.9 | 102.3 | 101.2 | 102.2 | 120.0 | 129.0 | 0.0 | 0.0 | 0.0 | 0.0 | | 66.9 |
| 1996 | 45.0 | 51.9 | 58.7 | 65.8 | 74.5 | 83.0 | 84.3 | 96.7 | 100.9 | 99.0 | 105.0 | 0.0 | 0.0 | 0.0 | 0.0 | | 66.4 |
| 1997 | 0.0 | 51.7 | 55.5 | 63.0 | 72.7 | 79.7 | 86.2 | 90.7 | 102.9 | 99.5 | 109.2 | 120.0 | 0.0 | 0.0 | 0.0 | | 68.8 |
| 1998 | 0.0 | 52.1 | 57.8 | 67.9 | 74.2 | 80.6 | 87.1 | 90.7 | 100.4 | 102.3 | 105.0 | 102.0 | 0.0 | 0.0 | 0.0 | | 70.4 |
| 1999 | 0.0 | 51.9 | 56.4 | 67.0 | 74.2 | 80.4 | 84.3 | 88.8 | 91.9 | 103.6 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | 66.0 |
| 2000 | 0.0 | 52.0 | 57.9 | 64.9 | 72.5 | 76.5 | 81.5 | 83.5 | 87.4 | 0.0 | 93.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 65.9 |
| 2001 | 0.0 | 50.2 | 56.1 | 62.3 | 67.2 | 76.8 | 80.1 | 87.1 | 94.5 | 97.9 | 92.4 | 99.0 | 0.0 | 0.0 | 0.0 | | 63.1 |
| 2002 | 0.0 | 52.1 | 57.6 | 65.0 | 72.5 | 77.8 | 84.7 | 94.6 | 90.9 | 101.4 | 111.9 | 107.1 | 0.0 | 0.0 | 0.0 | | 67.6 |
| 2003 | 0.0 | 54.6 | 60.2 | 65.4 | 70.5 | 75.5 | 81.3 | 87.5 | 90.9 | 94.6 | 104.8 | 0.0 | 0.0 | 0.0 | 0.0 | | 69.8 |
| 2004 | 0.0 | 57.4 | 59.1 | 66.2 | 71.4 | 78.0 | 79.8 | 90.3 | 91.8 | 92.6 | 97.7 | 105.0 | 0.0 | 0.0 | 0.0 | | 71.3 |
| 2005 | 0.0 | 52.1 | 57.3 | 66.3 | 70.5 | 74.1 | 77.9 | 85.2 | 83.1 | 88.3 | 0.0 | 0.0 | 96.0 | 0.0 | 0.0 | | 71.5 |
| 2006 | 0.0 | 0.0 | 62.1 | 65.1 | 69.9 | 69.6 | 81.1 | 79.6 | 79.8 | 87.0 | 99.0 | 85.3 | 0.0 | 0.0 | 0.0 | | 69.2 |
| 2007 | 0.0 | 54.0 | 57.0 | 65.9 | 68.6 | 72.6 | 87.6 | 85.8 | 85.1 | 93.3 | 96.0 | 0.0 | 0.0 | 0.0 | 0.0 | | 67.3 |

## Appendix A. Table A2. BASE MODEL VPA output and diagnostics for GB cod.

```
 VPA Version 2.7.1

 Model ID: Georges Bank   Cod - spr 2008 Assessment TY 2007


 Input File:
C:\LOB\GBCOD\ASSESS_2008\VPA\TY07\10_PLUS_SVSWEPT\10P_SVSWEPT_CORR_DFO2004_AU
G1
 Date of Run: 01-AUG-2008                         Time of Run: 11:40


 Levenburg-Marquardt Algorithm Completed     7 Iterations
 Residual Sum of Squares =     383.740

 Number of Residuals     =    595
 Number of Parameters    =      8
 Degrees of Freedom      =    587
 Mean Squared Residual   =     0.653730
 Standard Deviation      =     0.808536


 Number of Years =    30
 Number of Ages  =    10
 First Year      =  1978
 Youngest Age    =     1
 Oldest True Age =     9

 Number of Survey Indices Available        =    30
 Number of Survey Indices Used in Estimate =    30


 VPA Classic Method - Auto Estimated Q's


 Stock Numbers Predicted in Terminal Year Plus One (2008)
 Age    Stock Predicted     Std. Error      CV

   1           5158.350   0.246246E+04   0.477374E+00
   2           5777.533   0.195206E+04   0.337870E+00
   3           4312.780   0.134212E+04   0.311197E+00
   4           1201.636   0.348563E+03   0.290074E+00
   5           4150.462   0.112909E+04   0.272039E+00
   6            348.414   0.977986E+02   0.280697E+00
   7            566.199   0.170298E+03   0.300775E+00
   8            218.540   0.684464E+02   0.313198E+00

 Catchability Values for Each Survey Used in Estimate
 INDEX     Catchability    Std. Error      CV

   1       0.219439E-01   0.434391E-02   0.197955E+00
   2       0.919973E-01   0.727614E-02   0.790908E-01
   3       0.186189E+00   0.193080E-01   0.103701E+00
   4       0.316089E+00   0.450858E-01   0.142637E+00
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  5       0.402164E+00   0.624872E-01   0.155377E+00
  6       0.408966E+00   0.614000E-01   0.150135E+00
  7       0.427224E+00   0.771050E-01   0.180479E+00
  8       0.517786E+00   0.835569E-01   0.161374E+00
  9       0.141338E-01   0.106855E-01   0.756029E+00
 10       0.899870E-01   0.208708E-01   0.231931E+00
 11       0.198731E+00   0.467107E-01   0.235044E+00
 12       0.177261E+00   0.223604E-01   0.126144E+00
 13       0.216299E+00   0.540535E-01   0.249901E+00
 14       0.207689E+00   0.355707E-01   0.171269E+00
 15       0.300243E+00   0.112587E+00   0.374986E+00
 16       0.291472E+00   0.165071E+00   0.566335E+00
 17       0.209249E-01   0.562393E-02   0.268767E+00
 18       0.981470E-01   0.209510E-01   0.213466E+00
 19       0.327191E+00   0.335557E-01   0.102557E+00
 20       0.615292E+00   0.779107E-01   0.126624E+00
 21       0.949463E+00   0.112662E+00   0.118658E+00
 22       0.112928E+01   0.189453E+00   0.167763E+00
 23       0.121718E+01   0.235660E+00   0.193612E+00
 24       0.128152E+01   0.264935E+00   0.206735E+00
 25       0.172164E-01   0.366082E-02   0.212636E+00
 26       0.746671E-01   0.874968E-02   0.117182E+00
 27       0.131211E+00   0.152631E-01   0.116325E+00
 28       0.158575E+00   0.229384E-01   0.144654E+00
 29       0.122922E+00   0.223467E-01   0.181795E+00
 30       0.143092E+00   0.233551E-01   0.163218E+00


-- Non-Linear Least Squares Fit --

Default Tolerances Used

Scaled Gradient Tolerance      =    6.055454E-06
Scaled Step Tolerance          =    3.666853E-11
Relative Function Tolerance    =    3.666853E-11
Absolute Function Tolerance    =    4.930381E-32


VPA Method Options

- Catchability Values Estimated as an Analytic Function of N
- Catch Equation Used in Cohort Solution
- Plus Group Backward Calculation Method Used
- Rivard Weights Used for JAN-1 Biomass
- Rivard Weights Used for SSB Biomass
- Rivard Weights Calculation Used  5 Years for Terminal Year Plus One

- Heincke Rule Used in F-Oldest Calculation
- F-Oldest Calculation in Years Prior to Terminal Year
  Uses Stock Sizes in Ages  5 to  8
- Calculation of Population of Age 1 In Year 2008
  =  Stock Estimate

Stock Estimates

Age   1
Age   2
```

```
 Age   3
 Age   4
 Age   5
 Age   6
 Age   7
 Age   8

 Full F in Terminal Year               =   0.1407

 F in Oldest True Age in Terminal Year =   0.1407

 Full F Calculated Using Classic Method

 Age  Input Partial  Calc Partial   Fishing     Used In
      Recruitment    Recruitment    Mortality   Full F    Comments

   1      0.010          0.006       0.0017      NO      Stock Estimate in
T+1
   2      0.110          0.403       0.1044      NO      Stock Estimate in
T+1
   3      0.390          1.000       0.2591      NO      Stock Estimate in
T+1
   4      0.730          0.876       0.2271      NO      Stock Estimate in
T+1
   5      1.000          0.658       0.1705      YES     Stock Estimate in
T+1
   6      1.000          0.721       0.1869      YES     Stock Estimate in
T+1
   7      1.000          0.250       0.0647      YES     Stock Estimate in
T+1
   8      1.000          0.543       0.1407      NO      Input PR * Full F
   9      1.000          0.543       0.1407              Input PR * Full F
```

```
Catch At Age - Input Data

  AGE       1978        1979        1980        1981        1982
--------------------------------------------------------------------

   1        151.6       279.2       339.9      1219.2       775.4
   2        416.8      2242.7      4238.7      3910.7     10457.1
   3       8109.1       953.6      5955.4      4738.2      4434.4
   4       2429.6      4585.0       544.9      2685.5      2988.0
   5        896.8      1206.9      2464.6       317.9      2039.8
   6        178.4       449.8       983.0      1406.0       297.1
   7        240.8       159.5       418.1       417.0       707.2
   8         22.6       304.1        70.4       162.9       198.6
   9         42.1        12.9       138.7       155.5        74.6
  10         10.7        35.0        14.2        66.4        84.6

  AGE       1983        1984        1985        1986        1987
--------------------------------------------------------------------

   1        626.2       280.9       176.0       768.3       103.8
   2       5181.7      1547.7      7443.7      1594.1      7956.1
   3       8753.3      3485.7      2942.2      4576.3      1515.5
   4       2680.4      3328.4      1690.1       860.2      2170.1
   5       1155.3       923.9      2097.7       525.3       299.7
   6        746.4       560.2       496.5       615.4       249.9
   7         94.6       450.3       267.2        85.5       277.3
   8        175.0        58.9       196.8        70.4        56.1
   9         67.7       167.0        27.7        56.0        36.2
  10        112.6       124.9        89.7        27.8        26.0

  AGE       1988        1989        1990        1991        1992
--------------------------------------------------------------------

   1        324.9       891.5        71.8       278.7       191.7
   2       2352.1      2608.6      5561.1      1963.0      4808.4
   3       8368.3      3032.8      5373.4      3491.4      2286.3
   4       1074.1      4254.4      1964.0      3160.5      1070.7
   5       1575.6       383.5      2272.1      1442.1      1500.0
   6        223.8       534.2       230.6      1088.0       448.1
   7        150.3        81.4       229.4       141.3       356.0
   8        218.0        51.2        24.6        89.7        44.1
   9         46.5        60.2        23.2        27.5        36.4
  10         52.5        21.3        40.4        26.0        10.4
```

```
Catch At Age - Input Data

  AGE       1993        1994        1995        1996        1997
___________________________________________________________________

   1       299.2        94.4        32.3        64.9       126.9
   2      1534.9       614.6       652.8       287.3       685.2
   3      4429.4      1543.4      1429.0       986.6       749.6
   4      1224.8      1987.7       669.9      1269.8      1020.7
   5       475.3       425.6       382.3       256.3       882.9
   6       535.6        97.6        41.2       183.8       147.7
   7       178.0       146.2        21.4        17.9        94.4
   8       141.0        51.2        20.0        11.6        18.9
   9        43.1        30.5         6.4        11.3        10.1
  10        21.2         5.6         1.4         0.3         3.9

  AGE       1998        1999        2000        2001        2002
___________________________________________________________________

   1        63.3        47.7       113.5        11.7        33.6
   2       918.9       356.3       943.2       719.8       113.0
   3      1310.3      2021.8       741.1      2667.3      1182.7
   4       494.3       852.6      1156.4       751.6      1516.2
   5       385.6       286.6       315.8       698.7       365.4
   6       285.2       125.8        88.0       180.4       371.5
   7        40.2       143.8        46.3        54.8        84.7
   8        16.0        22.2        38.8        25.8        18.7
   9         5.6         5.0         4.2        14.8        10.6
  10         2.9         3.4         1.0         1.3         6.5

  AGE       2003        2004        2005        2006        2007
___________________________________________________________________

   1        17.0        50.5        12.3        32.8        10.6
   2       201.3        69.4       364.1        69.7       526.1
   3       404.4       434.3       201.8       842.8       395.2
   4       800.7       260.1       578.4       208.3      1175.8
   5       910.4       313.6       144.5       366.1        71.9
   6       156.0       253.0       106.0        70.8       129.2
   7       142.4        58.2        85.3        31.2        16.2
   8        28.2        49.2        18.0        28.5        10.4
   9         6.5        11.8         8.9         3.8         8.6
  10         2.9         5.0         3.7         3.4         1.1
```

```
Weight At Age - Input Data

 AGE        1978        1979        1980        1981        1982
--------------------------------------------------------------------

  1       0.5787      0.6942      0.6438      0.5873      0.6430
  2       1.2513      1.3643      1.4133      1.4411      1.3928
  3       2.4408      1.8920      2.4308      2.3815      2.5397
  4       3.4074      4.2804      3.5465      3.5294      3.7201
  5       4.0144      4.9312      5.5826      5.0546      5.2823
  6       5.6957      7.1757      6.7481      7.3032      6.5758
  7       6.6453      9.6642      8.3051      8.7797      9.4656
  8       8.7084     10.3497      9.9256      9.7997      9.7448
  9       9.9364     10.4378      9.2950     14.0178     12.9721
 10      13.8870     13.6108     14.8999     16.7990     15.6229

 AGE        1983        1984        1985        1986        1987
--------------------------------------------------------------------

  1       0.6763      0.5405      0.8055      0.6738      0.5817
  2       1.4363      1.4991      1.3855      1.3568      1.4684
  3       2.3895      2.4762      2.0750      2.4477      2.4763
  4       3.3518      3.6676      3.7198      3.6106      4.1715
  5       4.7839      4.9374      4.9774      5.4941      5.7677
  6       6.4468      6.5544      6.4394      7.1726      7.7772
  7       8.4913      8.7376      8.2465      8.8770      8.9078
  8      10.6665     10.3090     10.2787      9.9439     10.3361
  9      11.6989     11.0933     11.7651     12.9472     12.0274
 10      16.3190     14.6426     14.0475     14.5623     15.6415

 AGE        1988        1989        1990        1991        1992
--------------------------------------------------------------------

  1       0.4918      0.4347      0.5311      0.6581      0.8296
  2       1.3794      1.4362      1.4893      1.5196      1.4349
  3       2.3728      2.2041      2.4630      2.4992      2.4077
  4       3.5065      3.7324      3.5732      3.5198      3.7982
  5       5.4118      5.1806      4.9668      4.8089      4.5200
  6       6.7808      6.5629      6.4025      5.8249      6.0428
  7       8.7219      7.9373      8.4042      7.3177      7.0854
  8      10.4333      9.9761     11.1911      9.3877      9.4720
  9      11.5348     11.2867     12.4247      9.6151     11.8412
 10      14.9262     14.6514     14.5119     14.6490     18.8362
```

```
Weight At Age - Input Data

  AGE        1993        1994        1995        1996        1997
 ------------------------------------------------------------------

   1       0.2837      0.4771      0.3963      0.4867      0.5385
   2       1.3063      1.1976      1.3467      1.4419      1.4631
   3       2.2082      2.1531      1.9769      2.3910      2.3278
   4       3.2271      3.5435      3.7206      3.2180      3.4446
   5       4.9843      4.7869      5.2487      4.8754      4.0326
   6       5.8198      7.0741      7.4302      6.4963      5.7339
   7       7.3782      7.1760      9.3273      8.1007      7.7343
   8       8.9218      9.1163     12.1972      9.6991      8.0901
   9      11.1348      9.0029     11.8414     10.9742     11.4196
  10      12.2279     15.7618     19.1176      8.6207     12.0867

  AGE        1998        1999        2000        2001        2002
 ------------------------------------------------------------------

   1       0.6185      0.5340      0.3879      0.6008      0.4900
   2       1.4324      1.4313      1.5286      1.3651      1.3165
   3       2.2614      2.1372      2.3862      2.2118      2.1052
   4       3.4254      3.3549      3.3875      2.9372      2.9569
   5       4.5713      4.5433      4.5495      4.1007      3.9493
   6       5.5756      5.8669      5.4719      5.2650      5.1562
   7       7.3994      6.6406      6.9962      5.9799      6.4745
   8       7.7535      8.4061      8.0125      7.6805      8.0004
   9      11.8255      9.5624      8.0492      9.0431      9.2479
  10      12.3102     13.2010     12.5970      9.7372     11.7081

  AGE        2003        2004        2005        2006        2007
 ------------------------------------------------------------------

   1       0.6020      0.3318      0.4309      0.3791      0.4225
   2       1.4576      1.5332      1.0351      1.0785      1.4203
   3       2.2536      2.3640      2.1015      2.0931      1.9169
   4       2.9071      3.0802      3.0681      3.1067      2.8988
   5       3.8660      3.8831      4.0035      3.6792      3.6265
   6       4.7097      4.8244      4.9245      4.5349      4.1726
   7       5.7888      5.6511      5.4675      6.4617      5.9316
   8       6.9183      7.3709      7.4969      6.3936      6.9569
   9       8.2509      8.5524      8.7863      7.5189      6.9220
  10      10.4481     11.1003     11.3704      9.0737      9.0701
```

```
JAN-1 Weights at Age - Input Data

 AGE        1978         1979         1980         1981         1982
____________________________________________________________________

  1       0.3769       0.4865       0.4303       0.3814       0.4302
  2       1.0176       0.8885       0.9905       0.9632       0.9044
  3       1.8431       1.5387       1.8211       1.8346       1.9131
  4       2.8324       3.2323       2.5904       2.9290       2.9765
  5       3.0026       4.0991       4.8883       4.2339       4.3178
  6       4.3726       5.3671       5.7686       6.3852       5.7652
  7       5.3249       7.4192       7.7198       7.6972       8.3144
  8       7.9543       8.2932       9.7940       9.0215       9.2497
  9       9.3022       9.5340       9.8082      11.7956      11.2749
 10      13.8870      13.6108      14.8999      16.7990      15.6229

 AGE        1983         1984         1985         1986         1987
____________________________________________________________________

  1       0.4542       0.3376       0.6206       0.4564       0.3777
  2       0.9610       1.0069       0.8654       1.0454       0.9947
  3       1.8243       1.8859       1.7637       1.8415       1.8330
  4       2.9176       2.9604       3.0350       2.7372       3.1954
  5       4.2186       4.0681       4.2726       4.5207       4.5634
  6       5.8356       5.5996       5.6386       5.9750       6.5367
  7       7.4724       7.5053       7.3519       7.5606       7.9933
  8      10.0481       9.3561       9.4769       9.0555       9.5788
  9      10.6772      10.8778      11.0130      11.5361      10.9362
 10      16.3190      14.6426      14.0475      14.5623      15.6415

 AGE        1988         1989         1990         1991         1992
____________________________________________________________________

  1       0.2878       0.2349       0.3140       0.4457       0.6611
  2       0.8958       0.8404       0.8046       0.8984       0.9718
  3       1.8666       1.7437       1.8808       1.9293       1.9128
  4       2.9467       2.9759       2.8064       2.9444       3.0810
  5       4.7514       4.2621       4.3056       4.1453       3.9887
  6       6.2538       5.9596       5.7592       5.3788       5.3907
  7       8.2360       7.3363       7.4267       6.8448       6.4243
  8       9.6404       9.3279       9.4248       8.8823       8.3255
  9      10.9190      10.8516      11.1333      10.3732      10.5433
 10      14.9262      14.6514      14.5119      14.6490      18.8362
```

```
JAN-1 Weights at Age - Input Data

  AGE        1993        1994        1995        1996        1997

    1      0.1381      0.2840      0.2078      0.2807      0.3302
    2      1.0410      0.5829      0.8016      0.7559      0.8439
    3      1.7800      1.6771      1.5387      1.7944      1.8321
    4      2.7875      2.7973      2.8303      2.5222      2.8699
    5      4.3510      3.9304      4.3126      4.2590      3.6023
    6      5.1289      5.9380      5.9639      5.8393      5.2873
    7      6.6772      6.4624      8.1229      7.7582      7.0883
    8      7.9508      8.2013      9.3556      9.5114      8.0954
    9     10.2698      8.9623     10.3899     11.5696     10.5243
   10     12.2279     15.7618     19.1176      8.6207     12.0867

  AGE        1998        1999        2000        2001        2002

    1      0.4066      0.3156      0.2068      0.4059      0.2841
    2      0.8783      0.9409      0.9035      0.7277      0.8894
    3      1.8190      1.7497      1.8481      1.8387      1.6952
    4      2.8238      2.7544      2.6907      2.6474      2.5574
    5      3.9682      3.9449      3.9068      3.7271      3.4059
    6      4.7417      5.1787      4.9860      4.8942      4.5983
    7      6.5136      6.0848      6.4067      5.7203      5.8385
    8      7.7439      7.8867      7.2944      7.3304      6.9168
    9      9.7811      8.6106      8.2257      8.5122      8.4278
   10     12.3102     13.2010     12.5970      9.7372     11.7081

  AGE        2003        2004        2005        2006        2007

    1      0.3772      0.1879      0.2724      0.1959      0.2433
    2      0.8451      0.9607      0.5860      0.6817      0.7338
    3      1.7225      1.8563      1.7950      1.4719      1.4378
    4      2.4739      2.6347      2.6931      2.5551      2.4632
    5      3.3810      3.3598      3.5116      3.3598      3.3566
    6      4.3128      4.3187      4.3729      4.2609      3.9181
    7      5.4634      5.1590      5.1359      5.6410      5.1864
    8      6.6927      6.5321      6.5089      5.9124      6.7047
    9      8.1247      7.6921      8.0475      7.5079      6.6526
   10     10.4481     11.1003     11.3704      9.0737      9.0701
```

```
JAN-1 Weights at Age - Input Data

  AGE       2008
__________________________________________________________________

   1       0.2553
   2       0.7615
   3       1.6567
   4       2.5640
   5       3.3938
   6       4.2367
   7       5.3171
   8       6.4702
   9       7.6050
  10      10.2125

SSB Weight At Age - Input Data

  AGE       1978        1979        1980        1981        1982
__________________________________________________________________

   1       0.3769      0.4865      0.4303      0.3814      0.4302
   2       1.0176      0.8885      0.9905      0.9632      0.9044
   3       1.8431      1.5387      1.8211      1.8346      1.9131
   4       2.8324      3.2323      2.5904      2.9290      2.9765
   5       3.0026      4.0991      4.8883      4.2339      4.3178
   6       4.3726      5.3671      5.7686      6.3852      5.7652
   7       5.3249      7.4192      7.7198      7.6972      8.3144
   8       7.9543      8.2932      9.7940      9.0215      9.2497
   9       9.3022      9.5340      9.8082     11.7956     11.2749
  10      13.8870     13.6108     14.8999     16.7990     15.6229

  AGE       1983        1984        1985        1986        1987
__________________________________________________________________

   1       0.4542      0.3376      0.6206      0.4564      0.3777
   2       0.9610      1.0069      0.8654      1.0454      0.9947
   3       1.8243      1.8859      1.7637      1.8415      1.8330
   4       2.9176      2.9604      3.0350      2.7372      3.1954
   5       4.2186      4.0681      4.2726      4.5207      4.5634
   6       5.8356      5.5996      5.6386      5.9750      6.5367
   7       7.4724      7.5053      7.3519      7.5606      7.9933
   8      10.0481      9.3561      9.4769      9.0555      9.5788
   9      10.6772     10.8778     11.0130     11.5361     10.9362
  10      16.3190     14.6426     14.0475     14.5623     15.6415

  AGE       1988        1989        1990        1991        1992
__________________________________________________________________

   1       0.2878      0.2349      0.3140      0.4457      0.6611
   2       0.8958      0.8404      0.8046      0.8984      0.9718
   3       1.8666      1.7437      1.8808      1.9293      1.9128
   4       2.9467      2.9759      2.8064      2.9444      3.0810
```

```
   5      4.7514      4.2621      4.3056      4.1453      3.9887
   6      6.2538      5.9596      5.7592      5.3788      5.3907
   7      8.2360      7.3363      7.4267      6.8448      6.4243
   8      9.6404      9.3279      9.4248      8.8823      8.3255
   9     10.9190     10.8516     11.1333     10.3732     10.5433
  10     14.9262     14.6514     14.5119     14.6490     18.8362


SSB Weight At Age - Input Data


  AGE       1993        1994        1995        1996        1997
__________________________________________________________________

   1      0.1381      0.2840      0.2078      0.2807      0.3302
   2      1.0410      0.5829      0.8016      0.7559      0.8439
   3      1.7800      1.6771      1.5387      1.7944      1.8321
   4      2.7875      2.7973      2.8303      2.5222      2.8699
   5      4.3510      3.9304      4.3126      4.2590      3.6023
   6      5.1289      5.9380      5.9639      5.8393      5.2873
   7      6.6772      6.4624      8.1229      7.7582      7.0883
   8      7.9508      8.2013      9.3556      9.5114      8.0954
   9     10.2698      8.9623     10.3899     11.5696     10.5243
  10     12.2279     15.7618     19.1176      8.6207     12.0867

  AGE       1998        1999        2000        2001        2002
__________________________________________________________________

   1      0.4066      0.3156      0.2068      0.4059      0.2841
   2      0.8783      0.9409      0.9035      0.7277      0.8894
   3      1.8190      1.7497      1.8481      1.8387      1.6952
   4      2.8238      2.7544      2.6907      2.6474      2.5574
   5      3.9682      3.9449      3.9068      3.7271      3.4059
   6      4.7417      5.1787      4.9860      4.8942      4.5983
   7      6.5136      6.0848      6.4067      5.7203      5.8385
   8      7.7439      7.8867      7.2944      7.3304      6.9168
   9      9.7811      8.6106      8.2257      8.5122      8.4278
  10     12.3102     13.2010     12.5970      9.7372     11.7081

  AGE       2003        2004        2005        2006        2007
__________________________________________________________________

   1      0.3772      0.1879      0.2724      0.1959      0.2433
   2      0.8451      0.9607      0.5860      0.6817      0.7338
   3      1.7225      1.8563      1.7950      1.4719      1.4378
   4      2.4739      2.6347      2.6931      2.5551      2.4632
   5      3.3810      3.3598      3.5116      3.3598      3.3566
   6      4.3128      4.3187      4.3729      4.2609      3.9181
   7      5.4634      5.1590      5.1359      5.6410      5.1864
   8      6.6927      6.5321      6.5089      5.9124      6.7047
   9      8.1247      7.6921      8.0475      7.5079      6.6526
  10     10.4481     11.1003     11.3704      9.0737      9.0701
```

```
Natural Mortality - Input Data

 AGE         1978        1979        1980        1981        1982
---------------------------------------------------------------------

   1       0.2000      0.2000      0.2000      0.2000      0.2000
   2       0.2000      0.2000      0.2000      0.2000      0.2000
   3       0.2000      0.2000      0.2000      0.2000      0.2000
   4       0.2000      0.2000      0.2000      0.2000      0.2000
   5       0.2000      0.2000      0.2000      0.2000      0.2000
   6       0.2000      0.2000      0.2000      0.2000      0.2000
   7       0.2000      0.2000      0.2000      0.2000      0.2000
   8       0.2000      0.2000      0.2000      0.2000      0.2000
   9       0.2000      0.2000      0.2000      0.2000      0.2000
  10       0.2000      0.2000      0.2000      0.2000      0.2000

 AGE         1983        1984        1985        1986        1987
---------------------------------------------------------------------

   1       0.2000      0.2000      0.2000      0.2000      0.2000
   2       0.2000      0.2000      0.2000      0.2000      0.2000
   3       0.2000      0.2000      0.2000      0.2000      0.2000
   4       0.2000      0.2000      0.2000      0.2000      0.2000
   5       0.2000      0.2000      0.2000      0.2000      0.2000
   6       0.2000      0.2000      0.2000      0.2000      0.2000
   7       0.2000      0.2000      0.2000      0.2000      0.2000
   8       0.2000      0.2000      0.2000      0.2000      0.2000
   9       0.2000      0.2000      0.2000      0.2000      0.2000
  10       0.2000      0.2000      0.2000      0.2000      0.2000

 AGE         1988        1989        1990        1991        1992
---------------------------------------------------------------------

   1       0.2000      0.2000      0.2000      0.2000      0.2000
   2       0.2000      0.2000      0.2000      0.2000      0.2000
   3       0.2000      0.2000      0.2000      0.2000      0.2000
   4       0.2000      0.2000      0.2000      0.2000      0.2000
   5       0.2000      0.2000      0.2000      0.2000      0.2000
   6       0.2000      0.2000      0.2000      0.2000      0.2000
   7       0.2000      0.2000      0.2000      0.2000      0.2000
   8       0.2000      0.2000      0.2000      0.2000      0.2000
   9       0.2000      0.2000      0.2000      0.2000      0.2000
  10       0.2000      0.2000      0.2000      0.2000      0.2000
```

```
Natural Mortality - Input Data

  AGE        1993        1994        1995        1996        1997
-------------------------------------------------------------------

   1       0.2000      0.2000      0.2000      0.2000      0.2000
   2       0.2000      0.2000      0.2000      0.2000      0.2000
   3       0.2000      0.2000      0.2000      0.2000      0.2000
   4       0.2000      0.2000      0.2000      0.2000      0.2000
   5       0.2000      0.2000      0.2000      0.2000      0.2000
   6       0.2000      0.2000      0.2000      0.2000      0.2000
   7       0.2000      0.2000      0.2000      0.2000      0.2000
   8       0.2000      0.2000      0.2000      0.2000      0.2000
   9       0.2000      0.2000      0.2000      0.2000      0.2000
  10       0.2000      0.2000      0.2000      0.2000      0.2000

  AGE        1998        1999        2000        2001        2002
-------------------------------------------------------------------

   1       0.2000      0.2000      0.2000      0.2000      0.2000
   2       0.2000      0.2000      0.2000      0.2000      0.2000
   3       0.2000      0.2000      0.2000      0.2000      0.2000
   4       0.2000      0.2000      0.2000      0.2000      0.2000
   5       0.2000      0.2000      0.2000      0.2000      0.2000
   6       0.2000      0.2000      0.2000      0.2000      0.2000
   7       0.2000      0.2000      0.2000      0.2000      0.2000
   8       0.2000      0.2000      0.2000      0.2000      0.2000
   9       0.2000      0.2000      0.2000      0.2000      0.2000
  10       0.2000      0.2000      0.2000      0.2000      0.2000

  AGE        2003        2004        2005        2006        2007
-------------------------------------------------------------------

   1       0.2000      0.2000      0.2000      0.2000      0.2000
   2       0.2000      0.2000      0.2000      0.2000      0.2000
   3       0.2000      0.2000      0.2000      0.2000      0.2000
   4       0.2000      0.2000      0.2000      0.2000      0.2000
   5       0.2000      0.2000      0.2000      0.2000      0.2000
   6       0.2000      0.2000      0.2000      0.2000      0.2000
   7       0.2000      0.2000      0.2000      0.2000      0.2000
   8       0.2000      0.2000      0.2000      0.2000      0.2000
   9       0.2000      0.2000      0.2000      0.2000      0.2000
  10       0.2000      0.2000      0.2000      0.2000      0.2000

Proportion of Natural Mortality Before Spawning =       0.1667
Proportion of Fishing Mortality Before Spawning =       0.1667
```

```
Maturity - Input Data

  AGE       1978        1979        1980        1981        1982
_____________________________________________________________________

   1       0.0800      0.0700      0.0900      0.0900      0.0800
   2       0.3300      0.3400      0.3800      0.3800      0.3600
   3       0.7500      0.7800      0.7900      0.7900      0.7900
   4       0.9500      0.9600      0.9600      0.9600      0.9600
   5       0.9900      0.9900      0.9900      0.9900      0.9900
   6       1.0000      1.0000      1.0000      1.0000      1.0000
   7       1.0000      1.0000      1.0000      1.0000      1.0000
   8       1.0000      1.0000      1.0000      1.0000      1.0000
   9       1.0000      1.0000      1.0000      1.0000      1.0000
  10       1.0000      1.0000      1.0000      1.0000      1.0000

  AGE       1983        1984        1985        1986        1987
_____________________________________________________________________

   1       0.0800      0.1300      0.1800      0.1600      0.2000
   2       0.4100      0.4900      0.5900      0.5800      0.5900
   3       0.8500      0.8700      0.9100      0.9100      0.8900
   4       0.9800      0.9800      0.9900      0.9900      0.9800
   5       1.0000      1.0000      1.0000      1.0000      1.0000
   6       1.0000      1.0000      1.0000      1.0000      1.0000
   7       1.0000      1.0000      1.0000      1.0000      1.0000
   8       1.0000      1.0000      1.0000      1.0000      1.0000
   9       1.0000      1.0000      1.0000      1.0000      1.0000
  10       1.0000      1.0000      1.0000      1.0000      1.0000

  AGE       1988        1989        1990        1991        1992
_____________________________________________________________________

   1       0.2500      0.2000      0.1200      0.1300      0.0900
   2       0.6400      0.6100      0.4600      0.5300      0.4700
   3       0.9000      0.9100      0.8500      0.8900      0.8900
   4       0.9800      0.9800      0.9700      0.9800      0.9900
   5       1.0000      1.0000      1.0000      1.0000      1.0000
   6       1.0000      1.0000      1.0000      1.0000      1.0000
   7       1.0000      1.0000      1.0000      1.0000      1.0000
   8       1.0000      1.0000      1.0000      1.0000      1.0000
   9       1.0000      1.0000      1.0000      1.0000      1.0000
  10       1.0000      1.0000      1.0000      1.0000      1.0000
```

```
Maturity - Input Data

    AGE        1993         1994         1995         1996         1997
-----------------------------------------------------------------------

     1        0.0400       0.0400       0.0400       0.0500       0.1000
     2        0.4300       0.4100       0.5000       0.4800       0.5700
     3        0.9300       0.9200       0.9600       0.9500       0.9400
     4        1.0000       1.0000       1.0000       1.0000       0.9900
     5        1.0000       1.0000       1.0000       1.0000       1.0000
     6        1.0000       1.0000       1.0000       1.0000       1.0000
     7        1.0000       1.0000       1.0000       1.0000       1.0000
     8        1.0000       1.0000       1.0000       1.0000       1.0000
     9        1.0000       1.0000       1.0000       1.0000       1.0000
    10        1.0000       1.0000       1.0000       1.0000       1.0000

    AGE        1998         1999         2000         2001         2002
-----------------------------------------------------------------------

     1        0.0900       0.0700       0.0700       0.0800       0.0700
     2        0.5600       0.5100       0.5100       0.5000       0.4300
     3        0.9400       0.9300       0.9400       0.9300       0.8800
     4        1.0000       0.9900       1.0000       0.9900       0.9900
     5        1.0000       1.0000       1.0000       1.0000       1.0000
     6        1.0000       1.0000       1.0000       1.0000       1.0000
     7        1.0000       1.0000       1.0000       1.0000       1.0000
     8        1.0000       1.0000       1.0000       1.0000       1.0000
     9        1.0000       1.0000       1.0000       1.0000       1.0000
    10        1.0000       1.0000       1.0000       1.0000       1.0000

    AGE        2003         2004         2005         2006         2007
-----------------------------------------------------------------------

     1        0.0400       0.0700       0.0600       0.0500       0.0400
     2        0.3300       0.3800       0.3600       0.3500       0.3700
     3        0.8400       0.8300       0.8300       0.8400       0.8900
     4        0.9800       0.9800       0.9800       0.9800       0.9900
     5        1.0000       1.0000       1.0000       1.0000       1.0000
     6        1.0000       1.0000       1.0000       1.0000       1.0000
     7        1.0000       1.0000       1.0000       1.0000       1.0000
     8        1.0000       1.0000       1.0000       1.0000       1.0000
     9        1.0000       1.0000       1.0000       1.0000       1.0000
    10        1.0000       1.0000       1.0000       1.0000       1.0000
```

```
Input Partial Recruitment

  AGE

   1       0.0100
   2       0.1100
   3       0.3900
   4       0.7300
   5       1.0000
   6       1.0000
   7       1.0000
   8       1.0000
   9       1.0000


Input F-Plus Ratio

  YEAR

  1978       1.0000
  1979       1.0000
  1980       1.0000
  1981       1.0000
  1982       1.0000
  1983       1.0000
  1984       1.0000
  1985       1.0000
  1986       1.0000
  1987       1.0000
  1988       1.0000
  1989       1.0000
  1990       1.0000
  1991       1.0000
  1992       1.0000
  1993       1.0000
  1994       1.0000
  1995       1.0000
  1996       1.0000
  1997       1.0000
  1998       1.0000
  1999       1.0000
  2000       1.0000
  2001       1.0000
  2002       1.0000
  2003       1.0000
  2004       1.0000
  2005       1.0000
  2006       1.0000
  2007       1.0000
```

```
 SURVEY - INPUT DATA

INDEX             1           2           3           4           5

SURVEY TAG     spr_36      spr_36      spr_36      spr_36      spr_36

AGE                1           2           3           4           5
TIME            JAN-1       JAN-1       JAN-1       JAN-1       JAN-1
TYPE           NUMBERS     NUMBERS     NUMBERS     NUMBERS     NUMBERS
RETRO FLAG        1           1           1           1           1
 ________________________________________________________________________

    1978        0.0000      0.0000      0.0000      0.0000      0.0000
    1979        0.0000      0.0000      0.0000      0.0000      0.0000
    1980        0.0000      0.0000      0.0000      0.0000      0.0000
    1981        0.0000      0.0000      0.0000      0.0000      0.0000
    1982      693.8277   7425.1446  12980.2741  11371.7250   8480.5714
    1983      452.8527   2666.2982   4121.4375   1087.6661    952.1518
    1984      549.4339    588.7768   1039.1705   1691.4696    576.8920
    1985      151.7705   3624.3241    906.1152   1516.7491   1929.3027
    1986     1190.5313    558.7232   2519.5821    498.8893    737.6786
    1987       26.9116   2202.7902    516.9214   1042.7223     84.8330
    1988      983.8446    831.6643   4302.5786    558.4500    879.0670
    1989      424.0286   1926.7071    910.3500   2162.6277    321.1634
    1990      236.8768   1258.8348   2373.0027    921.0054   1245.7205
    1991     1402.4089    721.0125    940.8134   1268.9438    654.0750
    1992      167.6170   1710.8679    639.5946    229.6366    372.8009
    1993       11.6116    544.7893   1784.2259    280.4545    122.2634
    1994      170.4857    372.1179    273.2143    295.7545     45.3536
    1995       67.6205    521.4295   1166.4884    729.4821    818.2768
    1996       99.7232    292.2027   1005.7018   1703.7643    237.9696
    1997      397.2536    597.1098    232.5054    667.4625    576.8920
    1998      152.0438    908.7107   1773.1607   1158.1554   1031.2473
    1999      290.0170    397.3902    831.9375    696.2866    325.3982
    2000      301.4920   1101.8732   1133.5661   1558.8241    505.8563
    2001       82.9205    320.4804   1084.2509    218.8446    522.7955
    2002       88.3848    126.9080    523.6152   1356.5089    327.0375
    2003       22.4036    290.7000    370.4786    850.3795    951.3321
    2004      870.0509     79.2321    790.8188   1921.3795   1849.5241
    2005       16.2563    660.9054    188.2446    861.9911    374.8500
    2006      243.9804    315.5625   1783.9527    453.3991    988.2161
    2007      170.8955    872.7830    513.0964   2450.3223    247.1223
    2008      864.1768   1136.0250    790.2723    479.9009   1312.2482
```

```
 SURVEY - INPUT DATA

INDEX              6            7            8            9           10

SURVEY TAG      spr_36       spr_36       spr_36       spr_41       spr_41

AGE                6            7            8            1            2
TIME             JAN-1        JAN-1        JAN-1        JAN-1        JAN-1
TYPE            NUMBERS      NUMBERS      NUMBERS      NUMBERS      NUMBERS
RETRO FLAG         1            1            1            1            1
 _________________________________________________________________________

    1978        0.0000       0.0000       0.0000     477.9000     246.6000
    1979        0.0000       0.0000       0.0000     550.6714    1668.4714
    1980        0.0000       0.0000       0.0000      40.1143    2850.4286
    1981        0.0000       0.0000       0.0000    2959.9714    2381.4000
    1982      400.1223    2548.6795     503.3973       0.0000       0.0000
    1983      605.3063      37.1571     298.6232       0.0000       0.0000
    1984      546.9750     285.2357       0.0000       0.0000       0.0000
    1985      362.5554     262.1491     245.7563       0.0000       0.0000
    1986      844.0955      84.2866     170.8955       0.0000       0.0000
    1987      245.0732     185.1027      44.8071       0.0000       0.0000
    1988       87.4286      50.5446      67.2107       0.0000       0.0000
    1989      479.6277      68.9866      53.9598       0.0000       0.0000
    1990      178.1357     195.4848      17.6223       0.0000       0.0000
    1991      448.2080      73.9045      55.4625       0.0000       0.0000
    1992      194.5286     216.7955      26.7750       0.0000       0.0000
    1993      188.7911      40.0259      46.9929       0.0000       0.0000
    1994        7.7866      60.2438       0.0000       0.0000       0.0000
    1995      145.7598     319.1143      38.2500       0.0000       0.0000
    1996      284.8259      37.8402      24.7259       0.0000       0.0000
    1997       68.0304     182.9170      27.4580       0.0000       0.0000
    1998      727.5696     138.7929      42.2116       0.0000       0.0000
    1999      162.9723      86.8821      41.6652       0.0000       0.0000
    2000      139.8857      34.8348      27.4580       0.0000       0.0000
    2001      241.2482      31.5563      24.1795       0.0000       0.0000
    2002      306.9563      53.2768       0.0000       0.0000       0.0000
    2003       87.5652     108.6027      16.8027       0.0000       0.0000
    2004     1219.2188     243.9804     356.8179       0.0000       0.0000
    2005      280.4545     174.0375      40.7089       0.0000       0.0000
    2006      290.7000     165.7045      73.6313       0.0000       0.0000
    2007      285.7821      42.2116      24.7259       0.0000       0.0000
    2008       51.6375      61.4732       0.0000       0.0000       0.0000
```

```
 SURVEY - INPUT DATA

INDEX            11          12          13          14          15

SURVEY TAG     spr_41      spr_41      spr_41      spr_41      spr_41

AGE                3           4           5           6           7
TIME            JAN-1       JAN-1       JAN-1       JAN-1       JAN-1
TYPE          NUMBERS     NUMBERS     NUMBERS     NUMBERS     NUMBERS
RETRO FLAG       1           1           1           1           1

    1978     7111.1571   1249.0714    999.7714    182.0571    915.8143
    1979      353.7000   2380.5000    702.7714    302.7857    107.4857
    1980     3458.0571    272.9571   2192.1429    480.4714    238.5000
    1981     3613.8857   2166.3000    136.1571   1129.6286    331.9714
    1982        0.0000      0.0000      0.0000      0.0000      0.0000
    1983        0.0000      0.0000      0.0000      0.0000      0.0000
    1984        0.0000      0.0000      0.0000      0.0000      0.0000
    1985        0.0000      0.0000      0.0000      0.0000      0.0000
    1986        0.0000      0.0000      0.0000      0.0000      0.0000
    1987        0.0000      0.0000      0.0000      0.0000      0.0000
    1988        0.0000      0.0000      0.0000      0.0000      0.0000
    1989        0.0000      0.0000      0.0000      0.0000      0.0000
    1990        0.0000      0.0000      0.0000      0.0000      0.0000
    1991        0.0000      0.0000      0.0000      0.0000      0.0000
    1992        0.0000      0.0000      0.0000      0.0000      0.0000
    1993        0.0000      0.0000      0.0000      0.0000      0.0000
    1994        0.0000      0.0000      0.0000      0.0000      0.0000
    1995        0.0000      0.0000      0.0000      0.0000      0.0000
    1996        0.0000      0.0000      0.0000      0.0000      0.0000
    1997        0.0000      0.0000      0.0000      0.0000      0.0000
    1998        0.0000      0.0000      0.0000      0.0000      0.0000
    1999        0.0000      0.0000      0.0000      0.0000      0.0000
    2000        0.0000      0.0000      0.0000      0.0000      0.0000
    2001        0.0000      0.0000      0.0000      0.0000      0.0000
    2002        0.0000      0.0000      0.0000      0.0000      0.0000
    2003        0.0000      0.0000      0.0000      0.0000      0.0000
    2004        0.0000      0.0000      0.0000      0.0000      0.0000
    2005        0.0000      0.0000      0.0000      0.0000      0.0000
    2006        0.0000      0.0000      0.0000      0.0000      0.0000
    2007        0.0000      0.0000      0.0000      0.0000      0.0000
    2008        0.0000      0.0000      0.0000      0.0000      0.0000
```

```
 SURVEY - INPUT DATA

INDEX             16          17          18          19          20

SURVEY TAG      spr_41      sp_can      sp_can      sp_can      sp_can

AGE                8           1           2           3           4
TIME             JAN-1       JAN-1       JAN-1       JAN-1       JAN-1
TYPE            NUMBERS     NUMBERS     NUMBERS     NUMBERS     NUMBERS
RETRO FLAG         1           1           1           1           1
 ________________________________________________________________________

    1978       83.7000      0.0000      0.0000      0.0000      0.0000
    1979      178.2000      0.0000      0.0000      0.0000      0.0000
    1980       39.8571      0.0000      0.0000      0.0000      0.0000
    1981      169.8429      0.0000      0.0000      0.0000      0.0000
    1982        0.0000      0.0000      0.0000      0.0000      0.0000
    1983        0.0000      0.0000      0.0000      0.0000      0.0000
    1984        0.0000      0.0000      0.0000      0.0000      0.0000
    1985        0.0000      0.0000      0.0000      0.0000      0.0000
    1986        0.0000    844.4316   3194.7662   3954.7547    520.7328
    1987        0.0000    351.8465   2997.7322   1308.8690   1534.0507
    1988        0.0000    394.0681   1421.4599   6558.4188    816.2839
    1989        0.0000   2294.0392   3912.5331   1942.1927   4011.0501
    1990        0.0000    591.1021   3434.0218   5319.9191   2927.3629
    1991        0.0000   1660.7155   1632.5678   2589.5902   3025.8799
    1992        0.0000    154.8125   4025.1240   2491.0732   1125.9088
    1993        0.0000      0.0000      0.0000      0.0000      0.0000
    1994        0.0000      0.0000      0.0000      0.0000      0.0000
    1995        0.0000     98.5170    942.9486   2111.0790   1210.3520
    1996        0.0000    197.0340    689.6191   3251.0617   5657.6917
    1997        0.0000    450.3635    745.9146    774.0623   1759.2325
    1998        0.0000     14.0739    942.9486   1337.0167    492.5851
    1999        0.0000    464.4374    450.3635   2097.0051   1534.0507
    2000        0.0000    140.7386    619.2498   1477.7553   5516.9531
    2001        0.0000      0.0000     84.4432    900.7270    591.1021
    2002        0.0000     12.8934    121.7457    805.6169   2887.0783
    2003        0.0000      0.0000     31.3603    419.1448    912.1602
    2004        0.0000    753.7760    134.4987    551.7156    595.5775
    2005        0.0000     34.4185   1880.0260    661.9957   4092.5096
    2006        0.0000      0.0000     52.7756   1978.5841    925.6215
    2007        0.0000    193.3181    730.7096   1329.3200   4136.1066
    2008        0.0000     12.2714    454.9284   1259.8226    835.7757
```

```
 SURVEY - INPUT DATA

INDEX            21          22          23          24          25

SURVEY TAG     sp_can      sp_can      sp_can      sp_can      us0aut

AGE               5           6           7           8           1
TIME            JAN-1       JAN-1       JAN-1       JAN-1       JAN-1
TYPE           NUMBERS     NUMBERS     NUMBERS     NUMBERS     NUMBERS
RETRO FLAG        1           1           1           1           1
 ________________________________________________________________________

    1978        0.0000      0.0000      0.0000      0.0000    207.0964
    1979        0.0000      0.0000      0.0000      0.0000    540.0080
    1980        0.0000      0.0000      0.0000      0.0000    156.4152
    1981        0.0000      0.0000      0.0000      0.0000    382.0902
    1982        0.0000      0.0000      0.0000      0.0000    356.5446
    1983        0.0000      0.0000      0.0000      0.0000    494.5179
    1984        0.0000      0.0000      0.0000      0.0000   1752.5330
    1985        0.0000      0.0000      0.0000      0.0000    244.6634
    1986      914.8009    619.2498    365.9204     56.2954   1368.6670
    1987      478.5112    168.8863    309.6249    112.5909    103.9580
    1988     1435.5337    182.9602    112.5909    239.2556    278.2688
    1989      506.6590    591.1021     70.3693    140.7386    750.6563
    1990     5446.5838    591.1021   1308.8690    168.8863    342.6107
    1991     1477.7553   1843.6757    225.1818    309.6249    214.6098
    1992     1379.2383    844.4316    605.1760    168.8863     55.3259
    1993        0.0000      0.0000      0.0000      0.0000     47.9491
    1994        0.0000      0.0000      0.0000      0.0000    243.7071
    1995      844.4316    267.4033     56.2954     70.3693     91.2536
    1996     1534.0507   1111.8349    464.4374    112.5909    218.4348
    1997     1731.0848    379.9942     84.4432     42.2216     29.5071
    1998      492.5851    394.0681     98.5170     28.1477      8.7429
    1999      577.0283    365.9204    211.1079     14.0739     95.7616
    2000     2406.6301   1097.7611    562.9544    337.7726     95.7616
    2001     1562.1985    731.8407    365.9204    239.2556     26.6384
    2002      961.5430   1718.1603    563.8122    232.3755     38.7964
    2003     1706.7639    447.1511    474.4035    227.5985    319.6607
    2004      634.6213    545.4536    103.8278    165.3542    446.5688
    2005     1591.4896    721.6604    583.5206     18.8549   2302.2402
    2006     2297.1633    982.6574    283.5685    260.2498     71.1723
    2007      545.8412    851.2446    135.4739    106.6092    135.7875
    2008     3069.2880    196.4960    396.5004     41.2168    102.3188
```

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 SURVEY - INPUT DATA


INDEX            26           27           28           29           30

SURVEY TAG     us1aut       us2aut       us3aut       us4aut       us5aut

AGE               2            3            4            5            6
TIME           JAN-1        JAN-1        JAN-1        JAN-1        JAN-1
TYPE          NUMBERS      NUMBERS      NUMBERS      NUMBERS      NUMBERS
RETRO FLAG       1            1            1            1            1
 ________________________________________________________________________

    1978      323.4857    4690.4063     943.6821     345.3429     236.4670
    1979     2520.9482     534.4071    5543.1080    1316.3464     458.3170
    1980     2220.0027    2290.9018     221.4402    2303.8795     437.9625
    1981     1120.0420     769.9179    1057.2027      71.7188     361.7357
    1982     4815.4018    3073.6607    2129.7054     804.6161      73.7679
    1983      788.6330    2608.5134     330.3161      92.6196     157.3714
    1984     1160.4777    1488.0616    1011.1661      94.3955      44.8071
    1985     2607.9670     931.3875    1268.6705    1127.1455      33.0589
    1986      247.6688    1151.0518      91.1170     144.1205     104.6411
    1987     3113.1402     175.5402     449.4375      11.2018      66.5277
    1988      565.1438    1848.0214     147.5357     273.6241      38.2500
    1989     1194.9027     596.9732    1234.6554      81.9643     264.6080
    1990     3822.8143    1429.4571     220.0741     692.7348      74.7241
    1991      496.7036    2219.0464    2478.1902     563.3679     390.0134
    1992      556.8107     239.3357     374.5768      41.6652      39.6161
    1993      563.3679    1296.2652     238.1063     136.6071      59.6973
    1994     1324.9527     726.2036     522.6589      22.5402      34.5616
    1995      554.0786     907.4813     592.0554     209.5554      92.7563
    1996      334.2777    2473.4089    1705.5402     119.1214      73.9045
    1997      327.7205     267.4768     566.1000     195.3482      81.5545
    1998      322.6661     438.3723     149.3116     176.4964      66.3911
    1999      458.3170    1401.8625     480.5839      56.1455      48.3589
    2000      190.8402     210.6482     422.9357     348.2116     118.9848
    2001      780.0268     734.6732      96.3080     107.6464      41.8018
    2002       64.3420     520.2000     627.0268      81.1446      74.5875
    2003      652.9821     965.8125    1907.0357    2222.5982     161.1964
    2004      227.1777     422.3893     273.8973     212.5607     112.5643
    2005     1017.4500     185.5125     970.0473     344.2500     439.1920
    2006       75.5438     791.5018     176.0866     239.8821      35.3813
    2007      590.8259     221.0304     702.4339      46.1732     170.4857
    2008      156.6884     282.5036      68.8500     177.9991       8.7429

     Additional Output Files

Population File
C:\LOB\GBCOD\ASSESS_2008\VPA\TY07\10_PLUS_SVSWEPT\10P_SVSWEPT_CO
Auxilliary File
C:\LOB\GBCOD\ASSESS_2008\VPA\TY07\10_PLUS_SVSWEPT\10P_SVSWEPT_CO
Covariance File
C:\LOB\GBCOD\ASSESS_2008\VPA\TY07\10_PLUS_SVSWEPT\10P_SVSWEPT_CO
Residuals File
C:\LOB\GBCOD\ASSESS_2008\VPA\TY07\10_PLUS_SVSWEPT\10P_SVSWEPT_CO
```

```
Log File
C:\LOB\GBCOD\ASSESS_2008\VPA\TY07\10_PLUS_SVSWEPT\10P_SVSWEPT_CO

     Bootstrap Files

Bootstrap Stock Numbers
C:\LOB\GBCOD\ASSESS_2008\VPA\TY07\10_PLUS_SVSWEPT\10P_SVSWEPT_CO
Bootstrap Fishing Mortality
C:\LOB\GBCOD\ASSESS_2008\VPA\TY07\10_PLUS_SVSWEPT\10P_SVSWEPT_CO
Bootstrap Biomass
C:\LOB\GBCOD\ASSESS_2008\VPA\TY07\10_PLUS_SVSWEPT\10P_SVSWEPT_CO
Bootstrap Catchability
C:\LOB\GBCOD\ASSESS_2008\VPA\TY07\10_PLUS_SVSWEPT\10P_SVSWEPT_CO



                             Estimation Results

 JAN-1 Population Numbers


   AGE       1978        1979        1980        1981        1982
 -----------------------------------------------------------------------

    1       28705.      25943.      22914.      45891.      19863.
    2        4707.      23365.      20988.      18453.      36471.
    3       25333.       3478.      17107.      13370.      11591.
    4        7660.      13468.       1991.       8669.       6701.
    5        2967.       4093.       6916.       1141.       4688.
    6        1264.       1624.       2267.       3454.        649.
    7        1212.        874.        926.        978.       1570.
    8          82.        776.        572.        385.        428.
    9         174.         47.        363.        405.        169.
   10          44.        127.         37.        173.        192.
 ====================================================================
 Total      72148.      73793.      74082.      92919.      82323.

   AGE       1983        1984        1985        1986        1987
 -----------------------------------------------------------------------

    1       11305.      29021.       9615.      44505.      17898.
    2       15562.       8691.      23506.       7713.      35744.
    3       20473.       8096.       5723.      12569.       4881.
    4        5520.       8936.       3512.       2063.       6191.
    5        2817.       2128.       4336.       1367.        920.
    6        2015.       1273.        916.       1678.        649.
    7         266.        982.        541.        308.        823.
    8         654.        133.        402.        205.        176.
    9         173.        378.         56.        153.        105.
   10         288.        283.        182.         76.         75.
 ====================================================================
 Total      59073.      59920.      48789.      70638.      67462.

   AGE       1988        1989        1990        1991        1992
 -----------------------------------------------------------------------

    1       24854.      17849.      10204.      19796.       7470.
```

```
   2       14560.      20056.      13809.       8290.      15956.
   3       22111.       9803.      14070.       6330.       5023.
   4        2637.      10610.       5305.       6709.       2076.
   5        3124.       1198.       4880.       2584.       2671.
   6         484.       1153.        637.       1967.        833.
   7         308.        197.        467.        315.        642.
   8         425.        118.         88.        178.        132.
   9          93.        154.         51.         50.         66.
  10         105.         54.         88.         47.         19.
====================================================================
Total      68702.      61191.      49599.      46266.      34887.

JAN-1 Population Numbers


  AGE       1993        1994        1995        1996        1997


   1        9873.       6318.       3928.       6690.      10672.
   2        5943.       7814.       5088.       3187.       5419.
   3        8749.       3487.       5843.       3577.       2350.
   4        2070.       3214.       1476.       3500.       2043.
   5         745.        607.        868.        610.       1728.
   6         853.        189.        121.        369.        270.
   7         283.        223.         68.         62.        138.
   8         209.         74.         53.         36.         35.
   9          68.         46.         15.         26.         19.
  10          34.          9.          3.          1.          7.
====================================================================
Total      28827.      21980.      17463.      18057.      22681.

  AGE       1998        1999        2000        2001        2002


   1        4976.      12399.       6159.       2858.       5338.
   2        8623.       4017.      10108.       4940.       2330.
   3        3819.       6231.       2967.       7425.       3396.
   4        1252.       1952.       3289.       1764.       3690.
   5         762.        582.        836.       1656.        772.
   6         628.        280.        221.        402.        731.
   7          90.        259.        117.        102.        168.
   8          30.         37.         84.         54.         35.
   9          12.         10.         11.         34.         22.
  10           6.          7.          3.          3.         13.
====================================================================
Total      20196.      25776.      23796.      19240.      16495.

  AGE       2003        2004        2005        2006        2007




   1        1983.      13523.       2945.       7178.       7068.
   2        4340.       1608.      11026.       2400.       5847.
   3        1805.       3372.       1254.       8698.       1902.
   4        1721.       1115.       2369.        845.       6362.
```

```
    5        1665.        694.        679.       1420.        505.
    6         306.        553.        288.        426.        834.
    7         268.        111.        226.        141.        285.
    8          62.         92.         39.        109.         87.
    9          12.         26.         32.         16.         64.
   10           5.         11.         13.         14.          9.
 ====================================================================
 Total      12167.      21104.      18871.      21247.      22962.

JAN-1 Population Numbers


   AGE       2008
 ________________________________________________________________________

    1        5158.
    2        5778.
    3        4313.
    4        1202.
    5        4150.
    6         348.
    7         566.
    8         219.
    9          62.
   10          52.
 ====================================================================
 Total      21848.
```

```
Fishing Mortality Calculated

  AGE        1978         1979         1980         1981         1982
 ___________________________________________________________________________

   1        0.0058       0.0119       0.0165       0.0297       0.0440
   2        0.1026       0.1117       0.2509       0.2650       0.3774
   3        0.4318       0.3577       0.4797       0.4908       0.5419
   4        0.4269       0.4664       0.3569       0.4147       0.6667
   5        0.4024       0.3905       0.4942       0.3647       0.6443
   6        0.1688       0.3620       0.6411       0.5883       0.6924
   7        0.2463       0.2239       0.6785       0.6268       0.6760
   8        0.3601       0.5597       0.1456       0.6208       0.7059
   9        0.3083       0.3598       0.5414       0.5446       0.6558
  10        0.3083       0.3598       0.5414       0.5446       0.6558

  AGE        1983         1984         1985         1986         1987
 ___________________________________________________________________________

   1        0.0630       0.0107       0.0204       0.0192       0.0064
   2        0.4535       0.2179       0.4261       0.2575       0.2803
   3        0.6290       0.6351       0.8203       0.5081       0.4158
   4        0.7533       0.5232       0.7433       0.6078       0.4840
   5        0.5944       0.6425       0.7493       0.5448       0.4415
   6        0.5194       0.6547       0.8897       0.5129       0.5462
   7        0.4937       0.6939       0.7714       0.3628       0.4606
   8        0.3474       0.6618       0.7637       0.4717       0.4309
   9        0.5587       0.6574       0.7723       0.5108       0.4756
  10        0.5587       0.6574       0.7723       0.5108       0.4756

  AGE        1988         1989         1990         1991         1992
 ___________________________________________________________________________

   1        0.0145       0.0566       0.0078       0.0157       0.0287
   2        0.1956       0.1545       0.5800       0.3011       0.4009
   3        0.5343       0.4140       0.5406       0.9151       0.6864
   4        0.5889       0.5766       0.5192       0.7209       0.8244
   5        0.7968       0.4318       0.7087       0.9323       0.9419
   6        0.7013       0.7038       0.5044       0.9192       0.8797
   7        0.7592       0.6020       0.7662       0.6727       0.9223
   8        0.8176       0.6421       0.3653       0.7979       0.4573
   9        0.7815       0.5595       0.6891       0.9081       0.9261
  10        0.7815       0.5595       0.6891       0.9081       0.9261
```

```
Fishing Mortality Calculated

  AGE        1993        1994        1995        1996        1997
 ----------------------------------------------------------------------

   1       0.0340      0.0166      0.0091      0.0108      0.0132
   2       0.3332      0.0906      0.1522      0.1046      0.1499
   3       0.8014      0.6599      0.3126      0.3602      0.4299
   4       1.0271      1.1091      0.6837      0.5058      0.7857
   5       1.1730      1.4127      0.6553      0.6145      0.8127
   6       1.1405      0.8272      0.4666      0.7819      0.9028
   7       1.1436      1.2329      0.4261      0.3798      1.3371
   8       1.3043      1.3802      0.5289      0.4333      0.8935
   9       1.1537      1.2382      0.6158      0.6541      0.8508
  10       1.1537      1.2382      0.6158      0.6541      0.8508

  AGE        1998        1999        2000        2001        2002
 ----------------------------------------------------------------------

   1       0.0141      0.0043      0.0205      0.0045      0.0070
   2       0.1248      0.1028      0.1084      0.1747      0.0550
   3       0.4710      0.4391      0.3203      0.4993      0.4800
   4       0.5650      0.6476      0.4859      0.6262      0.5959
   5       0.8003      0.7680      0.5326      0.6175      0.7257
   6       0.6848      0.6727      0.5704      0.6726      0.8055
   7       0.6721      0.9245      0.5658      0.8724      0.7964
   8       0.8806      1.0292      0.6990      0.7266      0.8687
   9       0.7418      0.7765      0.5429      0.6384      0.7670
  10       0.7418      0.7765      0.5429      0.6384      0.7670

  AGE        2003        2004        2005        2006        2007
 ----------------------------------------------------------------------

   1       0.0095      0.0041      0.0046      0.0051      0.0017
   2       0.0525      0.0488      0.0371      0.0326      0.1044
   3       0.2823      0.1529      0.1948      0.1128      0.2591
   4       0.7083      0.2960      0.3119      0.3155      0.2271
   5       0.9027      0.6794      0.2664      0.3325      0.1705
   6       0.8102      0.6919      0.5154      0.2020      0.1869
   7       0.8651      0.8409      0.5308      0.2789      0.0647
   8       0.6852      0.8695      0.6915      0.3379      0.1407
   9       0.8851      0.6969      0.3688      0.2993      0.1407
  10       0.8851      0.6969      0.3688      0.2993      0.1407
```

```
Average Fishing Mortality For Ages   5-  8

Year      Average F   N Weighted  Biomass Wtd  Catch Wtd

______________________________________________________________________

1978       0.2944      0.3141      0.2944      0.3425
1979       0.3840      0.3823      0.3842      0.3962
1980       0.4898      0.5227      0.5158      0.5442
1981       0.5501      0.5539      0.5704      0.5667
1982       0.6796      0.6589      0.6647      0.6594
1983       0.4887      0.5354      0.5104      0.5443
1984       0.6633      0.6577      0.6626      0.6581
1985       0.7935      0.7729      0.7769      0.7749
1986       0.4730      0.5098      0.5017      0.5137
1987       0.4698      0.4734      0.4746      0.4765
1988       0.7687      0.7855      0.7846      0.7864
1989       0.5949      0.5713      0.5934      0.5936
1990       0.5862      0.6867      0.6799      0.6933
1991       0.8305      0.9063      0.8959      0.9095
1992       0.8003      0.9119      0.8981      0.9179
1993       1.1903      1.1689      1.1748      1.1699
1994       1.2133      1.2726      1.2443      1.2946
1995       0.5192      0.6147      0.5963      0.6226
1996       0.5524      0.6522      0.6477      0.6666
1997       0.9866      0.8586      0.8874      0.8690
1998       0.7595      0.7463      0.7416      0.7497
1999       0.8486      0.7884      0.8010      0.7962
2000       0.5919      0.5535      0.5620      0.5558
2001       0.7223      0.6420      0.6505      0.6454
2002       0.7991      0.7698      0.7773      0.7713
2003       0.8158      0.8802      0.8725      0.8818
2004       0.7705      0.7087      0.7197      0.7120
2005       0.5010      0.3868      0.4106      0.4264
2006       0.2878      0.3027      0.2981      0.3109
2007       0.1407      0.1594      0.1534      0.1709
```

```
Average Fishing Mortality For Ages   6-  8

Year      Average F   N Weighted  Biomass Wtd  Catch Wtd


1978       0.2584      0.2117      0.2183      0.2208
1979       0.3819      0.3720      0.3794      0.4037
1980       0.4884      0.5750      0.5440      0.6280
1981       0.6120      0.5987      0.6005      0.5990
1982       0.6914      0.6848      0.6846      0.6850
1983       0.4535      0.4788      0.4613      0.4874
1984       0.6702      0.6712      0.6736      0.6716
1985       0.8083      0.8280      0.8163      0.8310
1986       0.4491      0.4879      0.4829      0.4925
1987       0.4793      0.4912      0.4857      0.4944
1988       0.7594      0.7566      0.7658      0.7589
1989       0.6493      0.6852      0.6810      0.6867
1990       0.5453      0.5967      0.6039      0.6213
1991       0.7966      0.8789      0.8687      0.8846
1992       0.7531      0.8621      0.8502      0.8756
1993       1.1961      1.1666      1.1756      1.1682
1994       1.1468      1.0976      1.1175      1.1243
1995       0.4739      0.4690      0.4716      0.4712
1996       0.5317      0.7015      0.6767      0.7292
1997       1.0445      1.0376      1.0601      1.0593
1998       0.7458      0.6911      0.6947      0.6925
1999       0.8755      0.8089      0.8238      0.8239
2000       0.6117      0.5947      0.6010      0.5980
2001       0.7572      0.7145      0.7196      0.7199
2002       0.8235      0.8063      0.8069      0.8064
2003       0.7869      0.8211      0.8191      0.8234
2004       0.8008      0.7355      0.7460      0.7403
2005       0.5793      0.5342      0.5389      0.5368
2006       0.2729      0.2399      0.2477      0.2500
2007       0.1308      0.1547      0.1480      0.1711
```

```
Average Fishing Mortality For Ages   7-  8

Year      Average F   N Weighted  Biomass Wtd  Catch Wtd

_______________________________________________________________________

1978       0.3032      0.2535      0.2568      0.2561
1979       0.3918      0.3818      0.3911      0.4442
1980       0.4120      0.4750      0.4443      0.6017
1981       0.6238      0.6251      0.6249      0.6251
1982       0.6909      0.6824      0.6829      0.6825
1983       0.4206      0.3897      0.3814      0.3988
1984       0.6779      0.6901      0.6893      0.6902
1985       0.7676      0.7681      0.7676      0.7681
1986       0.4172      0.4063      0.4111      0.4120
1987       0.4458      0.4554      0.4546      0.4556
1988       0.7884      0.7931      0.7953      0.7938
1989       0.6220      0.6170      0.6193      0.6175
1990       0.5657      0.7025      0.6887      0.7274
1991       0.7353      0.7178      0.7256      0.7213
1992       0.6898      0.8433      0.8248      0.8711
1993       1.2239      1.2119      1.2188      1.2146
1994       1.3066      1.2695      1.2764      1.2711
1995       0.4775      0.4714      0.4750      0.4758
1996       0.4065      0.3995      0.4021      0.4008
1997       1.1153      1.2480      1.2381      1.2631
1998       0.7763      0.7240      0.7310      0.7314
1999       0.9769      0.9377      0.9410      0.9385
2000       0.6324      0.6215      0.6257      0.6265
2001       0.7995      0.8218      0.8133      0.8257
2002       0.8325      0.8089      0.8107      0.8095
2003       0.7752      0.8313      0.8254      0.8354
2004       0.8552      0.8539      0.8556      0.8540
2005       0.6112      0.5546      0.5598      0.5588
2006       0.3084      0.3046      0.3053      0.3070
2007       0.1027      0.0826      0.0863      0.0944
```

```
Back Calculated Partial Recruitment

 AGE       1978        1979        1980        1981        1982
_______________________________________________________________________

   1      0.0135      0.0213      0.0243      0.0474      0.0623
   2      0.2377      0.1996      0.3698      0.4228      0.5347
   3      1.0000      0.6391      0.7070      0.7830      0.7676
   4      0.9886      0.8332      0.5260      0.6616      0.9444
   5      0.9319      0.6976      0.7284      0.5819      0.9127
   6      0.3909      0.6467      0.9449      0.9386      0.9809
   7      0.5705      0.4000      1.0000      1.0000      0.9576
   8      0.8339      1.0000      0.2145      0.9905      1.0000
   9      0.7139      0.6428      0.7979      0.8689      0.9291
  10      0.7139      0.6428      0.7979      0.8689      0.9291

 AGE       1983        1984        1985        1986        1987
_______________________________________________________________________

   1      0.0836      0.0155      0.0229      0.0316      0.0118
   2      0.6021      0.3140      0.4789      0.4237      0.5132
   3      0.8350      0.9152      0.9220      0.8359      0.7613
   4      1.0000      0.7540      0.8355      1.0000      0.8861
   5      0.7891      0.9259      0.8422      0.8963      0.8083
   6      0.6895      0.9435      1.0000      0.8438      1.0000
   7      0.6554      1.0000      0.8671      0.5969      0.8433
   8      0.4613      0.9537      0.8584      0.7760      0.7890
   9      0.7417      0.9473      0.8681      0.8404      0.8707
  10      0.7417      0.9473      0.8681      0.8404      0.8707

 AGE       1988        1989        1990        1991        1992
_______________________________________________________________________
   1      0.0178      0.0805      0.0102      0.0168      0.0305
   2      0.2392      0.2195      0.7570      0.3229      0.4256
   3      0.6534      0.5882      0.7056      0.9815      0.7287
   4      0.7203      0.8193      0.6776      0.7732      0.8753
   5      0.9745      0.6135      0.9249      1.0000      1.0000
   6      0.8578      1.0000      0.6583      0.9860      0.9340
   7      0.9286      0.8553      1.0000      0.7215      0.9792
   8      1.0000      0.9123      0.4767      0.8558      0.4856
   9      0.9558      0.7949      0.8994      0.9740      0.9832
  10      0.9558      0.7949      0.8994      0.9740      0.9832
```

```
Back Calculated Partial Recruitment

 AGE       1993        1994        1995        1996        1997
-----------------------------------------------------------------
   1      0.0261      0.0118      0.0133      0.0138      0.0099
   2      0.2555      0.0642      0.2226      0.1337      0.1121
   3      0.6144      0.4671      0.4572      0.4607      0.3215
   4      0.7875      0.7851      1.0000      0.6469      0.5876
   5      0.8993      1.0000      0.9584      0.7858      0.6078
   6      0.8744      0.5856      0.6824      1.0000      0.6752
   7      0.8768      0.8727      0.6231      0.4857      1.0000
   8      1.0000      0.9770      0.7736      0.5542      0.6682
   9      0.8846      0.8765      0.9007      0.8365      0.6362
  10      0.8846      0.8765      0.9007      0.8365      0.6362

 AGE       1998        1999        2000        2001        2002
-----------------------------------------------------------------

   1      0.0160      0.0041      0.0294      0.0052      0.0080
   2      0.1417      0.0999      0.1551      0.2003      0.0633
   3      0.5348      0.4266      0.4582      0.5724      0.5525
   4      0.6416      0.6292      0.6951      0.7177      0.6860
   5      0.9089      0.7462      0.7619      0.7078      0.8354
   6      0.7776      0.6536      0.8160      0.7710      0.9273
   7      0.7632      0.8982      0.8093      1.0000      0.9168
   8      1.0000      1.0000      1.0000      0.8328      1.0000
   9      0.8424      0.7544      0.7766      0.7317      0.8830
  10      0.8424      0.7544      0.7766      0.7317      0.8830

 AGE       2003        2004        2005        2006        2007
-----------------------------------------------------------------

   1      0.0105      0.0047      0.0067      0.0150      0.0064
   2      0.0581      0.0561      0.0536      0.0963      0.4027
   3      0.3128      0.1758      0.2817      0.3340      1.0000
   4      0.7846      0.3405      0.4511      0.9337      0.8763
   5      1.0000      0.7814      0.3853      0.9842      0.6579
   6      0.8975      0.7957      0.7453      0.5978      0.7212
   7      0.9584      0.9671      0.7676      0.8254      0.2499
   8      0.7591      1.0000      1.0000      1.0000      0.5430
   9      0.9804      0.8014      0.5333      0.8859      0.5430
  10      0.9804      0.8014      0.5333      0.8859      0.5430
```

```
JAN-1 Biomass

  AGE       1978        1979        1980        1981        1982
______________________________________________________________________

   1       10819.      12621.       9860.      17503.       8545.
   2        4790.      20760.      20788.      17774.      32985.
   3       46691.       5351.      31154.      24529.      22175.
   4       21697.      43531.       5158.      25392.      19946.
   5        8908.      16776.      33810.       4830.      20244.
   6        5526.       8718.      13080.      22058.       3739.
   7        6453.       6485.       7149.       7527.      13058.
   8         652.       6432.       5603.       3470.       3957.
   9        1621.        446.       3558.       4776.       1909.
  10         615.       1729.        553.       2905.       2999.
===================================================================
Total     107772.     122849.     130713.     130763.     129555.

  AGE       1983        1984        1985        1986        1987
______________________________________________________________________

   1        5135.       9797.       5967.      20312.       6760.
   2       14955.       8751.      20342.       8064.      35555.
   3       37349.      15268.      10093.      23145.       8947.
   4       16105.      26455.      10660.       5647.      19783.
   5       11883.       8656.      18524.       6182.       4197.
   6       11761.       7127.       5167.      10026.       4244.
   7        1985.       7367.       3981.       2330.       6575.
   8        6572.       1242.       3805.       1856.       1681.
   9        1846.       4115.        618.       1767.       1145.
  10        4693.       4143.       2551.       1107.       1176.
===================================================================
Total     112284.      92921.      81708.      80435.      90064.

  AGE       1988        1989        1990        1991        1992
______________________________________________________________________

   1        7153.       4193.       3204.       8823.       4939.
   2       13043.      16855.      11111.       7447.      15506.
   3       41273.      17093.      26462.      12213.       9607.
   4        7770.      31575.      14888.      19753.       6395.
   5       14844.       5106.      21013.      10713.      10655.
   6        3028.       6871.       3668.      10580.       4490.
   7        2536.       1442.       3468.       2155.       4126.
   8        4096.       1100.        831.       1578.       1095.
   9        1020.       1667.        566.        520.        691.
  10        1574.        796.       1284.        694.        353.
===================================================================
Total      96337.      86699.      86495.      74476.      57856.
```

```
JAN-1 Biomass

  AGE       1993        1994        1995        1996        1997
___________________________________________________________________________

   1       1364.       1794.        816.       1878.       3524.
   2       6187.       4555.       4078.       2409.       4573.
   3      15573.       5848.       8990.       6419.       4306.
   4       5770.       8991.       4176.       8827.       5863.
   5       3242.       2385.       3743.       2597.       6224.
   6       4373.       1121.        721.       2155.       1428.
   7       1889.       1442.        549.        482.        980.
   8       1662.        605.        498.        344.        282.
   9        700.        416.        158.        297.        202.
  10        410.        134.         64.          6.         90.
======================================================================
Total     41171.      27292.      23795.      25413.      27469.

  AGE       1998        1999        2000        2001        2002
___________________________________________________________________________

   1       2023.       3913.       1274.       1160.       1517.
   2       7573.       3780.       9133.       3595.       2072.
   3       6947.      10903.       5484.      13653.       5757.
   4       3535.       5377.       8849.       4669.       9436.
   5       3025.       2298.       3268.       6173.       2629.
   6       2976.       1452.       1103.       1968.       3363.
   7        584.       1576.        750.        586.        981.
   8        230.        296.        614.        399.        242.
   9        114.         87.         90.        291.        182.
  10         74.         91.         33.         29.        155.
======================================================================
Total     27081.      29772.      30598.      32524.      26334.

  AGE       2003        2004        2005        2006        2007
___________________________________________________________________________

   1        748.       2541.        802.       1406.       1720.
   2       3668.       1545.       6461.       1636.       4291.
   3       3110.       6259.       2251.      12803.       2734.
   4       4257.       2936.       6380.       2159.      15670.
   5       5628.       2331.       2383.       4771.       1694.
   6       1319.       2387.       1259.       1814.       3266.
   7       1462.        575.       1163.        794.       1477.
   8        415.        602.        256.        645.        585.
   9         98.        197.        255.        121.        424.
  10         56.        121.        150.        131.         84.
======================================================================
Total     20760.      19494.      21360.      26280.      31945.
```

```
JAN-1 Biomass


  AGE       2008
_______________________________________________________________________

   1         1317.
   2         4400.
   3         7145.
   4         3081.
   5        14086.
   6         1476.
   7         3011.
   8         1414.
   9          472.
  10          530.
====================================================================
Total       36930.


Mean Biomass


  AGE       1978        1979        1980        1981        1982
_______________________________________________________________________

   1        15013.      16229.      13264.      24080.      11333.
   2         5082.      27387.      23876.      21266.      38590.
   3        45837.       5044.      30176.      22993.      20784.
   4        19392.      42080.       5415.      22857.      16673.
   5         8946.      15241.      27839.       4406.      16724.
   6         6020.       8917.      10347.      17455.       2821.
   7         6496.       6885.       5118.       5841.       9903.
   8          547.       5623.       4801.       2571.       2742.
   9         1357.        374.       2381.       4003.       1476.
  10          482.       1324.        391.       2048.       2015.
====================================================================
Total      109174.     129103.     123607.     127520.     123060.

  AGE       1983        1984        1985        1986        1987
_______________________________________________________________________

   1         6723.      14143.       6951.      26928.       9407.
   2        16410.      10649.      24205.       8398.      41679.
   3        33254.      13591.       7443.      22045.       9025.
   4        11927.      23330.       8458.       5110.      18705.
   5         9298.       7100.      13935.       5297.       3915.
   6         9264.       5608.       3594.       8606.       3558.
   7         1627.       5670.       2856.       2092.       5363.
   8         5372.        917.       2649.       1484.       1346.
   9         1418.       2818.        422.       1419.        916.
  10         3289.       2782.       1632.        793.        855.
====================================================================
Total       98582.      86608.      72144.      82173.      94769.
```

```
  AGE       1988        1989        1990        1991        1992
______________________________________________________________________

   1       11001.       6843.       4893.      11719.       5540.
   2       16587.      24252.      14280.       9908.      17210.
   3       37166.      16145.      24480.       9535.       8020.
   4        6395.      27538.      13518.      15432.       4933.
   5       10701.       4601.      15924.       7439.       7198.
   6        2164.       4981.       2927.       6894.       3078.
   7        1727.       1073.       2516.       1537.       2735.
   8        2782.        795.        754.       1055.        913.
   9         686.       1214.        418.        291.        465.
  10        1003.        558.        851.        419.        212.
===================================================================
Total      90212.      88002.      80560.      64231.      50304.


Mean Biomass

  AGE       1993        1994        1995        1996        1997
______________________________________________________________________

   1        2498.       2710.       1405.       2936.       5175.
   2        6017.       8120.       5775.       3961.       6690.
   3       12205.       5036.       9038.       6548.       4059.
   4        3848.       6351.       3645.       8078.       4475.
   5        2020.       1442.       3062.       2034.       4381.
   6        2733.        835.        656.       1527.        938.
   7        1148.        851.        468.        382.        546.
   8         965.        338.        461.        260.        171.
   9         416.        222.        123.        190.        136.
  10         225.         71.         43.          4.         55.
===================================================================
Total      32075.      25976.      24677.      25919.      26626.

  AGE       1998        1999        2000        2001        2002
______________________________________________________________________

   1        2771.       5989.       2144.       1553.       2363.
   2       10546.       4961.      13296.       5624.       2707.
   3        6291.       9840.       5521.      11815.       5187.
   4        2997.       4417.       8062.       3526.       7523.
   5        2202.       1695.       2698.       4640.       1988.
   6        2322.       1097.        844.       1412.       2378.
   7         443.       1033.        573.        376.        689.
   8         141.        181.        445.        273.        172.
   9          89.         62.         62.        210.        128.
  10          48.         58.         23.         20.         99.
===================================================================
Total      27850.      29332.      33667.      29447.      23235.

  AGE       2003        2004        2005        2006        2007
______________________________________________________________________

   1        1077.       4059.       1147.       2460.       2705.
   2        5591.       2183.      10161.       2309.       7160.
   3        3228.       6716.       2177.      15634.       2923.
```

```
    4        3286.       2706.       5689.       2051.      15009.
    5        3899.       1792.       2171.       4050.       1529.
    6         907.       1764.       1013.       1590.       2885.
    7         953.        391.        879.        723.       1484.
    8         285.        417.        195.        539.        514.
    9          61.        145.        212.         95.        374.
   10          34.         80.        114.        103.         71.
 ====================================================================
 Total      19320.      20253.      23759.      29556.      34654.

Spawning Stock Biomass

   AGE       1978        1979        1980        1981        1982

 _______________________________________________________________________
    1         836.        853.        856.       1516.        656.
    2        1503.       6701.       7328.       6250.      10785.
    3       31517.       3803.      21975.      17270.      15480.
    4       18567.      37396.       4512.      22002.      16572.
    5        7977.      15051.      29814.       4352.      17410.
    6        5197.       7938.      11369.      19341.       3223.
    7        5990.       6042.       6175.       6557.      11284.
    8         594.       5667.       5289.       3026.       3402.
    9        1489.        407.       3145.       4219.       1655.
   10         565.       1575.        489.       2566.       2600.
 ====================================================================
 Total      74235.      85433.      90951.      87101.      83067.

   AGE       1983        1984        1985        1986        1987

 _______________________________________________________________________

    1         393.       1230.       1035.       3133.       1306.
    2        5499.       3999.      10813.       4333.      19363.
    3       27649.      11557.       7748.      18717.       7186.
    4       13464.      22981.       9017.       4886.      17298.
    5       10409.       7522.      15813.       5460.       3771.
    6       10432.       6181.       4308.       8903.       3748.
    7        1769.       6347.       3385.       2121.       5890.
    8        5999.       1076.       3240.       1659.       1514.
    9        1627.       3567.        525.       1570.       1023.
   10        4135.       3591.       2170.        984.       1051.
 ====================================================================
 Total      81375.      68051.      58056.      51766.      62150
   AGE       1988        1989        1990        1991        1992

 _______________________________________________________________________

    1        1725.        803.        371.       1107.        428.
    2        7815.       9691.       4488.       3631.       6593.
    3       32866.      14041.      19881.       9025.       7376.
    4        6676.      27186.      12810.      16603.       5337.
    5       12571.       4596.      18059.       8870.       8808.
    6        2606.       5910.       3262.       8779.       3750.
    7        2161.       1262.       2952.       1863.       3422.
    8        3457.        956.        756.       1336.        982.
    9         866.       1468.        488.        432.        572.
   10        1336.        701.       1107.        577.        292.
 ====================================================================
 Total      72080.      66616.      64174.      52224.      37561.
```

```
Spawning Stock Biomass

  AGE       1993        1994        1995        1996        1997
_______________________________________________________________________

   1           52.         69.         32.         91.        340.
   2         2434.       1779.       1923.       1099.       2459.
   3        12256.       4661.       7924.       5554.       3644.
   4         4703.       7228.       3604.       7847.       4925.
   5         2579.       1823.       3246.       2267.       5257.
   6         3498.        945.        646.       1830.       1188.
   7         1510.       1136.        495.        437.        758.
   8         1294.        465.        441.        309.        235.
   9          559.        328.        138.        258.        169.
  10          327.        106.         55.          5.         75.
====================================================================
Total       29212.      18540.      18503.      19697.      19050.

  AGE       1998        1999        2000        2001        2002
_______________________________________________________________________

   1          176.        265.         86.         90.        103.
   2         4018.       1833.       4424.       1689.        854.
   3         5839.       9115.       4727.      11300.       4523.
   4         3112.       4622.       7893.       4028.       8181.
   5         2560.       1955.       2892.       5387.       2253.
   6         2568.       1255.        970.       1701.       2844.
   7          505.       1307.        660.        490.        831.
   8          192.        241.        528.        342.        203.
   9           97.         74.         80.        253.        155.
  10           63.         77.         29.         25.        132.
====================================================================
Total       19130.      20744.      22290.      25305.      20078.

  AGE       2003        2004        2005        2006        2007
_______________________________________________________________________

   1           29.        172.         47.         68.         67.
   2         1161.        563.       2236.        551.       1509.
   3         2410.       4898.       1749.      10208.       2254.
   4         3585.       2649.       5741.       1942.      14448.
   5         4683.       2013.       2205.       4365.       1592.
   6         1115.       2057.       1118.       1696.       3062.
   7         1224.        483.       1030.        733.       1413.
   8          358.        504.        221.        590.        552.
   9           82.        170.        232.        111.        400.
  10           47.        104.        136.        120.         79.
====================================================================
Total       14694.      13613.      14714.      20385.      25377.
```

```
Catch Biomass

  AGE       1978        1979        1980        1981        1982
_________________________________________________________________________

   1         88.        194.        219.        716.        499.
   2        522.       3060.       5991.       5636.      14565.
   3      19793.       1804.      14476.      11284.      11262.
   4       8279.      19626.       1932.       9478.      11116.
   5       3600.       5951.      13759.       1607.      10775.
   6       1016.       3228.       6633.      10268.       1954.
   7       1600.       1541.       3472.       3661.       6694.
   8        197.       3147.        699.       1596.       1935.
   9        418.        135.       1289.       2180.        968.
  10        149.        476.        212.       1115.       1322.
======================================================================
Total     35661.      39162.      48682.      47542.      61088.

  AGE       1983        1984        1985        1986        1987
_________________________________________________________________________

   1        423.        152.        142.        518.         60.
   2       7442.       2320.      10313.       2163.      11683.
   3      20916.       8631.       6105.      11201.       3753.
   4       8984.      12207.       6287.       3106.       9053.
   5       5527.       4562.      10441.       2886.       1729.
   6       4812.       3672.       3197.       4414.       1944.
   7        803.       3935.       2203.        759.       2470.
   8       1867.        607.       2023.        700.        580.
   9        792.       1853.        326.        725.        435.
  10       1838.       1829.       1260.        405.        407.
======================================================================
Total     53404.      39767.      42297.      26877.      32113.

  AGE       1988        1989        1990        1991        1992
_________________________________________________________________________

   1        160.        388.         38.        183.        159.
   2       3244.       3746.       8282.       2983.       6900.
   3      19856.       6685.      13235.       8726.       5505.
   4       3766.      15879.       7018.      11124.       4067.
   5       8527.       1987.      11285.       6935.       6780.
   6       1518.       3506.       1476.       6337.       2708.
   7       1311.        646.       1928.       1034.       2522.
   8       2274.        511.        275.        842.        418.
   9        536.        679.        288.        264.        431.
  10        784.        312.        586.        381.        196.
======================================================================
Total     41977.      34339.      44412.      38810.      29685.
```

```
Catch Biomass


  AGE       1993        1994        1995        1996        1997
_______________________________________________________________________
   1           85.         45.         13.         32.         68.
   2         2005.        736.        879.        414.       1003.
   3         9781.       3323.       2825.       2359.       1745.
   4         3953.       7043.       2492.       4086.       3516.
   5         2369.       2037.       2007.       1250.       3560.
   6         3117.        690.        306.       1194.        847.
   7         1313.       1049.        200.        145.        730.
   8         1258.        467.        244.        113.        153.
   9          480.        275.         76.        124.        115.
  10          259.         88.         27.          3.         47.
====================================================================
Total       24620.      15754.       9068.       9719.      11784.

  AGE       1998        1999        2000        2001        2002
_______________________________________________________________________

   1           39.         25.         44.          7.         16.
   2         1316.        510.       1442.        983.        149.
   3         2963.       4321.       1768.       5900.       2490.
   4         1693.       2860.       3917.       2208.       4483.
   5         1763.       1302.       1437.       2865.       1443.
   6         1590.        738.        482.        950.       1916.
   7          297.        955.        324.        328.        548.
   8          124.        187.        311.        198.        150.
   9           66.         48.         34.        134.         98.
  10           36.         45.         13.         13.         76.
====================================================================
Total        9888.      10991.       9771.      13584.      11369.

  AGE       2003        2004        2005        2006        2007
_______________________________________________________________________

   1           10.         17.          5.         12.          4.
   2          293.        106.        377.         75.        747.
   3          911.       1027.        424.       1764.        758.
   4         2328.        801.       1775.        647.       3408.
   5         3520.       1218.        579.       1347.        261.
   6          735.       1221.        522.        321.        539.
   7          824.        329.        466.        202.         96.
   8          195.        363.        135.        182.         72.
   9           54.        101.         78.         29.         60.
  10           30.         56.         42.         31.         10.
====================================================================
Total        8900.       5238.       4403.       4610.       5955.
```

```
Catch Numbers


  AGE       1978         1979         1980         1981         1982
_______________________________________________________________________

   1        151.6        279.2        339.9       1219.2        775.4
   2        416.8       2242.7       4238.7       3910.7      10457.1
   3       8109.1        953.6       5955.4       4738.2       4434.4
   4       2429.6       4585.0        544.9       2685.5       2988.0
   5        896.8       1206.9       2464.6        317.9       2039.8
   6        178.4        449.8        983.0       1406.0        297.1
   7        240.8        159.5        418.1        417.0        707.2
   8         22.6        304.1         70.4        162.9        198.6
   9         42.1         12.9        138.7        155.5         74.6
  10         10.7         35.0         14.2         66.4         84.6
====================================================================
Total     12498.5      10228.7      15167.9      15079.3      22056.8

  AGE       1983         1984         1985         1986         1987
_______________________________________________________________________

   1        626.2        280.9        176.0        768.3        103.8
   2       5181.7       1547.7       7443.7       1594.1       7956.1
   3       8753.3       3485.7       2942.2       4576.3       1515.5
   4       2680.4       3328.4       1690.1        860.2       2170.1
   5       1155.3        923.9       2097.7        525.3        299.7
   6        746.4        560.2        496.5        615.4        249.9
   7         94.6        450.3        267.2         85.5        277.3
   8        175.0         58.9        196.8         70.4         56.1
   9         67.7        167.0         27.7         56.0         36.2
  10        112.6        124.9         89.7         27.8         26.0
====================================================================
Total     19593.2      10927.9      15427.6       9179.3      12690.7

  AGE       1988         1989         1990         1991         1992
_______________________________________________________________________

   1        324.9        891.5         71.8        278.7        191.7
   2       2352.1       2608.6       5561.1       1963.0       4808.4
   3       8368.3       3032.8       5373.4       3491.4       2286.3
   4       1074.1       4254.4       1964.0       3160.5       1070.7
   5       1575.6        383.5       2272.1       1442.1       1500.0
   6        223.8        534.2        230.6       1088.0        448.1
   7        150.3         81.4        229.4        141.3        356.0
   8        218.0         51.2         24.6         89.7         44.1
   9         46.5         60.2         23.2         27.5         36.4
  10         52.5         21.3         40.4         26.0         10.4
====================================================================
Total     14386.1      11919.1      15790.6      11708.2      10752.1
```

```
Catch Numbers


  AGE       1993        1994        1995        1996        1997
_______________________________________________________________________
   1       299.2        94.4        32.3        64.9       126.9
   2      1534.9       614.6       652.8       287.3       685.2
   3      4429.4      1543.4      1429.0       986.6       749.6
   4      1224.8      1987.7       669.9      1269.8      1020.7
   5       475.3       425.6       382.3       256.3       882.9
   6       535.6        97.6        41.2       183.8       147.7
   7       178.0       146.2        21.4        17.9        94.4
   8       141.0        51.2        20.0        11.6        18.9
   9        43.1        30.5         6.4        11.3        10.1
  10        21.2         5.6         1.4         0.3         3.9
====================================================================
Total      8882.5      4996.8      3256.7      3089.8      3740.3

  AGE       1998        1999        2000        2001        2002
_______________________________________________________________________

   1        63.3        47.7       113.5        11.7        33.6
   2       918.9       356.3       943.2       719.8       113.0
   3      1310.3      2021.8       741.1      2667.3      1182.7
   4       494.3       852.6      1156.4       751.6      1516.2
   5       385.6       286.6       315.8       698.7       365.4
   6       285.2       125.8        88.0       180.4       371.5
   7        40.2       143.8        46.3        54.8        84.7
   8        16.0        22.2        38.8        25.8        18.7
   9         5.6         5.0         4.2        14.8        10.6
  10         2.9         3.4         1.0         1.3         6.5
====================================================================
Total      3522.3      3865.2      3448.3      5126.2      3702.9

  AGE       2003        2004        2005        2006        2007
_______________________________________________________________________

   1        17.0        50.5        12.3        32.8        10.6
   2       201.3        69.4       364.1        69.7       526.1
   3       404.4       434.3       201.8       842.8       395.2
   4       800.7       260.1       578.4       208.3      1175.8
   5       910.4       313.6       144.5       366.1        71.9
   6       156.0       253.0       106.0        70.8       129.2
   7       142.4        58.2        85.3        31.2        16.2
   8        28.2        49.2        18.0        28.5        10.4
   9         6.5        11.8         8.9         3.8         8.6
  10         2.9         5.0         3.7         3.4         1.1
====================================================================
Total      2669.8      1505.2      1523.0      1657.4      2345.1
```

```
              Surplus Production

    Average Adjustment Factor (Delta) =   1.0000

Year        Biomass  Delta Biomass  Catch Biomass  Surplus Production

1978     107771.534      15077.374      35660.721      50738.095
1979     122848.908       7864.015      39162.286      47026.301
1980     130712.923         50.259      48682.434      48732.694
1981     130763.183      -1207.795      47541.857      46334.062
1982     129555.388     -17271.698      61088.247      43816.549
1983     112283.690     -19362.222      53404.330      34042.108
1984      92921.468     -11213.851      39767.136      28553.284
1985      81707.616      -1272.242      42297.434      41025.193
1986      80435.375       9628.756      26876.781      36505.537
1987      90064.131       6272.381      32112.683      38385.065
1988      96336.512      -9637.748      41976.636      32338.888
1989      86698.764       -203.999      34338.791      34134.792
1990      86494.764     -12018.565      44411.969      32393.405
1991      74476.200     -16619.991      38810.185      22190.193
1992      57856.208     -16685.047      29684.877      12999.830
1993      41171.161     -13879.167      24620.033      10740.867
1994      27291.994      -3497.010      15754.070      12257.060
1995      23794.985       1618.018       9068.146      10686.164
1996      25413.002       2056.393       9718.713      11775.106
1997      27469.395       -388.372      11784.450      11396.079
1998      27081.024       2690.824       9887.960      12578.784
1999      29771.848        825.652      10991.218      11816.870
2000      30597.500       1926.115       9770.992      11697.107
2001      32523.616      -6190.113      13584.079       7393.966
2002      26333.503      -5573.083      11369.031       5795.948
2003      20760.420      -1266.742       8900.391       7633.649
2004      19493.678       1866.809       5237.603       7104.412
2005      21360.488       4919.513       4402.945       9322.458
2006      26280.000       5664.618       4610.067      10274.685
2007      31944.618       4985.780       5955.462      10941.242
2008      36930.398
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Summary of Survey Indices Used in the Estimate

INDEX    Survey Tag    Age   Time  Type  Catchability Std. Error   CV
_______________________________________________________________________

  1         spr_36      1   JAN-1 NUMBER  0.2194E-01  0.4344E-02  0.1980E+00
  2         spr_36      2   JAN-1 NUMBER  0.9200E-01  0.7276E-02  0.7909E-01
  3         spr_36      3   JAN-1 NUMBER  0.1862E+00  0.1931E-01  0.1037E+00
  4         spr_36      4   JAN-1 NUMBER  0.3161E+00  0.4509E-01  0.1426E+00
  5         spr_36      5   JAN-1 NUMBER  0.4022E+00  0.6249E-01  0.1554E+00
  6         spr_36      6   JAN-1 NUMBER  0.4090E+00  0.6140E-01  0.1501E+00
  7         spr_36      7   JAN-1 NUMBER  0.4272E+00  0.7710E-01  0.1805E+00
  8         spr_36      8   JAN-1 NUMBER  0.5178E+00  0.8356E-01  0.1614E+00
  9         spr_41      1   JAN-1 NUMBER  0.1413E-01  0.1069E-01  0.7560E+00
 10         spr_41      2   JAN-1 NUMBER  0.8999E-01  0.2087E-01  0.2319E+00
 11         spr_41      3   JAN-1 NUMBER  0.1987E+00  0.4671E-01  0.2350E+00
 12         spr_41      4   JAN-1 NUMBER  0.1773E+00  0.2236E-01  0.1261E+00
 13         spr_41      5   JAN-1 NUMBER  0.2163E+00  0.5405E-01  0.2499E+00
 14         spr_41      6   JAN-1 NUMBER  0.2077E+00  0.3557E-01  0.1713E+00
 15         spr_41      7   JAN-1 NUMBER  0.3002E+00  0.1126E+00  0.3750E+00
 16         spr_41      8   JAN-1 NUMBER  0.2915E+00  0.1651E+00  0.5663E+00
 17         sp_can      1   JAN-1 NUMBER  0.2092E-01  0.5624E-02  0.2688E+00
 18         sp_can      2   JAN-1 NUMBER  0.9815E-01  0.2095E-01  0.2135E+00
 19         sp_can      3   JAN-1 NUMBER  0.3272E+00  0.3356E-01  0.1026E+00
 20         sp_can      4   JAN-1 NUMBER  0.6153E+00  0.7791E-01  0.1266E+00
 21         sp_can      5   JAN-1 NUMBER  0.9495E+00  0.1127E+00  0.1187E+00
 22         sp_can      6   JAN-1 NUMBER  0.1129E+01  0.1895E+00  0.1678E+00
 23         sp_can      7   JAN-1 NUMBER  0.1217E+01  0.2357E+00  0.1936E+00
 24         sp_can      8   JAN-1 NUMBER  0.1282E+01  0.2649E+00  0.2067E+00
 25         us0aut      1   JAN-1 NUMBER  0.1722E-01  0.3661E-02  0.2126E+00
 26         us1aut      2   JAN-1 NUMBER  0.7467E-01  0.8750E-02  0.1172E+00
 27         us2aut      3   JAN-1 NUMBER  0.1312E+00  0.1526E-01  0.1163E+00
 28         us3aut      4   JAN-1 NUMBER  0.1586E+00  0.2294E-01  0.1447E+00
 29         us4aut      5   JAN-1 NUMBER  0.1229E+00  0.2235E-01  0.1818E+00
 30         us5aut      6   JAN-1 NUMBER  0.1431E+00  0.2336E-01  0.1632E+00


Survey Index:    1 Tag:         spr_36   AGE =  1
Time = JAN-1           Type = NUMBER
Catchability =    0.219439E-01   % Variance Contribution =     7.1686
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_______________________________________________________________________

1978     N/A             0.629901E+03     N/A
1979     N/A             0.569281E+03     N/A
1980     N/A             0.502813E+03     N/A
1981     N/A             0.100702E+04     N/A
1982     0.693828E+03     0.435869E+03     0.464881E+00
1983     0.452853E+03     0.248083E+03     0.601803E+00
1984     0.549434E+03     0.636826E+03    -0.147609E+00
1985     0.151770E+03     0.210997E+03    -0.329473E+00
1986     0.119053E+04     0.976626E+03     0.198052E+00
1987     0.269116E+02     0.392754E+03    -0.268063E+01
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1988     0.983845E+03     0.545403E+03     0.589944E+00
1989     0.424029E+03     0.391672E+03     0.793757E-01
1990     0.236877E+03     0.223922E+03     0.562433E-01
1991     0.140241E+04     0.434410E+03     0.117196E+01
1992     0.167617E+03     0.163924E+03     0.222766E-01
1993     0.116116E+02     0.216663E+03    -0.292634E+01
1994     0.170486E+03     0.138644E+03     0.206745E+00
1995     0.676205E+02     0.861973E+02    -0.242727E+00
1996     0.997232E+02     0.146805E+03    -0.386707E+00
1997     0.397254E+03     0.234179E+03     0.528488E+00
1998     0.152044E+03     0.109196E+03     0.331027E+00
1999     0.290017E+03     0.272079E+03     0.638480E-01
2000     0.301492E+03     0.135147E+03     0.802378E+00
2001     0.829205E+02     0.627228E+02     0.279157E+00
2002     0.883848E+02     0.117140E+03    -0.281673E+00
2003     0.224036E+02     0.435161E+02    -0.663908E+00
2004     0.870051E+03     0.296740E+03     0.107570E+01
2005     0.162563E+02     0.646176E+02    -0.138001E+01
2006     0.243980E+03     0.157510E+03     0.437598E+00
2007     0.170895E+03     0.155108E+03     0.969288E-01
2008     0.864177E+03     0.113194E+03     0.203267E+01
```

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Survey Index:    2 Tag:         spr_36   AGE =  2
Time = JAN-1           Type = NUMBER
Catchability =    0.919973E-01   % Variance Contribution =     1.1443
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_______________________________________________________________________

1978     N/A              0.433026E+03     N/A
1979     N/A              0.214949E+04     N/A
1980     N/A              0.193082E+04     N/A
1981     N/A              0.169763E+04     N/A
1982     0.742514E+04     0.335525E+04     0.794345E+00
1983     0.266630E+04     0.143170E+04     0.621829E+00
1984     0.588777E+03     0.799543E+03    -0.305993E+00
1985     0.362432E+04     0.216252E+04     0.516393E+00
1986     0.558723E+03     0.709610E+03    -0.239061E+00
1987     0.220279E+04     0.328837E+04    -0.400667E+00
1988     0.831664E+03     0.133947E+04    -0.476604E+00
1989     0.192671E+04     0.184506E+04     0.432995E-01
1990     0.125883E+04     0.127037E+04    -0.912143E-02
1991     0.721013E+03     0.762630E+03    -0.561161E-01
1992     0.171087E+04     0.146793E+04     0.153150E+00
1993     0.544789E+03     0.546735E+03    -0.356575E-02
1994     0.372118E+03     0.718830E+03    -0.658415E+00
1995     0.521429E+03     0.468042E+03     0.108017E+00
1996     0.292203E+03     0.293182E+03    -0.334671E-02
1997     0.597110E+03     0.498505E+03     0.180487E+00
1998     0.908711E+03     0.793261E+03     0.135875E+00
1999     0.397390E+03     0.369547E+03     0.726405E-01
2000     0.110187E+04     0.929927E+03     0.169660E+00
2001     0.320480E+03     0.454454E+03    -0.349277E+00
2002     0.126908E+03     0.214320E+03    -0.524006E+00
2003     0.290700E+03     0.399284E+03    -0.317381E+00
2004     0.792321E+02     0.147953E+03    -0.624515E+00
2005     0.660905E+03     0.101434E+04    -0.428386E+00
2006     0.315562E+03     0.220773E+03     0.357221E+00
2007     0.872783E+03     0.537917E+03     0.483983E+00
2008     0.113603E+04     0.531517E+03     0.759555E+00

Survey Index:    3 Tag:         spr_36   AGE =  3
Time = JAN-1           Type = NUMBER
Catchability =    0.186189E+00   % Variance Contribution =     1.9673
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_______________________________________________________________________

1978     N/A              0.471667E+04     N/A
1979     N/A              0.647539E+03     N/A
1980     N/A              0.318520E+04     N/A
1981     N/A              0.248941E+04     N/A
1982     0.129803E+05     0.215811E+04     0.179420E+01
1983     0.412144E+04     0.381182E+04     0.780942E-01
1984     0.103917E+04     0.150732E+04    -0.371914E+00
1985     0.906115E+03     0.106547E+04    -0.162005E+00
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1986     0.251958E+04     0.234013E+04     0.738855E-01
1987     0.516921E+03     0.908851E+03    -0.564291E+00
1988     0.430258E+04     0.411688E+04     0.441184E-01
1989     0.910350E+03     0.182518E+04    -0.695607E+00
1990     0.237300E+04     0.261964E+04    -0.988808E-01
1991     0.940813E+03     0.117859E+04    -0.225326E+00
1992     0.639595E+03     0.935161E+03    -0.379884E+00
1993     0.178423E+04     0.162897E+04     0.910342E-01
1994     0.273214E+03     0.649205E+03    -0.865492E+00
1995     0.116649E+04     0.108788E+04     0.697642E-01
1996     0.100570E+04     0.666025E+03     0.412114E+00
1997     0.232505E+03     0.437564E+03    -0.632309E+00
1998     0.177316E+04     0.711063E+03     0.913758E+00
1999     0.831938E+03     0.116020E+04    -0.332589E+00
2000     0.113357E+04     0.552513E+03     0.718646E+00
2001     0.108425E+04     0.138253E+04    -0.243027E+00
2002     0.523615E+03     0.632316E+03    -0.188632E+00
2003     0.370479E+03     0.336138E+03     0.972743E-01
2004     0.790819E+03     0.627784E+03     0.230873E+00
2005     0.188245E+03     0.233488E+03    -0.215388E+00
2006     0.178395E+04     0.161956E+04     0.966774E-01
2007     0.513096E+03     0.354103E+03     0.370876E+00
2008     0.790272E+03     0.802993E+03    -0.159690E-01

Survey Index:    4 Tag:         spr_36   AGE =  4
Time = JAN-1           Type = NUMBER
Catchability =    0.316089E+00   % Variance Contribution =     3.7219
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_______________________________________________________________________

1978     N/A              0.242136E+04     N/A
1979     N/A              0.425697E+04     N/A
1980     N/A              0.629366E+03     N/A
1981     N/A              0.274021E+04     N/A
1982     0.113717E+05     0.211816E+04     0.168058E+01
1983     0.108767E+04     0.174476E+04    -0.472583E+00
1984     0.169147E+04     0.282464E+04    -0.512783E+00
1985     0.151675E+04     0.111018E+04     0.312051E+00
1986     0.498889E+03     0.652071E+03    -0.267770E+00
1987     0.104272E+04     0.195689E+04    -0.629522E+00
1988     0.558450E+03     0.833493E+03    -0.400461E+00
1989     0.216263E+04     0.335380E+04    -0.438769E+00
1990     0.921005E+03     0.167685E+04    -0.599206E+00
1991     0.126894E+04     0.212050E+04    -0.513469E+00
1992     0.229637E+03     0.656061E+03    -0.104975E+01
1993     0.280454E+03     0.654340E+03    -0.847215E+00
1994     0.295755E+03     0.101596E+04    -0.123406E+01
1995     0.729482E+03     0.466430E+03     0.447226E+00
1996     0.170376E+04     0.110617E+04     0.431932E+00
1997     0.667462E+03     0.645705E+03     0.331410E-01
1998     0.115816E+04     0.395670E+03     0.107400E+01
1999     0.696287E+03     0.617105E+03     0.120722E+00
2000     0.155882E+04     0.103950E+04     0.405195E+00
2001     0.218845E+03     0.557473E+03    -0.935052E+00
2002     0.135651E+04     0.116630E+04     0.151080E+00
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2003     0.850380E+03     0.543852E+03     0.447005E+00
2004     0.192138E+04     0.352281E+03     0.169637E+01
2005     0.861991E+03     0.748876E+03     0.140671E+00
2006     0.453399E+03     0.267099E+03     0.529152E+00
2007     0.245032E+04     0.201089E+04     0.197642E+00
2008     0.479901E+03     0.379823E+03     0.233874E+00

Survey Index:    5 Tag:         spr_36   AGE =  5
Time = JAN-1           Type = NUMBER
Catchability =    0.402164E+00   % Variance Contribution =     4.4165
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
-----------------------------------------------------------------------

1978     N/A              0.119316E+04     N/A
1979     N/A              0.164587E+04     N/A
1980     N/A              0.278155E+04     N/A
1981     N/A              0.458814E+03     N/A
1982     0.848057E+04     0.188551E+04     0.150358E+01
1983     0.952152E+03     0.113281E+04    -0.173731E+00
1984     0.576892E+03     0.855716E+03    -0.394284E+00
1985     0.192930E+04     0.174363E+04     0.101187E+00
1986     0.737679E+03     0.549920E+03     0.293736E+00
1987     0.848330E+02     0.369872E+03    -0.147247E+01
1988     0.879067E+03     0.125638E+04    -0.357130E+00
1989     0.321163E+03     0.481806E+03    -0.405591E+00
1990     0.124572E+04     0.196268E+04    -0.454595E+00
1991     0.654075E+03     0.103935E+04    -0.463129E+00
1992     0.372801E+03     0.107426E+04    -0.105835E+01
1993     0.122263E+03     0.299661E+03    -0.896473E+00
1994     0.453536E+02     0.244043E+03    -0.168285E+01
1995     0.818277E+03     0.349092E+03     0.851866E+00
1996     0.237970E+03     0.245232E+03    -0.300622E-01
1997     0.576892E+03     0.694826E+03    -0.186007E+00
1998     0.103125E+04     0.306567E+03     0.121309E+01
1999     0.325398E+03     0.234259E+03     0.328623E+00
2000     0.505856E+03     0.336379E+03     0.408013E+00
2001     0.522795E+03     0.666086E+03    -0.242228E+00
2002     0.327038E+03     0.310469E+03     0.519894E-01
2003     0.951332E+03     0.669490E+03     0.351347E+00
2004     0.184952E+04     0.279009E+03     0.189144E+01
2005     0.374850E+03     0.272933E+03     0.317299E+00
2006     0.988216E+03     0.571052E+03     0.548421E+00
2007     0.247122E+03     0.202956E+03     0.196896E+00
2008     0.131225E+04     0.166917E+04    -0.240583E+00
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Survey Index:    6 Tag:         spr_36   AGE =  6
Time = JAN-1           Type = NUMBER
Catchability =    0.408966E+00   % Variance Contribution =     4.1235
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_______________________________________________________________________

1978     N/A              0.516862E+03     N/A
1979     N/A              0.664295E+03     N/A
1980     N/A              0.927325E+03     N/A
1981     N/A              0.141277E+04     N/A
1982     0.400122E+03     0.265264E+03     0.411044E+00
1983     0.605306E+03     0.824229E+03    -0.308714E+00
1984     0.546975E+03     0.520515E+03     0.495839E-01
1985     0.362555E+03     0.374729E+03    -0.330267E-01
1986     0.844096E+03     0.686242E+03     0.207035E+00
1987     0.245073E+03     0.265528E+03    -0.801644E-01
1988     0.874286E+02     0.198035E+03    -0.817621E+00
1989     0.479628E+03     0.471524E+03     0.170410E-01
1990     0.178136E+03     0.260474E+03    -0.379956E+00
1991     0.448208E+03     0.804430E+03    -0.584877E+00
1992     0.194529E+03     0.340640E+03    -0.560246E+00
1993     0.188791E+03     0.348724E+03    -0.613638E+00
1994     0.778660E+01     0.772038E+02    -0.229404E+01
1995     0.145760E+03     0.494726E+02     0.108054E+01
1996     0.284826E+03     0.150930E+03     0.635065E+00
1997     0.680304E+02     0.110445E+03    -0.484560E+00
1998     0.727570E+03     0.256647E+03     0.104201E+01
1999     0.162972E+03     0.114647E+03     0.351720E+00
2000     0.139886E+03     0.904873E+02     0.435616E+00
2001     0.241248E+03     0.164418E+03     0.383413E+00
2002     0.306956E+03     0.299063E+03     0.260502E-01
2003     0.875652E+02     0.125102E+03    -0.356744E+00
2004     0.121922E+04     0.226003E+03     0.168542E+01
2005     0.280454E+03     0.117751E+03     0.867840E+00
2006     0.290700E+03     0.174091E+03     0.512714E+00
2007     0.285782E+03     0.340941E+03    -0.176479E+00
2008     0.516375E+02     0.142489E+03    -0.101502E+01

Survey Index:    7 Tag:         spr_36   AGE =  7
Time = JAN-1           Type = NUMBER
Catchability =    0.427224E+00   % Variance Contribution =     5.9587
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_______________________________________________________________________

1978     N/A              0.517738E+03     N/A
1979     N/A              0.373407E+03     N/A
1980     N/A              0.395609E+03     N/A
1981     N/A              0.417749E+03     N/A
1982     0.254868E+04     0.670954E+03     0.133463E+01
1983     0.371571E+02     0.113517E+03    -0.111680E+01
1984     0.285236E+03     0.419358E+03    -0.385408E+00
1985     0.262149E+03     0.231313E+03     0.125142E+00
1986     0.842866E+02     0.131658E+03    -0.445982E+00
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1987     0.185103E+03     0.351439E+03    -0.641124E+00
1988     0.505446E+02     0.131526E+03    -0.956345E+00
1989     0.689866E+02     0.839973E+02    -0.196872E+00
1990     0.195485E+03     0.199499E+03    -0.203288E-01
1991     0.739045E+02     0.134524E+03    -0.598966E+00
1992     0.216796E+03     0.274393E+03    -0.235605E+00
1993     0.400259E+02     0.120883E+03    -0.110530E+01
1994     0.602438E+02     0.953431E+02    -0.459083E+00
1995     0.319114E+03     0.288724E+02     0.240266E+01
1996     0.378402E+02     0.265352E+02     0.354898E+00
1997     0.182917E+03     0.590595E+02     0.113049E+01
1998     0.138793E+03     0.382960E+02     0.128764E+01
1999     0.868821E+02     0.110674E+03    -0.242038E+00
2000     0.348348E+02     0.500415E+02    -0.362236E+00
2001     0.315563E+02     0.437492E+02    -0.326701E+00
2002     0.532768E+02     0.717704E+02    -0.297971E+00
2003     0.108603E+03     0.114295E+03    -0.510902E-01
2004     0.243980E+03     0.475882E+02     0.163450E+01
2005     0.174037E+03     0.967652E+02     0.586983E+00
2006     0.165704E+03     0.601494E+02     0.101338E+01
2007     0.422116E+02     0.121665E+03    -0.105858E+01
2008     0.614732E+02     0.241894E+03    -0.136990E+01

Survey Index:    8 Tag:         spr_36   AGE =  8
Time = JAN-1           Type = NUMBER
Catchability =    0.517786E+00   % Variance Contribution =     3.4338
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_______________________________________________________________________
1978     N/A              0.424445E+02     N/A
1979     N/A              0.401573E+03     N/A
1980     N/A              0.296199E+03     N/A
1981     N/A              0.199172E+03     N/A
1982     0.503397E+03     0.221488E+03     0.821012E+00
1983     0.298623E+03     0.338660E+03    -0.125813E+00
1984     N/A              0.687540E+02     N/A
1985     0.245756E+03     0.207895E+03     0.167306E+00
1986     0.170895E+03     0.106124E+03     0.476443E+00
1987     0.448071E+02     0.908907E+02    -0.707291E+00
1988     0.672107E+02     0.220010E+03    -0.118584E+01
1989     0.539598E+02     0.610824E+02    -0.123985E+00
1990     0.176223E+02     0.456522E+02    -0.951887E+00
1991     0.554625E+02     0.920049E+02    -0.506135E+00
1992     0.267750E+02     0.681236E+02    -0.933855E+00
1993     0.469929E+02     0.108255E+03    -0.834493E+00
1994     N/A              0.382234E+02     N/A
1995     0.382500E+02     0.275734E+02     0.327294E+00
1996     0.247259E+02     0.187106E+02     0.278764E+00
1997     0.274580E+02     0.180107E+02     0.421694E+00
1998     0.422116E+02     0.153890E+02     0.100904E+01
1999     0.416652E+02     0.194048E+02     0.764146E+00
2000     0.274580E+02     0.435692E+02    -0.461693E+00
2001     0.241795E+02     0.282009E+02    -0.153848E+00
2002     N/A              0.181436E+02     N/A
2003     0.168027E+02     0.321143E+02    -0.647762E+00
2004     0.356818E+03     0.477458E+02     0.201133E+01
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2005     0.407089E+02     0.203667E+02     0.692547E+00
2006     0.736313E+02     0.564696E+02     0.265367E+00
2007     0.247259E+02     0.451595E+02    -0.602348E+00
2008     N/A              0.113157E+03     N/A

Survey Index:    9 Tag:         spr_41   AGE =  1
Time = JAN-1           Type = NUMBER
Catchability =    0.141338E-01   % Variance Contribution =     1.7874
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
-----------------------------------------------------------------------

1978     0.477900E+03     0.405710E+03     0.163763E+00
1979     0.550671E+03     0.366665E+03     0.406688E+00
1980     0.401143E+02     0.323854E+03    -0.208856E+01
1981     0.295997E+04     0.648606E+03     0.151811E+01
1982     N/A              0.280737E+03     N/A
1983     N/A              0.159787E+03     N/A
1984     N/A              0.410170E+03     N/A
1985     N/A              0.135900E+03     N/A
1986     N/A              0.629030E+03     N/A
1987     N/A              0.252967E+03     N/A
1988     N/A              0.351286E+03     N/A
1989     N/A              0.252270E+03     N/A
1990     N/A              0.144225E+03     N/A
1991     N/A              0.279797E+03     N/A
1992     N/A              0.105581E+03     N/A
1993     N/A              0.139549E+03     N/A
1994     N/A              0.892983E+02     N/A
1995     N/A              0.555184E+02     N/A
1996     N/A              0.945549E+02     N/A
1997     N/A              0.150831E+03     N/A
1998     N/A              0.703313E+02     N/A
1999     N/A              0.175242E+03     N/A
2000     N/A              0.870463E+02     N/A
2001     N/A              0.403988E+02     N/A
2002     N/A              0.754484E+02     N/A
2003     N/A              0.280280E+02     N/A
2004     N/A              0.191126E+03     N/A
2005     N/A              0.416192E+02     N/A
2006     N/A              0.101450E+03     N/A
2007     N/A              0.999029E+02     N/A
2008     N/A              0.729069E+02     N/A
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Survey Index:   10 Tag:         spr_41   AGE =  2
Time = JAN-1           Type = NUMBER
Catchability =    0.899870E-01   % Variance Contribution =     0.1682
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_______________________________________________________________________

1978     0.246600E+03     0.423564E+03    -0.540937E+00
1979     0.166847E+04     0.210252E+04    -0.231231E+00
1980     0.285043E+04     0.188863E+04     0.411618E+00
1981     0.238140E+04     0.166053E+04     0.360549E+00
1982     N/A              0.328194E+04     N/A
1983     N/A              0.140041E+04     N/A
1984     N/A              0.782072E+03     N/A
1985     N/A              0.211527E+04     N/A
1986     N/A              0.694104E+03     N/A
1987     N/A              0.321651E+04     N/A
1988     N/A              0.131021E+04     N/A
1989     N/A              0.180474E+04     N/A
1990     N/A              0.124261E+04     N/A
1991     N/A              0.745965E+03     N/A
1992     N/A              0.143585E+04     N/A
1993     N/A              0.534788E+03     N/A
1994     N/A              0.703123E+03     N/A
1995     N/A              0.457814E+03     N/A
1996     N/A              0.286776E+03     N/A
1997     N/A              0.487612E+03     N/A
1998     N/A              0.775927E+03     N/A
1999     N/A              0.361472E+03     N/A
2000     N/A              0.909607E+03     N/A
2001     N/A              0.444524E+03     N/A
2002     N/A              0.209636E+03     N/A
2003     N/A              0.390559E+03     N/A
2004     N/A              0.144720E+03     N/A
2005     N/A              0.992178E+03     N/A
2006     N/A              0.215949E+03     N/A
2007     N/A              0.526163E+03     N/A
2008     N/A              0.519903E+03     N/A

Survey Index:   11 Tag:         spr_41   AGE =  3
Time = JAN-1           Type = NUMBER
Catchability =    0.198731E+00   % Variance Contribution =     0.1728
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_______________________________________________________________________

1978     0.711116E+04     0.503439E+04     0.345372E+00
1979     0.353700E+03     0.691159E+03    -0.669921E+00
1980     0.345806E+04     0.339976E+04     0.170022E-01
1981     0.361389E+04     0.265710E+04     0.307547E+00
1982     N/A              0.230348E+04     N/A
1983     N/A              0.406860E+04     N/A
1984     N/A              0.160886E+04     N/A
1985     N/A              0.113724E+04     N/A
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1986     N/A              0.249777E+04     N/A
1987     N/A              0.970074E+03     N/A
1988     N/A              0.439420E+04     N/A
1989     N/A              0.194813E+04     N/A
1990     N/A              0.279610E+04     N/A
1991     N/A              0.125798E+04     N/A
1992     N/A              0.998155E+03     N/A
1993     N/A              0.173871E+04     N/A
1994     N/A              0.692937E+03     N/A
1995     N/A              0.116117E+04     N/A
1996     N/A              0.710890E+03     N/A
1997     N/A              0.467039E+03     N/A
1998     N/A              0.758962E+03     N/A
1999     N/A              0.123835E+04     N/A
2000     N/A              0.589732E+03     N/A
2001     N/A              0.147566E+04     N/A
2002     N/A              0.674910E+03     N/A
2003     N/A              0.358781E+03     N/A
2004     N/A              0.670073E+03     N/A
2005     N/A              0.249216E+03     N/A
2006     N/A              0.172866E+04     N/A
2007     N/A              0.377956E+03     N/A
2008     N/A              0.857085E+03     N/A

Survey Index:   12 Tag:         spr_41   AGE =  4
Time = JAN-1           Type = NUMBER
Catchability =    0.177261E+00   % Variance Contribution =     0.0498
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_______________________________________________________________________
1978     0.124907E+04     0.135789E+04    -0.835318E-01
1979     0.238050E+04     0.238729E+04    -0.284902E-02
1980     0.272957E+03     0.352946E+03    -0.257001E+00
1981     0.216630E+04     0.153670E+04     0.343382E+00
1982     N/A              0.118786E+04     N/A
1983     N/A              0.978455E+03     N/A
1984     N/A              0.158405E+04     N/A
1985     N/A              0.622583E+03     N/A
1986     N/A              0.365679E+03     N/A
1987     N/A              0.109742E+04     N/A
1988     N/A              0.467420E+03     N/A
1989     N/A              0.188080E+04     N/A
1990     N/A              0.940372E+03     N/A
1991     N/A              0.118917E+04     N/A
1992     N/A              0.367917E+03     N/A
1993     N/A              0.366951E+03     N/A
1994     N/A              0.569748E+03     N/A
1995     N/A              0.261573E+03     N/A
1996     N/A              0.620339E+03     N/A
1997     N/A              0.362109E+03     N/A
1998     N/A              0.221891E+03     N/A
1999     N/A              0.346070E+03     N/A
2000     N/A              0.582946E+03     N/A
2001     N/A              0.312629E+03     N/A
2002     N/A              0.654056E+03     N/A
2003     N/A              0.304990E+03     N/A
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2004     N/A              0.197558E+03     N/A
2005     N/A              0.419967E+03     N/A
2006     N/A              0.149788E+03     N/A
2007     N/A              0.112770E+04     N/A
2008     N/A              0.213004E+03     N/A

Survey Index:   13 Tag:         spr_41   AGE =  5
Time = JAN-1           Type = NUMBER
Catchability =    0.216299E+00   % Variance Contribution =     0.1953
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_______________________________________________________________________

1978     0.999771E+03     0.641727E+03     0.443364E+00
1979     0.702771E+03     0.885211E+03    -0.230795E+00
1980     0.219214E+04     0.149602E+04     0.382068E+00
1981     0.136157E+03     0.246768E+03    -0.594637E+00
1982     N/A              0.101410E+04     N/A
1983     N/A              0.609268E+03     N/A
1984     N/A              0.460237E+03     N/A
1985     N/A              0.937793E+03     N/A
1986     N/A              0.295768E+03     N/A
1987     N/A              0.198931E+03     N/A
1988     N/A              0.675730E+03     N/A
1989     N/A              0.259133E+03     N/A
1990     N/A              0.105560E+04     N/A
1991     N/A              0.559003E+03     N/A
1992     N/A              0.577780E+03     N/A
1993     N/A              0.161169E+03     N/A
1994     N/A              0.131256E+03     N/A
1995     N/A              0.187755E+03     N/A
1996     N/A              0.131895E+03     N/A
1997     N/A              0.373704E+03     N/A
1998     N/A              0.164883E+03     N/A
1999     N/A              0.125993E+03     N/A
2000     N/A              0.180918E+03     N/A
2001     N/A              0.358247E+03     N/A
2002     N/A              0.166982E+03     N/A
2003     N/A              0.360077E+03     N/A
2004     N/A              0.150062E+03     N/A
2005     N/A              0.146794E+03     N/A
2006     N/A              0.307134E+03     N/A
2007     N/A              0.109157E+03     N/A
2008     N/A              0.897742E+03     N/A
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Survey Index:   14 Tag:         spr_41   AGE =  6
Time = JAN-1          Type = NUMBER
Catchability =    0.207689E+00   % Variance Contribution =     0.0917
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_______________________________________________________________________

1978     0.182057E+03     0.262483E+03    -0.365866E+00
1979     0.302786E+03     0.337355E+03    -0.108111E+00
1980     0.480471E+03     0.470932E+03     0.200532E-01
1981     0.112963E+04     0.717462E+03     0.453924E+00
1982     N/A              0.134712E+03     N/A
1983     N/A              0.418576E+03     N/A
1984     N/A              0.264338E+03     N/A
1985     N/A              0.190302E+03     N/A
1986     N/A              0.348501E+03     N/A
1987     N/A              0.134846E+03     N/A
1988     N/A              0.100570E+03     N/A
1989     N/A              0.239458E+03     N/A
1990     N/A              0.132279E+03     N/A
1991     N/A              0.408522E+03     N/A
1992     N/A              0.172990E+03     N/A
1993     N/A              0.177096E+03     N/A
1994     N/A              0.392072E+02     N/A
1995     N/A              0.251241E+02     N/A
1996     N/A              0.766480E+02     N/A
1997     N/A              0.560882E+02     N/A
1998     N/A              0.130335E+03     N/A
1999     N/A              0.582225E+02     N/A
2000     N/A              0.459530E+02     N/A
2001     N/A              0.834981E+02     N/A
2002     N/A              0.151876E+03     N/A
2003     N/A              0.635317E+02     N/A
2004     N/A              0.114773E+03     N/A
2005     N/A              0.597986E+02     N/A
2006     N/A              0.884103E+02     N/A
2007     N/A              0.173143E+03     N/A
2008     N/A              0.723618E+02     N/A

Survey Index:   15 Tag:         spr_41   AGE =  7
Time = JAN-1          Type = NUMBER
Catchability =    0.300243E+00   % Variance Contribution =     0.4397
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_______________________________________________________________________

1978     0.915814E+03     0.363855E+03     0.923058E+00
1979     0.107486E+03     0.262422E+03    -0.892596E+00
1980     0.238500E+03     0.278025E+03    -0.153343E+00
1981     0.331971E+03     0.293585E+03     0.122881E+00
1982     N/A              0.471532E+03     N/A
1983     N/A              0.797775E+02     N/A
1984     N/A              0.294715E+03     N/A
1985     N/A              0.162562E+03     N/A
1986     N/A              0.925261E+02     N/A
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1987     N/A              0.246983E+03     N/A
1988     N/A              0.924333E+02     N/A
1989     N/A              0.590315E+02     N/A
1990     N/A              0.140204E+03     N/A
1991     N/A              0.945403E+02     N/A
1992     N/A              0.192837E+03     N/A
1993     N/A              0.849539E+02     N/A
1994     N/A              0.670051E+02     N/A
1995     N/A              0.202909E+02     N/A
1996     N/A              0.186484E+02     N/A
1997     N/A              0.415057E+02     N/A
1998     N/A              0.269136E+02     N/A
1999     N/A              0.777793E+02     N/A
2000     N/A              0.351681E+02     N/A
2001     N/A              0.307460E+02     N/A
2002     N/A              0.504386E+02     N/A
2003     N/A              0.803243E+02     N/A
2004     N/A              0.334440E+02     N/A
2005     N/A              0.680045E+02     N/A
2006     N/A              0.422717E+02     N/A
2007     N/A              0.855034E+02     N/A
2008     N/A              0.169998E+03     N/A

Survey Index:   16 Tag:         spr_41   AGE =  8
Time = JAN-1           Type = NUMBER
Catchability =    0.291472E+00   % Variance Contribution =     1.0030
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
-----------------------------------------------------------------------

1978     0.837000E+02     0.238929E+02     0.125366E+01
1979     0.178200E+03     0.226054E+03    -0.237867E+00
1980     0.398571E+02     0.166737E+03    -0.143111E+01
1981     0.169843E+03     0.112118E+03     0.415324E+00
1982     N/A              0.124680E+03     N/A
1983     N/A              0.190639E+03     N/A
1984     N/A              0.387030E+02     N/A
1985     N/A              0.117028E+03     N/A
1986     N/A              0.597394E+02     N/A
1987     N/A              0.511642E+02     N/A
1988     N/A              0.123848E+03     N/A
1989     N/A              0.343846E+02     N/A
1990     N/A              0.256986E+02     N/A
1991     N/A              0.517915E+02     N/A
1992     N/A              0.383482E+02     N/A
1993     N/A              0.609389E+02     N/A
1994     N/A              0.215168E+02     N/A
1995     N/A              0.155216E+02     N/A
1996     N/A              0.105326E+02     N/A
1997     N/A              0.101386E+02     N/A
1998     N/A              0.866276E+01     N/A
1999     N/A              0.109234E+02     N/A
2000     N/A              0.245260E+02     N/A
2001     N/A              0.158749E+02     N/A
2002     N/A              0.102134E+02     N/A
2003     N/A              0.180778E+02     N/A
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2004     N/A              0.268771E+02     N/A
2005     N/A              0.114648E+02     N/A
2006     N/A              0.317879E+02     N/A
2007     N/A              0.254212E+02     N/A
2008     N/A              0.636984E+02     N/A

Survey Index:   17 Tag:         sp_can   AGE =  1
Time = JAN-1           Type = NUMBER
Catchability =    0.209249E-01   % Variance Contribution =     5.7602
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual

_____________________________________________________________________________

1978     N/A              0.600650E+03     N/A
1979     N/A              0.542845E+03     N/A
1980     N/A              0.479463E+03     N/A
1981     N/A              0.960256E+03     N/A
1982     N/A              0.415628E+03     N/A
1983     N/A              0.236563E+03     N/A
1984     N/A              0.607253E+03     N/A
1985     N/A              0.201198E+03     N/A
1986     0.844432E+03     0.931273E+03    -0.978887E-01
1987     0.351846E+03     0.374515E+03    -0.624372E-01
1988     0.394068E+03     0.520075E+03    -0.277450E+00
1989     0.229404E+04     0.373484E+03     0.181520E+01
1990     0.591102E+03     0.213523E+03     0.101824E+01
1991     0.166072E+04     0.414237E+03     0.138857E+01
1992     0.154812E+03     0.156312E+03    -0.963945E-02
1993     N/A              0.206602E+03     N/A
1994     N/A              0.132205E+03     N/A
1995     0.985170E+02     0.821945E+02     0.181141E+00
1996     0.197034E+03     0.139988E+03     0.341822E+00
1997     0.450363E+03     0.223305E+03     0.701519E+00
1998     0.140739E+02     0.104125E+03    -0.200127E+01
1999     0.464437E+03     0.259444E+03     0.582286E+00
2000     0.140739E+03     0.128871E+03     0.880899E-01
2001     N/A              0.598101E+02     N/A
2002     0.128934E+02     0.111701E+03    -0.215911E+01
2003     N/A              0.414953E+02     N/A
2004     0.753776E+03     0.282960E+03     0.979790E+00
2005     0.344185E+02     0.616168E+02    -0.582341E+00
2006     N/A              0.150196E+03     N/A
2007     0.193318E+03     0.147905E+03     0.267764E+00
2008     0.122714E+02     0.107938E+03    -0.217429E+01

Survey Index:   18 Tag:         sp_can   AGE =  2
Time = JAN-1           Type = NUMBER
Catchability =    0.981470E-01   % Variance Contribution =     4.9873
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_______________________________________________________________________

1978     N/A              0.461972E+03     N/A
1979     N/A              0.229318E+04     N/A
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1980     N/A              0.205989E+04     N/A
1981     N/A              0.181111E+04     N/A
1982     N/A              0.357954E+04     N/A
1983     N/A              0.152740E+04     N/A
1984     N/A              0.852989E+03     N/A
1985     N/A              0.230708E+04     N/A
1986     0.319477E+04     0.757045E+03     0.143985E+01
1987     0.299773E+04     0.350819E+04    -0.157243E+00
1988     0.142146E+04     0.142901E+04    -0.530002E-02
1989     0.391253E+04     0.196840E+04     0.686965E+00
1990     0.343402E+04     0.135529E+04     0.929717E+00
1991     0.163257E+04     0.813609E+03     0.696430E+00
1992     0.402512E+04     0.156605E+04     0.943998E+00
1993     N/A              0.583283E+03     N/A
1994     N/A              0.766882E+03     N/A
1995     0.942949E+03     0.499329E+03     0.635747E+00
1996     0.689619E+03     0.312780E+03     0.790638E+00
1997     0.745915E+03     0.531829E+03     0.338290E+00
1998     0.942949E+03     0.846287E+03     0.108153E+00
1999     0.450363E+03     0.394250E+03     0.133070E+00
2000     0.619250E+03     0.992090E+03    -0.471305E+00
2001     0.844432E+02     0.484833E+03    -0.174773E+01
2002     0.121746E+03     0.228646E+03    -0.630241E+00
2003     0.313603E+02     0.425975E+03    -0.260884E+01
2004     0.134499E+03     0.157843E+03    -0.160049E+00
2005     0.188003E+04     0.108215E+04     0.552337E+00
2006     0.527756E+02     0.235531E+03    -0.149579E+01
2007     0.730710E+03     0.573875E+03     0.241605E+00
2008     0.454928E+03     0.567047E+03    -0.220303E+00

Survey Index:   19 Tag:         sp_can   AGE =  3
Time = JAN-1           Type = NUMBER
Catchability =    0.327191E+00   % Variance Contribution =     1.1512
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_______________________________________________________________________

1978     N/A              0.828862E+04     N/A
1979     N/A              0.113792E+04     N/A
1980     N/A              0.559736E+04     N/A
1981     N/A              0.437466E+04     N/A
1982     N/A              0.379245E+04     N/A
1983     N/A              0.669854E+04     N/A
1984     N/A              0.264883E+04     N/A
1985     N/A              0.187236E+04     N/A
1986     0.395475E+04     0.411233E+04    -0.390703E-01
1987     0.130887E+04     0.159713E+04    -0.199044E+00
1988     0.655842E+04     0.723462E+04    -0.981279E-01
1989     0.194219E+04     0.320741E+04    -0.501645E+00
1990     0.531992E+04     0.460351E+04     0.144640E+00
1991     0.258959E+04     0.207114E+04     0.223403E+00
1992     0.249107E+04     0.164336E+04     0.415969E+00
1993     N/A              0.286260E+04     N/A
1994     N/A              0.114085E+04     N/A
1995     0.211108E+04     0.191174E+04     0.991842E-01
1996     0.325106E+04     0.117041E+04     0.102163E+01
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1997     0.774062E+03     0.768933E+03     0.664815E-02
1998     0.133702E+04     0.124955E+04     0.676540E-01
1999     0.209701E+04     0.203882E+04     0.281383E-01
2000     0.147776E+04     0.970934E+03     0.420021E+00
2001     0.900727E+03     0.242953E+04    -0.992251E+00
2002     0.805617E+03     0.111117E+04    -0.321562E+00
2003     0.419145E+03     0.590697E+03    -0.343086E+00
2004     0.551716E+03     0.110321E+04    -0.692945E+00
2005     0.661996E+03     0.410309E+03     0.478347E+00
2006     0.197858E+04     0.284606E+04    -0.363554E+00
2007     0.132932E+04     0.622267E+03     0.759053E+00
2008     0.125982E+04     0.141110E+04    -0.113402E+00

Survey Index:   20 Tag:         sp_can   AGE =  4
Time = JAN-1           Type = NUMBER
Catchability =    0.615292E+00   % Variance Contribution =     1.7549
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_______________________________________________________________________
1978     N/A              0.471337E+04     N/A
1979     N/A              0.828653E+04     N/A
1980     N/A              0.122511E+04     N/A
1981     N/A              0.533404E+04     N/A
1982     N/A              0.412317E+04     N/A
1983     N/A              0.339632E+04     N/A
1984     N/A              0.549839E+04     N/A
1985     N/A              0.216105E+04     N/A
1986     0.520733E+03     0.126931E+04    -0.890991E+00
1987     0.153405E+04     0.380925E+04    -0.909520E+00
1988     0.816284E+03     0.162246E+04    -0.686938E+00
1989     0.401105E+04     0.652844E+04    -0.487115E+00
1990     0.292736E+04     0.326412E+04    -0.108889E+00
1991     0.302588E+04     0.412773E+04    -0.310527E+00
1992     0.112591E+04     0.127707E+04    -0.125982E+00
1993     N/A              0.127372E+04     N/A
1994     N/A              0.197765E+04     N/A
1995     0.121035E+04     0.907944E+03     0.287484E+00
1996     0.565769E+04     0.215326E+04     0.966034E+00
1997     0.175923E+04     0.125692E+04     0.336216E+00
1998     0.492585E+03     0.770204E+03    -0.446988E+00
1999     0.153405E+04     0.120124E+04     0.244553E+00
2000     0.551695E+04     0.202346E+04     0.100301E+01
2001     0.591102E+03     0.108517E+04    -0.607499E+00
2002     0.288708E+04     0.227029E+04     0.240336E+00
2003     0.912160E+03     0.105865E+04    -0.148936E+00
2004     0.595577E+03     0.685744E+03    -0.140973E+00
2005     0.409251E+04     0.145775E+04     0.103227E+01
2006     0.925621E+03     0.519930E+03     0.576770E+00
2007     0.413611E+04     0.391436E+04     0.551031E-01
2008     0.835776E+03     0.739357E+03     0.122580E+00

Survey Index:   21 Tag:         sp_can   AGE =  5
Time = JAN-1           Type = NUMBER
Catchability =    0.949463E+00   % Variance Contribution =     1.5410
Residual = LN(Observed) - LN(Predicted)
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Year      Observed         Predicted         Residual
-----------------------------------------------------------------------

1978     N/A              0.281691E+04      N/A
1979     N/A              0.388570E+04      N/A
1980     N/A              0.656692E+04      N/A
1981     N/A              0.108321E+04      N/A
1982     N/A              0.445147E+04      N/A
1983     N/A              0.267443E+04      N/A
1984     N/A              0.202025E+04      N/A
1985     N/A              0.411652E+04      N/A
1986     0.914801E+03     0.129830E+04    -0.350102E+00
1987     0.478511E+03     0.873224E+03    -0.601512E+00
1988     0.143553E+04     0.296617E+04    -0.725735E+00
1989     0.506659E+03     0.113749E+04    -0.808738E+00
1990     0.544658E+04     0.463365E+04     0.161644E+00
1991     0.147776E+04     0.245379E+04    -0.507108E+00
1992     0.137924E+04     0.253621E+04    -0.609140E+00
1993     N/A              0.707464E+03     N/A
1994     N/A              0.576156E+03     N/A
1995     0.844432E+03     0.824164E+03     0.242937E-01
1996     0.153405E+04     0.578964E+03     0.974426E+00
1997     0.173108E+04     0.164040E+04     0.538060E-01
1998     0.492585E+03     0.723769E+03    -0.384805E+00
1999     0.577028E+03     0.553058E+03     0.424293E-01
2000     0.240663E+04     0.794152E+03     0.110871E+01
2001     0.156220E+04     0.157255E+04    -0.660507E-02
2002     0.961543E+03     0.732982E+03     0.271418E+00
2003     0.170676E+04     0.158059E+04     0.768030E-01
2004     0.634621E+03     0.658708E+03    -0.372520E-01
2005     0.159149E+04     0.644363E+03     0.904163E+00
2006     0.229716E+04     0.134819E+04     0.532914E+00
2007     0.545841E+03     0.479154E+03     0.130305E+00
2008     0.306929E+04     0.394071E+04    -0.249915E+00

Survey Index:   22 Tag:         sp_can   AGE =  6
Time = JAN-1           Type = NUMBER
Catchability =    0.112928E+01   % Variance Contribution =     3.0804
Residual = LN(Observed) - LN(Predicted)

Year      Observed         Predicted         Residual
-----------------------------------------------------------------------

1978     N/A              0.142722E+04      N/A
1979     N/A              0.183433E+04      N/A
1980     N/A              0.256064E+04      N/A
1981     N/A              0.390111E+04      N/A
1982     N/A              0.732478E+03      N/A
1983     N/A              0.227596E+04      N/A
1984     N/A              0.143731E+04      N/A
1985     N/A              0.103475E+04      N/A
1986     0.619250E+03     0.189493E+04    -0.111843E+01
1987     0.168886E+03     0.733207E+03    -0.146820E+01
1988     0.182960E+03     0.546837E+03    -0.109488E+01
1989     0.591102E+03     0.130202E+04    -0.789687E+00
1990     0.591102E+03     0.719250E+03    -0.196220E+00
1991     0.184368E+04     0.222128E+04    -0.186324E+00
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1992     0.844432E+03     0.940613E+03    -0.107868E+00
1993     N/A              0.962935E+03     N/A
1994     N/A              0.213184E+03     N/A
1995     0.267403E+03     0.136609E+03     0.671633E+00
1996     0.111183E+04     0.416764E+03     0.981247E+00
1997     0.379994E+03     0.304972E+03     0.219935E+00
1998     0.394068E+03     0.708683E+03    -0.586884E+00
1999     0.365920E+03     0.316577E+03     0.144849E+00
2000     0.109776E+04     0.249864E+03     0.148011E+01
2001     0.731841E+03     0.454010E+03     0.477443E+00
2002     0.171816E+04     0.825808E+03     0.732647E+00
2003     0.447151E+03     0.345445E+03     0.258062E+00
2004     0.545454E+03     0.624065E+03    -0.134636E+00
2005     0.721660E+03     0.325147E+03     0.797277E+00
2006     0.982657E+03     0.480720E+03     0.714976E+00
2007     0.851245E+03     0.941445E+03    -0.100716E+00
2008     0.196496E+03     0.393458E+03    -0.694333E+00

Survey Index:   23 Tag:         sp_can   AGE =  7
Time = JAN-1           Type = NUMBER
Catchability =    0.121718E+01   % Variance Contribution =     4.1028
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_______________________________________________________________________

1978     N/A              0.147506E+04     N/A
1979     N/A              0.106385E+04     N/A
1980     N/A              0.112711E+04     N/A
1981     N/A              0.119019E+04     N/A
1982     N/A              0.191158E+04     N/A
1983     N/A              0.323416E+03     N/A
1984     N/A              0.119477E+04     N/A
1985     N/A              0.659020E+03     N/A
1986     0.365920E+03     0.375098E+03    -0.247723E-01
1987     0.309625E+03     0.100126E+04    -0.117366E+01
1988     0.112591E+03     0.374722E+03    -0.120242E+01
1989     0.703693E+02     0.239312E+03    -0.122401E+01
1990     0.130887E+04     0.568382E+03     0.834124E+00
1991     0.225182E+03     0.383264E+03    -0.531815E+00
1992     0.605176E+03     0.781756E+03    -0.256023E+00
1993     N/A              0.344401E+03     N/A
1994     N/A              0.271637E+03     N/A
1995     0.562954E+02     0.822586E+02    -0.379256E+00
1996     0.464437E+03     0.756000E+02     0.181537E+01
1997     0.844432E+02     0.168263E+03    -0.689450E+00
1998     0.985170E+02     0.109107E+03    -0.102100E+00
1999     0.211108E+03     0.315315E+03    -0.401203E+00
2000     0.562954E+03     0.142570E+03     0.137336E+01
2001     0.365920E+03     0.124643E+03     0.107696E+01
2002     0.563812E+03     0.204477E+03     0.101427E+01
2003     0.474404E+03     0.325632E+03     0.376289E+00
2004     0.103828E+03     0.135581E+03    -0.266834E+00
2005     0.583521E+03     0.275688E+03     0.749810E+00
2006     0.283568E+03     0.171368E+03     0.503640E+00
2007     0.135474E+03     0.346628E+03    -0.939474E+00
2008     0.396500E+03     0.689165E+03    -0.552804E+00
```

```
Survey Index:   24 Tag:         sp_can   AGE =  8
Time = JAN-1           Type = NUMBER
Catchability =    0.128152E+01   % Variance Contribution =     4.6778
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_______________________________________________________________________

1978     N/A              0.105050E+03     N/A
1979     N/A              0.993891E+03     N/A
1980     N/A              0.733091E+03     N/A
1981     N/A              0.492948E+03     N/A
1982     N/A              0.548181E+03     N/A
1983     N/A              0.838180E+03     N/A
1984     N/A              0.170165E+03     N/A
1985     N/A              0.514539E+03     N/A
1986     0.562954E+02     0.262656E+03    -0.154023E+01
1987     0.112591E+03     0.224954E+03    -0.692134E+00
1988     0.239256E+03     0.544524E+03    -0.822379E+00
1989     0.140739E+03     0.151178E+03    -0.715569E-01
1990     0.168886E+03     0.112989E+03     0.401936E+00
1991     0.309625E+03     0.227711E+03     0.307283E+00
1992     0.168886E+03     0.168605E+03     0.166526E-02
1993     N/A              0.267930E+03     N/A
1994     N/A              0.946027E+02     N/A
1995     0.703693E+02     0.682438E+02     0.306702E-01
1996     0.112591E+03     0.463085E+02     0.888436E+00
1997     0.422216E+02     0.445762E+02    -0.542687E-01
1998     0.281477E+02     0.380876E+02    -0.302422E+00
1999     0.140739E+02     0.480267E+02    -0.122744E+01
2000     0.337773E+03     0.107833E+03     0.114179E+01
2001     0.239256E+03     0.697970E+02     0.123194E+01
2002     0.232375E+03     0.449052E+02     0.164380E+01
2003     0.227599E+03     0.794826E+02     0.105204E+01
2004     0.165354E+03     0.118170E+03     0.335962E+00
2005     0.188549E+02     0.504074E+02    -0.983364E+00
2006     0.260250E+03     0.139762E+03     0.621702E+00
2007     0.106609E+03     0.111769E+03    -0.472670E-01
2008     0.412168E+02     0.280063E+03    -0.191617E+01
```

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Survey Index:   25 Tag:         us0aut   AGE =  1
Time = JAN-1           Type = NUMBER
Catchability =    0.172164E-01   % Variance Contribution =    10.9577
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_______________________________________________________________________
1978     0.207096E+03     0.494197E+03    -0.869750E+00
1979     0.540008E+03     0.446637E+03     0.189839E+00
1980     0.156415E+03     0.394488E+03    -0.925075E+00
1981     0.382090E+03     0.790070E+03    -0.726465E+00
1982     0.356545E+03     0.341967E+03     0.417457E-01
1983     0.494518E+03     0.194637E+03     0.932448E+00
1984     0.175253E+04     0.499630E+03     0.125495E+01
1985     0.244663E+03     0.165540E+03     0.390670E+00
1986     0.136867E+04     0.766224E+03     0.580118E+00
1987     0.103958E+03     0.308140E+03    -0.108657E+01
1988     0.278269E+03     0.427902E+03    -0.430308E+00
1989     0.750656E+03     0.307291E+03     0.893152E+00
1990     0.342611E+03     0.175681E+03     0.667927E+00
1991     0.214610E+03     0.340822E+03    -0.462538E+00
1992     0.553259E+02     0.128609E+03    -0.843535E+00
1993     0.479491E+02     0.169986E+03    -0.126557E+01
1994     0.243707E+03     0.108775E+03     0.806689E+00
1995     0.912536E+02     0.676272E+02     0.299633E+00
1996     0.218435E+03     0.115178E+03     0.640012E+00
1997     0.295071E+02     0.183728E+03    -0.182883E+01
1998     0.874290E+01     0.856708E+02    -0.228227E+01
1999     0.957616E+02     0.213463E+03    -0.801601E+00
2000     0.957616E+02     0.106031E+03    -0.101874E+00
2001     0.266384E+02     0.492100E+02    -0.613743E+00
2002     0.387964E+02     0.919039E+02    -0.862416E+00
2003     0.319661E+03     0.341411E+02     0.223676E+01
2004     0.446569E+03     0.232811E+03     0.651366E+00
2005     0.230224E+04     0.506965E+02     0.381578E+01
2006     0.711723E+02     0.123577E+03    -0.551757E+00
2007     0.135787E+03     0.121692E+03     0.109597E+00
2008     0.102319E+03     0.888081E+02     0.141615E+00

Survey Index:   26 Tag:         us1aut   AGE =  2
Time = JAN-1           Type = NUMBER
Catchability =    0.746671E-01   % Variance Contribution =     3.3279
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_______________________________________________________________________
1978     0.323486E+03     0.351454E+03    -0.829237E-01
1979     0.252095E+04     0.174458E+04     0.368122E+00
1980     0.222000E+04     0.156710E+04     0.348283E+00
1981     0.112004E+04     0.137784E+04    -0.207148E+00
1982     0.481540E+04     0.272320E+04     0.570011E+00
1983     0.788633E+03     0.116200E+04    -0.387597E+00
1984     0.116048E+04     0.648927E+03     0.581266E+00
1985     0.260797E+04     0.175515E+04     0.396015E+00
1986     0.247669E+03     0.575936E+03    -0.843904E+00
1987     0.311314E+04     0.266892E+04     0.153959E+00
1988     0.565144E+03     0.108715E+04    -0.654233E+00
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1989     0.119490E+04     0.149749E+04    -0.225729E+00
1990     0.382281E+04     0.103106E+04     0.131040E+01
1991     0.496704E+03     0.618968E+03    -0.220060E+00
1992     0.556811E+03     0.119140E+04    -0.760661E+00
1993     0.563368E+03     0.443743E+03     0.238687E+00
1994     0.132495E+04     0.583419E+03     0.820226E+00
1995     0.554079E+03     0.379873E+03     0.377469E+00
1996     0.334278E+03     0.237953E+03     0.339897E+00
1997     0.327721E+03     0.404598E+03    -0.210734E+00
1998     0.322666E+03     0.643829E+03    -0.690814E+00
1999     0.458317E+03     0.299933E+03     0.424002E+00
2000     0.190840E+03     0.754750E+03    -0.137495E+01
2001     0.780027E+03     0.368846E+03     0.748950E+00
2002     0.643420E+02     0.173947E+03    -0.994536E+00
2003     0.652982E+03     0.324068E+03     0.700596E+00
2004     0.227178E+03     0.120082E+03     0.637555E+00
2005     0.101745E+04     0.823264E+03     0.211778E+00
2006     0.755438E+02     0.179185E+03    -0.863704E+00
2007     0.590826E+03     0.436586E+03     0.302536E+00
2008     0.156688E+03     0.431392E+03    -0.101276E+01

Survey Index:   27 Tag:         us2aut   AGE =  3
Time = JAN-1           Type = NUMBER
Catchability =    0.131211E+00   % Variance Contribution =     3.2794
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_______________________________________________________________________

1978     0.469041E+04     0.332391E+04     0.344377E+00
1979     0.534407E+03     0.456331E+03     0.157939E+00
1980     0.229090E+04     0.224466E+04     0.203913E-01
1981     0.769918E+03     0.175433E+04    -0.823558E+00
1982     0.307366E+04     0.152085E+04     0.703597E+00
1983     0.260851E+04     0.268625E+04    -0.293673E-01
1984     0.148806E+04     0.106224E+04     0.337098E+00
1985     0.931388E+03     0.750854E+03     0.215464E+00
1986     0.115105E+04     0.164913E+04    -0.359571E+00
1987     0.175540E+03     0.640482E+03    -0.129435E+01
1988     0.184802E+04     0.290123E+04    -0.451021E+00
1989     0.596973E+03     0.128624E+04    -0.767604E+00
1990     0.142946E+04     0.184610E+04    -0.255782E+00
1991     0.221905E+04     0.830569E+03     0.982722E+00
1992     0.239336E+03     0.659023E+03    -0.101289E+01
1993     0.129627E+04     0.114796E+04     0.121497E+00
1994     0.726204E+03     0.457505E+03     0.462042E+00
1995     0.907481E+03     0.766649E+03     0.168644E+00
1996     0.247341E+04     0.469359E+03     0.166199E+01
1997     0.267477E+03     0.308358E+03    -0.142230E+00
1998     0.438372E+03     0.501098E+03    -0.133732E+00
1999     0.140186E+04     0.817610E+03     0.539171E+00
2000     0.210648E+03     0.389365E+03    -0.614328E+00
2001     0.734673E+03     0.974293E+03    -0.282286E+00
2002     0.520200E+03     0.445603E+03     0.154784E+00
2003     0.965812E+03     0.236882E+03     0.140541E+01
2004     0.422389E+03     0.442410E+03    -0.463086E-01
2005     0.185512E+03     0.164543E+03     0.119952E+00
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2006     0.791502E+03     0.114133E+04    -0.366017E+00
2007     0.221030E+03     0.249542E+03    -0.121328E+00
2008     0.282504E+03     0.565883E+03    -0.694695E+00

Survey Index:   28 Tag:         us3aut   AGE =  4
Time = JAN-1           Type = NUMBER
Catchability =    0.158575E+00   % Variance Contribution =     5.0712
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_______________________________________________________________________

1978     0.943682E+03     0.121474E+04    -0.252498E+00
1979     0.554311E+04     0.213562E+04     0.953796E+00
1980     0.221440E+03     0.315739E+03    -0.354763E+00
1981     0.105720E+04     0.137470E+04    -0.262612E+00
1982     0.212971E+04     0.106263E+04     0.695234E+00
1983     0.330316E+03     0.875307E+03    -0.974525E+00
1984     0.101117E+04     0.141706E+04    -0.337479E+00
1985     0.126867E+04     0.556951E+03     0.823248E+00
1986     0.911170E+02     0.327130E+03    -0.127821E+01
1987     0.449438E+03     0.981729E+03    -0.781318E+00
1988     0.147536E+03     0.418145E+03    -0.104176E+01
1989     0.123466E+04     0.168253E+04    -0.309504E+00
1990     0.220074E+03     0.841238E+03    -0.134091E+01
1991     0.247819E+04     0.106381E+04     0.845672E+00
1992     0.374577E+03     0.329131E+03     0.129341E+00
1993     0.238106E+03     0.328268E+03    -0.321112E+00
1994     0.522659E+03     0.509685E+03     0.251356E-01
1995     0.592055E+03     0.233998E+03     0.928289E+00
1996     0.170554E+04     0.554943E+03     0.112277E+01
1997     0.566100E+03     0.323936E+03     0.558226E+00
1998     0.149312E+03     0.198499E+03    -0.284748E+00
1999     0.480584E+03     0.309588E+03     0.439760E+00
2000     0.422936E+03     0.521492E+03    -0.209474E+00
2001     0.963080E+02     0.279672E+03    -0.106606E+01
2002     0.627027E+03     0.585106E+03     0.691969E-01
2003     0.190704E+04     0.272838E+03     0.194443E+01
2004     0.273897E+03     0.176732E+03     0.438121E+00
2005     0.970047E+03     0.375694E+03     0.948569E+00
2006     0.176087E+03     0.133998E+03     0.273153E+00
2007     0.702434E+03     0.100882E+04    -0.361984E+00
2008     0.688500E+02     0.190549E+03    -0.101798E+01
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Survey Index:   29 Tag:         us4aut   AGE =  5
 Time = JAN-1           Type = NUMBER
 Catchability =    0.122922E+00   % Variance Contribution =     8.0096
 Residual = LN(Observed) - LN(Predicted)

 Year      Observed        Predicted         Residual
 ----------------------------------------------------------------------

 1978     0.345343E+03     0.364691E+03    -0.545130E-01
 1979     0.131635E+04     0.503063E+03     0.961900E+00
 1980     0.230388E+04     0.850186E+03     0.996895E+00
 1981     0.717188E+02     0.140237E+03    -0.670582E+00
 1982     0.804616E+03     0.576309E+03     0.333721E+00
 1983     0.926196E+02     0.346245E+03    -0.131865E+01
 1984     0.943955E+02     0.261551E+03    -0.101914E+01
 1985     0.112715E+04     0.532945E+03     0.749026E+00
 1986     0.144120E+03     0.168084E+03    -0.153813E+00
 1987     0.112018E+02     0.113052E+03    -0.231177E+01
 1988     0.273624E+03     0.384015E+03    -0.338927E+00
 1989     0.819643E+02     0.147265E+03    -0.585948E+00
 1990     0.692735E+03     0.599895E+03     0.143892E+00
 1991     0.563368E+03     0.317679E+03     0.572891E+00
 1992     0.416652E+02     0.328351E+03    -0.206442E+01
 1993     0.136607E+03     0.915918E+02     0.399767E+00
 1994     0.225402E+02     0.745921E+02    -0.119673E+01
 1995     0.209555E+03     0.106700E+03     0.674963E+00
 1996     0.119121E+03     0.749556E+02     0.463247E+00
 1997     0.195348E+03     0.212375E+03    -0.835692E-01
 1998     0.176496E+03     0.937027E+02     0.633173E+00
 1999     0.561455E+02     0.716016E+02    -0.243171E+00
 2000     0.348212E+03     0.102815E+03     0.121988E+01
 2001     0.107646E+03     0.203590E+03    -0.637258E+00
 2002     0.811446E+02     0.948955E+02    -0.156544E+00
 2003     0.222260E+04     0.204631E+03     0.238523E+01
 2004     0.212561E+03     0.852796E+02     0.913292E+00
 2005     0.344250E+03     0.834225E+02     0.141745E+01
 2006     0.239882E+03     0.174543E+03     0.317976E+00
 2007     0.461732E+02     0.620337E+02    -0.295279E+00
 2008     0.177999E+03     0.510184E+03    -0.105299E+01

 Survey Index:   30 Tag:         us5aut   AGE =  6
 Time = JAN-1           Type = NUMBER
 Catchability =    0.143092E+00   % Variance Contribution =     6.4563
 Residual = LN(Observed) - LN(Predicted)

 Year      Observed        Predicted         Residual
 ----------------------------------------------------------------------

 1978     0.236467E+03     0.180843E+03     0.268179E+00
 1979     0.458317E+03     0.232428E+03     0.678982E+00
 1980     0.437962E+03     0.324458E+03     0.299976E+00
 1981     0.361736E+03     0.494310E+03    -0.312249E+00
 1982     0.737679E+02     0.928123E+02    -0.229656E+00
 1983     0.157371E+03     0.288387E+03    -0.605693E+00
 1984     0.448071E+02     0.182121E+03    -0.140231E+01
 1985     0.330589E+02     0.131113E+03    -0.137777E+01
 1986     0.104641E+03     0.240107E+03    -0.830548E+00
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1987     0.665277E+02     0.929047E+02    -0.333956E+00
1988     0.382500E+02     0.692898E+02    -0.594154E+00
1989     0.264608E+03     0.164980E+03     0.472427E+00
1990     0.747241E+02     0.911362E+02    -0.198552E+00
1991     0.390013E+03     0.281459E+03     0.326194E+00
1992     0.396161E+02     0.119185E+03    -0.110144E+01
1993     0.596973E+02     0.122014E+03    -0.714846E+00
1994     0.345616E+02     0.270126E+02     0.246441E+00
1995     0.927563E+02     0.173098E+02     0.167870E+01
1996     0.739045E+02     0.528082E+02     0.336107E+00
1997     0.815545E+02     0.386431E+02     0.746903E+00
1998     0.663911E+02     0.897972E+02    -0.301991E+00
1999     0.483589E+02     0.401135E+02     0.186936E+00
2000     0.118985E+03     0.316603E+02     0.132393E+01
2001     0.418018E+02     0.575277E+02    -0.319327E+00
2002     0.745875E+02     0.104638E+03    -0.338536E+00
2003     0.161196E+03     0.437714E+02     0.130364E+01
2004     0.112564E+03     0.790753E+02     0.353124E+00
2005     0.439192E+03     0.411994E+02     0.236651E+01
2006     0.353813E+02     0.609121E+02    -0.543248E+00
2007     0.170486E+03     0.119291E+03     0.357089E+00
2008     0.874290E+01     0.498551E+02    -0.174088E+01
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Bootstrap Summary Report

Number of Bootstrap Repetitions Requested =  1000
Number of Bootstrap Repetitions Completed =  1000
Bootstrap Output Variable: Stock Estimates (2008)


              NLLS           Bootstrap      Bootstrap      C.V. For
              Estimate       Mean           Std Error      NLLS Soln.

N  1           5158.          6533.          4768.         0.7298
N  2           5778.          6266.          2534.         0.4044
N  3           4313.          4506.          1340.         0.2974
N  4           1202.          1248.           338.         0.2705
N  5           4150.          4291.          1102.         0.2569
N  6            348.           366.           102.         0.2794
N  7            566.           591.           173.         0.2934
N  8            219.           225.            71.         0.3143

                                               NLLS
                                               Estimate    C.V. For
           Bias        Bias        Per Cent    Corrected   Corrected
           Estimate    Std. Error  Bias        For Bias    Estimate

N  1        1375.        157.     26.6579       3783.      1.2603
N  2         489.         82.      8.4565       5289.      0.4792
N  3         194.         43.      4.4871       4119.      0.3254
N  4          47.         11.      3.8994       1155.      0.2925
N  5         141.         35.      3.3966       4009.      0.2749
N  6          17.          3.      4.9691        331.      0.3086
N  7          24.          6.      4.3101        542.      0.3198
N  8           6.          2.      2.8435        212.      0.3327

               LOWER          UPPER
            80. % CI       80. % CI
N  1            2262.         12026.
N  2            3513.          9413.
N  3            2952.          6223.
N  4             873.          1747.
N  5            3037.          5708.
N  6             248.           498.
N  7             378.           829.
N  8             139.           320.
```

```
Bootstrap Output Variable: Catchability Estimates

              NLLS           Bootstrap      Bootstrap      C.V. For
              Estimate       Mean           Std Error      NLLS Soln.

Q  1       0.219439E-01   0.224593E-01   0.453637E-02         0.2020
Q  2       0.919973E-01   0.918516E-01   0.740087E-02         0.0806
Q  3       0.186189E+00   0.186801E+00   0.193689E-01         0.1037
Q  4       0.316089E+00   0.318776E+00   0.461832E-01         0.1449
Q  5       0.402164E+00   0.405661E+00   0.630944E-01         0.1555
Q  6       0.408966E+00   0.411188E+00   0.605475E-01         0.1473
Q  7       0.427224E+00   0.434695E+00   0.805680E-01         0.1853
Q  8       0.517786E+00   0.522703E+00   0.856230E-01         0.1638
Q  9       0.141338E-01   0.187569E-01   0.153604E-01         0.8189
Q 10       0.899870E-01   0.908999E-01   0.203578E-01         0.2240
Q 11       0.198731E+00   0.205097E+00   0.478757E-01         0.2334
Q 12       0.177261E+00   0.178899E+00   0.226346E-01         0.1265
Q 13       0.216299E+00   0.223388E+00   0.550011E-01         0.2462
Q 14       0.207689E+00   0.209908E+00   0.352836E-01         0.1681
Q 15       0.300243E+00   0.322393E+00   0.124785E+00         0.3871
Q 16       0.291472E+00   0.340999E+00   0.192048E+00         0.5632
Q 17       0.209249E-01   0.214531E-01   0.589108E-02         0.2746
Q 18       0.981470E-01   0.990854E-01   0.214245E-01         0.2162
Q 19       0.327191E+00   0.327519E+00   0.339873E-01         0.1038
Q 20       0.615292E+00   0.621553E+00   0.782073E-01         0.1258
Q 21       0.949463E+00   0.957399E+00   0.112465E+00         0.1175
Q 22       0.112928E+01   0.114260E+01   0.190599E+00         0.1668
Q 23       0.121718E+01   0.123764E+01   0.248911E+00         0.2011
Q 24       0.128152E+01   0.129879E+01   0.274911E+00         0.2117
Q 25       0.172164E-01   0.175862E-01   0.371772E-02         0.2114
Q 26       0.746671E-01   0.753834E-01   0.859667E-02         0.1140
Q 27       0.131211E+00   0.132257E+00   0.151867E-01         0.1148
Q 28       0.158575E+00   0.159982E+00   0.228937E-01         0.1431
Q 29       0.122922E+00   0.124354E+00   0.224444E-01         0.1805
Q 30       0.143092E+00   0.145093E+00   0.237031E-01         0.1634
```

```
                                               NLLS
                                               Estimate    C.V. For
           Bias        Bias        Per Cent    Corrected   Corrected
           Estimate    Std. Error  Bias        For Bias    Estimate

Q  1      0.5154E-03  0.1444E-03      2.3488  0.2143E-01      0.2117
Q  2     -0.1457E-03  0.2341E-03     -0.1583  0.9214E-01      0.0803
Q  3      0.6121E-03  0.6128E-03      0.3288  0.1856E+00      0.1044
Q  4      0.2687E-02  0.1463E-02      0.8502  0.3134E+00      0.1474
Q  5      0.3497E-02  0.1998E-02      0.8695  0.3987E+00      0.1583
Q  6      0.2222E-02  0.1916E-02      0.5433  0.4067E+00      0.1489
Q  7      0.7471E-02  0.2559E-02      1.7488  0.4198E+00      0.1919
Q  8      0.4917E-02  0.2712E-02      0.9496  0.5129E+00      0.1669
Q  9      0.4623E-02  0.5073E-03     32.7102  0.9511E-02      1.6151
Q 10      0.9128E-03  0.6444E-03      1.0144  0.8907E-01      0.2285
Q 11      0.6365E-02  0.1527E-02      3.2030  0.1924E+00      0.2489
Q 12      0.1638E-02  0.7176E-03      0.9241  0.1756E+00      0.1289
Q 13      0.7089E-02  0.1754E-02      3.2772  0.2092E+00      0.2629
Q 14      0.2218E-02  0.1118E-02      1.0681  0.2055E+00      0.1717
Q 15      0.2215E-01  0.4008E-02      7.3772  0.2781E+00      0.4487
Q 16      0.4953E-01  0.6272E-02     16.9918  0.2419E+00      0.7938
Q 17      0.5282E-03  0.1870E-03      2.5244  0.2040E-01      0.2888
Q 18      0.9385E-03  0.6782E-03      0.9562  0.9721E-01      0.2204
Q 19      0.3276E-03  0.1075E-02      0.1001  0.3269E+00      0.1040
Q 20      0.6261E-02  0.2481E-02      1.0175  0.6090E+00      0.1284
Q 21      0.7936E-02  0.3565E-02      0.8359  0.9415E+00      0.1194
Q 22      0.1332E-01  0.6042E-02      1.1792  0.1116E+01      0.1708
Q 23      0.2046E-01  0.7898E-02      1.6808  0.1197E+01      0.2080
Q 24      0.1728E-01  0.8711E-02      1.3481  0.1264E+01      0.2175
Q 25      0.3698E-03  0.1181E-03      2.1481  0.1685E-01      0.2207
Q 26      0.7163E-03  0.2728E-03      0.9593  0.7395E-01      0.1162
Q 27      0.1046E-02  0.4814E-03      0.7972  0.1302E+00      0.1167
Q 28      0.1408E-02  0.7253E-03      0.8877  0.1572E+00      0.1457
Q 29      0.1432E-02  0.7112E-03      1.1650  0.1215E+00      0.1847
Q 30      0.2001E-02  0.7522E-03      1.3984  0.1411E+00      0.1680
```

```
               LOWER          UPPER
            80. % CI       80. % CI
Q  1     0.171080E-01   0.284747E-01
Q  2     0.824644E-01   0.101632E+00
Q  3     0.162848E+00   0.211664E+00
Q  4     0.261463E+00   0.379759E+00
Q  5     0.328721E+00   0.483634E+00
Q  6     0.340594E+00   0.492365E+00
Q  7     0.337448E+00   0.537725E+00
Q  8     0.421175E+00   0.634985E+00
Q  9     0.553354E-02   0.371053E-01
Q 10     0.667041E-01   0.117456E+00
Q 11     0.150990E+00   0.267690E+00
Q 12     0.150555E+00   0.208511E+00
Q 13     0.161493E+00   0.297084E+00
Q 14     0.166932E+00   0.258730E+00
Q 15     0.188704E+00   0.478061E+00
Q 16     0.159412E+00   0.573340E+00
Q 17     0.145844E-01   0.292114E-01
Q 18     0.735690E-01   0.127626E+00
Q 19     0.284556E+00   0.370216E+00
Q 20     0.528958E+00   0.725873E+00
Q 21     0.816656E+00   0.110392E+01
Q 22     0.894573E+00   0.138485E+01
Q 23     0.936371E+00   0.155873E+01
Q 24     0.978545E+00   0.164180E+01
Q 25     0.130753E-01   0.225537E-01
Q 26     0.643867E-01   0.868744E-01
Q 27     0.112881E+00   0.152329E+00
Q 28     0.131884E+00   0.190578E+00
Q 29     0.968790E-01   0.154540E+00
Q 30     0.115862E+00   0.177230E+00
```

```
 Bootstrap Output Variable: Fishing Mortality (2007)


              NLLS          Bootstrap     Bootstrap     C.V. For
              Estimate      Mean          Std Error     NLLS Soln.

AGE  1          0.0017        0.0018      0.000684        0.3877
AGE  2          0.1044        0.1080      0.030238        0.2801
AGE  3          0.2591        0.2646      0.061457        0.2323
AGE  4          0.2271        0.2321      0.053591        0.2309
AGE  5          0.1705        0.1738      0.044442        0.2557
AGE  6          0.1869        0.1939      0.056194        0.2898
AGE  7          0.0647        0.0694      0.023411        0.3371
AGE  8          0.1407        0.1457      0.025088        0.1721
AGE  9          0.1407        0.1457      0.025088        0.1721
AGE 10          0.1407        0.1457      0.025088        0.1721

                                                NLLS
                                                Estimate    C.V. For
            Bias        Bias        Per Cent    Corrected   Corrected
            Estimate    Std. Error  Bias        For Bias    Estimate

AGE  1      0.000109    0.000022      6.6054      0.0015      0.4425
AGE  2      0.003606    0.000963      3.4554      0.1008      0.3001
AGE  3      0.005418    0.001951      2.0909      0.2537      0.2422
AGE  4      0.005021    0.001702      2.2111      0.2221      0.2413
AGE  5      0.003348    0.001409      1.9636      0.1671      0.2659
AGE  6      0.007042    0.001791      3.7681      0.1798      0.3125
AGE  7      0.004697    0.000755      7.2536      0.0601      0.3898
AGE  8      0.005029    0.000809      3.5739      0.1357      0.1849
AGE  9      0.005029    0.000809      3.5739      0.1357      0.1849
AGE 10      0.005029    0.000809      3.5739      0.1357      0.1849

               LOWER          UPPER
             80. % CI       80. % CI
AGE  1        0.001016       0.002715
AGE  2        0.073390       0.148701
AGE  3        0.185377       0.341005
AGE  4        0.170090       0.298353
AGE  5        0.121952       0.231915
AGE  6        0.131244       0.266855
AGE  7        0.044370       0.099813
AGE  8        0.116780       0.180193
AGE  9        0.116780       0.180193
AGE 10        0.116780       0.180193
```

```
 Bootstrap Output Variable: Average F (2007) AGES    5 -    8

               NLLS           Bootstrap      Bootstrap      C.V. For
               Estimate       Mean           Std Error      NLLS Soln.

AVG F            0.1407         0.1457       0.025088         0.1721
N WTD            0.1594         0.1587       0.028073         0.1769
B WTD            0.1534         0.1531       0.027092         0.1769
C WTD            0.1709         0.1765       0.035695         0.2022

                                                NLLS
                                                Estimate    C.V. For
            Bias        Bias        Per Cent    Corrected   Corrected
            Estimate    Std. Error  Bias        For Bias    Estimate

AVG F       0.005029    0.000809      3.5739      0.1357      0.1849
N WTD      -0.000626    0.000888     -0.3929      0.1600      0.1755
B WTD      -0.000282    0.000857     -0.1841      0.1537      0.1763
C WTD       0.005617    0.001143      3.2863      0.1653      0.2159

                LOWER          UPPER
             80. % CI       80. % CI
AVG F        0.116780       0.180193
N WTD        0.127188       0.197961
B WTD        0.122381       0.191581
C WTD        0.136571       0.225136


 Bootstrap Output Variable: Biomass

 JAN-1 Biomass (2008) Mean Biomass  & SSB (2007)


               NLLS           Bootstrap      Bootstrap      C.V. For
               Estimate       Mean           Std Error      NLLS Soln.

JAN-1            36930.         38830.          5418.         0.1395
MEAN             34654.         35969.          4702.         0.1307
SSB              25377.         26151.          3597.         0.1375

                                                NLLS
                                                Estimate    C.V. For
            Bias        Bias        Per Cent    Corrected   Corrected
            Estimate    Std. Error  Bias        For Bias    Estimate

JAN-1          1899.        182.      5.1430      35031.      0.1547
MEAN           1315.        154.      3.7961      33338.      0.1410
SSB             774.        116.      3.0489      24604.      0.1462

                LOWER          UPPER
             80. % CI       80. % CI
JAN-1          32236.         45859.
MEAN           30122.         42067.
SSB            21956.         30777.
```

```
Plus Group Diagnostic Report

Calculation Method Selected = Backward

         Population  Population    F            F
Year     Backward     Forward    Forward     Backward    Ratio

1978         44.         44.    0.308259    0.308259    1.000000
1979        127.        131.    0.345514    0.359798    1.041340
1980         37.        103.    0.164657    0.541372    3.287884
1981        173.        244.    0.353951    0.544585    1.538590
1982        192.        333.    0.327151    0.655849    2.004726
1983        288.        268.    0.613105    0.558734    0.911319
1984        283.        200.    1.129093    0.657374    0.582214
1985        182.        213.    0.614331    0.772296    1.257135
1986         76.        116.    0.306033    0.510816    1.669156
1987         75.        145.    0.219497    0.475565    2.166617
1988        105.        149.    0.488756    0.781516    1.598990
1989         54.        110.    0.240156    0.559486    2.329678
1990         88.        142.    0.372456    0.689136    1.850247
1991         47.        101.    0.330944    0.908100    2.743969
1992         19.         76.    0.162994    0.926052    5.681498
1993         34.         74.    0.376019    1.153678    3.068139
1994          9.         59.    0.109812    1.238141   11.275120
1995          3.         55.    0.028722    0.615783   21.439721
1996          1.         50.    0.006627    0.653998   98.684231
1997          7.         52.    0.086785    0.850348    9.798357
1998          6.         46.    0.072801    0.741049   10.179071
1999          7.         39.    0.100418    0.774912    7.716849
2000          3.         33.    0.034158    0.539928   15.806849
2001          3.         31.    0.046971    0.632341   13.462251
2002         13.         39.    0.200182    0.754275    3.767954
2003          6.         35.    0.096275    0.850605    8.835135
2004         12.         30.    0.201696    0.636083    3.153673
2005         15.         32.    0.135933    0.311373    2.290637
2006         17.         45.    0.087321    0.243865    2.792736
2007         12.         46.    0.026732    0.105152    3.933531
2008         70.         98.       N/A         N/A
```

## Appendix A.Table A3. SPLIT MODEL VPA output and diagnostics for GB cod.

```
 VPA Version 2.8.0

 Model ID: Georges Bank   Cod - spr 2008 Assessment TY 2008 sv swept split


 Input File: C:\LOB\GBCOD\ASSESS_2008\VPA\TY07\10P_SWPT_SPLIT\10P-SWPT-
SPLT_AUG_CORR_DFO.DAT
 Date of Run: 05-AUG-2008                         Time of Run: 12:24


 Levenburg-Marquardt Algorithm Completed     9 Iterations
 Residual Sum of Squares =     323.853

 Number of Residuals     =    595
 Number of Parameters    =      8
 Degrees of Freedom      =    587
 Mean Squared Residual   =     0.551709
 Standard Deviation      =     0.742771


 Number of Years =    30
 Number of Ages  =    10
 First Year      =  1978
 Youngest Age    =     1
 Oldest True Age =     9

 Number of Survey Indices Available        =    52
 Number of Survey Indices Used in Estimate =    52


 VPA Classic Method - Auto Estimated Q's


 Stock Numbers Predicted in Terminal Year Plus One (2008)
 Age    Stock Predicted     Std. Error      CV

   1           4874.666   0.218662E+04   0.448568E+00
   2           5751.749   0.182760E+04   0.317747E+00
   3           3851.720   0.113398E+04   0.294410E+00
   4            970.307   0.274066E+03   0.282453E+00
   5           2929.571   0.803594E+03   0.274304E+00
   6            157.359   0.498832E+02   0.317002E+00
   7            237.651   0.866388E+02   0.364564E+00
   8             80.692   0.313443E+02   0.388442E+00

 Catchability Values for Each Survey Used in Estimate
 INDEX     Catchability    Std. Error      CV

   1       0.178394E-01   0.601117E-02   0.336960E+00
   2       0.918544E-01   0.111156E-01   0.121014E+00
   3       0.168705E+00   0.303091E-01   0.179657E+00
   4       0.215614E+00   0.433017E-01   0.200829E+00
   5       0.264241E+00   0.594130E-01   0.224844E+00
```

```
   6       0.278657E+00   0.523770E-01   0.187962E+00
   7       0.297561E+00   0.527492E-01   0.177272E+00
   8       0.363074E+00   0.710421E-01   0.195668E+00
   9       0.292985E-01   0.628344E-02   0.214463E+00
  10       0.101150E+00   0.921209E-02   0.910737E-01
  11       0.225276E+00   0.256921E-01   0.114047E+00
  12       0.506259E+00   0.867519E-01   0.171359E+00
  13       0.688799E+00   0.113946E+00   0.165426E+00
  14       0.701770E+00   0.122594E+00   0.174693E+00
  15       0.723118E+00   0.181470E+00   0.250954E+00
  16       0.816798E+00   0.174300E+00   0.213394E+00
  17       0.141338E-01   0.106855E-01   0.756029E+00
  18       0.899870E-01   0.208708E-01   0.231931E+00
  19       0.198731E+00   0.467107E-01   0.235044E+00
  20       0.177261E+00   0.223604E-01   0.126144E+00
  21       0.216299E+00   0.540535E-01   0.249901E+00
  22       0.207689E+00   0.355707E-01   0.171269E+00
  23       0.300243E+00   0.112587E+00   0.374986E+00
  24       0.291472E+00   0.165071E+00   0.566335E+00
  25       0.358799E-01   0.115005E-01   0.320529E+00
  26       0.187587E+00   0.396148E-01   0.211181E+00
  27       0.324684E+00   0.370155E-01   0.114005E+00
  28       0.372132E+00   0.475039E-01   0.127653E+00
  29       0.580779E+00   0.710335E-01   0.122307E+00
  30       0.555873E+00   0.114979E+00   0.206844E+00
  31       0.730017E+00   0.211842E+00   0.290188E+00
  32       0.644843E-03   0.171054E-03   0.265264E+00
  33       0.158633E-01   0.567279E-02   0.357605E+00
  34       0.779414E-01   0.200113E-01   0.256748E+00
  35       0.362628E+00   0.527704E-01   0.145522E+00
  36       0.888325E+00   0.130864E+00   0.147315E+00
  37       0.140774E+01   0.199374E+00   0.141627E+00
  38       0.193422E+01   0.294172E+00   0.152088E+00
  39       0.190133E+01   0.391504E+00   0.205911E+00
  40       0.127804E-02   0.320091E-03   0.250454E+00
  41       0.163752E-01   0.327145E-02   0.199780E+00
  42       0.811005E-01   0.114794E-01   0.141545E+00
  43       0.119082E+00   0.179800E-01   0.150989E+00
  44       0.126944E+00   0.225861E-01   0.177922E+00
  45       0.886514E-01   0.215241E-01   0.242795E+00
  46       0.104097E+00   0.162056E-01   0.155678E+00
  47       0.201548E-01   0.859432E-02   0.426415E+00
  48       0.741493E-01   0.152083E-01   0.205104E+00
  49       0.162972E+00   0.301554E-01   0.185035E+00
  50       0.233271E+00   0.520419E-01   0.223096E+00
  51       0.211986E+00   0.510959E-01   0.241035E+00
  52       0.253043E+00   0.646169E-01   0.255360E+00
```

```
 -- Non-Linear Least Squares Fit --
 Default Tolerances Used

 Scaled Gradient Tolerance      =    6.055454E-06
 Scaled Step Tolerance          =    3.666853E-11
 Relative Function Tolerance    =    3.666853E-11
 Absolute Function Tolerance    =    4.930381E-32
 VPA Method Options
 - Catchability Values Estimated as an Analytic Function of N
 - Catch Equation Used in Cohort Solution
 - Plus Group Backward Calculation Method Used
 - Rivard Weights Used for JAN-1 Biomass
 - Rivard Weights Used for SSB Biomass
 - Rivard Weights Calculation Used  5 Years for Terminal Year Plus One

 - Heincke Rule Used in F-Oldest Calculation
 - F-Oldest Calculation in Years Prior to Terminal Year
   Uses Stock Sizes in Ages  5 to  8
 - Calculation of Population of Age 1 In Year 2008
   =  Stock Estimate
 Stock Estimates

 Age   1
 Age   2
 Age   3
 Age   4
 Age   5
 Age   6
 Age   7
 Age   8
 Full F in Terminal Year                =   0.3025

 F in Oldest True Age in Terminal Year =   0.3025

 Full F Calculated Using Classic Method

 Age  Input Partial  Calc Partial   Fishing     Used In
      Recruitment    Recruitment    Mortality   Full F    Comments

   1      0.010          0.004       0.0017      NO      Stock Estimate in
T+1
   2      0.100          0.292       0.1161      NO      Stock Estimate in
T+1
   3      0.390          0.785       0.3119      NO      Stock Estimate in
T+1
   4      0.740          0.775       0.3080      NO      Stock Estimate in
T+1
   5      1.000          0.865       0.3439      YES     Stock Estimate in
T+1
   6      1.000          1.000       0.3973      YES     Stock Estimate in
T+1
   7      1.000          0.418       0.1662      YES     Stock Estimate in
T+1
   8      1.000          0.761       0.3025      NO      Input PR * Full F
   9      1.000          0.761       0.3025              Input PR * Full F
```

```
Catch At Age - Input Data

  AGE        1978         1979         1980         1981         1982
 ---------------------------------------------------------------------

   1        151.6        279.2        339.9       1219.2        775.4
   2        416.8       2242.7       4238.7       3910.7      10457.1
   3       8109.1        953.6       5955.4       4738.2       4434.4
   4       2429.6       4585.0        544.9       2685.5       2988.0
   5        896.8       1206.9       2464.6        317.9       2039.8
   6        178.4        449.8        983.0       1406.0        297.1
   7        240.8        159.5        418.1        417.0        707.2
   8         22.6        304.1         70.4        162.9        198.6
   9         42.1         12.9        138.7        155.5         74.6
  10         10.7         35.0         14.2         66.4         84.6

  AGE        1983         1984         1985         1986         1987
 ---------------------------------------------------------------------

   1        626.2        280.9        176.0        768.3        103.8
   2       5181.7       1547.7       7443.7       1594.1       7956.1
   3       8753.3       3485.7       2942.2       4576.3       1515.5
   4       2680.4       3328.4       1690.1        860.2       2170.1
   5       1155.3        923.9       2097.7        525.3        299.7
   6        746.4        560.2        496.5        615.4        249.9
   7         94.6        450.3        267.2         85.5        277.3
   8        175.0         58.9        196.8         70.4         56.1
   9         67.7        167.0         27.7         56.0         36.2
  10        112.6        124.9         89.7         27.8         26.0

  AGE        1988         1989         1990         1991         1992
 ---------------------------------------------------------------------

   1        324.9        891.5         71.8        278.7        191.7
   2       2352.1       2608.6       5561.1       1963.0       4808.4
   3       8368.3       3032.8       5373.4       3491.4       2286.3
   4       1074.1       4254.4       1964.0       3160.5       1070.7
   5       1575.6        383.5       2272.1       1442.1       1500.0
   6        223.8        534.2        230.6       1088.0        448.1
   7        150.3         81.4        229.4        141.3        356.0
   8        218.0         51.2         24.6         89.7         44.1
   9         46.5         60.2         23.2         27.5         36.4
  10         52.5         21.3         40.4         26.0         10.4
```

```
Catch At Age - Input Data

  AGE       1993        1994        1995        1996        1997


   1       299.2        94.4        32.3        64.9       126.9
   2      1534.9       614.6       652.8       287.3       685.2
   3      4429.4      1543.4      1429.0       986.6       749.6
   4      1224.8      1987.7       669.9      1269.8      1020.7
   5       475.3       425.6       382.3       256.3       882.9
   6       535.6        97.6        41.2       183.8       147.7
   7       178.0       146.2        21.4        17.9        94.4
   8       141.0        51.2        20.0        11.6        18.9
   9        43.1        30.5         6.4        11.3        10.1
  10        21.2         5.6         1.4         0.3         3.9

  AGE       1998        1999        2000        2001        2002


   1        63.3        47.7       113.5        11.7        33.6
   2       918.9       356.3       943.2       719.8       113.0
   3      1310.3      2021.8       741.1      2667.3      1182.7
   4       494.3       852.6      1156.4       751.6      1516.2
   5       385.6       286.6       315.8       698.7       365.4
   6       285.2       125.8        88.0       180.4       371.5
   7        40.2       143.8        46.3        54.8        84.7
   8        16.0        22.2        38.8        25.8        18.7
   9         5.6         5.0         4.2        14.8        10.6
  10         2.9         3.4         1.0         1.3         6.5

  AGE       2003        2004        2005        2006        2007


   1        17.0        50.5        12.3        32.8        10.6
   2       201.3        69.4       364.1        69.7       526.1
   3       404.4       434.3       201.8       842.8       395.2
   4       800.7       260.1       578.4       208.3      1175.8
   5       910.4       313.6       144.5       366.1        71.9
   6       156.0       253.0       106.0        70.8       129.2
   7       142.4        58.2        85.3        31.2        16.2
   8        28.2        49.2        18.0        28.5        10.4
   9         6.5        11.8         8.9         3.8         8.6
  10         2.9         5.0         3.7         3.4         1.1
```

```
Weight At Age - Input Data

 AGE        1978         1979         1980         1981         1982
____________________________________________________________________

  1       0.5787       0.6942       0.6438       0.5873       0.6430
  2       1.2513       1.3643       1.4133       1.4411       1.3928
  3       2.4408       1.8920       2.4308       2.3815       2.5397
  4       3.4074       4.2804       3.5465       3.5294       3.7201
  5       4.0144       4.9312       5.5826       5.0546       5.2823
  6       5.6957       7.1757       6.7481       7.3032       6.5758
  7       6.6453       9.6642       8.3051       8.7797       9.4656
  8       8.7084      10.3497       9.9256       9.7997       9.7448
  9       9.9364      10.4378       9.2950      14.0178      12.9721
 10      13.8870      13.6108      14.8999      16.7990      15.6229

 AGE        1983         1984         1985         1986         1987
____________________________________________________________________

  1       0.6763       0.5405       0.8055       0.6738       0.5817
  2       1.4363       1.4991       1.3855       1.3568       1.4684
  3       2.3895       2.4762       2.0750       2.4477       2.4763
  4       3.3518       3.6676       3.7198       3.6106       4.1715
  5       4.7839       4.9374       4.9774       5.4941       5.7677
  6       6.4468       6.5544       6.4394       7.1726       7.7772
  7       8.4913       8.7376       8.2465       8.8770       8.9078
  8      10.6665      10.3090      10.2787       9.9439      10.3361
  9      11.6989      11.0933      11.7651      12.9472      12.0274
 10      16.3190      14.6426      14.0475      14.5623      15.6415

 AGE        1988         1989         1990         1991         1992
____________________________________________________________________

  1       0.4918       0.4347       0.5311       0.6581       0.8296
  2       1.3794       1.4362       1.4893       1.5196       1.4349
  3       2.3728       2.2041       2.4630       2.4992       2.4077
  4       3.5065       3.7324       3.5732       3.5198       3.7982
  5       5.4118       5.1806       4.9668       4.8089       4.5200
  6       6.7808       6.5629       6.4025       5.8249       6.0428
  7       8.7219       7.9373       8.4042       7.3177       7.0854
  8      10.4333       9.9761      11.1911       9.3877       9.4720
  9      11.5348      11.2867      12.4247       9.6151      11.8412
 10      14.9262      14.6514      14.5119      14.6490      18.8362
```

```
Weight At Age - Input Data

 AGE        1993         1994         1995         1996         1997
____________________________________________________________________

  1       0.2837       0.4771       0.3963       0.4867       0.5385
  2       1.3063       1.1976       1.3467       1.4419       1.4631
  3       2.2082       2.1531       1.9769       2.3910       2.3278
  4       3.2271       3.5435       3.7206       3.2180       3.4446
  5       4.9843       4.7869       5.2487       4.8754       4.0326
  6       5.8198       7.0741       7.4302       6.4963       5.7339
  7       7.3782       7.1760       9.3273       8.1007       7.7343
  8       8.9218       9.1163      12.1972       9.6991       8.0901
  9      11.1348       9.0029      11.8414      10.9742      11.4196
 10      12.2279      15.7618      19.1176       8.6207      12.0867

 AGE        1998         1999         2000         2001         2002
____________________________________________________________________

  1       0.6185       0.5340       0.3879       0.6008       0.4900
  2       1.4324       1.4313       1.5286       1.3651       1.3165
  3       2.2614       2.1372       2.3862       2.2118       2.1052
  4       3.4254       3.3549       3.3875       2.9372       2.9569
  5       4.5713       4.5433       4.5495       4.1007       3.9493
  6       5.5756       5.8669       5.4719       5.2650       5.1562
  7       7.3994       6.6406       6.9962       5.9799       6.4745
  8       7.7535       8.4061       8.0125       7.6805       8.0004
  9      11.8255       9.5624       8.0492       9.0431       9.2479
 10      12.3102      13.2010      12.5970       9.7372      11.7081

 AGE        2003         2004         2005         2006         2007
____________________________________________________________________

  1       0.6020       0.3318       0.4309       0.3791       0.4225
  2       1.4576       1.5332       1.0351       1.0785       1.4203
  3       2.2536       2.3640       2.1015       2.0931       1.9169
  4       2.9071       3.0802       3.0681       3.1067       2.8988
  5       3.8660       3.8831       4.0035       3.6792       3.6265
  6       4.7097       4.8244       4.9245       4.5349       4.1726
  7       5.7888       5.6511       5.4675       6.4617       5.9316
  8       6.9183       7.3709       7.4969       6.3936       6.9569
  9       8.2509       8.5524       8.7863       7.5189       6.9220
 10      10.4481      11.1003      11.3704       9.0737       9.0701
```

```
JAN-1 Weights at Age - Input Data

 AGE        1978         1979         1980         1981         1982
--------------------------------------------------------------------

  1       0.3769       0.4865       0.4303       0.3814       0.4302
  2       1.0176       0.8885       0.9905       0.9632       0.9044
  3       1.8431       1.5387       1.8211       1.8346       1.9131
  4       2.8324       3.2323       2.5904       2.9290       2.9765
  5       3.0026       4.0991       4.8883       4.2339       4.3178
  6       4.3726       5.3671       5.7686       6.3852       5.7652
  7       5.3249       7.4192       7.7198       7.6972       8.3144
  8       7.9543       8.2932       9.7940       9.0215       9.2497
  9       9.3022       9.5340       9.8082      11.7956      11.2749
 10      13.8870      13.6108      14.8999      16.7990      15.6229

 AGE        1983         1984         1985         1986         1987
--------------------------------------------------------------------

  1       0.4542       0.3376       0.6206       0.4564       0.3777
  2       0.9610       1.0069       0.8654       1.0454       0.9947
  3       1.8243       1.8859       1.7637       1.8415       1.8330
  4       2.9176       2.9604       3.0350       2.7372       3.1954
  5       4.2186       4.0681       4.2726       4.5207       4.5634
  6       5.8356       5.5996       5.6386       5.9750       6.5367
  7       7.4724       7.5053       7.3519       7.5606       7.9933
  8      10.0481       9.3561       9.4769       9.0555       9.5788
  9      10.6772      10.8778      11.0130      11.5361      10.9362
 10      16.3190      14.6426      14.0475      14.5623      15.6415

 AGE        1988         1989         1990         1991         1992
--------------------------------------------------------------------

  1       0.2878       0.2349       0.3140       0.4457       0.6611
  2       0.8958       0.8404       0.8046       0.8984       0.9718
  3       1.8666       1.7437       1.8808       1.9293       1.9128
  4       2.9467       2.9759       2.8064       2.9444       3.0810
  5       4.7514       4.2621       4.3056       4.1453       3.9887
  6       6.2538       5.9596       5.7592       5.3788       5.3907
  7       8.2360       7.3363       7.4267       6.8448       6.4243
  8       9.6404       9.3279       9.4248       8.8823       8.3255
  9      10.9190      10.8516      11.1333      10.3732      10.5433
 10      14.9262      14.6514      14.5119      14.6490      18.8362
```

```
JAN-1 Weights at Age - Input Data

 AGE       1993        1994        1995        1996        1997
-----------------------------------------------------------------

  1       0.1381      0.2840      0.2078      0.2807      0.3302
  2       1.0410      0.5829      0.8016      0.7559      0.8439
  3       1.7800      1.6771      1.5387      1.7944      1.8321
  4       2.7875      2.7973      2.8303      2.5222      2.8699
  5       4.3510      3.9304      4.3126      4.2590      3.6023
  6       5.1289      5.9380      5.9639      5.8393      5.2873
  7       6.6772      6.4624      8.1229      7.7582      7.0883
  8       7.9508      8.2013      9.3556      9.5114      8.0954
  9      10.2698      8.9623     10.3899     11.5696     10.5243
 10      12.2279     15.7618     19.1176      8.6207     12.0867

 AGE       1998        1999        2000        2001        2002
-----------------------------------------------------------------

  1       0.4066      0.3156      0.2068      0.4059      0.2841
  2       0.8783      0.9409      0.9035      0.7277      0.8894
  3       1.8190      1.7497      1.8481      1.8387      1.6952
  4       2.8238      2.7544      2.6907      2.6474      2.5574
  5       3.9682      3.9449      3.9068      3.7271      3.4059
  6       4.7417      5.1787      4.9860      4.8942      4.5983
  7       6.5136      6.0848      6.4067      5.7203      5.8385
  8       7.7439      7.8867      7.2944      7.3304      6.9168
  9       9.7811      8.6106      8.2257      8.5122      8.4278
 10      12.3102     13.2010     12.5970      9.7372     11.7081

 AGE       2003        2004        2005        2006        2007
-----------------------------------------------------------------

  1       0.3772      0.1879      0.2724      0.1959      0.2433
  2       0.8451      0.9607      0.5860      0.6817      0.7338
  3       1.7225      1.8563      1.7950      1.4719      1.4378
  4       2.4739      2.6347      2.6931      2.5551      2.4632
  5       3.3810      3.3598      3.5116      3.3598      3.3566
  6       4.3128      4.3187      4.3729      4.2609      3.9181
  7       5.4634      5.1590      5.1359      5.6410      5.1864
  8       6.6927      6.5321      6.5089      5.9124      6.7047
  9       8.1247      7.6921      8.0475      7.5079      6.6526
 10      10.4481     11.1003     11.3704      9.0737      9.0701
```

```
 JAN-1 Weights at Age - Input Data

   AGE       2008
 ____________________________________________________________________

    1       0.2553
    2       0.7615
    3       1.6567
    4       2.5640
    5       3.3938
    6       4.2367
    7       5.3171
    8       6.4702
    9       7.6050
   10      10.2125

SSB Weight At Age - Input Data

   AGE       1978        1979        1980        1981        1982
 ____________________________________________________________________

    1       0.3769      0.4865      0.4303      0.3814      0.4302
    2       1.0176      0.8885      0.9905      0.9632      0.9044
    3       1.8431      1.5387      1.8211      1.8346      1.9131
    4       2.8324      3.2323      2.5904      2.9290      2.9765
    5       3.0026      4.0991      4.8883      4.2339      4.3178
    6       4.3726      5.3671      5.7686      6.3852      5.7652
    7       5.3249      7.4192      7.7198      7.6972      8.3144
    8       7.9543      8.2932      9.7940      9.0215      9.2497
    9       9.3022      9.5340      9.8082     11.7956     11.2749
   10      13.8870     13.6108     14.8999     16.7990     15.6229

   AGE       1983        1984        1985        1986        1987
 ____________________________________________________________________

    1       0.4542      0.3376      0.6206      0.4564      0.3777
    2       0.9610      1.0069      0.8654      1.0454      0.9947
    3       1.8243      1.8859      1.7637      1.8415      1.8330
    4       2.9176      2.9604      3.0350      2.7372      3.1954
    5       4.2186      4.0681      4.2726      4.5207      4.5634
    6       5.8356      5.5996      5.6386      5.9750      6.5367
    7       7.4724      7.5053      7.3519      7.5606      7.9933
    8      10.0481      9.3561      9.4769      9.0555      9.5788
    9      10.6772     10.8778     11.0130     11.5361     10.9362
   10      16.3190     14.6426     14.0475     14.5623     15.6415

   AGE       1988        1989        1990        1991        1992
 ____________________________________________________________________

    1       0.2878      0.2349      0.3140      0.4457      0.6611
    2       0.8958      0.8404      0.8046      0.8984      0.9718
    3       1.8666      1.7437      1.8808      1.9293      1.9128
    4       2.9467      2.9759      2.8064      2.9444      3.0810
```

```
  5      4.7514      4.2621      4.3056      4.1453      3.9887
  6      6.2538      5.9596      5.7592      5.3788      5.3907
  7      8.2360      7.3363      7.4267      6.8448      6.4243
  8      9.6404      9.3279      9.4248      8.8823      8.3255
  9     10.9190     10.8516     11.1333     10.3732     10.5433
 10     14.9262     14.6514     14.5119     14.6490     18.8362

SSB Weight At Age - Input Data


 AGE        1993        1994        1995        1996        1997
------------------------------------------------------------------

  1      0.1381      0.2840      0.2078      0.2807      0.3302
  2      1.0410      0.5829      0.8016      0.7559      0.8439
  3      1.7800      1.6771      1.5387      1.7944      1.8321
  4      2.7875      2.7973      2.8303      2.5222      2.8699
  5      4.3510      3.9304      4.3126      4.2590      3.6023
  6      5.1289      5.9380      5.9639      5.8393      5.2873
  7      6.6772      6.4624      8.1229      7.7582      7.0883
  8      7.9508      8.2013      9.3556      9.5114      8.0954
  9     10.2698      8.9623     10.3899     11.5696     10.5243
 10     12.2279     15.7618     19.1176      8.6207     12.0867

 AGE        1998        1999        2000        2001        2002
------------------------------------------------------------------

  1      0.4066      0.3156      0.2068      0.4059      0.2841
  2      0.8783      0.9409      0.9035      0.7277      0.8894
  3      1.8190      1.7497      1.8481      1.8387      1.6952
  4      2.8238      2.7544      2.6907      2.6474      2.5574
  5      3.9682      3.9449      3.9068      3.7271      3.4059
  6      4.7417      5.1787      4.9860      4.8942      4.5983
  7      6.5136      6.0848      6.4067      5.7203      5.8385
  8      7.7439      7.8867      7.2944      7.3304      6.9168
  9      9.7811      8.6106      8.2257      8.5122      8.4278
 10     12.3102     13.2010     12.5970      9.7372     11.7081

 AGE        2003        2004        2005        2006        2007
------------------------------------------------------------------

  1      0.3772      0.1879      0.2724      0.1959      0.2433
  2      0.8451      0.9607      0.5860      0.6817      0.7338
  3      1.7225      1.8563      1.7950      1.4719      1.4378
  4      2.4739      2.6347      2.6931      2.5551      2.4632
  5      3.3810      3.3598      3.5116      3.3598      3.3566
  6      4.3128      4.3187      4.3729      4.2609      3.9181
  7      5.4634      5.1590      5.1359      5.6410      5.1864
  8      6.6927      6.5321      6.5089      5.9124      6.7047
  9      8.1247      7.6921      8.0475      7.5079      6.6526
 10     10.4481     11.1003     11.3704      9.0737      9.0701
```

```
Natural Mortality - Input Data

 AGE         1978         1979         1980         1981         1982
_____________________________________________________________________

   1       0.2000       0.2000       0.2000       0.2000       0.2000
   2       0.2000       0.2000       0.2000       0.2000       0.2000
   3       0.2000       0.2000       0.2000       0.2000       0.2000
   4       0.2000       0.2000       0.2000       0.2000       0.2000
   5       0.2000       0.2000       0.2000       0.2000       0.2000
   6       0.2000       0.2000       0.2000       0.2000       0.2000
   7       0.2000       0.2000       0.2000       0.2000       0.2000
   8       0.2000       0.2000       0.2000       0.2000       0.2000
   9       0.2000       0.2000       0.2000       0.2000       0.2000
  10       0.2000       0.2000       0.2000       0.2000       0.2000

 AGE         1983         1984         1985         1986         1987
_____________________________________________________________________

   1       0.2000       0.2000       0.2000       0.2000       0.2000
   2       0.2000       0.2000       0.2000       0.2000       0.2000
   3       0.2000       0.2000       0.2000       0.2000       0.2000
   4       0.2000       0.2000       0.2000       0.2000       0.2000
   5       0.2000       0.2000       0.2000       0.2000       0.2000
   6       0.2000       0.2000       0.2000       0.2000       0.2000
   7       0.2000       0.2000       0.2000       0.2000       0.2000
   8       0.2000       0.2000       0.2000       0.2000       0.2000
   9       0.2000       0.2000       0.2000       0.2000       0.2000
  10       0.2000       0.2000       0.2000       0.2000       0.2000

 AGE         1988         1989         1990         1991         1992
_____________________________________________________________________

   1       0.2000       0.2000       0.2000       0.2000       0.2000
   2       0.2000       0.2000       0.2000       0.2000       0.2000
   3       0.2000       0.2000       0.2000       0.2000       0.2000
   4       0.2000       0.2000       0.2000       0.2000       0.2000
   5       0.2000       0.2000       0.2000       0.2000       0.2000
   6       0.2000       0.2000       0.2000       0.2000       0.2000
   7       0.2000       0.2000       0.2000       0.2000       0.2000
   8       0.2000       0.2000       0.2000       0.2000       0.2000
   9       0.2000       0.2000       0.2000       0.2000       0.2000
  10       0.2000       0.2000       0.2000       0.2000       0.2000
```

```
Natural Mortality - Input Data

  AGE       1993        1994        1995        1996        1997
____________________________________________________________________

   1       0.2000      0.2000      0.2000      0.2000      0.2000
   2       0.2000      0.2000      0.2000      0.2000      0.2000
   3       0.2000      0.2000      0.2000      0.2000      0.2000
   4       0.2000      0.2000      0.2000      0.2000      0.2000
   5       0.2000      0.2000      0.2000      0.2000      0.2000
   6       0.2000      0.2000      0.2000      0.2000      0.2000
   7       0.2000      0.2000      0.2000      0.2000      0.2000
   8       0.2000      0.2000      0.2000      0.2000      0.2000
   9       0.2000      0.2000      0.2000      0.2000      0.2000
  10       0.2000      0.2000      0.2000      0.2000      0.2000

  AGE       1998        1999        2000        2001        2002
____________________________________________________________________

   1       0.2000      0.2000      0.2000      0.2000      0.2000
   2       0.2000      0.2000      0.2000      0.2000      0.2000
   3       0.2000      0.2000      0.2000      0.2000      0.2000
   4       0.2000      0.2000      0.2000      0.2000      0.2000
   5       0.2000      0.2000      0.2000      0.2000      0.2000
   6       0.2000      0.2000      0.2000      0.2000      0.2000
   7       0.2000      0.2000      0.2000      0.2000      0.2000
   8       0.2000      0.2000      0.2000      0.2000      0.2000
   9       0.2000      0.2000      0.2000      0.2000      0.2000
  10       0.2000      0.2000      0.2000      0.2000      0.2000

  AGE       2003        2004        2005        2006        2007
____________________________________________________________________

   1       0.2000      0.2000      0.2000      0.2000      0.2000
   2       0.2000      0.2000      0.2000      0.2000      0.2000
   3       0.2000      0.2000      0.2000      0.2000      0.2000
   4       0.2000      0.2000      0.2000      0.2000      0.2000
   5       0.2000      0.2000      0.2000      0.2000      0.2000
   6       0.2000      0.2000      0.2000      0.2000      0.2000
   7       0.2000      0.2000      0.2000      0.2000      0.2000
   8       0.2000      0.2000      0.2000      0.2000      0.2000
   9       0.2000      0.2000      0.2000      0.2000      0.2000
  10       0.2000      0.2000      0.2000      0.2000      0.2000

Proportion of Natural Mortality Before Spawning =       0.1667
Proportion of Fishing Mortality Before Spawning =       0.1667
```

```
Maturity - Input Data

 AGE        1978         1979         1980         1981         1982
____________________________________________________________________

  1       0.0800       0.0700       0.0900       0.0900       0.0800
  2       0.3300       0.3400       0.3800       0.3800       0.3600
  3       0.7500       0.7800       0.7900       0.7900       0.7900
  4       0.9500       0.9600       0.9600       0.9600       0.9600
  5       0.9900       0.9900       0.9900       0.9900       0.9900
  6       1.0000       1.0000       1.0000       1.0000       1.0000
  7       1.0000       1.0000       1.0000       1.0000       1.0000
  8       1.0000       1.0000       1.0000       1.0000       1.0000
  9       1.0000       1.0000       1.0000       1.0000       1.0000
 10       1.0000       1.0000       1.0000       1.0000       1.0000

 AGE        1983         1984         1985         1986         1987
____________________________________________________________________

  1       0.0800       0.1300       0.1800       0.1600       0.2000
  2       0.4100       0.4900       0.5900       0.5800       0.5900
  3       0.8500       0.8700       0.9100       0.9100       0.8900
  4       0.9800       0.9800       0.9900       0.9900       0.9800
  5       1.0000       1.0000       1.0000       1.0000       1.0000
  6       1.0000       1.0000       1.0000       1.0000       1.0000
  7       1.0000       1.0000       1.0000       1.0000       1.0000
  8       1.0000       1.0000       1.0000       1.0000       1.0000
  9       1.0000       1.0000       1.0000       1.0000       1.0000
 10       1.0000       1.0000       1.0000       1.0000       1.0000

 AGE        1988         1989         1990         1991         1992
____________________________________________________________________

  1       0.2500       0.2000       0.1200       0.1300       0.0900
  2       0.6400       0.6100       0.4600       0.5300       0.4700
  3       0.9000       0.9100       0.8500       0.8900       0.8900
  4       0.9800       0.9800       0.9700       0.9800       0.9900
  5       1.0000       1.0000       1.0000       1.0000       1.0000
  6       1.0000       1.0000       1.0000       1.0000       1.0000
  7       1.0000       1.0000       1.0000       1.0000       1.0000
  8       1.0000       1.0000       1.0000       1.0000       1.0000
  9       1.0000       1.0000       1.0000       1.0000       1.0000
 10       1.0000       1.0000       1.0000       1.0000       1.0000
```

```
Maturity - Input Data

 AGE       1993        1994        1995        1996        1997
_______________________________________________________________

  1      0.0400      0.0400      0.0400      0.0500      0.1000
  2      0.4300      0.4100      0.5000      0.4800      0.5700
  3      0.9300      0.9200      0.9600      0.9500      0.9400
  4      1.0000      1.0000      1.0000      1.0000      0.9900
  5      1.0000      1.0000      1.0000      1.0000      1.0000
  6      1.0000      1.0000      1.0000      1.0000      1.0000
  7      1.0000      1.0000      1.0000      1.0000      1.0000
  8      1.0000      1.0000      1.0000      1.0000      1.0000
  9      1.0000      1.0000      1.0000      1.0000      1.0000
 10      1.0000      1.0000      1.0000      1.0000      1.0000

 AGE       1998        1999        2000        2001        2002
_______________________________________________________________

  1      0.0900      0.0700      0.0700      0.0800      0.0700
  2      0.5600      0.5100      0.5100      0.5000      0.4300
  3      0.9400      0.9300      0.9400      0.9300      0.8800
  4      1.0000      0.9900      1.0000      0.9900      0.9900
  5      1.0000      1.0000      1.0000      1.0000      1.0000
  6      1.0000      1.0000      1.0000      1.0000      1.0000
  7      1.0000      1.0000      1.0000      1.0000      1.0000
  8      1.0000      1.0000      1.0000      1.0000      1.0000
  9      1.0000      1.0000      1.0000      1.0000      1.0000
 10      1.0000      1.0000      1.0000      1.0000      1.0000

 AGE       2003        2004        2005        2006        2007
_______________________________________________________________

  1      0.0400      0.0700      0.0600      0.0500      0.0400
  2      0.3300      0.3800      0.3600      0.3500      0.3700
  3      0.8400      0.8300      0.8300      0.8400      0.8900
  4      0.9800      0.9800      0.9800      0.9800      0.9900
  5      1.0000      1.0000      1.0000      1.0000      1.0000
  6      1.0000      1.0000      1.0000      1.0000      1.0000
  7      1.0000      1.0000      1.0000      1.0000      1.0000
  8      1.0000      1.0000      1.0000      1.0000      1.0000
  9      1.0000      1.0000      1.0000      1.0000      1.0000
 10      1.0000      1.0000      1.0000      1.0000      1.0000
```

```
Input Partial Recruitment

  AGE

   1       0.0100
   2       0.1000
   3       0.3900
   4       0.7400
   5       1.0000
   6       1.0000
   7       1.0000
   8       1.0000
   9       1.0000


Input F-Plus Ratio

  YEAR

  1978       1.0000
  1979       1.0000
  1980       1.0000
  1981       1.0000
  1982       1.0000
  1983       1.0000
  1984       1.0000
  1985       1.0000
  1986       1.0000
  1987       1.0000
  1988       1.0000
  1989       1.0000
  1990       1.0000
  1991       1.0000
  1992       1.0000
  1993       1.0000
  1994       1.0000
  1995       1.0000
  1996       1.0000
  1997       1.0000
  1998       1.0000
  1999       1.0000
  2000       1.0000
  2001       1.0000
  2002       1.0000
  2003       1.0000
  2004       1.0000
  2005       1.0000
  2006       1.0000
  2007       1.0000
```

```
 SURVEY - INPUT DATA

INDEX             1           2           3           4           5

SURVEY TAG      spr_36pr    spr_36pr    spr_36pr    spr_36pr    spr_36pr

AGE                1           2           3           4           5
TIME            JAN-1       JAN-1       JAN-1       JAN-1       JAN-1
TYPE           NUMBERS     NUMBERS     NUMBERS     NUMBERS     NUMBERS
RETRO FLAG        1           1           1           1           1
 ________________________________________________________________________

    1978        0.0000      0.0000      0.0000      0.0000      0.0000
    1979        0.0000      0.0000      0.0000      0.0000      0.0000
    1980        0.0000      0.0000      0.0000      0.0000      0.0000
    1981        0.0000      0.0000      0.0000      0.0000      0.0000
    1982      693.8277   7425.1446  12980.2741  11371.7250   8480.5714
    1983      452.8527   2666.2982   4121.4375   1087.6661    952.1518
    1984      549.4339    588.7768   1039.1705   1691.4696    576.8920
    1985      151.7705   3624.3241    906.1152   1516.7491   1929.3027
    1986     1190.5313    558.7232   2519.5821    498.8893    737.6786
    1987       26.9116   2202.7902    516.9214   1042.7223     84.8330
    1988      983.8446    831.6643   4302.5786    558.4500    879.0670
    1989      424.0286   1926.7071    910.3500   2162.6277    321.1634
    1990      236.8768   1258.8348   2373.0027    921.0054   1245.7205
    1991     1402.4089    721.0125    940.8134   1268.9438    654.0750
    1992      167.6170   1710.8679    639.5946    229.6366    372.8009
    1993       11.6116    544.7893   1784.2259    280.4545    122.2634
    1994      170.4857    372.1179    273.2143    295.7545     45.3536
    1995        0.0000      0.0000      0.0000      0.0000      0.0000
    1996        0.0000      0.0000      0.0000      0.0000      0.0000
    1997        0.0000      0.0000      0.0000      0.0000      0.0000
    1998        0.0000      0.0000      0.0000      0.0000      0.0000
    1999        0.0000      0.0000      0.0000      0.0000      0.0000
    2000        0.0000      0.0000      0.0000      0.0000      0.0000
    2001        0.0000      0.0000      0.0000      0.0000      0.0000
    2002        0.0000      0.0000      0.0000      0.0000      0.0000
    2003        0.0000      0.0000      0.0000      0.0000      0.0000
    2004        0.0000      0.0000      0.0000      0.0000      0.0000
    2005        0.0000      0.0000      0.0000      0.0000      0.0000
    2006        0.0000      0.0000      0.0000      0.0000      0.0000
    2007        0.0000      0.0000      0.0000      0.0000      0.0000
    2008        0.0000      0.0000      0.0000      0.0000      0.0000
```

```
 SURVEY - INPUT DATA

INDEX             6           7           8           9          10

SURVEY TAG     spr_36pr    spr_36pr    spr_36pr    spr_36po    spr_36po

AGE                6           7           8           1           2
TIME           JAN-1       JAN-1       JAN-1       JAN-1       JAN-1
TYPE          NUMBERS     NUMBERS     NUMBERS     NUMBERS     NUMBERS
RETRO FLAG       1           1           1           1           1
 ________________________________________________________________________

    1978        0.0000      0.0000      0.0000      0.0000      0.0000
    1979        0.0000      0.0000      0.0000      0.0000      0.0000
    1980        0.0000      0.0000      0.0000      0.0000      0.0000
    1981        0.0000      0.0000      0.0000      0.0000      0.0000
    1982      400.1223   2548.6795    503.3973      0.0000      0.0000
    1983      605.3063     37.1571    298.6232      0.0000      0.0000
    1984      546.9750    285.2357      0.0000      0.0000      0.0000
    1985      362.5554    262.1491    245.7563      0.0000      0.0000
    1986      844.0955     84.2866    170.8955      0.0000      0.0000
    1987      245.0732    185.1027     44.8071      0.0000      0.0000
    1988       87.4286     50.5446     67.2107      0.0000      0.0000
    1989      479.6277     68.9866     53.9598      0.0000      0.0000
    1990      178.1357    195.4848     17.6223      0.0000      0.0000
    1991      448.2080     73.9045     55.4625      0.0000      0.0000
    1992      194.5286    216.7955     26.7750      0.0000      0.0000
    1993      188.7911     40.0259     46.9929      0.0000      0.0000
    1994        7.7866     60.2438      0.0000      0.0000      0.0000
    1995        0.0000      0.0000      0.0000     67.6205    521.4295
    1996        0.0000      0.0000      0.0000     99.7232    292.2027
    1997        0.0000      0.0000      0.0000    397.2536    597.1098
    1998        0.0000      0.0000      0.0000    152.0438    908.7107
    1999        0.0000      0.0000      0.0000    290.0170    397.3902
    2000        0.0000      0.0000      0.0000    301.4920   1101.8732
    2001        0.0000      0.0000      0.0000     82.9205    320.4804
    2002        0.0000      0.0000      0.0000     88.3848    126.9080
    2003        0.0000      0.0000      0.0000     22.4036    290.7000
    2004        0.0000      0.0000      0.0000    870.0509     79.2321
    2005        0.0000      0.0000      0.0000     16.2563    660.9054
    2006        0.0000      0.0000      0.0000    243.9804    315.5625
    2007        0.0000      0.0000      0.0000    170.8955    872.7830
    2008        0.0000      0.0000      0.0000    864.1768   1136.0250
```

```
 SURVEY - INPUT DATA

INDEX            11          12          13          14          15

SURVEY TAG     spr_36po    spr_36po    spr_36po    spr_36po    spr_36po

AGE               3           4           5           6           7
TIME            JAN-1       JAN-1       JAN-1       JAN-1       JAN-1
TYPE           NUMBERS     NUMBERS     NUMBERS     NUMBERS     NUMBERS
RETRO FLAG        1           1           1           1           1
 ------------------------------------------------------------------------

    1978        0.0000      0.0000      0.0000      0.0000      0.0000
    1979        0.0000      0.0000      0.0000      0.0000      0.0000
    1980        0.0000      0.0000      0.0000      0.0000      0.0000
    1981        0.0000      0.0000      0.0000      0.0000      0.0000
    1982        0.0000      0.0000      0.0000      0.0000      0.0000
    1983        0.0000      0.0000      0.0000      0.0000      0.0000
    1984        0.0000      0.0000      0.0000      0.0000      0.0000
    1985        0.0000      0.0000      0.0000      0.0000      0.0000
    1986        0.0000      0.0000      0.0000      0.0000      0.0000
    1987        0.0000      0.0000      0.0000      0.0000      0.0000
    1988        0.0000      0.0000      0.0000      0.0000      0.0000
    1989        0.0000      0.0000      0.0000      0.0000      0.0000
    1990        0.0000      0.0000      0.0000      0.0000      0.0000
    1991        0.0000      0.0000      0.0000      0.0000      0.0000
    1992        0.0000      0.0000      0.0000      0.0000      0.0000
    1993        0.0000      0.0000      0.0000      0.0000      0.0000
    1994        0.0000      0.0000      0.0000      0.0000      0.0000
    1995     1166.4884    729.4821    818.2768    145.7598    319.1143
    1996     1005.7018   1703.7643    237.9696    284.8259     37.8402
    1997      232.5054    667.4625    576.8920     68.0304    182.9170
    1998     1773.1607   1158.1554   1031.2473    727.5696    138.7929
    1999      831.9375    696.2866    325.3982    162.9723     86.8821
    2000     1133.5661   1558.8241    505.8563    139.8857     34.8348
    2001     1084.2509    218.8446    522.7955    241.2482     31.5563
    2002      523.6152   1356.5089    327.0375    306.9563     53.2768
    2003      370.4786    850.3795    951.3321     87.5652    108.6027
    2004      790.8188   1921.3795   1849.5241   1219.2188    243.9804
    2005      188.2446    861.9911    374.8500    280.4545    174.0375
    2006     1783.9527    453.3991    988.2161    290.7000    165.7045
    2007      513.0964   2450.3223    247.1223    285.7821     42.2116
    2008      790.2723    479.9009   1312.2482     51.6375     61.4732
```

```
 SURVEY - INPUT DATA

INDEX            16          17          18          19          20

SURVEY TAG     spr_36po    spr_41      spr_41      spr_41      spr_41

AGE               8           1           2           3           4
TIME           JAN-1       JAN-1       JAN-1       JAN-1       JAN-1
TYPE          NUMBERS     NUMBERS     NUMBERS     NUMBERS     NUMBERS
RETRO FLAG       1           1           1           1           1
 ___________________________________________________________________________

    1978       0.0000    477.9000    246.6000   7111.1571   1249.0714
    1979       0.0000    550.6714   1668.4714    353.7000   2380.5000
    1980       0.0000     40.1143   2850.4286   3458.0571    272.9571
    1981       0.0000   2959.9714   2381.4000   3613.8857   2166.3000
    1982       0.0000      0.0000      0.0000      0.0000      0.0000
    1983       0.0000      0.0000      0.0000      0.0000      0.0000
    1984       0.0000      0.0000      0.0000      0.0000      0.0000
    1985       0.0000      0.0000      0.0000      0.0000      0.0000
    1986       0.0000      0.0000      0.0000      0.0000      0.0000
    1987       0.0000      0.0000      0.0000      0.0000      0.0000
    1988       0.0000      0.0000      0.0000      0.0000      0.0000
    1989       0.0000      0.0000      0.0000      0.0000      0.0000
    1990       0.0000      0.0000      0.0000      0.0000      0.0000
    1991       0.0000      0.0000      0.0000      0.0000      0.0000
    1992       0.0000      0.0000      0.0000      0.0000      0.0000
    1993       0.0000      0.0000      0.0000      0.0000      0.0000
    1994       0.0000      0.0000      0.0000      0.0000      0.0000
    1995      38.2500      0.0000      0.0000      0.0000      0.0000
    1996      24.7259      0.0000      0.0000      0.0000      0.0000
    1997      27.4580      0.0000      0.0000      0.0000      0.0000
    1998      42.2116      0.0000      0.0000      0.0000      0.0000
    1999      41.6652      0.0000      0.0000      0.0000      0.0000
    2000      27.4580      0.0000      0.0000      0.0000      0.0000
    2001      24.1795      0.0000      0.0000      0.0000      0.0000
    2002       0.0000      0.0000      0.0000      0.0000      0.0000
    2003      16.8027      0.0000      0.0000      0.0000      0.0000
    2004     356.8179      0.0000      0.0000      0.0000      0.0000
    2005      40.7089      0.0000      0.0000      0.0000      0.0000
    2006      73.6313      0.0000      0.0000      0.0000      0.0000
    2007      24.7259      0.0000      0.0000      0.0000      0.0000
    2008       0.0000      0.0000      0.0000      0.0000      0.0000
```

```
 SURVEY - INPUT DATA

INDEX            21          22          23          24          25

SURVEY TAG     spr_41      spr_41      spr_41      spr_41      sp_can_p

AGE                5           6           7           8           1
TIME            JAN-1       JAN-1       JAN-1       JAN-1       JAN-1
TYPE          NUMBERS     NUMBERS     NUMBERS     NUMBERS     NUMBERS
RETRO FLAG         1           1           1           1           1
 _________________________________________________________________________

    1978      999.7714    182.0571    915.8143     83.7000      0.0000
    1979      702.7714    302.7857    107.4857    178.2000      0.0000
    1980     2192.1429    480.4714    238.5000     39.8571      0.0000
    1981      136.1571   1129.6286    331.9714    169.8429      0.0000
    1982        0.0000      0.0000      0.0000      0.0000      0.0000
    1983        0.0000      0.0000      0.0000      0.0000      0.0000
    1984        0.0000      0.0000      0.0000      0.0000      0.0000
    1985        0.0000      0.0000      0.0000      0.0000      0.0000
    1986        0.0000      0.0000      0.0000      0.0000    844.4316
    1987        0.0000      0.0000      0.0000      0.0000    351.8465
    1988        0.0000      0.0000      0.0000      0.0000    394.0681
    1989        0.0000      0.0000      0.0000      0.0000   2294.0392
    1990        0.0000      0.0000      0.0000      0.0000    591.1021
    1991        0.0000      0.0000      0.0000      0.0000   1660.7155
    1992        0.0000      0.0000      0.0000      0.0000    154.8125
    1993        0.0000      0.0000      0.0000      0.0000      0.0000
    1994        0.0000      0.0000      0.0000      0.0000      0.0000
    1995        0.0000      0.0000      0.0000      0.0000      0.0000
    1996        0.0000      0.0000      0.0000      0.0000      0.0000
    1997        0.0000      0.0000      0.0000      0.0000      0.0000
    1998        0.0000      0.0000      0.0000      0.0000      0.0000
    1999        0.0000      0.0000      0.0000      0.0000      0.0000
    2000        0.0000      0.0000      0.0000      0.0000      0.0000
    2001        0.0000      0.0000      0.0000      0.0000      0.0000
    2002        0.0000      0.0000      0.0000      0.0000      0.0000
    2003        0.0000      0.0000      0.0000      0.0000      0.0000
    2004        0.0000      0.0000      0.0000      0.0000      0.0000
    2005        0.0000      0.0000      0.0000      0.0000      0.0000
    2006        0.0000      0.0000      0.0000      0.0000      0.0000
    2007        0.0000      0.0000      0.0000      0.0000      0.0000
    2008        0.0000      0.0000      0.0000      0.0000      0.0000
```

```
 SURVEY - INPUT DATA

INDEX            26          27          28          29          30

SURVEY TAG     sp_can_p    sp_can_p    sp_can_p    sp_can_p    sp_can_p

AGE                2           3           4           5           6
TIME            JAN-1       JAN-1       JAN-1       JAN-1       JAN-1
TYPE           NUMBERS     NUMBERS     NUMBERS     NUMBERS     NUMBERS
RETRO FLAG        1           1           1           1           1
 ________________________________________________________________________

    1978        0.0000      0.0000      0.0000      0.0000      0.0000
    1979        0.0000      0.0000      0.0000      0.0000      0.0000
    1980        0.0000      0.0000      0.0000      0.0000      0.0000
    1981        0.0000      0.0000      0.0000      0.0000      0.0000
    1982        0.0000      0.0000      0.0000      0.0000      0.0000
    1983        0.0000      0.0000      0.0000      0.0000      0.0000
    1984        0.0000      0.0000      0.0000      0.0000      0.0000
    1985        0.0000      0.0000      0.0000      0.0000      0.0000
    1986     3194.7662   3954.7547    520.7328    914.8009    619.2498
    1987     2997.7322   1308.8690   1534.0507    478.5112    168.8863
    1988     1421.4599   6558.4188    816.2839   1435.5337    182.9602
    1989     3912.5331   1942.1927   4011.0501    506.6590    591.1021
    1990     3434.0218   5319.9191   2927.3629   5446.5838    591.1021
    1991     1632.5678   2589.5902   3025.8799   1477.7553   1843.6757
    1992     4025.1240   2491.0732   1125.9088   1379.2383    844.4316
    1993        0.0000      0.0000      0.0000      0.0000      0.0000
    1994        0.0000      0.0000      0.0000      0.0000      0.0000
    1995        0.0000      0.0000      0.0000      0.0000      0.0000
    1996        0.0000      0.0000      0.0000      0.0000      0.0000
    1997        0.0000      0.0000      0.0000      0.0000      0.0000
    1998        0.0000      0.0000      0.0000      0.0000      0.0000
    1999        0.0000      0.0000      0.0000      0.0000      0.0000
    2000        0.0000      0.0000      0.0000      0.0000      0.0000
    2001        0.0000      0.0000      0.0000      0.0000      0.0000
    2002        0.0000      0.0000      0.0000      0.0000      0.0000
    2003        0.0000      0.0000      0.0000      0.0000      0.0000
    2004        0.0000      0.0000      0.0000      0.0000      0.0000
    2005        0.0000      0.0000      0.0000      0.0000      0.0000
    2006        0.0000      0.0000      0.0000      0.0000      0.0000
    2007        0.0000      0.0000      0.0000      0.0000      0.0000
    2008        0.0000      0.0000      0.0000      0.0000      0.0000
```

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 SURVEY - INPUT DATA

INDEX            31          32          33          34          35

SURVEY TAG     sp_can_p    sp_can_p    sp_canpo    sp_canpo    sp_canpo

AGE               7           8           1           2           3
TIME           JAN-1       JAN-1       JAN-1       JAN-1       JAN-1
TYPE          NUMBERS     NUMBERS     NUMBERS     NUMBERS     NUMBERS
RETRO FLAG       1           1           1           1           1
____________________________________________________________________________

    1978        0.0000      0.0000      0.0000      0.0000      0.0000
    1979        0.0000      0.0000      0.0000      0.0000      0.0000
    1980        0.0000      0.0000      0.0000      0.0000      0.0000
    1981        0.0000      0.0000      0.0000      0.0000      0.0000
    1982        0.0000      0.0000      0.0000      0.0000      0.0000
    1983        0.0000      0.0000      0.0000      0.0000      0.0000
    1984        0.0000      0.0000      0.0000      0.0000      0.0000
    1985        0.0000      0.0000      0.0000      0.0000      0.0000
    1986      365.9204      0.0400      0.0000      0.0000      0.0000
    1987      309.6249      0.0800      0.0000      0.0000      0.0000
    1988      112.5909      0.1700      0.0000      0.0000      0.0000
    1989       70.3693      0.1000      0.0000      0.0000      0.0000
    1990     1308.8690      0.1200      0.0000      0.0000      0.0000
    1991      225.1818      0.2200      0.0000      0.0000      0.0000
    1992      605.1760      0.1200      0.0000      0.0000      0.0000
    1993        0.0000      0.0000      0.0000      0.0000      0.0000
    1994        0.0000      0.0000      0.0000      0.0000      0.0000
    1995        0.0000      0.0000     98.5170    942.9486   2111.0790
    1996        0.0000      0.0000    197.0340    689.6191   3251.0617
    1997        0.0000      0.0000    450.3635    745.9146    774.0623
    1998        0.0000      0.0000     14.0739    942.9486   1337.0167
    1999        0.0000      0.0000    464.4374    450.3635   2097.0051
    2000        0.0000      0.0000    140.7386    619.2498   1477.7553
    2001        0.0000      0.0000      0.0000     84.4432    900.7270
    2002        0.0000      0.0000     12.8934    121.7457    805.6169
    2003        0.0000      0.0000      0.0000     31.3603    419.1448
    2004        0.0000      0.0000    753.7760    134.4987    551.7156
    2005        0.0000      0.0000     34.4185   1880.0260    661.9957
    2006        0.0000      0.0000      0.0000     52.7756   1978.5841
    2007        0.0000      0.0000    193.3181    730.7096   1329.3200
    2008        0.0000      0.0000     12.2714    454.9284   1259.8226
```

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 SURVEY - INPUT DATA

INDEX            36          37          38          39          40

SURVEY TAG     sp_canpo    sp_canpo    sp_canpo    sp_canpo    sp_canpo

AGE               4           5           6           7           8
TIME           JAN-1       JAN-1       JAN-1       JAN-1       JAN-1
TYPE          NUMBERS     NUMBERS     NUMBERS     NUMBERS     NUMBERS
RETRO FLAG       1           1           1           1           1
 ________________________________________________________________________

    1978        0.0000      0.0000      0.0000      0.0000      0.0000
    1979        0.0000      0.0000      0.0000      0.0000      0.0000
    1980        0.0000      0.0000      0.0000      0.0000      0.0000
    1981        0.0000      0.0000      0.0000      0.0000      0.0000
    1982        0.0000      0.0000      0.0000      0.0000      0.0000
    1983        0.0000      0.0000      0.0000      0.0000      0.0000
    1984        0.0000      0.0000      0.0000      0.0000      0.0000
    1985        0.0000      0.0000      0.0000      0.0000      0.0000
    1986        0.0000      0.0000      0.0000      0.0000      0.0000
    1987        0.0000      0.0000      0.0000      0.0000      0.0000
    1988        0.0000      0.0000      0.0000      0.0000      0.0000
    1989        0.0000      0.0000      0.0000      0.0000      0.0000
    1990        0.0000      0.0000      0.0000      0.0000      0.0000
    1991        0.0000      0.0000      0.0000      0.0000      0.0000
    1992        0.0000      0.0000      0.0000      0.0000      0.0000
    1993        0.0000      0.0000      0.0000      0.0000      0.0000
    1994        0.0000      0.0000      0.0000      0.0000      0.0000
    1995     1210.3520    844.4316    267.4033     56.2954      0.0500
    1996     5657.6917   1534.0507   1111.8349    464.4374      0.0800
    1997     1759.2325   1731.0848    379.9942     84.4432      0.0300
    1998      492.5851    492.5851    394.0681     98.5170      0.0200
    1999     1534.0507    577.0283    365.9204    211.1079      0.0100
    2000     5516.9531   2406.6301   1097.7611    562.9544      0.2400
    2001      591.1021   1562.1985    731.8407    365.9204      0.1700
    2002     2887.0783    961.5430   1718.1603    563.8122      0.1700
    2003      912.1602   1706.7639    447.1511    474.4035      0.1600
    2004      595.5775    634.6213    545.4536    103.8278      0.1175
    2005     4092.5096   1591.4896    721.6604    583.5206      0.0100
    2006      925.6215   2297.1633    982.6574    283.5685      0.1850
    2007     4136.1066    545.8412    851.2446    135.4739      0.0757
    2008      835.7757   3069.2880    196.4960    396.5004      0.0300
```

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 SURVEY - INPUT DATA

INDEX            41          42          43          44          45

SURVEY TAG     us0autpr    us1autpr    us2autpr    us3autpr    us4autpr

AGE                1           2           3           4           5
TIME             JAN-1       JAN-1       JAN-1       JAN-1       JAN-1
TYPE            NUMBERS     NUMBERS     NUMBERS     NUMBERS     NUMBERS
RETRO FLAG        1           1           1           1           1
 ________________________________________________________________________

    1978      207.0964    323.4857   4690.4063    943.6821    345.3429
    1979      540.0080   2520.9482    534.4071   5543.1080   1316.3464
    1980      156.4152   2220.0027   2290.9018    221.4402   2303.8795
    1981      382.0902   1120.0420    769.9179   1057.2027     71.7188
    1982      356.5446   4815.4018   3073.6607   2129.7054    804.6161
    1983      494.5179    788.6330   2608.5134    330.3161     92.6196
    1984     1752.5330   1160.4777   1488.0616   1011.1661     94.3955
    1985      244.6634   2607.9670    931.3875   1268.6705   1127.1455
    1986     1368.6670    247.6688   1151.0518     91.1170    144.1205
    1987      103.9580   3113.1402    175.5402    449.4375     11.2018
    1988      278.2688    565.1438   1848.0214    147.5357    273.6241
    1989      750.6563   1194.9027    596.9732   1234.6554     81.9643
    1990      342.6107   3822.8143   1429.4571    220.0741    692.7348
    1991      214.6098    496.7036   2219.0464   2478.1902    563.3679
    1992       55.3259    556.8107    239.3357    374.5768     41.6652
    1993       47.9491    563.3679   1296.2652    238.1063    136.6071
    1994      243.7071   1324.9527    726.2036    522.6589     22.5402
    1995        0.0000      0.0000      0.0000      0.0000      0.0000
    1996        0.0000      0.0000      0.0000      0.0000      0.0000
    1997        0.0000      0.0000      0.0000      0.0000      0.0000
    1998        0.0000      0.0000      0.0000      0.0000      0.0000
    1999        0.0000      0.0000      0.0000      0.0000      0.0000
    2000        0.0000      0.0000      0.0000      0.0000      0.0000
    2001        0.0000      0.0000      0.0000      0.0000      0.0000
    2002        0.0000      0.0000      0.0000      0.0000      0.0000
    2003        0.0000      0.0000      0.0000      0.0000      0.0000
    2004        0.0000      0.0000      0.0000      0.0000      0.0000
    2005        0.0000      0.0000      0.0000      0.0000      0.0000
    2006        0.0000      0.0000      0.0000      0.0000      0.0000
    2007        0.0000      0.0000      0.0000      0.0000      0.0000
    2008        0.0000      0.0000      0.0000      0.0000      0.0000
```

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 SURVEY - INPUT DATA

INDEX            46          47          48          49          50

SURVEY TAG     us5autpr    us0autpo    us1autpo    us2autpo    us3autpo

AGE                6           1           2           3           4
TIME           JAN-1       JAN-1       JAN-1       JAN-1       JAN-1
TYPE          NUMBERS     NUMBERS     NUMBERS     NUMBERS     NUMBERS
RETRO FLAG       1           1           1           1           1
 ------------------------------------------------------------------------

    1978      236.4670      0.0000      0.0000      0.0000      0.0000
    1979      458.3170      0.0000      0.0000      0.0000      0.0000
    1980      437.9625      0.0000      0.0000      0.0000      0.0000
    1981      361.7357      0.0000      0.0000      0.0000      0.0000
    1982       73.7679      0.0000      0.0000      0.0000      0.0000
    1983      157.3714      0.0000      0.0000      0.0000      0.0000
    1984       44.8071      0.0000      0.0000      0.0000      0.0000
    1985       33.0589      0.0000      0.0000      0.0000      0.0000
    1986      104.6411      0.0000      0.0000      0.0000      0.0000
    1987       66.5277      0.0000      0.0000      0.0000      0.0000
    1988       38.2500      0.0000      0.0000      0.0000      0.0000
    1989      264.6080      0.0000      0.0000      0.0000      0.0000
    1990       74.7241      0.0000      0.0000      0.0000      0.0000
    1991      390.0134      0.0000      0.0000      0.0000      0.0000
    1992       39.6161      0.0000      0.0000      0.0000      0.0000
    1993       59.6973      0.0000      0.0000      0.0000      0.0000
    1994       34.5616      0.0000      0.0000      0.0000      0.0000
    1995        0.0000     91.2536    554.0786    907.4813    592.0554
    1996        0.0000    218.4348    334.2777   2473.4089   1705.5402
    1997        0.0000     29.5071    327.7205    267.4768    566.1000
    1998        0.0000      8.7429    322.6661    438.3723    149.3116
    1999        0.0000     95.7616    458.3170   1401.8625    480.5839
    2000        0.0000     95.7616    190.8402    210.6482    422.9357
    2001        0.0000     26.6384    780.0268    734.6732     96.3080
    2002        0.0000     38.7964     64.3420    520.2000    627.0268
    2003        0.0000    319.6607    652.9821    965.8125   1907.0357
    2004        0.0000    446.5688    227.1777    422.3893    273.8973
    2005        0.0000   2302.2402   1017.4500    185.5125    970.0473
    2006        0.0000     71.1723     75.5438    791.5018    176.0866
    2007        0.0000    135.7875    590.8259    221.0304    702.4339
    2008        0.0000    102.3188    156.6884    282.5036     68.8500
```

```
 SURVEY - INPUT DATA


INDEX            51          52

SURVEY TAG     us4autpo    us5autpo

AGE               5           6      NUMBERS     NUMBERS     NUMBERS
TIME            JAN-1       JAN-1    NUMBERS     NUMBERS     NUMBERS
TYPE           NUMBERS     NUMBERS   NUMBERS     NUMBERS     NUMBERS
RETRO FLAG       1           1
 ________________________________________________________________________

    1978        0.0000      0.0000
    1979        0.0000      0.0000
    1980        0.0000      0.0000
    1981        0.0000      0.0000
    1982        0.0000      0.0000
    1983        0.0000      0.0000
    1984        0.0000      0.0000
    1985        0.0000      0.0000
    1986        0.0000      0.0000
    1987        0.0000      0.0000
    1988        0.0000      0.0000
    1989        0.0000      0.0000
    1990        0.0000      0.0000
    1991        0.0000      0.0000
    1992        0.0000      0.0000
    1993        0.0000      0.0000
    1994        0.0000      0.0000
    1995      209.5554     92.7563
    1996      119.1214     73.9045
    1997      195.3482     81.5545
    1998      176.4964     66.3911
    1999       56.1455     48.3589
    2000      348.2116    118.9848
    2001      107.6464     41.8018
    2002       81.1446     74.5875
    2003     2222.5982    161.1964
    2004      212.5607    112.5643
    2005      344.2500    439.1920
    2006      239.8821     35.3813
    2007       46.1732    170.4857
    2008      177.9991      8.7429

     Additional Output Files

Population File C:\LOB\GBCOD\ASSESS_2008\VPA\TY07\10P_SWPT_SPLIT\10P-SWPT-
SPLT_A
Auxilliary File C:\LOB\GBCOD\ASSESS_2008\VPA\TY07\10P_SWPT_SPLIT\10P-SWPT-
SPLT_A
Covariance File C:\LOB\GBCOD\ASSESS_2008\VPA\TY07\10P_SWPT_SPLIT\10P-SWPT-
SPLT_A
Residuals File  C:\LOB\GBCOD\ASSESS_2008\VPA\TY07\10P_SWPT_SPLIT\10P-SWPT-
SPLT_A
```

```
Log File        C:\LOB\GBCOD\ASSESS_2008\VPA\TY07\10P_SWPT_SPLIT\10P-SWPT-
SPLT_A

     Bootstrap Files

Bootstrap Stock Numbers
C:\LOB\GBCOD\ASSESS_2008\VPA\TY07\10P_SWPT_SPLIT\10P-SWPT-SPLT_A
Bootstrap Fishing Mortality
C:\LOB\GBCOD\ASSESS_2008\VPA\TY07\10P_SWPT_SPLIT\10P-SWPT-SPLT_A
Bootstrap Biomass
C:\LOB\GBCOD\ASSESS_2008\VPA\TY07\10P_SWPT_SPLIT\10P-SWPT-SPLT_A
Bootstrap Catchability
C:\LOB\GBCOD\ASSESS_2008\VPA\TY07\10P_SWPT_SPLIT\10P-SWPT-SPLT_A



                             Estimation Results

 JAN-1 Population Numbers


   AGE       1978        1979        1980        1981        1982

_____________________________________________________________________________

    1      28705.      25943.      22914.      45891.      19863.
    2       4707.      23365.      20988.      18453.      36471.
    3      25333.       3478.      17107.      13370.      11591.
    4       7660.      13468.       1991.       8669.       6701.
    5       2967.       4093.       6916.       1141.       4688.
    6       1264.       1624.       2267.       3454.        649.
    7       1212.        874.        926.        978.       1570.
    8         82.        776.        572.        385.        428.
    9        174.         47.        363.        405.        169.
   10         44.        127.         37.        173.        192.
 ===================================================================
 Total     72148.      73793.      74082.      92919.      82323.

   AGE       1983        1984        1985        1986        1987

_____________________________________________________________________________

    1      11305.      29021.       9615.      44505.      17898.
    2      15562.       8691.      23506.       7713.      35744.
    3      20473.       8096.       5723.      12569.       4881.
    4       5520.       8936.       3512.       2063.       6191.
    5       2817.       2128.       4336.       1367.        920.
    6       2015.       1273.        916.       1678.        649.
    7        266.        982.        541.        308.        823.
    8        654.        133.        402.        205.        176.
    9        173.        378.         56.        153.        105.
   10        288.        283.        182.         76.         75.
 ===================================================================
 Total     59073.      59920.      48789.      70638.      67462.

   AGE       1988        1989        1990        1991        1992
```

```
   1      24854.      17849.      10204.      19796.       7470.
   2      14560.      20056.      13809.       8290.      15956.
   3      22111.       9803.      14070.       6330.       5023.
   4       2637.      10610.       5305.       6709.       2076.
   5       3124.       1198.       4880.       2584.       2671.
   6        484.       1153.        637.       1967.        833.
   7        308.        197.        467.        315.        642.
   8        425.        118.         88.        178.        132.
   9         93.        154.         51.         50.         66.
  10        105.         54.         88.         47.         19.
=====================================================================
 Total    68702.      61191.      49599.      46266.      34886.

 JAN-1 Population Numbers


   AGE      1993        1994        1995        1996        1997


   1       9871.       6316.       3925.       6675.      10621.
   2       5943.       7812.       5086.       3185.       5407.
   3       8749.       3487.       5841.       3575.       2348.
   4       2070.       3214.       1475.       3498.       2041.
   5        745.        607.        868.        610.       1727.
   6        853.        189.        121.        369.        270.
   7        283.        223.         68.         62.        138.
   8        209.         74.         53.         36.         35.
   9         68.         46.         15.         26.         19.
  10         34.          9.          3.          1.          7.
=====================================================================
 Total    28824.      21975.      17456.      18037.      22614.

   AGE      1998        1999        2000        2001        2002


   1       4944.      12234.       5977.       2295.       4239.
   2       8581.       3991.       9973.       4791.       1868.
   3       3809.       6197.       2946.       7315.       3274.
   4       1250.       1944.       3261.       1746.       3600.
   5        761.        581.        830.       1634.        758.
   6        627.        279.        220.        397.        713.
   7         90.        258.        116.        102.        164.
   8         30.         37.         84.         54.         34.
   9         12.         10.         11.         34.         21.
  10          6.          7.          3.          3.         13.
=====================================================================
 Total    20110.      25540.      23421.      18370.      14685.

   AGE      2003        2004        2005        2006        2007

```

```
   1        1461.      10802.       2523.       6490.       7037.
   2        3441.       1181.       8798.       2054.       5284.
   3        1428.       2635.        904.       6874.       1619.
   4        1621.        806.       1767.        559.       4869.
   5        1591.        613.        427.        928.        271.
   6         294.        493.        223.        220.        432.
   7         253.        102.        179.         88.        116.
   8          59.         80.         32.         70.         44.
   9          11.         23.         22.         10.         32.
  10           5.         10.          9.          9.          5.
=====================================================================
Total      10164.      16745.      14882.      17301.      19708.

JAN-1 Population Numbers


  AGE       2008

______________________________________________________________________________

   1        4875.
   2        5752.
   3        3852.
   4         970.
   5        2930.
   6         157.
   7         238.
   8          81.
   9          26.
  10          22.
=====================================================================
Total      18902.
```

```
Fishing Mortality Calculated

   AGE       1978         1979         1980         1981         1982

____________________________________________________________________________

    1       0.0058       0.0119       0.0165       0.0297       0.0440
    2       0.1026       0.1117       0.2509       0.2650       0.3774
    3       0.4318       0.3577       0.4797       0.4908       0.5419
    4       0.4269       0.4664       0.3569       0.4147       0.6667
    5       0.4024       0.3905       0.4942       0.3647       0.6443
    6       0.1688       0.3620       0.6411       0.5883       0.6924
    7       0.2463       0.2239       0.6785       0.6268       0.6760
    8       0.3601       0.5597       0.1456       0.6208       0.7059
    9       0.3083       0.3598       0.5414       0.5446       0.6558
   10       0.3083       0.3598       0.5414       0.5446       0.6558

   AGE       1983         1984         1985         1986         1987

____________________________________________________________________________

    1       0.0630       0.0107       0.0204       0.0192       0.0064
    2       0.4535       0.2179       0.4261       0.2575       0.2803
    3       0.6290       0.6351       0.8203       0.5081       0.4158
    4       0.7533       0.5232       0.7433       0.6078       0.4840
    5       0.5944       0.6425       0.7493       0.5448       0.4415
    6       0.5194       0.6547       0.8897       0.5129       0.5462
    7       0.4937       0.6939       0.7714       0.3628       0.4606
    8       0.3474       0.6618       0.7637       0.4717       0.4309
    9       0.5587       0.6574       0.7723       0.5108       0.4756
   10       0.5587       0.6574       0.7723       0.5108       0.4756

   AGE       1988         1989         1990         1991         1992

____________________________________________________________________________

    1       0.0145       0.0566       0.0078       0.0157       0.0287
    2       0.1956       0.1545       0.5800       0.3011       0.4009
    3       0.5343       0.4140       0.5406       0.9151       0.6864
    4       0.5889       0.5766       0.5192       0.7209       0.8245
    5       0.7968       0.4318       0.7087       0.9323       0.9419
    6       0.7013       0.7038       0.5044       0.9193       0.8797
    7       0.7592       0.6020       0.7662       0.6727       0.9223
    8       0.8176       0.6421       0.3653       0.7979       0.4573
    9       0.7815       0.5595       0.6891       0.9081       0.9261
   10       0.7815       0.5595       0.6891       0.9081       0.9261
```

```
Fishing Mortality Calculated

   AGE       1993        1994        1995        1996        1997

----------------------------------------------------------------------------

    1       0.0340      0.0166      0.0091      0.0108      0.0133
    2       0.3332      0.0907      0.1523      0.1047      0.1502
    3       0.8014      0.6600      0.3127      0.3604      0.4303
    4       1.0272      1.1091      0.6839      0.5061      0.7865
    5       1.1730      1.4129      0.6554      0.6147      0.8135
    6       1.1405      0.8274      0.4668      0.7821      0.9036
    7       1.1436      1.2330      0.4262      0.3799      1.3379
    8       1.3043      1.3803      0.5290      0.4335      0.8944
    9       1.1537      1.2384      0.6159      0.6543      0.8515
   10       1.1537      1.2384      0.6159      0.6543      0.8515

   AGE       1998        1999        2000        2001        2002

----------------------------------------------------------------------------

    1       0.0142      0.0043      0.0212      0.0056      0.0088
    2       0.1255      0.1035      0.1100      0.1806      0.0690
    3       0.4725      0.4421      0.3230      0.5091      0.5029
    4       0.5659      0.6513      0.4912      0.6348      0.6162
    5       0.8021      0.7704      0.5380      0.6293      0.7456
    6       0.6861      0.6757      0.5739      0.6852      0.8374
    7       0.6733      0.9285      0.5704      0.8835      0.8281
    8       0.8821      1.0337      0.7057      0.7381      0.8951
    9       0.7434      0.7794      0.5479      0.6503      0.7929
   10       0.7434      0.7794      0.5479      0.6503      0.7929

   AGE       2003        2004        2005        2006        2007

----------------------------------------------------------------------------

    1       0.0129      0.0052      0.0054      0.0056      0.0017
    2       0.0667      0.0670      0.0467      0.0381      0.1161
    3       0.3719      0.2000      0.2811      0.1450      0.3119
    4       0.7723      0.4362      0.4441      0.5236      0.3080
    5       0.9709      0.8136      0.4635      0.5645      0.3439
    6       0.8593      0.8168      0.7325      0.4354      0.3973
    7       0.9477      0.9661      0.7358      0.4941      0.1662
    8       0.7441      1.0957      0.9542      0.5883      0.3025
    9       0.9521      0.8269      0.5855      0.5353      0.3025
   10       0.9521      0.8269      0.5855      0.5353      0.3025
```

```
Average Fishing Mortality For Ages   5-  8

Year      Average F   N Weighted  Biomass Wtd  Catch Wtd



1978       0.2944      0.3141      0.2944      0.3425
1979       0.3840      0.3823      0.3842      0.3962
1980       0.4898      0.5227      0.5158      0.5442
1981       0.5501      0.5539      0.5704      0.5667
1982       0.6796      0.6589      0.6647      0.6594
1983       0.4887      0.5354      0.5104      0.5443
1984       0.6633      0.6577      0.6626      0.6581
1985       0.7935      0.7729      0.7769      0.7749
1986       0.4730      0.5098      0.5017      0.5137
1987       0.4698      0.4734      0.4746      0.4765
1988       0.7687      0.7855      0.7846      0.7864
1989       0.5949      0.5713      0.5934      0.5936
1990       0.5862      0.6867      0.6799      0.6933
1991       0.8305      0.9063      0.8960      0.9095
1992       0.8003      0.9119      0.8982      0.9180
1993       1.1904      1.1689      1.1749      1.1699
1994       1.2134      1.2728      1.2444      1.2948
1995       0.5193      0.6148      0.5964      0.6227
1996       0.5526      0.6525      0.6479      0.6668
1997       0.9873      0.8594      0.8881      0.8697
1998       0.7609      0.7478      0.7431      0.7512
1999       0.8521      0.7914      0.8041      0.7992
2000       0.5970      0.5586      0.5671      0.5609
2001       0.7340      0.6539      0.6625      0.6572
2002       0.8265      0.7960      0.8045      0.7978
2003       0.8805      0.9473      0.9397      0.9490
2004       0.9231      0.8445      0.8584      0.8486
2005       0.7215      0.6079      0.6340      0.6347
2006       0.5206      0.5393      0.5351      0.5431
2007       0.3025      0.3446      0.3356      0.3597
```

```
 Back Calculated Partial Recruitment

   AGE       1978        1979        1980        1981        1982
 ________________________________________________________________________________

    1       0.0135      0.0213      0.0243      0.0474      0.0623
    2       0.2377      0.1996      0.3698      0.4228      0.5347
    3       1.0000      0.6391      0.7070      0.7830      0.7676
    4       0.9886      0.8332      0.5260      0.6616      0.9444
    5       0.9319      0.6976      0.7284      0.5819      0.9127
    6       0.3909      0.6467      0.9449      0.9386      0.9809
    7       0.5705      0.4000      1.0000      1.0000      0.9576
    8       0.8339      1.0000      0.2145      0.9905      1.0000
    9       0.7139      0.6428      0.7979      0.8689      0.9291
   10       0.7139      0.6428      0.7979      0.8689      0.9291

   AGE       1983        1984        1985        1986        1987
 ________________________________________________________________________________

    1       0.0836      0.0155      0.0229      0.0316      0.0118
    2       0.6021      0.3140      0.4789      0.4237      0.5132
    3       0.8350      0.9152      0.9220      0.8359      0.7613
    4       1.0000      0.7540      0.8355      1.0000      0.8861
    5       0.7891      0.9259      0.8422      0.8963      0.8083
    6       0.6895      0.9435      1.0000      0.8438      1.0000
    7       0.6554      1.0000      0.8671      0.5969      0.8433
    8       0.4613      0.9537      0.8584      0.7760      0.7890
    9       0.7417      0.9473      0.8681      0.8404      0.8707
   10       0.7417      0.9473      0.8681      0.8404      0.8707

   AGE       1988        1989        1990        1991        1992
 ________________________________________________________________________________

    1       0.0178      0.0805      0.0102      0.0168      0.0305
    2       0.2392      0.2195      0.7570      0.3229      0.4256
    3       0.6534      0.5882      0.7056      0.9815      0.7287
    4       0.7203      0.8193      0.6776      0.7732      0.8753
    5       0.9745      0.6135      0.9249      1.0000      1.0000
    6       0.8578      1.0000      0.6583      0.9860      0.9340
    7       0.9286      0.8553      1.0000      0.7215      0.9792
    8       1.0000      0.9123      0.4767      0.8558      0.4856
    9       0.9558      0.7949      0.8994      0.9740      0.9832
   10       0.9558      0.7949      0.8994      0.9740      0.9832
```

```
 Back Calculated Partial Recruitment

   AGE       1993         1994         1995         1996         1997

 ______________________________________________________________________________

     1      0.0261       0.0118       0.0133       0.0138       0.0099
     2      0.2555       0.0642       0.2227       0.1338       0.1123
     3      0.6144       0.4671       0.4572       0.4609       0.3216
     4      0.7875       0.7850       1.0000       0.6471       0.5879
     5      0.8994       1.0000       0.9583       0.7860       0.6080
     6      0.8744       0.5856       0.6825       1.0000       0.6754
     7      0.8768       0.8727       0.6232       0.4858       1.0000
     8      1.0000       0.9769       0.7736       0.5543       0.6685
     9      0.8846       0.8765       0.9006       0.8367       0.6364
    10      0.8846       0.8765       0.9006       0.8367       0.6364

   AGE       1998         1999         2000         2001         2002

 ______________________________________________________________________________

     1      0.0161       0.0042       0.0300       0.0064       0.0098
     2      0.1422       0.1001       0.1559       0.2045       0.0771
     3      0.5357       0.4277       0.4578       0.5762       0.5618
     4      0.6416       0.6301       0.6960       0.7185       0.6884
     5      0.9093       0.7453       0.7624       0.7123       0.8329
     6      0.7778       0.6537       0.8132       0.7756       0.9355
     7      0.7633       0.8982       0.8083       1.0000       0.9251
     8      1.0000       1.0000       1.0000       0.8354       1.0000
     9      0.8427       0.7540       0.7764       0.7361       0.8857
    10      0.8427       0.7540       0.7764       0.7361       0.8857

   AGE       2003         2004         2005         2006         2007

 ______________________________________________________________________________

     1      0.0133       0.0047       0.0057       0.0095       0.0042
     2      0.0686       0.0611       0.0489       0.0648       0.2923
     3      0.3830       0.1825       0.2946       0.2464       0.7850
     4      0.7954       0.3981       0.4654       0.8900       0.7751
     5      1.0000       0.7426       0.4857       0.9596       0.8654
     6      0.8850       0.7455       0.7677       0.7401       1.0000
     7      0.9761       0.8818       0.7711       0.8399       0.4184
     8      0.7664       1.0000       1.0000       1.0000       0.7613
     9      0.9806       0.7547       0.6136       0.9098       0.7613
    10      0.9806       0.7547       0.6136       0.9098       0.7613
```

```
JAN-1 Biomass

  AGE       1978        1979        1980        1981        1982


   1       10819.      12621.       9860.      17503.       8545.
   2        4790.      20760.      20788.      17774.      32985.
   3       46691.       5351.      31154.      24529.      22175.
   4       21697.      43531.       5158.      25392.      19946.
   5        8908.      16776.      33810.       4830.      20244.
   6        5526.       8718.      13080.      22058.       3739.
   7        6453.       6485.       7149.       7527.      13058.
   8         652.       6432.       5603.       3470.       3957.
   9        1621.        446.       3558.       4776.       1909.
  10         615.       1729.        553.       2905.       2999.
====================================================================
Total     107772.     122849.     130713.     130763.     129555.

  AGE       1983        1984        1985        1986        1987


   1        5135.       9797.       5967.      20312.       6760.
   2       14955.       8751.      20342.       8064.      35555.
   3       37349.      15268.      10093.      23145.       8947.
   4       16105.      26455.      10660.       5647.      19783.
   5       11883.       8656.      18524.       6182.       4197.
   6       11761.       7127.       5167.      10026.       4244.
   7        1985.       7367.       3981.       2330.       6575.
   8        6572.       1242.       3805.       1856.       1681.
   9        1846.       4115.        618.       1767.       1145.
  10        4693.       4143.       2551.       1107.       1176.
====================================================================
Total     112284.      92921.      81708.      80435.      90064.

  AGE       1988        1989        1990        1991        1992


   1        7153.       4193.       3204.       8823.       4938.
   2       13043.      16855.      11111.       7447.      15506.
   3       41273.      17093.      26462.      12212.       9607.
   4        7770.      31575.      14888.      19753.       6395.
   5       14844.       5106.      21013.      10713.      10655.
   6        3028.       6871.       3668.      10580.       4490.
   7        2536.       1442.       3468.       2155.       4126.
   8        4096.       1100.        831.       1578.       1095.
   9        1020.       1667.        566.        520.        691.
  10        1574.        796.       1284.        694.        353.
====================================================================
Total      96336.      86699.      86495.      74476.      57855.
```

```
JAN-1 Biomass

  AGE       1993        1994        1995        1996        1997

_____________________________________________________________________________

   1        1363.       1794.        816.       1874.       3507.
   2        6186.       4553.       4077.       2407.       4563.
   3       15573.       5847.       8988.       6416.       4302.
   4        5770.       8991.       4176.       8823.       5859.
   5        3242.       2385.       3743.       2596.       6220.
   6        4373.       1121.        721.       2155.       1427.
   7        1889.       1442.        549.        482.        980.
   8        1662.        605.        498.        344.        281.
   9         700.        416.        158.        297.        202.
  10         410.        134.         64.          6.         89.
====================================================================
Total      41170.      27289.      23789.      25400.      27430.

  AGE       1998        1999        2000        2001        2002

_____________________________________________________________________________

   1        2010.       3861.       1236.        932.       1204.
   2        7537.       3755.       9011.       3486.       1662.
   3        6929.      10843.       5445.      13450.       5550.
   4        3530.       5356.       8774.       4623.       9206.
   5        3021.       2293.       3243.       6089.       2581.
   6        2972.       1447.       1098.       1942.       3278.
   7         583.       1572.        746.        581.        956.
   8         230.        295.        610.        395.        238.
   9         114.         87.         90.        288.        178.
  10          74.         90.         33.         29.        151.
====================================================================
Total      27000.      29599.      30284.      31814.      25004.

  AGE       2003        2004        2005        2006        2007

_____________________________________________________________________________

   1         551.       2030.        687.       1271.       1712.
   2        2908.       1135.       5156.       1400.       3877.
   3        2459.       4892.       1623.      10119.       2328.
   4        4011.       2123.       4758.       1428.      11993.
   5        5380.       2060.       1498.       3117.        910.
   6        1270.       2131.        973.        936.       1692.
   7        1380.        527.        917.        494.        604.
   8         392.        524.        207.        414.        293.
   9          93.        175.        177.         75.        212.
  10          54.        108.        104.         81.         42.
====================================================================
Total      18498.      15704.      16099.      19336.      23663.
```

```
JAN-1 Biomass

  AGE       2008


   1        1245.
   2        4380.
   3        6381.
   4        2488.
   5        9942.
   6         667.
   7        1264.
   8         522.
   9         201.
  10         225.
====================================================================
Total      27315.

Mean Biomass

  AGE       1978        1979        1980        1981        1982


   1       15013.      16229.      13264.      24080.      11333.
   2        5082.      27387.      23876.      21266.      38590.
   3       45837.       5044.      30176.      22993.      20784.
   4       19392.      42080.       5415.      22857.      16673.
   5        8946.      15241.      27839.       4406.      16724.
   6        6020.       8917.      10347.      17455.       2821.
   7        6496.       6885.       5118.       5841.       9903.
   8         547.       5623.       4801.       2571.       2742.
   9        1357.        374.       2381.       4003.       1476.
  10         482.       1324.        391.       2048.       2015.
====================================================================
Total     109174.     129103.     123607.     127520.     123060.

  AGE       1983        1984        1985        1986        1987


   1        6723.      14143.       6951.      26928.       9407.
   2       16410.      10649.      24205.       8398.      41679.
   3       33254.      13591.       7443.      22045.       9025.
   4       11927.      23330.       8458.       5110.      18705.
   5        9298.       7100.      13935.       5297.       3915.
   6        9264.       5608.       3594.       8606.       3558.
   7        1627.       5670.       2856.       2092.       5363.
   8        5372.        917.       2649.       1484.       1346.
   9        1418.       2818.        422.       1419.        916.
  10        3289.       2782.       1632.        793.        855.
====================================================================
Total      98582.      86608.      72144.      82173.      94769.
```

```
  AGE      1988        1989        1990        1991        1992

___________________________________________________________________________

   1      11001.       6843.       4893.      11719.       5539.
   2      16587.      24252.      14280.       9908.      17210.
   3      37166.      16145.      24480.       9535.       8020.
   4       6395.      27538.      13518.      15432.       4933.
   5      10701.       4601.      15924.       7438.       7198.
   6       2164.       4981.       2927.       6894.       3078.
   7       1727.       1073.       2516.       1537.       2735.
   8       2782.        795.        754.       1055.        913.
   9        686.       1214.        418.        291.        465.
  10       1003.        558.        851.        419.        212.
 ====================================================================
 Total    90212.      88002.      80559.      64230.      50303.


 Mean Biomass


  AGE      1993        1994        1995        1996        1997

___________________________________________________________________________

   1       2497.       2709.       1404.       2929.       5151.
   2       6017.       8118.       5772.       3958.       6674.
   3      12205.       5035.       9035.       6545.       4055.
   4       3848.       6350.       3645.       8074.       4470.
   5       2020.       1442.       3062.       2033.       4377.
   6       2733.        834.        656.       1527.        937.
   7       1148.        851.        468.        382.        546.
   8        964.        338.        461.        260.        171.
   9        416.        222.        123.        190.        135.
  10        225.         71.         43.          4.         55.
 ====================================================================
 Total    32073.      25972.      24669.      25901.      26571.

  AGE      1998        1999        2000        2001        2002

___________________________________________________________________________

   1       2753.       5909.       2080.       1246.       1875.
   2      10492.       4927.      13108.       5439.       2157.
   3       6271.       9773.       5474.      11589.       4951.
   4       2992.       4392.       7975.       3478.       7275.
   5       2198.       1690.       2670.       4553.       1936.
   6       2318.       1092.        839.       1386.       2288.
   7        442.       1028.        568.        371.        662.
   8        141.        181.        441.        268.        167.
   9         89.         61.         62.        206.        124.
  10         48.         58.         23.         19.         96.
 ====================================================================
 Total    27742.      29111.      33240.      28556.      21530.
```

```
  AGE       2003        2004        2005        2006        2007


   1         792.       3240.        983.       2224.       2692.
   2        4402.       1589.       8070.       1971.       6434.
   3        2451.       5135.       1509.      12170.       2429.
   4        3014.       1837.       3996.       1236.      11066.
   5        3625.       1496.       1248.       2386.        758.
   6         855.       1494.        713.        737.       1357.
   7         870.        340.        634.        408.        578.
   8         262.        331.        141.        310.        239.
   9          56.        122.        134.         53.        173.
  10          32.         67.         72.         58.         33.
====================================================================
Total      16359.      15652.      17499.      21553.      25760.


Spawning Stock Biomass


  AGE       1978        1979        1980        1981        1982


   1         836.        853.        856.       1516.        656.
   2        1503.       6701.       7328.       6250.      10785.
   3       31517.       3803.      21975.      17270.      15480.
   4       18567.      37396.       4512.      22002.      16572.
   5        7977.      15051.      29814.       4352.      17410.
   6        5197.       7938.      11369.      19341.       3223.
   7        5990.       6042.       6175.       6557.      11284.
   8         594.       5667.       5289.       3026.       3402.
   9        1489.        407.       3145.       4219.       1655.
  10         565.       1575.        489.       2566.       2600.
====================================================================
Total      74235.      85433.      90951.      87101.      83067.

  AGE       1983        1984        1985        1986        1987


   1         393.       1230.       1035.       3133.       1306.
   2        5499.       3999.      10813.       4333.      19363.
   3       27649.      11557.       7748.      18717.       7186.
   4       13464.      22981.       9017.       4886.      17298.
   5       10409.       7522.      15813.       5460.       3771.
   6       10432.       6181.       4308.       8903.       3748.
   7        1769.       6347.       3385.       2121.       5890.
   8        5999.       1076.       3240.       1659.       1514.
   9        1627.       3567.        525.       1570.       1023.
  10        4135.       3591.       2170.        984.       1051.
====================================================================
Total      81375.      68051.      58056.      51766.      62150.
```

```
   AGE       1988         1989         1990         1991         1992

 ____________________________________________________________________________

    1        1725.         803.         371.        1107.         428.
    2        7815.        9691.        4488.        3631.        6593.
    3       32866.       14041.       19881.        9025.        7376.
    4        6676.       27186.       12810.       16603.        5337.
    5       12571.        4596.       18059.        8870.        8808.
    6        2606.        5910.        3262.        8779.        3750.
    7        2161.        1262.        2952.        1863.        3422.
    8        3457.         956.         756.        1336.         982.
    9         866.        1468.         488.         432.         572.
   10        1336.         701.        1107.         577.         292.
 ====================================================================
 Total      72080.       66616.       64173.       52224.       37560.

Spawning Stock Biomass

   AGE       1993         1994         1995         1996         1997

 ____________________________________________________________________________

    1          52.          69.          32.          90.         338.
    2        2434.        1779.        1922.        1098.        2453.
    3       12256.        4661.        7922.        5551.        3641.
    4        4703.        7228.        3604.        7844.        4921.
    5        2579.        1823.        3246.        2267.        5253.
    6        3498.         944.         645.        1829.        1187.
    7        1510.        1136.         494.         437.         758.
    8        1294.         465.         441.         309.         234.
    9         559.         328.         138.         258.         169.
   10         327.         106.          55.           5.          75.
 ====================================================================
 Total      29211.       18538.       18499.       19689.       19030.

   AGE       1998         1999         2000         2001         2002

 ____________________________________________________________________________

    1         175.         261.          83.          72.          81.
    2        3998.        1821.        4364.        1636.         683.
    3        5823.        9061.        4691.       11114.        4344.
    4        3107.        4601.        7819.        3982.        7954.
    5        2556.        1950.        2867.        5303.        2205.
    6        2564.        1251.         965.        1675.        2757.
    7         504.        1302.         656.         485.         805.
    8         192.         240.         524.         338.         198.
    9          97.          74.          79.         250.         151.
   10          63.          77.          29.          25.         128.
 ====================================================================
 Total      19078.       20637.       22078.       24880.       19308.
```

```
   AGE       2003         2004         2005         2006         2007

______________________________________________________________________________

    1          21.         137.          40.          61.          66.
    2         918.         412.        1781.         471.        1361.
    3        1878.        3798.        1243.        8025.        1902.
    4        3342.        1872.        4188.        1241.       10909.
    5        4426.        1740.        1341.        2744.         831.
    6        1064.        1799.         833.         842.        1532.
    7        1140.         434.         784.         440.         568.
    8         335.         422.         171.         363.         270.
    9          77.         148.         155.          67.         195.
   10          44.          91.          91.          72.          39.
 ===================================================================
 Total      13246.       10852.       10627.       14325.       17672.


Catch Biomass


   AGE       1978         1979         1980         1981         1982

______________________________________________________________________________

    1          88.         194.         219.         716.         499.
    2         522.        3060.        5991.        5636.       14565.
    3       19793.        1804.       14476.       11284.       11262.
    4        8279.       19626.        1932.        9478.       11116.
    5        3600.        5951.       13759.        1607.       10775.
    6        1016.        3228.        6633.       10268.        1954.
    7        1600.        1541.        3472.        3661.        6694.
    8         197.        3147.         699.        1596.        1935.
    9         418.         135.        1289.        2180.         968.
   10         149.         476.         212.        1115.        1322.
 ===================================================================
 Total      35661.       39162.       48682.       47542.       61088.

   AGE       1983         1984         1985         1986         1987

______________________________________________________________________________

    1         423.         152.         142.         518.          60.
    2        7442.        2320.       10313.        2163.       11683.
    3       20916.        8631.        6105.       11201.        3753.
    4        8984.       12207.        6287.        3106.        9053.
    5        5527.        4562.       10441.        2886.        1729.
    6        4812.        3672.        3197.        4414.        1944.
    7         803.        3935.        2203.         759.        2470.
    8        1867.         607.        2023.         700.         580.
    9         792.        1853.         326.         725.         435.
   10        1838.        1829.        1260.         405.         407.
 ===================================================================
 Total      53404.       39767.       42297.       26877.       32113.
```

```
  AGE       1988        1989        1990        1991        1992
_____________________________________________________________________________

   1         160.        388.         38.        183.        159.
   2        3244.       3746.       8282.       2983.       6900.
   3       19856.       6685.      13235.       8726.       5505.
   4        3766.      15879.       7018.      11124.       4067.
   5        8527.       1987.      11285.       6935.       6780.
   6        1518.       3506.       1476.       6337.       2708.
   7        1311.        646.       1928.       1034.       2522.
   8        2274.        511.        275.        842.        418.
   9         536.        679.        288.        264.        431.
  10         784.        312.        586.        381.        196.
====================================================================
Total      41977.      34339.      44412.      38810.      29685.

Catch Biomass

  AGE       1993        1994        1995        1996        1997
_____________________________________________________________________________

   1          85.         45.         13.         32.         68.
   2        2005.        736.        879.        414.       1003.
   3        9781.       3323.       2825.       2359.       1745.
   4        3953.       7043.       2492.       4086.       3516.
   5        2369.       2037.       2007.       1250.       3560.
   6        3117.        690.        306.       1194.        847.
   7        1313.       1049.        200.        145.        730.
   8        1258.        467.        244.        113.        153.
   9         480.        275.         76.        124.        115.
  10         259.         88.         27.          3.         47.
====================================================================
Total      24620.      15754.       9068.       9719.      11784.

  AGE       1998        1999        2000        2001        2002
_____________________________________________________________________________

   1          39.         25.         44.          7.         16.
   2        1316.        510.       1442.        983.        149.
   3        2963.       4321.       1768.       5900.       2490.
   4        1693.       2860.       3917.       2208.       4483.
   5        1763.       1302.       1437.       2865.       1443.
   6        1590.        738.        482.        950.       1916.
   7         297.        955.        324.        328.        548.
   8         124.        187.        311.        198.        150.
   9          66.         48.         34.        134.         98.
  10          36.         45.         13.         13.         76.
====================================================================
Total       9888.      10991.       9771.      13584.      11369.
```

```
   AGE       2003         2004         2005         2006         2007

 ____________________________________________________________________________

     1          10.          17.           5.          12.           4.
     2         293.         106.         377.          75.         747.
     3         911.        1027.         424.        1764.         758.
     4        2328.         801.        1775.         647.        3408.
     5        3520.        1218.         579.        1347.         261.
     6         735.        1221.         522.         321.         539.
     7         824.         329.         466.         202.          96.
     8         195.         363.         135.         182.          72.
     9          54.         101.          78.          29.          60.
    10          30.          56.          42.          31.          10.
  ===================================================================
  Total       8900.        5238.        4403.        4610.        5955.


Catch Numbers


   AGE       1978         1979         1980         1981         1982

 ____________________________________________________________________________

     1        151.6        279.2        339.9       1219.2        775.4
     2        416.8       2242.7       4238.7       3910.7      10457.1
     3       8109.1        953.6       5955.4       4738.2       4434.4
     4       2429.6       4585.0        544.9       2685.5       2988.0
     5        896.8       1206.9       2464.6        317.9       2039.8
     6        178.4        449.8        983.0       1406.0        297.1
     7        240.8        159.5        418.1        417.0        707.2
     8         22.6        304.1         70.4        162.9        198.6
     9         42.1         12.9        138.7        155.5         74.6
    10         10.7         35.0         14.2         66.4         84.6
  ===================================================================
  Total     12498.5      10228.7      15167.9      15079.3      22056.8

   AGE       1983         1984         1985         1986         1987

 ____________________________________________________________________________

     1        626.2        280.9        176.0        768.3        103.8
     2       5181.7       1547.7       7443.7       1594.1       7956.1
     3       8753.3       3485.7       2942.2       4576.3       1515.5
     4       2680.4       3328.4       1690.1        860.2       2170.1
     5       1155.3        923.9       2097.7        525.3        299.7
     6        746.4        560.2        496.5        615.4        249.9
     7         94.6        450.3        267.2         85.5        277.3
     8        175.0         58.9        196.8         70.4         56.1
     9         67.7        167.0         27.7         56.0         36.2
    10        112.6        124.9         89.7         27.8         26.0
  ===================================================================
  Total     19593.2      10927.9      15427.6       9179.3      12690.7
```

```
  AGE       1988        1989        1990        1991        1992

 1        324.9       891.5        71.8       278.7       191.7
 2       2352.1      2608.6      5561.1      1963.0      4808.4
 3       8368.3      3032.8      5373.4      3491.4      2286.3
 4       1074.1      4254.4      1964.0      3160.5      1070.7
 5       1575.6       383.5      2272.1      1442.1      1500.0
 6        223.8       534.2       230.6      1088.0       448.1
 7        150.3        81.4       229.4       141.3       356.0
 8        218.0        51.2        24.6        89.7        44.1
 9         46.5        60.2        23.2        27.5        36.4
10         52.5        21.3        40.4        26.0        10.4
===================================================================
Total   14386.1     11919.1     15790.6     11708.2     10752.1
```

```
Catch Numbers

  AGE       1993        1994        1995        1996        1997

 1        299.2        94.4        32.3        64.9       126.9
 2       1534.9       614.6       652.8       287.3       685.2
 3       4429.4      1543.4      1429.0       986.6       749.6
 4       1224.8      1987.7       669.9      1269.8      1020.7
 5        475.3       425.6       382.3       256.3       882.9
 6        535.6        97.6        41.2       183.8       147.7
 7        178.0       146.2        21.4        17.9        94.4
 8        141.0        51.2        20.0        11.6        18.9
 9         43.1        30.5         6.4        11.3        10.1
10         21.2         5.6         1.4         0.3         3.9
===================================================================
Total    8882.5      4996.8      3256.7      3089.8      3740.3

  AGE       1998        1999        2000        2001        2002

 1         63.3        47.7       113.5        11.7        33.6
 2        918.9       356.3       943.2       719.8       113.0
 3       1310.3      2021.8       741.1      2667.3      1182.7
 4        494.3       852.6      1156.4       751.6      1516.2
 5        385.6       286.6       315.8       698.7       365.4
 6        285.2       125.8        88.0       180.4       371.5
 7         40.2       143.8        46.3        54.8        84.7
 8         16.0        22.2        38.8        25.8        18.7
 9          5.6         5.0         4.2        14.8        10.6
10          2.9         3.4         1.0         1.3         6.5
===================================================================
Total    3522.3      3865.2      3448.3      5126.2      3702.9
```

```
   AGE       2003         2004         2005         2006         2007
____________________________________________________________________________

    1         17.0         50.5         12.3         32.8         10.6
    2        201.3         69.4        364.1         69.7        526.1
    3        404.4        434.3        201.8        842.8        395.2
    4        800.7        260.1        578.4        208.3       1175.8
    5        910.4        313.6        144.5        366.1         71.9
    6        156.0        253.0        106.0         70.8        129.2
    7        142.4         58.2         85.3         31.2         16.2
    8         28.2         49.2         18.0         28.5         10.4
    9          6.5         11.8          8.9          3.8          8.6
   10          2.9          5.0          3.7          3.4          1.1
 ===================================================================
 Total      2669.8       1505.2       1523.0       1657.4       2345.1


               Surplus Production

     Average Adjustment Factor (Delta) =   1.0000

 Year        Biomass  Delta Biomass  Catch Biomass  Surplus Production

 1978     107771.534      15077.374      35660.721      50738.095
 1979     122848.908       7864.015      39162.286      47026.301
 1980     130712.922         50.259      48682.434      48732.693
 1981     130763.181      -1207.795      47541.857      46334.062
 1982     129555.386     -17271.699      61088.247      43816.548
 1983     112283.687     -19362.224      53404.330      34042.106
 1984      92921.463     -11213.858      39767.136      28553.278
 1985      81707.605      -1272.252      42297.434      41025.182
 1986      80435.353       9628.743      26876.781      36505.524
 1987      90064.095       6272.358      32112.683      38385.042
 1988      96336.453      -9637.788      41976.636      32338.849
 1989      86698.666       -204.079      34338.791      34134.713
 1990      86494.587     -12018.713      44411.969      32393.257
 1991      74475.874     -16620.379      38810.185      22189.806
 1992      57855.495     -16685.545      29684.877      12999.332
 1993      41169.950     -13880.833      24620.033      10739.201
 1994      27289.117      -3500.057      15754.070      12254.013
 1995      23789.060       1610.467       9068.146      10678.613
 1996      25399.527       2030.589       9718.713      11749.303
 1997      27430.116       -430.234      11784.450      11354.216
 1998      26999.882       2599.052       9887.960      12487.012
 1999      29598.934        684.951      10991.218      11676.169
 2000      30283.885       1529.855       9770.992      11300.847
 2001      31813.740      -6809.653      13584.079       6774.425
 2002      25004.087      -6506.016      11369.031       4863.015
 2003      18498.071      -2794.267       8900.391       6106.124
 2004      15703.804        394.698       5237.603       5632.301
 2005      16098.502       3237.519       4402.945       7640.464
 2006      19336.021       4326.664       4610.067       8936.731
 2007      23662.684       3652.084       5955.462       9607.545
 2008      27314.768
```

```
 Summary of Survey Indices Used in the Estimate
 INDEX    Survey Tag    Age   Time  Type  Catchability Std. Error   CV
___________________________________________________________________________
   1         spr_36pr    1   JAN-1 NUMBER  0.1784E-01  0.6011E-02  0.3370E+00
   2         spr_36pr    2   JAN-1 NUMBER  0.9185E-01  0.1112E-01  0.1210E+00
   3         spr_36pr    3   JAN-1 NUMBER  0.1687E+00  0.3031E-01  0.1797E+00
   4         spr_36pr    4   JAN-1 NUMBER  0.2156E+00  0.4330E-01  0.2008E+00
   5         spr_36pr    5   JAN-1 NUMBER  0.2642E+00  0.5941E-01  0.2248E+00
   6         spr_36pr    6   JAN-1 NUMBER  0.2787E+00  0.5238E-01  0.1880E+00
   7         spr_36pr    7   JAN-1 NUMBER  0.2976E+00  0.5275E-01  0.1773E+00
   8         spr_36pr    8   JAN-1 NUMBER  0.3631E+00  0.7104E-01  0.1957E+00
   9         spr_36po    1   JAN-1 NUMBER  0.2930E-01  0.6283E-02  0.2145E+00
  10         spr_36po    2   JAN-1 NUMBER  0.1011E+00  0.9212E-02  0.9107E-01
  11         spr_36po    3   JAN-1 NUMBER  0.2253E+00  0.2569E-01  0.1140E+00
  12         spr_36po    4   JAN-1 NUMBER  0.5063E+00  0.8675E-01  0.1714E+00
  13         spr_36po    5   JAN-1 NUMBER  0.6888E+00  0.1139E+00  0.1654E+00
  14         spr_36po    6   JAN-1 NUMBER  0.7018E+00  0.1226E+00  0.1747E+00
  15         spr_36po    7   JAN-1 NUMBER  0.7231E+00  0.1815E+00  0.2510E+00
  16         spr_36po    8   JAN-1 NUMBER  0.8168E+00  0.1743E+00  0.2134E+00
  17         spr_41      1   JAN-1 NUMBER  0.1413E-01  0.1069E-01  0.7560E+00
  18         spr_41      2   JAN-1 NUMBER  0.8999E-01  0.2087E-01  0.2319E+00
  19         spr_41      3   JAN-1 NUMBER  0.1987E+00  0.4671E-01  0.2350E+00
  20         spr_41      4   JAN-1 NUMBER  0.1773E+00  0.2236E-01  0.1261E+00
  21         spr_41      5   JAN-1 NUMBER  0.2163E+00  0.5405E-01  0.2499E+00
  22         spr_41      6   JAN-1 NUMBER  0.2077E+00  0.3557E-01  0.1713E+00
  23         spr_41      7   JAN-1 NUMBER  0.3002E+00  0.1126E+00  0.3750E+00
  24         spr_41      8   JAN-1 NUMBER  0.2915E+00  0.1651E+00  0.5663E+00
  25         sp_can_p    1   JAN-1 NUMBER  0.3588E-01  0.1150E-01  0.3205E+00
  26         sp_can_p    2   JAN-1 NUMBER  0.1876E+00  0.3961E-01  0.2112E+00
  27         sp_can_p    3   JAN-1 NUMBER  0.3247E+00  0.3702E-01  0.1140E+00
  28         sp_can_p    4   JAN-1 NUMBER  0.3721E+00  0.4750E-01  0.1277E+00
  29         sp_can_p    5   JAN-1 NUMBER  0.5808E+00  0.7103E-01  0.1223E+00
  30         sp_can_p    6   JAN-1 NUMBER  0.5559E+00  0.1150E+00  0.2068E+00
  31         sp_can_p    7   JAN-1 NUMBER  0.7300E+00  0.2118E+00  0.2902E+00
  32         sp_can_p    8   JAN-1 NUMBER  0.6448E-03  0.1711E-03  0.2653E+00
  33         sp_canpo    1   JAN-1 NUMBER  0.1586E-01  0.5673E-02  0.3576E+00
  34         sp_canpo    2   JAN-1 NUMBER  0.7794E-01  0.2001E-01  0.2567E+00
  35         sp_canpo    3   JAN-1 NUMBER  0.3626E+00  0.5277E-01  0.1455E+00
  36         sp_canpo    4   JAN-1 NUMBER  0.8883E+00  0.1309E+00  0.1473E+00
  37         sp_canpo    5   JAN-1 NUMBER  0.1408E+01  0.1994E+00  0.1416E+00
  38         sp_canpo    6   JAN-1 NUMBER  0.1934E+01  0.2942E+00  0.1521E+00
  39         sp_canpo    7   JAN-1 NUMBER  0.1901E+01  0.3915E+00  0.2059E+00
  40         sp_canpo    8   JAN-1 NUMBER  0.1278E-02  0.3201E-03  0.2505E+00
  41         us0autpr    1   JAN-1 NUMBER  0.1638E-01  0.3271E-02  0.1998E+00
  42         us1autpr    2   JAN-1 NUMBER  0.8110E-01  0.1148E-01  0.1415E+00
  43         us2autpr    3   JAN-1 NUMBER  0.1191E+00  0.1798E-01  0.1510E+00
  44         us3autpr    4   JAN-1 NUMBER  0.1269E+00  0.2259E-01  0.1779E+00
  45         us4autpr    5   JAN-1 NUMBER  0.8865E-01  0.2152E-01  0.2428E+00
  46         us5autpr    6   JAN-1 NUMBER  0.1041E+00  0.1621E-01  0.1557E+00
  47         us0autpo    1   JAN-1 NUMBER  0.2015E-01  0.8594E-02  0.4264E+00
  48         us1autpo    2   JAN-1 NUMBER  0.7415E-01  0.1521E-01  0.2051E+00
  49         us2autpo    3   JAN-1 NUMBER  0.1630E+00  0.3016E-01  0.1850E+00
  50         us3autpo    4   JAN-1 NUMBER  0.2333E+00  0.5204E-01  0.2231E+00
  51         us4autpo    5   JAN-1 NUMBER  0.2120E+00  0.5110E-01  0.2410E+00
  52         us5autpo    6   JAN-1 NUMBER  0.2530E+00  0.6462E-01  0.2554E+00
```

```
Survey Index:    1 Tag:         spr_36pr AGE =  1
Time = JAN-1           Type = NUMBER
Catchability =    0.178394E-01   % Variance Contribution =     5.4693
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
```

---

```
1978     N/A              0.512080E+03     N/A
1979     N/A              0.462799E+03     N/A
1980     N/A              0.408763E+03     N/A
1981     N/A              0.818660E+03     N/A
1982     0.693828E+03     0.354341E+03     0.671963E+00
1983     0.452853E+03     0.201680E+03     0.808885E+00
1984     0.549434E+03     0.517710E+03     0.594732E-01
1985     0.151770E+03     0.171530E+03    -0.122390E+00
1986     0.119053E+04     0.793951E+03     0.405134E+00
1987     0.269116E+02     0.319290E+03    -0.247354E+01
1988     0.983845E+03     0.443386E+03     0.797027E+00
1989     0.424029E+03     0.318410E+03     0.286461E+00
1990     0.236877E+03     0.182036E+03     0.263334E+00
1991     0.140241E+04     0.353152E+03     0.137905E+01
1992     0.167617E+03     0.133256E+03     0.229412E+00
1993     0.116116E+02     0.176095E+03    -0.271902E+01
1994     0.170486E+03     0.112667E+03     0.414217E+00
1995     N/A              0.700245E+02     N/A
1996     N/A              0.119086E+03     N/A
1997     N/A              0.189472E+03     N/A
1998     N/A              0.882021E+02     N/A
1999     N/A              0.218245E+03     N/A
2000     N/A              0.106623E+03     N/A
2001     N/A              0.409422E+02     N/A
2002     N/A              0.756296E+02     N/A
2003     N/A              0.260685E+02     N/A
2004     N/A              0.192693E+03     N/A
2005     N/A              0.450014E+02     N/A
2006     N/A              0.115776E+03     N/A
2007     N/A              0.125534E+03     N/A
2008     N/A              0.869611E+02     N/A

Survey Index:    2 Tag:         spr_36pr AGE =  2
Time = JAN-1           Type = NUMBER
Catchability =    0.918544E-01   % Variance Contribution =     0.7054
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
```

---

```
1978     N/A              0.432354E+03     N/A
1979     N/A              0.214616E+04     N/A
1980     N/A              0.192782E+04     N/A
1981     N/A              0.169499E+04     N/A
1982     0.742514E+04     0.335004E+04     0.795899E+00
1983     0.266630E+04     0.142948E+04     0.623383E+00
```

```
1984     0.588777E+03     0.798301E+03    -0.304439E+00
1985     0.362432E+04     0.215916E+04     0.517947E+00
1986     0.558723E+03     0.708508E+03    -0.237507E+00
1987     0.220279E+04     0.328326E+04    -0.399113E+00
1988     0.831664E+03     0.133739E+04    -0.475049E+00
1989     0.192671E+04     0.184219E+04     0.448548E-01
1990     0.125883E+04     0.126839E+04    -0.756392E-02
1991     0.721013E+03     0.761439E+03    -0.545535E-01
1992     0.171087E+04     0.146564E+04     0.154711E+00
1993     0.544789E+03     0.545856E+03    -0.195628E-02
1994     0.372118E+03     0.717536E+03    -0.656613E+00
1995     N/A              0.467129E+03     N/A
1996     N/A              0.292517E+03     N/A
1997     N/A              0.496638E+03     N/A
1998     N/A              0.788213E+03     N/A
1999     N/A              0.366575E+03     N/A
2000     N/A              0.916079E+03     N/A
2001     N/A              0.440068E+03     N/A
2002     N/A              0.171626E+03     N/A
2003     N/A              0.316038E+03     N/A
2004     N/A              0.108484E+03     N/A
2005     N/A              0.808129E+03     N/A
2006     N/A              0.188688E+03     N/A
2007     N/A              0.485344E+03     N/A
2008     N/A              0.528324E+03     N/A

Survey Index:    3 Tag:         spr_36pr AGE =  3
Time = JAN-1           Type = NUMBER
Catchability =    0.168705E+00   % Variance Contribution =     1.5548
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual


1978     N/A              0.427374E+04     N/A
1979     N/A              0.586731E+03     N/A
1980     N/A              0.288609E+04     N/A
1981     N/A              0.225564E+04     N/A
1982     0.129803E+05     0.195545E+04     0.189281E+01
1983     0.412144E+04     0.345387E+04     0.176706E+00
1984     0.103917E+04     0.136578E+04    -0.273301E+00
1985     0.906115E+03     0.965416E+03    -0.633923E-01
1986     0.251958E+04     0.212038E+04     0.172498E+00
1987     0.516921E+03     0.823504E+03    -0.465678E+00
1988     0.430258E+04     0.373028E+04     0.142731E+00
1989     0.910350E+03     0.165379E+04    -0.596994E+00
1990     0.237300E+04     0.237364E+04    -0.267003E-03
1991     0.940813E+03     0.106790E+04    -0.126708E+00
1992     0.639595E+03     0.847334E+03    -0.281260E+00
1993     0.178423E+04     0.147599E+04     0.189657E+00
1994     0.273214E+03     0.588195E+03    -0.766803E+00
1995     N/A              0.985457E+03     N/A
1996     N/A              0.603202E+03     N/A
1997     N/A              0.396158E+03     N/A
1998     N/A              0.642647E+03     N/A
1999     N/A              0.104551E+04     N/A
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2000     N/A              0.497023E+03     N/A
2001     N/A              0.123406E+04     N/A
2002     N/A              0.552376E+03     N/A
2003     N/A              0.240878E+03     N/A
2004     N/A              0.444591E+03     N/A
2005     N/A              0.152560E+03     N/A
2006     N/A              0.115976E+04     N/A
2007     N/A              0.273120E+03     N/A
2008     N/A              0.649804E+03     N/A

Survey Index:    4 Tag:         spr_36pr AGE =  4
Time = JAN-1           Type = NUMBER
Catchability =    0.215614E+00   % Variance Contribution =     1.9428
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual

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1978     N/A              0.165169E+04     N/A
1979     N/A              0.290382E+04     N/A
1980     N/A              0.429311E+03     N/A
1981     N/A              0.186919E+04     N/A
1982     0.113717E+05     0.144487E+04     0.206311E+01
1983     0.108767E+04     0.119016E+04    -0.900524E-01
1984     0.169147E+04     0.192678E+04    -0.130253E+00
1985     0.151675E+04     0.757288E+03     0.694581E+00
1986     0.498889E+03     0.444800E+03     0.114761E+00
1987     0.104272E+04     0.133486E+04    -0.246992E+00
1988     0.558450E+03     0.568553E+03    -0.179289E-01
1989     0.216263E+04     0.228773E+04    -0.562382E-01
1990     0.921005E+03     0.114383E+04    -0.216675E+00
1991     0.126894E+04     0.144646E+04    -0.130936E+00
1992     0.229637E+03     0.447514E+03    -0.667209E+00
1993     0.280454E+03     0.446337E+03    -0.464662E+00
1994     0.295755E+03     0.693005E+03    -0.851508E+00
1995     N/A              0.318120E+03     N/A
1996     N/A              0.754280E+03     N/A
1997     N/A              0.440166E+03     N/A
1998     N/A              0.269571E+03     N/A
1999     N/A              0.419235E+03     N/A
2000     N/A              0.703092E+03     N/A
2001     N/A              0.376504E+03     N/A
2002     N/A              0.776139E+03     N/A
2003     N/A              0.349550E+03     N/A
2004     N/A              0.173769E+03     N/A
2005     N/A              0.380896E+03     N/A
2006     N/A              0.120515E+03     N/A
2007     N/A              0.104980E+04     N/A
2008     N/A              0.209212E+03     N/A

Survey Index:    5 Tag:         spr_36pr AGE =  5
Time = JAN-1           Type = NUMBER
Catchability =    0.264241E+00   % Variance Contribution =     2.4352
Residual = LN(Observed) - LN(Predicted)
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Year      Observed        Predicted        Residual



1978     N/A              0.783962E+03     N/A
1979     N/A              0.108141E+04     N/A
1980     N/A              0.182761E+04     N/A
1981     N/A              0.301462E+03     N/A
1982     0.848057E+04     0.123887E+04     0.192358E+01
1983     0.952152E+03     0.744309E+03     0.246268E+00
1984     0.576892E+03     0.562246E+03     0.257159E-01
1985     0.192930E+04     0.114565E+04     0.521187E+00
1986     0.737679E+03     0.361323E+03     0.713735E+00
1987     0.848330E+02     0.243023E+03    -0.105247E+01
1988     0.879067E+03     0.825502E+03     0.628697E-01
1989     0.321163E+03     0.316568E+03     0.144114E-01
1990     0.124572E+04     0.128957E+04    -0.345941E-01
1991     0.654075E+03     0.682901E+03    -0.431286E-01
1992     0.372801E+03     0.705838E+03    -0.638342E+00
1993     0.122263E+03     0.196884E+03    -0.476439E+00
1994     0.453536E+02     0.160338E+03    -0.126279E+01
1995     N/A              0.229354E+03     N/A
1996     N/A              0.161082E+03     N/A
1997     N/A              0.456255E+03     N/A
1998     N/A              0.201140E+03     N/A
1999     N/A              0.153590E+03     N/A
2000     N/A              0.219310E+03     N/A
2001     N/A              0.431670E+03     N/A
2002     N/A              0.200239E+03     N/A
2003     N/A              0.420507E+03     N/A
2004     N/A              0.162015E+03     N/A
2005     N/A              0.112715E+03     N/A
2006     N/A              0.245131E+03     N/A
2007     N/A              0.716297E+02     N/A
2008     N/A              0.774113E+03     N/A

Survey Index:    6 Tag:         spr_36pr AGE =  6
Time = JAN-1           Type = NUMBER
Catchability =    0.278657E+00   % Variance Contribution =     1.7018
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted        Residual



1978     N/A              0.352174E+03     N/A
1979     N/A              0.452630E+03     N/A
1980     N/A              0.631851E+03     N/A
1981     N/A              0.962621E+03     N/A
1982     0.400122E+03     0.180743E+03     0.794694E+00
1983     0.605306E+03     0.561605E+03     0.749358E-01
1984     0.546975E+03     0.354663E+03     0.433234E+00
1985     0.362555E+03     0.255329E+03     0.350623E+00
1986     0.844096E+03     0.467585E+03     0.590685E+00
1987     0.245073E+03     0.180923E+03     0.303486E+00
1988     0.874286E+02     0.134935E+03    -0.433971E+00
1989     0.479628E+03     0.321282E+03     0.400691E+00
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1990     0.178136E+03     0.177478E+03     0.369799E-02
1991     0.448208E+03     0.548113E+03    -0.201224E+00
1992     0.194529E+03     0.232101E+03    -0.176592E+00
1993     0.188791E+03     0.237606E+03    -0.229974E+00
1994     0.778660E+01     0.525986E+02    -0.191029E+01
1995     N/A              0.337007E+02     N/A
1996     N/A              0.102825E+03     N/A
1997     N/A              0.752134E+02     N/A
1998     N/A              0.174633E+03     N/A
1999     N/A              0.778703E+02     N/A
2000     N/A              0.613743E+02     N/A
2001     N/A              0.110563E+03     N/A
2002     N/A              0.198643E+03     N/A
2003     N/A              0.820283E+02     N/A
2004     N/A              0.137503E+03     N/A
2005     N/A              0.620035E+02     N/A
2006     N/A              0.612222E+02     N/A
2007     N/A              0.120347E+03     N/A
2008     N/A              0.438493E+02     N/A

Survey Index:    7 Tag:         spr_36pr AGE =  7
Time = JAN-1           Type = NUMBER
Catchability =    0.297561E+00   % Variance Contribution =     1.5138
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual

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1978     N/A              0.360604E+03     N/A
1979     N/A              0.260077E+03     N/A
1980     N/A              0.275541E+03     N/A
1981     N/A              0.290962E+03     N/A
1982     0.254868E+04     0.467318E+03     0.169632E+01
1983     0.371571E+02     0.790646E+02    -0.755111E+00
1984     0.285236E+03     0.292082E+03    -0.237182E-01
1985     0.262149E+03     0.161109E+03     0.486832E+00
1986     0.842866E+02     0.916993E+02    -0.842922E-01
1987     0.185103E+03     0.244776E+03    -0.279434E+00
1988     0.505446E+02     0.916073E+02    -0.594655E+00
1989     0.689866E+02     0.585039E+02     0.164819E+00
1990     0.195485E+03     0.138951E+03     0.341362E+00
1991     0.739045E+02     0.936948E+02    -0.237269E+00
1992     0.216796E+03     0.191112E+03     0.126092E+00
1993     0.400259E+02     0.841940E+02    -0.743597E+00
1994     0.602438E+02     0.664035E+02    -0.973499E-01
1995     N/A              0.201046E+02     N/A
1996     N/A              0.184744E+02     N/A
1997     N/A              0.411231E+02     N/A
1998     N/A              0.266383E+02     N/A
1999     N/A              0.768777E+02     N/A
2000     N/A              0.346396E+02     N/A
2001     N/A              0.302269E+02     N/A
2002     N/A              0.487155E+02     N/A
2003     N/A              0.751719E+02     N/A
2004     N/A              0.303690E+02     N/A
2005     N/A              0.531161E+02     N/A
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2006     N/A              0.260568E+02     N/A
2007     N/A              0.346308E+02     N/A
2008     N/A              0.707155E+02     N/A

Survey Index:    8 Tag:         spr_36pr AGE =  8
Time = JAN-1           Type = NUMBER
Catchability =    0.363074E+00   % Variance Contribution =     1.3004
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
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1978     N/A              0.297623E+02     N/A
1979     N/A              0.281585E+03     N/A
1980     N/A              0.207696E+03     N/A
1981     N/A              0.139660E+03     N/A
1982     0.503397E+03     0.155309E+03     0.117597E+01
1983     0.298623E+03     0.237470E+03     0.229141E+00
1984     N/A              0.482106E+02     N/A
1985     0.245756E+03     0.145777E+03     0.522261E+00
1986     0.170895E+03     0.744148E+02     0.831398E+00
1987     0.448071E+02     0.637330E+02    -0.352336E+00
1988     0.672107E+02     0.154272E+03    -0.830886E+00
1989     0.539598E+02     0.428313E+02     0.230971E+00
1990     0.176223E+02     0.320115E+02    -0.596931E+00
1991     0.554625E+02     0.645142E+02    -0.151178E+00
1992     0.267750E+02     0.477680E+02    -0.578887E+00
1993     0.469929E+02     0.759075E+02    -0.479519E+00
1994     N/A              0.268018E+02     N/A
1995     N/A              0.193318E+02     N/A
1996     N/A              0.131150E+02     N/A
1997     N/A              0.126219E+02     N/A
1998     N/A              0.107794E+02     N/A
1999     N/A              0.135722E+02     N/A
2000     N/A              0.303475E+02     N/A
2001     N/A              0.195617E+02     N/A
2002     N/A              0.124814E+02     N/A
2003     N/A              0.212615E+02     N/A
2004     N/A              0.291097E+02     N/A
2005     N/A              0.115453E+02     N/A
2006     N/A              0.254226E+02     N/A
2007     N/A              0.158810E+02     N/A
2008     N/A              0.292973E+02     N/A

Survey Index:    9 Tag:         spr_36po AGE =  1
Time = JAN-1           Type = NUMBER
Catchability =    0.292985E-01   % Variance Contribution =     2.5848
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
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1978     N/A              0.841015E+03     N/A
1979     N/A              0.760078E+03     N/A
1980     N/A              0.671332E+03     N/A
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1981     N/A              0.134453E+04     N/A
1982     N/A              0.581953E+03     N/A
1983     N/A              0.331229E+03     N/A
1984     N/A              0.850261E+03     N/A
1985     N/A              0.281713E+03     N/A
1986     N/A              0.130394E+04     N/A
1987     N/A              0.524386E+03     N/A
1988     N/A              0.728195E+03     N/A
1989     N/A              0.522941E+03     N/A
1990     N/A              0.298967E+03     N/A
1991     N/A              0.580000E+03     N/A
1992     N/A              0.218852E+03     N/A
1993     N/A              0.289209E+03     N/A
1994     N/A              0.185038E+03     N/A
1995     0.676205E+02     0.115005E+03    -0.531063E+00
1996     0.997232E+02     0.195581E+03    -0.673578E+00
1997     0.397254E+03     0.311179E+03     0.244207E+00
1998     0.152044E+03     0.144859E+03     0.484103E-01
1999     0.290017E+03     0.358434E+03    -0.211806E+00
2000     0.301492E+03     0.175112E+03     0.543315E+00
2001     0.829205E+02     0.672415E+02     0.209592E+00
2002     0.883848E+02     0.124210E+03    -0.340275E+00
2003     0.224036E+02     0.428135E+02    -0.647632E+00
2004     0.870051E+03     0.316469E+03     0.101133E+01
2005     0.162563E+02     0.739080E+02    -0.151434E+01
2006     0.243980E+03     0.190144E+03     0.249306E+00
2007     0.170895E+03     0.206171E+03    -0.187652E+00
2008     0.864177E+03     0.142821E+03     0.180019E+01

Survey Index:   10 Tag:         spr_36po AGE =  2
Time = JAN-1           Type = NUMBER
Catchability =    0.101150E+00   % Variance Contribution =     0.4661
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual

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1978     N/A              0.476107E+03     N/A
1979     N/A              0.236334E+04     N/A
1980     N/A              0.212291E+04     N/A
1981     N/A              0.186652E+04     N/A
1982     N/A              0.368906E+04     N/A
1983     N/A              0.157414E+04     N/A
1984     N/A              0.879087E+03     N/A
1985     N/A              0.237767E+04     N/A
1986     N/A              0.780207E+03     N/A
1987     N/A              0.361552E+04     N/A
1988     N/A              0.147273E+04     N/A
1989     N/A              0.202862E+04     N/A
1990     N/A              0.139675E+04     N/A
1991     N/A              0.838494E+03     N/A
1992     N/A              0.161396E+04     N/A
1993     N/A              0.601095E+03     N/A
1994     N/A              0.790149E+03     N/A
1995     0.521429E+03     0.514402E+03     0.135697E-01
1996     0.292203E+03     0.322119E+03    -0.974731E-01
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1997     0.597110E+03     0.546897E+03     0.878413E-01
1998     0.908711E+03     0.867978E+03     0.458604E-01
1999     0.397390E+03     0.403671E+03    -0.156827E-01
2000     0.110187E+04     0.100878E+04     0.882662E-01
2001     0.320480E+03     0.484602E+03    -0.413506E+00
2002     0.126908E+03     0.188994E+03    -0.398254E+00
2003     0.290700E+03     0.348020E+03    -0.179968E+00
2004     0.792321E+02     0.119463E+03    -0.410622E+00
2005     0.660905E+03     0.889910E+03    -0.297509E+00
2006     0.315562E+03     0.207783E+03     0.417864E+00
2007     0.872783E+03     0.534460E+03     0.490430E+00
2008     0.113603E+04     0.581788E+03     0.669184E+00

Survey Index:   11 Tag:         spr_36po AGE =  3
Time = JAN-1           Type = NUMBER
Catchability =    0.225276E+00   % Variance Contribution =     0.7310
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual


1978     N/A              0.570683E+04     N/A
1979     N/A              0.783476E+03     N/A
1980     N/A              0.385386E+04     N/A
1981     N/A              0.301201E+04     N/A
1982     N/A              0.261116E+04     N/A
1983     N/A              0.461204E+04     N/A
1984     N/A              0.182376E+04     N/A
1985     N/A              0.128914E+04     N/A
1986     N/A              0.283139E+04     N/A
1987     N/A              0.109964E+04     N/A
1988     N/A              0.498113E+04     N/A
1989     N/A              0.220834E+04     N/A
1990     N/A              0.316957E+04     N/A
1991     N/A              0.142600E+04     N/A
1992     N/A              0.113146E+04     N/A
1993     N/A              0.197092E+04     N/A
1994     N/A              0.785431E+03     N/A
1995     0.116649E+04     0.131590E+04    -0.120526E+00
1996     0.100570E+04     0.805470E+03     0.222014E+00
1997     0.232505E+03     0.529000E+03    -0.822074E+00
1998     0.177316E+04     0.858141E+03     0.725750E+00
1999     0.831938E+03     0.139610E+04    -0.517678E+00
2000     0.113357E+04     0.663687E+03     0.535313E+00
2001     0.108425E+04     0.164786E+04    -0.418590E+00
2002     0.523615E+03     0.737601E+03    -0.342645E+00
2003     0.370479E+03     0.321650E+03     0.141333E+00
2004     0.790819E+03     0.593673E+03     0.286740E+00
2005     0.188245E+03     0.203717E+03    -0.789908E-01
2006     0.178395E+04     0.154866E+04     0.141444E+00
2007     0.513096E+03     0.364704E+03     0.341379E+00
2008     0.790272E+03     0.867699E+03    -0.934675E-01

Survey Index:   12 Tag:         spr_36po AGE =  4
Time = JAN-1           Type = NUMBER
Catchability =    0.506259E+00   % Variance Contribution =     1.6502
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Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual


1978     N/A              0.387814E+04     N/A
1979     N/A              0.681812E+04     N/A
1980     N/A              0.100802E+04     N/A
1981     N/A              0.438883E+04     N/A
1982     N/A              0.339252E+04     N/A
1983     N/A              0.279447E+04     N/A
1984     N/A              0.452405E+04     N/A
1985     N/A              0.177810E+04     N/A
1986     N/A              0.104438E+04     N/A
1987     N/A              0.313423E+04     N/A
1988     N/A              0.133495E+04     N/A
1989     N/A              0.537156E+04     N/A
1990     N/A              0.268570E+04     N/A
1991     N/A              0.339627E+04     N/A
1992     N/A              0.105076E+04     N/A
1993     N/A              0.104799E+04     N/A
1994     N/A              0.162716E+04     N/A
1995     0.729482E+03     0.746942E+03    -0.236520E-01
1996     0.170376E+04     0.177104E+04    -0.387246E-01
1997     0.667462E+03     0.103350E+04    -0.437225E+00
1998     0.115816E+04     0.632947E+03     0.604197E+00
1999     0.696287E+03     0.984357E+03    -0.346227E+00
2000     0.155882E+04     0.165085E+04    -0.573575E-01
2001     0.218845E+03     0.884026E+03    -0.139612E+01
2002     0.135651E+04     0.182236E+04    -0.295219E+00
2003     0.850380E+03     0.820738E+03     0.354789E-01
2004     0.192138E+04     0.408008E+03     0.154951E+01
2005     0.861991E+03     0.894338E+03    -0.368391E-01
2006     0.453399E+03     0.282967E+03     0.471443E+00
2007     0.245032E+04     0.246491E+04    -0.593506E-02
2008     0.479901E+03     0.491227E+03    -0.233271E-01

Survey Index:   13 Tag:         spr_36po AGE =  5
Time = JAN-1           Type = NUMBER
Catchability =    0.688799E+00   % Variance Contribution =     1.5379
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual


1978     N/A              0.204356E+04     N/A
1979     N/A              0.281893E+04     N/A
1980     N/A              0.476405E+04     N/A
1981     N/A              0.785824E+03     N/A
1982     N/A              0.322937E+04     N/A
1983     N/A              0.194020E+04     N/A
1984     N/A              0.146561E+04     N/A
1985     N/A              0.298637E+04     N/A
1986     N/A              0.941864E+03     N/A
1987     N/A              0.633490E+03     N/A
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1988     N/A               0.215184E+04     N/A
1989     N/A               0.825201E+03     N/A
1990     N/A               0.336153E+04     N/A
1991     N/A               0.178012E+04     N/A
1992     N/A               0.183991E+04     N/A
1993     N/A               0.513220E+03     N/A
1994     N/A               0.417953E+03     N/A
1995     0.818277E+03      0.597858E+03     0.313847E+00
1996     0.237970E+03      0.419894E+03    -0.567859E+00
1997     0.576892E+03      0.118932E+04    -0.723484E+00
1998     0.103125E+04      0.524313E+03     0.676436E+00
1999     0.325398E+03      0.400365E+03    -0.207328E+00
2000     0.505856E+03      0.571678E+03    -0.122323E+00
2001     0.522795E+03      0.112524E+04    -0.766560E+00
2002     0.327038E+03      0.521964E+03    -0.467524E+00
2003     0.951332E+03      0.109614E+04    -0.141687E+00
2004     0.184952E+04      0.422326E+03     0.147691E+01
2005     0.374850E+03      0.293814E+03     0.243579E+00
2006     0.988216E+03      0.638986E+03     0.436019E+00
2007     0.247122E+03      0.186718E+03     0.280286E+00
2008     0.131225E+04      0.201789E+04    -0.430308E+00

Survey Index:   14 Tag:         spr_36po AGE =  6
Time = JAN-1           Type = NUMBER
Catchability =    0.701770E+00   % Variance Contribution =     1.7150
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
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1978     N/A               0.886915E+03     N/A
1979     N/A               0.113990E+04     N/A
1980     N/A               0.159125E+04     N/A
1981     N/A               0.242426E+04     N/A
1982     N/A               0.455183E+03     N/A
1983     N/A               0.141435E+04     N/A
1984     N/A               0.893184E+03     N/A
1985     N/A               0.643021E+03     N/A
1986     N/A               0.117756E+04     N/A
1987     N/A               0.455636E+03     N/A
1988     N/A               0.339820E+03     N/A
1989     N/A               0.809116E+03     N/A
1990     N/A               0.446961E+03     N/A
1991     N/A               0.138037E+04     N/A
1992     N/A               0.584522E+03     N/A
1993     N/A               0.598388E+03     N/A
1994     N/A               0.132464E+03     N/A
1995     0.145760E+03      0.848718E+02     0.540818E+00
1996     0.284826E+03      0.258955E+03     0.952237E-01
1997     0.680304E+02      0.189417E+03    -0.102400E+01
1998     0.727570E+03      0.439796E+03     0.503398E+00
1999     0.162972E+03      0.196109E+03    -0.185088E+00
2000     0.139886E+03      0.154565E+03    -0.997887E-01
2001     0.241248E+03      0.278442E+03    -0.143383E+00
2002     0.306956E+03      0.500262E+03    -0.488427E+00
2003     0.875652E+02      0.206580E+03    -0.858303E+00
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2004     0.121922E+04     0.346287E+03     0.125870E+01
2005     0.280454E+03     0.156150E+03     0.585597E+00
2006     0.290700E+03     0.154182E+03     0.634159E+00
2007     0.285782E+03     0.303082E+03    -0.587728E-01
2008     0.516375E+02     0.110430E+03    -0.760133E+00

Survey Index:   15 Tag:         spr_36po AGE =  7
Time = JAN-1           Type = NUMBER
Catchability =    0.723118E+00   % Variance Contribution =     3.5393
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual



1978     N/A              0.876323E+03     N/A
1979     N/A              0.632027E+03     N/A
1980     N/A              0.669607E+03     N/A
1981     N/A              0.707082E+03     N/A
1982     N/A              0.113566E+04     N/A
1983     N/A              0.192139E+03     N/A
1984     N/A              0.709804E+03     N/A
1985     N/A              0.391520E+03     N/A
1986     N/A              0.222844E+03     N/A
1987     N/A              0.594844E+03     N/A
1988     N/A              0.222620E+03     N/A
1989     N/A              0.142174E+03     N/A
1990     N/A              0.337672E+03     N/A
1991     N/A              0.227693E+03     N/A
1992     N/A              0.464433E+03     N/A
1993     N/A              0.204604E+03     N/A
1994     N/A              0.161371E+03     N/A
1995     0.319114E+03     0.488573E+02     0.187665E+01
1996     0.378402E+02     0.448957E+02    -0.170970E+00
1997     0.182917E+03     0.999355E+02     0.604508E+00
1998     0.138793E+03     0.647353E+02     0.762676E+00
1999     0.868821E+02     0.186825E+03    -0.765618E+00
2000     0.348348E+02     0.841796E+02    -0.882335E+00
2001     0.315563E+02     0.734561E+02    -0.844914E+00
2002     0.532768E+02     0.118386E+03    -0.798452E+00
2003     0.108603E+03     0.182679E+03    -0.520036E+00
2004     0.243980E+03     0.738014E+02     0.119571E+01
2005     0.174037E+03     0.129080E+03     0.298836E+00
2006     0.165704E+03     0.633221E+02     0.961972E+00
2007     0.422116E+02     0.841583E+02    -0.690004E+00
2008     0.614732E+02     0.171850E+03    -0.102802E+01

Survey Index:   16 Tag:         spr_36po AGE =  8
Time = JAN-1           Type = NUMBER
Catchability =    0.816798E+00   % Variance Contribution =     1.8560
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual



1978     N/A              0.669555E+02     N/A
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1979     N/A              0.633475E+03     N/A
1980     N/A              0.467249E+03     N/A
1981     N/A              0.314189E+03     N/A
1982     N/A              0.349393E+03     N/A
1983     N/A              0.534230E+03     N/A
1984     N/A              0.108458E+03     N/A
1985     N/A              0.327951E+03     N/A
1986     N/A              0.167409E+03     N/A
1987     N/A              0.143378E+03     N/A
1988     N/A              0.347062E+03     N/A
1989     N/A              0.963563E+02     N/A
1990     N/A              0.720154E+02     N/A
1991     N/A              0.145136E+03     N/A
1992     N/A              0.107462E+03     N/A
1993     N/A              0.170767E+03     N/A
1994     N/A              0.602952E+02     N/A
1995     0.382500E+02     0.434902E+02    -0.128393E+00
1996     0.247259E+02     0.295044E+02    -0.176688E+00
1997     0.274580E+02     0.283950E+02    -0.335569E-01
1998     0.422116E+02     0.242502E+02     0.554272E+00
1999     0.416652E+02     0.305331E+02     0.310855E+00
2000     0.274580E+02     0.682718E+02    -0.910840E+00
2001     0.241795E+02     0.440075E+02    -0.598854E+00
2002     N/A              0.280790E+02     N/A
2003     0.168027E+02     0.478314E+02    -0.104614E+01
2004     0.356818E+03     0.654872E+02     0.169537E+01
2005     0.407089E+02     0.259731E+02     0.449385E+00
2006     0.736313E+02     0.571926E+02     0.252646E+00
2007     0.247259E+02     0.357269E+02    -0.368054E+00
2008     N/A              0.659093E+02     N/A

Survey Index:   17 Tag:         spr_41   AGE =  1
Time = JAN-1           Type = NUMBER
Catchability =    0.141338E-01   % Variance Contribution =     2.1179
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual


1978     0.477900E+03     0.405710E+03     0.163763E+00
1979     0.550671E+03     0.366665E+03     0.406688E+00
1980     0.401143E+02     0.323854E+03    -0.208856E+01
1981     0.295997E+04     0.648606E+03     0.151811E+01
1982     N/A              0.280737E+03     N/A
1983     N/A              0.159787E+03     N/A
1984     N/A              0.410170E+03     N/A
1985     N/A              0.135900E+03     N/A
1986     N/A              0.629030E+03     N/A
1987     N/A              0.252967E+03     N/A
1988     N/A              0.351285E+03     N/A
1989     N/A              0.252269E+03     N/A
1990     N/A              0.144223E+03     N/A
1991     N/A              0.279795E+03     N/A
1992     N/A              0.105576E+03     N/A
1993     N/A              0.139516E+03     N/A
1994     N/A              0.892634E+02     N/A
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1995     N/A               0.554789E+02     N/A
1996     N/A               0.943495E+02     N/A
1997     N/A               0.150114E+03     N/A
1998     N/A               0.698806E+02     N/A
1999     N/A               0.172911E+03     N/A
2000     N/A               0.844751E+02     N/A
2001     N/A               0.324376E+02     N/A
2002     N/A               0.599196E+02     N/A
2003     N/A               0.206535E+02     N/A
2004     N/A               0.152666E+03     N/A
2005     N/A               0.356536E+02     N/A
2006     N/A               0.917265E+02     N/A
2007     N/A               0.994578E+02     N/A
2008     N/A               0.688974E+02     N/A

Survey Index:   18 Tag:         spr_41   AGE =  2
Time = JAN-1           Type = NUMBER
Catchability =    0.899870E-01   % Variance Contribution =     0.1993
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
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1978     0.246600E+03     0.423564E+03    -0.540937E+00
1979     0.166847E+04     0.210252E+04    -0.231231E+00
1980     0.285043E+04     0.188863E+04     0.411618E+00
1981     0.238140E+04     0.166053E+04     0.360549E+00
1982     N/A               0.328194E+04     N/A
1983     N/A               0.140041E+04     N/A
1984     N/A               0.782072E+03     N/A
1985     N/A               0.211527E+04     N/A
1986     N/A               0.694104E+03     N/A
1987     N/A               0.321651E+04     N/A
1988     N/A               0.131020E+04     N/A
1989     N/A               0.180474E+04     N/A
1990     N/A               0.124261E+04     N/A
1991     N/A               0.745959E+03     N/A
1992     N/A               0.143584E+04     N/A
1993     N/A               0.534759E+03     N/A
1994     N/A               0.702949E+03     N/A
1995     N/A               0.457633E+03     N/A
1996     N/A               0.286570E+03     N/A
1997     N/A               0.486541E+03     N/A
1998     N/A               0.772189E+03     N/A
1999     N/A               0.359123E+03     N/A
2000     N/A               0.897455E+03     N/A
2001     N/A               0.431121E+03     N/A
2002     N/A               0.168137E+03     N/A
2003     N/A               0.309613E+03     N/A
2004     N/A               0.106279E+03     N/A
2005     N/A               0.791700E+03     N/A
2006     N/A               0.184852E+03     N/A
2007     N/A               0.475477E+03     N/A
2008     N/A               0.517583E+03     N/A

Survey Index:   19 Tag:         spr_41   AGE =  3
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Time = JAN-1           Type = NUMBER
Catchability =    0.198731E+00   % Variance Contribution =     0.2047
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual



1978     0.711116E+04     0.503439E+04     0.345372E+00
1979     0.353700E+03     0.691159E+03    -0.669921E+00
1980     0.345806E+04     0.339976E+04     0.170022E-01
1981     0.361389E+04     0.265710E+04     0.307547E+00
1982     N/A              0.230348E+04     N/A
1983     N/A              0.406860E+04     N/A
1984     N/A              0.160886E+04     N/A
1985     N/A              0.113724E+04     N/A
1986     N/A              0.249777E+04     N/A
1987     N/A              0.970073E+03     N/A
1988     N/A              0.439420E+04     N/A
1989     N/A              0.194813E+04     N/A
1990     N/A              0.279610E+04     N/A
1991     N/A              0.125797E+04     N/A
1992     N/A              0.998144E+03     N/A
1993     N/A              0.173869E+04     N/A
1994     N/A              0.692883E+03     N/A
1995     N/A              0.116085E+04     N/A
1996     N/A              0.710561E+03     N/A
1997     N/A              0.466667E+03     N/A
1998     N/A              0.757026E+03     N/A
1999     N/A              0.123159E+04     N/A
2000     N/A              0.585485E+03     N/A
2001     N/A              0.145369E+04     N/A
2002     N/A              0.650689E+03     N/A
2003     N/A              0.283750E+03     N/A
2004     N/A              0.523720E+03     N/A
2005     N/A              0.179713E+03     N/A
2006     N/A              0.136618E+04     N/A
2007     N/A              0.321730E+03     N/A
2008     N/A              0.765458E+03     N/A

Survey Index:   20 Tag:         spr_41   AGE =  4
Time = JAN-1           Type = NUMBER
Catchability =    0.177261E+00   % Variance Contribution =     0.0590
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual



1978     0.124907E+04     0.135789E+04    -0.835318E-01
1979     0.238050E+04     0.238729E+04    -0.284902E-02
1980     0.272957E+03     0.352946E+03    -0.257001E+00
1981     0.216630E+04     0.153670E+04     0.343382E+00
1982     N/A              0.118786E+04     N/A
1983     N/A              0.978455E+03     N/A
1984     N/A              0.158405E+04     N/A
1985     N/A              0.622583E+03     N/A
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1986     N/A              0.365679E+03     N/A
1987     N/A              0.109742E+04     N/A
1988     N/A              0.467420E+03     N/A
1989     N/A              0.188080E+04     N/A
1990     N/A              0.940371E+03     N/A
1991     N/A              0.118917E+04     N/A
1992     N/A              0.367911E+03     N/A
1993     N/A              0.366943E+03     N/A
1994     N/A              0.569735E+03     N/A
1995     N/A              0.261534E+03     N/A
1996     N/A              0.620110E+03     N/A
1997     N/A              0.361870E+03     N/A
1998     N/A              0.221620E+03     N/A
1999     N/A              0.344662E+03     N/A
2000     N/A              0.578027E+03     N/A
2001     N/A              0.309532E+03     N/A
2002     N/A              0.638081E+03     N/A
2003     N/A              0.287373E+03     N/A
2004     N/A              0.142860E+03     N/A
2005     N/A              0.313143E+03     N/A
2006     N/A              0.990779E+02     N/A
2007     N/A              0.863062E+03     N/A
2008     N/A              0.171998E+03     N/A

Survey Index:   21 Tag:         spr_41   AGE =  5
Time = JAN-1           Type = NUMBER
Catchability =    0.216299E+00   % Variance Contribution =     0.2314
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual


1978     0.999771E+03     0.641727E+03     0.443364E+00
1979     0.702771E+03     0.885211E+03    -0.230795E+00
1980     0.219214E+04     0.149602E+04     0.382068E+00
1981     0.136157E+03     0.246768E+03    -0.594637E+00
1982     N/A              0.101410E+04     N/A
1983     N/A              0.609268E+03     N/A
1984     N/A              0.460237E+03     N/A
1985     N/A              0.937793E+03     N/A
1986     N/A              0.295768E+03     N/A
1987     N/A              0.198931E+03     N/A
1988     N/A              0.675730E+03     N/A
1989     N/A              0.259133E+03     N/A
1990     N/A              0.105560E+04     N/A
1991     N/A              0.559002E+03     N/A
1992     N/A              0.577777E+03     N/A
1993     N/A              0.161163E+03     N/A
1994     N/A              0.131247E+03     N/A
1995     N/A              0.187742E+03     N/A
1996     N/A              0.131857E+03     N/A
1997     N/A              0.373476E+03     N/A
1998     N/A              0.164647E+03     N/A
1999     N/A              0.125724E+03     N/A
2000     N/A              0.179521E+03     N/A
2001     N/A              0.353352E+03     N/A
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2002     N/A             0.163909E+03     N/A
2003     N/A             0.344214E+03     N/A
2004     N/A             0.132620E+03     N/A
2005     N/A             0.922646E+02     N/A
2006     N/A             0.200657E+03     N/A
2007     N/A             0.586338E+02     N/A
2008     N/A             0.633664E+03     N/A

Survey Index:   22 Tag:         spr_41   AGE =  6
Time = JAN-1           Type = NUMBER
Catchability =    0.207689E+00   % Variance Contribution =     0.1087
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
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```
1978     0.182057E+03     0.262483E+03    -0.365866E+00
1979     0.302786E+03     0.337355E+03    -0.108111E+00
1980     0.480471E+03     0.470932E+03     0.200532E-01
1981     0.112963E+04     0.717462E+03     0.453924E+00
1982     N/A             0.134712E+03     N/A
1983     N/A             0.418576E+03     N/A
1984     N/A             0.264338E+03     N/A
1985     N/A             0.190302E+03     N/A
1986     N/A             0.348501E+03     N/A
1987     N/A             0.134846E+03     N/A
1988     N/A             0.100570E+03     N/A
1989     N/A             0.239458E+03     N/A
1990     N/A             0.132278E+03     N/A
1991     N/A             0.408520E+03     N/A
1992     N/A             0.172990E+03     N/A
1993     N/A             0.177093E+03     N/A
1994     N/A             0.392029E+02     N/A
1995     N/A             0.251179E+02     N/A
1996     N/A             0.766379E+02     N/A
1997     N/A             0.560581E+02     N/A
1998     N/A             0.130158E+03     N/A
1999     N/A             0.580384E+02     N/A
2000     N/A             0.457436E+02     N/A
2001     N/A             0.824050E+02     N/A
2002     N/A             0.148053E+03     N/A
2003     N/A             0.611374E+02     N/A
2004     N/A             0.102484E+03     N/A
2005     N/A             0.462126E+02     N/A
2006     N/A             0.456302E+02     N/A
2007     N/A             0.896972E+02     N/A
2008     N/A             0.326818E+02     N/A

Survey Index:   23 Tag:         spr_41   AGE =  7
Time = JAN-1           Type = NUMBER
Catchability =    0.300243E+00   % Variance Contribution =     0.5210
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
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```
1978     0.915814E+03     0.363855E+03     0.923058E+00
1979     0.107486E+03     0.262422E+03    -0.892596E+00
1980     0.238500E+03     0.278025E+03    -0.153343E+00
1981     0.331971E+03     0.293585E+03     0.122881E+00
1982     N/A              0.471532E+03     N/A
1983     N/A              0.797775E+02     N/A
1984     N/A              0.294715E+03     N/A
1985     N/A              0.162562E+03     N/A
1986     N/A              0.925261E+02     N/A
1987     N/A              0.246983E+03     N/A
1988     N/A              0.924333E+02     N/A
1989     N/A              0.590314E+02     N/A
1990     N/A              0.140204E+03     N/A
1991     N/A              0.945396E+02     N/A
1992     N/A              0.192836E+03     N/A
1993     N/A              0.849532E+02     N/A
1994     N/A              0.670022E+02     N/A
1995     N/A              0.202859E+02     N/A
1996     N/A              0.186410E+02     N/A
1997     N/A              0.414939E+02     N/A
1998     N/A              0.268785E+02     N/A
1999     N/A              0.775708E+02     N/A
2000     N/A              0.349519E+02     N/A
2001     N/A              0.304994E+02     N/A
2002     N/A              0.491548E+02     N/A
2003     N/A              0.758497E+02     N/A
2004     N/A              0.306428E+02     N/A
2005     N/A              0.535950E+02     N/A
2006     N/A              0.262917E+02     N/A
2007     N/A              0.349431E+02     N/A
2008     N/A              0.713531E+02     N/A

Survey Index:   24 Tag:         spr_41   AGE =  8
Time = JAN-1           Type = NUMBER
Catchability =    0.291472E+00   % Variance Contribution =     1.1884
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
```

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```
1978     0.837000E+02     0.238929E+02     0.125366E+01
1979     0.178200E+03     0.226054E+03    -0.237867E+00
1980     0.398571E+02     0.166737E+03    -0.143111E+01
1981     0.169843E+03     0.112118E+03     0.415324E+00
1982     N/A              0.124680E+03     N/A
1983     N/A              0.190639E+03     N/A
1984     N/A              0.387030E+02     N/A
1985     N/A              0.117028E+03     N/A
1986     N/A              0.597394E+02     N/A
1987     N/A              0.511642E+02     N/A
1988     N/A              0.123848E+03     N/A
1989     N/A              0.343845E+02     N/A
1990     N/A              0.256985E+02     N/A
1991     N/A              0.517913E+02     N/A
1992     N/A              0.383476E+02     N/A
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1993     N/A              0.609378E+02     N/A
1994     N/A              0.215162E+02     N/A
1995     N/A              0.155194E+02     N/A
1996     N/A              0.105286E+02     N/A
1997     N/A              0.101327E+02     N/A
1998     N/A              0.865361E+01     N/A
1999     N/A              0.108957E+02     N/A
2000     N/A              0.243626E+02     N/A
2001     N/A              0.157040E+02     N/A
2002     N/A              0.100199E+02     N/A
2003     N/A              0.170685E+02     N/A
2004     N/A              0.233689E+02     N/A
2005     N/A              0.926844E+01     N/A
2006     N/A              0.204090E+02     N/A
2007     N/A              0.127491E+02     N/A
2008     N/A              0.235196E+02     N/A

Survey Index:   25 Tag:         sp_can_p AGE =  1
Time = JAN-1           Type = NUMBER
Catchability =    0.358799E-01   % Variance Contribution =     1.3324
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
```

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```
1978     N/A              0.102993E+04     N/A
1979     N/A              0.930816E+03     N/A
1980     N/A              0.822135E+03     N/A
1981     N/A              0.164655E+04     N/A
1982     N/A              0.712678E+03     N/A
1983     N/A              0.405634E+03     N/A
1984     N/A              0.104126E+04     N/A
1985     N/A              0.344995E+03     N/A
1986     0.844432E+03     0.159685E+04    -0.637126E+00
1987     0.351846E+03     0.642180E+03    -0.601674E+00
1988     0.394068E+03     0.891771E+03    -0.816686E+00
1989     0.229404E+04     0.640410E+03     0.127596E+01
1990     0.591102E+03     0.366125E+03     0.479014E+00
1991     0.166072E+04     0.710287E+03     0.849335E+00
1992     0.154812E+03     0.268014E+03    -0.548823E+00
1993     N/A              0.354175E+03     N/A
1994     N/A              0.226604E+03     N/A
1995     N/A              0.140839E+03     N/A
1996     N/A              0.239515E+03     N/A
1997     N/A              0.381080E+03     N/A
1998     N/A              0.177399E+03     N/A
1999     N/A              0.438950E+03     N/A
2000     N/A              0.214448E+03     N/A
2001     N/A              0.823461E+02     N/A
2002     N/A              0.152112E+03     N/A
2003     N/A              0.524308E+02     N/A
2004     N/A              0.387558E+03     N/A
2005     N/A              0.905101E+02     N/A
2006     N/A              0.232857E+03     N/A
2007     N/A              0.252483E+03     N/A
2008     N/A              0.174903E+03     N/A
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Survey Index:   26 Tag:         sp_can_p AGE =  2
Time = JAN-1           Type = NUMBER
Catchability =    0.187587E+00   % Variance Contribution =     0.5784
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual



1978     N/A              0.882961E+03     N/A
1979     N/A              0.438292E+04     N/A
1980     N/A              0.393704E+04     N/A
1981     N/A              0.346155E+04     N/A
1982     N/A              0.684153E+04     N/A
1983     N/A              0.291931E+04     N/A
1984     N/A              0.163031E+04     N/A
1985     N/A              0.440949E+04     N/A
1986     0.319477E+04     0.144693E+04     0.792071E+00
1987     0.299773E+04     0.670515E+04    -0.805019E+00
1988     0.142146E+04     0.273125E+04    -0.653076E+00
1989     0.391253E+04     0.376217E+04     0.391899E-01
1990     0.343402E+04     0.259034E+04     0.281944E+00
1991     0.163257E+04     0.155503E+04     0.486618E-01
1992     0.402512E+04     0.299315E+04     0.296228E+00
1993     N/A              0.111476E+04     N/A
1994     N/A              0.146537E+04     N/A
1995     N/A              0.953981E+03     N/A
1996     N/A              0.597384E+03     N/A
1997     N/A              0.101424E+04     N/A
1998     N/A              0.160970E+04     N/A
1999     N/A              0.748627E+03     N/A
2000     N/A              0.187084E+04     N/A
2001     N/A              0.898715E+03     N/A
2002     N/A              0.350498E+03     N/A
2003     N/A              0.645419E+03     N/A
2004     N/A              0.221549E+03     N/A
2005     N/A              0.165038E+04     N/A
2006     N/A              0.385343E+03     N/A
2007     N/A              0.991180E+03     N/A
2008     N/A              0.107895E+04     N/A

Survey Index:   27 Tag:         sp_can_p AGE =  3
Time = JAN-1           Type = NUMBER
Catchability =    0.324684E+00   % Variance Contribution =     0.1686
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual



1978     N/A              0.822510E+04     N/A
1979     N/A              0.112920E+04     N/A
1980     N/A              0.555447E+04     N/A
1981     N/A              0.434113E+04     N/A
1982     N/A              0.376339E+04     N/A
1983     N/A              0.664720E+04     N/A
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1984     N/A               0.262853E+04     N/A
1985     N/A               0.185801E+04     N/A
1986     0.395475E+04      0.408081E+04    -0.313768E-01
1987     0.130887E+04      0.158489E+04    -0.191350E+00
1988     0.655842E+04      0.717917E+04    -0.904340E-01
1989     0.194219E+04      0.318282E+04    -0.493951E+00
1990     0.531992E+04      0.456822E+04     0.152335E+00
1991     0.258959E+04      0.205525E+04     0.231102E+00
1992     0.249107E+04      0.163075E+04     0.423674E+00
1993     N/A               0.284064E+04     N/A
1994     N/A               0.113202E+04     N/A
1995     N/A               0.189658E+04     N/A
1996     N/A               0.116090E+04     N/A
1997     N/A               0.762433E+03     N/A
1998     N/A               0.123682E+04     N/A
1999     N/A               0.201216E+04     N/A
2000     N/A               0.956554E+03     N/A
2001     N/A               0.237502E+04     N/A
2002     N/A               0.106308E+04     N/A
2003     N/A               0.463585E+03     N/A
2004     N/A               0.855645E+03     N/A
2005     N/A               0.293612E+03     N/A
2006     N/A               0.223204E+04     N/A
2007     N/A               0.525637E+03     N/A
2008     N/A               0.125059E+04     N/A

Survey Index:   28 Tag:         sp_can_p AGE =  4
Time = JAN-1           Type = NUMBER
Catchability =    0.372132E+00   % Variance Contribution =     0.2113
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
```

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```
1978     N/A               0.285067E+04     N/A
1979     N/A               0.501174E+04     N/A
1980     N/A               0.740954E+03     N/A
1981     N/A               0.322606E+04     N/A
1982     N/A               0.249371E+04     N/A
1983     N/A               0.205411E+04     N/A
1984     N/A               0.332546E+04     N/A
1985     N/A               0.130701E+04     N/A
1986     0.520733E+03      0.767685E+03    -0.388143E+00
1987     0.153405E+04      0.230385E+04    -0.406671E+00
1988     0.816284E+03      0.981272E+03    -0.184088E+00
1989     0.401105E+04      0.394843E+04     0.157348E-01
1990     0.292736E+04      0.197416E+04     0.393960E+00
1991     0.302588E+04      0.249647E+04     0.192325E+00
1992     0.112591E+04      0.772370E+03     0.376882E+00
1993     N/A               0.770338E+03     N/A
1994     N/A               0.119607E+04     N/A
1995     N/A               0.549048E+03     N/A
1996     N/A               0.130182E+04     N/A
1997     N/A               0.759687E+03     N/A
1998     N/A               0.465255E+03     N/A
1999     N/A               0.723563E+03     N/A
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2000     N/A              0.121348E+04     N/A
2001     N/A              0.649814E+03     N/A
2002     N/A              0.133955E+04     N/A
2003     N/A              0.603293E+03     N/A
2004     N/A              0.299911E+03     N/A
2005     N/A              0.657394E+03     N/A
2006     N/A              0.207998E+03     N/A
2007     N/A              0.181186E+04     N/A
2008     N/A              0.361082E+03     N/A

Survey Index:   29 Tag:         sp_can_p AGE =  5
Time = JAN-1           Type = NUMBER
Catchability =    0.580779E+00   % Variance Contribution =     0.1940
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual


1978     N/A              0.172308E+04     N/A
1979     N/A              0.237686E+04     N/A
1980     N/A              0.401693E+04     N/A
1981     N/A              0.662589E+03     N/A
1982     N/A              0.272293E+04     N/A
1983     N/A              0.163593E+04     N/A
1984     N/A              0.123577E+04     N/A
1985     N/A              0.251804E+04     N/A
1986     0.914801E+03     0.794158E+03     0.141424E+00
1987     0.478511E+03     0.534144E+03    -0.109986E+00
1988     0.143553E+04     0.181438E+04    -0.234209E+00
1989     0.506659E+03     0.695790E+03    -0.317210E+00
1990     0.544658E+04     0.283436E+04     0.653171E+00
1991     0.147776E+04     0.150096E+04    -0.155807E-01
1992     0.137924E+04     0.155137E+04    -0.117609E+00
1993     N/A              0.432735E+03     N/A
1994     N/A              0.352408E+03     N/A
1995     N/A              0.504100E+03     N/A
1996     N/A              0.354045E+03     N/A
1997     N/A              0.100281E+04     N/A
1998     N/A              0.442089E+03     N/A
1999     N/A              0.337579E+03     N/A
2000     N/A              0.482026E+03     N/A
2001     N/A              0.948775E+03     N/A
2002     N/A              0.440108E+03     N/A
2003     N/A              0.924240E+03     N/A
2004     N/A              0.356095E+03     N/A
2005     N/A              0.247737E+03     N/A
2006     N/A              0.538778E+03     N/A
2007     N/A              0.157436E+03     N/A
2008     N/A              0.170143E+04     N/A

Survey Index:   30 Tag:         sp_can_p AGE =  6
Time = JAN-1           Type = NUMBER
Catchability =    0.555873E+00   % Variance Contribution =     0.5549
Residual = LN(Observed) - LN(Predicted)
```

```
Year      Observed        Predicted         Residual

------------------------------------------------------------------------------

1978     N/A             0.702526E+03     N/A
1979     N/A             0.902919E+03     N/A
1980     N/A             0.126043E+04     N/A
1981     N/A             0.192026E+04     N/A
1982     N/A             0.360551E+03     N/A
1983     N/A             0.112030E+04     N/A
1984     N/A             0.707492E+03     N/A
1985     N/A             0.509337E+03     N/A
1986     0.619250E+03    0.932750E+03    -0.409629E+00
1987     0.168886E+03    0.360910E+03    -0.759402E+00
1988     0.182960E+03    0.269172E+03    -0.386082E+00
1989     0.591102E+03    0.640901E+03    -0.808866E-01
1990     0.591102E+03    0.354038E+03     0.512584E+00
1991     0.184368E+04    0.109339E+04     0.522479E+00
1992     0.844432E+03    0.463000E+03     0.600936E+00
1993     N/A             0.473983E+03     N/A
1994     N/A             0.104925E+03     N/A
1995     N/A             0.672270E+02     N/A
1996     N/A             0.205119E+03     N/A
1997     N/A             0.150038E+03     N/A
1998     N/A             0.348363E+03     N/A
1999     N/A             0.155338E+03     N/A
2000     N/A             0.122431E+03     N/A
2001     N/A             0.220554E+03     N/A
2002     N/A             0.396258E+03     N/A
2003     N/A             0.163632E+03     N/A
2004     N/A             0.274294E+03     N/A
2005     N/A             0.123686E+03     N/A
2006     N/A             0.122128E+03     N/A
2007     N/A             0.240071E+03     N/A
2008     N/A             0.874717E+02     N/A

Survey Index:   31 Tag:         sp_can_p AGE =  7
Time = JAN-1           Type = NUMBER
Catchability =    0.730017E+00   % Variance Contribution =     1.0921
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual

------------------------------------------------------------------------------

1978     N/A             0.884683E+03     N/A
1979     N/A             0.638057E+03     N/A
1980     N/A             0.675996E+03     N/A
1981     N/A             0.713828E+03     N/A
1982     N/A             0.114649E+04     N/A
1983     N/A             0.193972E+03     N/A
1984     N/A             0.716576E+03     N/A
1985     N/A             0.395255E+03     N/A
1986     0.365920E+03    0.224970E+03     0.486450E+00
1987     0.309625E+03    0.600519E+03    -0.662433E+00
1988     0.112591E+03    0.224744E+03    -0.691200E+00
1989     0.703693E+02    0.143530E+03    -0.712787E+00
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```
1990     0.130887E+04     0.340894E+03     0.134535E+01
1991     0.225182E+03     0.229865E+03    -0.205853E-01
1992     0.605176E+03     0.468864E+03     0.255207E+00
1993     N/A              0.206557E+03     N/A
1994     N/A              0.162910E+03     N/A
1995     N/A              0.493234E+02     N/A
1996     N/A              0.453240E+02     N/A
1997     N/A              0.100889E+03     N/A
1998     N/A              0.653529E+02     N/A
1999     N/A              0.188607E+03     N/A
2000     N/A              0.849827E+02     N/A
2001     N/A              0.741569E+02     N/A
2002     N/A              0.119516E+03     N/A
2003     N/A              0.184422E+03     N/A
2004     N/A              0.745055E+02     N/A
2005     N/A              0.130312E+03     N/A
2006     N/A              0.639262E+02     N/A
2007     N/A              0.849612E+02     N/A
2008     N/A              0.173489E+03     N/A

Survey Index:   32 Tag:         sp_can_p AGE =  8
Time = JAN-1           Type = NUMBER
Catchability =    0.644843E-03   % Variance Contribution =     0.9126
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
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```
1978     N/A              0.528599E-01     N/A
1979     N/A              0.500114E+00     N/A
1980     N/A              0.368883E+00     N/A
1981     N/A              0.248046E+00     N/A
1982     N/A              0.275838E+00     N/A
1983     N/A              0.421762E+00     N/A
1984     N/A              0.856253E-01     N/A
1985     N/A              0.258910E+00     N/A
1986     0.400000E-01     0.132166E+00    -0.119518E+01
1987     0.800000E-01     0.113194E+00    -0.347077E+00
1988     0.170000E+00     0.273998E+00    -0.477321E+00
1989     0.100000E+00     0.760712E-01     0.273501E+00
1990     0.120000E+00     0.568546E-01     0.746995E+00
1991     0.220000E+00     0.114581E+00     0.652342E+00
1992     0.120000E+00     0.848391E-01     0.346736E+00
1993     N/A              0.134817E+00     N/A
1994     N/A              0.476017E-01     N/A
1995     N/A              0.343346E-01     N/A
1996     N/A              0.232931E-01     N/A
1997     N/A              0.224173E-01     N/A
1998     N/A              0.191450E-01     N/A
1999     N/A              0.241052E-01     N/A
2000     N/A              0.538991E-01     N/A
2001     N/A              0.347429E-01     N/A
2002     N/A              0.221678E-01     N/A
2003     N/A              0.377618E-01     N/A
2004     N/A              0.517007E-01     N/A
2005     N/A              0.205052E-01     N/A
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2006     N/A              0.451523E-01     N/A
2007     N/A              0.282056E-01     N/A
2008     N/A              0.520339E-01     N/A

Survey Index:   33 Tag:         sp_canpo AGE =  1
Time = JAN-1           Type = NUMBER
Catchability =    0.158633E-01   % Variance Contribution =     4.3436
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual


1978     N/A              0.455356E+03     N/A
1979     N/A              0.411533E+03     N/A
1980     N/A              0.363483E+03     N/A
1981     N/A              0.727975E+03     N/A
1982     N/A              0.315090E+03     N/A
1983     N/A              0.179339E+03     N/A
1984     N/A              0.460362E+03     N/A
1985     N/A              0.152529E+03     N/A
1986     N/A              0.706002E+03     N/A
1987     N/A              0.283922E+03     N/A
1988     N/A              0.394271E+03     N/A
1989     N/A              0.283139E+03     N/A
1990     N/A              0.161872E+03     N/A
1991     N/A              0.314033E+03     N/A
1992     N/A              0.118495E+03     N/A
1993     N/A              0.156588E+03     N/A
1994     N/A              0.100186E+03     N/A
1995     0.985170E+02     0.622677E+02     0.458786E+00
1996     0.197034E+03     0.105895E+03     0.620930E+00
1997     0.450363E+03     0.168483E+03     0.983218E+00
1998     0.140739E+02     0.784317E+02    -0.171791E+01
1999     0.464437E+03     0.194069E+03     0.872612E+00
2000     0.140739E+03     0.948121E+02     0.395007E+00
2001     N/A              0.364069E+02     N/A
2002     0.128934E+02     0.672519E+02    -0.165173E+01
2003     N/A              0.231808E+02     N/A
2004     0.753776E+03     0.171348E+03     0.148140E+01
2005     0.344185E+02     0.400164E+02    -0.150696E+00
2006     N/A              0.102951E+03     N/A
2007     0.193318E+03     0.111628E+03     0.549163E+00
2008     0.122714E+02     0.773281E+02    -0.184079E+01

Survey Index:   34 Tag:         sp_canpo AGE =  2
Time = JAN-1           Type = NUMBER
Catchability =    0.779414E-01   % Variance Contribution =     3.7046
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual


1978     N/A              0.366866E+03     N/A
1979     N/A              0.182108E+04     N/A
1980     N/A              0.163582E+04     N/A
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1981     N/A              0.143826E+04     N/A
1982     N/A              0.284262E+04     N/A
1983     N/A              0.121296E+04     N/A
1984     N/A              0.677384E+03     N/A
1985     N/A              0.183212E+04     N/A
1986     N/A              0.601191E+03     N/A
1987     N/A              0.278595E+04     N/A
1988     N/A              0.113482E+04     N/A
1989     N/A              0.156316E+04     N/A
1990     N/A              0.107627E+04     N/A
1991     N/A              0.646105E+03     N/A
1992     N/A              0.124364E+04     N/A
1993     N/A              0.463176E+03     N/A
1994     N/A              0.608852E+03     N/A
1995     0.942949E+03     0.396374E+03     0.866653E+00
1996     0.689619E+03     0.248210E+03     0.102186E+01
1997     0.745915E+03     0.421413E+03     0.570997E+00
1998     0.942949E+03     0.668824E+03     0.343491E+00
1999     0.450363E+03     0.311051E+03     0.370100E+00
2000     0.619250E+03     0.777322E+03    -0.227346E+00
2001     0.844432E+02     0.373412E+03    -0.148660E+01
2002     0.121746E+03     0.145630E+03    -0.179136E+00
2003     0.313603E+02     0.268168E+03    -0.214607E+01
2004     0.134499E+03     0.920524E+02     0.379197E+00
2005     0.188003E+04     0.685723E+03     0.100857E+01
2006     0.527756E+02     0.160108E+03    -0.110980E+01
2007     0.730710E+03     0.411830E+03     0.573405E+00
2008     0.454928E+03     0.448299E+03     0.146790E-01

Survey Index:   35 Tag:         sp_canpo AGE =  3
Time = JAN-1           Type = NUMBER
Catchability =    0.362628E+00   % Variance Contribution =     1.1901
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual



1978     N/A              0.918634E+04     N/A
1979     N/A              0.126117E+04     N/A
1980     N/A              0.620359E+04     N/A
1981     N/A              0.484846E+04     N/A
1982     N/A              0.420320E+04     N/A
1983     N/A              0.742403E+04     N/A
1984     N/A              0.293572E+04     N/A
1985     N/A              0.207514E+04     N/A
1986     N/A              0.455772E+04     N/A
1987     N/A              0.177011E+04     N/A
1988     N/A              0.801817E+04     N/A
1989     N/A              0.355479E+04     N/A
1990     N/A              0.510209E+04     N/A
1991     N/A              0.229544E+04     N/A
1992     N/A              0.182133E+04     N/A
1993     N/A              0.317261E+04     N/A
1994     N/A              0.126432E+04     N/A
1995     0.211108E+04     0.211822E+04    -0.337802E-02
1996     0.325106E+04     0.129657E+04     0.919257E+00
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1997     0.774062E+03     0.851535E+03    -0.953887E-01
1998     0.133702E+04     0.138136E+04    -0.326260E-01
1999     0.209701E+04     0.224731E+04    -0.692234E-01
2000     0.147776E+04     0.106834E+04     0.324415E+00
2001     0.900727E+03     0.265258E+04    -0.108009E+01
2002     0.805617E+03     0.118732E+04    -0.387847E+00
2003     0.419145E+03     0.517762E+03    -0.211300E+00
2004     0.551716E+03     0.955641E+03    -0.549349E+00
2005     0.661996E+03     0.327925E+03     0.702473E+00
2006     0.197858E+04     0.249289E+04    -0.231060E+00
2007     0.132932E+04     0.587067E+03     0.817285E+00
2008     0.125982E+04     0.139674E+04    -0.103172E+00

Survey Index:   36 Tag:         sp_canpo AGE =  4
Time = JAN-1           Type = NUMBER
Catchability =    0.888325E+00   % Variance Contribution =     1.2196
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual

______________________________________________________________________________

1978     N/A              0.680491E+04     N/A
1979     N/A              0.119636E+05     N/A
1980     N/A              0.176875E+04     N/A
1981     N/A              0.770101E+04     N/A
1982     N/A              0.595280E+04     N/A
1983     N/A              0.490342E+04     N/A
1984     N/A              0.793828E+04     N/A
1985     N/A              0.312000E+04     N/A
1986     N/A              0.183256E+04     N/A
1987     N/A              0.549958E+04     N/A
1988     N/A              0.234242E+04     N/A
1989     N/A              0.942540E+04     N/A
1990     N/A              0.471256E+04     N/A
1991     N/A              0.595938E+04     N/A
1992     N/A              0.184374E+04     N/A
1993     N/A              0.183889E+04     N/A
1994     N/A              0.285516E+04     N/A
1995     0.121035E+04     0.131065E+04    -0.796090E-01
1996     0.565769E+04     0.310761E+04     0.599163E+00
1997     0.175923E+04     0.181347E+04    -0.303637E-01
1998     0.492585E+03     0.111062E+04    -0.813008E+00
1999     0.153405E+04     0.172724E+04    -0.118610E+00
2000     0.551695E+04     0.289672E+04     0.644248E+00
2001     0.591102E+03     0.155119E+04    -0.964786E+00
2002     0.288708E+04     0.319767E+04    -0.102177E+00
2003     0.912160E+03     0.144014E+04    -0.456677E+00
2004     0.595577E+03     0.715925E+03    -0.184044E+00
2005     0.409251E+04     0.156928E+04     0.958541E+00
2006     0.925621E+03     0.496517E+03     0.622847E+00
2007     0.413611E+04     0.432513E+04    -0.446883E-01
2008     0.835776E+03     0.861948E+03    -0.308351E-01

Survey Index:   37 Tag:         sp_canpo AGE =  5
Time = JAN-1           Type = NUMBER
Catchability =    0.140774E+01   % Variance Contribution =     1.1272
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Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual

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1978     N/A              0.417655E+04     N/A
1979     N/A              0.576122E+04     N/A
1980     N/A              0.973658E+04     N/A
1981     N/A              0.160604E+04     N/A
1982     N/A              0.660006E+04     N/A
1983     N/A              0.396530E+04     N/A
1984     N/A              0.299536E+04     N/A
1985     N/A              0.610344E+04     N/A
1986     N/A              0.192495E+04     N/A
1987     N/A              0.129470E+04     N/A
1988     N/A              0.439785E+04     N/A
1989     N/A              0.168651E+04     N/A
1990     N/A              0.687017E+04     N/A
1991     N/A              0.363815E+04     N/A
1992     N/A              0.376034E+04     N/A
1993     N/A              0.104890E+04     N/A
1994     N/A              0.854196E+03     N/A
1995     0.844432E+03     0.122188E+04    -0.369482E+00
1996     0.153405E+04     0.858163E+03     0.580873E+00
1997     0.173108E+04     0.243069E+04    -0.339428E+00
1998     0.492585E+03     0.107157E+04    -0.777213E+00
1999     0.577028E+03     0.818251E+03    -0.349278E+00
2000     0.240663E+04     0.116837E+04     0.722615E+00
2001     0.156220E+04     0.229972E+04    -0.386693E+00
2002     0.961543E+03     0.106677E+04    -0.103852E+00
2003     0.170676E+04     0.224025E+04    -0.271987E+00
2004     0.634621E+03     0.863133E+03    -0.307541E+00
2005     0.159149E+04     0.600486E+03     0.974687E+00
2006     0.229716E+04     0.130593E+04     0.564756E+00
2007     0.545841E+03     0.381606E+03     0.357939E+00
2008     0.306929E+04     0.412408E+04    -0.295397E+00

Survey Index:   38 Tag:         sp_canpo AGE =  6
Time = JAN-1           Type = NUMBER
Catchability =    0.193422E+01   % Variance Contribution =     1.2999
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual

________________________________________________________________________________

1978     N/A              0.244451E+04     N/A
1979     N/A              0.314180E+04     N/A
1980     N/A              0.438581E+04     N/A
1981     N/A              0.668175E+04     N/A
1982     N/A              0.125457E+04     N/A
1983     N/A              0.389821E+04     N/A
1984     N/A              0.246179E+04     N/A
1985     N/A              0.177229E+04     N/A
1986     N/A              0.324560E+04     N/A
1987     N/A              0.125582E+04     N/A
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1988     N/A               0.936611E+03     N/A
1989     N/A               0.223008E+04     N/A
1990     N/A               0.123191E+04     N/A
1991     N/A               0.380456E+04     N/A
1992     N/A               0.161106E+04     N/A
1993     N/A               0.164927E+04     N/A
1994     N/A               0.365098E+03     N/A
1995     0.267403E+03     0.233923E+03     0.133765E+00
1996     0.111183E+04     0.713731E+03     0.443261E+00
1997     0.379994E+03     0.522071E+03    -0.317647E+00
1998     0.394068E+03     0.121216E+04    -0.112364E+01
1999     0.365920E+03     0.540514E+03    -0.390104E+00
2000     0.109776E+04     0.426011E+03     0.946562E+00
2001     0.731841E+03     0.767440E+03    -0.474979E-01
2002     0.171816E+04     0.137882E+04     0.220025E+00
2003     0.447151E+03     0.569375E+03    -0.241642E+00
2004     0.545454E+03     0.954435E+03    -0.559502E+00
2005     0.721660E+03     0.430379E+03     0.516889E+00
2006     0.982657E+03     0.424956E+03     0.838276E+00
2007     0.851245E+03     0.835353E+03     0.188456E-01
2008     0.196496E+03     0.304367E+03    -0.437591E+00

Survey Index:   39 Tag:         sp_canpo AGE =  7
Time = JAN-1           Type = NUMBER
Catchability =    0.190133E+01   % Variance Contribution =     2.3828
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
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1978     N/A               0.230416E+04     N/A
1979     N/A               0.166182E+04     N/A
1980     N/A               0.176063E+04     N/A
1981     N/A               0.185916E+04     N/A
1982     N/A               0.298603E+04     N/A
1983     N/A               0.505201E+03     N/A
1984     N/A               0.186632E+04     N/A
1985     N/A               0.102944E+04     N/A
1986     N/A               0.585933E+03     N/A
1987     N/A               0.156405E+04     N/A
1988     N/A               0.585345E+03     N/A
1989     N/A               0.373824E+03     N/A
1990     N/A               0.887857E+03     N/A
1991     N/A               0.598684E+03     N/A
1992     N/A               0.122116E+04     N/A
1993     N/A               0.537976E+03     N/A
1994     N/A               0.424300E+03     N/A
1995     0.562954E+02     0.128463E+03    -0.825026E+00
1996     0.464437E+03     0.118046E+03     0.136975E+01
1997     0.844432E+02     0.262765E+03    -0.113518E+01
1998     0.985170E+02     0.170212E+03    -0.546813E+00
1999     0.211108E+03     0.491227E+03    -0.844536E+00
2000     0.562954E+03     0.221337E+03     0.933511E+00
2001     0.365920E+03     0.193141E+03     0.638993E+00
2002     0.563812E+03     0.311279E+03     0.594033E+00
2003     0.474404E+03     0.480327E+03    -0.124098E-01
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2004     0.103828E+03     0.194050E+03    -0.625380E+00
2005     0.583521E+03     0.339397E+03     0.541909E+00
2006     0.283568E+03     0.166496E+03     0.532484E+00
2007     0.135474E+03     0.221281E+03    -0.490656E+00
2008     0.396500E+03     0.451852E+03    -0.130678E+00

Survey Index:   40 Tag:         sp_canpo AGE =  8
Time = JAN-1           Type = NUMBER
Catchability =    0.127804E-02   % Variance Contribution =     3.5252
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual


1978     N/A              0.104765E+00     N/A
1979     N/A              0.991198E+00     N/A
1980     N/A              0.731104E+00     N/A
1981     N/A              0.491612E+00     N/A
1982     N/A              0.546696E+00     N/A
1983     N/A              0.835909E+00     N/A
1984     N/A              0.169704E+00     N/A
1985     N/A              0.513145E+00     N/A
1986     N/A              0.261945E+00     N/A
1987     N/A              0.224344E+00     N/A
1988     N/A              0.543048E+00     N/A
1989     N/A              0.150769E+00     N/A
1990     N/A              0.112683E+00     N/A
1991     N/A              0.227094E+00     N/A
1992     N/A              0.168146E+00     N/A
1993     N/A              0.267199E+00     N/A
1994     N/A              0.943439E-01     N/A
1995     0.500000E-01     0.680492E-01    -0.308208E+00
1996     0.800000E-01     0.461655E-01     0.549793E+00
1997     0.300000E-01     0.444297E-01    -0.392711E+00
1998     0.200000E-01     0.379442E-01    -0.640385E+00
1999     0.100000E-01     0.477752E-01    -0.156392E+01
2000     0.240000E+00     0.106825E+00     0.809447E+00
2001     0.170000E+00     0.688585E-01     0.903745E+00
2002     0.170000E+00     0.439352E-01     0.135308E+01
2003     0.160000E+00     0.748417E-01     0.759798E+00
2004     0.117500E+00     0.102468E+00     0.136890E+00
2005     0.100000E-01     0.406401E-01    -0.140217E+01
2006     0.185000E+00     0.894892E-01     0.726237E+00
2007     0.757000E-01     0.559019E-01     0.303179E+00
2008     0.300000E-01     0.103128E+00    -0.123478E+01

Survey Index:   41 Tag:         us0autpr AGE =  1
Time = JAN-1           Type = NUMBER
Catchability =    0.163752E-01   % Variance Contribution =     3.3522
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual


1978     0.207096E+03     0.470051E+03    -0.819657E+00
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1979     0.540008E+03     0.424815E+03     0.239931E+00
1980     0.156415E+03     0.375214E+03    -0.874982E+00
1981     0.382090E+03     0.751469E+03    -0.676373E+00
1982     0.356545E+03     0.325259E+03     0.918379E-01
1983     0.494518E+03     0.185127E+03     0.982541E+00
1984     0.175253E+04     0.475219E+03     0.130504E+01
1985     0.244663E+03     0.157452E+03     0.440763E+00
1986     0.136867E+04     0.728787E+03     0.630211E+00
1987     0.103958E+03     0.293085E+03    -0.103647E+01
1988     0.278269E+03     0.406995E+03    -0.380214E+00
1989     0.750656E+03     0.292277E+03     0.943247E+00
1990     0.342611E+03     0.167096E+03     0.718028E+00
1991     0.214610E+03     0.324168E+03    -0.412439E+00
1992     0.553259E+02     0.122319E+03    -0.793389E+00
1993     0.479491E+02     0.161642E+03    -0.121524E+01
1994     0.243707E+03     0.103420E+03     0.857172E+00
1995     N/A              0.642773E+02     N/A
1996     N/A              0.109312E+03     N/A
1997     N/A              0.173921E+03     N/A
1998     N/A              0.809629E+02     N/A
1999     N/A              0.200332E+03     N/A
2000     N/A              0.978720E+02     N/A
2001     N/A              0.375819E+02     N/A
2002     N/A              0.694223E+02     N/A
2003     N/A              0.239289E+02     N/A
2004     N/A              0.176878E+03     N/A
2005     N/A              0.413079E+02     N/A
2006     N/A              0.106273E+03     N/A
2007     N/A              0.115231E+03     N/A
2008     N/A              0.798238E+02     N/A

Survey Index:   42 Tag:         us1autpr AGE =  2
Time = JAN-1           Type = NUMBER
Catchability =    0.811005E-01   % Variance Contribution =     1.6827
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
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```
1978     0.323486E+03     0.381735E+03    -0.165573E+00
1979     0.252095E+04     0.189489E+04     0.285473E+00
1980     0.222000E+04     0.170212E+04     0.265634E+00
1981     0.112004E+04     0.149655E+04    -0.289797E+00
1982     0.481540E+04     0.295784E+04     0.487362E+00
1983     0.788633E+03     0.126212E+04    -0.470246E+00
1984     0.116048E+04     0.704839E+03     0.498617E+00
1985     0.260797E+04     0.190638E+04     0.313366E+00
1986     0.247669E+03     0.625558E+03    -0.926552E+00
1987     0.311314E+04     0.289887E+04     0.713103E-01
1988     0.565144E+03     0.118082E+04    -0.736882E+00
1989     0.119490E+04     0.162652E+04    -0.308377E+00
1990     0.382281E+04     0.111989E+04     0.122775E+01
1991     0.496704E+03     0.672293E+03    -0.302701E+00
1992     0.556811E+03     0.129405E+04    -0.843304E+00
1993     0.563368E+03     0.481950E+03     0.156093E+00
1994     0.132495E+04     0.633530E+03     0.737824E+00
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1995     N/A              0.412440E+03     N/A
1996     N/A              0.258270E+03     N/A
1997     N/A              0.438494E+03     N/A
1998     N/A              0.695932E+03     N/A
1999     N/A              0.323658E+03     N/A
2000     N/A              0.808828E+03     N/A
2001     N/A              0.388547E+03     N/A
2002     N/A              0.151533E+03     N/A
2003     N/A              0.279037E+03     N/A
2004     N/A              0.957835E+02     N/A
2005     N/A              0.713517E+03     N/A
2006     N/A              0.166597E+03     N/A
2007     N/A              0.428522E+03     N/A
2008     N/A              0.466470E+03     N/A

Survey Index:   43 Tag:         us2autpr AGE =  3
Time = JAN-1           Type = NUMBER
Catchability =    0.119082E+00   % Variance Contribution =     1.9147
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual


1978     0.469041E+04     0.301665E+04     0.441371E+00
1979     0.534407E+03     0.414148E+03     0.254934E+00
1980     0.229090E+04     0.203717E+04     0.117386E+00
1981     0.769918E+03     0.159216E+04    -0.726563E+00
1982     0.307366E+04     0.138027E+04     0.800592E+00
1983     0.260851E+04     0.243794E+04     0.676275E-01
1984     0.148806E+04     0.964044E+03     0.434093E+00
1985     0.931388E+03     0.681445E+03     0.312459E+00
1986     0.115105E+04     0.149668E+04    -0.262576E+00
1987     0.175540E+03     0.581276E+03    -0.119736E+01
1988     0.184802E+04     0.263304E+04    -0.354025E+00
1989     0.596973E+03     0.116734E+04    -0.670609E+00
1990     0.142946E+04     0.167545E+04    -0.158786E+00
1991     0.221905E+04     0.753787E+03     0.107972E+01
1992     0.239336E+03     0.598096E+03    -0.915885E+00
1993     0.129627E+04     0.104184E+04     0.218502E+00
1994     0.726204E+03     0.415182E+03     0.559114E+00
1995     N/A              0.695592E+03     N/A
1996     N/A              0.425775E+03     N/A
1997     N/A              0.279631E+03     N/A
1998     N/A              0.453617E+03     N/A
1999     N/A              0.737982E+03     N/A
2000     N/A              0.350827E+03     N/A
2001     N/A              0.871067E+03     N/A
2002     N/A              0.389898E+03     N/A
2003     N/A              0.170025E+03     N/A
2004     N/A              0.313818E+03     N/A
2005     N/A              0.107686E+03     N/A
2006     N/A              0.818626E+03     N/A
2007     N/A              0.192784E+03     N/A
2008     N/A              0.458669E+03     N/A

Survey Index:   44 Tag:         us3autpr AGE =  4
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```
Time = JAN-1           Type = NUMBER
Catchability =    0.126944E+00   % Variance Contribution =     2.6588
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual


1978     0.943682E+03     0.972437E+03    -0.300155E-01
1979     0.554311E+04     0.170963E+04     0.117628E+01
1980     0.221440E+03     0.252758E+03    -0.132281E+00
1981     0.105720E+04     0.110049E+04    -0.401295E-01
1982     0.212971E+04     0.850669E+03     0.917716E+00
1983     0.330316E+03     0.700709E+03    -0.752042E+00
1984     0.101117E+04     0.113440E+04    -0.114997E+00
1985     0.126867E+04     0.445855E+03     0.104573E+01
1986     0.911170E+02     0.261877E+03    -0.105573E+01
1987     0.449438E+03     0.785902E+03    -0.558836E+00
1988     0.147536E+03     0.334737E+03    -0.819275E+00
1989     0.123466E+04     0.134691E+04    -0.870210E-01
1990     0.220074E+03     0.673435E+03    -0.111843E+01
1991     0.247819E+04     0.851609E+03     0.106816E+01
1992     0.374577E+03     0.263475E+03     0.351839E+00
1993     0.238106E+03     0.262782E+03    -0.986068E-01
1994     0.522659E+03     0.408009E+03     0.247641E+00
1995     N/A              0.187294E+03     N/A
1996     N/A              0.444084E+03     N/A
1997     N/A              0.259149E+03     N/A
1998     N/A              0.158710E+03     N/A
1999     N/A              0.246826E+03     N/A
2000     N/A              0.413947E+03     N/A
2001     N/A              0.221668E+03     N/A
2002     N/A              0.456954E+03     N/A
2003     N/A              0.205799E+03     N/A
2004     N/A              0.102307E+03     N/A
2005     N/A              0.224254E+03     N/A
2006     N/A              0.709534E+02     N/A
2007     N/A              0.618071E+03     N/A
2008     N/A              0.123174E+03     N/A

Survey Index:   45 Tag:         us4autpr AGE =  5
Time = JAN-1           Type = NUMBER
Catchability =    0.886514E-01   % Variance Contribution =     4.9511
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual


1978     0.345343E+03     0.263015E+03     0.272327E+00
1979     0.131635E+04     0.362808E+03     0.128874E+01
1980     0.230388E+04     0.613153E+03     0.132373E+01
1981     0.717188E+02     0.101139E+03    -0.343742E+00
1982     0.804616E+03     0.415633E+03     0.660562E+00
1983     0.926196E+02     0.249712E+03    -0.991806E+00
1984     0.943955E+02     0.188630E+03    -0.692296E+00
1985     0.112715E+04     0.384359E+03     0.107587E+01
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1986     0.144120E+03     0.121222E+03     0.173027E+00
1987     0.112018E+02     0.815329E+02    -0.198493E+01
1988     0.273624E+03     0.276951E+03    -0.120861E-01
1989     0.819643E+02     0.106207E+03    -0.259105E+00
1990     0.692735E+03     0.432643E+03     0.470734E+00
1991     0.563368E+03     0.229110E+03     0.899732E+00
1992     0.416652E+02     0.236805E+03    -0.173757E+01
1993     0.136607E+03     0.660536E+02     0.726642E+00
1994     0.225402E+02     0.537923E+02    -0.869831E+00
1995     N/A              0.769469E+02     N/A
1996     N/A              0.540421E+02     N/A
1997     N/A              0.153071E+03     N/A
1998     N/A              0.674813E+02     N/A
1999     N/A              0.515287E+02     N/A
2000     N/A              0.735774E+02     N/A
2001     N/A              0.144823E+03     N/A
2002     N/A              0.671790E+02     N/A
2003     N/A              0.141078E+03     N/A
2004     N/A              0.543551E+02     N/A
2005     N/A              0.378151E+02     N/A
2006     N/A              0.822402E+02     N/A
2007     N/A              0.240314E+02     N/A
2008     N/A              0.259710E+03     N/A

Survey Index:   46 Tag:         us5autpr AGE =  6
Time = JAN-1           Type = NUMBER
Catchability =    0.104097E+00   % Variance Contribution =     2.0355
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual



1978     0.236467E+03     0.131560E+03     0.586346E+00
1979     0.458317E+03     0.169087E+03     0.997149E+00
1980     0.437962E+03     0.236037E+03     0.618143E+00
1981     0.361736E+03     0.359601E+03     0.591760E-02
1982     0.737679E+02     0.675192E+02     0.885110E-01
1983     0.157371E+03     0.209796E+03    -0.287527E+00
1984     0.448071E+02     0.132490E+03    -0.108414E+01
1985     0.330589E+02     0.953821E+02    -0.105960E+01
1986     0.104641E+03     0.174673E+03    -0.512381E+00
1987     0.665277E+02     0.675865E+02    -0.157893E-01
1988     0.382500E+02     0.504070E+02    -0.275986E+00
1989     0.264608E+03     0.120020E+03     0.790594E+00
1990     0.747241E+02     0.662996E+02     0.119619E+00
1991     0.390013E+03     0.204756E+03     0.644364E+00
1992     0.396161E+02     0.867047E+02    -0.783272E+00
1993     0.596973E+02     0.887614E+02    -0.396665E+00
1994     0.345616E+02     0.196490E+02     0.564717E+00
1995     N/A              0.125894E+02     N/A
1996     N/A              0.384119E+02     N/A
1997     N/A              0.280971E+02     N/A
1998     N/A              0.652369E+02     N/A
1999     N/A              0.290896E+02     N/A
2000     N/A              0.229273E+02     N/A
2001     N/A              0.413025E+02     N/A
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2002     N/A              0.742061E+02     N/A
2003     N/A              0.306429E+02     N/A
2004     N/A              0.513663E+02     N/A
2005     N/A              0.231623E+02     N/A
2006     N/A              0.228705E+02     N/A
2007     N/A              0.449574E+02     N/A
2008     N/A              0.163806E+02     N/A

Survey Index:   47 Tag:         us0autpo AGE =  1
Time = JAN-1           Type = NUMBER
Catchability =    0.201548E-01   % Variance Contribution =    10.2185
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual


1978     N/A              0.578545E+03     N/A
1979     N/A              0.522867E+03     N/A
1980     N/A              0.461818E+03     N/A
1981     N/A              0.924917E+03     N/A
1982     N/A              0.400333E+03     N/A
1983     N/A              0.227857E+03     N/A
1984     N/A              0.584905E+03     N/A
1985     N/A              0.193794E+03     N/A
1986     N/A              0.897000E+03     N/A
1987     N/A              0.360732E+03     N/A
1988     N/A              0.500935E+03     N/A
1989     N/A              0.359738E+03     N/A
1990     N/A              0.205664E+03     N/A
1991     N/A              0.398989E+03     N/A
1992     N/A              0.150551E+03     N/A
1993     N/A              0.198951E+03     N/A
1994     N/A              0.127290E+03     N/A
1995     0.912536E+02     0.791133E+02     0.142762E+00
1996     0.218435E+03     0.134543E+03     0.484604E+00
1997     0.295071E+02     0.214064E+03    -0.198164E+01
1998     0.874290E+01     0.996501E+02    -0.243342E+01
1999     0.957616E+02     0.246572E+03    -0.945791E+00
2000     0.957616E+02     0.120462E+03    -0.229473E+00
2001     0.266384E+02     0.462563E+02    -0.551843E+00
2002     0.387964E+02     0.854458E+02    -0.789555E+00
2003     0.319661E+03     0.294520E+02     0.238450E+01
2004     0.446569E+03     0.217703E+03     0.718462E+00
2005     0.230224E+04     0.508423E+02     0.381291E+01
2006     0.711723E+02     0.130803E+03    -0.608585E+00
2007     0.135787E+03     0.141827E+03    -0.435200E-01
2008     0.102319E+03     0.982481E+02     0.405978E-01

Survey Index:   48 Tag:         us1autpo AGE =  2
Time = JAN-1           Type = NUMBER
Catchability =    0.741493E-01   % Variance Contribution =     2.3641
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
```

```
1978     N/A              0.349017E+03     N/A
1979     N/A              0.173248E+04     N/A
1980     N/A              0.155623E+04     N/A
1981     N/A              0.136828E+04     N/A
1982     N/A              0.270432E+04     N/A
1983     N/A              0.115394E+04     N/A
1984     N/A              0.644427E+03     N/A
1985     N/A              0.174298E+04     N/A
1986     N/A              0.571941E+03     N/A
1987     N/A              0.265041E+04     N/A
1988     N/A              0.107961E+04     N/A
1989     N/A              0.148711E+04     N/A
1990     N/A              0.102391E+04     N/A
1991     N/A              0.614670E+03     N/A
1992     N/A              0.118313E+04     N/A
1993     N/A              0.440641E+03     N/A
1994     N/A              0.579230E+03     N/A
1995     0.554079E+03     0.377089E+03     0.384824E+00
1996     0.334278E+03     0.236134E+03     0.347573E+00
1997     0.327721E+03     0.400910E+03    -0.201576E+00
1998     0.322666E+03     0.636283E+03    -0.679026E+00
1999     0.458317E+03     0.295917E+03     0.437482E+00
2000     0.190840E+03     0.739503E+03    -0.135454E+01
2001     0.780027E+03     0.355244E+03     0.786524E+00
2002     0.643420E+02     0.138545E+03    -0.766981E+00
2003     0.652982E+03     0.255121E+03     0.939812E+00
2004     0.227178E+03     0.875738E+02     0.953251E+00
2005     0.101745E+04     0.652361E+03     0.444457E+00
2006     0.755438E+02     0.152318E+03    -0.701258E+00
2007     0.590826E+03     0.391793E+03     0.410787E+00
2008     0.156688E+03     0.426488E+03    -0.100133E+01

Survey Index:   49 Tag:         us2autpo AGE =  3
Time = JAN-1           Type = NUMBER
Catchability =    0.162972E+00   % Variance Contribution =     1.9241
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
```

```
1978     N/A              0.412850E+04     N/A
1979     N/A              0.566792E+03     N/A
1980     N/A              0.278801E+04     N/A
1981     N/A              0.217898E+04     N/A
1982     N/A              0.188899E+04     N/A
1983     N/A              0.333649E+04     N/A
1984     N/A              0.131936E+04     N/A
1985     N/A              0.932606E+03     N/A
1986     N/A              0.204832E+04     N/A
1987     N/A              0.795518E+03     N/A
1988     N/A              0.360351E+04     N/A
1989     N/A              0.159758E+04     N/A
1990     N/A              0.229297E+04     N/A
1991     N/A              0.103161E+04     N/A
1992     N/A              0.818537E+03     N/A
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1993     N/A              0.142583E+04     N/A
1994     N/A              0.568206E+03     N/A
1995     0.907481E+03     0.951967E+03    -0.478571E-01
1996     0.247341E+04     0.582703E+03     0.144568E+01
1997     0.267477E+03     0.382695E+03    -0.358206E+00
1998     0.438372E+03     0.620807E+03    -0.347951E+00
1999     0.140186E+04     0.100998E+04     0.327870E+00
2000     0.210648E+03     0.480132E+03    -0.823872E+00
2001     0.734673E+03     0.119212E+04    -0.484060E+00
2002     0.520200E+03     0.533604E+03    -0.254400E-01
2003     0.965812E+03     0.232692E+03     0.142326E+01
2004     0.422389E+03     0.429482E+03    -0.166521E-01
2005     0.185512E+03     0.147376E+03     0.230138E+00
2006     0.791502E+03     0.112035E+04    -0.347462E+00
2007     0.221030E+03     0.263838E+03    -0.177035E+00
2008     0.282504E+03     0.627721E+03    -0.798405E+00

Survey Index:   50 Tag:         us3autpo AGE =  4
Time = JAN-1           Type = NUMBER
Catchability =    0.233271E+00   % Variance Contribution =     2.7971
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
```

```
1978     N/A              0.178695E+04     N/A
1979     N/A              0.314161E+04     N/A
1980     N/A              0.464468E+03     N/A
1981     N/A              0.202226E+04     N/A
1982     N/A              0.156319E+04     N/A
1983     N/A              0.128762E+04     N/A
1984     N/A              0.208457E+04     N/A
1985     N/A              0.819302E+03     N/A
1986     N/A              0.481224E+03     N/A
1987     N/A              0.144417E+04     N/A
1988     N/A              0.615112E+03     N/A
1989     N/A              0.247508E+04     N/A
1990     N/A              0.123750E+04     N/A
1991     N/A              0.156491E+04     N/A
1992     N/A              0.484161E+03     N/A
1993     N/A              0.482887E+03     N/A
1994     N/A              0.749755E+03     N/A
1995     0.592055E+03     0.344171E+03     0.542461E+00
1996     0.170554E+04     0.816047E+03     0.737165E+00
1997     0.566100E+03     0.476211E+03     0.172910E+00
1998     0.149312E+03     0.291646E+03    -0.669504E+00
1999     0.480584E+03     0.453566E+03     0.578607E-01
2000     0.422936E+03     0.760668E+03    -0.586977E+00
2001     0.963080E+02     0.407336E+03    -0.144209E+01
2002     0.627027E+03     0.839697E+03    -0.292052E+00
2003     0.190704E+04     0.378175E+03     0.161795E+01
2004     0.273897E+03     0.187999E+03     0.376314E+00
2005     0.970047E+03     0.412088E+03     0.856108E+00
2006     0.176087E+03     0.130384E+03     0.300494E+00
2007     0.702434E+03     0.113577E+04    -0.480511E+00
2008     0.688500E+02     0.226345E+03    -0.119013E+01
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Survey Index:   51 Tag:         us4autpo AGE =  5
Time = JAN-1           Type = NUMBER
Catchability =    0.211986E+00   % Variance Contribution =     3.2650
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual


1978     N/A              0.628928E+03     N/A
1979     N/A              0.867557E+03     N/A
1980     N/A              0.146619E+04     N/A
1981     N/A              0.241846E+03     N/A
1982     N/A              0.993874E+03     N/A
1983     N/A              0.597117E+03     N/A
1984     N/A              0.451058E+03     N/A
1985     N/A              0.919090E+03     N/A
1986     N/A              0.289869E+03     N/A
1987     N/A              0.194964E+03     N/A
1988     N/A              0.662253E+03     N/A
1989     N/A              0.253965E+03     N/A
1990     N/A              0.103455E+04     N/A
1991     N/A              0.547853E+03     N/A
1992     N/A              0.566254E+03     N/A
1993     N/A              0.157949E+03     N/A
1994     N/A              0.128630E+03     N/A
1995     0.209555E+03     0.183998E+03     0.130065E+00
1996     0.119121E+03     0.129227E+03    -0.814277E-01
1997     0.195348E+03     0.366027E+03    -0.627925E+00
1998     0.176496E+03     0.161363E+03     0.896428E-01
1999     0.561455E+02     0.123217E+03    -0.786000E+00
2000     0.348212E+03     0.175940E+03     0.682665E+00
2001     0.107646E+03     0.346305E+03    -0.116847E+01
2002     0.811446E+02     0.160640E+03    -0.682935E+00
2003     0.222260E+04     0.337349E+03     0.188531E+01
2004     0.212561E+03     0.129976E+03     0.491882E+00
2005     0.344250E+03     0.904246E+02     0.133685E+01
2006     0.239882E+03     0.196655E+03     0.198696E+00
2007     0.461732E+02     0.574644E+02    -0.218767E+00
2008     0.177999E+03     0.621027E+03    -0.124960E+01

Survey Index:   52 Tag:         us5autpo AGE =  6
Time = JAN-1           Type = NUMBER
Catchability =    0.253043E+00   % Variance Contribution =     3.6646
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual


1978     N/A              0.319802E+03     N/A
1979     N/A              0.411024E+03     N/A
1980     N/A              0.573771E+03     N/A
1981     N/A              0.874135E+03     N/A
1982     N/A              0.164129E+03     N/A
1983     N/A              0.509981E+03     N/A
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1984     N/A              0.322062E+03     N/A
1985     N/A              0.231859E+03     N/A
1986     N/A              0.424604E+03     N/A
1987     N/A              0.164292E+03     N/A
1988     N/A              0.122532E+03     N/A
1989     N/A              0.291749E+03     N/A
1990     N/A              0.161164E+03     N/A
1991     N/A              0.497729E+03     N/A
1992     N/A              0.210766E+03     N/A
1993     N/A              0.215765E+03     N/A
1994     N/A              0.477637E+02     N/A
1995     0.927563E+02     0.306029E+02     0.110888E+01
1996     0.739045E+02     0.933734E+02    -0.233833E+00
1997     0.815545E+02     0.682996E+02     0.177367E+00
1998     0.663911E+02     0.158581E+03    -0.870701E+00
1999     0.483589E+02     0.707124E+02    -0.379970E+00
2000     0.118985E+03     0.557327E+02     0.758429E+00
2001     0.418018E+02     0.100400E+03    -0.876222E+00
2002     0.745875E+02     0.180383E+03    -0.883112E+00
2003     0.161196E+03     0.744881E+02     0.771984E+00
2004     0.112564E+03     0.124863E+03    -0.103696E+00
2005     0.439192E+03     0.563041E+02     0.205417E+01
2006     0.353813E+02     0.555946E+02    -0.451902E+00
2007     0.170486E+03     0.109285E+03     0.444697E+00
2008     0.874290E+01     0.398186E+02    -0.151609E+01
```

```
Bootstrap Summary Report

Number of Bootstrap Repetitions Requested =  1000
Number of Bootstrap Repetitions Completed =  1000
Bootstrap Output Variable: Stock Estimates (2008)


              NLLS           Bootstrap      Bootstrap      C.V. For
              Estimate       Mean           Std Error      NLLS Soln.

N  1           4875.          6694.          5979.         0.8932
N  2           5752.          6358.          2707.         0.4257
N  3           3852.          4065.          1293.         0.3181
N  4            970.          1003.           303.         0.3015
N  5           2930.          3019.           841.         0.2787
N  6            157.           165.            50.         0.3014
N  7            238.           251.            96.         0.3835
N  8             81.            85.            36.         0.4197

                                               NLLS
                                               Estimate    C.V. For
           Bias        Bias        Per Cent    Corrected   Corrected
           Estimate    Std. Error  Bias        For Bias    Estimate

N  1        1819.        198.     37.3120       3056.      1.9565
N  2         606.         88.     10.5393       5146.      0.5260
N  3         214.         41.      5.5481       3638.      0.3555
N  4          33.         10.      3.4200        937.      0.3228
N  5          89.         27.      3.0394       2841.      0.2961
N  6           7.          2.      4.6315        150.      0.3306
N  7          13.          3.      5.5863        224.      0.4289
N  8           4.          1.      5.4608         76.      0.4682

               LOWER          UPPER
            80. % CI       80. % CI
N  1            1954.         13428.
N  2            3484.          9918.
N  3            2596.          5739.
N  4             653.          1395.
N  5            2031.          4074.
N  6             108.           229.
N  7             138.           379.
N  8              44.           130.
```

```
Bootstrap Output Variable: Catchability Estimates


              NLLS            Bootstrap       Bootstrap       C.V. For
              Estimate        Mean            Std Error       NLLS Soln.

Q  1       0.178394E-01   0.187930E-01   0.627300E-02          0.3338
Q  2       0.918544E-01   0.923297E-01   0.108349E-01          0.1174
Q  3       0.168705E+00   0.170720E+00   0.280406E-01          0.1642
Q  4       0.215614E+00   0.218945E+00   0.436434E-01          0.1993
Q  5       0.264241E+00   0.273535E+00   0.598480E-01          0.2188
Q  6       0.278657E+00   0.282841E+00   0.530001E-01          0.1874
Q  7       0.297561E+00   0.304346E+00   0.543058E-01          0.1784
Q  8       0.363074E+00   0.364229E+00   0.660452E-01          0.1813
Q  9       0.292985E-01   0.295983E-01   0.641135E-02          0.2166
Q 10       0.101150E+00   0.101495E+00   0.986629E-02          0.0972
Q 11       0.225276E+00   0.225825E+00   0.266989E-01          0.1182
Q 12       0.506259E+00   0.512075E+00   0.850898E-01          0.1662
Q 13       0.688799E+00   0.698933E+00   0.118738E+00          0.1699
Q 14       0.701770E+00   0.711636E+00   0.121819E+00          0.1712
Q 15       0.723118E+00   0.751632E+00   0.191788E+00          0.2552
Q 16       0.816798E+00   0.830399E+00   0.170318E+00          0.2051
Q 17       0.141338E-01   0.179475E-01   0.154487E-01          0.8608
Q 18       0.899870E-01   0.918702E-01   0.202105E-01          0.2200
Q 19       0.198731E+00   0.204879E+00   0.453433E-01          0.2213
Q 20       0.177261E+00   0.177987E+00   0.220123E-01          0.1237
Q 21       0.216299E+00   0.224095E+00   0.553287E-01          0.2469
Q 22       0.207689E+00   0.210823E+00   0.352334E-01          0.1671
Q 23       0.300243E+00   0.323287E+00   0.122228E+00          0.3781
Q 24       0.291472E+00   0.338867E+00   0.202053E+00          0.5963
Q 25       0.358799E-01   0.376050E-01   0.123109E-01          0.3274
Q 26       0.187587E+00   0.191192E+00   0.383436E-01          0.2006
Q 27       0.324684E+00   0.325478E+00   0.353214E-01          0.1085
Q 28       0.372132E+00   0.373357E+00   0.465633E-01          0.1247
Q 29       0.580779E+00   0.584819E+00   0.673329E-01          0.1151
Q 30       0.555873E+00   0.565143E+00   0.117326E+00          0.2076
Q 31       0.730017E+00   0.755580E+00   0.222638E+00          0.2947
Q 32       0.644843E-03   0.657234E-03   0.169703E-03          0.2582
Q 33       0.158633E-01   0.166693E-01   0.623586E-02          0.3741
Q 34       0.779414E-01   0.816357E-01   0.211843E-01          0.2595
Q 35       0.362628E+00   0.364545E+00   0.524685E-01          0.1439
Q 36       0.888325E+00   0.893783E+00   0.130016E+00          0.1455
Q 37       0.140774E+01   0.141534E+01   0.184223E+00          0.1302
Q 38       0.193422E+01   0.195304E+01   0.293137E+00          0.1501
Q 39       0.190133E+01   0.196087E+01   0.399811E+00          0.2039
Q 40       0.127804E-02   0.129603E-02   0.300947E-03          0.2322
Q 41       0.163752E-01   0.167592E-01   0.307154E-02          0.1833
Q 42       0.811005E-01   0.818014E-01   0.110507E-01          0.1351
Q 43       0.119082E+00   0.120320E+00   0.175370E-01          0.1458
Q 44       0.126944E+00   0.128267E+00   0.225092E-01          0.1755
Q 45       0.886514E-01   0.904213E-01   0.206588E-01          0.2285
Q 46       0.104097E+00   0.105532E+00   0.157620E-01          0.1494
Q 47       0.201548E-01   0.219539E-01   0.100801E-01          0.4591
Q 48       0.741493E-01   0.754117E-01   0.151957E-01          0.2015
Q 49       0.162972E+00   0.163349E+00   0.290142E-01          0.1776
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Q 50       0.233271E+00   0.236413E+00   0.505131E-01         0.2137
Q 51       0.211986E+00   0.217195E+00   0.523856E-01         0.2412
Q 52       0.253043E+00   0.262837E+00   0.658035E-01         0.2504


                                               NLLS
                                               Estimate    C.V. For
           Bias        Bias        Per Cent    Corrected   Corrected
           Estimate    Std. Error  Bias        For Bias    Estimate

Q  1      0.9536E-03  0.2007E-03      5.3453  0.1689E-01      0.3715
Q  2      0.4753E-03  0.3430E-03      0.5175  0.9138E-01      0.1186
Q  3      0.2015E-02  0.8890E-03      1.1946  0.1667E+00      0.1682
Q  4      0.3330E-02  0.1384E-02      1.5445  0.2123E+00      0.2056
Q  5      0.9294E-02  0.1915E-02      3.5171  0.2549E+00      0.2347
Q  6      0.4184E-02  0.1681E-02      1.5013  0.2745E+00      0.1931
Q  7      0.6786E-02  0.1731E-02      2.2805  0.2908E+00      0.1868
Q  8      0.1155E-02  0.2089E-02      0.3181  0.3619E+00      0.1825
Q  9      0.2997E-03  0.2030E-03      1.0231  0.2900E-01      0.2211
Q 10      0.3451E-03  0.3122E-03      0.3412  0.1008E+00      0.0979
Q 11      0.5493E-03  0.8445E-03      0.2438  0.2247E+00      0.1188
Q 12      0.5815E-02  0.2697E-02      1.1487  0.5004E+00      0.1700
Q 13      0.1013E-01  0.3768E-02      1.4713  0.6787E+00      0.1750
Q 14      0.9866E-02  0.3865E-02      1.4059  0.6919E+00      0.1761
Q 15      0.2851E-01  0.6132E-02      3.9432  0.6946E+00      0.2761
Q 16      0.1360E-01  0.5403E-02      1.6651  0.8032E+00      0.2121
Q 17      0.3814E-02  0.5032E-03     26.9833  0.1032E-01      1.4970
Q 18      0.1883E-02  0.6419E-03      2.0928  0.8810E-01      0.2294
Q 19      0.6147E-02  0.1447E-02      3.0934  0.1926E+00      0.2354
Q 20      0.7258E-03  0.6965E-03      0.4094  0.1765E+00      0.1247
Q 21      0.7796E-02  0.1767E-02      3.6042  0.2085E+00      0.2654
Q 22      0.3133E-02  0.1119E-02      1.5087  0.2046E+00      0.1722
Q 23      0.2304E-01  0.3933E-02      7.6749  0.2772E+00      0.4409
Q 24      0.4740E-01  0.6563E-02     16.2606  0.2441E+00      0.8278
Q 25      0.1725E-02  0.3931E-03      4.8079  0.3415E-01      0.3604
Q 26      0.3605E-02  0.1218E-02      1.9216  0.1840E+00      0.2084
Q 27      0.7940E-03  0.1117E-02      0.2446  0.3239E+00      0.1091
Q 28      0.1225E-02  0.1473E-02      0.3292  0.3709E+00      0.1255
Q 29      0.4040E-02  0.2133E-02      0.6956  0.5767E+00      0.1167
Q 30      0.9271E-02  0.3722E-02      1.6678  0.5466E+00      0.2146
Q 31      0.2556E-01  0.7087E-02      3.5017  0.7045E+00      0.3160
Q 32      0.1239E-04  0.5381E-05      1.9215  0.6325E-03      0.2683
Q 33      0.8060E-03  0.1988E-03      5.0809  0.1506E-01      0.4141
Q 34      0.3694E-02  0.6800E-03      4.7399  0.7425E-01      0.2853
Q 35      0.1917E-02  0.1660E-02      0.5286  0.3607E+00      0.1455
Q 36      0.5458E-02  0.4115E-02      0.6144  0.8829E+00      0.1473
Q 37      0.7601E-02  0.5831E-02      0.5400  0.1400E+01      0.1316
Q 38      0.1883E-01  0.9289E-02      0.9734  0.1915E+01      0.1530
Q 39      0.5954E-01  0.1278E-01      3.1314  0.1842E+01      0.2171
Q 40      0.1799E-04  0.9534E-05      1.4075  0.1260E-02      0.2388
Q 41      0.3840E-03  0.9789E-04      2.3450  0.1599E-01      0.1921
Q 42      0.7009E-03  0.3502E-03      0.8643  0.8040E-01      0.1374
Q 43      0.1238E-02  0.5560E-03      1.0399  0.1178E+00      0.1488
Q 44      0.1324E-02  0.7130E-03      1.0429  0.1256E+00      0.1792
Q 45      0.1770E-02  0.6557E-03      1.9965  0.8688E-01      0.2378
Q 46      0.1435E-02  0.5005E-03      1.3789  0.1027E+00      0.1535
Q 47      0.1799E-02  0.3238E-03      8.9262  0.1836E-01      0.5492
```

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Q 48      0.1262E-02  0.4822E-03      1.7024  0.7289E-01      0.2085
Q 49      0.3777E-03  0.9176E-03      0.2318  0.1626E+00      0.1784
Q 50      0.3142E-02  0.1600E-02      1.3470  0.2301E+00      0.2195
Q 51      0.5210E-02  0.1665E-02      2.4576  0.2068E+00      0.2533
Q 52      0.9794E-02  0.2104E-02      3.8705  0.2432E+00      0.2705


               LOWER          UPPER
            80. % CI       80. % CI
Q  1     0.119738E-01   0.268905E-01
Q  2     0.787491E-01   0.106205E+00
Q  3     0.135282E+00   0.208162E+00
Q  4     0.166710E+00   0.276879E+00
Q  5     0.203211E+00   0.354625E+00
Q  6     0.218803E+00   0.351076E+00
Q  7     0.241163E+00   0.376140E+00
Q  8     0.284267E+00   0.450136E+00
Q  9     0.220487E-01   0.382057E-01
Q 10     0.891654E-01   0.113979E+00
Q 11     0.192796E+00   0.260044E+00
Q 12     0.409531E+00   0.630641E+00
Q 13     0.555093E+00   0.868470E+00
Q 14     0.565726E+00   0.881835E+00
Q 15     0.525975E+00   0.100552E+01
Q 16     0.625795E+00   0.105897E+01
Q 17     0.527488E-02   0.362726E-01
Q 18     0.675451E-01   0.119442E+00
Q 19     0.151073E+00   0.264704E+00
Q 20     0.151667E+00   0.207328E+00
Q 21     0.161290E+00   0.297728E+00
Q 22     0.169228E+00   0.257906E+00
Q 23     0.185918E+00   0.486119E+00
Q 24     0.144110E+00   0.577096E+00
Q 25     0.243866E-01   0.536093E-01
Q 26     0.145636E+00   0.242102E+00
Q 27     0.281805E+00   0.374254E+00
Q 28     0.316473E+00   0.434718E+00
Q 29     0.500193E+00   0.674773E+00
Q 30     0.428176E+00   0.724742E+00
Q 31     0.504484E+00   0.106412E+01
Q 32     0.450307E-03   0.895896E-03
Q 33     0.972364E-02   0.248184E-01
Q 34     0.569554E-01   0.110027E+00
Q 35     0.302125E+00   0.435224E+00
Q 36     0.731529E+00   0.106845E+01
Q 37     0.117973E+01   0.165983E+01
Q 38     0.159058E+01   0.233071E+01
Q 39     0.149533E+01   0.249015E+01
Q 40     0.931809E-03   0.169488E-02
Q 41     0.130108E-01   0.207385E-01
Q 42     0.679859E-01   0.963778E-01
Q 43     0.999247E-01   0.142363E+00
Q 44     0.100339E+00   0.158053E+00
Q 45     0.657883E-01   0.117191E+00
Q 46     0.873508E-01   0.126044E+00
Q 47     0.115838E-01   0.346139E-01
Q 48     0.573770E-01   0.959451E-01
```
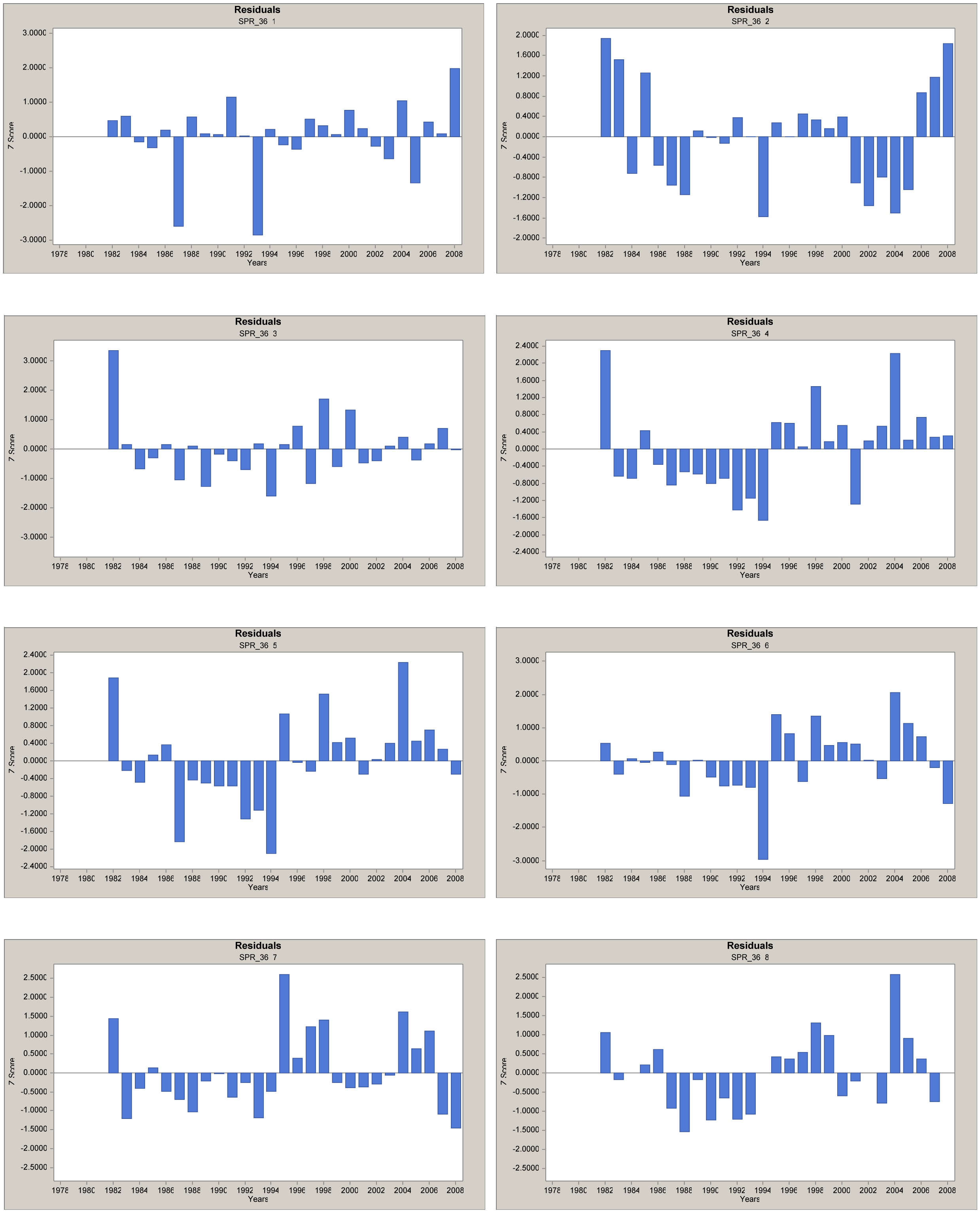

```
 Q 49     0.128922E+00   0.202014E+00
 Q 50     0.177210E+00   0.303958E+00
 Q 51     0.157548E+00   0.286259E+00
 Q 52     0.185426E+00   0.355102E+00


 Bootstrap Output Variable: Fishing Mortality (2007)


               NLLS           Bootstrap      Bootstrap      C.V. For
               Estimate       Mean           Std Error      NLLS Soln.

AGE  1           0.0017         0.0018       0.000727         0.4096
AGE  2           0.1161         0.1200       0.034663         0.2889
AGE  3           0.3119         0.3232       0.081705         0.2528
AGE  4           0.3080         0.3172       0.074404         0.2345
AGE  5           0.3439         0.3520       0.086883         0.2468
AGE  6           0.3973         0.4208       0.140749         0.3345
AGE  7           0.1662         0.1848       0.079164         0.4283
AGE  8           0.3025         0.3192       0.065865         0.2063
AGE  9           0.3025         0.3192       0.065865         0.2063
AGE 10           0.3025         0.3192       0.065865         0.2063

                                                NLLS
                                                Estimate    C.V. For
            Bias        Bias        Per Cent    Corrected   Corrected
            Estimate    Std. Error  Bias        For Bias    Estimate

AGE  1      0.000111    0.000023      6.6776      0.0016      0.4682
AGE  2      0.003842    0.001103      3.3082      0.1123      0.3087
AGE  3      0.011255    0.002608      3.6084      0.3006      0.2718
AGE  4      0.009239    0.002371      2.9997      0.2988      0.2490
AGE  5      0.008150    0.002760      2.3699      0.3357      0.2588
AGE  6      0.023443    0.004512      5.8998      0.3739      0.3764
AGE  7      0.018574    0.002571     11.1729      0.1477      0.5361
AGE  8      0.016722    0.002149      5.5282      0.2858      0.2305
AGE  9      0.016722    0.002149      5.5282      0.2858      0.2305
AGE 10      0.016722    0.002149      5.5282      0.2858      0.2305

                LOWER          UPPER
             80. % CI       80. % CI
AGE  1        0.000962       0.002744
AGE  2        0.079354       0.167325
AGE  3        0.226352       0.433711
AGE  4        0.230071       0.417925
AGE  5        0.248083       0.468221
AGE  6        0.267313       0.606938
AGE  7        0.105918       0.284319
AGE  8        0.241887       0.406217
AGE  9        0.241887       0.406217
AGE 10        0.241887       0.406217
```

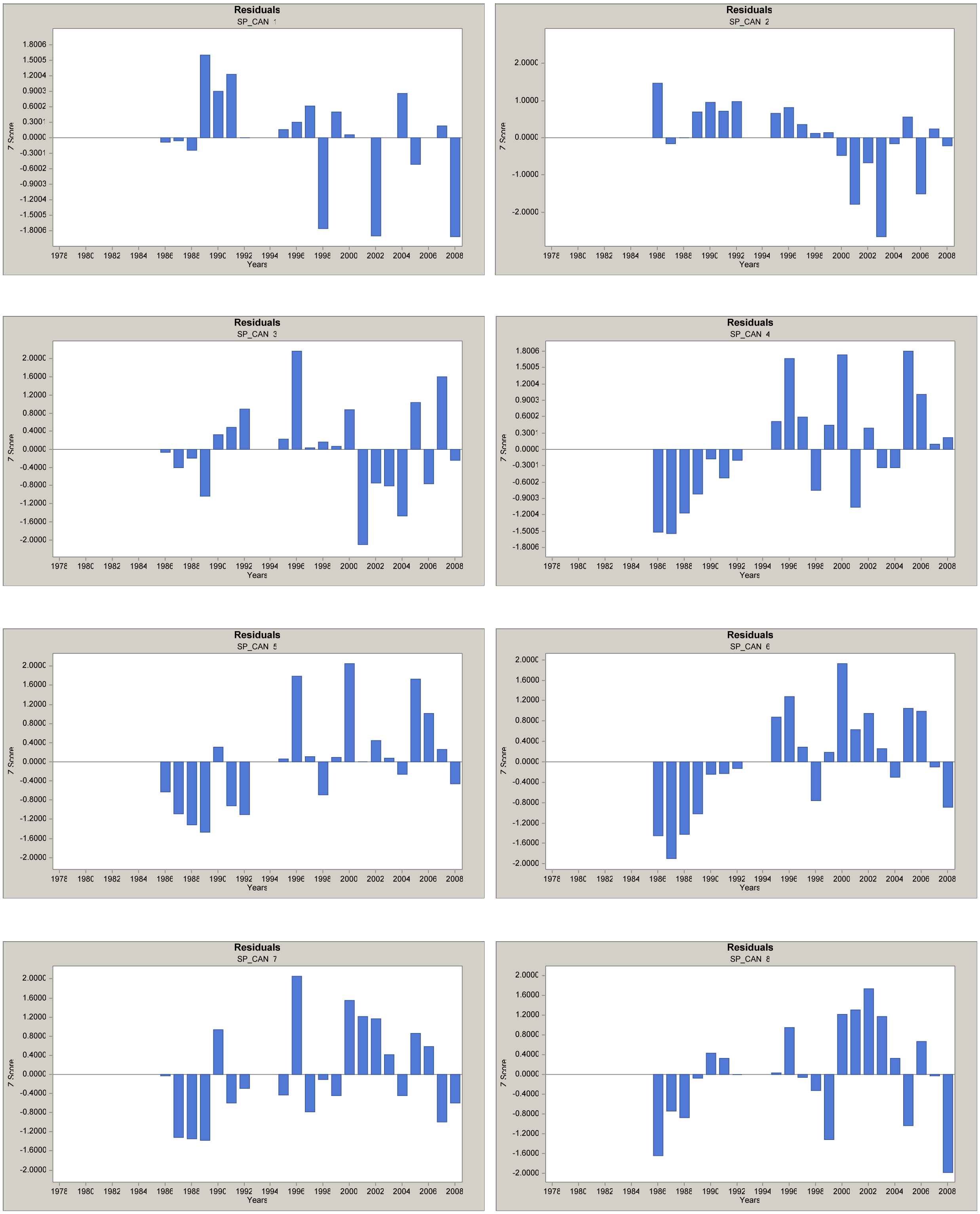
```
 Bootstrap Output Variable: Average F (2007) AGES    5 -    8

               NLLS           Bootstrap      Bootstrap      C.V. For
               Estimate       Mean           Std Error      NLLS Soln.

AVG F            0.3025         0.3192       0.065865         0.2063
N WTD            0.3446         0.3486       0.075233         0.2158
B WTD            0.3356         0.3403       0.074416         0.2187
C WTD            0.3597         0.3776       0.090018         0.2384

                                                NLLS
                                                Estimate    C.V. For
            Bias        Bias        Per Cent    Corrected   Corrected
            Estimate    Std. Error  Bias        For Bias    Estimate

AVG F       0.016722    0.002149      5.5282      0.2858      0.2305
N WTD       0.003978    0.002382      1.1545      0.3406      0.2209
B WTD       0.004673    0.002358      1.3925      0.3309      0.2249
C WTD       0.017960    0.002903      4.9933      0.3417      0.2634

                LOWER          UPPER
             80. % CI       80. % CI
AVG F        0.241887       0.406217
N WTD        0.257390       0.443835
B WTD        0.250281       0.437768
C WTD        0.273103       0.493857


 Bootstrap Output Variable: Biomass

 JAN-1 Biomass (2008) Mean Biomass  & SSB (2007)


               NLLS           Bootstrap      Bootstrap      C.V. For
               Estimate       Mean           Std Error      NLLS Soln.

JAN-1            27315.         29117.          4850.         0.1666
MEAN             25760.         26854.          3963.         0.1476
SSB              17672.         18172.          2716.         0.1494

                                                NLLS
                                                Estimate    C.V. For
            Bias        Bias        Per Cent    Corrected   Corrected
            Estimate    Std. Error  Bias        For Bias    Estimate

JAN-1          1802.        164.      6.5972      25513.      0.1901
MEAN           1094.        130.      4.2465      24666.      0.1607
SSB             500.         87.      2.8292      17172.      0.1581

                LOWER          UPPER
             80. % CI       80. % CI
JAN-1          22993.         35591.
MEAN           21852.         32188.
SSB            14956.         21655.
```

```
Plus Group Diagnostic Report

Calculation Method Selected = Backward

         Population  Population    F            F
Year     Backward     Forward    Forward     Backward    Ratio

1978         44.         44.    0.308259    0.308259    1.000000
1979        127.        131.    0.345514    0.359798    1.041340
1980         37.        103.    0.164657    0.541372    3.287884
1981        173.        244.    0.353951    0.544585    1.538590
1982        192.        333.    0.327151    0.655849    2.004726
1983        288.        268.    0.613105    0.558734    0.911319
1984        283.        200.    1.129093    0.657374    0.582214
1985        182.        213.    0.614331    0.772297    1.257135
1986         76.        116.    0.306033    0.510817    1.669156
1987         75.        145.    0.219497    0.475565    2.166618
1988        105.        149.    0.488757    0.781517    1.598990
1989         54.        110.    0.240156    0.559488    2.329684
1990         88.        142.    0.372457    0.689139    1.850248
1991         47.        101.    0.330946    0.908106    2.743972
1992         19.         76.    0.162996    0.926066    5.681536
1993         34.         74.    0.376025    1.153756    3.068296
1994          9.         59.    0.109817    1.238415   11.277052
1995          3.         55.    0.028725    0.615929   21.442171
1996          1.         50.    0.006628    0.654373   98.725815
1997          7.         52.    0.086811    0.851678    9.810757
1998          6.         45.    0.072847    0.743661   10.208472
1999          7.         39.    0.100541    0.779848    7.756524
2000          3.         33.    0.034234    0.548413   16.019363
2001          3.         31.    0.047227    0.653113   13.829337
2002         13.         39.    0.204668    0.798154    3.899747
2003          5.         34.    0.100203    0.957827    9.558863
2004         10.         28.    0.215770    0.841706    3.900942
2005          8.         27.    0.165477    0.694653    4.197875
2006          8.         26.    0.152554    0.600590    3.936897
2007          4.         23.    0.054852    0.357014    6.508634
2008         20.         35.       N/A         N/A
```

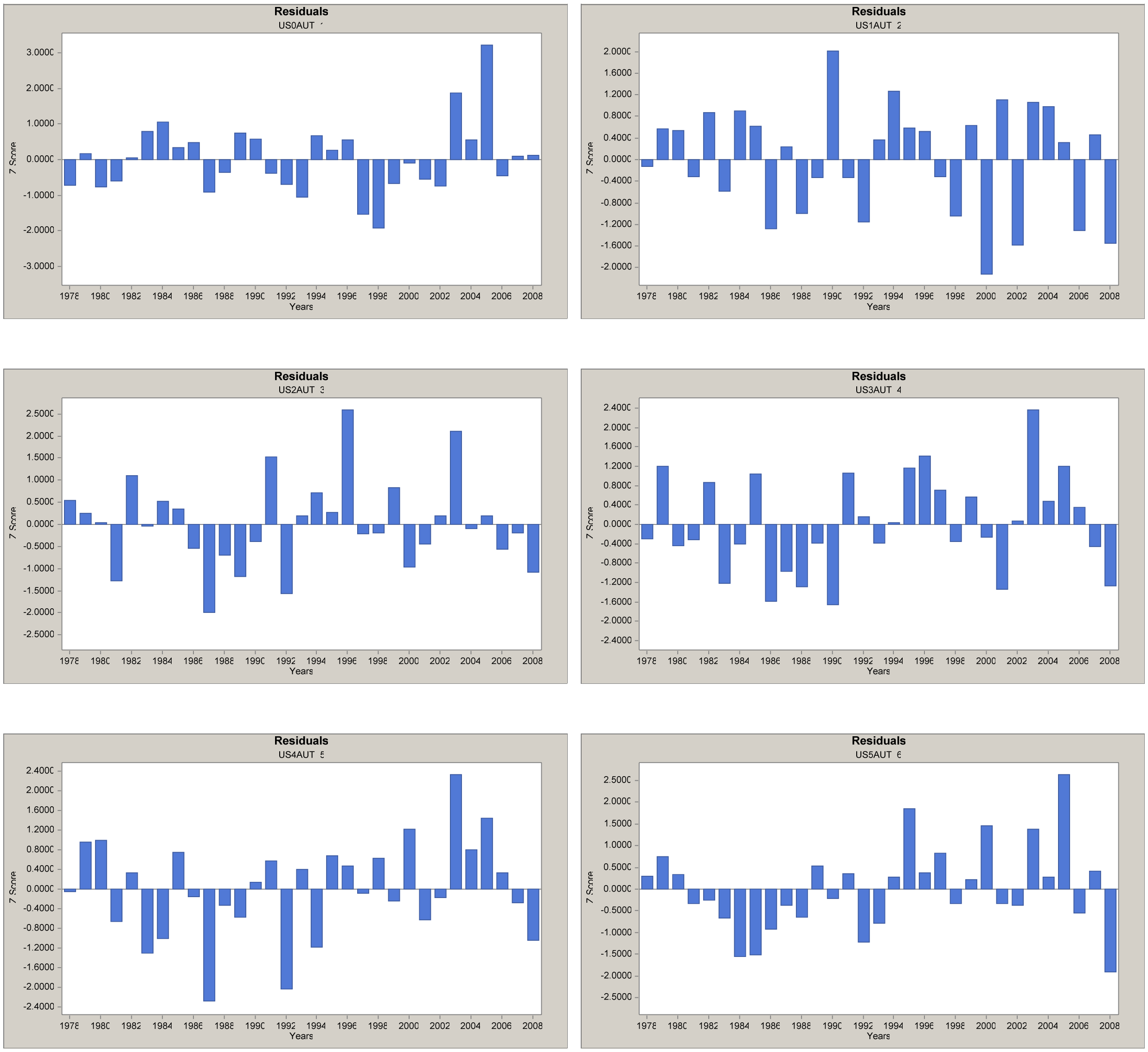


Appendix A. Figure A1a. Base VPA residuals for ages 1-8 for NEFSC spring survey, 1978-2008.

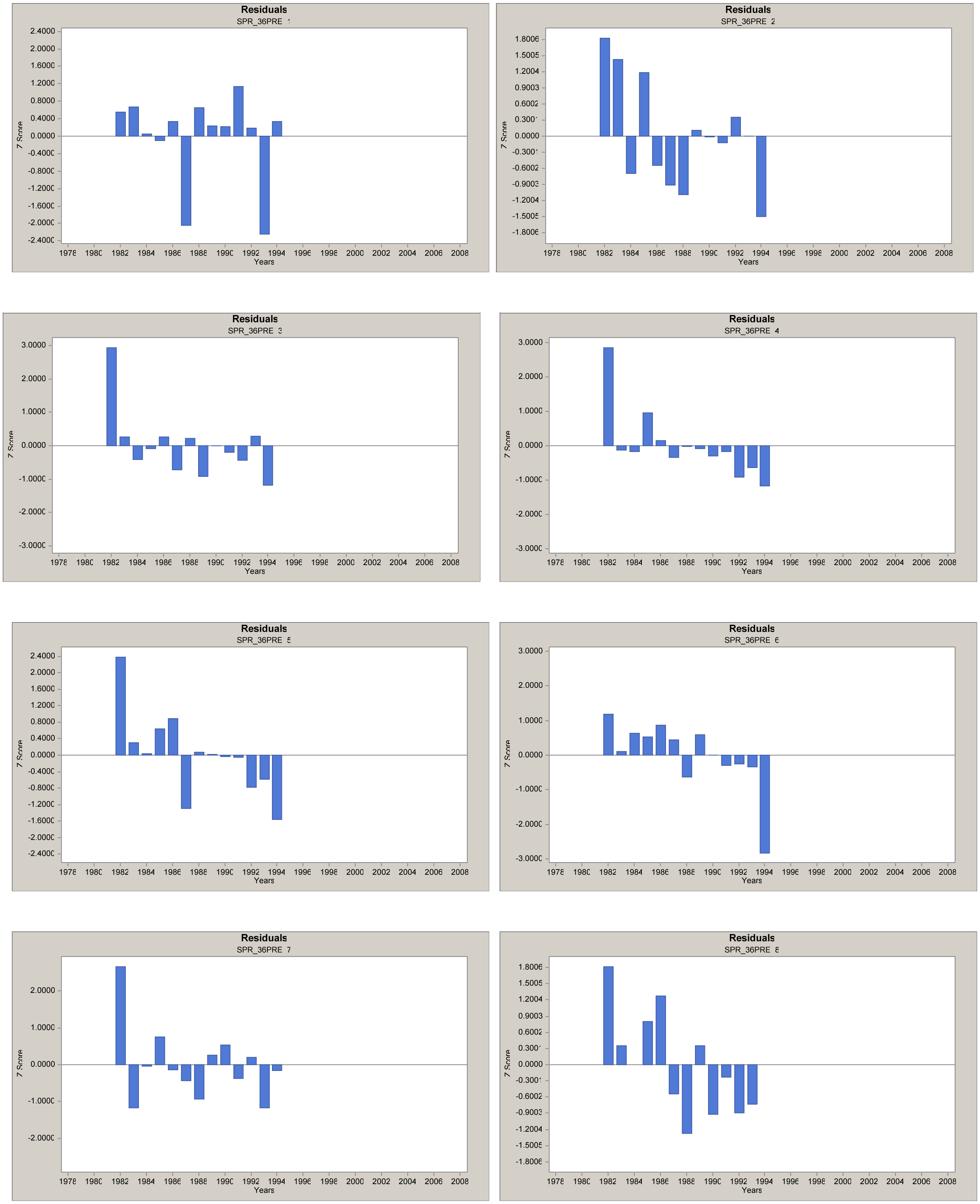
Appendix A. Figure A1b. Base VPA residuals for ages 1-8 for NEFSC spring survey, 1978-1981



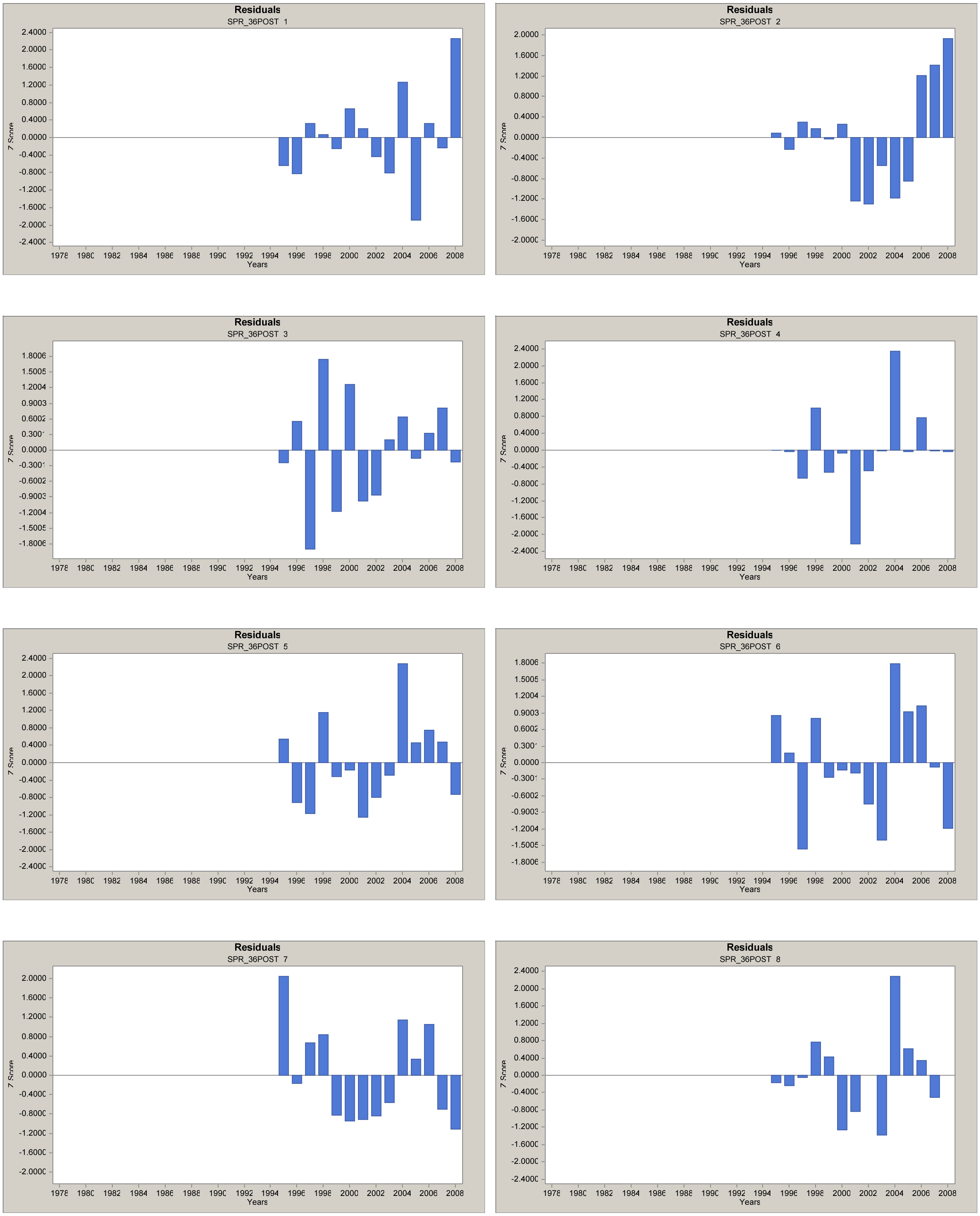
Appendix A. Figure A1c. Base VPA residuals for ages 1-8 for DFO spring survey, 1986-2008



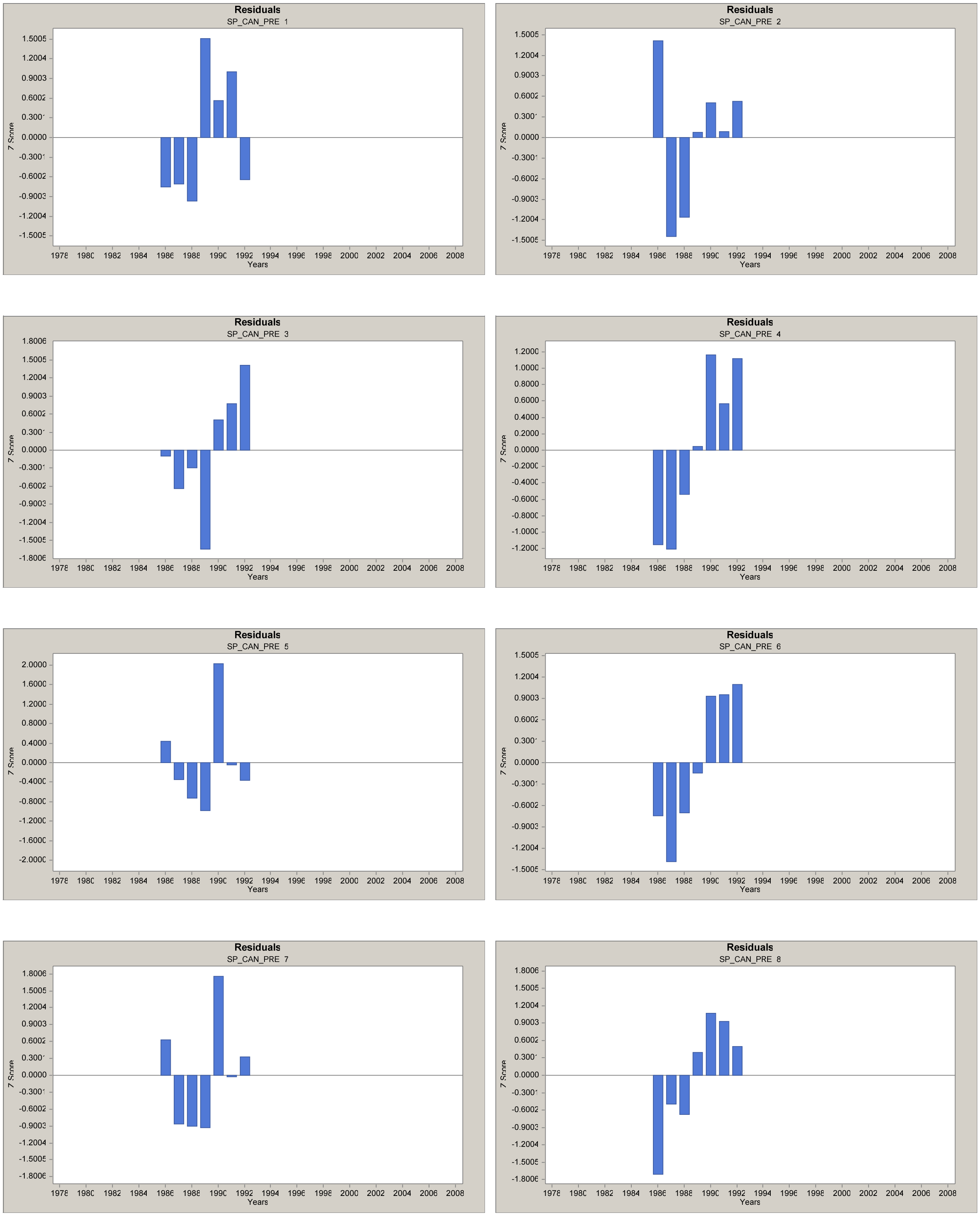
Appendix A. Figure A1d. Base VPA residuals for ages 1-6 for NEFSC autumn survey, 1978-2008.



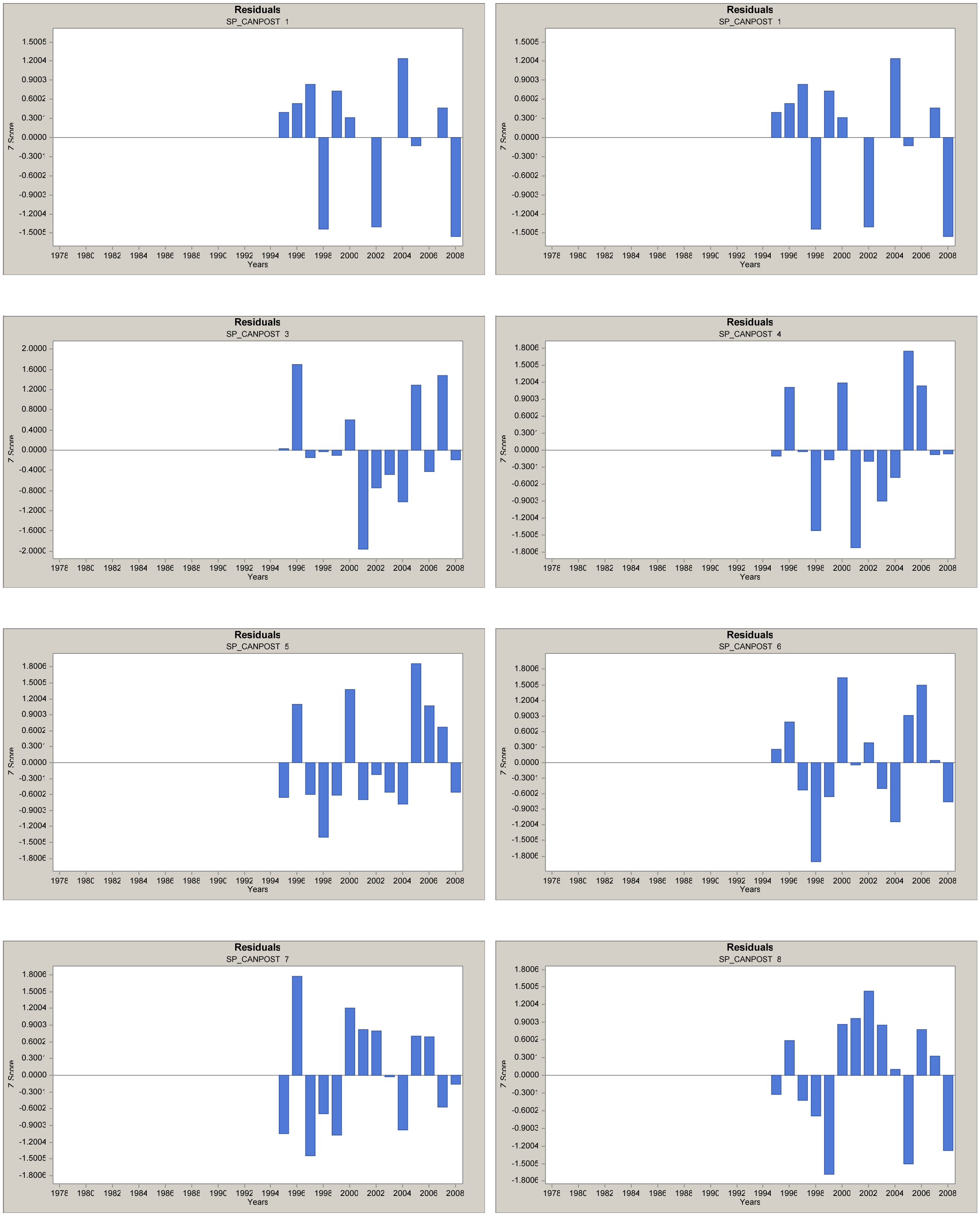
Appendix A. Figure A2a. Split survey VPA residual for ages 1-8 for NEFSC spring survey, 1982-1994.



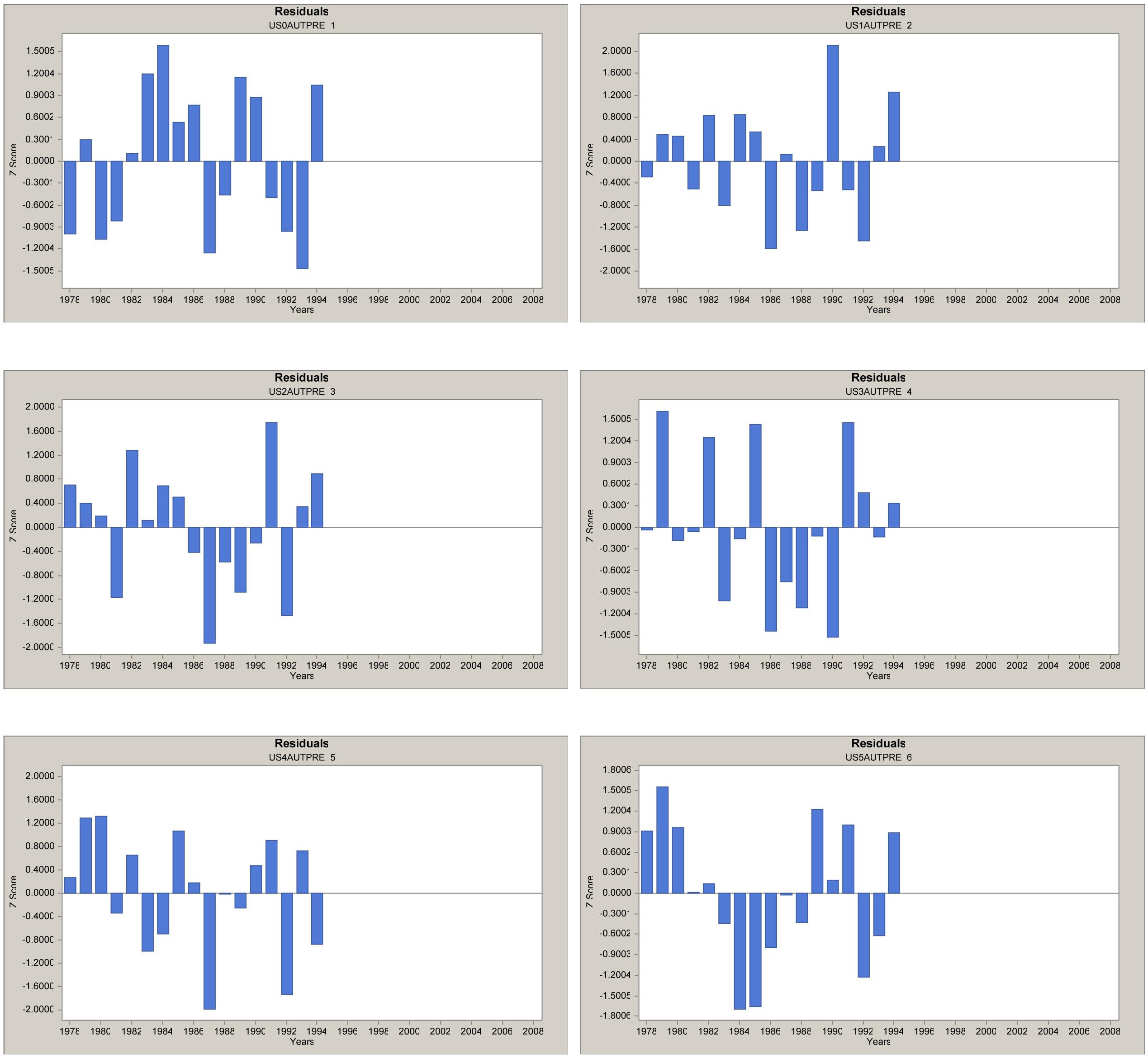
Appendix A. Figure A2b. Split survey VPA residual for ages 1-8 for NEFSC spring survey, 1995-2007.



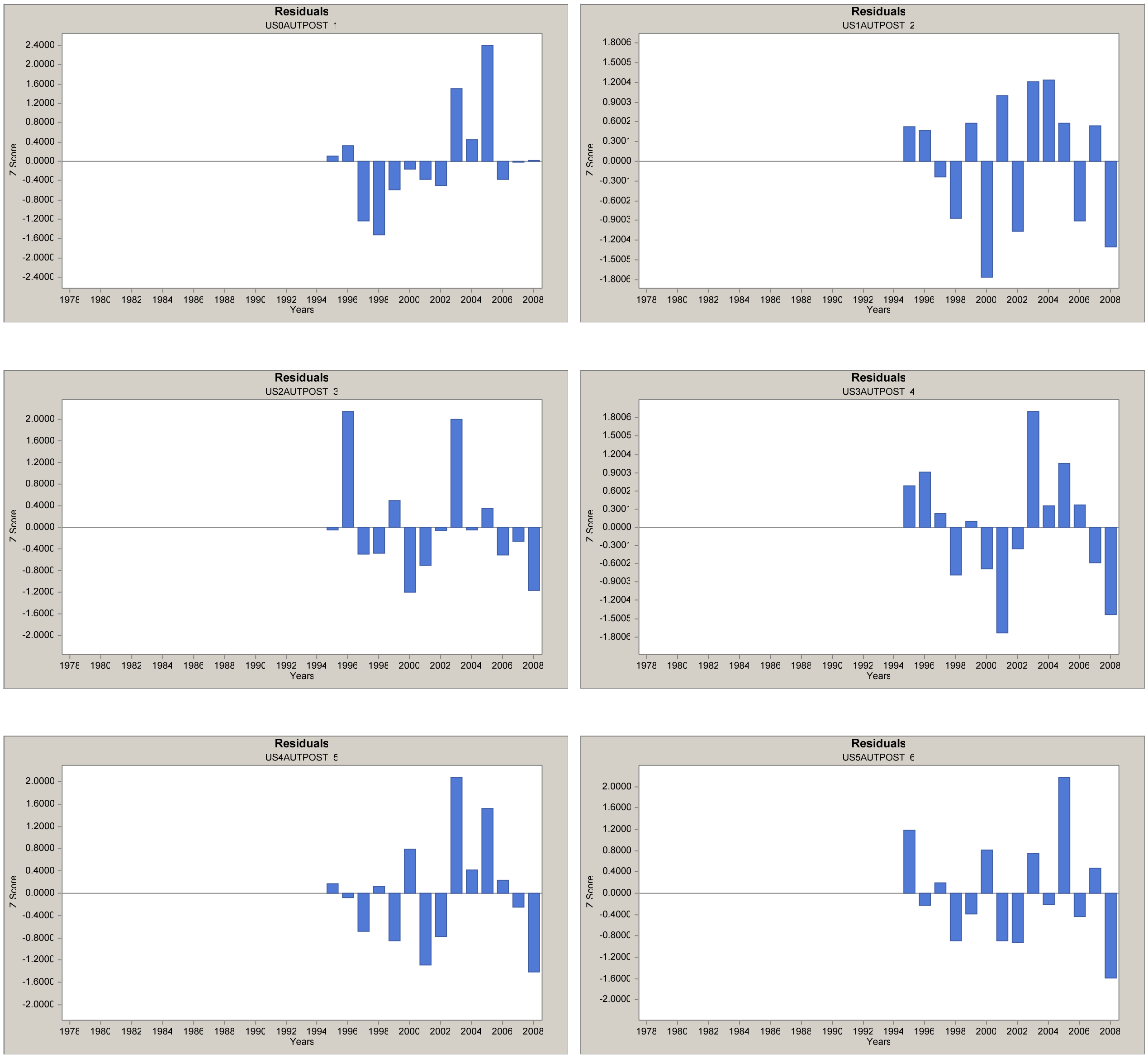
Appendix A. Figure A2c. Split survey VPA residual for ages 1-8 for DFO spring survey, 1986-1994.



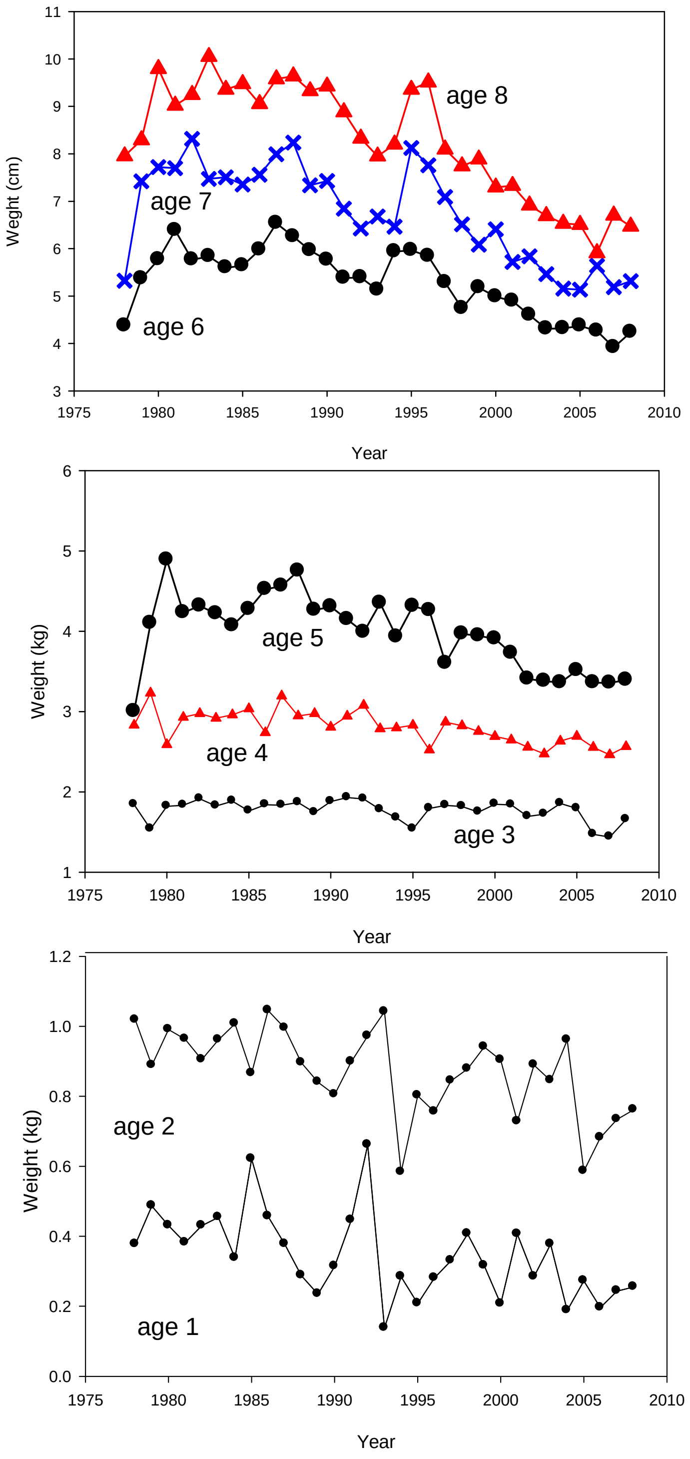
Appendix A. Figure A2d. Split survey VPA residual for ages 1-8 for DFO spring survey, 1995-2007.



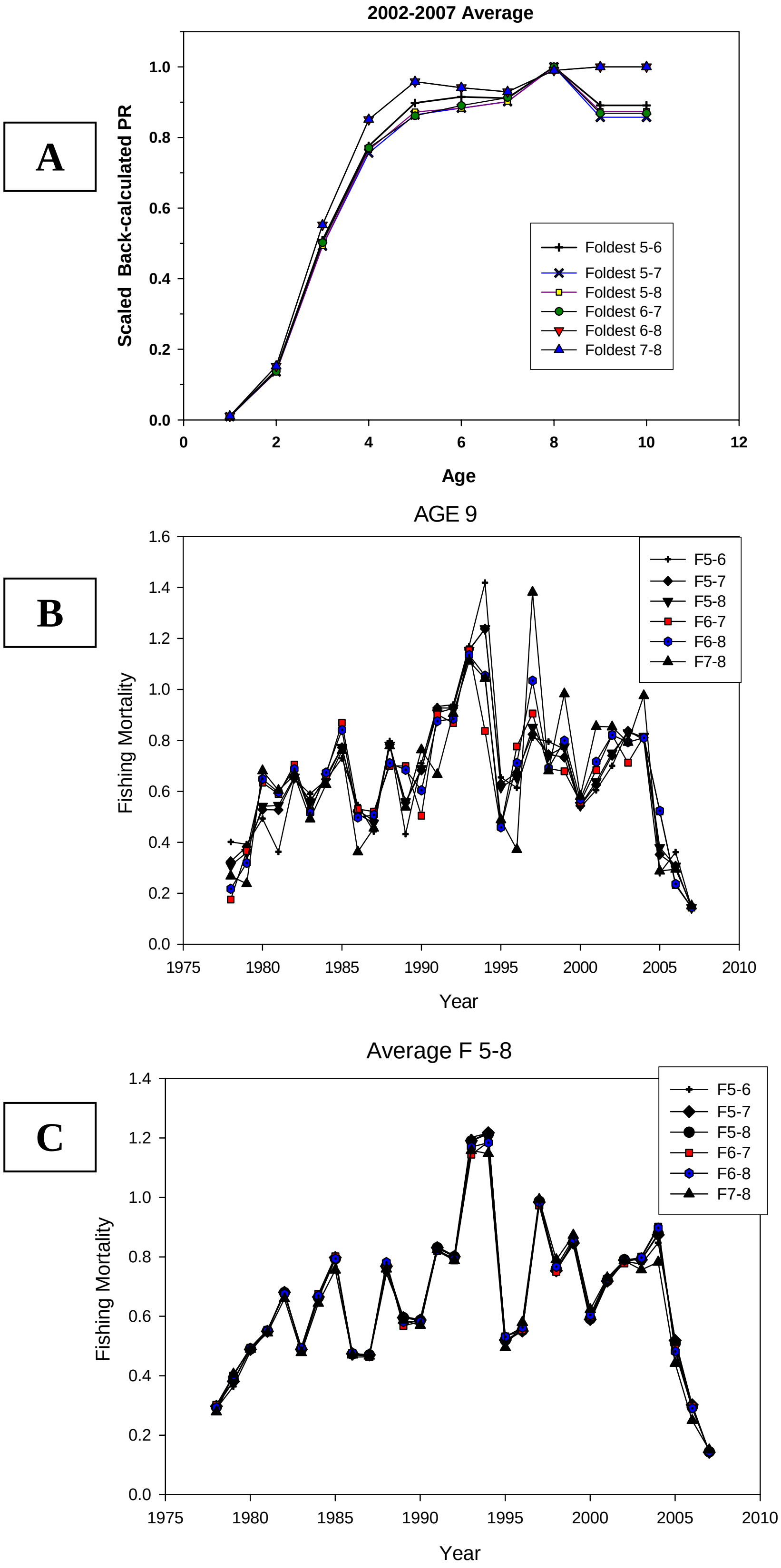
Appendix A. Figure A2e. Split survey VPA residual for ages 1-8 for NEFSC autumn survey, 1978-1994.



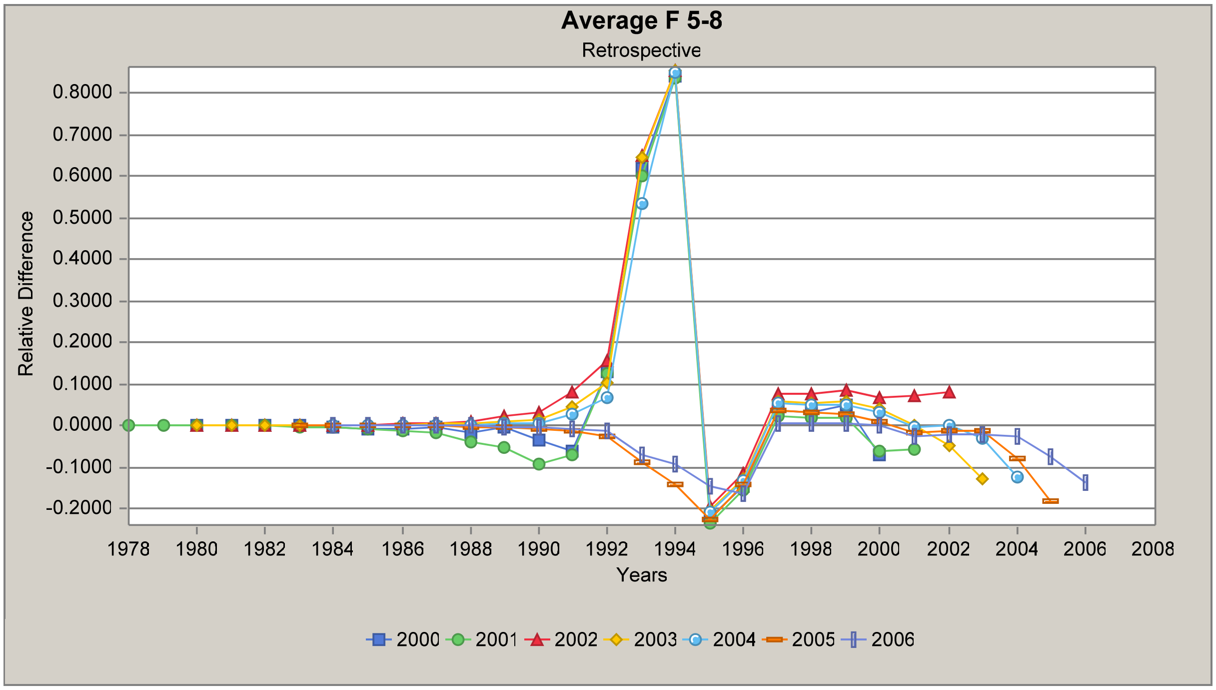
Appendix A. Figure A2f. Split survey VPA residual for ages 1-8 for NEFSC autumn survey, 1995-2007.



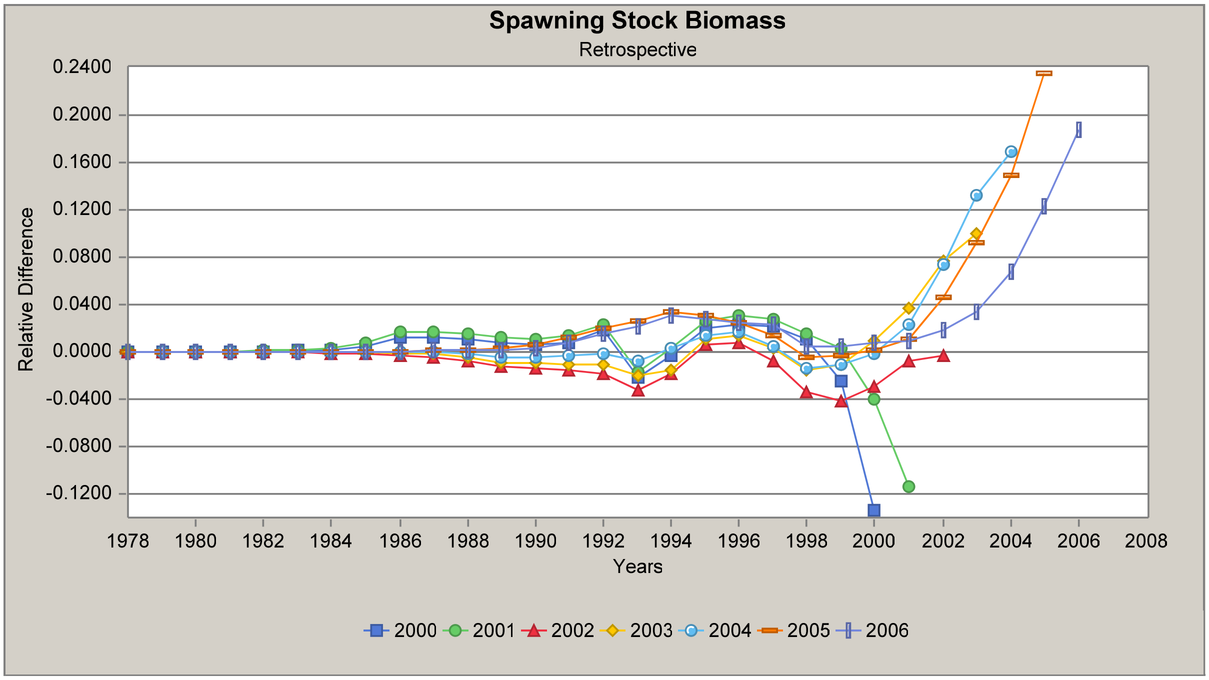
Appendix A. Figure A3. Stock mean weights for ages 1-8 for Georges Bank cod, 1978-2008, from revised August VPA.



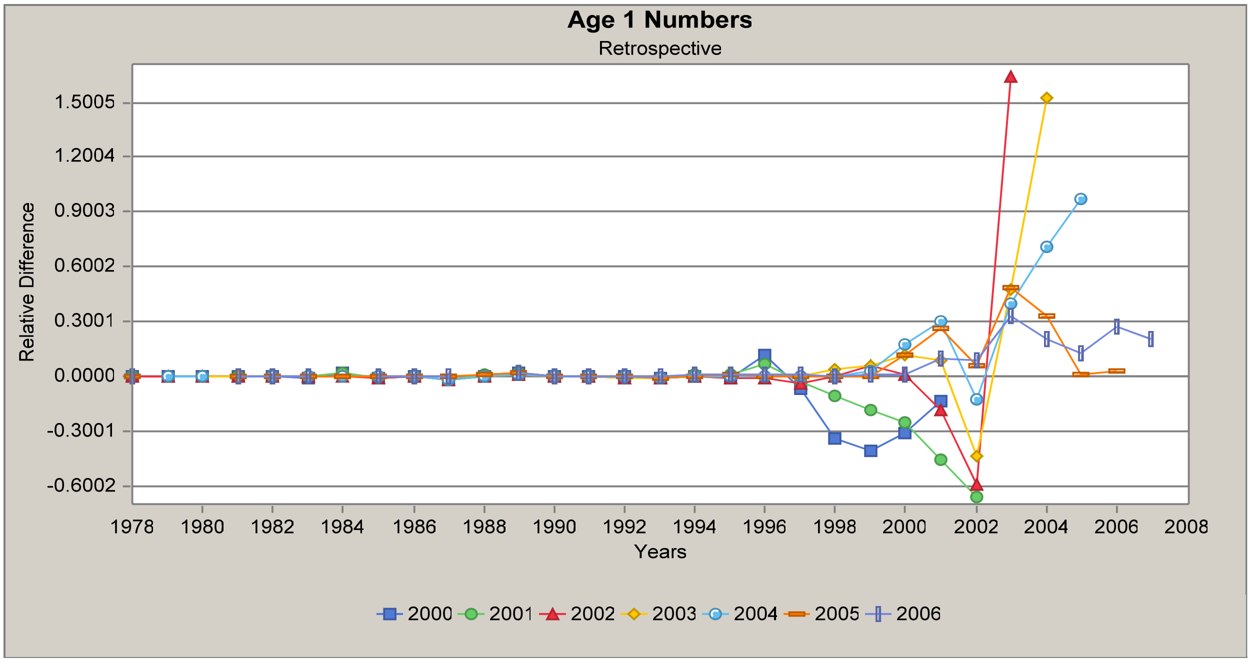
Appendix A. Figure A4. Sensitivity runs of BASE Model, with F on oldest age (9) estimated by averaging different age groups (5-6, 5-7, 5-8, 6-7, 6-8, and 7-8) and the effect on the partial recruitment (A), F on age 9 (B) , and F averaged over ages 5-8 (C), for each scenario.



Appendix A. Figure A5a. Retrospective analysis of relative difference to terminal year 2007 of Georges Bank Atlantic cod fishing mortality (ages 5-8, unweighted), based on around the corner ADAPT VPA, 2000-2007.



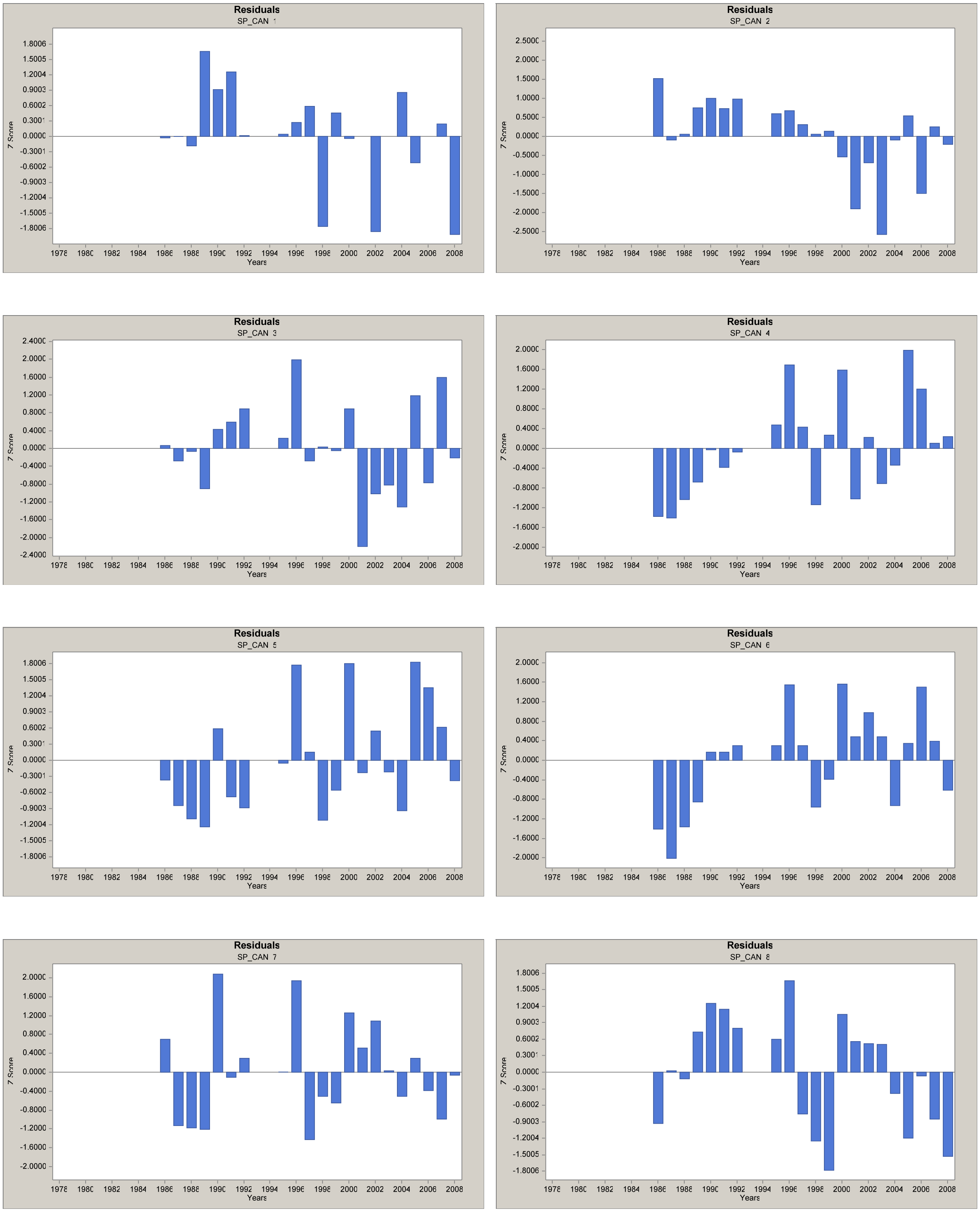
Appendix A. Figure A5b. Retrospective analysis of relative difference to terminal year 2007 of Georges Bank Atlantic cod spawning stock biomass, based on around the corner ADAPT VPA, 2000-2007



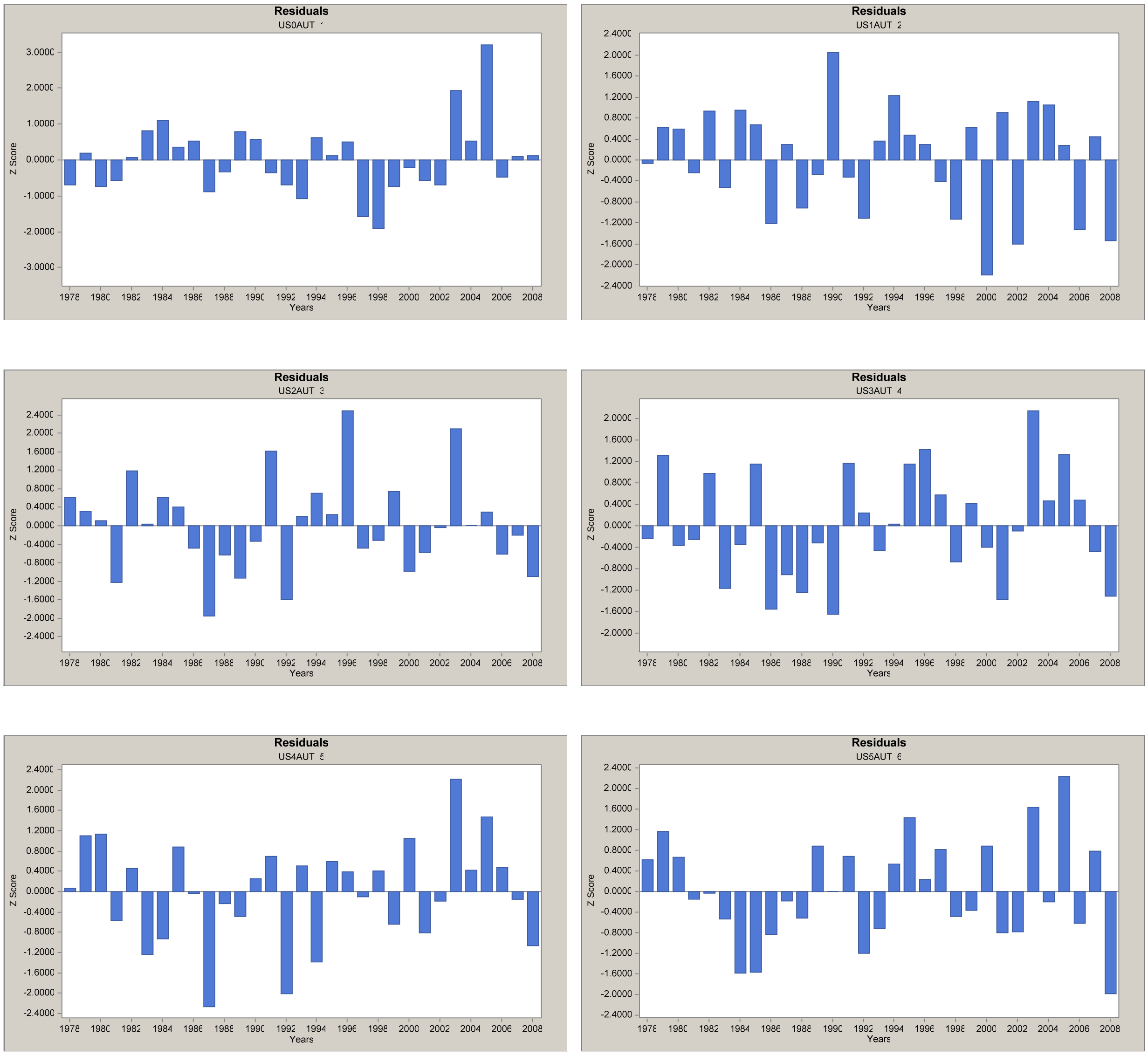
Appendix A. Figure A5c. Retrospective analysis of relative difference to terminal year 2007 of Georges Bank Atlantic cod age 1 recruitment based on around the corner ADAPT VPA, 2000-2007.

Appendix A. Figure A6a. Around the corner VPA residual for ages 1-8 for NEFSC spring survey, 1982-2008.

Appendix A. Figure A6b. Around the corner VPA residual for ages 1-8 for NEFSC spring survey, 1978-1981.



Appendix A. Figure A6c.Around the corner VPA residual for ages 1-8 for DFO spring survey, 1986-2008



Appendix A. Figure A6d. Around the corner VPA residual for ages 1-8 for NEFSC autumn survey, 1978-2008.

# Appendix B. Georges Bank haddock

by Elizabeth N. Brooks, Michele L. Traver, Sandy Sutherland, L. Van Eeckhaute and Laurel Col

Appendix Contents

- VPA input and output
- YPR input and output

### VPA input GB haddock

```
VPA/ADAPT V         2.8
##
MODEL     ID
garm3-rev-base      F5to7     backward  1931      to        2007      data
PARAM
77        9         30        30        9         1931      1         0         123456
PARTIAL   RECRUIT
0.001     0.41      0.84      1         1         1         1         1
AGE       ESTIMATE
1         2         3         4         5         6         7         8         9
STOCK     ESTIMATE
10000     1000      10000     5000      15000     1000      500       300       300
STOCK     MIN-MAX
1         1000000000
F-PLUS
1.0000*77
OMEGA
1.0000*78
WTFSURV
1.0000*30
AGES-F
7-May
AGES-SUMMARY
7-May
MFSPAWN
0.25      0.25
CATCH     AT        AGE
1755      8801      2041      5785      9100      6045      3380      1794      559
118       2084      25871     2421      3676      2894      1320      664       391
244       8476      6023      10046     2092      1579      1210      538       647
341       4454      5414      3734      3149      1051      619       250       168
1197      11872     8819      3706      2944      2458      499       442       109
880       12327     11486     5431      2141      1377      1362      259       124
1288      11034     10910     5629      4143      1875      952       481       222
1030      20199     7755      3755      2113      1600      945       327       173
607       13937     19617     5163      2152      967       837       326       239
2040      7254      12317     8253      2510      1479      752       222       136
780       23464     9808      8033      5764      1781      941       307       384
310       14307     16348     6531      3996      2331      1036      227       176
19        4191      17738     8364      3102      2693      790       354       178
64        761       8437      14843     5689      2281      497       469       108
121       8522      2029      6386      5795      2315      914       265       205
209       7466      15213     2738      5785      3840      1827      272       23
90        16621     10334     7181      2127      2739      1501      745       457
80        11227     19237     5116      2744      1157      780       450       369
328       6472      12479     9608      2347      1061      624       409       353
88        28971     4107      4272      3315      1131      520       225       250
645       8266      26472     2177      2448      2138      740       297       215
0         25120     8892      8485      1361      944       530       182       107
1083      1807      17588     5726      3757      1012      542       337       152
108       31858     5107      5611      2315      2131      720       353       98
90        3941      19251     3316      3278      1649      1068      320       173
52        11948     6698      12066     3405      3378      1348      563       201
35        6594      14046     4523      5822      2357      1630      473       366
125       5571      7088      6665      3784      2366      903       442       142
94        5716      7994      5169      3934      1758      1172      424       334
258       16010     6122      4562      3067      1792      787       406       348
62        10689     14927     4198      2917      1856      1266      496       674
74        4455      16245     10440     3448      2089      1566      1185      898
2910      4047      7418      11152     8198      2205      1405      721       1096
10101     15935     4554      4776      8722      5794      2082      1028      1332
9601      125818    44496     5356      4391      6690      3772      1094      1366
114       6843      100810    19167     2768      2591      2332      1268      867
1150      168       2891      20667     10338     1209      993       917       698
8         2994      709       1921      14519     3499      667       453       842
2         11        1698      448       654       5954      1574      225       570
46        158       16        570       186       214       2308      746       464
1         1375      223       40        289       246       285       1469      928
160       2         460       83        33        123       80        68        1265
2607      2113      3         393       54        31        78        15        455
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48        4481      682       2         73        2         2         55        258
199       1070      1928      388       4         43        4         4         91
149       491       570       913       224       0         24        4         116
1         19858     190       690       522       362       4         40        113
1         767       14509     307       572       521       140       14        68
1         26        1743      7238      530       414       318       97        46
8         31170     349       980       6087      597       549       154       81
1         1755      11076     837       944       2590      333       159       95
1         1174      1645      3761      394       573       1127      107       111
0         216       821       697       2261      275       188       808       77
0         94        301       736       402       1500      237       270       550
0         2464      563       199       472       234       539       80        156
6         55        2848      226       148       175       152       270       61
0         2035      132       1646      125       75        91        108       138
4         53        2439      137       953       152       56        66        108
2         1462      123       1019      217       478       62        37        57
63        12        1697      269       1124      154       218       55        49
7         486       123       2370      144       518       128       172       65
84        265       408       197       1960      181       426       47        100
33        363       439       340       120       741       63        169       82
27        538       1192      242       142       73        313       55        110
17        94        614       471       59        29        9         61        16
7         56        566       919       450       66        22        7         78
15        143       273       745       561       218       18        18        49
6         230       471       558       767       571       169       23        49
3         43        906       541       606       566       384       163       48
2         407       626       1571      588       528       377       258       99
14        145       2393      996       1281      656       438       359       262
3         397       345       3177      926       1105      402       306       551
5         18        1943      461       2686      605       719       212       389
646       33        122       5116      729       2935      687       563       408
20        612       42        339       8505      778       1843      315       343
164       18        3164      71        375       5418      327       842       228
13        175       240       11216     194       311       2512      229       564
WEIGHT    AT        AGE
0.75      0.78      1.18      1.37      1.65      2.01      2.31      2.54      3.03
0.64      0.85      1.09      1.82      1.89      2.19      2.74      2.93      3.20
0.54      0.73      1.35      1.42      1.73      2.39      2.46      2.59      2.60
0.42      0.73      1.13      1.49      1.75      2.11      2.54      2.85      2.98
0.46      0.87      1.22      1.60      1.79      1.98      2.56      2.79      3.42
0.51      0.81      1.19      1.56      1.72      2.09      2.35      2.63      3.32
0.48      0.87      1.24      1.52      1.94      2.19      2.82      3.08      3.56
0.56      0.87      1.37      1.76      2.16      2.30      2.67      2.75      3.71
0.57      0.82      1.18      1.64      1.98      2.48      2.66      2.96      3.42
0.56      0.89      1.27      1.59      1.87      2.34      2.90      3.10      3.87
0.52      0.79      1.20      1.57      1.87      2.31      2.67      2.93      3.52
0.52      0.79      1.15      1.46      1.71      2.03      2.64      3.15      3.38
0.52      0.73      0.99      1.43      1.69      1.89      2.34      2.84      3.37
0.62      0.80      1.09      1.40      1.87      2.31      2.61      3.07      3.68
0.58      0.84      1.24      1.57      1.93      2.37      2.69      3.23      3.35
0.52      0.78      1.20      1.63      1.83      2.22      2.70      3.28      4.18
0.58      0.73      1.15      1.61      2.02      2.36      2.79      3.06      3.32
0.52      0.67      1.04      1.54      1.94      2.35      2.69      3.16      3.50
0.54      0.73      0.99      1.44      1.94      2.40      2.72      3.20      3.69
0.43      0.68      1.07      1.33      1.80      2.24      2.60      3.26      3.42
0.53      0.70      0.95      1.40      1.79      2.34      2.81      3.11      3.30
0.49      0.69      0.94      1.29      1.71      2.22      2.54      3.13      3.49
0.55      0.64      0.94      1.19      1.62      2.02      2.37      2.71      3.31
0.44      0.77      0.90      1.27      1.49      1.82      2.24      2.43      3.08
0.58      0.83      1.08      1.29      1.67      1.95      2.32      2.53      2.96
0.42      0.84      1.04      1.38      1.70      2.13      2.43      2.88      3.62
0.54      0.80      1.11      1.41      1.77      2.08      2.41      2.77      3.11
0.67      0.82      1.12      1.35      1.77      2.25      2.63      2.93      3.39
0.56      0.85      1.15      1.45      1.80      2.18      2.57      3.05      3.52
0.60      0.81      1.22      1.55      1.92      2.47      2.94      3.26      3.78
0.52      0.84      1.11      1.54      1.87      2.26      2.54      2.88      3.24
0.54      0.85      1.07      1.41      1.77      2.14      2.47      2.62      3.29
0.57      0.87      1.18      1.47      1.68      2.15      2.35      3.04      3.10
0.50      0.83      1.12      1.43      1.64      2.01      2.40      2.64      2.97
0.58      0.69      1.03      1.35      1.67      1.99      2.26      2.66      3.11
0.58      0.73      0.89      1.26      1.70      2.07      2.28      2.87      3.18
0.66      0.70      0.95      1.18      1.42      2.05      2.31      2.66      3.10
0.59      0.81      1.05      1.32      1.57      2.10      2.32      2.62      2.86
0.52      0.78      1.10      1.69      1.75      1.99      2.52      2.99      3.63
0.71      1.27      1.22      1.93      2.19      2.39      2.58      3.23      3.75
0.67      1.03      1.31      1.74      2.39      2.81      2.92      3.10      3.72
0.62      1.03      1.74      2.04      2.42      2.92      3.06      3.44      3.66
0.60      1.03      1.58      2.13      2.41      3.29      3.42      3.86      3.94
0.72      1.06      1.82      2.32      2.83      3.76      4.05      3.92      4.26
0.62      0.98      1.63      2.21      2.20      2.94      4.00      4.05      4.33
0.50      0.99      1.39      1.99      2.66      3.08      3.69      4.67      4.94
0.53      1.07      1.44      2.17      2.73      3.21      4.15      4.00      4.99
0.53      0.94      1.50      2.04      2.79      3.19      3.37      3.61      5.11
0.53      1.00      1.28      2.02      2.51      3.14      3.78      3.79      4.87
0.55      0.94      1.21      1.73      2.17      2.82      3.60      3.56      3.87
0.39      0.87      1.24      1.83      2.30      2.72      3.71      4.04      4.44
0.22      0.97      1.45      1.88      2.37      2.76      3.24      3.96      4.09
0.33      1.02      1.37      1.83      2.21      2.65      3.25      3.36      4.27
0.33      0.92      1.32      1.83      2.20      2.67      2.96      3.41      3.72
0.33      0.99      1.39      1.98      2.46      2.72      3.06      3.72      3.80
0.45      0.94      1.36      1.83      2.56      2.83      2.96      3.46      3.78
0.43      0.83      1.43      2.00      2.25      2.63      3.02      3.77      4.29
0.42      0.98      1.34      1.68      2.06      2.45      2.97      3.49      3.96
0.53      0.89      1.48      1.79      2.21      2.57      3.24      3.56      3.82
0.64      0.97      1.48      1.78      2.12      2.55      2.81      2.99      4.16
```

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0.58      1.20      1.31      1.82      2.18      2.65      2.85      3.05      4.34
0.54      1.18      1.64      1.77      2.19      2.52      2.97      3.37      4.27
0.66      1.17      1.73      2.17      2.12      2.63      2.65      3.12      4.01
0.45      1.09      1.64      2.21      2.63      2.73      2.90      3.78      4.55
0.43      0.97      1.49      2.03      2.54      2.82      3.28      3.09      3.98
0.46      1.10      1.50      1.84      2.33      2.54      3.42      3.52      3.71
0.42      1.00      1.69      1.89      2.21      2.55      3.14      3.38      3.66
0.51      0.97      1.49      1.92      2.33      2.69      3.03      3.04      4.07
0.68      1.10      1.53      1.83      2.11      2.34      2.70      2.97      3.68
0.66      1.13      1.46      1.89      2.25      2.37      2.73      2.99      3.30
0.36      1.17      1.46      1.75      2.16      2.53      2.63      2.73      3.41
0.31      0.91      1.34      1.74      1.95      2.47      3.13      3.07      3.34
0.26      0.65      1.36      1.61      1.86      2.05      2.52      3.09      3.17
0.21      0.39      1.00      1.50      1.67      1.95      2.07      2.47      2.91
0.18      0.57      1.05      1.45      1.67      1.83      2.03      2.13      2.63
0.19      0.48      0.95      1.06      1.61      1.78      1.89      2.06      2.31
0.15      0.88      1.09      1.26      1.48      1.83      1.93      2.02      2.18
BIOMASS
0.70      0.66      0.95      1.17      1.43      1.72      2.05      2.42      3.03
0.60      0.80      0.92      1.47      1.61      1.90      2.35      2.60      3.20
0.46      0.68      1.07      1.24      1.77      2.13      2.32      2.66      2.60
0.29      0.63      0.91      1.42      1.58      1.91      2.46      2.65      2.98
0.35      0.60      0.94      1.34      1.63      1.86      2.32      2.66      3.42
0.39      0.61      1.02      1.38      1.66      1.93      2.16      2.59      3.32
0.36      0.67      1.00      1.34      1.74      1.94      2.43      2.69      3.56
0.46      0.65      1.09      1.48      1.81      2.11      2.42      2.78      3.71
0.46      0.68      1.01      1.50      1.87      2.31      2.47      2.81      3.42
0.47      0.71      1.02      1.37      1.75      2.15      2.68      2.87      3.87
0.42      0.67      1.03      1.41      1.72      2.08      2.50      2.92      3.52
0.44      0.64      0.95      1.32      1.64      1.95      2.47      2.90      3.38
0.42      0.62      0.88      1.28      1.57      1.80      2.18      2.74      3.37
0.53      0.65      0.89      1.18      1.64      1.98      2.22      2.68      3.68
0.50      0.72      1.00      1.31      1.64      2.11      2.49      2.90      3.35
0.44      0.67      1.00      1.42      1.70      2.07      2.53      2.97      4.18
0.54      0.62      0.95      1.39      1.81      2.08      2.49      2.87      3.32
0.44      0.62      0.87      1.33      1.77      2.18      2.52      2.97      3.50
0.48      0.62      0.81      1.22      1.73      2.16      2.53      2.93      3.69
0.34      0.61      0.88      1.15      1.61      2.08      2.50      2.98      3.42
0.46      0.55      0.80      1.22      1.54      2.05      2.51      2.84      3.30
0.43      0.60      0.81      1.11      1.55      1.99      2.44      2.97      3.49
0.46      0.56      0.81      1.06      1.45      1.86      2.29      2.62      3.31
0.32      0.65      0.76      1.09      1.33      1.72      2.13      2.40      3.08
0.48      0.60      0.91      1.08      1.46      1.70      2.05      2.38      2.96
0.30      0.70      0.93      1.22      1.48      1.89      2.18      2.58      3.62
0.44      0.58      0.97      1.21      1.56      1.88      2.27      2.59      3.11
0.59      0.67      0.95      1.22      1.58      2.00      2.34      2.66      3.39
0.47      0.75      0.97      1.27      1.56      1.96      2.40      2.83      3.52
0.51      0.67      1.02      1.34      1.67      2.11      2.53      2.89      3.78
0.41      0.71      0.95      1.37      1.70      2.08      2.50      2.91      3.24
0.43      0.66      0.95      1.25      1.65      2.00      2.36      2.58      3.29
0.47      0.69      1.00      1.25      1.54      1.95      2.24      2.74      3.10
0.43      0.69      0.99      1.30      1.55      1.84      2.27      2.49      2.97
0.52      0.59      0.92      1.23      1.55      1.81      2.13      2.53      3.11
0.53      0.65      0.78      1.14      1.51      1.86      2.13      2.55      3.18
0.60      0.64      0.83      1.02      1.34      1.87      2.19      2.46      3.10
0.51      0.73      0.86      1.12      1.36      1.73      2.18      2.46      2.86
0.33      0.68      0.94      1.33      1.52      1.77      2.30      2.63      3.63
0.59      0.81      0.98      1.46      1.92      2.05      2.27      2.85      3.75
0.54      0.86      1.29      1.46      2.15      2.48      2.64      2.83      3.72
0.48      0.83      1.34      1.63      2.05      2.64      2.93      3.17      3.66
0.45      0.80      1.28      1.93      2.22      2.82      3.16      3.44      3.94
0.62      0.80      1.37      1.91      2.46      3.01      3.65      3.66      4.26
0.49      0.84      1.31      2.01      2.26      2.88      3.88      4.05      4.33
0.34      0.78      1.17      1.80      2.42      2.60      3.29      4.32      4.94
0.40      0.73      1.19      1.74      2.33      2.92      3.58      3.84      4.99
0.39      0.71      1.27      1.71      2.46      2.95      3.29      3.87      5.11
0.40      0.73      1.10      1.74      2.26      2.96      3.47      3.57      4.87
0.44      0.71      1.10      1.49      2.09      2.66      3.36      3.67      3.87
0.25      0.69      1.08      1.49      1.99      2.43      3.23      3.81      4.44
0.10      0.62      1.12      1.53      2.08      2.52      2.97      3.83      4.09
0.20      0.47      1.15      1.63      2.04      2.51      3.00      3.30      4.27
0.19      0.55      1.16      1.58      2.01      2.43      2.80      3.33      3.72
0.20      0.57      1.13      1.62      2.12      2.45      2.86      3.32      3.80
0.33      0.56      1.16      1.59      2.25      2.64      2.84      3.25      3.78
0.28      0.61      1.16      1.65      2.03      2.59      2.92      3.34      4.29
0.29      0.65      1.05      1.55      2.03      2.35      2.79      3.25      3.96
0.39      0.61      1.20      1.55      1.93      2.30      2.82      3.25      3.82
0.47      0.72      1.15      1.62      1.95      2.37      2.69      3.11      4.16
0.41      0.88      1.13      1.64      1.97      2.37      2.70      2.93      4.34
0.37      0.83      1.40      1.52      1.99      2.35      2.80      3.10      4.27
0.51      0.79      1.42      1.89      1.94      2.40      2.58      3.04      4.01
0.30      0.85      1.39      1.95      2.39      2.40      2.76      3.17      4.55
0.27      0.66      1.28      1.82      2.37      2.72      2.99      3.00      3.98
0.31      0.69      1.20      1.65      2.17      2.54      3.10      3.39      3.71
0.27      0.67      1.36      1.68      2.02      2.43      2.83      3.40      3.66
0.35      0.63      1.22      1.80      2.10      2.44      2.78      3.09      4.07
0.52      0.75      1.22      1.65      2.01      2.34      2.69      3.00      3.68
0.50      0.88      1.27      1.70      2.03      2.24      2.53      2.84      3.30
0.22      0.88      1.29      1.60      2.02      2.39      2.50      2.73      3.41
0.21      0.57      1.25      1.59      1.85      2.31      2.81      2.84      3.34
0.21      0.44      1.11      1.47      1.79      2.00      2.50      3.11      3.17
0.13      0.32      0.80      1.43      1.64      1.90      2.06      2.49      2.91
0.11      0.35      0.64      1.21      1.58      1.75      1.99      2.10      2.63
0.09      0.29      0.73      1.06      1.53      1.72      1.86      2.05      2.31
0.02      0.41      0.72      1.09      1.26      1.72      1.86      1.95      2.18
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0.11      0.36      0.80      1.25      1.56      1.82      2.05      2.34      2.64
SSB
0.70      0.66      0.95      1.17      1.43      1.72      2.05      2.42      3.03
0.60      0.80      0.92      1.47      1.61      1.90      2.35      2.60      3.20
0.46      0.68      1.07      1.24      1.77      2.13      2.32      2.66      2.60
0.29      0.63      0.91      1.42      1.58      1.91      2.46      2.65      2.98
0.35      0.60      0.94      1.34      1.63      1.86      2.32      2.66      3.42
0.39      0.61      1.02      1.38      1.66      1.93      2.16      2.59      3.32
0.36      0.67      1.00      1.34      1.74      1.94      2.43      2.69      3.56
0.46      0.65      1.09      1.48      1.81      2.11      2.42      2.78      3.71
0.46      0.68      1.01      1.50      1.87      2.31      2.47      2.81      3.42
0.47      0.71      1.02      1.37      1.75      2.15      2.68      2.87      3.87
0.42      0.67      1.03      1.41      1.72      2.08      2.50      2.92      3.52
0.44      0.64      0.95      1.32      1.64      1.95      2.47      2.90      3.38
0.42      0.62      0.88      1.28      1.57      1.80      2.18      2.74      3.37
0.53      0.65      0.89      1.18      1.64      1.98      2.22      2.68      3.68
0.50      0.72      1.00      1.31      1.64      2.11      2.49      2.90      3.35
0.44      0.67      1.00      1.42      1.70      2.07      2.53      2.97      4.18
0.54      0.62      0.95      1.39      1.81      2.08      2.49      2.87      3.32
0.44      0.62      0.87      1.33      1.77      2.18      2.52      2.97      3.50
0.48      0.62      0.81      1.22      1.73      2.16      2.53      2.93      3.69
0.34      0.61      0.88      1.15      1.61      2.08      2.50      2.98      3.42
0.46      0.55      0.80      1.22      1.54      2.05      2.51      2.84      3.30
0.43      0.60      0.81      1.11      1.55      1.99      2.44      2.97      3.49
0.46      0.56      0.81      1.06      1.45      1.86      2.29      2.62      3.31
0.32      0.65      0.76      1.09      1.33      1.72      2.13      2.40      3.08
0.48      0.60      0.91      1.08      1.46      1.70      2.05      2.38      2.96
0.30      0.70      0.93      1.22      1.48      1.89      2.18      2.58      3.62
0.44      0.58      0.97      1.21      1.56      1.88      2.27      2.59      3.11
0.59      0.67      0.95      1.22      1.58      2.00      2.34      2.66      3.39
0.47      0.75      0.97      1.27      1.56      1.96      2.40      2.83      3.52
0.51      0.67      1.02      1.34      1.67      2.11      2.53      2.89      3.78
0.41      0.71      0.95      1.37      1.70      2.08      2.50      2.91      3.24
0.43      0.66      0.95      1.25      1.65      2.00      2.36      2.58      3.29
0.47      0.69      1.00      1.25      1.54      1.95      2.24      2.74      3.10
0.43      0.69      0.99      1.30      1.55      1.84      2.27      2.49      2.97
0.52      0.59      0.92      1.23      1.55      1.81      2.13      2.53      3.11
0.53      0.65      0.78      1.14      1.51      1.86      2.13      2.55      3.18
0.60      0.64      0.83      1.02      1.34      1.87      2.19      2.46      3.10
0.51      0.73      0.86      1.12      1.36      1.73      2.18      2.46      2.86
0.33      0.68      0.94      1.33      1.52      1.77      2.30      2.63      3.63
0.59      0.81      0.98      1.46      1.92      2.05      2.27      2.85      3.75
0.54      0.86      1.29      1.46      2.15      2.48      2.64      2.83      3.72
0.48      0.83      1.34      1.63      2.05      2.64      2.93      3.17      3.66
0.45      0.80      1.28      1.93      2.22      2.82      3.16      3.44      3.94
0.62      0.80      1.37      1.91      2.46      3.01      3.65      3.66      4.26
0.49      0.84      1.31      2.01      2.26      2.88      3.88      4.05      4.33
0.34      0.78      1.17      1.80      2.42      2.60      3.29      4.32      4.94
0.40      0.73      1.19      1.74      2.33      2.92      3.58      3.84      4.99
0.39      0.71      1.27      1.71      2.46      2.95      3.29      3.87      5.11
0.40      0.73      1.10      1.74      2.26      2.96      3.47      3.57      4.87
0.44      0.71      1.10      1.49      2.09      2.66      3.36      3.67      3.87
0.25      0.69      1.08      1.49      1.99      2.43      3.23      3.81      4.44
0.10      0.62      1.12      1.53      2.08      2.52      2.97      3.83      4.09
0.20      0.47      1.15      1.63      2.04      2.51      3.00      3.30      4.27
0.19      0.55      1.16      1.58      2.01      2.43      2.80      3.33      3.72
0.20      0.57      1.13      1.62      2.12      2.45      2.86      3.32      3.80
0.33      0.56      1.16      1.59      2.25      2.64      2.84      3.25      3.78
0.28      0.61      1.16      1.65      2.03      2.59      2.92      3.34      4.29
0.29      0.65      1.05      1.55      2.03      2.35      2.79      3.25      3.96
0.39      0.61      1.20      1.55      1.93      2.30      2.82      3.25      3.82
0.47      0.72      1.15      1.62      1.95      2.37      2.69      3.11      4.16
0.41      0.88      1.13      1.64      1.97      2.37      2.70      2.93      4.34
0.37      0.83      1.40      1.52      1.99      2.35      2.80      3.10      4.27
0.51      0.79      1.42      1.89      1.94      2.40      2.58      3.04      4.01
0.30      0.85      1.39      1.95      2.39      2.40      2.76      3.17      4.55
0.27      0.66      1.28      1.82      2.37      2.72      2.99      3.00      3.98
0.31      0.69      1.20      1.65      2.17      2.54      3.10      3.39      3.71
0.27      0.67      1.36      1.68      2.02      2.43      2.83      3.40      3.66
0.35      0.63      1.22      1.80      2.10      2.44      2.78      3.09      4.07
0.52      0.75      1.22      1.65      2.01      2.34      2.69      3.00      3.68
0.50      0.88      1.27      1.70      2.03      2.24      2.53      2.84      3.30
0.22      0.88      1.29      1.60      2.02      2.39      2.50      2.73      3.41
0.21      0.57      1.25      1.59      1.85      2.31      2.81      2.84      3.34
0.21      0.44      1.11      1.47      1.79      2.00      2.50      3.11      3.17
0.13      0.32      0.80      1.43      1.64      1.90      2.06      2.49      2.91
0.11      0.35      0.64      1.21      1.58      1.75      1.99      2.10      2.63
0.09      0.29      0.73      1.06      1.53      1.72      1.86      2.05      2.31
0.02      0.41      0.72      1.09      1.26      1.72      1.86      1.95      2.18
M         MATRIX
0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2
0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2
0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2
0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2
0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2
0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2
0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2
0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2
0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2
0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2
0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2
0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2
0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2
0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2
0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2
```

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0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2
0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2
0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2
0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2
0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2
0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2
0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2
0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2
0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2
0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2
0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2
0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2
0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2
0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2
0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2
0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2
0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2
0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2
0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2
0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2
0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2
0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2
0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2
0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2
0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2
0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2
0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2
0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2
0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2
0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2
0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2
0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2
0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2
0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2
0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2
0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2
0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2
0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2
0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2
0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2
0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2
0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2
0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2
0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2
0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2
0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2
0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2
0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2
0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2
0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2
0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2
0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2
0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2
0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2
0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2
0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2
0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2
0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2
0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2
0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2
0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2
0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2       0.2
MATURITY
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0.04      0.38      0.87      0.99      1         1         1         1         1
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0.04      0.38      0.87      0.99      1         1         1         1         1
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0.04      0.38      0.87      0.99      1         1         1         1         1
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0.04      0.38      0.87      0.99      1         1         1         1         1
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0.06      0.47      0.92      0.99      1         1         1         1         1
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0.06      0.47      0.92      0.99      1         1         1         1         1
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0.06      0.47      0.92      0.99      1         1         1         1         1
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0.06      0.47      0.92      0.99      1         1         1         1         1
0.06      0.47      0.92      0.99      1         1         1         1         1
0.06      0.47      0.92      0.99      1         1         1         1         1
SURVEY    INDEX

US_Sp     US_Sp     US_Sp     US_Sp     US_Sp     US_Sp     US_Sp     US_Sp     US_S41    US_S41    US_S41    US_S41    US_S41
          US_S41    US_S41    US_S41    US_Au0    US_Au1    US_Au2    US_Au3    US_Au4    US_Au5    Can_Sp    Can_Sp    Can_Sp
          Can_Sp    Can_Sp    Can_Sp    Can_Sp    Can_Sp
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          6         7         8         1         2         3         4         5         6         1         2         3
          4         5         6         7         8
1-Jan     1-Jan     1-Jan     1-Jan     1-Jan     1-Jan     1-Jan     1-Jan     1-Jan     1-Jan     1-Jan     1-Jan     1-Jan
          1-Jan     1-Jan     1-Jan     1-Jan     1-Jan     1-Jan     1-Jan     1-Jan     1-Jan     1-Jan     1-Jan     1-Jan
          1-Jan     1-Jan     1-Jan     1-Jan     1-Jan
number    number    number    number    number    number    number    number    number    number    number    number    number
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          0         0         0         0         0
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          0         0         0         290       193       3095      435       1064      12526     0         0         0
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13048     292       1980      389       97        130       422       97        0         0         0         0         0
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          0         0         0         0         0
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0         0         0         0         0         0         0         0         1980      108439    1363      3960      1947
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          2661      519       195       436       6941      60803     1824      1864      2062      0         0         0
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          519       1201      195       42915     2737      3371      30104     595       833       0         0         0
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0         0         0         0         0         0         0         0         16878     151575    1655      3376      15807
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          5777      779       357       37917     8805      41289     1467      595       5513      0         0         0
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2467      4966      3051      13210     1363      909       1980      0         0         0         0         0         0
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1396      1785      1883      714       7822      32        130       3765      0         0         0         0         0
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6784      3830      2077      2045      1883      2337      227       130       0         0         0         0         0
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8082      584       6686      779       357       682       389       1071      0         0         0         0         0
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          1506      267       408       479       521
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          3533      943       113       422       141
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          239       4011      253       239       155
65        11328     1461      2304      454       1331      195       162       0         0         0         0         0
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          2984      267       591       42        42
2791      0         18565     1071      1883      195       422       0         0         0         0         0         0
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          183       4729      324       1534      183
1753      3473      779       6005      292       325       65        130       0         0         0         0         0
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          12652     155       2252      127       619
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          239       5376      42        1492      56
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          633       56        1801      28        450
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          591       338       28        985       14
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          7093      4110      366       338       56
5826      3319      10885     11871     6522      2887      409       228       0         0         0         0         0
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          3293      3336      2393      324       127
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          3110      1970      1900      1773      464
5937      7692      13322     6521      3604      3591      3292      1543      0         0         0         0         0
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          12540     2970      2181      2730      1604
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          4349      5813      1816      1618      1984
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          7229      18640     4133      3779      1697
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          55692     5541      10384     1739      1023
2597      173126    519       1233      10873     1461      3278      617       0         0         0         0         0
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2789      22744     5937      146687    1113      792       4528      431       0         0         0         0         0
          0         0         0         3051      14742     2374      156979    1282      1404      4215      15001     4419
          80460     1121      178       4177      299
5979      2842      8374      712       65850     1275      553       2920      0         0         0         0         0
          0         0         0         0         0         0         0         0         0         3923      1248      4813
          5204      109124    1009      195       8595
CHECKED   INDEX


1         2         3         4         5         6         7         8         9         10        11        12        13
          14        15        16        17        18        19        20        21        22        23        24        25
          26        27        28        29        30
OPTIONS


0         1         0         0         1         1         0         0         1         1         5


CHECKED   RETRO


1         1         1         1         1         1         1         1         1         1         1         1         1
          1         1         1         1         1         1         1         1         1         1         1         1
          1         1         1         1         1
```

### VPA output GB haddock

```
VPA Version 2.8.0

 Model ID: garm3-rev-base F5to7 backward 1931 to 2007 data


 Input File: C:\X-APPS\ADAPT\VPA280\GARM3_REVIEW\BASE_CASE\31TO07_BOOTRUN\GARM3_REV_31TO07.DA
 Date of Run: 14-JUL-2008                         Time of Run: 12:20


 Levenburg-Marquardt Algorithm Completed     9 Iterations
 Residual Sum of Squares =     475.995

 Number of Residuals     =    730
 Number of Parameters    =      9
 Degrees of Freedom      =    721
 Mean Squared Residual   =     0.660188
 Standard Deviation      =     0.812519


 Number of Years =    77
 Number of Ages  =     9
 First Year      =  1931
 Youngest Age    =     1
 Oldest True Age =     8

 Number of Survey Indices Available        =    30
 Number of Survey Indices Used in Estimate =    30


 VPA Classic Method - Auto Estimated Q's


 Stock Numbers Predicted in Terminal Year Plus One (2008)
 Age    Stock Predicted     Std. Error      CV

   1          16376.323   0.747071E-02   0.456190E-06
   2           6063.866   0.154433E-01   0.254678E-05
   3          17450.483   0.987350E-02   0.565801E-06
   4           4174.856   0.211557E-01   0.506740E-05
   5         209204.143   0.320218E-02   0.153065E-07
   6            790.289   0.507316E-01   0.641937E-04
   7            910.624   0.449378E-01   0.493483E-04
   8           9298.882   0.134804E-01   0.144968E-05
   9            300.000   0.000000E+00   0.000000E+00

 Catchability Values for Each Survey Used in Estimate
 INDEX     Catchability    Std. Error      CV

   1       0.309573E+00   0.617671E-01   0.199524E+00
   2       0.559059E+00   0.792243E-01   0.141710E+00
   3       0.633341E+00   0.869441E-01   0.137278E+00
   4       0.572417E+00   0.571733E-01   0.998804E-01
   5       0.634646E+00   0.795321E-01   0.125317E+00
   6       0.540223E+00   0.879206E-01   0.162749E+00
   7       0.535573E+00   0.783308E-01   0.146256E+00
   8       0.623145E+00   0.105493E+00   0.169291E+00
```

```
  9       0.721024E+00   0.367805E+00   0.510115E+00
 10       0.898814E+00   0.314331E+00   0.349718E+00
 11       0.775702E+00   0.244101E+00   0.314684E+00
 12       0.838990E+00   0.183046E+00   0.218174E+00
 13       0.888891E+00   0.146199E+00   0.164473E+00
 14       0.884529E+00   0.245112E+00   0.277110E+00
 15       0.911762E+00   0.236731E+00   0.259641E+00
 16       0.861378E+00   0.271423E+00   0.315103E+00
 17       0.433137E+00   0.621932E-01   0.143588E+00
 18       0.688246E+00   0.103249E+00   0.150018E+00
 19       0.572374E+00   0.710432E-01   0.124120E+00
 20       0.653808E+00   0.640887E-01   0.980236E-01
 21       0.571735E+00   0.623636E-01   0.109078E+00
 22       0.560770E+00   0.664267E-01   0.118456E+00
 23       0.282518E+00   0.659275E-01   0.233357E+00
 24       0.399130E+00   0.834303E-01   0.209030E+00
 25       0.655467E+00   0.829613E-01   0.126568E+00
 26       0.620509E+00   0.830449E-01   0.133834E+00
 27       0.707918E+00   0.992401E-01   0.140186E+00
 28       0.523142E+00   0.988187E-01   0.188895E+00
 29       0.679959E+00   0.121998E+00   0.179420E+00
 30       0.620286E+00   0.997301E-01   0.160781E+00
```

```
-- Non-Linear Least Squares Fit --

Default Tolerances Used

Scaled Gradient Tolerance      =    6.055454E-06
Scaled Step Tolerance          =    3.666853E-11
Relative Function Tolerance    =    3.666853E-11
Absolute Function Tolerance    =    4.930381E-32


VPA Method Options

- Catchability Values Estimated as an Analytic Function of N
- Catch Equation Used in Cohort Solution
- Plus Group Backward Calculation Method Used
- Rivard Weights Used for JAN-1 Biomass
- Rivard Weights Used for SSB Biomass
- Rivard Weights Calculation Used  5 Years for Terminal Year Plus One

- Arithmetic Average Used in F-Oldest Calculation
- F-Oldest Calculation in Years Prior to Terminal Year
  Uses Fishing Mortality in Ages  5 to  7
- Calculation of Population of Age 1 In Year 2008
  =  Stock Estimate

Stock Estimates

Age   1
Age   2
Age   3
Age   4
Age   5
Age   6
Age   7
Age   8
Age   9

Full F in Terminal Year               =   0.1832

F in Oldest True Age in Terminal Year =   0.2285

Full F Calculated Using Classic Method

F in Oldest True Age in Terminal Year has been
Calculated in Same Manner as in All Other Years

Age  Input Partial  Calc Partial   Fishing     Used In
     Recruitment    Recruitment    Mortality   Full F    Comments

  1      0.001          0.007       0.0019      NO      Stock Estimate in T+1
  2      0.410          0.034       0.0090      NO      Stock Estimate in T+1
  3      0.840          0.189       0.0506      NO      Stock Estimate in T+1
  4      1.000          0.176       0.0473      YES     Stock Estimate in T+1
  5      1.000          0.745       0.1999      YES     Stock Estimate in T+1
  6      1.000          1.000       0.2681      YES     Stock Estimate in T+1
  7      1.000          0.812       0.2176      YES     Stock Estimate in T+1
  8      1.000          0.852       0.2285              F-Oldest


Catch At Age - Input Data


  AGE       1931        1932        1933        1934        1935
--------------------------------------------------------------------

   1      1755.0       118.0       244.0       341.0      1197.0
   2      8801.0      2084.0      8476.0      4454.0     11872.0
   3      2041.0     25871.0      6023.0      5414.0      8819.0
   4      5785.0      2421.0     10046.0      3734.0      3706.0
   5      9100.0      3676.0      2092.0      3149.0      2944.0
   6      6045.0      2894.0      1579.0      1051.0      2458.0
   7      3380.0      1320.0      1210.0       619.0       499.0
   8      1794.0       664.0       538.0       250.0       442.0
   9       559.0       391.0       647.0       168.0       109.0

  AGE       1936        1937        1938        1939        1940
--------------------------------------------------------------------

   1       880.0      1288.0      1030.0       607.0      2040.0
   2     12327.0     11034.0     20199.0     13937.0      7254.0
   3     11486.0     10910.0      7755.0     19617.0     12317.0
   4      5431.0      5629.0      3755.0      5163.0      8253.0
   5      2141.0      4143.0      2113.0      2152.0      2510.0
   6      1377.0      1875.0      1600.0       967.0      1479.0
   7      1362.0       952.0       945.0       837.0       752.0
   8       259.0       481.0       327.0       326.0       222.0
   9       124.0       222.0       173.0       239.0       136.0

  AGE       1941        1942        1943        1944        1945
--------------------------------------------------------------------

   1       780.0       310.0        19.0        64.0       121.0
   2     23464.0     14307.0      4191.0       761.0      8522.0
```

```
   3       9808.0     16348.0     17738.0      8437.0      2029.0
   4       8033.0      6531.0      8364.0     14843.0      6386.0
   5       5764.0      3996.0      3102.0      5689.0      5795.0
   6       1781.0      2331.0      2693.0      2281.0      2315.0
   7        941.0      1036.0       790.0       497.0       914.0
   8        307.0       227.0       354.0       469.0       265.0
   9        384.0       176.0       178.0       108.0       205.0

  AGE       1946        1947        1948        1949        1950
---------------------------------------------------------------------

   1        209.0        90.0        80.0       328.0        88.0
   2       7466.0     16621.0     11227.0      6472.0     28971.0
   3      15213.0     10334.0     19237.0     12479.0      4107.0
   4       2738.0      7181.0      5116.0      9608.0      4272.0
   5       5785.0      2127.0      2744.0      2347.0      3315.0
   6       3840.0      2739.0      1157.0      1061.0      1131.0
   7       1827.0      1501.0       780.0       624.0       520.0
   8        272.0       745.0       450.0       409.0       225.0
   9         23.0       457.0       369.0       353.0       250.0


Catch At Age - Input Data


  AGE       1951        1952        1953        1954        1955
---------------------------------------------------------------------

   1        645.0         0.0      1083.0       108.0        90.0
   2       8266.0     25120.0      1807.0     31858.0      3941.0
   3      26472.0      8892.0     17588.0      5107.0     19251.0
   4       2177.0      8485.0      5726.0      5611.0      3316.0
   5       2448.0      1361.0      3757.0      2315.0      3278.0
   6       2138.0       944.0      1012.0      2131.0      1649.0
   7        740.0       530.0       542.0       720.0      1068.0
   8        297.0       182.0       337.0       353.0       320.0
   9        215.0       107.0       152.0        98.0       173.0

  AGE       1956        1957        1958        1959        1960
---------------------------------------------------------------------

   1         52.0        35.0       125.0        94.0       258.0
   2      11948.0      6594.0      5571.0      5716.0     16010.0
   3       6698.0     14046.0      7088.0      7994.0      6122.0
   4      12066.0      4523.0      6665.0      5169.0      4562.0
   5       3405.0      5822.0      3784.0      3934.0      3067.0
   6       3378.0      2357.0      2366.0      1758.0      1792.0
   7       1348.0      1630.0       903.0      1172.0       787.0
   8        563.0       473.0       442.0       424.0       406.0
   9        201.0       366.0       142.0       334.0       348.0

  AGE       1961        1962        1963        1964        1965
---------------------------------------------------------------------

   1         62.0        74.0      2910.0     10101.0      9601.0
   2      10689.0      4455.0      4047.0     15935.0    125818.0
   3      14927.0     16245.0      7418.0      4554.0     44496.0
   4       4198.0     10440.0     11152.0      4776.0      5356.0
   5       2917.0      3448.0      8198.0      8722.0      4391.0
   6       1856.0      2089.0      2205.0      5794.0      6690.0
   7       1266.0      1566.0      1405.0      2082.0      3772.0
   8        496.0      1185.0       721.0      1028.0      1094.0
   9        674.0       898.0      1096.0      1332.0      1366.0

  AGE       1966        1967        1968        1969        1970
---------------------------------------------------------------------

   1        114.0      1150.0         8.0         2.0        46.0
   2       6843.0       168.0      2994.0        11.0       158.0
   3     100810.0      2891.0       709.0      1698.0        16.0
   4      19167.0     20667.0      1921.0       448.0       570.0
   5       2768.0     10338.0     14519.0       654.0       186.0
   6       2591.0      1209.0      3499.0      5954.0       214.0
   7       2332.0       993.0       667.0      1574.0      2308.0
   8       1268.0       917.0       453.0       225.0       746.0
   9        867.0       698.0       842.0       570.0       464.0
```

```
Catch At Age - Input Data

  AGE       1971        1972        1973        1974        1975
--------------------------------------------------------------------

   1          1.0       159.6      2607.1        47.7       198.6
   2       1375.0         2.0      2113.1      4481.1      1069.5
   3        223.0       460.4         3.1       681.5      1928.0
   4         40.0        82.9       393.1         2.1       387.9
   5        289.0        32.7        54.0        72.6         4.1
   6        246.0       122.8        30.6         2.1        43.4
   7        285.0        79.8        78.4         2.1         4.1
   8       1469.0        67.5        15.3        55.0         4.1
   9        928.0      1264.7       455.2       258.3        91.0

  AGE       1976        1977        1978        1979        1980
--------------------------------------------------------------------

   1        149.3         1.0         1.0         1.0         8.0
   2        490.5     19857.7       767.0        26.2     31170.3
   3        570.4       189.6     14509.1      1742.5       348.9
   4        912.6       689.5       307.4      7237.5       980.4
   5        224.0       522.2       571.5       530.0      6087.3
   6          0.0       362.0       521.1       413.9       597.3
   7         23.9         4.1       140.1       318.0       549.0
   8          4.1        39.5        14.1        96.9       153.8
   9        116.1       112.5        67.5        46.4        81.4

  AGE       1981        1982        1983        1984        1985
--------------------------------------------------------------------

   1          1.0         1.0         0.0         0.0         0.0
   2       1755.4      1173.7       216.1        94.1      2463.7
   3      11076.4      1645.1       821.1       300.6       563.2
   4        836.9      3760.7       696.9       735.8       198.7
   5        943.7       393.9      2261.4       401.8       472.1
   6       2590.3       573.2       274.7      1499.9       233.5
   7        333.4      1127.3       187.9       236.8       538.6
   8        159.1       106.8       808.0       270.2        79.9
   9         94.7       110.8        76.8       549.6       155.6

  AGE       1986        1987        1988        1989        1990
--------------------------------------------------------------------

   1          6.1         0.0         4.1         1.9        62.9
   2         54.7      2035.1        53.2      1462.2        11.6
   3       2848.3       131.6      2439.1       122.5      1697.0
   4        226.0      1645.5       137.1      1018.7       268.9
   5        148.0       124.5       952.5       217.3      1124.1
   6        175.4        74.5       152.4       477.8       154.3
   7        152.0        90.8        56.3        61.7       217.6
   8        269.6       108.1        65.5        37.0        55.4
   9         60.8       137.7       108.4        56.7        48.9

Catch At Age - Input Data

  AGE       1991        1992        1993        1994        1995
--------------------------------------------------------------------

   1          7.0        83.6        33.0        27.3        17.0
   2        486.1       265.1       363.3       537.5        93.5
   3        122.8       407.5       439.1      1191.5       614.3
   4       2370.1       197.2       340.4       241.5       470.8
   5        144.3      1960.1       120.1       142.1        58.9
   6        517.6       181.2       741.4        73.4        29.4
   7        127.9       425.7        62.6       313.4         8.5
   8        171.9        46.6       169.2        55.2        61.4
   9         65.0        99.5        82.2       109.7        16.2

  AGE       1996        1997        1998        1999        2000
--------------------------------------------------------------------

   1          6.8        14.5         6.0         2.6         1.6
   2         56.4       143.3       230.1        43.2       406.6
   3        566.3       273.0       470.9       906.0       625.6
   4        918.6       745.1       557.6       541.1      1570.9
   5        450.3       561.3       767.2       605.7       588.0
   6         66.0       217.9       570.7       565.5       527.7
   7         22.1        17.5       168.9       383.5       377.0
   8          6.9        18.4        23.4       163.2       258.1
   9         78.2        48.8        48.6        47.6        98.5

  AGE       2001        2002        2003        2004        2005
--------------------------------------------------------------------

   1         14.0         2.9         4.5       646.0        19.5
   2        145.1       396.7        17.7        33.0       612.4
   3       2393.3       345.3      1942.8       121.7        41.8
   4        996.1      3177.4       461.1      5115.6       339.0
   5       1280.6       926.2      2686.1       729.4      8505.4
   6        655.6      1105.4       604.9      2935.4       777.7
```

```
   7       437.6       401.6       719.1       686.7      1842.6
   8       358.8       306.4       212.3       562.9       315.2
   9       262.2       551.2       388.8       408.2       343.2

 AGE       2006        2007
─────────────────────────────────────────────────────────────────

   1       164.4        13.0
   2        18.4       174.6
   3      3164.2       240.0
   4        70.9     11215.7
   5       375.2       194.2
   6      5418.3       311.4
   7       326.5      2511.7
   8       841.9       228.9
   9       227.6       564.4


Weight At Age - Input Data


 AGE       1931        1932        1933        1934        1935
─────────────────────────────────────────────────────────────────

   1      0.7500      0.6400      0.5400      0.4200      0.4600
   2      0.7800      0.8500      0.7300      0.7300      0.8700
   3      1.1800      1.0900      1.3500      1.1300      1.2200
   4      1.3700      1.8200      1.4200      1.4900      1.6000
   5      1.6500      1.8900      1.7300      1.7500      1.7900
   6      2.0100      2.1900      2.3900      2.1100      1.9800
   7      2.3100      2.7400      2.4600      2.5400      2.5600
   8      2.5400      2.9300      2.5900      2.8500      2.7900
   9      3.0300      3.2000      2.6000      2.9800      3.4200

 AGE       1936        1937        1938        1939        1940
─────────────────────────────────────────────────────────────────

   1      0.5100      0.4800      0.5600      0.5700      0.5600
   2      0.8100      0.8700      0.8700      0.8200      0.8900
   3      1.1900      1.2400      1.3700      1.1800      1.2700
   4      1.5600      1.5200      1.7600      1.6400      1.5900
   5      1.7200      1.9400      2.1600      1.9800      1.8700
   6      2.0900      2.1900      2.3000      2.4800      2.3400
   7      2.3500      2.8200      2.6700      2.6600      2.9000
   8      2.6300      3.0800      2.7500      2.9600      3.1000
   9      3.3200      3.5600      3.7100      3.4200      3.8700

 AGE       1941        1942        1943        1944        1945
─────────────────────────────────────────────────────────────────

   1      0.5200      0.5200      0.5200      0.6200      0.5800
   2      0.7900      0.7900      0.7300      0.8000      0.8400
   3      1.2000      1.1500      0.9900      1.0900      1.2400
   4      1.5700      1.4600      1.4300      1.4000      1.5700
   5      1.8700      1.7100      1.6900      1.8700      1.9300
   6      2.3100      2.0300      1.8900      2.3100      2.3700
   7      2.6700      2.6400      2.3400      2.6100      2.6900
   8      2.9300      3.1500      2.8400      3.0700      3.2300
   9      3.5200      3.3800      3.3700      3.6800      3.3500

 AGE       1946        1947        1948        1949        1950
─────────────────────────────────────────────────────────────────

   1      0.5200      0.5800      0.5200      0.5400      0.4300
   2      0.7800      0.7300      0.6700      0.7300      0.6800
   3      1.2000      1.1500      1.0400      0.9900      1.0700
   4      1.6300      1.6100      1.5400      1.4400      1.3300
   5      1.8300      2.0200      1.9400      1.9400      1.8000
   6      2.2200      2.3600      2.3500      2.4000      2.2400
   7      2.7000      2.7900      2.6900      2.7200      2.6000
   8      3.2800      3.0600      3.1600      3.2000      3.2600
   9      4.1800      3.3200      3.5000      3.6900      3.4200


Weight At Age - Input Data


 AGE       1951        1952        1953        1954        1955
─────────────────────────────────────────────────────────────────

   1      0.5300      0.4880      0.5500      0.4400      0.5800
   2      0.7000      0.6900      0.6400      0.7700      0.8300
   3      0.9500      0.9400      0.9400      0.9000      1.0800
   4      1.4000      1.2900      1.1900      1.2700      1.2900
   5      1.7900      1.7100      1.6200      1.4900      1.6700
   6      2.3400      2.2200      2.0200      1.8200      1.9500
   7      2.8100      2.5400      2.3700      2.2400      2.3200
   8      3.1100      3.1300      2.7100      2.4300      2.5300
   9      3.3000      3.4900      3.3100      3.0800      2.9600

 AGE       1956        1957        1958        1959        1960
─────────────────────────────────────────────────────────────────

   1      0.4200      0.5400      0.6700      0.5600      0.6000
   2      0.8400      0.8000      0.8200      0.8500      0.8100
```

```
   3      1.0400     1.1100     1.1200     1.1500     1.2200
   4      1.3800     1.4100     1.3500     1.4500     1.5500
   5      1.7000     1.7700     1.7700     1.8000     1.9200
   6      2.1300     2.0800     2.2500     2.1800     2.4700
   7      2.4300     2.4100     2.6300     2.5700     2.9400
   8      2.8800     2.7700     2.9300     3.0500     3.2600
   9      3.6200     3.1100     3.3900     3.5200     3.7800

  AGE      1961       1962       1963       1964       1965
__________________________________________________________

   1      0.5200     0.5400     0.5700     0.5000     0.5800
   2      0.8400     0.8500     0.8700     0.8300     0.6900
   3      1.1100     1.0700     1.1800     1.1200     1.0300
   4      1.5400     1.4100     1.4700     1.4300     1.3500
   5      1.8700     1.7700     1.6800     1.6400     1.6700
   6      2.2600     2.1400     2.1500     2.0100     1.9900
   7      2.5400     2.4700     2.3500     2.4000     2.2600
   8      2.8800     2.6200     3.0400     2.6400     2.6600
   9      3.2400     3.2900     3.1000     2.9700     3.1100

  AGE      1966       1967       1968       1969       1970
__________________________________________________________

   1      0.5800     0.6600     0.5900     0.5200     0.7100
   2      0.7300     0.7000     0.8100     0.7800     1.2700
   3      0.8900     0.9500     1.0500     1.1000     1.2200
   4      1.2600     1.1800     1.3200     1.6900     1.9300
   5      1.7000     1.4200     1.5700     1.7500     2.1900
   6      2.0700     2.0500     2.1000     1.9900     2.3900
   7      2.2800     2.3100     2.3200     2.5200     2.5800
   8      2.8700     2.6600     2.6200     2.9900     3.2300
   9      3.1800     3.1000     2.8600     3.6300     3.7500


Weight At Age - Input Data


  AGE      1971       1972       1973       1974       1975
__________________________________________________________

   1      0.6700     0.6200     0.6000     0.7200     0.6200
   2      1.0300     1.0300     1.0300     1.0600     0.9800
   3      1.3100     1.7400     1.5800     1.8200     1.6300
   4      1.7400     2.0400     2.1300     2.3200     2.2100
   5      2.3900     2.4200     2.4100     2.8300     2.2000
   6      2.8100     2.9200     3.2900     3.7600     2.9400
   7      2.9200     3.0600     3.4200     4.0500     4.0000
   8      3.1000     3.4400     3.8600     3.9200     4.0500
   9      3.7200     3.6600     3.9400     4.2600     4.3300

  AGE      1976       1977       1978       1979       1980
__________________________________________________________

   1      0.5000     0.5300     0.5300     0.5300     0.5500
   2      0.9900     1.0700     0.9400     1.0000     0.9400
   3      1.3900     1.4400     1.5000     1.2800     1.2100
   4      1.9900     2.1700     2.0400     2.0200     1.7300
   5      2.6600     2.7300     2.7900     2.5100     2.1700
   6      3.0800     3.2100     3.1900     3.1400     2.8200
   7      3.6900     4.1500     3.3700     3.7800     3.6000
   8      4.6700     4.0000     3.6100     3.7900     3.5600
   9      4.9400     4.9900     5.1100     4.8700     3.8700

  AGE      1981       1982       1983       1984       1985
__________________________________________________________

   1      0.3900     0.2200     0.3300     0.3300     0.3300
   2      0.8700     0.9700     1.0200     0.9200     0.9900
   3      1.2400     1.4500     1.3700     1.3200     1.3900
   4      1.8300     1.8800     1.8300     1.8300     1.9800
   5      2.3000     2.3700     2.2100     2.2000     2.4600
   6      2.7200     2.7600     2.6500     2.6700     2.7200
   7      3.7100     3.2400     3.2500     2.9600     3.0600
   8      4.0400     3.9600     3.3600     3.4100     3.7200
   9      4.4400     4.0900     4.2700     3.7200     3.8000

  AGE      1986       1987       1988       1989       1990
__________________________________________________________

   1      0.4500     0.4300     0.4200     0.5300     0.6400
   2      0.9400     0.8300     0.9800     0.8900     0.9700
   3      1.3600     1.4300     1.3400     1.4800     1.4800
   4      1.8300     2.0000     1.6800     1.7900     1.7800
   5      2.5600     2.2500     2.0600     2.2100     2.1200
   6      2.8300     2.6300     2.4500     2.5700     2.5500
   7      2.9600     3.0200     2.9700     3.2400     2.8100
   8      3.4600     3.7700     3.4900     3.5600     2.9900
   9      3.7800     4.2900     3.9600     3.8200     4.1600
```

```
Weight At Age - Input Data

  AGE      1991        1992        1993        1994        1995
---------------------------------------------------------------------

   1      0.5810      0.5380      0.6590      0.4470      0.4290
   2      1.2010      1.1750      1.1690      1.0930      0.9670
   3      1.3110      1.6390      1.7280      1.6430      1.4890
   4      1.8170      1.7680      2.1710      2.2090      2.0250
   5      2.1830      2.1860      2.1190      2.6280      2.5420
   6      2.6450      2.5190      2.6280      2.7280      2.8150
   7      2.8520      2.9670      2.6490      2.9020      3.2750
   8      3.0480      3.3650      3.1230      3.7830      3.0910
   9      4.3370      4.2670      4.0140      4.5460      3.9810

  AGE      1996        1997        1998        1999        2000
---------------------------------------------------------------------

   1      0.4560      0.4160      0.5110      0.6780      0.6640
   2      1.0980      0.9980      0.9680      1.1010      1.1330
   3      1.4970      1.6900      1.4850      1.5270      1.4640
   4      1.8380      1.8910      1.9170      1.8300      1.8930
   5      2.3250      2.2130      2.3330      2.1110      2.2520
   6      2.5430      2.5470      2.6880      2.3390      2.3720
   7      3.4230      3.1400      3.0270      2.6970      2.7320
   8      3.5160      3.3800      3.0380      2.9730      2.9910
   9      3.7120      3.6550      4.0700      3.6820      3.2980

  AGE      2001        2002        2003        2004        2005
---------------------------------------------------------------------

   1      0.3580      0.3050      0.2580      0.2120      0.1802
   2      1.1730      0.9100      0.6470      0.3940      0.5659
   3      1.4590      1.3360      1.3600      1.0010      1.0523
   4      1.7540      1.7350      1.6140      1.4970      1.4530
   5      2.1570      1.9490      1.8550      1.6660      1.6688
   6      2.5260      2.4740      2.0470      1.9530      1.8311
   7      2.6270      3.1270      2.5200      2.0710      2.0312
   8      2.7280      3.0690      3.0900      2.4680      2.1322
   9      3.4110      3.3380      3.1660      2.9140      2.6310

  AGE      2006        2007
---------------------------------------------------------------------

   1      0.1936      0.1475
   2      0.4769      0.8781
   3      0.9502      1.0866
   4      1.0638      1.2582
   5      1.6088      1.4819
   6      1.7809      1.8319
   7      1.8856      1.9325
   8      2.0639      2.0155
   9      2.3078      2.1751

JAN-1 Weights at Age - Input Data

  AGE      1931        1932        1933        1934        1935
---------------------------------------------------------------------

   1      0.7045      0.5993      0.4644      0.2918      0.3467
   2      0.6598      0.7984      0.6835      0.6279      0.6045
   3      0.9501      0.9221      1.0712      0.9082      0.9437
   4      1.1664      1.4655      1.2441      1.4183      1.3446
   5      1.4322      1.6091      1.7744      1.5764      1.6331
   6      1.7215      1.9009      2.1253      1.9106      1.8615
   7      2.0511      2.3468      2.3211      2.4639      2.3241
   8      2.4223      2.6016      2.6639      2.6478      2.6621
   9      3.0300      3.2000      2.6000      2.9800      3.4200

  AGE      1936        1937        1938        1939        1940
---------------------------------------------------------------------

   1      0.3905      0.3565      0.4628      0.4562      0.4715
   2      0.6104      0.6661      0.6462      0.6776      0.7122
   3      1.0175      1.0022      1.0917      1.0132      1.0205
   4      1.3796      1.3449      1.4773      1.4989      1.3697
   5      1.6589      1.7397      1.8120      1.8668      1.7512
   6      1.9342      1.9408      2.1123      2.3145      2.1525
   7      2.1571      2.4277      2.4181      2.4735      2.6818
   8      2.5948      2.6904      2.7848      2.8113      2.8716
   9      3.3200      3.5600      3.7100      3.4200      3.8700

  AGE      1941        1942        1943        1944        1945
---------------------------------------------------------------------

   1      0.4219      0.4389      0.4192      0.5327      0.5001
   2      0.6651      0.6409      0.6161      0.6450      0.7217
   3      1.0334      0.9532      0.8844      0.8920      0.9960
   4      1.4121      1.3236      1.2824      1.1773      1.3082
   5      1.7243      1.6385      1.5708      1.6353      1.6438
   6      2.0784      1.9484      1.7977      1.9758      2.1052
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   7       2.4996      2.4695      2.1795      2.2210      2.4928
   8       2.9150      2.9001      2.7382      2.6803      2.9035
   9       3.5200      3.3800      3.3700      3.6800      3.3500

  AGE       1946        1947        1948        1949        1950
 ------------------------------------------------------------------

   1       0.4389      0.5396      0.4389      0.4812      0.3370
   2       0.6726      0.6161      0.6234      0.6161      0.6060
   3       1.0040      0.9471      0.8713      0.8144      0.8838
   4       1.4217      1.3900      1.3308      1.2238      1.1475
   5       1.6950      1.8146      1.7673      1.7285      1.6100
   6       2.0699      2.0782      2.1788      2.1578      2.0846
   7       2.5296      2.4887      2.5196      2.5282      2.4980
   8       2.9704      2.8744      2.9692      2.9339      2.9778
   9       4.1800      3.3200      3.5000      3.6900      3.4200

 JAN-1 Weights at Age - Input Data

  AGE       1951        1952        1953        1954        1955
 ------------------------------------------------------------------

   1       0.4645      0.4261      0.4648      0.3204      0.4820
   2       0.5486      0.6047      0.5589      0.6508      0.6043
   3       0.8037      0.8112      0.8054      0.7589      0.9119
   4       1.2239      1.1070      1.0576      1.0926      1.0775
   5       1.5430      1.5473      1.4456      1.3316      1.4563
   6       2.0523      1.9934      1.8585      1.7171      1.7046
   7       2.5089      2.4380      2.2938      2.1272      2.0548
   8       2.8436      2.9657      2.6236      2.3998      2.3806
   9       3.3000      3.4900      3.3100      3.0800      2.9600

  AGE       1956        1957        1958        1959        1960
 ------------------------------------------------------------------

   1       0.3043      0.4382      0.5948      0.4656      0.5071
   2       0.6980      0.5797      0.6654      0.7547      0.6735
   3       0.9291      0.9656      0.9466      0.9711      1.0183
   4       1.2208      1.2110      1.2241      1.2744      1.3351
   5       1.4809      1.5629      1.5798      1.5588      1.6685
   6       1.8860      1.8804      1.9956      1.9643      2.1086
   7       2.1768      2.2657      2.3389      2.4047      2.5316
   8       2.5849      2.5944      2.6573      2.8322      2.8945
   9       3.6200      3.1100      3.3900      3.5200      3.7800

  AGE       1961        1962        1963        1964        1965
 ------------------------------------------------------------------

   1       0.4067      0.4254      0.4724      0.4256      0.5170
   2       0.7099      0.6648      0.6854      0.6878      0.5874
   3       0.9482      0.9481      1.0015      0.9871      0.9246
   4       1.3707      1.2510      1.2542      1.2990      1.2296
   5       1.7025      1.6510      1.5391      1.5527      1.5453
   6       2.0831      2.0005      1.9508      1.8376      1.8065
   7       2.5048      2.3627      2.2425      2.2716      2.1313
   8       2.9098      2.5797      2.7402      2.4908      2.5267
   9       3.2400      3.2900      3.1000      2.9700      3.1100

  AGE       1966        1967        1968        1969        1970
 ------------------------------------------------------------------

   1       0.5280      0.5958      0.5131      0.3327      0.5895
   2       0.6507      0.6372      0.7312      0.6784      0.8127
   3       0.7836      0.8328      0.8573      0.9439      0.9755
   4       1.1392      1.0248      1.1198      1.3321      1.4571
   5       1.5149      1.3376      1.3611      1.5199      1.9238
   6       1.8593      1.8668      1.7268      1.7676      2.0451
   7       2.1301      2.1867      2.1808      2.3004      2.2659
   8       2.5468      2.4627      2.4601      2.6338      2.8530
   9       3.1800      3.1000      2.8600      3.6300      3.7500

 JAN-1 Weights at Age - Input Data

  AGE       1971        1972        1973        1974        1975
 ------------------------------------------------------------------

   1       0.5404      0.4810      0.4514      0.6171      0.4906
   2       0.8552      0.8307      0.7991      0.7975      0.8400
   3       1.2898      1.3387      1.2757      1.3692      1.3145
   4       1.4570      1.6347      1.9251      1.9146      2.0055
   5       2.1477      2.0520      2.2173      2.4552      2.2592
   6       2.4807      2.6417      2.8217      3.0102      2.8845
   7       2.6417      2.9323      3.1601      3.6503      3.8781
   8       2.8281      3.1694      3.4368      3.6615      4.0500
   9       3.7200      3.6600      3.9400      4.2600      4.3300

  AGE       1976        1977        1978        1979        1980
 ------------------------------------------------------------------

   1       0.3418      0.3980      0.3858      0.3980      0.4373
   2       0.7835      0.7314      0.7058      0.7280      0.7058
```

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   3      1.1671      1.1940      1.2669      1.0969      1.1000
   4      1.8010      1.7368      1.7139      1.7407      1.4881
   5      2.4246      2.3308      2.4605      2.2628      2.0937
   6      2.6031      2.9221      2.9511      2.9598      2.6605
   7      3.2937      3.5752      3.2890      3.4725      3.3621
   8      4.3220      3.8419      3.8706      3.5738      3.6684
   9      4.9400      4.9900      5.1100      4.8700      3.8700

 AGE       1981        1982        1983        1984        1985
___________________________________________________________________

   1      0.2473      0.1022      0.1976      0.1905      0.1955
   2      0.6917      0.6151      0.4737      0.5510      0.5716
   3      1.0796      1.1232      1.1528      1.1603      1.1308
   4      1.4881      1.5268      1.6290      1.5834      1.6167
   5      1.9947      2.0826      2.0383      2.0065      2.1217
   6      2.4295      2.5195      2.5061      2.4291      2.4462
   7      3.2345      2.9686      2.9950      2.8007      2.8584
   8      3.8137      3.8330      3.2995      3.3290      3.3183
   9      4.4400      4.0900      4.2700      3.7200      3.8000

 AGE       1986        1987        1988        1989        1990
___________________________________________________________________

   1      0.3313      0.2848      0.2885      0.3918      0.4672
   2      0.5570      0.6111      0.6492      0.6114      0.7170
   3      1.1603      1.1594      1.0546      1.2043      1.1477
   4      1.5949      1.6492      1.5500      1.5487      1.6231
   5      2.2514      2.0292      2.0298      1.9269      1.9480
   6      2.6385      2.5948      2.3479      2.3009      2.3739
   7      2.8375      2.9235      2.7948      2.8174      2.6873
   8      3.2539      3.3405      3.2465      3.2516      3.1125
   9      3.7800      4.2900      3.9600      3.8200      4.1600


JAN-1 Weights at Age - Input Data


 AGE       1991        1992        1993        1994        1995
___________________________________________________________________

   1      0.4086      0.3650      0.5117      0.3039      0.2682
   2      0.8767      0.8262      0.7930      0.8487      0.6575
   3      1.1277      1.4030      1.4249      1.3859      1.2757
   4      1.6399      1.5224      1.8863      1.9538      1.8240
   5      1.9712      1.9930      1.9356      2.3886      2.3697
   6      2.3680      2.3450      2.3968      2.4043      2.7199
   7      2.6968      2.8014      2.5832      2.7616      2.9890
   8      2.9266      3.0979      3.0440      3.1656      2.9950
   9      4.3370      4.2670      4.0140      4.5460      3.9810

 AGE       1996        1997        1998        1999        2000
___________________________________________________________________

   1      0.3082      0.2727      0.3481      0.5245      0.4996
   2      0.6863      0.6746      0.6346      0.7501      0.8765
   3      1.2032      1.3622      1.2174      1.2158      1.2696
   4      1.6543      1.6825      1.7999      1.6485      1.7002
   5      2.1698      2.0168      2.1004      2.0117      2.0301
   6      2.5425      2.4335      2.4390      2.3360      2.2377
   7      3.1042      2.8258      2.7766      2.6925      2.5279
   8      3.3934      3.4014      3.0886      2.9999      2.8402
   9      3.7120      3.6550      4.0700      3.6820      3.2980

 AGE       2001        2002        2003        2004        2005
___________________________________________________________________

   1      0.2245      0.2094      0.2088      0.1298      0.1107
   2      0.8825      0.5708      0.4442      0.3188      0.3464
   3      1.2857      1.2519      1.1125      0.8048      0.6439
   4      1.6025      1.5910      1.4684      1.4269      1.2060
   5      2.0207      1.8489      1.7940      1.6398      1.5806
   6      2.3851      2.3101      1.9974      1.9034      1.7466
   7      2.4962      2.8105      2.4969      2.0590      1.9917
   8      2.7300      2.8394      3.1084      2.4939      2.1014
   9      3.4110      3.3380      3.1660      2.9140      2.6310

 AGE       2006        2007        2008
___________________________________________________________________

   1      0.0906      0.0231      0.1126
   2      0.2931      0.4139      0.3633
   3      0.7333      0.7198      0.8029
   4      1.0580      1.0934      1.2505
   5      1.5289      1.2553      1.5597
   6      1.7239      1.7166      1.8176
   7      1.8581      1.8551      2.0522
   8      2.0474      1.9495      2.3401
   9      2.3078      2.1750      2.6388
```

```
SSB Weight At Age - Input Data

  AGE      1931        1932        1933        1934        1935
___________________________________________________________________

   1      0.7045      0.5993      0.4644      0.2918      0.3467
   2      0.6598      0.7984      0.6835      0.6279      0.6045
   3      0.9501      0.9221      1.0712      0.9082      0.9437
   4      1.1664      1.4655      1.2441      1.4183      1.3446
   5      1.4322      1.6091      1.7744      1.5764      1.6331
   6      1.7215      1.9009      2.1253      1.9106      1.8615
   7      2.0511      2.3468      2.3211      2.4639      2.3241
   8      2.4223      2.6016      2.6639      2.6478      2.6621
   9      3.0300      3.2000      2.6000      2.9800      3.4200

  AGE      1936        1937        1938        1939        1940
___________________________________________________________________

   1      0.3905      0.3565      0.4628      0.4562      0.4715
   2      0.6104      0.6661      0.6462      0.6776      0.7122
   3      1.0175      1.0022      1.0917      1.0132      1.0205
   4      1.3796      1.3449      1.4773      1.4989      1.3697
   5      1.6589      1.7397      1.8120      1.8668      1.7512
   6      1.9342      1.9408      2.1123      2.3145      2.1525
   7      2.1571      2.4277      2.4181      2.4735      2.6818
   8      2.5948      2.6904      2.7848      2.8113      2.8716
   9      3.3200      3.5600      3.7100      3.4200      3.8700

  AGE      1941        1942        1943        1944        1945
___________________________________________________________________

   1      0.4219      0.4389      0.4192      0.5327      0.5001
   2      0.6651      0.6409      0.6161      0.6450      0.7217
   3      1.0334      0.9532      0.8844      0.8920      0.9960
   4      1.4121      1.3236      1.2824      1.1773      1.3082
   5      1.7243      1.6385      1.5708      1.6353      1.6438
   6      2.0784      1.9484      1.7977      1.9758      2.1052
   7      2.4996      2.4695      2.1795      2.2210      2.4928
   8      2.9150      2.9001      2.7382      2.6803      2.9035
   9      3.5200      3.3800      3.3700      3.6800      3.3500

  AGE      1946        1947        1948        1949        1950
___________________________________________________________________

   1      0.4389      0.5396      0.4389      0.4812      0.3370
   2      0.6726      0.6161      0.6234      0.6161      0.6060
   3      1.0040      0.9471      0.8713      0.8144      0.8838
   4      1.4217      1.3900      1.3308      1.2238      1.1475
   5      1.6950      1.8146      1.7673      1.7285      1.6100
   6      2.0699      2.0782      2.1788      2.1578      2.0846
   7      2.5296      2.4887      2.5196      2.5282      2.4980
   8      2.9704      2.8744      2.9692      2.9339      2.9778
   9      4.1800      3.3200      3.5000      3.6900      3.4200

SSB Weight At Age - Input Data

  AGE      1951        1952        1953        1954        1955
___________________________________________________________________

   1      0.4645      0.4261      0.4648      0.3204      0.4820
   2      0.5486      0.6047      0.5589      0.6508      0.6043
   3      0.8037      0.8112      0.8054      0.7589      0.9119
   4      1.2239      1.1070      1.0576      1.0926      1.0775
   5      1.5430      1.5473      1.4456      1.3316      1.4563
   6      2.0523      1.9934      1.8585      1.7171      1.7046
   7      2.5089      2.4380      2.2938      2.1272      2.0548
   8      2.8436      2.9657      2.6236      2.3998      2.3806
   9      3.3000      3.4900      3.3100      3.0800      2.9600

  AGE      1956        1957        1958        1959        1960
___________________________________________________________________

   1      0.3043      0.4382      0.5948      0.4656      0.5071
   2      0.6980      0.5797      0.6654      0.7547      0.6735
   3      0.9291      0.9656      0.9466      0.9711      1.0183
   4      1.2208      1.2110      1.2241      1.2744      1.3351
   5      1.4809      1.5629      1.5798      1.5588      1.6685
   6      1.8860      1.8804      1.9956      1.9643      2.1086
   7      2.1768      2.2657      2.3389      2.4047      2.5316
   8      2.5849      2.5944      2.6573      2.8322      2.8945
   9      3.6200      3.1100      3.3900      3.5200      3.7800

  AGE      1961        1962        1963        1964        1965
___________________________________________________________________

   1      0.4067      0.4254      0.4724      0.4256      0.5170
   2      0.7099      0.6648      0.6854      0.6878      0.5874
   3      0.9482      0.9481      1.0015      0.9871      0.9246
   4      1.3707      1.2510      1.2542      1.2990      1.2296
   5      1.7025      1.6510      1.5391      1.5527      1.5453
   6      2.0831      2.0005      1.9508      1.8376      1.8065
```

```
   7       2.5048      2.3627      2.2425      2.2716      2.1313
   8       2.9098      2.5797      2.7402      2.4908      2.5267
   9       3.2400      3.2900      3.1000      2.9700      3.1100

  AGE       1966        1967        1968        1969        1970
 ------------------------------------------------------------------

   1       0.5280      0.5958      0.5131      0.3327      0.5895
   2       0.6507      0.6372      0.7312      0.6784      0.8127
   3       0.7836      0.8328      0.8573      0.9439      0.9755
   4       1.1392      1.0248      1.1198      1.3321      1.4571
   5       1.5149      1.3376      1.3611      1.5199      1.9238
   6       1.8593      1.8668      1.7268      1.7676      2.0451
   7       2.1301      2.1867      2.1808      2.3004      2.2659
   8       2.5468      2.4627      2.4601      2.6338      2.8530
   9       3.1800      3.1000      2.8600      3.6300      3.7500

SSB Weight At Age - Input Data

  AGE       1971        1972        1973        1974        1975
 ------------------------------------------------------------------

   1       0.5404      0.4810      0.4514      0.6171      0.4906
   2       0.8552      0.8307      0.7991      0.7975      0.8400
   3       1.2898      1.3387      1.2757      1.3692      1.3145
   4       1.4570      1.6347      1.9251      1.9146      2.0055
   5       2.1477      2.0520      2.2173      2.4552      2.2592
   6       2.4807      2.6417      2.8217      3.0102      2.8845
   7       2.6417      2.9323      3.1601      3.6503      3.8781
   8       2.8281      3.1694      3.4368      3.6615      4.0500
   9       3.7200      3.6600      3.9400      4.2600      4.3300

  AGE       1976        1977        1978        1979        1980
 ------------------------------------------------------------------

   1       0.3418      0.3980      0.3858      0.3980      0.4373
   2       0.7835      0.7314      0.7058      0.7280      0.7058
   3       1.1671      1.1940      1.2669      1.0969      1.1000
   4       1.8010      1.7368      1.7139      1.7407      1.4881
   5       2.4246      2.3308      2.4605      2.2628      2.0937
   6       2.6031      2.9221      2.9511      2.9598      2.6605
   7       3.2937      3.5752      3.2890      3.4725      3.3621
   8       4.3220      3.8419      3.8706      3.5738      3.6684
   9       4.9400      4.9900      5.1100      4.8700      3.8700

  AGE       1981        1982        1983        1984        1985
 ------------------------------------------------------------------

   1       0.2473      0.1022      0.1976      0.1905      0.1955
   2       0.6917      0.6151      0.4737      0.5510      0.5716
   3       1.0796      1.1232      1.1528      1.1603      1.1308
   4       1.4881      1.5268      1.6290      1.5834      1.6167
   5       1.9947      2.0826      2.0383      2.0065      2.1217
   6       2.4295      2.5195      2.5061      2.4291      2.4462
   7       3.2345      2.9686      2.9950      2.8007      2.8584
   8       3.8137      3.8330      3.2995      3.3290      3.3183
   9       4.4400      4.0900      4.2700      3.7200      3.8000

  AGE       1986        1987        1988        1989        1990
 ------------------------------------------------------------------

   1       0.3313      0.2848      0.2885      0.3918      0.4672
   2       0.5570      0.6111      0.6492      0.6114      0.7170
   3       1.1603      1.1594      1.0546      1.2043      1.1477
   4       1.5949      1.6492      1.5500      1.5487      1.6231
   5       2.2514      2.0292      2.0298      1.9269      1.9480
   6       2.6385      2.5948      2.3479      2.3009      2.3739
   7       2.8375      2.9235      2.7948      2.8174      2.6873
   8       3.2539      3.3405      3.2465      3.2516      3.1125
   9       3.7800      4.2900      3.9600      3.8200      4.1600
```

```
SSB Weight At Age - Input Data

  AGE      1991        1992        1993        1994        1995
 ---------------------------------------------------------------

   1      0.4086      0.3650      0.5117      0.3039      0.2682
   2      0.8767      0.8262      0.7930      0.8487      0.6575
   3      1.1277      1.4030      1.4249      1.3859      1.2757
   4      1.6399      1.5224      1.8863      1.9538      1.8240
   5      1.9712      1.9930      1.9356      2.3886      2.3697
   6      2.3680      2.3450      2.3968      2.4043      2.7199
   7      2.6968      2.8014      2.5832      2.7616      2.9890
   8      2.9266      3.0979      3.0440      3.1656      2.9950
   9      4.3370      4.2670      4.0140      4.5460      3.9810

  AGE      1996        1997        1998        1999        2000
 ---------------------------------------------------------------

   1      0.3082      0.2727      0.3481      0.5245      0.4996
   2      0.6863      0.6746      0.6346      0.7501      0.8765
   3      1.2032      1.3622      1.2174      1.2158      1.2696
   4      1.6543      1.6825      1.7999      1.6485      1.7002
   5      2.1698      2.0168      2.1004      2.0117      2.0301
   6      2.5425      2.4335      2.4390      2.3360      2.2377
   7      3.1042      2.8258      2.7766      2.6925      2.5279
   8      3.3934      3.4014      3.0886      2.9999      2.8402
   9      3.7120      3.6550      4.0700      3.6820      3.2980

  AGE      2001        2002        2003        2004        2005
 ---------------------------------------------------------------

   1      0.2245      0.2094      0.2088      0.1298      0.1107
   2      0.8825      0.5708      0.4442      0.3188      0.3464
   3      1.2857      1.2519      1.1125      0.8048      0.6439
   4      1.6025      1.5910      1.4684      1.4269      1.2060
   5      2.0207      1.8489      1.7940      1.6398      1.5806
   6      2.3851      2.3101      1.9974      1.9034      1.7466
   7      2.4962      2.8105      2.4969      2.0590      1.9917
   8      2.7300      2.8394      3.1084      2.4939      2.1014
   9      3.4110      3.3380      3.1660      2.9140      2.6310

  AGE      2006        2007
 ---------------------------------------------------------------

   1      0.0906      0.0231
   2      0.2931      0.4139
   3      0.7333      0.7198
   4      1.0580      1.0934
   5      1.5289      1.2553
   6      1.7239      1.7166
   7      1.8581      1.8551
   8      2.0474      1.9495
   9      2.3078      2.1750

Natural Mortality - Input Data

  AGE      1931        1932        1933        1934        1935
 ---------------------------------------------------------------

   1      0.2000      0.2000      0.2000      0.2000      0.2000
   2      0.2000      0.2000      0.2000      0.2000      0.2000
   3      0.2000      0.2000      0.2000      0.2000      0.2000
   4      0.2000      0.2000      0.2000      0.2000      0.2000
   5      0.2000      0.2000      0.2000      0.2000      0.2000
   6      0.2000      0.2000      0.2000      0.2000      0.2000
   7      0.2000      0.2000      0.2000      0.2000      0.2000
   8      0.2000      0.2000      0.2000      0.2000      0.2000
   9      0.2000      0.2000      0.2000      0.2000      0.2000

  AGE      1936        1937        1938        1939        1940
 ---------------------------------------------------------------

   1      0.2000      0.2000      0.2000      0.2000      0.2000
   2      0.2000      0.2000      0.2000      0.2000      0.2000
   3      0.2000      0.2000      0.2000      0.2000      0.2000
   4      0.2000      0.2000      0.2000      0.2000      0.2000
   5      0.2000      0.2000      0.2000      0.2000      0.2000
   6      0.2000      0.2000      0.2000      0.2000      0.2000
   7      0.2000      0.2000      0.2000      0.2000      0.2000
   8      0.2000      0.2000      0.2000      0.2000      0.2000
   9      0.2000      0.2000      0.2000      0.2000      0.2000

  AGE      1941        1942        1943        1944        1945
 ---------------------------------------------------------------

   1      0.2000      0.2000      0.2000      0.2000      0.2000
   2      0.2000      0.2000      0.2000      0.2000      0.2000
   3      0.2000      0.2000      0.2000      0.2000      0.2000
   4      0.2000      0.2000      0.2000      0.2000      0.2000
   5      0.2000      0.2000      0.2000      0.2000      0.2000
   6      0.2000      0.2000      0.2000      0.2000      0.2000
```

```
   7       0.2000      0.2000      0.2000      0.2000      0.2000
   8       0.2000      0.2000      0.2000      0.2000      0.2000
   9       0.2000      0.2000      0.2000      0.2000      0.2000

  AGE       1946        1947        1948        1949        1950
 ---------------------------------------------------------------

   1       0.2000      0.2000      0.2000      0.2000      0.2000
   2       0.2000      0.2000      0.2000      0.2000      0.2000
   3       0.2000      0.2000      0.2000      0.2000      0.2000
   4       0.2000      0.2000      0.2000      0.2000      0.2000
   5       0.2000      0.2000      0.2000      0.2000      0.2000
   6       0.2000      0.2000      0.2000      0.2000      0.2000
   7       0.2000      0.2000      0.2000      0.2000      0.2000
   8       0.2000      0.2000      0.2000      0.2000      0.2000
   9       0.2000      0.2000      0.2000      0.2000      0.2000

 Natural Mortality - Input Data

  AGE       1951        1952        1953        1954        1955
 ---------------------------------------------------------------

   1       0.2000      0.2000      0.2000      0.2000      0.2000
   2       0.2000      0.2000      0.2000      0.2000      0.2000
   3       0.2000      0.2000      0.2000      0.2000      0.2000
   4       0.2000      0.2000      0.2000      0.2000      0.2000
   5       0.2000      0.2000      0.2000      0.2000      0.2000
   6       0.2000      0.2000      0.2000      0.2000      0.2000
   7       0.2000      0.2000      0.2000      0.2000      0.2000
   8       0.2000      0.2000      0.2000      0.2000      0.2000
   9       0.2000      0.2000      0.2000      0.2000      0.2000

  AGE       1956        1957        1958        1959        1960
 ---------------------------------------------------------------

   1       0.2000      0.2000      0.2000      0.2000      0.2000
   2       0.2000      0.2000      0.2000      0.2000      0.2000
   3       0.2000      0.2000      0.2000      0.2000      0.2000
   4       0.2000      0.2000      0.2000      0.2000      0.2000
   5       0.2000      0.2000      0.2000      0.2000      0.2000
   6       0.2000      0.2000      0.2000      0.2000      0.2000
   7       0.2000      0.2000      0.2000      0.2000      0.2000
   8       0.2000      0.2000      0.2000      0.2000      0.2000
   9       0.2000      0.2000      0.2000      0.2000      0.2000

  AGE       1961        1962        1963        1964        1965
 ---------------------------------------------------------------

   1       0.2000      0.2000      0.2000      0.2000      0.2000
   2       0.2000      0.2000      0.2000      0.2000      0.2000
   3       0.2000      0.2000      0.2000      0.2000      0.2000
   4       0.2000      0.2000      0.2000      0.2000      0.2000
   5       0.2000      0.2000      0.2000      0.2000      0.2000
   6       0.2000      0.2000      0.2000      0.2000      0.2000
   7       0.2000      0.2000      0.2000      0.2000      0.2000
   8       0.2000      0.2000      0.2000      0.2000      0.2000
   9       0.2000      0.2000      0.2000      0.2000      0.2000

  AGE       1966        1967        1968        1969        1970
 ---------------------------------------------------------------

   1       0.2000      0.2000      0.2000      0.2000      0.2000
   2       0.2000      0.2000      0.2000      0.2000      0.2000
   3       0.2000      0.2000      0.2000      0.2000      0.2000
   4       0.2000      0.2000      0.2000      0.2000      0.2000
   5       0.2000      0.2000      0.2000      0.2000      0.2000
   6       0.2000      0.2000      0.2000      0.2000      0.2000
   7       0.2000      0.2000      0.2000      0.2000      0.2000
   8       0.2000      0.2000      0.2000      0.2000      0.2000
   9       0.2000      0.2000      0.2000      0.2000      0.2000
```

```
Natural Mortality - Input Data

  AGE      1971       1972       1973       1974       1975
 ------------------------------------------------------------

   1      0.2000     0.2000     0.2000     0.2000     0.2000
   2      0.2000     0.2000     0.2000     0.2000     0.2000
   3      0.2000     0.2000     0.2000     0.2000     0.2000
   4      0.2000     0.2000     0.2000     0.2000     0.2000
   5      0.2000     0.2000     0.2000     0.2000     0.2000
   6      0.2000     0.2000     0.2000     0.2000     0.2000
   7      0.2000     0.2000     0.2000     0.2000     0.2000
   8      0.2000     0.2000     0.2000     0.2000     0.2000
   9      0.2000     0.2000     0.2000     0.2000     0.2000

  AGE      1976       1977       1978       1979       1980
 ------------------------------------------------------------

   1      0.2000     0.2000     0.2000     0.2000     0.2000
   2      0.2000     0.2000     0.2000     0.2000     0.2000
   3      0.2000     0.2000     0.2000     0.2000     0.2000
   4      0.2000     0.2000     0.2000     0.2000     0.2000
   5      0.2000     0.2000     0.2000     0.2000     0.2000
   6      0.2000     0.2000     0.2000     0.2000     0.2000
   7      0.2000     0.2000     0.2000     0.2000     0.2000
   8      0.2000     0.2000     0.2000     0.2000     0.2000
   9      0.2000     0.2000     0.2000     0.2000     0.2000

  AGE      1981       1982       1983       1984       1985
 ------------------------------------------------------------

   1      0.2000     0.2000     0.2000     0.2000     0.2000
   2      0.2000     0.2000     0.2000     0.2000     0.2000
   3      0.2000     0.2000     0.2000     0.2000     0.2000
   4      0.2000     0.2000     0.2000     0.2000     0.2000
   5      0.2000     0.2000     0.2000     0.2000     0.2000
   6      0.2000     0.2000     0.2000     0.2000     0.2000
   7      0.2000     0.2000     0.2000     0.2000     0.2000
   8      0.2000     0.2000     0.2000     0.2000     0.2000
   9      0.2000     0.2000     0.2000     0.2000     0.2000

  AGE      1986       1987       1988       1989       1990
 ------------------------------------------------------------

   1      0.2000     0.2000     0.2000     0.2000     0.2000
   2      0.2000     0.2000     0.2000     0.2000     0.2000
   3      0.2000     0.2000     0.2000     0.2000     0.2000
   4      0.2000     0.2000     0.2000     0.2000     0.2000
   5      0.2000     0.2000     0.2000     0.2000     0.2000
   6      0.2000     0.2000     0.2000     0.2000     0.2000
   7      0.2000     0.2000     0.2000     0.2000     0.2000
   8      0.2000     0.2000     0.2000     0.2000     0.2000
   9      0.2000     0.2000     0.2000     0.2000     0.2000

Natural Mortality - Input Data

  AGE      1991       1992       1993       1994       1995
 ------------------------------------------------------------

   1      0.2000     0.2000     0.2000     0.2000     0.2000
   2      0.2000     0.2000     0.2000     0.2000     0.2000
   3      0.2000     0.2000     0.2000     0.2000     0.2000
   4      0.2000     0.2000     0.2000     0.2000     0.2000
   5      0.2000     0.2000     0.2000     0.2000     0.2000
   6      0.2000     0.2000     0.2000     0.2000     0.2000
   7      0.2000     0.2000     0.2000     0.2000     0.2000
   8      0.2000     0.2000     0.2000     0.2000     0.2000
   9      0.2000     0.2000     0.2000     0.2000     0.2000

  AGE      1996       1997       1998       1999       2000
 ------------------------------------------------------------

   1      0.2000     0.2000     0.2000     0.2000     0.2000
   2      0.2000     0.2000     0.2000     0.2000     0.2000
   3      0.2000     0.2000     0.2000     0.2000     0.2000
   4      0.2000     0.2000     0.2000     0.2000     0.2000
   5      0.2000     0.2000     0.2000     0.2000     0.2000
   6      0.2000     0.2000     0.2000     0.2000     0.2000
   7      0.2000     0.2000     0.2000     0.2000     0.2000
   8      0.2000     0.2000     0.2000     0.2000     0.2000
   9      0.2000     0.2000     0.2000     0.2000     0.2000

  AGE      2001       2002       2003       2004       2005
 ------------------------------------------------------------

   1      0.2000     0.2000     0.2000     0.2000     0.2000
   2      0.2000     0.2000     0.2000     0.2000     0.2000
   3      0.2000     0.2000     0.2000     0.2000     0.2000
   4      0.2000     0.2000     0.2000     0.2000     0.2000
   5      0.2000     0.2000     0.2000     0.2000     0.2000
   6      0.2000     0.2000     0.2000     0.2000     0.2000
```

```
   7       0.2000      0.2000      0.2000      0.2000      0.2000
   8       0.2000      0.2000      0.2000      0.2000      0.2000
   9       0.2000      0.2000      0.2000      0.2000      0.2000

  AGE       2006        2007
 ------------------------------------------------------------------

   1       0.2000      0.2000
   2       0.2000      0.2000
   3       0.2000      0.2000
   4       0.2000      0.2000
   5       0.2000      0.2000
   6       0.2000      0.2000
   7       0.2000      0.2000
   8       0.2000      0.2000
   9       0.2000      0.2000

 Proportion of Natural Mortality Before Spawning =       0.2500
 Proportion of Fishing Mortality Before Spawning =       0.2500


Maturity - Input Data


  AGE       1931        1932        1933        1934        1935
 ------------------------------------------------------------------

   1       0.0400      0.0400      0.0400      0.0400      0.0400
   2       0.3800      0.3800      0.3800      0.3800      0.3800
   3       0.8700      0.8700      0.8700      0.8700      0.8700
   4       0.9900      0.9900      0.9900      0.9900      0.9900
   5       1.0000      1.0000      1.0000      1.0000      1.0000
   6       1.0000      1.0000      1.0000      1.0000      1.0000
   7       1.0000      1.0000      1.0000      1.0000      1.0000
   8       1.0000      1.0000      1.0000      1.0000      1.0000
   9       1.0000      1.0000      1.0000      1.0000      1.0000

  AGE       1936        1937        1938        1939        1940
 ------------------------------------------------------------------

   1       0.0400      0.0400      0.0400      0.0400      0.0400
   2       0.3800      0.3800      0.3800      0.3800      0.3800
   3       0.8700      0.8700      0.8700      0.8700      0.8700
   4       0.9900      0.9900      0.9900      0.9900      0.9900
   5       1.0000      1.0000      1.0000      1.0000      1.0000
   6       1.0000      1.0000      1.0000      1.0000      1.0000
   7       1.0000      1.0000      1.0000      1.0000      1.0000
   8       1.0000      1.0000      1.0000      1.0000      1.0000
   9       1.0000      1.0000      1.0000      1.0000      1.0000

  AGE       1941        1942        1943        1944        1945
 ------------------------------------------------------------------

   1       0.0400      0.0400      0.0400      0.0400      0.0400
   2       0.3800      0.3800      0.3800      0.3800      0.3800
   3       0.8700      0.8700      0.8700      0.8700      0.8700
   4       0.9900      0.9900      0.9900      0.9900      0.9900
   5       1.0000      1.0000      1.0000      1.0000      1.0000
   6       1.0000      1.0000      1.0000      1.0000      1.0000
   7       1.0000      1.0000      1.0000      1.0000      1.0000
   8       1.0000      1.0000      1.0000      1.0000      1.0000
   9       1.0000      1.0000      1.0000      1.0000      1.0000

  AGE       1946        1947        1948        1949        1950
 ------------------------------------------------------------------

   1       0.0400      0.0400      0.0400      0.0400      0.0400
   2       0.3800      0.3800      0.3800      0.3800      0.3800
   3       0.8700      0.8700      0.8700      0.8700      0.8700
   4       0.9900      0.9900      0.9900      0.9900      0.9900
   5       1.0000      1.0000      1.0000      1.0000      1.0000
   6       1.0000      1.0000      1.0000      1.0000      1.0000
   7       1.0000      1.0000      1.0000      1.0000      1.0000
   8       1.0000      1.0000      1.0000      1.0000      1.0000
   9       1.0000      1.0000      1.0000      1.0000      1.0000
```

```
Maturity - Input Data

  AGE      1951       1952       1953       1954       1955
------------------------------------------------------------

   1      0.0400     0.0400     0.0400     0.0400     0.0400
   2      0.3800     0.3800     0.3800     0.3800     0.3800
   3      0.8700     0.8700     0.8700     0.8700     0.8700
   4      0.9900     0.9900     0.9900     0.9900     0.9900
   5      1.0000     1.0000     1.0000     1.0000     1.0000
   6      1.0000     1.0000     1.0000     1.0000     1.0000
   7      1.0000     1.0000     1.0000     1.0000     1.0000
   8      1.0000     1.0000     1.0000     1.0000     1.0000
   9      1.0000     1.0000     1.0000     1.0000     1.0000

  AGE      1956       1957       1958       1959       1960
------------------------------------------------------------

   1      0.0400     0.0400     0.0400     0.0400     0.0400
   2      0.3800     0.3800     0.3800     0.3800     0.3800
   3      0.8700     0.8700     0.8700     0.8700     0.8700
   4      0.9900     0.9900     0.9900     0.9900     0.9900
   5      1.0000     1.0000     1.0000     1.0000     1.0000
   6      1.0000     1.0000     1.0000     1.0000     1.0000
   7      1.0000     1.0000     1.0000     1.0000     1.0000
   8      1.0000     1.0000     1.0000     1.0000     1.0000
   9      1.0000     1.0000     1.0000     1.0000     1.0000

  AGE      1961       1962       1963       1964       1965
------------------------------------------------------------

   1      0.0400     0.0400     0.0630     0.0630     0.0630
   2      0.3800     0.3800     0.4690     0.4690     0.4690
   3      0.8700     0.8700     0.9200     0.9200     0.9200
   4      0.9900     0.9900     0.9930     0.9930     0.9930
   5      1.0000     1.0000     0.9990     0.9990     0.9990
   6      1.0000     1.0000     1.0000     1.0000     1.0000
   7      1.0000     1.0000     1.0000     1.0000     1.0000
   8      1.0000     1.0000     1.0000     1.0000     1.0000
   9      1.0000     1.0000     1.0000     1.0000     1.0000

  AGE      1966       1967       1968       1969       1970
------------------------------------------------------------

   1      0.0630     0.0630     0.0630     0.0630     0.0630
   2      0.4690     0.4690     0.4690     0.4690     0.4690
   3      0.9200     0.9200     0.9200     0.9200     0.9200
   4      0.9930     0.9930     0.9930     0.9930     0.9930
   5      0.9990     0.9990     0.9990     0.9990     0.9990
   6      1.0000     1.0000     1.0000     1.0000     1.0000
   7      1.0000     1.0000     1.0000     1.0000     1.0000
   8      1.0000     1.0000     1.0000     1.0000     1.0000
   9      1.0000     1.0000     1.0000     1.0000     1.0000

Maturity - Input Data

  AGE      1971       1972       1973       1974       1975
------------------------------------------------------------

   1      0.0630     0.0630     0.0630     0.0630     0.0630
   2      0.4690     0.4690     0.4690     0.4690     0.4690
   3      0.9200     0.9200     0.9200     0.9200     0.9200
   4      0.9930     0.9930     0.9930     0.9930     0.9930
   5      0.9990     0.9990     0.9990     0.9990     0.9990
   6      1.0000     1.0000     1.0000     1.0000     1.0000
   7      1.0000     1.0000     1.0000     1.0000     1.0000
   8      1.0000     1.0000     1.0000     1.0000     1.0000
   9      1.0000     1.0000     1.0000     1.0000     1.0000

  AGE      1976       1977       1978       1979       1980
------------------------------------------------------------

   1      0.0630     0.0630     0.0630     0.0630     0.0630
   2      0.4690     0.4690     0.4690     0.4690     0.4690
   3      0.9200     0.9200     0.9200     0.9200     0.9200
   4      0.9930     0.9930     0.9930     0.9930     0.9930
   5      0.9990     0.9990     0.9990     0.9990     0.9990
   6      1.0000     1.0000     1.0000     1.0000     1.0000
   7      1.0000     1.0000     1.0000     1.0000     1.0000
   8      1.0000     1.0000     1.0000     1.0000     1.0000
   9      1.0000     1.0000     1.0000     1.0000     1.0000

  AGE      1981       1982       1983       1984       1985
------------------------------------------------------------

   1      0.0630     0.0630     0.0630     0.0630     0.0630
   2      0.4690     0.4690     0.4690     0.4690     0.4690
   3      0.9200     0.9200     0.9200     0.9200     0.9200
   4      0.9930     0.9930     0.9930     0.9930     0.9930
   5      0.9990     0.9990     0.9990     0.9990     0.9990
   6      1.0000     1.0000     1.0000     1.0000     1.0000
```

```
   7       1.0000      1.0000      1.0000      1.0000      1.0000
   8       1.0000      1.0000      1.0000      1.0000      1.0000
   9       1.0000      1.0000      1.0000      1.0000      1.0000

  AGE       1986        1987        1988        1989        1990


   1       0.0630      0.0630      0.0630      0.0630      0.0630
   2       0.4690      0.4690      0.4690      0.4690      0.4690
   3       0.9200      0.9200      0.9200      0.9200      0.9200
   4       0.9930      0.9930      0.9930      0.9930      0.9930
   5       0.9990      0.9990      0.9990      0.9990      0.9990
   6       1.0000      1.0000      1.0000      1.0000      1.0000
   7       1.0000      1.0000      1.0000      1.0000      1.0000
   8       1.0000      1.0000      1.0000      1.0000      1.0000
   9       1.0000      1.0000      1.0000      1.0000      1.0000


Maturity - Input Data


  AGE       1991        1992        1993        1994        1995


   1       0.0630      0.0630      0.0630      0.0630      0.0630
   2       0.4690      0.4690      0.4690      0.4690      0.4690
   3       0.9200      0.9200      0.9200      0.9200      0.9200
   4       0.9930      0.9930      0.9930      0.9930      0.9930
   5       0.9990      0.9990      0.9990      0.9990      0.9990
   6       1.0000      1.0000      1.0000      1.0000      1.0000
   7       1.0000      1.0000      1.0000      1.0000      1.0000
   8       1.0000      1.0000      1.0000      1.0000      1.0000
   9       1.0000      1.0000      1.0000      1.0000      1.0000

  AGE       1996        1997        1998        1999        2000


   1       0.0630      0.0630      0.0630      0.0630      0.0630
   2       0.4690      0.4690      0.4690      0.4690      0.4690
   3       0.9200      0.9200      0.9200      0.9200      0.9200
   4       0.9930      0.9930      0.9930      0.9930      0.9930
   5       0.9990      0.9990      0.9990      0.9990      0.9990
   6       1.0000      1.0000      1.0000      1.0000      1.0000
   7       1.0000      1.0000      1.0000      1.0000      1.0000
   8       1.0000      1.0000      1.0000      1.0000      1.0000
   9       1.0000      1.0000      1.0000      1.0000      1.0000

  AGE       2001        2002        2003        2004        2005


   1       0.0630      0.0630      0.0630      0.0630      0.0630
   2       0.4690      0.4690      0.4690      0.4690      0.4690
   3       0.9200      0.9200      0.9200      0.9200      0.9200
   4       0.9930      0.9930      0.9930      0.9930      0.9930
   5       0.9990      0.9990      0.9990      0.9990      0.9990
   6       1.0000      1.0000      1.0000      1.0000      1.0000
   7       1.0000      1.0000      1.0000      1.0000      1.0000
   8       1.0000      1.0000      1.0000      1.0000      1.0000
   9       1.0000      1.0000      1.0000      1.0000      1.0000

  AGE       2006        2007


   1       0.0630      0.0630
   2       0.4690      0.4690
   3       0.9200      0.9200
   4       0.9930      0.9930
   5       0.9990      0.9990
   6       1.0000      1.0000
   7       1.0000      1.0000
   8       1.0000      1.0000
   9       1.0000      1.0000
```

```
Input Partial Recruitment

  AGE

   1       0.0010
   2       0.4100
   3       0.8400
   4       1.0000
   5       1.0000
   6       1.0000
   7       1.0000
   8       1.0000

Input F-Plus Ratio

  YEAR

  1931       1.0000
  1932       1.0000
  1933       1.0000
  1934       1.0000
  1935       1.0000
  1936       1.0000
  1937       1.0000
  1938       1.0000
  1939       1.0000
  1940       1.0000
  1941       1.0000
  1942       1.0000
  1943       1.0000
  1944       1.0000
  1945       1.0000
  1946       1.0000
  1947       1.0000
  1948       1.0000
  1949       1.0000
  1950       1.0000
  1951       1.0000
  1952       1.0000
  1953       1.0000
  1954       1.0000
  1955       1.0000
  1956       1.0000
  1957       1.0000
  1958       1.0000
  1959       1.0000
  1960       1.0000
  1961       1.0000
  1962       1.0000
  1963       1.0000
  1964       1.0000
  1965       1.0000
  1966       1.0000
  1967       1.0000
  1968       1.0000
  1969       1.0000
  1970       1.0000
  1971       1.0000
  1972       1.0000
  1973       1.0000
  1974       1.0000
  1975       1.0000
  1976       1.0000
  1977       1.0000
  1978       1.0000
  1979       1.0000
  1980       1.0000
  1981       1.0000
  1982       1.0000
  1983       1.0000
  1984       1.0000
  1985       1.0000
  1986       1.0000
  1987       1.0000
  1988       1.0000
  1989       1.0000
  1990       1.0000
  1991       1.0000
  1992       1.0000
  1993       1.0000
  1994       1.0000
  1995       1.0000
  1996       1.0000
  1997       1.0000
  1998       1.0000
  1999       1.0000
  2000       1.0000
  2001       1.0000
  2002       1.0000
  2003       1.0000
  2004       1.0000
  2005       1.0000
  2006       1.0000
  2007       1.0000
```

```
 SURVEY - INPUT DATA

INDEX             1           2           3           4           5

SURVEY TAG     US_Sp       US_Sp       US_Sp       US_Sp       US_Sp

AGE                1           2           3           4           5
TIME           JAN-1       JAN-1       JAN-1       JAN-1       JAN-1
TYPE          NUMBERS     NUMBERS     NUMBERS     NUMBERS     NUMBERS
RETRO FLAG       1           1           1           1           1
 _________________________________________________________________________

    1931        0.0000      0.0000      0.0000      0.0000      0.0000
    1932        0.0000      0.0000      0.0000      0.0000      0.0000
    1933        0.0000      0.0000      0.0000      0.0000      0.0000
    1934        0.0000      0.0000      0.0000      0.0000      0.0000
    1935        0.0000      0.0000      0.0000      0.0000      0.0000
    1936        0.0000      0.0000      0.0000      0.0000      0.0000
    1937        0.0000      0.0000      0.0000      0.0000      0.0000
    1938        0.0000      0.0000      0.0000      0.0000      0.0000
    1939        0.0000      0.0000      0.0000      0.0000      0.0000
    1940        0.0000      0.0000      0.0000      0.0000      0.0000
    1941        0.0000      0.0000      0.0000      0.0000      0.0000
    1942        0.0000      0.0000      0.0000      0.0000      0.0000
    1943        0.0000      0.0000      0.0000      0.0000      0.0000
    1944        0.0000      0.0000      0.0000      0.0000      0.0000
    1945        0.0000      0.0000      0.0000      0.0000      0.0000
    1946        0.0000      0.0000      0.0000      0.0000      0.0000
    1947        0.0000      0.0000      0.0000      0.0000      0.0000
    1948        0.0000      0.0000      0.0000      0.0000      0.0000
    1949        0.0000      0.0000      0.0000      0.0000      0.0000
    1950        0.0000      0.0000      0.0000      0.0000      0.0000
    1951        0.0000      0.0000      0.0000      0.0000      0.0000
    1952        0.0000      0.0000      0.0000      0.0000      0.0000
    1953        0.0000      0.0000      0.0000      0.0000      0.0000
    1954        0.0000      0.0000      0.0000      0.0000      0.0000
    1955        0.0000      0.0000      0.0000      0.0000      0.0000
    1956        0.0000      0.0000      0.0000      0.0000      0.0000
    1957        0.0000      0.0000      0.0000      0.0000      0.0000
    1958        0.0000      0.0000      0.0000      0.0000      0.0000
    1959        0.0000      0.0000      0.0000      0.0000      0.0000
    1960        0.0000      0.0000      0.0000      0.0000      0.0000
    1961        0.0000      0.0000      0.0000      0.0000      0.0000
    1962        0.0000      0.0000      0.0000      0.0000      0.0000
    1963        0.0000      0.0000      0.0000      0.0000      0.0000
    1964        0.0000      0.0000      0.0000      0.0000      0.0000
    1965        0.0000      0.0000      0.0000      0.0000      0.0000
    1966        0.0000      0.0000      0.0000      0.0000      0.0000
    1967        0.0000      0.0000      0.0000      0.0000      0.0000
    1968     1298.2857   9185.3714   1493.0286   2272.0000  21811.2000
    1969        0.0000    227.2000   1882.5143    811.4286   1363.2000
    1970     2174.6286    811.4286      0.0000   1071.0857   1493.0286
    1971        0.0000   3765.0286    811.4286      0.0000    389.4857
    1972    13047.7714    292.1143   1979.8857    389.4857     97.3714
    1973        0.0000      0.0000      0.0000      0.0000      0.0000
    1974        0.0000      0.0000      0.0000      0.0000      0.0000
    1975        0.0000      0.0000      0.0000      0.0000      0.0000
    1976        0.0000      0.0000      0.0000      0.0000      0.0000
    1977        0.0000      0.0000      0.0000      0.0000      0.0000
    1978        0.0000      0.0000      0.0000      0.0000      0.0000
    1979        0.0000      0.0000      0.0000      0.0000      0.0000
    1980        0.0000      0.0000      0.0000      0.0000      0.0000
    1981        0.0000      0.0000      0.0000      0.0000      0.0000
    1982     2466.7429   4965.9429   3050.9714  13210.0571   1363.2000
    1983     1395.6571   1785.1429   1882.5143    714.0571   7822.1714
    1984     6783.5429   3829.9429   2077.2571   2044.8000   1882.5143
    1985        0.0000  16098.7429   2466.7429   1298.2857   2823.7714
    1986     8081.8286    584.2286   6686.1714    778.9714    357.0286
    1987        0.0000  11749.4857    194.7429   2629.0286    259.6571
    1988     5030.8571    129.8286   3213.2571    421.9429   1038.6286
    1989       64.9143  11327.5429   1460.5714   2304.4571    454.4000
    1990     2791.3143      0.0000  18565.4857   1071.0857   1882.5143
    1991     1752.6857   3472.9143    778.9714   6004.5714    292.1143
    1992     1298.2857    584.2286    357.0286    227.2000   1071.0857
    1993     3797.4857   2109.7143    584.2286    454.4000    389.4857
    1994     2269.0789   8707.6023   3254.1531    481.0149    330.4137
    1995     1627.0766   4172.0411   7528.1097   2969.1794    536.1920
    1996     3524.8457  14907.5657  28744.0457  16893.9429   8497.2800
    1997     5825.7326   3319.3920  10884.5029  11870.8754   6521.9383
    1998     2672.8457   9581.9977   4048.7040   3437.2114   2773.4629
    1999    33135.4971   6581.3349   6950.3726   2327.5017   2085.0469
    2000     5937.0606   7692.3429  13322.3589   6521.2891   3604.0411
    2001    32501.6091   2789.3669   7910.1303   2707.2503    976.6354
    2002      592.9920  62468.6400  21806.6560  10459.3143   3545.9429
    2003       32.4571    811.4286  17689.1429   3927.3143  15741.7143
    2004   363974.4000   6004.5714   3894.8571  29406.1714   7075.6571
    2005     2596.5714 173126.4000    519.3143   1233.3714  10873.1429
    2006     6532.3246   1850.0571  93249.3714   1643.9543   2058.1074
    2007     2788.7177  22743.6937   5937.0606 146686.8114   1113.2800
    2008     5978.6057   2841.6229   8373.9429    712.1097  65850.0251
```

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 SURVEY - INPUT DATA

INDEX             6           7           8           9          10

SURVEY TAG     US_Sp       US_Sp       US_Sp       US_S41      US_S41

AGE                6           7           8           1           2
TIME            JAN-1       JAN-1       JAN-1       JAN-1       JAN-1
TYPE          NUMBERS     NUMBERS     NUMBERS     NUMBERS     NUMBERS
RETRO FLAG        1           1           1           1           1
 ________________________________________________________________________

    1931        0.0000      0.0000      0.0000      0.0000      0.0000
    1932        0.0000      0.0000      0.0000      0.0000      0.0000
    1933        0.0000      0.0000      0.0000      0.0000      0.0000
    1934        0.0000      0.0000      0.0000      0.0000      0.0000
    1935        0.0000      0.0000      0.0000      0.0000      0.0000
    1936        0.0000      0.0000      0.0000      0.0000      0.0000
    1937        0.0000      0.0000      0.0000      0.0000      0.0000
    1938        0.0000      0.0000      0.0000      0.0000      0.0000
    1939        0.0000      0.0000      0.0000      0.0000      0.0000
    1940        0.0000      0.0000      0.0000      0.0000      0.0000
    1941        0.0000      0.0000      0.0000      0.0000      0.0000
    1942        0.0000      0.0000      0.0000      0.0000      0.0000
    1943        0.0000      0.0000      0.0000      0.0000      0.0000
    1944        0.0000      0.0000      0.0000      0.0000      0.0000
    1945        0.0000      0.0000      0.0000      0.0000      0.0000
    1946        0.0000      0.0000      0.0000      0.0000      0.0000
    1947        0.0000      0.0000      0.0000      0.0000      0.0000
    1948        0.0000      0.0000      0.0000      0.0000      0.0000
    1949        0.0000      0.0000      0.0000      0.0000      0.0000
    1950        0.0000      0.0000      0.0000      0.0000      0.0000
    1951        0.0000      0.0000      0.0000      0.0000      0.0000
    1952        0.0000      0.0000      0.0000      0.0000      0.0000
    1953        0.0000      0.0000      0.0000      0.0000      0.0000
    1954        0.0000      0.0000      0.0000      0.0000      0.0000
    1955        0.0000      0.0000      0.0000      0.0000      0.0000
    1956        0.0000      0.0000      0.0000      0.0000      0.0000
    1957        0.0000      0.0000      0.0000      0.0000      0.0000
    1958        0.0000      0.0000      0.0000      0.0000      0.0000
    1959        0.0000      0.0000      0.0000      0.0000      0.0000
    1960        0.0000      0.0000      0.0000      0.0000      0.0000
    1961        0.0000      0.0000      0.0000      0.0000      0.0000
    1962        0.0000      0.0000      0.0000      0.0000      0.0000
    1963        0.0000      0.0000      0.0000      0.0000      0.0000
    1964        0.0000      0.0000      0.0000      0.0000      0.0000
    1965        0.0000      0.0000      0.0000      0.0000      0.0000
    1966        0.0000      0.0000      0.0000      0.0000      0.0000
    1967        0.0000      0.0000      0.0000      0.0000      0.0000
    1968     5452.8000    811.4286   1460.5714      0.0000      0.0000
    1969    13729.3714   3343.0857    908.8000      0.0000      0.0000
    1970     1493.0286   6491.4286   3180.8000      0.0000      0.0000
    1971      389.4857    292.1143   2661.4857      0.0000      0.0000
    1972      129.8286    421.9429     97.3714      0.0000      0.0000
    1973        0.0000      0.0000      0.0000  99578.5143  15709.2571
    1974        0.0000      0.0000      0.0000   6913.3714  43135.5429
    1975        0.0000      0.0000      0.0000   3050.9714   3148.3429
    1976        0.0000      0.0000      0.0000 262221.2571    973.7143
    1977        0.0000      0.0000      0.0000   1979.8857 108439.3143
    1978        0.0000      0.0000      0.0000    227.2000   3148.3429
    1979        0.0000      0.0000      0.0000 117235.2000   5128.2286
    1980        0.0000      0.0000      0.0000  16877.7143 151574.8571
    1981        0.0000      0.0000      0.0000  10710.8571  10678.4000
    1982      908.8000   1979.8857      0.0000      0.0000      0.0000
    1983       32.4571    129.8286   3765.0286      0.0000      0.0000
    1984     2336.9143    227.2000    129.8286      0.0000      0.0000
    1985     1103.5429   3797.4857    324.5714      0.0000      0.0000
    1986      681.6000    389.4857   1071.0857      0.0000      0.0000
    1987      324.5714    162.2857    714.0571      0.0000      0.0000
    1988      389.4857    357.0286    389.4857      0.0000      0.0000
    1989     1330.7429    194.7429    162.2857      0.0000      0.0000
    1990      194.7429    421.9429      0.0000      0.0000      0.0000
    1991      324.5714     64.9143    129.8286      0.0000      0.0000
    1992       97.3714     97.3714     97.3714      0.0000      0.0000
    1993     1200.9143    194.7429     64.9143      0.0000      0.0000
    1994      213.5680    503.4103     49.0103      0.0000      0.0000
    1995      369.6869     92.8274    577.7371      0.0000      0.0000
    1996     1132.7543    236.9371    243.4286      0.0000      0.0000
    1997     2886.7383    408.9600    228.4983      0.0000      0.0000
    1998      695.8811    196.0411     17.8514      0.0000      0.0000
    1999     1645.9017    662.7749    651.7394      0.0000      0.0000
    2000     3590.7337   3292.4526   1543.3371      0.0000      0.0000
    2001      681.6000    373.5817    265.1749      0.0000      0.0000
    2002     1548.2057   1969.4994    552.4206      0.0000      0.0000
    2003     3115.8857   3700.1143   2791.3143      0.0000      0.0000
    2004     8666.0571   1395.6571   3115.8857      0.0000      0.0000
    2005     1460.5714   3278.1714    616.6857      0.0000      0.0000
    2006    12005.8971   1683.5520   1536.8457      0.0000      0.0000
    2007      791.6297   4528.0960    431.0309      0.0000      0.0000
    2008     1275.2411    552.7451   2919.8446      0.0000      0.0000
```

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 SURVEY - INPUT DATA

INDEX            11          12          13          14          15

SURVEY TAG     US_S41      US_S41      US_S41      US_S41      US_S41

AGE                3           4           5           6           7
TIME            JAN-1       JAN-1       JAN-1       JAN-1       JAN-1
TYPE          NUMBERS     NUMBERS     NUMBERS     NUMBERS     NUMBERS
RETRO FLAG       1           1           1           1           1
 ________________________________________________________________________

    1931        0.0000      0.0000      0.0000      0.0000      0.0000
    1932        0.0000      0.0000      0.0000      0.0000      0.0000
    1933        0.0000      0.0000      0.0000      0.0000      0.0000
    1934        0.0000      0.0000      0.0000      0.0000      0.0000
    1935        0.0000      0.0000      0.0000      0.0000      0.0000
    1936        0.0000      0.0000      0.0000      0.0000      0.0000
    1937        0.0000      0.0000      0.0000      0.0000      0.0000
    1938        0.0000      0.0000      0.0000      0.0000      0.0000
    1939        0.0000      0.0000      0.0000      0.0000      0.0000
    1940        0.0000      0.0000      0.0000      0.0000      0.0000
    1941        0.0000      0.0000      0.0000      0.0000      0.0000
    1942        0.0000      0.0000      0.0000      0.0000      0.0000
    1943        0.0000      0.0000      0.0000      0.0000      0.0000
    1944        0.0000      0.0000      0.0000      0.0000      0.0000
    1945        0.0000      0.0000      0.0000      0.0000      0.0000
    1946        0.0000      0.0000      0.0000      0.0000      0.0000
    1947        0.0000      0.0000      0.0000      0.0000      0.0000
    1948        0.0000      0.0000      0.0000      0.0000      0.0000
    1949        0.0000      0.0000      0.0000      0.0000      0.0000
    1950        0.0000      0.0000      0.0000      0.0000      0.0000
    1951        0.0000      0.0000      0.0000      0.0000      0.0000
    1952        0.0000      0.0000      0.0000      0.0000      0.0000
    1953        0.0000      0.0000      0.0000      0.0000      0.0000
    1954        0.0000      0.0000      0.0000      0.0000      0.0000
    1955        0.0000      0.0000      0.0000      0.0000      0.0000
    1956        0.0000      0.0000      0.0000      0.0000      0.0000
    1957        0.0000      0.0000      0.0000      0.0000      0.0000
    1958        0.0000      0.0000      0.0000      0.0000      0.0000
    1959        0.0000      0.0000      0.0000      0.0000      0.0000
    1960        0.0000      0.0000      0.0000      0.0000      0.0000
    1961        0.0000      0.0000      0.0000      0.0000      0.0000
    1962        0.0000      0.0000      0.0000      0.0000      0.0000
    1963        0.0000      0.0000      0.0000      0.0000      0.0000
    1964        0.0000      0.0000      0.0000      0.0000      0.0000
    1965        0.0000      0.0000      0.0000      0.0000      0.0000
    1966        0.0000      0.0000      0.0000      0.0000      0.0000
    1967        0.0000      0.0000      0.0000      0.0000      0.0000
    1968        0.0000      0.0000      0.0000      0.0000      0.0000
    1969        0.0000      0.0000      0.0000      0.0000      0.0000
    1970        0.0000      0.0000      0.0000      0.0000      0.0000
    1971        0.0000      0.0000      0.0000      0.0000      0.0000
    1972        0.0000      0.0000      0.0000      0.0000      0.0000
    1973        0.0000   1752.6857    292.1143      0.0000    584.2286
    1974     9282.7429      0.0000    778.9714      0.0000     32.4571
    1975    10775.7714   2044.8000      0.0000    421.9429    292.1143
    1976     1947.4286   2986.0571   1395.6571      0.0000    129.8286
    1977     1363.2000   3959.7714   1947.4286   1460.5714      0.0000
    1978    51704.2286   1168.4571   3050.9714   2661.4857    519.3143
    1979     3667.6571  18533.0286   1071.0857    519.3143   1200.9143
    1980     1655.3143   3375.5429  15806.6286   2174.6286   1200.9143
    1981    63258.9714   7108.1143   2466.7429   5777.3714    778.9714
    1982        0.0000      0.0000      0.0000      0.0000      0.0000
    1983        0.0000      0.0000      0.0000      0.0000      0.0000
    1984        0.0000      0.0000      0.0000      0.0000      0.0000
    1985        0.0000      0.0000      0.0000      0.0000      0.0000
    1986        0.0000      0.0000      0.0000      0.0000      0.0000
    1987        0.0000      0.0000      0.0000      0.0000      0.0000
    1988        0.0000      0.0000      0.0000      0.0000      0.0000
    1989        0.0000      0.0000      0.0000      0.0000      0.0000
    1990        0.0000      0.0000      0.0000      0.0000      0.0000
    1991        0.0000      0.0000      0.0000      0.0000      0.0000
    1992        0.0000      0.0000      0.0000      0.0000      0.0000
    1993        0.0000      0.0000      0.0000      0.0000      0.0000
    1994        0.0000      0.0000      0.0000      0.0000      0.0000
    1995        0.0000      0.0000      0.0000      0.0000      0.0000
    1996        0.0000      0.0000      0.0000      0.0000      0.0000
    1997        0.0000      0.0000      0.0000      0.0000      0.0000
    1998        0.0000      0.0000      0.0000      0.0000      0.0000
    1999        0.0000      0.0000      0.0000      0.0000      0.0000
    2000        0.0000      0.0000      0.0000      0.0000      0.0000
    2001        0.0000      0.0000      0.0000      0.0000      0.0000
    2002        0.0000      0.0000      0.0000      0.0000      0.0000
    2003        0.0000      0.0000      0.0000      0.0000      0.0000
    2004        0.0000      0.0000      0.0000      0.0000      0.0000
    2005        0.0000      0.0000      0.0000      0.0000      0.0000
    2006        0.0000      0.0000      0.0000      0.0000      0.0000
    2007        0.0000      0.0000      0.0000      0.0000      0.0000
    2008        0.0000      0.0000      0.0000      0.0000      0.0000
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 SURVEY - INPUT DATA

INDEX            16          17          18          19          20

SURVEY TAG     US_S41      US_Au0      US_Au1      US_Au2      US_Au3

AGE                8           1           2           3           4
TIME          JAN-1       JAN-1       JAN-1       JAN-1       JAN-1
TYPE          NUMBERS     NUMBERS     NUMBERS     NUMBERS     NUMBERS
RETRO FLAG       1           1           1           1           1
 _______________________________________________________________________

    1931        0.0000      0.0000      0.0000      0.0000      0.0000
    1932        0.0000      0.0000      0.0000      0.0000      0.0000
    1933        0.0000      0.0000      0.0000      0.0000      0.0000
    1934        0.0000      0.0000      0.0000      0.0000      0.0000
    1935        0.0000      0.0000      0.0000      0.0000      0.0000
    1936        0.0000      0.0000      0.0000      0.0000      0.0000
    1937        0.0000      0.0000      0.0000      0.0000      0.0000
    1938        0.0000      0.0000      0.0000      0.0000      0.0000
    1939        0.0000      0.0000      0.0000      0.0000      0.0000
    1940        0.0000      0.0000      0.0000      0.0000      0.0000
    1941        0.0000      0.0000      0.0000      0.0000      0.0000
    1942        0.0000      0.0000      0.0000      0.0000      0.0000
    1943        0.0000      0.0000      0.0000      0.0000      0.0000
    1944        0.0000      0.0000      0.0000      0.0000      0.0000
    1945        0.0000      0.0000      0.0000      0.0000      0.0000
    1946        0.0000      0.0000      0.0000      0.0000      0.0000
    1947        0.0000      0.0000      0.0000      0.0000      0.0000
    1948        0.0000      0.0000      0.0000      0.0000      0.0000
    1949        0.0000      0.0000      0.0000      0.0000      0.0000
    1950        0.0000      0.0000      0.0000      0.0000      0.0000
    1951        0.0000      0.0000      0.0000      0.0000      0.0000
    1952        0.0000      0.0000      0.0000      0.0000      0.0000
    1953        0.0000      0.0000      0.0000      0.0000      0.0000
    1954        0.0000      0.0000      0.0000      0.0000      0.0000
    1955        0.0000      0.0000      0.0000      0.0000      0.0000
    1956        0.0000      0.0000      0.0000      0.0000      0.0000
    1957        0.0000      0.0000      0.0000      0.0000      0.0000
    1958        0.0000      0.0000      0.0000      0.0000      0.0000
    1959        0.0000      0.0000      0.0000      0.0000      0.0000
    1960        0.0000      0.0000      0.0000      0.0000      0.0000
    1961        0.0000      0.0000      0.0000      0.0000      0.0000
    1962        0.0000      0.0000      0.0000      0.0000      0.0000
    1963        0.0000      0.0000      0.0000      0.0000      0.0000
    1964        0.0000 272418.3177  82407.3874  29935.5474  22101.0423
    1965        0.0000   7689.4217 366335.6571 206888.9691  18909.2069
    1966        0.0000   1063.9451  32982.2994 251187.7760  31483.1040
    1967        0.0000  19924.7909   3095.1131   9382.0617  59677.6503
    1968        0.0000     96.7223  21810.8754   1160.6674   3240.1966
    1969        0.0000    290.1669    193.4446   3095.1131    435.2503
    1970        0.0000   1257.3897     96.7223      0.0000    918.8617
    1971        0.0000    145.0834  13396.0366    677.0560     48.3611
    1972        0.0000   7882.8663      0.0000   1015.5840    241.8057
    1973       32.4571  21907.5977   8173.0331      0.0000   1692.6400
    1974      324.5714  10494.3680  29210.1303   5223.0034      0.0000
    1975       32.4571   2418.0571   5754.9760   3191.8354   1015.5840
    1976        0.0000  76217.1611   2031.1680   2321.3349  15765.7326
    1977      129.8286  14024.7314 208291.4423   1692.6400   1741.0011
    1978      194.7429    436.2240   6940.9600  60802.9394   1824.4160
    1979      194.7429  42914.8343   2736.7863   3371.3234  30104.0000
    1980     1493.0286   4283.6937 147902.0069    119.1177   2935.0994
    1981      357.0286  37917.4080   8804.9737  41288.7314   1467.3874
    1982        0.0000   1229.4766  19910.5097   6742.6469  12017.9063
    1983        0.0000   4400.8640      0.0000   4304.1417   1112.3063
    1984        0.0000  18812.4846    773.7783    677.0560    870.5006
    1985        0.0000     96.7223  10784.5349   2853.3074    773.7783
    1986        0.0000  36838.8571   2109.7143   4965.9429    714.0571
    1987        0.0000      0.0000  16585.6000    292.1143   3927.3143
    1988        0.0000   5842.2857      0.0000   2564.1143    324.5714
    1989        0.0000    227.2000   9802.0571    584.2286   4219.4286
    1990        0.0000   1517.0469    159.6891   8782.9029    638.7566
    1991        0.0000   2501.7966   2182.4183     79.8446   3859.1543
    1992        0.0000   6999.7074    665.3714    771.8309    159.6891
    1993        0.0000   9250.2857   6751.0857    746.5143    778.9714
    1994        0.0000   4923.7486  13121.1246   6520.6400    984.7497
    1995        0.0000   2954.5737   2505.6914   2621.8880   2165.8651
    1996        0.0000   7377.1840  23168.2331  15916.9829   7519.0217
    1997        0.0000   4255.7806   1765.0194   3005.2069   3369.7006
    1998        0.0000   1048.6903   8002.9577   4762.1120   2430.7154
    1999        0.0000  14007.8537   9050.0251   8027.6251   2347.6251
    2000        0.0000   5922.4549   2728.0229  10934.1623  26129.9474
    2001        0.0000  13433.3623   9161.0286  17790.7337  10076.6446
    2002        0.0000   2774.4366  28471.0811   5458.6423  24146.8160
    2003        0.0000    377.4766   6203.2091  72275.5657  17672.9143
    2004        0.0000 501602.0983    230.7703   1464.1417  27760.5943
    2005        0.0000   5287.9177 531167.9589    710.8114   2740.6811
    2006        0.0000  13817.9794   5744.9143 250706.7611    904.2560
    2007        0.0000   3050.9714  14742.3589   2374.2400 156978.6469
    2008        0.0000      0.0000      0.0000      0.0000      0.0000
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 SURVEY - INPUT DATA

INDEX            21          22          23          24          25

SURVEY TAG     US_Au4      US_Au5      Can_Sp      Can_Sp      Can_Sp

AGE                 5           6           1           2           3
TIME          JAN-1       JAN-1       JAN-1       JAN-1       JAN-1
TYPE          NUMBERS     NUMBERS     NUMBERS     NUMBERS     NUMBERS
RETRO FLAG       1           1           1           1           1
 _________________________________________________________________________

    1931        0.0000      0.0000      0.0000      0.0000      0.0000
    1932        0.0000      0.0000      0.0000      0.0000      0.0000
    1933        0.0000      0.0000      0.0000      0.0000      0.0000
    1934        0.0000      0.0000      0.0000      0.0000      0.0000
    1935        0.0000      0.0000      0.0000      0.0000      0.0000
    1936        0.0000      0.0000      0.0000      0.0000      0.0000
    1937        0.0000      0.0000      0.0000      0.0000      0.0000
    1938        0.0000      0.0000      0.0000      0.0000      0.0000
    1939        0.0000      0.0000      0.0000      0.0000      0.0000
    1940        0.0000      0.0000      0.0000      0.0000      0.0000
    1941        0.0000      0.0000      0.0000      0.0000      0.0000
    1942        0.0000      0.0000      0.0000      0.0000      0.0000
    1943        0.0000      0.0000      0.0000      0.0000      0.0000
    1944        0.0000      0.0000      0.0000      0.0000      0.0000
    1945        0.0000      0.0000      0.0000      0.0000      0.0000
    1946        0.0000      0.0000      0.0000      0.0000      0.0000
    1947        0.0000      0.0000      0.0000      0.0000      0.0000
    1948        0.0000      0.0000      0.0000      0.0000      0.0000
    1949        0.0000      0.0000      0.0000      0.0000      0.0000
    1950        0.0000      0.0000      0.0000      0.0000      0.0000
    1951        0.0000      0.0000      0.0000      0.0000      0.0000
    1952        0.0000      0.0000      0.0000      0.0000      0.0000
    1953        0.0000      0.0000      0.0000      0.0000      0.0000
    1954        0.0000      0.0000      0.0000      0.0000      0.0000
    1955        0.0000      0.0000      0.0000      0.0000      0.0000
    1956        0.0000      0.0000      0.0000      0.0000      0.0000
    1957        0.0000      0.0000      0.0000      0.0000      0.0000
    1958        0.0000      0.0000      0.0000      0.0000      0.0000
    1959        0.0000      0.0000      0.0000      0.0000      0.0000
    1960        0.0000      0.0000      0.0000      0.0000      0.0000
    1961        0.0000      0.0000      0.0000      0.0000      0.0000
    1962        0.0000      0.0000      0.0000      0.0000      0.0000
    1963        0.0000      0.0000      0.0000      0.0000      0.0000
    1964    27082.2400  19296.0960      0.0000      0.0000      0.0000
    1965     5803.3371  12380.4526      0.0000      0.0000      0.0000
    1966     3482.0023   2611.5017      0.0000      0.0000      0.0000
    1967    10881.2571   1692.6400      0.0000      0.0000      0.0000
    1968    21955.9589   5271.3646      0.0000      0.0000      0.0000
    1969     1063.9451  12525.5360      0.0000      0.0000      0.0000
    1970      435.2503    531.9726      0.0000      0.0000      0.0000
    1971      918.8617    870.5006      0.0000      0.0000      0.0000
    1972       48.3611    725.4171      0.0000      0.0000      0.0000
    1973      290.1669      0.0000      0.0000      0.0000      0.0000
    1974      628.6949    145.0834      0.0000      0.0000      0.0000
    1975        0.0000     48.3611      0.0000      0.0000      0.0000
    1976     2998.3909      0.0000      0.0000      0.0000      0.0000
    1977     2659.8629    967.2229      0.0000      0.0000      0.0000
    1978     1864.0137   2062.3269      0.0000      0.0000      0.0000
    1979      594.9394    832.8503      0.0000      0.0000      0.0000
    1980    12374.6103    832.8503      0.0000      0.0000      0.0000
    1981      594.9394   5513.1703      0.0000      0.0000      0.0000
    1982      674.1349   1348.5943      0.0000      0.0000      0.0000
    1983     4545.9474    435.2503      0.0000      0.0000      0.0000
    1984      967.2229   3046.7520      0.0000      0.0000      0.0000
    1985      918.8617    193.4446      0.0000      0.0000      0.0000
    1986      162.2857    324.5714   5713.9874    309.6249   8514.6857
    1987      194.7429    421.9429     42.2216   4278.4536    971.0964
    1988     2499.2000    194.7429   2068.8575     70.3693  12005.0031
    1989      389.4857   1298.2857     42.2216   7515.4416   1013.3180
    1990     2155.8034    292.7634   1308.8690    154.8125  13890.9005
    1991      159.6891    558.9120   1055.5395   2350.3347    197.0340
    1992      718.6011     53.2297   4644.3740   4151.7889   1590.3463
    1993        0.0000   1525.4857   5573.2488   3039.9539    774.0623
    1994        0.0000    186.3040   4672.5217  16213.0875   5742.1351
    1995      401.8194    147.0309   2730.3290   3687.3515   6051.7601
    1996     1221.6869     38.6240   8599.1289   4067.3457   6811.7486
    1997     1582.6103    462.8389   2448.8518   1632.5678   1393.3122
    1998     1776.7040   1056.4800   3391.8004  11512.4180   4334.7491
    1999     1337.5589    570.9211  27795.8748   4799.1865  10076.8842
    2000    11429.4583   7535.5749  25797.3866  96546.6841  13116.8381
    2001     3561.8469   2143.1451  31356.5615   3982.9026  15312.3604
    2002     6877.3440   3774.1166   2786.6244  44614.1383   9359.1173
    2003    27709.3120   6074.6789   1922.0671   3582.3605  97566.8982
    2004     5758.8709  10892.6171 207872.0477    579.8431   2806.8908
    2005    44206.3040   3814.0389      0.0000      0.0000      0.0000
    2006     2260.3154  15370.4046      0.0000      0.0000      0.0000
    2007     1282.0571   1404.0960   4215.1298  15001.2952   4418.9837
    2008        0.0000      0.0000   3923.2138   1248.3493   4813.2667
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 SURVEY - INPUT DATA

INDEX            26          27          28          29          30

SURVEY TAG     Can_Sp      Can_Sp      Can_Sp      Can_Sp      Can_Sp

AGE                4           5           6           7           8
TIME            JAN-1       JAN-1       JAN-1       JAN-1       JAN-1
TYPE          NUMBERS     NUMBERS     NUMBERS     NUMBERS     NUMBERS
RETRO FLAG       1           1           1           1           1
 ________________________________________________________________________

    1931        0.0000      0.0000      0.0000      0.0000      0.0000
    1932        0.0000      0.0000      0.0000      0.0000      0.0000
    1933        0.0000      0.0000      0.0000      0.0000      0.0000
    1934        0.0000      0.0000      0.0000      0.0000      0.0000
    1935        0.0000      0.0000      0.0000      0.0000      0.0000
    1936        0.0000      0.0000      0.0000      0.0000      0.0000
    1937        0.0000      0.0000      0.0000      0.0000      0.0000
    1938        0.0000      0.0000      0.0000      0.0000      0.0000
    1939        0.0000      0.0000      0.0000      0.0000      0.0000
    1940        0.0000      0.0000      0.0000      0.0000      0.0000
    1941        0.0000      0.0000      0.0000      0.0000      0.0000
    1942        0.0000      0.0000      0.0000      0.0000      0.0000
    1943        0.0000      0.0000      0.0000      0.0000      0.0000
    1944        0.0000      0.0000      0.0000      0.0000      0.0000
    1945        0.0000      0.0000      0.0000      0.0000      0.0000
    1946        0.0000      0.0000      0.0000      0.0000      0.0000
    1947        0.0000      0.0000      0.0000      0.0000      0.0000
    1948        0.0000      0.0000      0.0000      0.0000      0.0000
    1949        0.0000      0.0000      0.0000      0.0000      0.0000
    1950        0.0000      0.0000      0.0000      0.0000      0.0000
    1951        0.0000      0.0000      0.0000      0.0000      0.0000
    1952        0.0000      0.0000      0.0000      0.0000      0.0000
    1953        0.0000      0.0000      0.0000      0.0000      0.0000
    1954        0.0000      0.0000      0.0000      0.0000      0.0000
    1955        0.0000      0.0000      0.0000      0.0000      0.0000
    1956        0.0000      0.0000      0.0000      0.0000      0.0000
    1957        0.0000      0.0000      0.0000      0.0000      0.0000
    1958        0.0000      0.0000      0.0000      0.0000      0.0000
    1959        0.0000      0.0000      0.0000      0.0000      0.0000
    1960        0.0000      0.0000      0.0000      0.0000      0.0000
    1961        0.0000      0.0000      0.0000      0.0000      0.0000
    1962        0.0000      0.0000      0.0000      0.0000      0.0000
    1963        0.0000      0.0000      0.0000      0.0000      0.0000
    1964        0.0000      0.0000      0.0000      0.0000      0.0000
    1965        0.0000      0.0000      0.0000      0.0000      0.0000
    1966        0.0000      0.0000      0.0000      0.0000      0.0000
    1967        0.0000      0.0000      0.0000      0.0000      0.0000
    1968        0.0000      0.0000      0.0000      0.0000      0.0000
    1969        0.0000      0.0000      0.0000      0.0000      0.0000
    1970        0.0000      0.0000      0.0000      0.0000      0.0000
    1971        0.0000      0.0000      0.0000      0.0000      0.0000
    1972        0.0000      0.0000      0.0000      0.0000      0.0000
    1973        0.0000      0.0000      0.0000      0.0000      0.0000
    1974        0.0000      0.0000      0.0000      0.0000      0.0000
    1975        0.0000      0.0000      0.0000      0.0000      0.0000
    1976        0.0000      0.0000      0.0000      0.0000      0.0000
    1977        0.0000      0.0000      0.0000      0.0000      0.0000
    1978        0.0000      0.0000      0.0000      0.0000      0.0000
    1979        0.0000      0.0000      0.0000      0.0000      0.0000
    1980        0.0000      0.0000      0.0000      0.0000      0.0000
    1981        0.0000      0.0000      0.0000      0.0000      0.0000
    1982        0.0000      0.0000      0.0000      0.0000      0.0000
    1983        0.0000      0.0000      0.0000      0.0000      0.0000
    1984        0.0000      0.0000      0.0000      0.0000      0.0000
    1985        0.0000      0.0000      0.0000      0.0000      0.0000
    1986     1505.9031    267.4034    408.1420    478.5113    520.7328
    1987     3532.5390    942.9487    112.5909    422.2158    140.7386
    1988      239.2556   4011.0503    253.3295    239.2556    154.8125
    1989     2983.6585    267.4034    591.1021     42.2216     42.2216
    1990      182.9602   4728.8172    323.6988   1534.0508    182.9602
    1991    12652.4007    154.8125   2251.8177    126.6647    619.2499
    1992      239.2556   5376.2148     42.2216   1491.8292     56.2954
    1993      633.3237     56.2954   1801.4542     28.1477    450.3635
    1994      591.1021    337.7727     28.1477    985.1702     14.0739
    1995     3124.3971    788.1362     42.2216      0.0000    675.5453
    1996     7093.2258   4109.5673    365.9204    337.7727     56.2954
    1997     3293.2834   3335.5050   2392.5563    323.6988    126.6647
    1998     3616.9822   5291.7716   5165.1069   2786.6244    337.7727
    1999     3110.3232   1970.3405   1899.9712   1773.3064    464.4374
    2000    12539.8098   2969.5846   2181.4484   2730.3290   1604.4201
    2001     4348.8229   5812.5044   1815.5280   1618.4940   1984.4144
    2002    21617.4500   6079.9078   7487.2939   2237.7438   1857.7496
    2003     7228.6163  18640.2655   4132.9299   3779.3945   1697.4483
    2004    55692.3777   5541.3012  10383.9759   1738.9662   1023.4511
    2005        0.0000      0.0000      0.0000      0.0000      0.0000
    2006        0.0000      0.0000      0.0000      0.0000      0.0000
    2007    80460.3945   1120.6229    177.5060   4177.2086    299.0375
    2008     5203.7707 109124.4661   1008.9984    194.6924   8594.6729

     Additional Output Files
```

```
Population File C:\X-APPS\ADAPT\VPA280\GARM3_REVIEW\BASE_CASE\31TO07_BOOTRUN\GAR
Auxilliary File C:\X-APPS\ADAPT\VPA280\GARM3_REVIEW\BASE_CASE\31TO07_BOOTRUN\GAR
Covariance File C:\X-APPS\ADAPT\VPA280\GARM3_REVIEW\BASE_CASE\31TO07_BOOTRUN\GAR
Residuals File  C:\X-APPS\ADAPT\VPA280\GARM3_REVIEW\BASE_CASE\31TO07_BOOTRUN\GAR
Log File        C:\X-APPS\ADAPT\VPA280\GARM3_REVIEW\BASE_CASE\31TO07_BOOTRUN\GAR


   Estimation Results
 JAN-1 Population Numbers


   AGE       1931        1932        1933        1934        1935
 _____________________________________________________________________________

    1       39938.      45315.      51615.      59569.      58214.
    2       80387.      31115.      36994.      42038.      48463.
    3       14081.      57882.      23594.      22668.      30403.
    4       17665.       9690.      24276.      13906.      13693.
    5       17144.       9275.       5758.      10890.       8032.
    6       10197.       5932.       4304.       2841.       6090.
    7        5491.       2979.       2275.       2110.       1384.
    8        3086.       1496.       1260.        785.       1172.
    9         961.        881.       1515.        527.        289.
 =====================================================================
 Total     188951.     164565.     151591.     155335.     167739.

   AGE       1936        1937        1938        1939        1940
 _____________________________________________________________________________

    1       57147.     105311.      78051.      59486.     111227.
    2       46580.      45993.      85058.      62972.      48155.
    3       29009.      27065.      27739.      51484.      39026.
    4       16976.      13472.      12397.      15748.      24588.
    5        7883.       9028.       5996.       6781.       8264.
    6        3939.       4531.       3691.       3016.       3621.
    7        2787.       1991.       2033.       1592.       1602.
    8         686.       1066.        780.        821.        558.
    9         329.        492.        413.        602.        342.
 =====================================================================
 Total     165336.     208949.     216158.     202501.     237382.

   AGE       1941        1942        1943        1944        1945
 _____________________________________________________________________________

    1      114267.      61875.      23306.      65151.      51807.
    2       89222.      92850.      50379.      19064.      53283.
    3       32893.      51973.      63135.      37467.      14922.
    4       20903.      18129.      27887.      35765.      23090.
    5       12732.       9923.       8992.      15326.      16006.
    6        4513.       5276.       4549.       4581.       7453.
    7        1642.       2101.       2236.       1332.       1717.
    8         640.        508.        796.       1123.        645.
    9         801.        394.        400.        259.        499.
 =====================================================================
 Total     277614.     243027.     181680.     180068.     169422.

   AGE       1946        1947        1948        1949        1950
 _____________________________________________________________________________

    1       93899.      59136.      32955.     124141.      57212.
    2       42306.      76689.      48335.      26909.     101342.
    3       35951.      27917.      47841.      29481.      16214.
    4       10389.      15832.      13602.      21957.      12979.
    5       13170.       6046.       6548.       6555.       9390.
    6        7914.       5613.       3044.       2907.       3264.
    7        4025.       3053.       2152.       1457.       1430.
    8         592.       1664.       1161.       1063.        635.
    9          50.       1021.        952.        918.        705.
 =====================================================================
 Total     208296.     196971.     156589.     215387.     203172


 JAN-1 Population Numbers


   AGE       1951        1952        1953        1954        1955
 _____________________________________________________________________________

    1      103780.      42290.     132790.      52280.      89900.
    2       46762.      84386.      34620.     107741.      42706.
    3       56964.      30845.      46546.      26714.      59619.
    4        9585.      23002.      17272.      22360.      17276.
    5        6796.       5891.      11233.       9007.      13265.
    6        4718.       3371.       3599.       5828.       5295.
    7        1659.       1953.       1912.       2038.       2863.
    8         705.        697.       1123.       1079.       1024.
    9         510.        410.        506.        300.        553.
 =====================================================================
 Total     231479.     192843.     249602.     227348.     232502.

   AGE       1956        1957        1958        1959        1960
 _____________________________________________________________________________

    1       60261.      59630.      58676.     129847.     122245.
    2       73523.      49291.      48790.      47927.     106224.
```

```
   3       31411.      49438.      34415.      34924.      34088.
   4       31547.      19693.      27866.      21801.      21407.
   5       11161.      15026.      12058.      16825.      13203.
   6        7915.       6083.       7091.       6477.      10239.
   7        2856.       3460.       2870.       3684.       3725.
   8        1388.       1135.       1378.       1540.       1965.
   9         495.        878.        443.       1213.       1685.
====================================================================
Total     220557.     204634.     193586.     264238.     314780.

  AGE       1961        1962        1963        1964        1965
_____________________________________________________________________________

   1       54312.      39050.     188241.     460816.      32513.
   2       99853.      44411.      31905.     151491.     368163.
   3       72550.      72117.      32344.      22475.     109665.
   4       22399.      45973.      44439.      19812.      14304.
   5       13424.      14561.      28253.      26363.      11929.
   6        8053.       8367.       8822.      15773.      13764.
   7        6770.       4925.       4974.       5242.       7724.
   8        2342.       4403.       2627.       2811.       2428.
   9        3182.       3337.       3994.       3642.       3032.
====================================================================
Total     282883.     237143.     345599.     708424.     563523.

  AGE       1966        1967        1968        1969        1970
_____________________________________________________________________________

   1        4155.      14013.        542.       1111.       4616.
   2       18003.       3299.      10436.        437.        908.
   3      188650.       8612.       2549.       5856.        348.
   4       49979.      64678.       4459.       1451.       3271.
   5        6915.      23760.      34417.       1934.        786.
   6        5833.       3185.      10213.      15196.        997.
   7        5300.       2461.       1525.       5225.       7112.
   8        2959.       2256.       1126.        652.       2866.
   9        2023.       1717.       2094.       1653.       1782.
====================================================================
Total     283817.     123980.      67362.      33515.      22685.


JAN-1 Population Numbers


  AGE       1971        1972        1973        1974        1975
_____________________________________________________________________________

   1         267.       8526.      19498.      10577.       7930.
   2        3737.        217.       6836.      13615.       8617.
   3         601.       1828.        176.       3701.       7129.
   4         270.        292.       1083.        141.       2417.
   5        2165.        185.        165.        535.        114.
   6         476.       1512.        122.         87.        372.
   7         624.        171.       1127.         73.         69.
   8        3753.        256.         68.        852.         57.
   9        2371.       4801.       2036.       4002.       1276.
====================================================================
Total      14264.      17789.      31112.      33582.      27981.

  AGE       1976        1977        1978        1979        1980
_____________________________________________________________________________

   1      105349.      13984.       6125.      83889.      10935.
   2        6313.      86118.      11448.       5014.      68676.
   3        6091.       4726.      52656.       8681.       4081.
   4        4105.       4473.       3699.      30082.       5540.
   5        1630.       2540.       3041.       2751.      18125.
   6          90.       1132.       1610.       1975.       1775.
   7         266.         73.        602.        851.       1245.
   8          53.        196.         56.        367.        412.
   9        1495.        558.        270.        176.        218.
====================================================================
Total     125391.     113801.      79507.     133787.     111007.

  AGE       1981        1982        1983        1984        1985
_____________________________________________________________________________

   1        7364.       2581.       3284.      18083.       2519.
   2        8946.       6028.       2112.       2689.      14804.
   3       28385.       5745.       3880.       1535.       2116.
   4        3027.      13326.       3227.       2438.        986.
   5        3653.       1727.       7534.       2015.       1336.
   6        9382.       2143.       1060.       4139.       1288.
   7         918.       5355.       1240.        621.       2045.
   8         529.        453.       3371.        846.        296.
   9         315.        470.        320.       1720.        577.
====================================================================
Total      62518.      37828.      26027.      34085.      25967.

  AGE       1986        1987        1988        1989        1990
_____________________________________________________________________________

   1       16793.       2618.      20015.       1366.       3415.
   2        2062.      13744.       2143.      16383.       1117.
   3        9902.       1639.       9419.       1707.      12095.
```

```
   4        1227.       5551.       1223.       5521.       1287.
   5         628.        801.       3068.        878.       3603.
   6         671.        382.        544.       1657.        524.
   7         845.        391.        245.        308.        928.
   8        1190.        555.        239.        150.        197.
   9         268.        707.        395.        230.        174.
====================================================================
Total      33587.      26387.      37292.      28201.      23339.


JAN-1 Population Numbers


  AGE       1991        1992        1993        1994        1995
-----------------------------------------------------------------------------

   1        2725.      10812.      15695.      15580.      12850.
   2        2739.       2225.       8776.      12820.      12731.
   3         904.       1805.       1583.       6857.      10011.
   4        8374.        629.       1112.        901.       4542.
   5         812.       4728.        338.        605.        521.
   6        1942.        535.       2118.        169.        367.
   7         290.       1125.        275.       1070.         73.
   8         564.        123.        540.        169.        594.
   9         213.        263.        262.        336.        157.
====================================================================
Total      18563.      22245.      30699.      38508.      41846.

  AGE       1996        1997        1998        1999        2000
-----------------------------------------------------------------------------

   1       11939.      23830.      14944.      50508.      11982.
   2       10505.       9769.      19497.      12230.      41348.
   3       10339.       8550.       7868.      15755.       9974.
   4        7642.       7954.       6754.       6017.      12082.
   5        3294.       5429.       5840.       5027.       4439.
   6         374.       2291.       3939.       4090.       3570.
   7         274.        246.       1680.       2711.       2839.
   8          52.        205.        186.       1223.       1874.
   9         591.        543.        386.        357.        715.
====================================================================
Total      45010.      58816.      61094.      97917.      88822.

  AGE       2001        2002        2003        2004        2005
-----------------------------------------------------------------------------

   1       97844.       5779.       2884.     494868.       8048.
   2        9808.      80095.       4728.       2357.     404580.
   3       33486.       7899.      65218.       3855.       1900.
   4        7602.      25257.       6156.      51642.       3047.
   5        8476.       5326.      17815.       4624.      37669.
   6        3104.       5787.       3527.      12167.       3129.
   7        2447.       1952.       3743.       2343.       7323.
   8        1985.       1610.       1237.       2417.       1302.
   9        1451.       2896.       2265.       1753.       1418.
====================================================================
Total     166203.     136600.     107574.     576027.     468416.

  AGE       2006        2007        2008
-----------------------------------------------------------------------------

   1       26450.       7421.      16376.
   2        6572.      21507.       6064.
   3      330689.       5364.      17450.
   4        1518.     267887.       4175.
   5        2189.       1179.     209204.
   6       23194.       1454.        790.
   7        1863.      14119.        911.
   8        4340.       1231.       9299.
   9        1173.       3036.        300.
====================================================================
Total     397987.     323198.     264569.
```

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Fishing Mortality Calculated

  AGE       1931        1932        1933        1934        1935
 ____________________________________________________________________

    1       0.0497      0.0029      0.0052      0.0063      0.0229
    2       0.1284      0.0767      0.2898      0.1240      0.3132
    3       0.1737      0.6689      0.3287      0.3041      0.3828
    4       0.4442      0.3205      0.6016      0.3489      0.3522
    5       0.8614      0.5677      0.5066      0.3813      0.5125
    6       1.0305      0.7585      0.5130      0.5188      0.5818
    7       1.1002      0.6608      0.8644      0.3881      0.5015
    8       0.9973      0.6623      0.6280      0.4294      0.5319
    9       0.9973      0.6623      0.6280      0.4294      0.5319

  AGE       1936        1937        1938        1939        1940
 ____________________________________________________________________

    1       0.0171      0.0136      0.0147      0.0113      0.0204
    2       0.3430      0.3056      0.3021      0.2785      0.1812
    3       0.5670      0.5807      0.3661      0.5390      0.4243
    4       0.4315      0.6095      0.4034      0.4448      0.4581
    5       0.3537      0.6943      0.4873      0.4272      0.4048
    6       0.4823      0.6016      0.6410      0.4327      0.5910
    7       0.7605      0.7365      0.7072      0.8488      0.7173
    8       0.5322      0.6775      0.6118      0.5696      0.5710
    9       0.5322      0.6775      0.6118      0.5696      0.5710

  AGE       1941        1942        1943        1944        1945
 ____________________________________________________________________

    1       0.0076      0.0055      0.0009      0.0011      0.0026
    2       0.3404      0.1857      0.0961      0.0450      0.1935
    3       0.3958      0.4226      0.3683      0.2841      0.1621
    4       0.5451      0.5012      0.3986      0.6040      0.3614
    5       0.6810      0.5800      0.4743      0.5209      0.5044
    6       0.5645      0.6582      1.0282      0.7816      0.4160
    7       0.9739      0.7702      0.4887      0.5245      0.8655
    8       0.7398      0.6695      0.6638      0.6090      0.5953
    9       0.7398      0.6695      0.6638      0.6090      0.5953

  AGE       1946        1947        1948        1949        1950
 ____________________________________________________________________

    1       0.0025      0.0017      0.0027      0.0029      0.0017
    2       0.2157      0.2719      0.2944      0.3066      0.3761
    3       0.6201      0.5191      0.5788      0.6204      0.3257
    4       0.3413      0.6829      0.5300      0.6494      0.4470
    5       0.6529      0.4862      0.6120      0.4973      0.4884
    6       0.7525      0.7587      0.5372      0.5097      0.4769
    7       0.6835      0.7671      0.5052      0.6307      0.5075
    8       0.6963      0.6707      0.5515      0.5459      0.4909
    9       0.6963      0.6707      0.5515      0.5459      0.4909

Fishing Mortality Calculated

  AGE       1951        1952        1953        1954        1955
 ____________________________________________________________________

    1       0.0069      0.0001      0.0090      0.0023      0.0011
    2       0.2161      0.3950      0.0593      0.3918      0.1072
    3       0.7068      0.3799      0.5332      0.2359      0.4365
    4       0.2869      0.5167      0.4511      0.3221      0.2369
    5       0.5011      0.2926      0.4561      0.3313      0.3164
    6       0.6821      0.3669      0.3686      0.5108      0.4174
    7       0.6672      0.3534      0.3722      0.4887      0.5243
    8       0.6168      0.3376      0.3990      0.4436      0.4194
    9       0.6168      0.3376      0.3990      0.4436      0.4194

  AGE       1956        1957        1958        1959        1960
 ____________________________________________________________________

    1       0.0010      0.0006      0.0024      0.0008      0.0023
    2       0.1969      0.1592      0.1343      0.1407      0.1813
    3       0.2669      0.3733      0.2565      0.2895      0.2199
    4       0.5417      0.2906      0.3046      0.3015      0.2667
    5       0.4070      0.5510      0.4214      0.2967      0.2944
    6       0.6274      0.5511      0.4547      0.3534      0.2137
    7       0.7229      0.7207      0.4227      0.4285      0.2641
    8       0.5858      0.6076      0.4329      0.3595      0.2574
    9       0.5858      0.6076      0.4329      0.3595      0.2574

  AGE       1961        1962        1963        1964        1965
 ____________________________________________________________________

    1       0.0013      0.0021      0.0172      0.0245      0.3911
    2       0.1254      0.1171      0.1504      0.1231      0.4686
    3       0.2562      0.2842      0.2901      0.2518      0.5858
    4       0.2307      0.2868      0.3221      0.3074      0.5269
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   5      0.2727     0.3011     0.3829     0.4499     0.5153
   6      0.2918     0.3202     0.3206     0.5139     0.7543
   7      0.2301     0.4283     0.3707     0.5694     0.7595
   8      0.2649     0.3498     0.3581     0.5111     0.6764
   9      0.2649     0.3498     0.3581     0.5111     0.6764

  AGE      1966       1967       1968       1969       1970
 ____________________________________________________________________

   1      0.0307     0.0948     0.0164     0.0020     0.0111
   2      0.5373     0.0578     0.3777     0.0282     0.2124
   3      0.8705     0.4582     0.3638     0.3825     0.0521
   4      0.5436     0.4309     0.6355     0.4131     0.2127
   5      0.5753     0.6443     0.6175     0.4625     0.3009
   6      0.6631     0.5364     0.4701     0.5592     0.2689
   7      0.6544     0.5815     0.6491     0.4007     0.4392
   8      0.6309     0.5874     0.5789     0.4741     0.3363
   9      0.6309     0.5874     0.5789     0.4741     0.3363


Fishing Mortality Calculated


  AGE      1971       1972       1973       1974       1975
 ____________________________________________________________________

   1      0.0041     0.0209     0.1592     0.0050     0.0280
   2      0.5150     0.0102     0.4136     0.4470     0.1469
   3      0.5207     0.3234     0.0196     0.2261     0.3519
   4      0.1778     0.3725     0.5059     0.0165     0.1942
   5      0.1589     0.2159     0.4442     0.1618     0.0405
   6      0.8264     0.0937     0.3214     0.0271     0.1373
   7      0.6898     0.7136     0.0797     0.0325     0.0677
   8      0.5584     0.3411     0.2818     0.0738     0.0818
   9      0.5584     0.3411     0.2818     0.0738     0.0818

  AGE      1976       1977       1978       1979       1980
 ____________________________________________________________________

   1      0.0016     0.0001     0.0002     0.0001     0.0008
   2      0.0895     0.2919     0.0767     0.0058     0.6835
   3      0.1089     0.0452     0.3598     0.2492     0.0989
   4      0.2799     0.1858     0.0960     0.3067     0.2164
   5      0.1640     0.2560     0.2314     0.2379     0.4585
   6      0.0001     0.4311     0.4377     0.2616     0.4595
   7      0.1043     0.0636     0.2948     0.5254     0.6564
   8      0.0895     0.2502     0.3213     0.3416     0.5248
   9      0.0895     0.2502     0.3213     0.3416     0.5248

  AGE      1981       1982       1983       1984       1985
 ____________________________________________________________________

   1      0.0001     0.0004     0.0001     0.0001     0.0001
   2      0.2429     0.2407     0.1195     0.0394     0.2021
   3      0.5562     0.3769     0.2646     0.2424     0.3452
   4      0.3613     0.3703     0.2708     0.4017     0.2503
   5      0.3333     0.2883     0.3990     0.2473     0.4891
   6      0.3607     0.3473     0.3347     0.5051     0.2222
   7      0.5064     0.2630     0.1824     0.5398     0.3410
   8      0.4001     0.2995     0.3054     0.4307     0.3508
   9      0.4001     0.2995     0.3054     0.4307     0.3508

  AGE      1986       1987       1988       1989       1990
 ____________________________________________________________________

   1      0.0004     0.0001     0.0002     0.0015     0.0205
   2      0.0297     0.1778     0.0278     0.1035     0.0115
   3      0.3789     0.0926     0.3342     0.0824     0.1677
   4      0.2262     0.3930     0.1317     0.2267     0.2608
   5      0.2991     0.1874     0.4159     0.3170     0.4183
   6      0.3383     0.2415     0.3672     0.3800     0.3902
   7      0.2204     0.2940     0.2903     0.2482     0.2977
   8      0.2859     0.2410     0.3578     0.3151     0.3687
   9      0.2859     0.2410     0.3578     0.3151     0.3687
```

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Fishing Mortality Calculated

   AGE       1991        1992        1993        1994        1995
 ----------------------------------------------------------------------------

    1       0.0028      0.0086      0.0023      0.0019      0.0015
    2       0.2170      0.1406      0.0467      0.0473      0.0081
    3       0.1620      0.2849      0.3628      0.2120      0.0700
    4       0.3716      0.4206      0.4089      0.3480      0.1212
    5       0.2174      0.6031      0.4918      0.2984      0.1329
    6       0.3459      0.4637      0.4831      0.6407      0.0923
    7       0.6562      0.5342      0.2872      0.3874      0.1370
    8       0.4065      0.5336      0.4207      0.4422      0.1207
    9       0.4065      0.5336      0.4207      0.4422      0.1207

   AGE       1996        1997        1998        1999        2000
 ----------------------------------------------------------------------------

    1       0.0006      0.0007      0.0004      0.0001      0.0001
    2       0.0059      0.0163      0.0131      0.0039      0.0109
    3       0.0623      0.0358      0.0682      0.0655      0.0716
    4       0.1419      0.1089      0.0954      0.1043      0.1544
    5       0.1630      0.1209      0.1562      0.1423      0.1576
    6       0.2160      0.1106      0.1736      0.1650      0.1775
    7       0.0930      0.0815      0.1174      0.1692      0.1580
    8       0.1573      0.1043      0.1491      0.1588      0.1643
    9       0.1573      0.1043      0.1491      0.1588      0.1643

   AGE       2001        2002        2003        2004        2005
 ----------------------------------------------------------------------------

    1       0.0002      0.0006      0.0017      0.0014      0.0027
    2       0.0165      0.0055      0.0041      0.0156      0.0017
    3       0.0820      0.0494      0.0334      0.0354      0.0246
    4       0.1557      0.1490      0.0861      0.1155      0.1307
    5       0.1817      0.2122      0.1813      0.1905      0.2850
    6       0.2640      0.2357      0.2090      0.3077      0.3185
    7       0.2189      0.2562      0.2372      0.3875      0.3231
    8       0.2215      0.2347      0.2092      0.2952      0.3089
    9       0.2215      0.2347      0.2092      0.2952      0.3089

   AGE       2006        2007
 ----------------------------------------------------------------------------

    1       0.0069      0.0019
    2       0.0031      0.0090
    3       0.0106      0.0506
    4       0.0529      0.0473
    5       0.2088      0.1999
    6       0.2964      0.2681
    7       0.2140      0.2176
    8       0.2397      0.2285
    9       0.2397      0.2285

Average Fishing Mortality For Ages   5-  7

 Year      Average F   N Weighted  Biomass Wtd  Catch Wtd

 ----------------------------------------------------------------------------

 1931       0.9973      0.9538      0.9674      0.9601
 1932       0.6623      0.6452      0.6521      0.6533
 1933       0.6280      0.5748      0.5857      0.5974
 1934       0.4294      0.4068      0.4094      0.4121
 1935       0.5319      0.5387      0.5396      0.5404
 1936       0.5322      0.4660      0.4819      0.5035
 1937       0.6775      0.6727      0.6735      0.6751
 1938       0.6118      0.5738      0.5840      0.5847
 1939       0.5696      0.4876      0.4993      0.5178
 1940       0.5710      0.4919      0.5100      0.5125
 1941       0.7398      0.6786      0.6841      0.6890
 1942       0.6695      0.6270      0.6365      0.6315
 1943       0.6638      0.6360      0.6436      0.7026
 1944       0.6090      0.5774      0.5849      0.5914
 1945       0.5953      0.5029      0.5078      0.5183
 1946       0.6963      0.6892      0.6926      0.6912
 1947       0.6707      0.6484      0.6619      0.6696
 1948       0.5515      0.5730      0.5665      0.5757
 1949       0.5459      0.5184      0.5240      0.5212
 1950       0.4909      0.4877      0.4880      0.4878
 1951       0.6168      0.5869      0.6016      0.5969
 1952       0.3376      0.3255      0.3309      0.3287
 1953       0.3990      0.4277      0.4212      0.4309
 1954       0.4436      0.4123      0.4254      0.4273
 1955       0.4194      0.3691      0.3788      0.3812
 1956       0.5858      0.5277      0.5465      0.5509
 1957       0.6076      0.5749      0.5821      0.5792
 1958       0.4329      0.4323      0.4334      0.4327
 1959       0.3595      0.3283      0.3362      0.3337
 1960       0.2574      0.2599      0.2562      0.2646
```

```
1961       0.2649     0.2679     0.2656     0.2696
1962       0.3498     0.3293     0.3354     0.3347
1963       0.3581     0.3684     0.3661     0.3698
1964       0.5111     0.4844     0.4900     0.4872
1965       0.6764     0.6702     0.6820     0.6850
1966       0.6309     0.6269     0.6319     0.6289
1967       0.5874     0.6274     0.6216     0.6290
1968       0.5789     0.5860     0.5807     0.5911
1969       0.4741     0.5138     0.5068     0.5210
1970       0.3363     0.4079     0.4109     0.4162
1971       0.5584     0.3577     0.3813     0.5437
1972       0.3411     0.1625     0.1669     0.3209
1973       0.2818     0.1431     0.1304     0.2459
1974       0.0738     0.1315     0.1241     0.1546
1975       0.0818     0.1088     0.1101     0.1241
1976       0.0895     0.1486     0.1461     0.1582
1977       0.2502     0.3051     0.3117     0.3264
1978       0.3213     0.3019     0.3092     0.3258
1979       0.3416     0.2902     0.3037     0.3181
1980       0.5248     0.4702     0.4763     0.4736
1981       0.4001     0.3631     0.3677     0.3666
1982       0.2995     0.2873     0.2849     0.2908
1983       0.3054     0.3648     0.3541     0.3776
1984       0.4307     0.4316     0.4431     0.4605
1985       0.3508     0.3506     0.3448     0.3749
1986       0.2859     0.2804     0.2777     0.2884
1987       0.2410     0.2270     0.2341     0.2347
1988       0.3578     0.4010     0.3978     0.4034
1989       0.3151     0.3463     0.3453     0.3512
1990       0.3687     0.3932     0.3871     0.3978
1991       0.4065     0.3412     0.3512     0.3727
1992       0.5336     0.5793     0.5747     0.5818
1993       0.4207     0.4645     0.4624     0.4710
1994       0.4422     0.3815     0.3822     0.3987
1995       0.1207     0.1177     0.1167     0.1209
1996       0.1573     0.1632     0.1620     0.1666
1997       0.1043     0.1167     0.1160     0.1172
1998       0.1491     0.1565     0.1557     0.1584
1999       0.1588     0.1563     0.1576     0.1572
2000       0.1643     0.1642     0.1643     0.1647
2001       0.2215     0.2064     0.2090     0.2113
2002       0.2347     0.2292     0.2315     0.2301
2003       0.2092     0.1936     0.1962     0.1955
2004       0.2952     0.2891     0.2935     0.3006
2005       0.3089     0.2929     0.2943     0.2936
2006       0.2397     0.2837     0.2840     0.2866
2007       0.2285     0.2208     0.2209     0.2217

Back Calculated Partial Recruitment

  AGE       1931       1932       1933       1934       1935
-----------------------------------------------------------------------------

   1       0.0451     0.0038     0.0060     0.0122     0.0394
   2       0.1168     0.1011     0.3353     0.2391     0.5383
   3       0.1579     0.8819     0.3802     0.5862     0.6579
   4       0.4038     0.4225     0.6960     0.6726     0.6054
   5       0.7830     0.7485     0.5861     0.7350     0.8809
   6       0.9367     1.0000     0.5935     1.0000     1.0000
   7       1.0000     0.8711     1.0000     0.7481     0.8621
   8       0.9065     0.8732     0.7265     0.8277     0.9144
   9       0.9065     0.8732     0.7265     0.8277     0.9144

  AGE       1936       1937       1938       1939       1940
-----------------------------------------------------------------------------

   1       0.0225     0.0184     0.0207     0.0133     0.0285
   2       0.4510     0.4150     0.4271     0.3281     0.2526
   3       0.7456     0.7885     0.5177     0.6350     0.5916
   4       0.5674     0.8276     0.5704     0.5241     0.6387
   5       0.4651     0.9428     0.6890     0.5033     0.5644
   6       0.6342     0.8168     0.9064     0.5098     0.8240
   7       1.0000     1.0000     1.0000     1.0000     1.0000
   8       0.6998     0.9198     0.8651     0.6710     0.7961
   9       0.6998     0.9198     0.8651     0.6710     0.7961

  AGE       1941       1942       1943       1944       1945
-----------------------------------------------------------------------------

   1       0.0078     0.0072     0.0009     0.0014     0.0030
   2       0.3495     0.2411     0.0935     0.0576     0.2235
   3       0.4064     0.5486     0.3582     0.3635     0.1873
   4       0.5597     0.6507     0.3876     0.7727     0.4176
   5       0.6993     0.7530     0.4612     0.6665     0.5828
   6       0.5796     0.8546     1.0000     1.0000     0.4807
   7       1.0000     1.0000     0.4753     0.6711     1.0000
   8       0.7596     0.8692     0.6455     0.7792     0.6878
   9       0.7596     0.8692     0.6455     0.7792     0.6878

  AGE       1946       1947       1948       1949       1950
-----------------------------------------------------------------------------

   1       0.0033     0.0022     0.0044     0.0045     0.0033
```

```
   2       0.2866      0.3544      0.4810      0.4720      0.7411
   3       0.8242      0.6766      0.9457      0.9553      0.6418
   4       0.4535      0.8902      0.8659      1.0000      0.8809
   5       0.8677      0.6337      1.0000      0.7657      0.9624
   6       1.0000      0.9890      0.8777      0.7848      0.9398
   7       0.9084      1.0000      0.8254      0.9711      1.0000
   8       0.9254      0.8743      0.9010      0.8405      0.9674
   9       0.9254      0.8743      0.9010      0.8405      0.9674

Back Calculated Partial Recruitment


  AGE       1951        1952        1953        1954        1955
_____________________________________________________________________________

   1       0.0097      0.0002      0.0170      0.0045      0.0021
   2       0.3057      0.7643      0.1111      0.7669      0.2044
   3       1.0000      0.7352      1.0000      0.4617      0.8326
   4       0.4059      1.0000      0.8460      0.6306      0.4519
   5       0.7090      0.5663      0.8555      0.6486      0.6035
   6       0.9650      0.7100      0.6914      1.0000      0.7962
   7       0.9439      0.6840      0.6981      0.9568      1.0000
   8       0.8726      0.6534      0.7483      0.8684      0.7999
   9       0.8726      0.6534      0.7483      0.8684      0.7999

  AGE       1956        1957        1958        1959        1960
_____________________________________________________________________________

   1       0.0013      0.0009      0.0052      0.0019      0.0079
   2       0.2723      0.2209      0.2954      0.3285      0.6157
   3       0.3692      0.5179      0.5642      0.6756      0.7470
   4       0.7493      0.4032      0.6698      0.7037      0.9058
   5       0.5630      0.7645      0.9266      0.6924      1.0000
   6       0.8679      0.7646      1.0000      0.8248      0.7259
   7       1.0000      1.0000      0.9295      1.0000      0.8970
   8       0.8103      0.8430      0.9520      0.8391      0.8743
   9       0.8103      0.8430      0.9520      0.8391      0.8743

  AGE       1961        1962        1963        1964        1965
_____________________________________________________________________________

   1       0.0043      0.0049      0.0449      0.0430      0.5150
   2       0.4298      0.2733      0.3927      0.2162      0.6170
   3       0.8782      0.6635      0.7577      0.4423      0.7713
   4       0.7906      0.6697      0.8413      0.5398      0.6937
   5       0.9346      0.7030      1.0000      0.7901      0.6785
   6       1.0000      0.7476      0.8374      0.9026      0.9932
   7       0.7886      1.0000      0.9682      1.0000      1.0000
   8       0.9077      0.8169      0.9352      0.8976      0.8906
   9       0.9077      0.8169      0.9352      0.8976      0.8906

  AGE       1966        1967        1968        1969        1970
_____________________________________________________________________________

   1       0.0353      0.1471      0.0253      0.0036      0.0252
   2       0.6173      0.0897      0.5819      0.0504      0.4837
   3       1.0000      0.7111      0.5606      0.6841      0.1186
   4       0.6245      0.6687      0.9791      0.7388      0.4843
   5       0.6609      1.0000      0.9514      0.8270      0.6852
   6       0.7617      0.8325      0.7243      1.0000      0.6122
   7       0.7517      0.9025      1.0000      0.7166      1.0000
   8       0.7248      0.9117      0.8919      0.8479      0.7658
   9       0.7248      0.9117      0.8919      0.8479      0.7658


Back Calculated Partial Recruitment


  AGE       1971        1972        1973        1974        1975
_____________________________________________________________________________

   1       0.0050      0.0292      0.3146      0.0112      0.0796
   2       0.6231      0.0143      0.8174      1.0000      0.4174
   3       0.6301      0.4533      0.0387      0.5059      1.0000
   4       0.2151      0.5220      1.0000      0.0369      0.5518
   5       0.1923      0.3025      0.8781      0.3620      0.1151
   6       1.0000      0.1314      0.6353      0.0607      0.3901
   7       0.8347      1.0000      0.1576      0.0726      0.1925
   8       0.6756      0.4780      0.5570      0.1651      0.2326
   9       0.6756      0.4780      0.5570      0.1651      0.2326

  AGE       1976        1977        1978        1979        1980
_____________________________________________________________________________

   1       0.0056      0.0002      0.0004      0.0002      0.0012
   2       0.3197      0.6772      0.1752      0.0110      1.0000
   3       0.3889      0.1049      0.8221      0.4742      0.1447
   4       1.0000      0.4310      0.2194      0.5836      0.3166
   5       0.5859      0.5938      0.5286      0.4528      0.6708
   6       0.0004      1.0000      1.0000      0.4979      0.6722
   7       0.3726      0.1476      0.6735      1.0000      0.9602
   8       0.3196      0.5805      0.7341      0.6502      0.7677
   9       0.3196      0.5805      0.7341      0.6502      0.7677
```

```
  AGE       1981        1982        1983        1984        1985
 ---------------------------------------------------------------------

   1      0.0003      0.0011      0.0003      0.0002      0.0002
   2      0.4367      0.6388      0.2996      0.0729      0.4132
   3      1.0000      1.0000      0.6632      0.4490      0.7058
   4      0.6496      0.9826      0.6787      0.7441      0.5117
   5      0.5993      0.7651      1.0000      0.4581      1.0000
   6      0.6485      0.9216      0.8389      0.9356      0.4543
   7      0.9105      0.6978      0.4571      1.0000      0.6972
   8      0.7194      0.7948      0.7653      0.7979      0.7172
   9      0.7194      0.7948      0.7653      0.7979      0.7172

  AGE       1986        1987        1988        1989        1990
 ---------------------------------------------------------------------

   1      0.0011      0.0003      0.0005      0.0040      0.0491
   2      0.0784      0.4524      0.0667      0.2723      0.0276
   3      1.0000      0.2357      0.8037      0.2168      0.4009
   4      0.5971      1.0000      0.3167      0.5965      0.6235
   5      0.7895      0.4770      1.0000      0.8342      1.0000
   6      0.8928      0.6146      0.8830      1.0000      0.9330
   7      0.5818      0.7480      0.6981      0.6533      0.7118
   8      0.7547      0.6132      0.8603      0.8291      0.8816
   9      0.7547      0.6132      0.8603      0.8291      0.8816

Back Calculated Partial Recruitment

  AGE       1991        1992        1993        1994        1995
 ---------------------------------------------------------------------

   1      0.0043      0.0142      0.0047      0.0030      0.0107
   2      0.3307      0.2331      0.0950      0.0739      0.0594
   3      0.2468      0.4724      0.7377      0.3309      0.5110
   4      0.5663      0.6974      0.8313      0.5431      0.8844
   5      0.3314      1.0000      1.0000      0.4658      0.9697
   6      0.5272      0.7688      0.9823      1.0000      0.6736
   7      1.0000      0.8858      0.5839      0.6047      1.0000
   8      0.6195      0.8849      0.8554      0.6901      0.8811
   9      0.6195      0.8849      0.8554      0.6901      0.8811

  AGE       1996        1997        1998        1999        2000
 ---------------------------------------------------------------------

   1      0.0029      0.0056      0.0026      0.0006      0.0008
   2      0.0275      0.1350      0.0755      0.0231      0.0615
   3      0.2883      0.2966      0.3930      0.3870      0.4036
   4      0.6572      0.9010      0.5491      0.6165      0.8700
   5      0.7548      1.0000      0.8993      0.8411      0.8878
   6      1.0000      0.9153      1.0000      0.9754      1.0000
   7      0.4305      0.6741      0.6759      1.0000      0.8900
   8      0.7284      0.8631      0.8584      0.9388      0.9259
   9      0.7284      0.8631      0.8584      0.9388      0.9259

  AGE       2001        2002        2003        2004        2005
 ---------------------------------------------------------------------

   1      0.0006      0.0022      0.0073      0.0037      0.0083
   2      0.0623      0.0214      0.0174      0.0402      0.0052
   3      0.3107      0.1927      0.1408      0.0914      0.0760
   4      0.5899      0.5816      0.3632      0.2980      0.4044
   5      0.6885      0.8281      0.7646      0.4917      0.8818
   6      1.0000      0.9196      0.8811      0.7939      0.9857
   7      0.8292      1.0000      1.0000      1.0000      1.0000
   8      0.8392      0.9159      0.8819      0.7618      0.9559
   9      0.8392      0.9159      0.8819      0.7618      0.9559

  AGE       2006        2007
 ---------------------------------------------------------------------

   1      0.0232      0.0072
   2      0.0104      0.0336
   3      0.0358      0.1886
   4      0.1784      0.1762
   5      0.7047      0.7454
   6      1.0000      1.0000
   7      0.7222      0.8116
   8      0.8089      0.8523
   9      0.8089      0.8523
```

```
 JAN-1 Biomass

   AGE       1931        1932        1933        1934        1935
 -----------------------------------------------------------------------------

    1       28136.      27157.      23970.      17382.      20183.
    2       53040.      24842.      25285.      26396.      29296.
    3       13379.      53373.      25274.      20587.      28691.
    4       20604.      14201.      30202.      19723.      18412.
    5       24554.      14925.      10218.      17168.      13117.
    6       17555.      11275.       9148.       5427.      11336.
    7       11262.       6992.       5279.       5198.       3217.
    8        7474.       3892.       3356.       2077.       3119.
    9        2913.       2819.       3939.       1571.        988.
 ====================================================================
 Total     178917.     159477.     136671.     115530.     128360.

   AGE       1936        1937        1938        1939        1940
 -----------------------------------------------------------------------------

    1       22316.      37543.      36122.      27138.      52443.
    2       28433.      30636.      54964.      42670.      34296.
    3       29517.      27124.      30283.      52164.      39826.
    4       23420.      18119.      18315.      23604.      33679.
    5       13077.      15705.      10865.      12658.      14471.
    6        7619.       8794.       7797.       6980.       7795.
    7        6011.       4833.       4915.       3938.       4296.
    8        1781.       2869.       2173.       2307.       1602.
    9        1091.       1752.       1532.       2057.       1322.
 ====================================================================
 Total     133264.     147376.     166966.     173516.     189729.

   AGE       1941        1942        1943        1944        1945
 -----------------------------------------------------------------------------

    1       48209.      27157.       9770.      34706.      25908.
    2       59342.      59507.      31038.      12297.      38454.
    3       33992.      49540.      55836.      33420.      14862.
    4       29517.      23995.      35762.      42106.      30206.
    5       21955.      16258.      14124.      25063.      26311.
    6        9381.      10279.       8177.       9052.      15690.
    7        4104.       5189.       4874.       2958.       4279.
    8        1866.       1472.       2181.       3010.       1874.
    9        2818.       1330.       1350.        952.       1673.
 ====================================================================
 Total     211183.     194729.     163113.     163564.     159258.

   AGE       1946        1947        1948        1949        1950
 -----------------------------------------------------------------------------

    1       41212.      31910.      14464.      59737.      19281.
    2       28455.      47248.      30132.      16579.      61413.
    3       36095.      26441.      41684.      24009.      14330.
    4       14770.      22006.      18101.      26871.      14894.
    5       22323.      10972.      11572.      11330.      15118.
    6       16380.      11665.       6633.       6273.       6804.
    7       10182.       7598.       5422.       3683.       3571.
    8        1757.       4782.       3446.       3119.       1890.
    9         209.       3388.       3331.       3386.       2412.
 ====================================================================
 Total     171384.     166009.     134785.     154986.     139713.


JAN-1 Biomass

   AGE       1951        1952        1953        1954        1955
 -----------------------------------------------------------------------------

    1       48206.      18020.      61721.      16751.      43332.
    2       25654.      51028.      19349.      70118.      25807.
    3       45782.      25022.      37488.      20273.      54367.
    4       11731.      25463.      18267.      24430.      18615.
    5       10486.       9114.      16238.      11994.      19318.
    6        9682.       6720.       6689.      10008.       9025.
    7        4161.       4761.       4386.       4336.       5883.
    8        2004.       2067.       2946.       2590.       2437.
    9        1683.       1430.       1676.        923.       1638.
 ====================================================================
 Total     159389.     143623.     168761.     161422.     180423.

   AGE       1956        1957        1958        1959        1960
 -----------------------------------------------------------------------------

    1       18337.      26130.      34900.      60457.      61991.
    2       51319.      28574.      32465.      36170.      71542.
    3       29184.      47737.      32577.      33915.      34711.
    4       38513.      23849.      34111.      27783.      28580.
    5       16528.      23485.      19049.      26226.      22029.
    6       14928.      11438.      14151.      12724.      21589.
    7        6216.       7840.       6713.       8860.       9429.
    8        3587.       2944.       3662.       4361.       5689.
    9        1793.       2731.       1501.       4270.       6368.
```

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 ===================================================================
 Total     180406.     174727.     179128.     214766.     261928.

   AGE      1961        1962        1963        1964        1965
 ____________________________________________________________________________

     1      22089.      16612.      88925.     196123.      16809.
     2      70886.      29524.      21867.     104196.     216259.
     3      68792.      68374.      32393.      22185.     101397.
     4      30702.      57512.      55735.      25736.      17588.
     5      22854.      24040.      43484.      40934.      18433.
     6      16775.      16739.      17210.      28985.      24865.
     7      16957.      11635.      11153.      11907.      16463.
     8       6814.      11359.       7199.       7001.       6136.
     9      10309.      10978.      12381.      10816.       9430.
 ===================================================================
 Total     266177.     246773.     290348.     447882.     427380.

   AGE      1966        1967        1968        1969        1970
 ____________________________________________________________________________

     1       2194.       8349.        278.        370.       2721.
     2      11714.       2102.       7631.        296.        738.
     3     147826.       7172.       2186.       5528.        339.
     4      56936.      66282.       4994.       1932.       4766.
     5      10475.      31781.      46845.       2939.       1512.
     6      10846.       5945.      17636.      26860.       2039.
     7      11290.       5381.       3325.      12021.      16116.
     8       7536.       5555.       2771.       1718.       8176.
     9       6434.       5322.       5988.       5999.       6684.
 ===================================================================
 Total     265251.     137890.      91654.      57664.      43090.

JAN-1 Biomass


   AGE      1971        1972        1973        1974        1975
 ____________________________________________________________________________

     1        144.       4101.       8802.       6527.       3890.
     2       3196.        181.       5463.      10858.       7238.
     3        775.       2448.        225.       5068.       9371.
     4        394.        478.       2085.        271.       4847.
     5       4649.        380.        366.       1313.        257.
     6       1181.       3994.        345.        261.       1074.
     7       1648.        500.       3562.        265.        268.
     8      10615.        812.        235.       3120.        233.
     9       8820.      17573.       8020.      17047.       5525.
 ===================================================================
 Total      31423.      30466.      29102.      44728.      32703.

   AGE      1976        1977        1978        1979        1980
 ____________________________________________________________________________

     1      36008.       5566.       2363.      33388.       4782.
     2       4946.      62986.       8080.       3650.      48471.
     3       7109.       5643.      66710.       9522.       4490.
     4       7393.       7768.       6339.      52364.       8243.
     5       3951.       5921.       7482.       6225.      37948.
     6        233.       3309.       4752.       5847.       4723.
     7        875.        262.       1982.       2955.       4186.
     8        228.        753.        218.       1313.       1511.
     9       7384.       2786.       1378.        857.        844.
 ===================================================================
 Total      68129.      94995.      99303.     116120.     115199.

   AGE      1981        1982        1983        1984        1985
 ____________________________________________________________________________

     1       1821.        264.        649.       3445.        492.
     2       6188.       3708.       1001.       1482.       8462.
     3      30644.       6453.       4472.       1781.       2393.
     4       4504.      20345.       5256.       3860.       1594.
     5       7287.       3596.      15356.       4043.       2834.
     6      22794.       5399.       2656.      10053.       3152.
     7       2969.      15898.       3713.       1739.       5845.
     8       2017.       1736.      11122.       2816.        983.
     9       1397.       1922.       1368.       6400.       2192.
 ===================================================================
 Total      79622.      59322.      45592.      35618.      27947.

   AGE      1986        1987        1988        1989        1990
 ____________________________________________________________________________

     1       5564.        746.       5774.        535.       1596.
     2       1149.       8399.       1391.      10017.        801.
     3      11490.       1900.       9934.       2055.      13881.
     4       1957.       9154.       1896.       8550.       2089.
     5       1415.       1626.       6227.       1692.       7019.
     6       1769.        990.       1277.       3813.       1243.
     7       2397.       1144.        686.        869.       2493.
     8       3873.       1853.        775.        489.        613.
     9       1015.       3031.       1565.        880.        723.
 ===================================================================
 Total      30628.      28843.      29525.      28899.      30458.
```

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JAN-1 Biomass

  AGE      1991        1992        1993        1994        1995
____________________________________________________________________________

   1        1113.       3946.       8031.       4735.       3446.
   2        2401.       1838.       6960.      10880.       8370.
   3        1019.       2533.       2255.       9504.      12771.
   4       13732.        958.       2097.       1761.       8284.
   5        1600.       9423.        655.       1444.       1235.
   6        4598.       1254.       5076.        407.        999.
   7         782.       3151.        711.       2954.        218.
   8        1651.        382.       1643.        536.       1780.
   9         925.       1123.       1053.       1528.        624.
====================================================================
Total      27822.      24608.      28481.      33749.      37729.
  AGE      1996        1997        1998        1999        2000
____________________________________________________________________________

   1        3680.       6498.       5202.      26491.       5986.
   2        7210.       6590.      12373.       9174.      36242.
   3       12439.      11647.       9579.      19155.      12663.
   4       12642.      13382.      12156.       9919.      20541.
   5        7148.      10949.      12266.      10112.       9011.
   6         950.       5576.       9607.       9554.       7988.
   7         851.        696.       4663.       7299.       7177.
   8         177.        696.        574.       3668.       5322.
   9        2194.       1983.       1572.       1313.       2359.
====================================================================
Total      47291.      58018.      67993.      96686.     107289.
  AGE      2001        2002        2003        2004        2005
____________________________________________________________________________

   1       21966.       1210.        602.      64234.        891.
   2        8656.      45718.       2100.        751.     140147.
   3       43053.       9889.      72555.       3103.       1224.
   4       12182.      40184.       9039.      73688.       3674.
   5       17128.       9848.      31961.       7583.      59539.
   6        7404.      13367.       7045.      23158.       5465.
   7        6109.       5486.       9346.       4825.      14586.
   8        5419.       4571.       3844.       6029.       2736.
   9        4948.       9666.       7171.       5108.       3730.
====================================================================
Total     126863.     139939.     143664.     188479.     231992.
  AGE      2006        2007        2008
____________________________________________________________________________

   1        2396.        171.       1844.
   2        1926.       8902.       2203.
   3      242494.       3861.      14011.
   4        1606.     292908.       5221.
   5        3346.       1480.     326296.
   6       39984.       2496.       1436.
   7        3462.      26192.       1869.
   8        8886.       2401.      21760.
   9        2708.       6604.        792.
====================================================================
Total     306808.     345015.     375431.


Mean Biomass

  AGE      1931        1932        1933        1934        1935
____________________________________________________________________________

   1       26507.      26249.      25198.      22607.      24003.
   2       53446.      23104.      21352.      26212.      32980.
   3       13864.      42157.      24739.      20120.      28110.
   4       17841.      13749.      23712.      15945.      16835.
   5       17431.      12238.       7143.      14453.      10283.
   6       11791.       8356.       7356.       4275.       8366.
   7        7097.       5474.       3444.       4052.       2547.
   8        4569.       2937.       2219.       1659.       2318.
   9        1698.       1889.       2679.       1166.        701.
====================================================================
Total     154245.     136152.     117841.     110489.     126143.
  AGE      1936        1937        1938        1939        1940
____________________________________________________________________________

   1       26198.      45516.      39335.      30564.      55900.
   2       29114.      31407.      58179.      41039.      35636.
   3       24106.      23295.      29018.      42946.      36865.
   4       19634.      14037.      16383.      19034.      28644.
   5       10411.      11576.       9367.       9973.      11595.
   6        5967.       6826.       5741.       5542.       5856.
   7        4209.       3645.       3568.       2623.       3040.
   8        1280.       2187.       1470.       1694.       1205.
   9         774.       1167.       1049.       1435.        922.
```

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==================================================================
Total     121693.     139655.     164109.     154851.     179662.

  AGE       1941        1942        1943        1944        1945
______________________________________________________________________________

    1      53658.      29084.      10980.      36591.      27200.
    2      54453.      60861.      31831.      13527.      37002.
    3      29739.      44492.      47679.      32374.      15523.
    4      23138.      19024.      30007.      34406.      27739.
    5      15827.      11782.      11053.      20422.      22174.
    6       7289.       7189.       4950.       6742.      13188.
    7       2580.       3551.       3782.       2473.       2841.
    8       1216.       1068.       1515.       2364.       1438.
    9       1827.        889.        904.        653.       1154.
==================================================================
Total     189725.     177939.     142701.     149551.     148258.

  AGE       1946        1947        1948        1949        1950
______________________________________________________________________________

    1      44202.      31061.      15511.      60672.      22279.
    2      27000.      44629.      25550.      15412.      52383.
    3      29438.      22895.      34565.      19913.      13494.
    4      13077.      16930.      14866.      21304.      12710.
    5      16215.       8838.       8698.       9156.      12218.
    6      11329.       8520.       5062.       4996.       5312.
    7       7217.       5459.       4153.       2691.       2664.
    8       1281.       3399.       2579.       2398.       1494.
    9        138.       2262.       2342.       2386.       1742.
==================================================================
Total     149897.     143993.     113327.     138929.     124296.

Mean Biomass


  AGE       1951        1952        1953        1954        1955
______________________________________________________________________________

    1      49687.      18704.      65906.      20826.      47234.
    2      26777.      43884.      19518.      62617.      30519.
    3      35578.      22002.      31009.      19488.      47633.
    4      10624.      21182.      15106.      22122.      18056.
    5       8744.       7954.      13344.      10411.      17303.
    6       7335.       5712.       5545.       7592.       7703.
    7       3117.       3809.       3451.       3300.       4726.
    8       1497.       1687.       2289.       1934.       1931.
    9       1150.       1106.       1261.        680.       1221.
==================================================================
Total     144510.     126040.     157430.     148970.     176325.

  AGE       1956        1957        1958        1959        1960
______________________________________________________________________________

    1      22929.      29176.      35590.      65879.      66403.
    2      50976.      33127.      34006.      34523.      71539.
    3      26102.      41766.      30945.      31759.      33959.
    4      30739.      21946.      29542.      24859.      26514.
    5      14223.      18703.      15895.      23868.      20000.
    6      11468.       8897.      11707.      10845.      20711.
    7       4531.       5450.       5619.       7030.       8761.
    8       2768.       2156.       2992.       3597.       5142.
    9       1242.       1873.       1112.       3270.       5110.
==================================================================
Total     164978.     163094.     167409.     205630.     258138.

  AGE       1961        1962        1963        1964        1965
______________________________________________________________________________

    1      25582.      19093.      96445.     206379.      14237.
    2      71597.      32350.      23416.     107447.     185250.
    3      64662.      61167.      30171.      20253.      78232.
    4      28027.      51319.      50889.      22220.      13724.
    5      20004.      20271.      35969.      31793.      14230.
    6      14376.      13961.      14786.      22660.      17649.
    7      13975.       9031.       8906.       8775.      11224.
    8       5393.       8874.       6121.       5310.       4302.
    9       8245.       8445.       9488.       7740.       6281.
==================================================================
Total     251860.     224513.     276191.     432578.     345129.

  AGE       1966        1967        1968        1969        1970
______________________________________________________________________________

    1       2152.       8010.        288.        523.       2954.
    2       9297.       2036.       6421.        305.        945.
    3     103071.       5994.       2046.       4883.        375.
    4      44427.      56601.       3990.       1833.       5172.
    5       8179.      22783.      36913.       2475.       1354.
    6       8089.       4620.      15630.      21189.       1902.
    7       8125.       3945.       2384.       9899.      13558.
    8       5768.       4152.       2050.       1419.       7164.
    9       4370.       3684.       4160.       4364.       5173.
==================================================================
Total     193478.     111825.      73881.      46888.      38598.
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Mean Biomass


  AGE      1971        1972        1973        1974        1975
_____________________________________________________________________________

   1        162.       4743.       9829.       6886.       4396.
   2       2750.        202.       5263.      10626.       7135.
   3        561.       2477.        250.       5485.       8930.
   4        391.        454.       1655.        295.       4415.
   5       4347.        367.        293.       1270.        223.
   6        836.       3825.        313.        291.        929.
   7       1206.        342.       3362.        262.        242.
   8       8156.        681.        210.       2922.        203.
   9       6183.      13572.       6364.      14912.       4814.
==================================================================
Total     24592.      26663.      27539.      42949.      31288.

  AGE      1976        1977        1978        1979        1980
_____________________________________________________________________________

   1      47705.       6717.       2942.      40295.       5449.
   2       5427.      72782.       9400.       4532.      42866.
   3       7284.       6036.      60482.       8951.       4269.
   4       6488.       8053.       6531.      47674.       7839.
   5       3634.       5570.       6891.       5591.      28811.
   6        250.       2696.       3798.       4968.       3666.
   7        846.        267.       1602.       2288.       3011.
   8        214.        631.        158.       1075.       1043.
   9       6411.       2244.       1074.        661.        600.
==================================================================
Total     78259.     104995.      92878.     116035.      97554.

  AGE      1981        1982        1983        1984        1985
_____________________________________________________________________________

   1       2603.        515.        982.       5408.        753.
   2       6288.       4729.       1844.       2200.      12067.
   3      24695.       6330.       4251.       1637.       2268.
   4       4239.      19093.       4710.       3352.       1572.
   5       6512.       3238.      12526.       3574.       2374.
   6      19534.       4555.       2175.       7929.       2859.
   7       2443.      13889.       3348.       1298.       4833.
   8       1606.       1412.       8891.       2139.        847.
   9       1051.       1513.       1074.       4747.       1686.
==================================================================
Total     68970.      55273.      39801.      32285.      29259.

  AGE      1986        1987        1988        1989        1990
_____________________________________________________________________________

   1       6848.       1020.       7618.        656.       1961.
   2       1732.       9500.       1878.      12576.        976.
   3      10224.       2032.       9779.       2201.      14978.
   4       1828.       8374.       1749.       8045.       1835.
   5       1267.       1494.       4718.       1515.       5697.
   6       1467.        811.       1017.       3231.       1008.
   7       2041.        933.        576.        805.       2054.
   8       3262.       1691.        639.        418.        449.
   9        804.       2451.       1200.        687.        552.
==================================================================
Total     29473.      28307.      29174.      30134.      29512.


Mean Biomass


  AGE      1991        1992        1993        1994        1995
_____________________________________________________________________________

   1       1433.       5250.       9364.       6306.       4993.
   2       2690.       2215.       9092.      12414.      11114.
   3        994.       2344.       2091.       9234.      13063.
   4      11589.        829.       1807.       1533.       7867.
   5       1449.       7105.        517.       1251.       1127.
   6       3958.        984.       4033.        313.        897.
   7        556.       2364.        577.       2347.        203.
   8       1289.        294.       1256.        472.       1572.
   9        693.        796.        784.       1128.        534.
==================================================================
Total     24651.      22182.      29522.      34999.      41369.

  AGE      1996        1997        1998        1999        2000
_____________________________________________________________________________

   1       4933.       8982.       6920.      31036.       7210.
   2      10425.       8767.      16998.      12181.      42237.
   3      13614.      12872.      10249.      21130.      12787.
   4      11897.      12939.      11210.       9494.      19257.
   5       6423.      10277.      11462.       8986.       8404.
   6        777.       5017.       8835.       8015.       7052.
   7        814.        674.       4356.       6113.       6520.
   8        154.        596.        477.       3055.       4697.
   9       1845.       1710.       1327.       1103.       1977.
```

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====================================================================
Total      50881.      61834.      71834.     101112.     110142.

  AGE       2001        2002        2003        2004        2005
_____________________________________________________________________________

   1       31745.       1597.        674.      95020.       1313.
   2       10345.      65886.       2767.        835.     207358.
   3       42571.       9341.      79106.       3439.       1791.
   4       11220.      36990.       8641.      66300.       3769.
   5       15198.       8507.      27476.       6378.      49811.
   6        6274.      11605.       5926.      18634.       4471.
   7        5252.       4901.       7641.       3670.      11582.
   8        4418.       4007.       3136.       4705.       2176.
   9        4037.       7840.       5885.       4029.       2923.
====================================================================
Total     131061.     150673.     141253.     203010.     285194.

  AGE       2006        2007
_____________________________________________________________________________

   1        4627.        991.
   2        2836.      17042.
   3      283345.       5155.
   4        1427.     298626.
   5        2890.       1440.
   6       32559.       2127.
   7        2877.      22304.
   8        7248.       2019.
   9        2191.       5371.
====================================================================
Total     340000.     355077.

Spawning Stock Biomass


  AGE       1931        1932        1933        1934        1935
_____________________________________________________________________________

   1        1057.       1033.        911.        660.        764.
   2       18566.       8809.       8501.       9250.       9792.
   3       10601.      37368.      19266.      15790.      21577.
   4       17364.      12344.      24470.      17022.      15877.
   5       18832.      12319.       8563.      14846.      10977.
   6       12906.       8873.       7654.       4535.       9324.
   7        8137.       5638.       4046.       4488.       2700.
   8        5541.       3137.       2728.       1775.       2598.
   9        2160.       2272.       3202.       1342.        823.
====================================================================
Total      95164.      91793.      79343.      69708.      74431.

  AGE       1936        1937        1938        1939        1940
_____________________________________________________________________________

   1         845.       1424.       1369.       1030.       1985.
   2        9433.      10259.      18423.      14387.      11848.
   3       21199.      19414.      22869.      37727.      29641.
   4       19799.      14651.      15593.      19889.      28284.
   5       11386.      12559.       9150.      10821.      12441.
   6        6424.       7197.       6318.       5959.       6396.
   7        4728.       3825.       3918.       3029.       3415.
   8        1483.       2304.       1774.       1903.       1321.
   9         909.       1407.       1250.       1697.       1090.
====================================================================
Total      76207.      73039.      80664.      96442.      96422.

  AGE       1941        1942        1943        1944        1945
_____________________________________________________________________________

   1        1831.       1032.        372.       1320.        985.
   2       19700.      20534.      10953.       4395.      13244.
   3       25480.      36888.      42144.      25762.      11811.
   4       24256.      19935.      30484.      34095.      25988.
   5       17614.      13378.      11933.      20930.      22063.
   6        7749.       8294.       6015.       7082.      13451.
   7        3060.       4072.       4103.       2468.       3279.
   8        1475.       1184.       1757.       2459.       1536.
   9        2228.       1070.       1087.        778.       1371.
====================================================================
Total     103394.     106388.     108848.      99288.      93727.

  AGE       1946        1947        1948        1949        1950
_____________________________________________________________________________

   1        1567.       1214.        550.       2271.        733.
   2        9746.      15956.      10119.       5550.      20207.
   3       25581.      19218.      29849.      17015.      10932.
   4       12772.      17471.      14931.      21513.      12542.
   5       18037.       9242.       9446.       9518.      12728.
   6       12910.       9179.       5517.       5253.       5745.
   7        8164.       5966.       4546.       2992.       2992.
   8        1404.       3847.       2856.       2588.       1590.
   9         167.       2726.       2761.       2810.       2029.
====================================================================
Total      90348.      84819.      80573.      69510.      69499.
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Spawning Stock Biomass

  AGE      1951        1952        1953        1954        1955
_____________________________________________________________________________

   1        1831.        686.       2343.        637.       1648.
   2        8785.      16711.       6891.      22981.       9082.
   3       31751.      18831.      27152.      15817.      40341.
   4       10283.      21073.      15368.      21226.      16522.
   5        8800.       8058.      13782.      10502.      16979.
   6        7766.       5832.       5803.       8379.       7734.
   7        3350.       4145.       3802.       3650.       4909.
   8        1634.       1807.       2536.       2205.       2087.
   9        1372.       1250.       1443.        786.       1403.
====================================================================
Total      75572.      78393.      79120.      86182.     100705.

  AGE      1956        1957        1958        1959        1960
_____________________________________________________________________________

   1         698.        994.       1327.       2300.       2357.
   2       17659.       9925.      11347.      12622.      24714.
   3       22593.      35986.      25285.      26108.      27189.
   4       31675.      20885.      29768.      24264.      25179.
   5       14201.      19465.      16308.      23164.      19468.
   6       12138.       9480.      12014.      11080.      19468.
   7        4935.       6228.       5745.       7572.       8396.
   8        2947.       2406.       3126.       3792.       5074.
   9        1474.       2231.       1281.       3713.       5680.
====================================================================
Total     108320.     107600.     106202.     114614.     137525.

  AGE      1961        1962        1963        1964        1965
_____________________________________________________________________________

   1         840.        632.       5306.      11681.        913.
   2       24832.      10364.       9396.      45076.      85813.
   3       53398.      52704.      26364.      18230.      76646.
   4       27292.      50412.      48572.      22512.      14563.
   5       20307.      21209.      37550.      34761.      15399.
   6       14834.      14698.      15110.      24247.      19587.
   7       15228.       9944.       9670.       9823.      12952.
   8        6066.       9900.       6262.       5860.       4929.
   9        9178.       9568.      10769.       9054.       7575.
====================================================================
Total     171975.     179431.     168999.     181245.     238377.

  AGE      1966        1967        1968        1969        1970
_____________________________________________________________________________

   1         130.        489.         17.         22.        163.
   2        4569.        924.       3097.        131.        312.
   3      104067.       5598.       1746.       4396.        293.
   4       46946.      56214.       4024.       1646.       4268.
   5        8621.      25708.      38148.       2488.       1332.
   6        8741.       4945.      14915.      22217.       1814.
   7        9119.       4426.       2689.      10344.      13736.
   8        6123.       4562.       2281.       1452.       7150.
   9        5227.       4371.       4928.       5069.       5846.
====================================================================
Total     193543.     107237.      71846.      47766.      34913.

Spawning Stock Biomass

  AGE      1971        1972        1973        1974        1975
_____________________________________________________________________________

   1           9.        244.        507.        391.        232.
   2        1254.         80.       2198.       4332.       3113.
   3         596.       1976.        196.       4191.       7510.
   4         356.        411.       1736.        255.       4362.
   5        4246.        342.        311.       1198.        242.
   6         914.       3711.        303.        246.        987.
   7        1319.        398.       3321.        250.        250.
   8        8782.        709.        208.       2913.        217.
   9        7297.      15350.       7110.      15919.       5149.
====================================================================
Total      24771.      23222.      15889.      29695.      22061.

  AGE      1976        1977        1978        1979        1980
_____________________________________________________________________________

   1        2157.        334.        142.       2001.        287.
   2        2158.      26122.       3536.       1626.      18228.
   3        6054.       4883.      53357.       7830.       3833.
   4        6512.       7004.       5846.      45812.       7377.
   5        3604.       5278.       6711.       5574.      32156.
   6         222.       2826.       4052.       5210.       4005.
   7         811.        245.       1751.       2465.       3379.
   8         212.        673.        191.       1147.       1261.
   9        6868.       2490.       1209.        748.        704.
====================================================================
```

```
 Total      28598.      49856.      76794.      72411.      71229.

   AGE       1981        1982        1983        1984        1985
 _____________________________________________________________________________

     1        109.         16.         39.        206.         30.
     2       2598.       1558.        433.        654.       3589.
     3      23337.       5139.       3663.       1467.       1921.
     4       3887.      17519.       4640.       3298.       1414.
     5       6371.       3180.      13207.       3612.       2383.
     6      19812.       4709.       2323.       8429.       2836.
     7       2489.      14160.       3375.       1445.       5106.
     8       1736.       1532.       9802.       2405.        857.
     9       1203.       1696.       1206.       5466.       1910.
 ====================================================================
 Total      61541.      49509.      38688.      26982.      20045.

   AGE       1986        1987        1988        1989        1990
 _____________________________________________________________________________

     1        333.         45.        346.         32.         95.
     2        509.       3584.        616.       4355.        356.
     3       9146.       1625.       7996.       1762.      11649.
     4       1747.       7837.       1733.       7631.       1848.
     5       1248.       1474.       5333.       1485.       6008.
     6       1546.        887.       1108.       3298.       1072.
     7       2158.       1011.        607.        777.       2201.
     8       3430.       1660.        674.        430.        532.
     9        899.       2715.       1362.        773.        627.
 ====================================================================
 Total      21016.      20838.      19775.      20543.      24390.


Spawning Stock Biomass


   AGE       1991        1992        1993        1994        1995
 _____________________________________________________________________________

     1         67.        236.        481.        284.        206.
     2       1015.        792.       3069.       4797.       3727.
     3        856.       2064.       1802.       7888.      10982.
     4      11820.        815.       1788.       1525.       7592.
     5       1440.       7701.        550.       1274.       1135.
     6       4011.       1062.       4279.        330.        929.
     7        632.       2623.        630.       2550.        201.
     8       1418.        318.       1407.        456.       1643.
     9        795.        935.        901.       1302.        576.
 ====================================================================
 Total      22055.      16545.      14908.      20405.      26991.

   AGE       1996        1997        1998        1999        2000
 _____________________________________________________________________________

     1        220.        389.        312.       1588.        359.
     2       3212.       2928.       5502.       4089.      16124.
     3      10718.      10102.       8241.      16491.      10885.
     4      11525.      12301.      11212.       9128.      18668.
     5       6521.      10095.      11210.       9273.       8232.
     6        856.       5159.       8750.       8721.       7268.
     7        791.        649.       4308.       6655.       6563.
     8        162.        645.        526.       3354.       4859.
     9       2007.       1838.       1441.       1201.       2153.
 ====================================================================
 Total      36012.      44106.      51501.      60500.      75112.

   AGE       2001        2002        2003        2004        2005
 _____________________________________________________________________________

     1       1316.         73.         36.       3848.         53.
     2       3846.      20368.        936.        334.      62497.
     3      36912.       8548.      62967.       2691.       1064.
     4      11067.      36568.       8356.      67623.       3359.
     5      15553.       8875.      29025.       6870.      52689.
     6       6593.      11988.       6360.      20398.       4801.
     7       5501.       4894.       8378.       4165.      12798.
     8       4877.       4100.       3471.       5327.       2409.
     9       4453.       8671.       6474.       4514.       3284.
 ====================================================================
 Total      90119.     104085.     126004.     115770.     142954.

   AGE       2006        2007
 _____________________________________________________________________________

     1        143.         10.
     2        859.       3962.
     3     211652.       3336.
     4       1497.     273423.
     5       3018.       1338.
     6      35317.       2221.
     7       3121.      23595.
     8       7961.       2157.
     9       2426.       5933.
 ====================================================================
 Total     265995.     315976.
```

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Catch Biomass


  AGE       1931        1932        1933        1934        1935
_____________________________________________________________________________

   1        1316.         76.        132.        143.        551.
   2        6865.       1771.       6187.       3251.      10329.
   3        2408.      28199.       8131.       6118.      10759.
   4        7925.       4406.      14265.       5564.       5930.
   5       15015.       6948.       3619.       5511.       5270.
   6       12150.       6338.       3774.       2218.       4867.
   7        7808.       3617.       2977.       1572.       1277.
   8        4557.       1946.       1393.        712.       1233.
   9        1694.       1251.       1682.        501.        373.
====================================================================
Total      59739.      54552.      42161.      25590.      40588.

  AGE       1936        1937        1938        1939        1940
_____________________________________________________________________________

   1         449.        618.        577.        346.       1142.
   2        9985.       9600.      17573.      11428.       6456.
   3       13668.      13528.      10624.      23148.      15643.
   4        8472.       8556.       6609.       8467.      13122.
   5        3683.       8037.       4564.       4261.       4694.
   6        2878.       4106.       3680.       2398.       3461.
   7        3201.       2685.       2523.       2226.       2181.
   8         681.       1481.        899.        965.        688.
   9         412.        790.        642.        817.        526.
====================================================================
Total      43428.      49402.      47691.      54058.      47913.

  AGE       1941        1942        1943        1944        1945
_____________________________________________________________________________

   1         406.        161.         10.         40.         70.
   2       18537.      11303.       3059.        609.       7158.
   3       11770.      18800.      17561.       9196.       2516.
   4       12612.       9535.      11961.      20780.      10026.
   5       10779.       6833.       5242.      10638.      11184.
   6        4114.       4732.       5090.       5269.       5487.
   7        2512.       2735.       1849.       1297.       2459.
   8         900.        715.       1005.       1440.        856.
   9        1352.        595.        600.        397.        687.
====================================================================
Total      62980.      55409.      46376.      49667.      40443.

  AGE       1946        1947        1948        1949        1950
_____________________________________________________________________________

   1         109.         52.         42.        177.         38.
   2        5823.      12133.       7522.       4725.      19700.
   3       18256.      11884.      20006.      12354.       4394.
   4        4463.      11561.       7879.      13836.       5682.
   5       10587.       4297.       5323.       4553.       5967.
   6        8525.       6464.       2719.       2546.       2533.
   7        4933.       4188.       2098.       1697.       1352.
   8         892.       2280.       1422.       1309.        734.
   9          96.       1517.       1292.       1303.        855.
====================================================================
Total      53683.      54376.      48303.      42500.      41255.


Catch Biomass


  AGE       1951        1952        1953        1954        1955
_____________________________________________________________________________

   1         342.          0.        596.         48.         52.
   2        5786.      17333.       1156.      24531.       3271.
   3       25148.       8358.      16533.       4596.      20791.
   4        3048.      10946.       6814.       7126.       4278.
   5        4382.       2327.       6086.       3449.       5474.
   6        5003.       2096.       2044.       3878.       3216.
   7        2079.       1346.       1285.       1613.       2478.
   8         924.        570.        913.        858.        810.
   9         710.        373.        503.        302.        512.
====================================================================
Total      47422.      43349.      35930.      46401.      40881.

  AGE       1956        1957        1958        1959        1960
_____________________________________________________________________________

   1          22.         19.         84.         53.        155.
   2       10036.       5275.       4568.       4859.      12968.
   3        6966.      15591.       7939.       9193.       7469.
   4       16651.       6377.       8998.       7495.       7071.
   5        5788.      10305.       6698.       7081.       5889.
   6        7195.       4903.       5324.       3832.       4426.
   7        3276.       3928.       2375.       3012.       2314.
   8        1621.       1310.       1295.       1293.       1324.
   9         728.       1138.        481.       1176.       1315.
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====================================================================
Total      52284.      48847.      37761.      37994.      42930.

  AGE       1961        1962        1963        1964        1965
_____________________________________________________________________________

   1          32.         40.       1659.       5050.       5569.
   2        8979.       3787.       3521.      13226.      86814.
   3       16569.      17382.       8753.       5100.      45831.
   4        6465.      14720.      16393.       6830.       7231.
   5        5455.       6103.      13773.      14304.       7333.
   6        4195.       4470.       4741.      11646.      13313.
   7        3216.       3868.       3302.       4997.       8525.
   8        1428.       3105.       2192.       2714.       2910.
   9        2184.       2954.       3398.       3956.       4248.
====================================================================
Total      48522.      56430.      57731.      67823.     181774.

  AGE       1966        1967        1968        1969        1970
_____________________________________________________________________________

   1          66.        759.          5.          1.         33.
   2        4995.        118.       2425.          9.        201.
   3       89721.       2746.        744.       1868.         20.
   4       24150.      24387.       2536.        757.       1100.
   5        4706.      14680.      22795.       1144.        407.
   6        5363.       2478.       7348.      11848.        511.
   7        5317.       2294.       1547.       3966.       5955.
   8        3639.       2439.       1187.        673.       2410.
   9        2757.       2164.       2408.       2069.       1740.
====================================================================
Total     140715.      52065.      40995.      22336.      12376.

Catch Biomass


  AGE       1971        1972        1973        1974        1975
_____________________________________________________________________________

   1           1.         99.       1564.         34.        123.
   2        1416.          2.       2176.       4750.       1048.
   3         292.        801.          5.       1240.       3143.
   4          70.        169.        837.          5.        857.
   5         691.         79.        130.        205.          9.
   6         691.        359.        101.          8.        128.
   7         832.        244.        268.          9.         16.
   8        4554.        232.         59.        216.         17.
   9        3452.       4629.       1793.       1100.        394.
====================================================================
Total      11999.       6614.       6934.       7567.       5735.

  AGE       1976        1977        1978        1979        1980
_____________________________________________________________________________

   1          75.          1.          1.          1.          4.
   2         486.      21248.        721.         26.      29300.
   3         793.        273.      21764.       2230.        422.
   4        1816.       1496.        627.      14620.       1696.
   5         596.       1426.       1594.       1330.      13209.
   6           0.       1162.       1662.       1300.       1684.
   7          88.         17.        472.       1202.       1976.
   8          19.        158.         51.        367.        548.
   9         574.        561.        345.        226.        315.
====================================================================
Total       4446.      26342.      27237.      21302.      49156.

  AGE       1981        1982        1983        1984        1985
_____________________________________________________________________________

   1           0.          0.          0.          0.          0.
   2        1527.       1138.        220.         87.       2439.
   3       13735.       2385.       1125.        397.        783.
   4        1532.       7070.       1275.       1347.        393.
   5        2171.        934.       4998.        884.       1161.
   6        7046.       1582.        728.       4005.        635.
   7        1237.       3652.        611.        701.       1648.
   8         643.        423.       2715.        921.        297.
   9         420.        453.        328.       2045.        591.
====================================================================
Total      28310.      17638.      12000.      10385.       7948.

  AGE       1986        1987        1988        1989        1990
_____________________________________________________________________________

   1           3.          0.          2.          1.         40.
   2          51.       1689.         52.       1301.         11.
   3        3874.        188.       3268.        181.       2512.
   4         414.       3291.        230.       1823.        479.
   5         379.        280.       1962.        480.       2383.
   6         496.        196.        373.       1228.        393.
   7         450.        274.        167.        200.        611.
   8         933.        408.        229.        132.        166.
   9         230.        591.        429.        217.        203.
====================================================================
Total       6829.       6917.       6713.       5564.       6799.
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Catch Biomass


  AGE       1991        1992        1993        1994        1995
____________________________________________________________________________

   1           4.         45.         22.         12.          7.
   2         584.        311.        425.        587.         90.
   3         161.        668.        759.       1958.        915.
   4        4306.        349.        739.        533.        953.
   5         315.       4285.        254.        373.        150.
   6        1369.        456.       1948.        200.         83.
   7         365.       1263.        166.        909.         28.
   8         524.        157.        528.        209.        190.
   9         282.        425.        330.        499.         64.
====================================================================
Total       7910.       7959.       5171.       5281.       2480.

  AGE       1996        1997        1998        1999        2000
____________________________________________________________________________

   1           3.          6.          3.          2.          1.
   2          62.        143.        223.         48.        461.
   3         848.        461.        699.       1383.        916.
   4        1688.       1409.       1069.        990.       2974.
   5        1047.       1242.       1790.       1279.       1324.
   6         168.        555.       1534.       1323.       1252.
   7          76.         55.        511.       1034.       1030.
   8          24.         62.         71.        485.        772.
   9         290.        178.        198.        175.        325.
====================================================================
Total       4206.       4112.       6098.       6719.       9054.

  AGE       2001        2002        2003        2004        2005
____________________________________________________________________________

   1           5.          1.          1.        137.          4.
   2         170.        361.         11.         13.        347.
   3        3492.        461.       2642.        122.         44.
   4        1747.       5513.        744.       7658.        493.
   5        2762.       1805.       4983.       1215.      14194.
   6        1656.       2735.       1238.       5733.       1424.
   7        1150.       1256.       1812.       1422.       3743.
   8         979.        940.        656.       1389.        672.
   9         894.       1840.       1231.       1189.        903.
====================================================================
Total      12855.      14912.      13319.      18879.      21822.

  AGE       2006        2007
____________________________________________________________________________

   1          32.          2.
   2           9.        153.
   3        3007.        261.
   4          75.      14112.
   5         604.        288.
   6        9649.        570.
   7         616.       4854.
   8        1738.        461.
   9         525.       1228.
====================================================================
Total      16254.      21929.


Catch Numbers


  AGE       1931        1932        1933        1934        1935
____________________________________________________________________________

   1       1755.0       118.0       244.0       341.0      1197.0
   2       8801.0      2084.0      8476.0      4454.0     11872.0
   3       2041.0     25871.0      6023.0      5414.0      8819.0
   4       5785.0      2421.0     10046.0      3734.0      3706.0
   5       9100.0      3676.0      2092.0      3149.0      2944.0
   6       6045.0      2894.0      1579.0      1051.0      2458.0
   7       3380.0      1320.0      1210.0       619.0       499.0
   8       1794.0       664.0       538.0       250.0       442.0
   9        559.0       391.0       647.0       168.0       109.0
====================================================================
Total    39260.0     39439.0     30855.0     19180.0     32046.0

  AGE       1936        1937        1938        1939        1940
____________________________________________________________________________

   1        880.0      1288.0      1030.0       607.0      2040.0
   2      12327.0     11034.0     20199.0     13937.0      7254.0
   3      11486.0     10910.0      7755.0     19617.0     12317.0
   4       5431.0      5629.0      3755.0      5163.0      8253.0
   5       2141.0      4143.0      2113.0      2152.0      2510.0
   6       1377.0      1875.0      1600.0       967.0      1479.0
   7       1362.0       952.0       945.0       837.0       752.0
   8        259.0       481.0       327.0       326.0       222.0
   9        124.0       222.0       173.0       239.0       136.0
```

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====================================================================
Total    35387.0     36534.0     37897.0     43845.0     34963.0

  AGE       1941        1942        1943        1944        1945
_____________________________________________________________________________

   1       780.0       310.0        19.0        64.0       121.0
   2     23464.0     14307.0      4191.0       761.0      8522.0
   3      9808.0     16348.0     17738.0      8437.0      2029.0
   4      8033.0      6531.0      8364.0     14843.0      6386.0
   5      5764.0      3996.0      3102.0      5689.0      5795.0
   6      1781.0      2331.0      2693.0      2281.0      2315.0
   7       941.0      1036.0       790.0       497.0       914.0
   8       307.0       227.0       354.0       469.0       265.0
   9       384.0       176.0       178.0       108.0       205.0
====================================================================
Total    51262.0     45262.0     37429.0     33149.0     26552.0

  AGE       1946        1947        1948        1949        1950
_____________________________________________________________________________

   1       209.0        90.0        80.0       328.0        88.0
   2      7466.0     16621.0     11227.0      6472.0     28971.0
   3     15213.0     10334.0     19237.0     12479.0      4107.0
   4      2738.0      7181.0      5116.0      9608.0      4272.0
   5      5785.0      2127.0      2744.0      2347.0      3315.0
   6      3840.0      2739.0      1157.0      1061.0      1131.0
   7      1827.0      1501.0       780.0       624.0       520.0
   8       272.0       745.0       450.0       409.0       225.0
   9        23.0       457.0       369.0       353.0       250.0
====================================================================
Total    37373.0     41795.0     41160.0     33681.0     42879.0

Catch Numbers


  AGE       1951        1952        1953        1954        1955
_____________________________________________________________________________

   1       645.0         0.0      1083.0       108.0        90.0
   2      8266.0     25120.0      1807.0     31858.0      3941.0
   3     26472.0      8892.0     17588.0      5107.0     19251.0
   4      2177.0      8485.0      5726.0      5611.0      3316.0
   5      2448.0      1361.0      3757.0      2315.0      3278.0
   6      2138.0       944.0      1012.0      2131.0      1649.0
   7       740.0       530.0       542.0       720.0      1068.0
   8       297.0       182.0       337.0       353.0       320.0
   9       215.0       107.0       152.0        98.0       173.0
====================================================================
Total    43398.0     45621.0     32004.0     48301.0     33086.0

  AGE       1956        1957        1958        1959        1960
_____________________________________________________________________________

   1        52.0        35.0       125.0        94.0       258.0
   2     11948.0      6594.0      5571.0      5716.0     16010.0
   3      6698.0     14046.0      7088.0      7994.0      6122.0
   4     12066.0      4523.0      6665.0      5169.0      4562.0
   5      3405.0      5822.0      3784.0      3934.0      3067.0
   6      3378.0      2357.0      2366.0      1758.0      1792.0
   7      1348.0      1630.0       903.0      1172.0       787.0
   8       563.0       473.0       442.0       424.0       406.0
   9       201.0       366.0       142.0       334.0       348.0
====================================================================
Total    39659.0     35846.0     27086.0     26595.0     33352.0

  AGE       1961        1962        1963        1964        1965
_____________________________________________________________________________

   1        62.0        74.0      2910.0     10101.0      9601.0
   2     10689.0      4455.0      4047.0     15935.0    125818.0
   3     14927.0     16245.0      7418.0      4554.0     44496.0
   4      4198.0     10440.0     11152.0      4776.0      5356.0
   5      2917.0      3448.0      8198.0      8722.0      4391.0
   6      1856.0      2089.0      2205.0      5794.0      6690.0
   7      1266.0      1566.0      1405.0      2082.0      3772.0
   8       496.0      1185.0       721.0      1028.0      1094.0
   9       674.0       898.0      1096.0      1332.0      1366.0
====================================================================
Total    37085.0     40400.0     39152.0     54324.0    202584.0

  AGE       1966        1967        1968        1969        1970
_____________________________________________________________________________

   1       114.0      1150.0         8.0         2.0        46.0
   2      6843.0       168.0      2994.0        11.0       158.0
   3    100810.0      2891.0       709.0      1698.0        16.0
   4     19167.0     20667.0      1921.0       448.0       570.0
   5      2768.0     10338.0     14519.0       654.0       186.0
   6      2591.0      1209.0      3499.0      5954.0       214.0
   7      2332.0       993.0       667.0      1574.0      2308.0
   8      1268.0       917.0       453.0       225.0       746.0
   9       867.0       698.0       842.0       570.0       464.0
====================================================================
Total   136760.0     39031.0     25612.0     11136.0      4708.0
```

```
Catch Numbers


  AGE       1971        1972        1973        1974        1975
_____________________________________________________________________________

   1          1.0       159.6      2607.1        47.7       198.6
   2       1375.0         2.0      2113.1      4481.1      1069.5
   3        223.0       460.4         3.1       681.5      1928.0
   4         40.0        82.9       393.1         2.1       387.9
   5        289.0        32.7        54.0        72.6         4.1
   6        246.0       122.8        30.6         2.1        43.4
   7        285.0        79.8        78.4         2.1         4.1
   8       1469.0        67.5        15.3        55.0         4.1
   9        928.0      1264.7       455.2       258.3        91.0
====================================================================
Total      4856.0      2272.4      5749.9      5602.5      3730.7

  AGE       1976        1977        1978        1979        1980
_____________________________________________________________________________

   1        149.3         1.0         1.0         1.0         8.0
   2        490.5     19857.7       767.0        26.2     31170.3
   3        570.4       189.6     14509.1      1742.5       348.9
   4        912.6       689.5       307.4      7237.5       980.4
   5        224.0       522.2       571.5       530.0      6087.3
   6          0.0       362.0       521.1       413.9       597.3
   7         23.9         4.1       140.1       318.0       549.0
   8          4.1        39.5        14.1        96.9       153.8
   9        116.1       112.5        67.5        46.4        81.4
====================================================================
Total      2490.9     21778.1     16898.8     10412.4     39976.4

  AGE       1981        1982        1983        1984        1985
_____________________________________________________________________________

   1          1.0         1.0         0.0         0.0         0.0
   2       1755.4      1173.7       216.1        94.1      2463.7
   3      11076.4      1645.1       821.1       300.6       563.2
   4        836.9      3760.7       696.9       735.8       198.7
   5        943.7       393.9      2261.4       401.8       472.1
   6       2590.3       573.2       274.7      1499.9       233.5
   7        333.4      1127.3       187.9       236.8       538.6
   8        159.1       106.8       808.0       270.2        79.9
   9         94.7       110.8        76.8       549.6       155.6
====================================================================
Total     17790.9      8892.5      5342.9      4088.8      4705.3

  AGE       1986        1987        1988        1989        1990
_____________________________________________________________________________

   1          6.1         0.0         4.1         1.9        62.9
   2         54.7      2035.1        53.2      1462.2        11.6
   3       2848.3       131.6      2439.1       122.5      1697.0
   4        226.0      1645.5       137.1      1018.7       268.9
   5        148.0       124.5       952.5       217.3      1124.1
   6        175.4        74.5       152.4       477.8       154.3
   7        152.0        90.8        56.3        61.7       217.6
   8        269.6       108.1        65.5        37.0        55.4
   9         60.8       137.7       108.4        56.7        48.9
====================================================================
Total      3940.9      4347.8      3968.6      3455.8      3640.7

Catch Numbers


  AGE       1991        1992        1993        1994        1995
_____________________________________________________________________________

   1          7.0        83.6        33.0        27.3        17.0
   2        486.1       265.1       363.3       537.5        93.5
   3        122.8       407.5       439.1      1191.5       614.3
   4       2370.1       197.2       340.4       241.5       470.8
   5        144.3      1960.1       120.1       142.1        58.9
   6        517.6       181.2       741.4        73.4        29.4
   7        127.9       425.7        62.6       313.4         8.5
   8        171.9        46.6       169.2        55.2        61.4
   9         65.0        99.5        82.2       109.7        16.2
====================================================================
Total      4012.7      3666.5      2351.3      2691.6      1370.0

  AGE       1996        1997        1998        1999        2000
_____________________________________________________________________________

   1          6.8        14.5         6.0         2.6         1.6
   2         56.4       143.3       230.1        43.2       406.6
   3        566.3       273.0       470.9       906.0       625.6
   4        918.6       745.1       557.6       541.1      1570.9
   5        450.3       561.3       767.2       605.7       588.0
   6         66.0       217.9       570.7       565.5       527.7
   7         22.1        17.5       168.9       383.5       377.0
   8          6.9        18.4        23.4       163.2       258.1
   9         78.2        48.8        48.6        47.6        98.5
====================================================================
```

```
Total      2171.6      2039.8      2843.4      3258.4      4454.0

  AGE       2001        2002        2003        2004        2005
_____________________________________________________________________________

   1         14.0         2.9         4.5       646.0        19.5
   2        145.1       396.7        17.7        33.0       612.4
   3       2393.3       345.3      1942.8       121.7        41.8
   4        996.1      3177.4       461.1      5115.6       339.0
   5       1280.6       926.2      2686.1       729.4      8505.4
   6        655.6      1105.4       604.9      2935.4       777.7
   7        437.6       401.6       719.1       686.7      1842.6
   8        358.8       306.4       212.3       562.9       315.2
   9        262.2       551.2       388.8       408.2       343.2
====================================================================
Total      6543.3      7213.1      7037.3     11238.9     12796.8

  AGE       2006        2007
_____________________________________________________________________________

   1        164.4        13.0
   2         18.4       174.6
   3       3164.2       240.0
   4         70.9     11215.7
   5        375.2       194.2
   6       5418.3       311.4
   7        326.5      2511.7
   8        841.9       228.9
   9        227.6       564.4
====================================================================
Total     10607.4     15453.9


              Surplus Production

    Average Adjustment Factor (Delta) =   1.0000

Year        Biomass  Delta Biomass  Catch Biomass  Surplus Production

1931     178917.421     -19440.405      59738.640      40298.235
1932     159477.016     -22805.645      54551.550      31745.905
1933     136671.371     -21140.915      42160.800      21019.885
1934     115530.456      12829.164      25589.880      38419.044
1935     128359.620       4904.405      40588.040      45492.445
1936     133264.026      14112.048      43428.370      57540.418
1937     147376.074      19589.657      49402.410      68992.067
1938     166965.731       6550.065      47691.390      54241.455
1939     173515.796      16213.416      54057.590      70271.006
1940     189729.212      21454.047      47913.200      69367.247
1941     211183.259     -16454.638      62980.020      46525.382
1942     194728.620     -31615.891      55409.250      23793.359
1943     163112.729        451.016      46376.420      46827.436
1944     163563.745      -4305.337      49666.990      45361.653
1945     159258.408      12126.066      40442.900      52568.966
1946     171384.474      -5375.027      53683.250      48308.223
1947     166009.447     -31224.528      54376.350      23151.822
1948     134784.919      20200.791      48302.820      68503.611
1949     154985.710     -15272.626      42499.640      27227.014
1950     139713.084      19676.304      41255.310      60931.614
1951     159389.388     -15765.890      47421.660      31655.770
1952     143623.498      25137.099      43349.210      68486.309
1953     168760.597      -7338.173      35930.300      28592.127
1954     161422.424      19000.388      46400.650      65401.038
1955     180422.812        -16.605      40881.200      40864.595
1956     180406.207      -5679.558      52283.500      46603.942
1957     174726.649       4401.442      48846.860      53248.302
1958     179128.091      35638.117      37760.790      73398.907
1959     214766.208      47162.237      37993.950      85156.187
1960     261928.445       4248.220      42930.500      47178.720
1961     266176.665     -19403.343      48522.120      29118.777
1962     246773.322      43575.148      56429.820     100004.968
1963     290348.470     157533.650      57730.850     215264.500
1964     447882.120     -20502.304      67823.490      47321.186
1965     427379.816    -162128.452     181773.570      19645.118
1966     265251.364    -127361.825     140714.980      13353.155
1967     137889.539     -46235.908      52065.370       5829.462
1968      91653.631     -33990.131      40995.180       7005.049
1969      57663.500     -14573.223      22335.830       7762.607
1970      43090.277     -11667.751      12375.960        708.209
1971      31422.526       -956.235      11998.880      11042.645
1972      30466.291      -1364.427       6614.124       5249.697
1973      29101.865      15626.507       6934.442      22560.949
1974      44728.372     -12025.062       7567.329      -4457.733
1975      32703.309      35425.275       5734.792      41160.067
1976      68128.584      26866.860       4445.890      31312.750
1977      94995.444       4307.427      26341.524      30648.951
1978      99302.871      16817.564      27237.013      44054.577
1979     116120.435       -921.824      21302.085      20380.261
1980     115198.611     -35577.103      49155.516      13578.413
1981      79621.509     -20299.687      28310.123       8010.436
1982      59321.822     -13729.330      17638.347       3909.017
1983      45592.491      -9974.619      11999.796       2025.177
1984      35617.872      -7670.575      10385.393       2714.818
1985      27947.297       2680.623       7948.447      10629.070
1986      30627.919      -1784.792       6829.253       5044.461
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 1987      28843.128        682.252       6916.867       7599.120
 1988      29525.380       -626.466       6713.180       6086.714
 1989      28898.914       1558.998       5563.539       7122.537
 1990      30457.912      -2635.572       6798.793       4163.221
 1991      27822.340      -3214.572       7910.021       4695.449
 1992      24607.768       3872.909       7958.660      11831.569
 1993      28480.677       5268.595       5171.299      10439.893
 1994      33749.272       3980.161       5281.477       9261.639
 1995      37729.433       9561.784       2480.372      12042.156
 1996      47291.217      10726.296       4206.139      14932.434
 1997      58017.513       9975.674       4112.054      14087.727
 1998      67993.187      28693.254       6098.079      34791.333
 1999      96686.441      10602.521       6719.095      17321.615
 2000     107288.962      19574.490       9054.007      28628.496
 2001     126863.451      13075.901      12855.244      25931.145
 2002     139939.352       3724.871      14911.965      18636.836
 2003     143664.223      44814.902      13319.062      58133.964
 2004     188479.125      43512.594      18878.733      62391.327
 2005     231991.719      74816.732      21822.015      96638.748
 2006     306808.452      38206.541      16254.266      54460.807
 2007     345014.992      30416.501      21928.976      52345.477
 2008     375431.493
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Summary of Survey Indices Used in the Estimate

 INDEX    Survey Tag    Age   Time  Type  Catchability Std. Error   CV


   1         US_Sp       1   JAN-1 NUMBER  0.3096E+00  0.6177E-01  0.1995E+00
   2         US_Sp       2   JAN-1 NUMBER  0.5591E+00  0.7922E-01  0.1417E+00
   3         US_Sp       3   JAN-1 NUMBER  0.6333E+00  0.8694E-01  0.1373E+00
   4         US_Sp       4   JAN-1 NUMBER  0.5724E+00  0.5717E-01  0.9988E-01
   5         US_Sp       5   JAN-1 NUMBER  0.6346E+00  0.7953E-01  0.1253E+00
   6         US_Sp       6   JAN-1 NUMBER  0.5402E+00  0.8792E-01  0.1627E+00
   7         US_Sp       7   JAN-1 NUMBER  0.5356E+00  0.7833E-01  0.1463E+00
   8         US_Sp       8   JAN-1 NUMBER  0.6231E+00  0.1055E+00  0.1693E+00
   9         US_S41      1   JAN-1 NUMBER  0.7210E+00  0.3678E+00  0.5101E+00
  10         US_S41      2   JAN-1 NUMBER  0.8988E+00  0.3143E+00  0.3497E+00
  11         US_S41      3   JAN-1 NUMBER  0.7757E+00  0.2441E+00  0.3147E+00
  12         US_S41      4   JAN-1 NUMBER  0.8390E+00  0.1830E+00  0.2182E+00
  13         US_S41      5   JAN-1 NUMBER  0.8889E+00  0.1462E+00  0.1645E+00
  14         US_S41      6   JAN-1 NUMBER  0.8845E+00  0.2451E+00  0.2771E+00
  15         US_S41      7   JAN-1 NUMBER  0.9118E+00  0.2367E+00  0.2596E+00
  16         US_S41      8   JAN-1 NUMBER  0.8614E+00  0.2714E+00  0.3151E+00
  17         US_Au0      1   JAN-1 NUMBER  0.4331E+00  0.6219E-01  0.1436E+00
  18         US_Au1      2   JAN-1 NUMBER  0.6882E+00  0.1032E+00  0.1500E+00
  19         US_Au2      3   JAN-1 NUMBER  0.5724E+00  0.7104E-01  0.1241E+00
  20         US_Au3      4   JAN-1 NUMBER  0.6538E+00  0.6409E-01  0.9802E-01
  21         US_Au4      5   JAN-1 NUMBER  0.5717E+00  0.6236E-01  0.1091E+00
  22         US_Au5      6   JAN-1 NUMBER  0.5608E+00  0.6643E-01  0.1185E+00
  23         Can_Sp      1   JAN-1 NUMBER  0.2825E+00  0.6593E-01  0.2334E+00
  24         Can_Sp      2   JAN-1 NUMBER  0.3991E+00  0.8343E-01  0.2090E+00
  25         Can_Sp      3   JAN-1 NUMBER  0.6555E+00  0.8296E-01  0.1266E+00
  26         Can_Sp      4   JAN-1 NUMBER  0.6205E+00  0.8304E-01  0.1338E+00
  27         Can_Sp      5   JAN-1 NUMBER  0.7079E+00  0.9924E-01  0.1402E+00
  28         Can_Sp      6   JAN-1 NUMBER  0.5231E+00  0.9882E-01  0.1889E+00
  29         Can_Sp      7   JAN-1 NUMBER  0.6800E+00  0.1220E+00  0.1794E+00
  30         Can_Sp      8   JAN-1 NUMBER  0.6203E+00  0.9973E-01  0.1608E+00
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 Survey Index:    1 Tag:         US_Sp    AGE =  1
 Time = JAN-1           Type = NUMBER
 Catchability =    0.309573E+00   % Variance Contribution =     6.3228
 Residual = LN(Observed) - LN(Predicted)

 Year      Observed        Predicted         Residual


 1931     N/A              0.123638E+05     N/A
 1932     N/A              0.140282E+05     N/A
 1933     N/A              0.159786E+05     N/A
 1934     N/A              0.184410E+05     N/A
 1935     N/A              0.180213E+05     N/A
 1936     N/A              0.176911E+05     N/A
 1937     N/A              0.326013E+05     N/A
 1938     N/A              0.241623E+05     N/A
 1939     N/A              0.184154E+05     N/A
 1940     N/A              0.344327E+05     N/A
 1941     N/A              0.353740E+05     N/A
 1942     N/A              0.191547E+05     N/A
 1943     N/A              0.721502E+04     N/A
 1944     N/A              0.201688E+05     N/A
 1945     N/A              0.160379E+05     N/A
 1946     N/A              0.290685E+05     N/A
 1947     N/A              0.183068E+05     N/A
 1948     N/A              0.102019E+05     N/A
 1949     N/A              0.384308E+05     N/A
 1950     N/A              0.177114E+05     N/A
 1951     N/A              0.321276E+05     N/A
 1952     N/A              0.130917E+05     N/A
 1953     N/A              0.411083E+05     N/A
 1954     N/A              0.161846E+05     N/A
 1955     N/A              0.278307E+05     N/A
 1956     N/A              0.186552E+05     N/A
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1957     N/A              0.184599E+05     N/A
1958     N/A              0.181643E+05     N/A
1959     N/A              0.401969E+05     N/A
1960     N/A              0.378438E+05     N/A
1961     N/A              0.168135E+05     N/A
1962     N/A              0.120888E+05     N/A
1963     N/A              0.582744E+05     N/A
1964     N/A              0.142656E+06     N/A
1965     N/A              0.100652E+05     N/A
1966     N/A              0.128629E+04     N/A
1967     N/A              0.433805E+04     N/A
1968     0.129829E+04     0.167858E+03     0.204568E+01
1969     N/A              0.343901E+03     N/A
1970     0.217463E+04     0.142885E+04     0.419990E+00
1971     N/A              0.825241E+02     N/A
1972     0.130478E+05     0.263939E+04     0.159807E+01
1973     N/A              0.603612E+04     N/A
1974     N/A              0.327439E+04     N/A
1975     N/A              0.245494E+04     N/A
1976     N/A              0.326132E+05     N/A
1977     N/A              0.432899E+04     N/A
1978     N/A              0.189617E+04     N/A
1979     N/A              0.259697E+05     N/A
1980     N/A              0.338524E+04     N/A
1981     N/A              0.227971E+04     N/A
1982     0.246674E+04     0.799029E+03     0.112726E+01
1983     0.139566E+04     0.101676E+04     0.316745E+00
1984     0.678354E+04     0.559811E+04     0.192070E+00
1985     N/A              0.779824E+03     N/A
1986     0.808183E+04     0.519876E+04     0.441197E+00
1987     N/A              0.810504E+03     N/A
1988     0.503086E+04     0.619613E+04    -0.208335E+00
1989     0.649143E+02     0.422859E+03    -0.187397E+01
1990     0.279131E+04     0.105720E+04     0.970884E+00
1991     0.175269E+04     0.843594E+03     0.731233E+00
1992     0.129829E+04     0.334698E+04    -0.947013E+00
1993     0.379749E+04     0.485872E+04    -0.246436E+00
1994     0.226908E+04     0.482300E+04    -0.754021E+00
1995     0.162708E+04     0.397799E+04    -0.893992E+00
1996     0.352485E+04     0.369593E+04    -0.473952E-01
1997     0.582573E+04     0.737714E+04    -0.236102E+00
1998     0.267285E+04     0.462640E+04    -0.548635E+00
1999     0.331355E+05     0.156358E+05     0.751043E+00
2000     0.593706E+04     0.370926E+04     0.470381E+00
2001     0.325016E+05     0.302899E+05     0.704758E-01
2002     0.592992E+03     0.178889E+04    -0.110417E+01
2003     0.324571E+02     0.892844E+03    -0.331449E+01
2004     0.363974E+06     0.153198E+06     0.865355E+00
2005     0.259657E+04     0.249147E+04     0.413188E-01
2006     0.653232E+04     0.818810E+04    -0.225919E+00
2007     0.278872E+04     0.229727E+04     0.193862E+00
2008     0.597861E+04     0.506966E+04     0.164913E+00

Survey Index:    2 Tag:          US_Sp    AGE =  2
Time = JAN-1           Type = NUMBER
Catchability =    0.559059E+00   % Variance Contribution =     3.9236
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_____________________________________________________________________________

1931     N/A              0.449413E+05     N/A
1932     N/A              0.173949E+05     N/A
1933     N/A              0.206818E+05     N/A
1934     N/A              0.235019E+05     N/A
1935     N/A              0.270937E+05     N/A
1936     N/A              0.260411E+05     N/A
1937     N/A              0.257128E+05     N/A
1938     N/A              0.475523E+05     N/A
1939     N/A              0.352052E+05     N/A
1940     N/A              0.269215E+05     N/A
1941     N/A              0.498805E+05     N/A
1942     N/A              0.519083E+05     N/A
1943     N/A              0.281647E+05     N/A
1944     N/A              0.106582E+05     N/A
1945     N/A              0.297883E+05     N/A
1946     N/A              0.236517E+05     N/A
1947     N/A              0.428737E+05     N/A
1948     N/A              0.270220E+05     N/A
1949     N/A              0.150436E+05     N/A
1950     N/A              0.566561E+05     N/A
1951     N/A              0.261427E+05     N/A
1952     N/A              0.471766E+05     N/A
1953     N/A              0.193548E+05     N/A
1954     N/A              0.602338E+05     N/A
1955     N/A              0.238752E+05     N/A
1956     N/A              0.411037E+05     N/A
1957     N/A              0.275564E+05     N/A
1958     N/A              0.272762E+05     N/A
1959     N/A              0.267937E+05     N/A
1960     N/A              0.593857E+05     N/A
1961     N/A              0.558236E+05     N/A
1962     N/A              0.248283E+05     N/A
1963     N/A              0.178365E+05     N/A
1964     N/A              0.846924E+05     N/A
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1965     N/A              0.205825E+06     N/A
1966     N/A              0.100645E+05     N/A
1967     N/A              0.184430E+04     N/A
1968     0.918537E+04     0.583417E+04     0.453881E+00
1969     0.227200E+03     0.244147E+03    -0.719397E-01
1970     0.811429E+03     0.507465E+03     0.469369E+00
1971     0.376503E+04     0.208939E+04     0.588881E+00
1972     0.292114E+03     0.121511E+03     0.877141E+00
1973     N/A              0.382189E+04     N/A
1974     N/A              0.761156E+04     N/A
1975     N/A              0.481727E+04     N/A
1976     N/A              0.352949E+04     N/A
1977     N/A              0.481448E+05     N/A
1978     N/A              0.639998E+04     N/A
1979     N/A              0.280308E+04     N/A
1980     N/A              0.383937E+05     N/A
1981     N/A              0.500120E+04     N/A
1982     0.496594E+04     0.337017E+04     0.387641E+00
1983     0.178514E+04     0.118090E+04     0.413223E+00
1984     0.382994E+04     0.150318E+04     0.935268E+00
1985     0.160987E+05     0.827625E+04     0.665351E+00
1986     0.584229E+03     0.115289E+04    -0.679737E+00
1987     0.117495E+05     0.768355E+04     0.424728E+00
1988     0.129829E+03     0.119825E+04    -0.222240E+01
1989     0.113275E+05     0.915922E+04     0.212476E+00
1990     N/A              0.624258E+03     N/A
1991     0.347291E+04     0.153137E+04     0.818829E+00
1992     0.584229E+03     0.124376E+04    -0.755603E+00
1993     0.210971E+04     0.490646E+04    -0.843999E+00
1994     0.870760E+04     0.716719E+04     0.194683E+00
1995     0.417204E+04     0.711725E+04    -0.534116E+00
1996     0.149076E+05     0.587307E+04     0.931492E+00
1997     0.331939E+04     0.546118E+04    -0.497883E+00
1998     0.958200E+04     0.109001E+05    -0.128890E+00
1999     0.658133E+04     0.683732E+04    -0.381590E-01
2000     0.769234E+04     0.231160E+05    -0.110030E+01
2001     0.278937E+04     0.548352E+04    -0.675933E+00
2002     0.624686E+05     0.447780E+05     0.332947E+00
2003     0.811429E+03     0.264349E+04    -0.118106E+01
2004     0.600457E+04     0.131784E+04     0.151653E+01
2005     0.173126E+06     0.226184E+06    -0.267327E+00
2006     0.185006E+04     0.367391E+04    -0.686041E+00
2007     0.227437E+05     0.120235E+05     0.637425E+00
2008     0.284162E+04     0.339006E+04    -0.176471E+00

Survey Index:    3 Tag:         US_Sp    AGE =  3
Time = JAN-1           Type = NUMBER
Catchability =    0.633341E+00   % Variance Contribution =     3.6820
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_____________________________________________________________________________

1931     N/A              0.891821E+04     N/A
1932     N/A              0.366593E+05     N/A
1933     N/A              0.149432E+05     N/A
1934     N/A              0.143567E+05     N/A
1935     N/A              0.192554E+05     N/A
1936     N/A              0.183729E+05     N/A
1937     N/A              0.171411E+05     N/A
1938     N/A              0.175683E+05     N/A
1939     N/A              0.326072E+05     N/A
1940     N/A              0.247166E+05     N/A
1941     N/A              0.208325E+05     N/A
1942     N/A              0.329165E+05     N/A
1943     N/A              0.399858E+05     N/A
1944     N/A              0.237293E+05     N/A
1945     N/A              0.945057E+04     N/A
1946     N/A              0.227692E+05     N/A
1947     N/A              0.176812E+05     N/A
1948     N/A              0.302998E+05     N/A
1949     N/A              0.186716E+05     N/A
1950     N/A              0.102692E+05     N/A
1951     N/A              0.360777E+05     N/A
1952     N/A              0.195356E+05     N/A
1953     N/A              0.294792E+05     N/A
1954     N/A              0.169191E+05     N/A
1955     N/A              0.377593E+05     N/A
1956     N/A              0.198940E+05     N/A
1957     N/A              0.313110E+05     N/A
1958     N/A              0.217964E+05     N/A
1959     N/A              0.221190E+05     N/A
1960     N/A              0.215891E+05     N/A
1961     N/A              0.459492E+05     N/A
1962     N/A              0.456747E+05     N/A
1963     N/A              0.204848E+05     N/A
1964     N/A              0.142341E+05     N/A
1965     N/A              0.694556E+05     N/A
1966     N/A              0.119480E+06     N/A
1967     N/A              0.545463E+04     N/A
1968     0.149303E+04     0.161460E+04    -0.782800E-01
1969     0.188251E+04     0.370906E+04    -0.678171E+00
1970     N/A              0.220160E+03     N/A
1971     0.811429E+03     0.380606E+03     0.757031E+00
1972     0.197989E+04     0.115796E+04     0.536380E+00
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1973     N/A              0.111559E+03     N/A
1974     N/A              0.234418E+04     N/A
1975     N/A              0.451505E+04     N/A
1976     N/A              0.385771E+04     N/A
1977     N/A              0.299346E+04     N/A
1978     N/A              0.333491E+05     N/A
1979     N/A              0.549783E+04     N/A
1980     N/A              0.258491E+04     N/A
1981     N/A              0.179774E+05     N/A
1982     0.305097E+04     0.363845E+04    -0.176097E+00
1983     0.188251E+04     0.245707E+04    -0.266362E+00
1984     0.207726E+04     0.971914E+03     0.759537E+00
1985     0.246674E+04     0.134042E+04     0.609915E+00
1986     0.668617E+04     0.627157E+04     0.640154E-01
1987     0.194743E+03     0.103805E+04    -0.167342E+01
1988     0.321326E+04     0.596574E+04    -0.618748E+00
1989     0.146057E+04     0.108097E+04     0.300965E+00
1990     0.185655E+05     0.766021E+04     0.885264E+00
1991     0.778971E+03     0.572374E+03     0.308181E+00
1992     0.357029E+03     0.114327E+04    -0.116383E+01
1993     0.584229E+03     0.100229E+04    -0.539755E+00
1994     0.325415E+04     0.434313E+04    -0.288663E+00
1995     0.752811E+04     0.634041E+04     0.171700E+00
1996     0.287440E+05     0.654788E+04     0.147929E+01
1997     0.108845E+05     0.541510E+04     0.698148E+00
1998     0.404870E+04     0.498337E+04    -0.207710E+00
1999     0.695037E+04     0.997845E+04    -0.361632E+00
2000     0.133224E+05     0.631702E+04     0.746197E+00
2001     0.791013E+04     0.212079E+05    -0.986228E+00
2002     0.218067E+05     0.500306E+04     0.147216E+01
2003     0.176891E+05     0.413054E+05    -0.848042E+00
2004     0.389486E+04     0.244176E+04     0.466938E+00
2005     0.519314E+03     0.120344E+04    -0.840433E+00
2006     0.932494E+05     0.209439E+06    -0.809155E+00
2007     0.593706E+04     0.339709E+04     0.558295E+00
2008     0.837394E+04     0.110521E+05    -0.277497E+00

Survey Index:    4 Tag:         US_Sp    AGE =  4
Time = JAN-1           Type = NUMBER
Catchability =    0.572417E+00   % Variance Contribution =     1.9491
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_____________________________________________________________________________

1931     N/A              0.101117E+05     N/A
1932     N/A              0.554692E+04     N/A
1933     N/A              0.138961E+05     N/A
1934     N/A              0.796015E+04     N/A
1935     N/A              0.783819E+04     N/A
1936     N/A              0.971720E+04     N/A
1937     N/A              0.771161E+04     N/A
1938     N/A              0.709644E+04     N/A
1939     N/A              0.901436E+04     N/A
1940     N/A              0.140748E+05     N/A
1941     N/A              0.119653E+05     N/A
1942     N/A              0.103771E+05     N/A
1943     N/A              0.159630E+05     N/A
1944     N/A              0.204723E+05     N/A
1945     N/A              0.132169E+05     N/A
1946     N/A              0.594683E+04     N/A
1947     N/A              0.906232E+04     N/A
1948     N/A              0.778579E+04     N/A
1949     N/A              0.125685E+05     N/A
1950     N/A              0.742949E+04     N/A
1951     N/A              0.548676E+04     N/A
1952     N/A              0.131667E+05     N/A
1953     N/A              0.988681E+04     N/A
1954     N/A              0.127992E+05     N/A
1955     N/A              0.988928E+04     N/A
1956     N/A              0.180582E+05     N/A
1957     N/A              0.112729E+05     N/A
1958     N/A              0.159512E+05     N/A
1959     N/A              0.124793E+05     N/A
1960     N/A              0.122537E+05     N/A
1961     N/A              0.128213E+05     N/A
1962     N/A              0.263155E+05     N/A
1963     N/A              0.254376E+05     N/A
1964     N/A              0.113409E+05     N/A
1965     N/A              0.818787E+04     N/A
1966     N/A              0.286087E+05     N/A
1967     N/A              0.370226E+05     N/A
1968     0.227200E+04     0.255269E+04    -0.116488E+00
1969     0.811429E+03     0.830355E+03    -0.230566E-01
1970     0.107109E+04     0.187215E+04    -0.558416E+00
1971     N/A              0.154646E+03     N/A
1972     0.389486E+03     0.167318E+03     0.844933E+00
1973     N/A              0.620069E+03     N/A
1974     N/A              0.809485E+02     N/A
1975     N/A              0.138356E+04     N/A
1976     N/A              0.234988E+04     N/A
1977     N/A              0.256019E+04     N/A
1978     N/A              0.211711E+04     N/A
1979     N/A              0.172197E+05     N/A
1980     N/A              0.317096E+04     N/A
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1981     N/A              0.173265E+04     N/A
1982     0.132101E+05     0.762777E+04     0.549183E+00
1983     0.714057E+03     0.184700E+04    -0.950356E+00
1984     0.204480E+04     0.139545E+04     0.382081E+00
1985     0.129829E+04     0.564380E+03     0.833072E+00
1986     0.778971E+03     0.702319E+03     0.103587E+00
1987     0.262903E+04     0.317721E+04    -0.189389E+00
1988     0.421943E+03     0.700184E+03    -0.506473E+00
1989     0.230446E+04     0.316025E+04    -0.315806E+00
1990     0.107109E+04     0.736636E+03     0.374334E+00
1991     0.600457E+04     0.479331E+04     0.225300E+00
1992     0.227200E+03     0.360215E+03    -0.460870E+00
1993     0.454400E+03     0.636273E+03    -0.336650E+00
1994     0.481015E+03     0.515983E+03    -0.701756E-01
1995     0.296918E+04     0.259986E+04     0.132827E+00
1996     0.168939E+05     0.437446E+04     0.135117E+01
1997     0.118709E+05     0.455274E+04     0.958360E+00
1998     0.343721E+04     0.386595E+04    -0.117547E+00
1999     0.232750E+04     0.344434E+04    -0.391937E+00
2000     0.652129E+04     0.691582E+04    -0.587390E-01
2001     0.270725E+04     0.435132E+04    -0.474546E+00
2002     0.104593E+05     0.144574E+05    -0.323714E+00
2003     0.392731E+04     0.352373E+04     0.108436E+00
2004     0.294062E+05     0.295609E+05    -0.524647E-02
2005     0.123337E+04     0.174394E+04    -0.346398E+00
2006     0.164395E+04     0.868911E+03     0.637619E+00
2007     0.146687E+06     0.153343E+06    -0.443797E-01
2008     0.712110E+03     0.238976E+04    -0.121072E+01

Survey Index:    5 Tag:         US_Sp    AGE =  5
Time = JAN-1           Type = NUMBER
Catchability =    0.634646E+00   % Variance Contribution =     3.2729
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
____________________________________________________________________________

1931     N/A              0.108807E+05     N/A
1932     N/A              0.588657E+04     N/A
1933     N/A              0.365456E+04     N/A
1934     N/A              0.691159E+04     N/A
1935     N/A              0.509740E+04     N/A
1936     N/A              0.500276E+04     N/A
1937     N/A              0.572928E+04     N/A
1938     N/A              0.380533E+04     N/A
1939     N/A              0.430333E+04     N/A
1940     N/A              0.524447E+04     N/A
1941     N/A              0.808057E+04     N/A
1942     N/A              0.629738E+04     N/A
1943     N/A              0.570642E+04     N/A
1944     N/A              0.972678E+04     N/A
1945     N/A              0.101584E+05     N/A
1946     N/A              0.835833E+04     N/A
1947     N/A              0.383734E+04     N/A
1948     N/A              0.415541E+04     N/A
1949     N/A              0.416006E+04     N/A
1950     N/A              0.595937E+04     N/A
1951     N/A              0.431297E+04     N/A
1952     N/A              0.373840E+04     N/A
1953     N/A              0.712889E+04     N/A
1954     N/A              0.571637E+04     N/A
1955     N/A              0.841872E+04     N/A
1956     N/A              0.708328E+04     N/A
1957     N/A              0.953641E+04     N/A
1958     N/A              0.765229E+04     N/A
1959     N/A              0.106777E+05     N/A
1960     N/A              0.837932E+04     N/A
1961     N/A              0.851934E+04     N/A
1962     N/A              0.924088E+04     N/A
1963     N/A              0.179307E+05     N/A
1964     N/A              0.167313E+05     N/A
1965     N/A              0.757046E+04     N/A
1966     N/A              0.438849E+04     N/A
1967     N/A              0.150791E+05     N/A
1968     0.218112E+05     0.218427E+05    -0.144380E-02
1969     0.136320E+04     0.122735E+04     0.104975E+00
1970     0.149303E+04     0.498660E+03     0.109664E+01
1971     0.389486E+03     0.137380E+04    -0.126051E+01
1972     0.973714E+02     0.117514E+03    -0.188025E+00
1973     N/A              0.104647E+03     N/A
1974     N/A              0.339375E+03     N/A
1975     N/A              0.722763E+02     N/A
1976     N/A              0.103425E+04     N/A
1977     N/A              0.161231E+04     N/A
1978     N/A              0.192991E+04     N/A
1979     N/A              0.174583E+04     N/A
1980     N/A              0.115028E+05     N/A
1981     N/A              0.231835E+04     N/A
1982     0.136320E+04     0.109587E+04     0.218287E+00
1983     0.782217E+04     0.478122E+04     0.492267E+00
1984     0.188251E+04     0.127886E+04     0.386643E+00
1985     0.282377E+04     0.847673E+03     0.120333E+01
1986     0.357029E+03     0.398867E+03    -0.110813E+00
1987     0.259657E+03     0.508442E+03    -0.671989E+00
1988     0.103863E+04     0.194684E+04    -0.628306E+00
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1989     0.454400E+03     0.557156E+03    -0.203867E+00
1990     0.188251E+04     0.228685E+04    -0.194569E+00
1991     0.292114E+03     0.515179E+03    -0.567369E+00
1992     0.107109E+04     0.300064E+04    -0.103015E+01
1993     0.389486E+03     0.214712E+03     0.595532E+00
1994     0.330414E+03     0.383737E+03    -0.149611E+00
1995     0.536192E+03     0.330723E+03     0.483211E+00
1996     0.849728E+04     0.209063E+04     0.140228E+01
1997     0.652194E+04     0.344547E+04     0.638110E+00
1998     0.277346E+04     0.370630E+04    -0.289936E+00
1999     0.208505E+04     0.319010E+04    -0.425262E+00
2000     0.360404E+04     0.281688E+04     0.246425E+00
2001     0.976635E+03     0.537946E+04    -0.170623E+01
2002     0.354594E+04     0.338027E+04     0.478481E-01
2003     0.157417E+05     0.113064E+05     0.330942E+00
2004     0.707566E+04     0.293465E+04     0.880072E+00
2005     0.108731E+05     0.239064E+05    -0.787848E+00
2006     0.205811E+04     0.138912E+04     0.393119E+00
2007     0.111328E+04     0.748131E+03     0.397487E+00
2008     0.658500E+05     0.132771E+06    -0.701242E+00

Survey Index:    6 Tag:         US_Sp    AGE =  6
Time = JAN-1           Type = NUMBER
Catchability =    0.540223E+00   % Variance Contribution =     5.5201
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_____________________________________________________________________________


1931     N/A              0.550891E+04     N/A
1932     N/A              0.320439E+04     N/A
1933     N/A              0.232532E+04     N/A
1934     N/A              0.153456E+04     N/A
1935     N/A              0.328979E+04     N/A
1936     N/A              0.212793E+04     N/A
1937     N/A              0.244783E+04     N/A
1938     N/A              0.199404E+04     N/A
1939     N/A              0.162915E+04     N/A
1940     N/A              0.195630E+04     N/A
1941     N/A              0.243828E+04     N/A
1942     N/A              0.285006E+04     N/A
1943     N/A              0.245731E+04     N/A
1944     N/A              0.247498E+04     N/A
1945     N/A              0.402636E+04     N/A
1946     N/A              0.427513E+04     N/A
1947     N/A              0.303222E+04     N/A
1948     N/A              0.164466E+04     N/A
1949     N/A              0.157037E+04     N/A
1950     N/A              0.176327E+04     N/A
1951     N/A              0.254851E+04     N/A
1952     N/A              0.182103E+04     N/A
1953     N/A              0.194442E+04     N/A
1954     N/A              0.314864E+04     N/A
1955     N/A              0.286032E+04     N/A
1956     N/A              0.427588E+04     N/A
1957     N/A              0.328601E+04     N/A
1958     N/A              0.383073E+04     N/A
1959     N/A              0.349929E+04     N/A
1960     N/A              0.553117E+04     N/A
1961     N/A              0.435032E+04     N/A
1962     N/A              0.452023E+04     N/A
1963     N/A              0.476591E+04     N/A
1964     N/A              0.852098E+04     N/A
1965     N/A              0.743565E+04     N/A
1966     N/A              0.315138E+04     N/A
1967     N/A              0.172042E+04     N/A
1968     0.545280E+04     0.551727E+04    -0.117548E-01
1969     0.137294E+05     0.820917E+04     0.514286E+00
1970     0.149303E+04     0.538649E+03     0.101950E+01
1971     0.389486E+03     0.257210E+03     0.414934E+00
1972     0.129829E+03     0.816766E+03    -0.183914E+01
1973     N/A              0.659973E+02     N/A
1974     N/A              0.467717E+02     N/A
1975     N/A              0.201183E+03     N/A
1976     N/A              0.483713E+02     N/A
1977     N/A              0.611773E+03     N/A
1978     N/A              0.869900E+03     N/A
1979     N/A              0.106717E+04     N/A
1980     N/A              0.959084E+03     N/A
1981     N/A              0.506838E+04     N/A
1982     0.908800E+03     0.115772E+04    -0.242083E+00
1983     0.324571E+02     0.572428E+03    -0.286997E+01
1984     0.233691E+04     0.223584E+04     0.442161E-01
1985     0.110354E+04     0.695985E+03     0.460953E+00
1986     0.681600E+03     0.362232E+03     0.632158E+00
1987     0.324571E+03     0.206112E+03     0.454084E+00
1988     0.389486E+03     0.293776E+03     0.282009E+00
1989     0.133074E+04     0.895163E+03     0.396487E+00
1990     0.194743E+03     0.282807E+03    -0.373084E+00
1991     0.324571E+03     0.104898E+04    -0.117307E+01
1992     0.973714E+02     0.288874E+03    -0.108746E+01
1993     0.120091E+04     0.114415E+04     0.484194E-01
1994     0.213568E+03     0.915029E+02     0.847584E+00
1995     0.369687E+03     0.198431E+03     0.622213E+00
1996     0.113275E+04     0.201808E+03     0.172509E+01
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1997     0.288674E+04     0.123785E+04     0.846753E+00
1998     0.695881E+03     0.212785E+04    -0.111769E+01
1999     0.164590E+04     0.220957E+04    -0.294508E+00
2000     0.359073E+04     0.192836E+04     0.621686E+00
2001     0.681600E+03     0.167695E+04    -0.900288E+00
2002     0.154821E+04     0.312600E+04    -0.702659E+00
2003     0.311589E+04     0.190538E+04     0.491831E+00
2004     0.866606E+04     0.657280E+04     0.276473E+00
2005     0.146057E+04     0.169039E+04    -0.146134E+00
2006     0.120059E+05     0.125298E+05    -0.427089E-01
2007     0.791630E+03     0.785639E+03     0.759574E-02
2008     0.127524E+04     0.426932E+03     0.109427E+01

Survey Index:    7 Tag:         US_Sp    AGE =  7
Time = JAN-1           Type = NUMBER
Catchability =    0.535573E+00   % Variance Contribution =     4.4580
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
____________________________________________________________________________

1931     N/A              0.294060E+04     N/A
1932     N/A              0.159560E+04     N/A
1933     N/A              0.121818E+04     N/A
1934     N/A              0.112996E+04     N/A
1935     N/A              0.741446E+03     N/A
1936     N/A              0.149246E+04     N/A
1937     N/A              0.106631E+04     N/A
1938     N/A              0.108870E+04     N/A
1939     N/A              0.852593E+03     N/A
1940     N/A              0.857859E+03     N/A
1941     N/A              0.879309E+03     N/A
1942     N/A              0.112547E+04     N/A
1943     N/A              0.119778E+04     N/A
1944     N/A              0.713324E+03     N/A
1945     N/A              0.919430E+03     N/A
1946     N/A              0.215584E+04     N/A
1947     N/A              0.163511E+04     N/A
1948     N/A              0.115250E+04     N/A
1949     N/A              0.780136E+03     N/A
1950     N/A              0.765645E+03     N/A
1951     N/A              0.888347E+03     N/A
1952     N/A              0.104577E+04     N/A
1953     N/A              0.102417E+04     N/A
1954     N/A              0.109163E+04     N/A
1955     N/A              0.153340E+04     N/A
1956     N/A              0.152939E+04     N/A
1957     N/A              0.185322E+04     N/A
1958     N/A              0.153722E+04     N/A
1959     N/A              0.197326E+04     N/A
1960     N/A              0.199477E+04     N/A
1961     N/A              0.362567E+04     N/A
1962     N/A              0.263749E+04     N/A
1963     N/A              0.266370E+04     N/A
1964     N/A              0.280730E+04     N/A
1965     N/A              0.413694E+04     N/A
1966     N/A              0.283867E+04     N/A
1967     N/A              0.131802E+04     N/A
1968     0.811429E+03     0.816687E+03    -0.645937E-02
1969     0.334309E+04     0.279859E+04     0.177777E+00
1970     0.649143E+04     0.380920E+04     0.533063E+00
1971     0.292114E+03     0.334141E+03    -0.134418E+00
1972     0.421943E+03     0.913610E+02     0.153005E+01
1973     N/A              0.603638E+03     N/A
1974     N/A              0.388435E+02     N/A
1975     N/A              0.369483E+02     N/A
1976     N/A              0.142348E+03     N/A
1977     N/A              0.392583E+02     N/A
1978     N/A              0.322677E+03     N/A
1979     N/A              0.455797E+03     N/A
1980     N/A              0.666829E+03     N/A
1981     N/A              0.491690E+03     N/A
1982     0.197989E+04     0.286821E+04    -0.370649E+00
1983     0.129829E+03     0.663982E+03    -0.163204E+01
1984     0.227200E+03     0.332467E+03    -0.380710E+00
1985     0.379749E+04     0.109518E+04     0.124342E+01
1986     0.389486E+03     0.452369E+03    -0.149671E+00
1987     0.162286E+03     0.209635E+03    -0.256007E+00
1988     0.357029E+03     0.131399E+03     0.999574E+00
1989     0.194743E+03     0.165170E+03     0.164705E+00
1990     0.421943E+03     0.496882E+03    -0.163483E+00
1991     0.649143E+02     0.155381E+03    -0.872812E+00
1992     0.973714E+02     0.602460E+03    -0.182249E+01
1993     0.194743E+03     0.147480E+03     0.277986E+00
1994     0.503410E+03     0.572858E+03    -0.129232E+00
1995     0.928274E+02     0.391338E+02     0.863755E+00
1996     0.236937E+03     0.146862E+03     0.478303E+00
1997     0.408960E+03     0.131988E+03     0.113091E+01
1998     0.196041E+03     0.899515E+03    -0.152353E+01
1999     0.662775E+03     0.145184E+04    -0.784149E+00
2000     0.329245E+04     0.152063E+04     0.772507E+00
2001     0.373582E+03     0.131067E+04    -0.125516E+01
2002     0.196950E+04     0.104536E+04     0.633417E+00
2003     0.370011E+04     0.200463E+04     0.612906E+00
2004     0.139566E+04     0.125493E+04     0.106283E+00
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2005     0.327817E+04     0.392213E+04    -0.179349E+00
2006     0.168355E+04     0.997799E+03     0.523109E+00
2007     0.452810E+04     0.756171E+04    -0.512795E+00
2008     0.552745E+03     0.487705E+03     0.125185E+00

Survey Index:    8 Tag:         US_Sp    AGE =  8
Time = JAN-1           Type = NUMBER
Catchability =    0.623145E+00   % Variance Contribution =     5.2382
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_____________________________________________________________________________

1931     N/A              0.192278E+04     N/A
1932     N/A              0.932299E+03     N/A
1933     N/A              0.784985E+03     N/A
1934     N/A              0.488901E+03     N/A
1935     N/A              0.730200E+03     N/A
1936     N/A              0.427734E+03     N/A
1937     N/A              0.664568E+03     N/A
1938     N/A              0.486336E+03     N/A
1939     N/A              0.511310E+03     N/A
1940     N/A              0.347539E+03     N/A
1941     N/A              0.398860E+03     N/A
1942     N/A              0.316290E+03     N/A
1943     N/A              0.496284E+03     N/A
1944     N/A              0.699892E+03     N/A
1945     N/A              0.402165E+03     N/A
1946     N/A              0.368597E+03     N/A
1947     N/A              0.103674E+04     N/A
1948     N/A              0.723267E+03     N/A
1949     N/A              0.662463E+03     N/A
1950     N/A              0.395540E+03     N/A
1951     N/A              0.439091E+03     N/A
1952     N/A              0.434245E+03     N/A
1953     N/A              0.699611E+03     N/A
1954     N/A              0.672407E+03     N/A
1955     N/A              0.637862E+03     N/A
1956     N/A              0.864726E+03     N/A
1957     N/A              0.707076E+03     N/A
1958     N/A              0.858661E+03     N/A
1959     N/A              0.959606E+03     N/A
1960     N/A              0.122467E+04     N/A
1961     N/A              0.145915E+04     N/A
1962     N/A              0.274390E+04     N/A
1963     N/A              0.163720E+04     N/A
1964     N/A              0.175141E+04     N/A
1965     N/A              0.151324E+04     N/A
1966     N/A              0.184391E+04     N/A
1967     N/A              0.140551E+04     N/A
1968     0.146057E+04     0.701926E+03     0.732756E+00
1969     0.908800E+03     0.406516E+03     0.804503E+00
1970     0.318080E+04     0.178580E+04     0.577268E+00
1971     0.266149E+04     0.233888E+04     0.129211E+00
1972     0.973714E+02     0.159687E+03    -0.494685E+00
1973     N/A              0.426352E+02     N/A
1974     N/A              0.530954E+03     N/A
1975     N/A              0.358209E+02     N/A
1976     N/A              0.328917E+02     N/A
1977     N/A              0.122171E+03     N/A
1978     N/A              0.350921E+02     N/A
1979     N/A              0.228905E+03     N/A
1980     N/A              0.256738E+03     N/A
1981     N/A              0.329513E+03     N/A
1982     N/A              0.282278E+03     N/A
1983     0.376503E+04     0.210046E+04     0.583597E+00
1984     0.129829E+03     0.527061E+03    -0.140110E+01
1985     0.324571E+03     0.184597E+03     0.564332E+00
1986     0.107109E+04     0.741800E+03     0.367349E+00
1987     0.714057E+03     0.345679E+03     0.725453E+00
1988     0.389486E+03     0.148835E+03     0.961986E+00
1989     0.162286E+03     0.936322E+02     0.549984E+00
1990     N/A              0.122753E+03     N/A
1991     0.129829E+03     0.351447E+03    -0.995844E+00
1992     0.973714E+02     0.767951E+02     0.237392E+00
1993     0.649143E+02     0.336382E+03    -0.164518E+01
1994     0.490103E+02     0.105420E+03    -0.765919E+00
1995     0.577737E+03     0.370420E+03     0.444480E+00
1996     0.243429E+03     0.325052E+02     0.201342E+01
1997     0.228498E+03     0.127480E+03     0.583570E+00
1998     0.178514E+02     0.115894E+03    -0.187059E+01
1999     0.651739E+03     0.761991E+03    -0.156289E+00
2000     0.154334E+04     0.116775E+04     0.278865E+00
2001     0.265175E+03     0.123690E+04    -0.153997E+01
2002     0.552421E+03     0.100312E+04    -0.596556E+00
2003     0.279131E+04     0.770710E+03     0.128696E+01
2004     0.311589E+04     0.150642E+04     0.726779E+00
2005     0.616686E+03     0.811380E+03    -0.274378E+00
2006     0.153685E+04     0.270457E+04    -0.565210E+00
2007     0.431031E+03     0.767370E+03    -0.576789E+00
2008     0.291984E+04     0.579455E+04    -0.685388E+00

Survey Index:    9 Tag:         US_S41   AGE =  1
Time = JAN-1           Type = NUMBER
Catchability =    0.721024E+00   % Variance Contribution =     3.9361
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Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_____________________________________________________________________________

1931     N/A             0.287963E+05     N/A
1932     N/A             0.326730E+05     N/A
1933     N/A             0.372156E+05     N/A
1934     N/A             0.429507E+05     N/A
1935     N/A             0.419733E+05     N/A
1936     N/A             0.412041E+05     N/A
1937     N/A             0.759315E+05     N/A
1938     N/A             0.562763E+05     N/A
1939     N/A             0.428911E+05     N/A
1940     N/A             0.801969E+05     N/A
1941     N/A             0.823893E+05     N/A
1942     N/A             0.446132E+05     N/A
1943     N/A             0.168045E+05     N/A
1944     N/A             0.469751E+05     N/A
1945     N/A             0.373538E+05     N/A
1946     N/A             0.677034E+05     N/A
1947     N/A             0.426382E+05     N/A
1948     N/A             0.237612E+05     N/A
1949     N/A             0.895088E+05     N/A
1950     N/A             0.412514E+05     N/A
1951     N/A             0.748282E+05     N/A
1952     N/A             0.304918E+05     N/A
1953     N/A             0.957450E+05     N/A
1954     N/A             0.376955E+05     N/A
1955     N/A             0.648204E+05     N/A
1956     N/A             0.434497E+05     N/A
1957     N/A             0.429948E+05     N/A
1958     N/A             0.423064E+05     N/A
1959     N/A             0.936224E+05     N/A
1960     N/A             0.881417E+05     N/A
1961     N/A             0.391602E+05     N/A
1962     N/A             0.281559E+05     N/A
1963     N/A             0.135727E+06     N/A
1964     N/A             0.332259E+06     N/A
1965     N/A             0.234427E+05     N/A
1966     N/A             0.299589E+04     N/A
1967     N/A             0.101037E+05     N/A
1968     N/A             0.390956E+03     N/A
1969     N/A             0.800978E+03     N/A
1970     N/A             0.332792E+04     N/A
1971     N/A             0.192206E+03     N/A
1972     N/A             0.614738E+04     N/A
1973     0.995785E+05    0.140587E+05     0.195771E+01
1974     0.691337E+04    0.762637E+04    -0.981546E-01
1975     0.305097E+04    0.571777E+04    -0.628119E+00
1976     0.262221E+06    0.759591E+05     0.123899E+01
1977     0.197989E+04    0.100826E+05    -0.162777E+01
1978     0.227200E+03    0.441636E+04    -0.296724E+01
1979     0.117235E+06    0.604860E+05     0.661771E+00
1980     0.168777E+05    0.788454E+04     0.761091E+00
1981     0.107109E+05    0.530967E+04     0.701728E+00
1982     N/A             0.186101E+04     N/A
1983     N/A             0.236813E+04     N/A
1984     N/A             0.130385E+05     N/A
1985     N/A             0.181628E+04     N/A
1986     N/A             0.121084E+05     N/A
1987     N/A             0.188774E+04     N/A
1988     N/A             0.144314E+05     N/A
1989     N/A             0.984878E+03     N/A
1990     N/A             0.246233E+04     N/A
1991     N/A             0.196481E+04     N/A
1992     N/A             0.779542E+04     N/A
1993     N/A             0.113164E+05     N/A
1994     N/A             0.112332E+05     N/A
1995     N/A             0.926511E+04     N/A
1996     N/A             0.860816E+04     N/A
1997     N/A             0.171821E+05     N/A
1998     N/A             0.107753E+05     N/A
1999     N/A             0.364172E+05     N/A
2000     N/A             0.863922E+04     N/A
2001     N/A             0.705480E+05     N/A
2002     N/A             0.416649E+04     N/A
2003     N/A             0.207952E+04     N/A
2004     N/A             0.356812E+06     N/A
2005     N/A             0.580287E+04     N/A
2006     N/A             0.190709E+05     N/A
2007     N/A             0.535055E+04     N/A
2008     N/A             0.118077E+05     N/A

Survey Index:   10 Tag:         US_S41   AGE =  2
Time = JAN-1           Type = NUMBER
Catchability =    0.898814E+00   % Variance Contribution =     1.8500
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_____________________________________________________________________________

1931     N/A             0.722533E+05     N/A
1932     N/A             0.279662E+05     N/A
1933     N/A             0.332507E+05     N/A
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1934     N/A              0.377846E+05     N/A
1935     N/A              0.435592E+05     N/A
1936     N/A              0.418670E+05     N/A
1937     N/A              0.413392E+05     N/A
1938     N/A              0.764511E+05     N/A
1939     N/A              0.566003E+05     N/A
1940     N/A              0.432825E+05     N/A
1941     N/A              0.801943E+05     N/A
1942     N/A              0.834544E+05     N/A
1943     N/A              0.452811E+05     N/A
1944     N/A              0.171354E+05     N/A
1945     N/A              0.478915E+05     N/A
1946     N/A              0.380255E+05     N/A
1947     N/A              0.689293E+05     N/A
1948     N/A              0.434441E+05     N/A
1949     N/A              0.241860E+05     N/A
1950     N/A              0.910876E+05     N/A
1951     N/A              0.420303E+05     N/A
1952     N/A              0.758470E+05     N/A
1953     N/A              0.311173E+05     N/A
1954     N/A              0.968394E+05     N/A
1955     N/A              0.383848E+05     N/A
1956     N/A              0.660835E+05     N/A
1957     N/A              0.443031E+05     N/A
1958     N/A              0.438527E+05     N/A
1959     N/A              0.430770E+05     N/A
1960     N/A              0.954760E+05     N/A
1961     N/A              0.897491E+05     N/A
1962     N/A              0.399171E+05     N/A
1963     N/A              0.286762E+05     N/A
1964     N/A              0.136162E+06     N/A
1965     N/A              0.330910E+06     N/A
1966     N/A              0.161810E+05     N/A
1967     N/A              0.296514E+04     N/A
1968     N/A              0.937975E+04     N/A
1969     N/A              0.392522E+03     N/A
1970     N/A              0.815865E+03     N/A
1971     N/A              0.335918E+04     N/A
1972     N/A              0.195356E+03     N/A
1973     0.157093E+05     0.614456E+04     0.938683E+00
1974     0.431355E+05     0.122373E+05     0.125986E+01
1975     0.314834E+04     0.774485E+04    -0.900152E+00
1976     0.973714E+03     0.567446E+04    -0.176261E+01
1977     0.108439E+06     0.774036E+05     0.337157E+00
1978     0.314834E+04     0.102894E+05    -0.118424E+01
1979     0.512823E+04     0.450659E+04     0.129220E+00
1980     0.151575E+06     0.617266E+05     0.898365E+00
1981     0.106784E+05     0.804057E+04     0.283723E+00
1982     N/A              0.541831E+04     N/A
1983     N/A              0.189856E+04     N/A
1984     N/A              0.241670E+04     N/A
1985     N/A              0.133060E+05     N/A
1986     N/A              0.185354E+04     N/A
1987     N/A              0.123530E+05     N/A
1988     N/A              0.192646E+04     N/A
1989     N/A              0.147255E+05     N/A
1990     N/A              0.100364E+04     N/A
1991     N/A              0.246203E+04     N/A
1992     N/A              0.199963E+04     N/A
1993     N/A              0.788824E+04     N/A
1994     N/A              0.115229E+05     N/A
1995     N/A              0.114426E+05     N/A
1996     N/A              0.944229E+04     N/A
1997     N/A              0.878008E+04     N/A
1998     N/A              0.175245E+05     N/A
1999     N/A              0.109926E+05     N/A
2000     N/A              0.371642E+05     N/A
2001     N/A              0.881600E+04     N/A
2002     N/A              0.719908E+05     N/A
2003     N/A              0.425002E+04     N/A
2004     N/A              0.211873E+04     N/A
2005     N/A              0.363642E+06     N/A
2006     N/A              0.590665E+04     N/A
2007     N/A              0.193305E+05     N/A
2008     N/A              0.545029E+04     N/A

Survey Index:   11 Tag:         US_S41   AGE =  3
Time = JAN-1           Type = NUMBER
Catchability =    0.775702E+00   % Variance Contribution =     1.1650
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_____________________________________________________________________________

1931     N/A              0.109228E+05     N/A
1932     N/A              0.448995E+05     N/A
1933     N/A              0.183021E+05     N/A
1934     N/A              0.175838E+05     N/A
1935     N/A              0.235836E+05     N/A
1936     N/A              0.225027E+05     N/A
1937     N/A              0.209941E+05     N/A
1938     N/A              0.215172E+05     N/A
1939     N/A              0.399365E+05     N/A
1940     N/A              0.302723E+05     N/A
1941     N/A              0.255152E+05     N/A
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1942     N/A              0.403154E+05     N/A
1943     N/A              0.489737E+05     N/A
1944     N/A              0.290631E+05     N/A
1945     N/A              0.115748E+05     N/A
1946     N/A              0.278872E+05     N/A
1947     N/A              0.216556E+05     N/A
1948     N/A              0.371105E+05     N/A
1949     N/A              0.228685E+05     N/A
1950     N/A              0.125775E+05     N/A
1951     N/A              0.441872E+05     N/A
1952     N/A              0.239268E+05     N/A
1953     N/A              0.361055E+05     N/A
1954     N/A              0.207222E+05     N/A
1955     N/A              0.462468E+05     N/A
1956     N/A              0.243657E+05     N/A
1957     N/A              0.383490E+05     N/A
1958     N/A              0.266958E+05     N/A
1959     N/A              0.270908E+05     N/A
1960     N/A              0.264418E+05     N/A
1961     N/A              0.562775E+05     N/A
1962     N/A              0.559413E+05     N/A
1963     N/A              0.250893E+05     N/A
1964     N/A              0.174336E+05     N/A
1965     N/A              0.850676E+05     N/A
1966     N/A              0.146336E+06     N/A
1967     N/A              0.668070E+04     N/A
1968     N/A              0.197753E+04     N/A
1969     N/A              0.454278E+04     N/A
1970     N/A              0.269647E+03     N/A
1971     N/A              0.466158E+03     N/A
1972     N/A              0.141824E+04     N/A
1973     N/A              0.136635E+03     N/A
1974     0.928274E+04     0.287111E+04     0.117346E+01
1975     0.107758E+05     0.552993E+04     0.667125E+00
1976     0.194743E+04     0.472483E+04    -0.886323E+00
1977     0.136320E+04     0.366632E+04    -0.989354E+00
1978     0.517042E+05     0.408452E+05     0.235750E+00
1979     0.366766E+04     0.673362E+04    -0.607561E+00
1980     0.165531E+04     0.316595E+04    -0.648461E+00
1981     0.632590E+05     0.220183E+05     0.105536E+01
1982     N/A              0.445629E+04     N/A
1983     N/A              0.300937E+04     N/A
1984     N/A              0.119038E+04     N/A
1985     N/A              0.164172E+04     N/A
1986     N/A              0.768127E+04     N/A
1987     N/A              0.127138E+04     N/A
1988     N/A              0.730671E+04     N/A
1989     N/A              0.132395E+04     N/A
1990     N/A              0.938206E+04     N/A
1991     N/A              0.701031E+03     N/A
1992     N/A              0.140025E+04     N/A
1993     N/A              0.122759E+04     N/A
1994     N/A              0.531937E+04     N/A
1995     N/A              0.776560E+04     N/A
1996     N/A              0.801970E+04     N/A
1997     N/A              0.663230E+04     N/A
1998     N/A              0.610352E+04     N/A
1999     N/A              0.122214E+05     N/A
2000     N/A              0.773694E+04     N/A
2001     N/A              0.259749E+05     N/A
2002     N/A              0.612764E+04     N/A
2003     N/A              0.505899E+05     N/A
2004     N/A              0.299061E+04     N/A
2005     N/A              0.147395E+04     N/A
2006     N/A              0.256516E+06     N/A
2007     N/A              0.416068E+04     N/A
2008     N/A              0.135364E+05     N/A

Survey Index:   12 Tag:         US_S41   AGE =  4
Time = JAN-1           Type = NUMBER
Catchability =    0.838990E+00   % Variance Contribution =     0.5600
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
____________________________________________________________________________

1931     N/A              0.148207E+05     N/A
1932     N/A              0.813010E+04     N/A
1933     N/A              0.203675E+05     N/A
1934     N/A              0.116672E+05     N/A
1935     N/A              0.114884E+05     N/A
1936     N/A              0.142425E+05     N/A
1937     N/A              0.113029E+05     N/A
1938     N/A              0.104012E+05     N/A
1939     N/A              0.132123E+05     N/A
1940     N/A              0.206294E+05     N/A
1941     N/A              0.175375E+05     N/A
1942     N/A              0.152097E+05     N/A
1943     N/A              0.233970E+05     N/A
1944     N/A              0.300061E+05     N/A
1945     N/A              0.193720E+05     N/A
1946     N/A              0.871625E+04     N/A
1947     N/A              0.132826E+05     N/A
1948     N/A              0.114116E+05     N/A
1949     N/A              0.184217E+05     N/A
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1950     N/A              0.108894E+05     N/A
1951     N/A              0.804192E+04     N/A
1952     N/A              0.192984E+05     N/A
1953     N/A              0.144911E+05     N/A
1954     N/A              0.187598E+05     N/A
1955     N/A              0.144947E+05     N/A
1956     N/A              0.264679E+05     N/A
1957     N/A              0.165226E+05     N/A
1958     N/A              0.233796E+05     N/A
1959     N/A              0.182908E+05     N/A
1960     N/A              0.179602E+05     N/A
1961     N/A              0.187921E+05     N/A
1962     N/A              0.385705E+05     N/A
1963     N/A              0.372838E+05     N/A
1964     N/A              0.166224E+05     N/A
1965     N/A              0.120009E+05     N/A
1966     N/A              0.419316E+05     N/A
1967     N/A              0.542638E+05     N/A
1968     N/A              0.374147E+04     N/A
1969     N/A              0.121705E+04     N/A
1970     N/A              0.274401E+04     N/A
1971     N/A              0.226665E+03     N/A
1972     N/A              0.245237E+03     N/A
1973     0.175269E+04     0.908832E+03     0.656744E+00
1974     N/A              0.118646E+03     N/A
1975     0.204480E+04     0.202788E+04     0.830663E-02
1976     0.298606E+04     0.344422E+04    -0.142742E+00
1977     0.395977E+04     0.375246E+04     0.537745E-01
1978     0.116846E+04     0.310304E+04    -0.976700E+00
1979     0.185330E+05     0.252388E+05    -0.308829E+00
1980     0.337554E+04     0.464766E+04    -0.319807E+00
1981     0.710811E+04     0.253954E+04     0.102925E+01
1982     N/A              0.111800E+05     N/A
1983     N/A              0.270714E+04     N/A
1984     N/A              0.204531E+04     N/A
1985     N/A              0.827210E+03     N/A
1986     N/A              0.102939E+04     N/A
1987     N/A              0.465683E+04     N/A
1988     N/A              0.102626E+04     N/A
1989     N/A              0.463196E+04     N/A
1990     N/A              0.107968E+04     N/A
1991     N/A              0.702553E+04     N/A
1992     N/A              0.527965E+03     N/A
1993     N/A              0.932583E+03     N/A
1994     N/A              0.756274E+03     N/A
1995     N/A              0.381061E+04     N/A
1996     N/A              0.641163E+04     N/A
1997     N/A              0.667293E+04     N/A
1998     N/A              0.566631E+04     N/A
1999     N/A              0.504836E+04     N/A
2000     N/A              0.101365E+05     N/A
2001     N/A              0.637771E+04     N/A
2002     N/A              0.211902E+05     N/A
2003     N/A              0.516472E+04     N/A
2004     N/A              0.433272E+05     N/A
2005     N/A              0.255609E+04     N/A
2006     N/A              0.127356E+04     N/A
2007     N/A              0.224755E+06     N/A
2008     N/A              0.350266E+04     N/A

Survey Index:   13 Tag:         US_S41   AGE =  5
Time = JAN-1           Type = NUMBER
Catchability =    0.888891E+00   % Variance Contribution =     0.3183
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
______________________________________________________________________________

1931     N/A              0.152396E+05     N/A
1932     N/A              0.824479E+04     N/A
1933     N/A              0.511861E+04     N/A
1934     N/A              0.968044E+04     N/A
1935     N/A              0.713946E+04     N/A
1936     N/A              0.700692E+04     N/A
1937     N/A              0.802448E+04     N/A
1938     N/A              0.532978E+04     N/A
1939     N/A              0.602728E+04     N/A
1940     N/A              0.734545E+04     N/A
1941     N/A              0.113177E+05     N/A
1942     N/A              0.882017E+04     N/A
1943     N/A              0.799247E+04     N/A
1944     N/A              0.136234E+05     N/A
1945     N/A              0.142280E+05     N/A
1946     N/A              0.117068E+05     N/A
1947     N/A              0.537462E+04     N/A
1948     N/A              0.582012E+04     N/A
1949     N/A              0.582662E+04     N/A
1950     N/A              0.834676E+04     N/A
1951     N/A              0.604079E+04     N/A
1952     N/A              0.523604E+04     N/A
1953     N/A              0.998480E+04     N/A
1954     N/A              0.800640E+04     N/A
1955     N/A              0.117913E+05     N/A
1956     N/A              0.992092E+04     N/A
1957     N/A              0.133568E+05     N/A
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1958     N/A              0.107179E+05     N/A
1959     N/A              0.149554E+05     N/A
1960     N/A              0.117362E+05     N/A
1961     N/A              0.119323E+05     N/A
1962     N/A              0.129429E+05     N/A
1963     N/A              0.251140E+05     N/A
1964     N/A              0.234341E+05     N/A
1965     N/A              0.106033E+05     N/A
1966     N/A              0.614657E+04     N/A
1967     N/A              0.211199E+05     N/A
1968     N/A              0.305931E+05     N/A
1969     N/A              0.171904E+04     N/A
1970     N/A              0.698428E+03     N/A
1971     N/A              0.192415E+04     N/A
1972     N/A              0.164591E+03     N/A
1973     0.292114E+03     0.146570E+03     0.689645E+00
1974     0.778971E+03     0.475332E+03     0.493961E+00
1975     N/A              0.101231E+03     N/A
1976     0.139566E+04     0.144858E+04    -0.372168E-01
1977     0.194743E+04     0.225822E+04    -0.148068E+00
1978     0.305097E+04     0.270305E+04     0.121078E+00
1979     0.107109E+04     0.244523E+04    -0.825466E+00
1980     0.158066E+05     0.161109E+05    -0.190672E-01
1981     0.246674E+04     0.324711E+04    -0.274866E+00
1982     N/A              0.153489E+04     N/A
1983     N/A              0.669662E+04     N/A
1984     N/A              0.179118E+04     N/A
1985     N/A              0.118726E+04     N/A
1986     N/A              0.558658E+03     N/A
1987     N/A              0.712129E+03     N/A
1988     N/A              0.272676E+04     N/A
1989     N/A              0.780358E+03     N/A
1990     N/A              0.320299E+04     N/A
1991     N/A              0.721565E+03     N/A
1992     N/A              0.420273E+04     N/A
1993     N/A              0.300727E+03     N/A
1994     N/A              0.537465E+03     N/A
1995     N/A              0.463214E+03     N/A
1996     N/A              0.292815E+04     N/A
1997     N/A              0.482576E+04     N/A
1998     N/A              0.519108E+04     N/A
1999     N/A              0.446809E+04     N/A
2000     N/A              0.394536E+04     N/A
2001     N/A              0.753453E+04     N/A
2002     N/A              0.473444E+04     N/A
2003     N/A              0.158359E+05     N/A
2004     N/A              0.411030E+04     N/A
2005     N/A              0.334835E+05     N/A
2006     N/A              0.194561E+04     N/A
2007     N/A              0.104784E+04     N/A
2008     N/A              0.185960E+06     N/A

Survey Index:   14 Tag:         US_S41   AGE =  6
Time = JAN-1           Type = NUMBER
Catchability =    0.884529E+00   % Variance Contribution =     0.4840
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_____________________________________________________________________________

1931     N/A              0.901997E+04     N/A
1932     N/A              0.524667E+04     N/A
1933     N/A              0.380735E+04     N/A
1934     N/A              0.251259E+04     N/A
1935     N/A              0.538651E+04     N/A
1936     N/A              0.348415E+04     N/A
1937     N/A              0.400793E+04     N/A
1938     N/A              0.326493E+04     N/A
1939     N/A              0.266747E+04     N/A
1940     N/A              0.320314E+04     N/A
1941     N/A              0.399230E+04     N/A
1942     N/A              0.466652E+04     N/A
1943     N/A              0.402345E+04     N/A
1944     N/A              0.405238E+04     N/A
1945     N/A              0.659253E+04     N/A
1946     N/A              0.699985E+04     N/A
1947     N/A              0.496478E+04     N/A
1948     N/A              0.269287E+04     N/A
1949     N/A              0.257124E+04     N/A
1950     N/A              0.288708E+04     N/A
1951     N/A              0.417277E+04     N/A
1952     N/A              0.298165E+04     N/A
1953     N/A              0.318367E+04     N/A
1954     N/A              0.515540E+04     N/A
1955     N/A              0.468332E+04     N/A
1956     N/A              0.700108E+04     N/A
1957     N/A              0.538032E+04     N/A
1958     N/A              0.627221E+04     N/A
1959     N/A              0.572952E+04     N/A
1960     N/A              0.905641E+04     N/A
1961     N/A              0.712295E+04     N/A
1962     N/A              0.740116E+04     N/A
1963     N/A              0.780343E+04     N/A
1964     N/A              0.139518E+05     N/A
1965     N/A              0.121747E+05     N/A
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1966     N/A              0.515988E+04     N/A
1967     N/A              0.281691E+04     N/A
1968     N/A              0.903366E+04     N/A
1969     N/A              0.134412E+05     N/A
1970     N/A              0.881952E+03     N/A
1971     N/A              0.421141E+03     N/A
1972     N/A              0.133732E+04     N/A
1973     N/A              0.108060E+03     N/A
1974     N/A              0.765812E+02     N/A
1975     0.421943E+03     0.329406E+03     0.247580E+00
1976     N/A              0.792003E+02     N/A
1977     0.146057E+04     0.100168E+04     0.377148E+00
1978     0.266149E+04     0.142432E+04     0.625188E+00
1979     0.519314E+03     0.174732E+04    -0.121333E+01
1980     0.217463E+04     0.157035E+04     0.325560E+00
1981     0.577737E+04     0.829866E+04    -0.362145E+00
1982     N/A              0.189558E+04     N/A
1983     N/A              0.937260E+03     N/A
1984     N/A              0.366083E+04     N/A
1985     N/A              0.113956E+04     N/A
1986     N/A              0.593097E+03     N/A
1987     N/A              0.337476E+03     N/A
1988     N/A              0.481012E+03     N/A
1989     N/A              0.146569E+04     N/A
1990     N/A              0.463051E+03     N/A
1991     N/A              0.171754E+04     N/A
1992     N/A              0.472985E+03     N/A
1993     N/A              0.187337E+04     N/A
1994     N/A              0.149822E+03     N/A
1995     N/A              0.324900E+03     N/A
1996     N/A              0.330428E+03     N/A
1997     N/A              0.202678E+04     N/A
1998     N/A              0.348402E+04     N/A
1999     N/A              0.361782E+04     N/A
2000     N/A              0.315739E+04     N/A
2001     N/A              0.274574E+04     N/A
2002     N/A              0.511833E+04     N/A
2003     N/A              0.311976E+04     N/A
2004     N/A              0.107619E+05     N/A
2005     N/A              0.276775E+04     N/A
2006     N/A              0.205155E+05     N/A
2007     N/A              0.128636E+04     N/A
2008     N/A              0.699033E+03     N/A

Survey Index:   15 Tag:         US_S41   AGE =  7
Time = JAN-1           Type = NUMBER
Catchability =    0.911762E+00   % Variance Contribution =     0.7931
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_____________________________________________________________________________

1931     N/A              0.500610E+04     N/A
1932     N/A              0.271636E+04     N/A
1933     N/A              0.207384E+04     N/A
1934     N/A              0.192365E+04     N/A
1935     N/A              0.126224E+04     N/A
1936     N/A              0.254078E+04     N/A
1937     N/A              0.181529E+04     N/A
1938     N/A              0.185341E+04     N/A
1939     N/A              0.145146E+04     N/A
1940     N/A              0.146042E+04     N/A
1941     N/A              0.149694E+04     N/A
1942     N/A              0.191600E+04     N/A
1943     N/A              0.203910E+04     N/A
1944     N/A              0.121437E+04     N/A
1945     N/A              0.156524E+04     N/A
1946     N/A              0.367011E+04     N/A
1947     N/A              0.278361E+04     N/A
1948     N/A              0.196202E+04     N/A
1949     N/A              0.132811E+04     N/A
1950     N/A              0.130344E+04     N/A
1951     N/A              0.151233E+04     N/A
1952     N/A              0.178033E+04     N/A
1953     N/A              0.174355E+04     N/A
1954     N/A              0.185840E+04     N/A
1955     N/A              0.261047E+04     N/A
1956     N/A              0.260364E+04     N/A
1957     N/A              0.315493E+04     N/A
1958     N/A              0.261698E+04     N/A
1959     N/A              0.335928E+04     N/A
1960     N/A              0.339590E+04     N/A
1961     N/A              0.617235E+04     N/A
1962     N/A              0.449008E+04     N/A
1963     N/A              0.453469E+04     N/A
1964     N/A              0.477916E+04     N/A
1965     N/A              0.704275E+04     N/A
1966     N/A              0.483256E+04     N/A
1967     N/A              0.224381E+04     N/A
1968     N/A              0.139033E+04     N/A
1969     N/A              0.476434E+04     N/A
1970     N/A              0.648480E+04     N/A
1971     N/A              0.568843E+03     N/A
1972     N/A              0.155533E+03     N/A
1973     0.584229E+03     0.102764E+04    -0.564725E+00
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1974     0.324571E+02     0.661274E+02    -0.711662E+00
1975     0.292114E+03     0.629010E+02     0.153558E+01
1976     0.129829E+03     0.242335E+03    -0.624104E+00
1977     N/A              0.668335E+02     N/A
1978     0.519314E+03     0.549327E+03    -0.561854E-01
1979     0.120091E+04     0.775952E+03     0.436748E+00
1980     0.120091E+04     0.113521E+04     0.562626E-01
1981     0.778971E+03     0.837056E+03    -0.719168E-01
1982     N/A              0.488285E+04     N/A
1983     N/A              0.113037E+04     N/A
1984     N/A              0.565993E+03     N/A
1985     N/A              0.186444E+04     N/A
1986     N/A              0.770115E+03     N/A
1987     N/A              0.356883E+03     N/A
1988     N/A              0.223695E+03     N/A
1989     N/A              0.281186E+03     N/A
1990     N/A              0.845895E+03     N/A
1991     N/A              0.264521E+03     N/A
1992     N/A              0.102563E+04     N/A
1993     N/A              0.251071E+03     N/A
1994     N/A              0.975236E+03     N/A
1995     N/A              0.666216E+02     N/A
1996     N/A              0.250018E+03     N/A
1997     N/A              0.224696E+03     N/A
1998     N/A              0.153134E+04     N/A
1999     N/A              0.247161E+04     N/A
2000     N/A              0.258873E+04     N/A
2001     N/A              0.223129E+04     N/A
2002     N/A              0.177963E+04     N/A
2003     N/A              0.341269E+04     N/A
2004     N/A              0.213640E+04     N/A
2005     N/A              0.667706E+04     N/A
2006     N/A              0.169866E+04     N/A
2007     N/A              0.128731E+05     N/A
2008     N/A              0.830272E+03     N/A

Survey Index:   16 Tag:         US_S41   AGE =  8
Time = JAN-1           Type = NUMBER
Catchability =    0.861378E+00   % Variance Contribution =     1.1681
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_____________________________________________________________________________

1931     N/A              0.265787E+04     N/A
1932     N/A              0.128872E+04     N/A
1933     N/A              0.108509E+04     N/A
1934     N/A              0.675812E+03     N/A
1935     N/A              0.100936E+04     N/A
1936     N/A              0.591260E+03     N/A
1937     N/A              0.918638E+03     N/A
1938     N/A              0.672266E+03     N/A
1939     N/A              0.706788E+03     N/A
1940     N/A              0.480406E+03     N/A
1941     N/A              0.551347E+03     N/A
1942     N/A              0.437210E+03     N/A
1943     N/A              0.686017E+03     N/A
1944     N/A              0.967466E+03     N/A
1945     N/A              0.555916E+03     N/A
1946     N/A              0.509515E+03     N/A
1947     N/A              0.143309E+04     N/A
1948     N/A              0.999778E+03     N/A
1949     N/A              0.915727E+03     N/A
1950     N/A              0.546758E+03     N/A
1951     N/A              0.606959E+03     N/A
1952     N/A              0.600261E+03     N/A
1953     N/A              0.967078E+03     N/A
1954     N/A              0.929473E+03     N/A
1955     N/A              0.881722E+03     N/A
1956     N/A              0.119532E+04     N/A
1957     N/A              0.977396E+03     N/A
1958     N/A              0.118693E+04     N/A
1959     N/A              0.132647E+04     N/A
1960     N/A              0.169287E+04     N/A
1961     N/A              0.201700E+04     N/A
1962     N/A              0.379291E+04     N/A
1963     N/A              0.226312E+04     N/A
1964     N/A              0.242099E+04     N/A
1965     N/A              0.209177E+04     N/A
1966     N/A              0.254886E+04     N/A
1967     N/A              0.194284E+04     N/A
1968     N/A              0.970277E+03     N/A
1969     N/A              0.561930E+03     N/A
1970     N/A              0.246852E+04     N/A
1971     N/A              0.323306E+04     N/A
1972     N/A              0.220737E+03     N/A
1973     0.324571E+02     0.589350E+02    -0.596515E+00
1974     0.324571E+03     0.733941E+03    -0.815924E+00
1975     0.324571E+02     0.495156E+02    -0.422367E+00
1976     N/A              0.454665E+02     N/A
1977     0.129829E+03     0.168878E+03    -0.262963E+00
1978     0.194743E+03     0.485080E+02     0.138995E+01
1979     0.194743E+03     0.316417E+03    -0.485381E+00
1980     0.149303E+04     0.354891E+03     0.143675E+01
1981     0.357029E+03     0.455488E+03    -0.243554E+00
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1982     N/A              0.390195E+03     N/A
1983     N/A              0.290349E+04     N/A
1984     N/A              0.728561E+03     N/A
1985     N/A              0.255169E+03     N/A
1986     N/A              0.102540E+04     N/A
1987     N/A              0.477834E+03     N/A
1988     N/A              0.205736E+03     N/A
1989     N/A              0.129428E+03     N/A
1990     N/A              0.169682E+03     N/A
1991     N/A              0.485808E+03     N/A
1992     N/A              0.106154E+03     N/A
1993     N/A              0.464984E+03     N/A
1994     N/A              0.145722E+03     N/A
1995     N/A              0.512035E+03     N/A
1996     N/A              0.449321E+02     N/A
1997     N/A              0.176216E+03     N/A
1998     N/A              0.160201E+03     N/A
1999     N/A              0.105331E+04     N/A
2000     N/A              0.161420E+04     N/A
2001     N/A              0.170977E+04     N/A
2002     N/A              0.138661E+04     N/A
2003     N/A              0.106536E+04     N/A
2004     N/A              0.208233E+04     N/A
2005     N/A              0.112158E+04     N/A
2006     N/A              0.373854E+04     N/A
2007     N/A              0.106074E+04     N/A
2008     N/A              0.800985E+04     N/A

Survey Index:   17 Tag:         US_Au0   AGE =  1
Time = JAN-1           Type = NUMBER
Catchability =    0.433137E+00   % Variance Contribution =     7.8226
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_____________________________________________________________________________

1931     N/A              0.172987E+05     N/A
1932     N/A              0.196275E+05     N/A
1933     N/A              0.223563E+05     N/A
1934     N/A              0.258016E+05     N/A
1935     N/A              0.252144E+05     N/A
1936     N/A              0.247523E+05     N/A
1937     N/A              0.456139E+05     N/A
1938     N/A              0.338066E+05     N/A
1939     N/A              0.257657E+05     N/A
1940     N/A              0.481763E+05     N/A
1941     N/A              0.494933E+05     N/A
1942     N/A              0.268002E+05     N/A
1943     N/A              0.100949E+05     N/A
1944     N/A              0.282191E+05     N/A
1945     N/A              0.224394E+05     N/A
1946     N/A              0.406711E+05     N/A
1947     N/A              0.256138E+05     N/A
1948     N/A              0.142739E+05     N/A
1949     N/A              0.537702E+05     N/A
1950     N/A              0.247808E+05     N/A
1951     N/A              0.449511E+05     N/A
1952     N/A              0.183172E+05     N/A
1953     N/A              0.575164E+05     N/A
1954     N/A              0.226446E+05     N/A
1955     N/A              0.389392E+05     N/A
1956     N/A              0.261013E+05     N/A
1957     N/A              0.258281E+05     N/A
1958     N/A              0.254145E+05     N/A
1959     N/A              0.562413E+05     N/A
1960     N/A              0.529489E+05     N/A
1961     N/A              0.235245E+05     N/A
1962     N/A              0.169140E+05     N/A
1963     N/A              0.815343E+05     N/A
1964     0.272418E+06     0.199596E+06     0.311042E+00
1965     0.768942E+04     0.140826E+05    -0.605094E+00
1966     0.106395E+04     0.179971E+04    -0.525641E+00
1967     0.199248E+05     0.606955E+04     0.118868E+01
1968     0.967223E+02     0.234857E+03    -0.887134E+00
1969     0.290167E+03     0.481167E+03    -0.505759E+00
1970     0.125739E+04     0.199916E+04    -0.463691E+00
1971     0.145083E+03     0.115463E+03     0.228358E+00
1972     0.788287E+04     0.369288E+04     0.758284E+00
1973     0.219076E+05     0.844541E+04     0.953211E+00
1974     0.104944E+05     0.458135E+04     0.828845E+00
1975     0.241806E+04     0.343481E+04    -0.350997E+00
1976     0.762172E+05     0.456305E+05     0.513010E+00
1977     0.140247E+05     0.605688E+04     0.839628E+00
1978     0.436224E+03     0.265302E+04    -0.180530E+01
1979     0.429148E+05     0.363354E+05     0.166425E+00
1980     0.428369E+04     0.473644E+04    -0.100469E+00
1981     0.379174E+05     0.318965E+04     0.247550E+01
1982     0.122948E+04     0.111796E+04     0.950861E-01
1983     0.440086E+04     0.142259E+04     0.112932E+01
1984     0.188125E+05     0.783256E+04     0.876231E+00
1985     0.967223E+02     0.109109E+04    -0.242308E+01
1986     0.368389E+05     0.727382E+04     0.162227E+01
1987     N/A              0.113401E+04     N/A
1988     0.584229E+04     0.866928E+04    -0.394664E+00
1989     0.227200E+03     0.591640E+03    -0.957068E+00
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1990     0.151705E+04     0.147918E+04     0.252768E-01
1991     0.250180E+04     0.118031E+04     0.751232E+00
1992     0.699971E+04     0.468290E+04     0.401950E+00
1993     0.925029E+04     0.679805E+04     0.308019E+00
1994     0.492375E+04     0.674807E+04    -0.315186E+00
1995     0.295457E+04     0.556578E+04    -0.633283E+00
1996     0.737718E+04     0.517114E+04     0.355300E+00
1997     0.425578E+04     0.103217E+05    -0.885969E+00
1998     0.104869E+04     0.647299E+04    -0.182010E+01
1999     0.140079E+05     0.218767E+05    -0.445805E+00
2000     0.592245E+04     0.518979E+04     0.132057E+00
2001     0.134334E+05     0.423799E+05    -0.114893E+01
2002     0.277444E+04     0.250291E+04     0.102993E+00
2003     0.377477E+03     0.124922E+04    -0.119676E+01
2004     0.501602E+06     0.214346E+06     0.850218E+00
2005     0.528792E+04     0.348593E+04     0.416691E+00
2006     0.138180E+05     0.114563E+05     0.187428E+00
2007     0.305097E+04     0.321421E+04    -0.521205E-01
2008     N/A              0.709319E+04     N/A

Survey Index:   18 Tag:         US_Au1   AGE =  2
Time = JAN-1           Type = NUMBER
Catchability =    0.688246E+00   % Variance Contribution =     7.7540
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_____________________________________________________________________________

1931     N/A              0.553263E+05     N/A
1932     N/A              0.214145E+05     N/A
1933     N/A              0.254609E+05     N/A
1934     N/A              0.289327E+05     N/A
1935     N/A              0.333545E+05     N/A
1936     N/A              0.320587E+05     N/A
1937     N/A              0.316545E+05     N/A
1938     N/A              0.585407E+05     N/A
1939     N/A              0.433404E+05     N/A
1940     N/A              0.331426E+05     N/A
1941     N/A              0.614070E+05     N/A
1942     N/A              0.639033E+05     N/A
1943     N/A              0.346730E+05     N/A
1944     N/A              0.131211E+05     N/A
1945     N/A              0.366718E+05     N/A
1946     N/A              0.291172E+05     N/A
1947     N/A              0.527810E+05     N/A
1948     N/A              0.332663E+05     N/A
1949     N/A              0.185199E+05     N/A
1950     N/A              0.697483E+05     N/A
1951     N/A              0.321838E+05     N/A
1952     N/A              0.580781E+05     N/A
1953     N/A              0.238273E+05     N/A
1954     N/A              0.741526E+05     N/A
1955     N/A              0.293923E+05     N/A
1956     N/A              0.506019E+05     N/A
1957     N/A              0.339241E+05     N/A
1958     N/A              0.335792E+05     N/A
1959     N/A              0.329852E+05     N/A
1960     N/A              0.731085E+05     N/A
1961     N/A              0.687233E+05     N/A
1962     N/A              0.305656E+05     N/A
1963     N/A              0.219582E+05     N/A
1964     0.824074E+05     0.104263E+06    -0.235243E+00
1965     0.366336E+06     0.253387E+06     0.368633E+00
1966     0.329823E+05     0.123902E+05     0.979063E+00
1967     0.309511E+04     0.227049E+04     0.309830E+00
1968     0.218109E+05     0.718233E+04     0.111079E+01
1969     0.193445E+03     0.300565E+03    -0.440672E+00
1970     0.967223E+02     0.624730E+03    -0.186548E+01
1971     0.133960E+05     0.257221E+04     0.165019E+01
1972     N/A              0.149590E+03     N/A
1973     0.817303E+04     0.470506E+04     0.552203E+00
1974     0.292101E+05     0.937045E+04     0.113695E+01
1975     0.575498E+04     0.593044E+04    -0.300339E-01
1976     0.203117E+04     0.434509E+04    -0.760436E+00
1977     0.208291E+06     0.592701E+05     0.125683E+01
1978     0.694096E+04     0.787889E+04    -0.126747E+00
1979     0.273679E+04     0.345082E+04    -0.231826E+00
1980     0.147902E+06     0.472657E+05     0.114076E+01
1981     0.880497E+04     0.615688E+04     0.357746E+00
1982     0.199105E+05     0.414894E+04     0.156839E+01
1983     N/A              0.145378E+04     N/A
1984     0.773778E+03     0.185053E+04    -0.871944E+00
1985     0.107845E+05     0.101887E+05     0.568305E-01
1986     0.210971E+04     0.141930E+04     0.396386E+00
1987     0.165856E+05     0.945907E+04     0.561561E+00
1988     N/A              0.147514E+04     N/A
1989     0.980206E+04     0.112757E+05    -0.140061E+00
1990     0.159689E+03     0.768512E+03    -0.157123E+01
1991     0.218242E+04     0.188524E+04     0.146376E+00
1992     0.665371E+03     0.153117E+04    -0.833442E+00
1993     0.675109E+04     0.604024E+04     0.111259E+00
1994     0.131211E+05     0.882339E+04     0.396818E+00
1995     0.250569E+04     0.876191E+04    -0.125185E+01
1996     0.231682E+05     0.723022E+04     0.116451E+01
1997     0.176502E+04     0.672315E+04    -0.133740E+01
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1998     0.800296E+04     0.134190E+05    -0.516857E+00
1999     0.905003E+04     0.841730E+04     0.724788E-01
2000     0.272802E+04     0.284576E+05    -0.234484E+01
2001     0.916103E+04     0.675065E+04     0.305319E+00
2002     0.284711E+05     0.551253E+05    -0.660720E+00
2003     0.620321E+04     0.325435E+04     0.645073E+00
2004     0.230770E+03     0.162237E+04    -0.195022E+01
2005     0.531168E+06     0.278451E+06     0.645837E+00
2006     0.574491E+04     0.452288E+04     0.239165E+00
2007     0.147424E+05     0.148019E+05    -0.402994E-02
2008     N/A              0.417343E+04     N/A

Survey Index:   19 Tag:         US_Au2   AGE =  3
Time = JAN-1           Type = NUMBER
Catchability =    0.572374E+00   % Variance Contribution =     5.5734
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_____________________________________________________________________________


1931     N/A              0.805972E+04     N/A
1932     N/A              0.331304E+05     N/A
1933     N/A              0.135048E+05     N/A
1934     N/A              0.129747E+05     N/A
1935     N/A              0.174018E+05     N/A
1936     N/A              0.166043E+05     N/A
1937     N/A              0.154911E+05     N/A
1938     N/A              0.158771E+05     N/A
1939     N/A              0.294683E+05     N/A
1940     N/A              0.223373E+05     N/A
1941     N/A              0.188271E+05     N/A
1942     N/A              0.297478E+05     N/A
1943     N/A              0.361366E+05     N/A
1944     N/A              0.214450E+05     N/A
1945     N/A              0.854083E+04     N/A
1946     N/A              0.205774E+05     N/A
1947     N/A              0.159792E+05     N/A
1948     N/A              0.273830E+05     N/A
1949     N/A              0.168742E+05     N/A
1950     N/A              0.928070E+04     N/A
1951     N/A              0.326048E+05     N/A
1952     N/A              0.176551E+05     N/A
1953     N/A              0.266415E+05     N/A
1954     N/A              0.152904E+05     N/A
1955     N/A              0.341245E+05     N/A
1956     N/A              0.179789E+05     N/A
1957     N/A              0.282969E+05     N/A
1958     N/A              0.196982E+05     N/A
1959     N/A              0.199897E+05     N/A
1960     N/A              0.195108E+05     N/A
1961     N/A              0.415260E+05     N/A
1962     N/A              0.412779E+05     N/A
1963     N/A              0.185129E+05     N/A
1964     0.299355E+05     0.128639E+05     0.844625E+00
1965     0.206889E+06     0.627696E+05     0.119271E+01
1966     0.251188E+06     0.107978E+06     0.844272E+00
1967     0.938206E+04     0.492955E+04     0.643553E+00
1968     0.116067E+04     0.145917E+04    -0.228874E+00
1969     0.309511E+04     0.335202E+04    -0.797376E-01
1970     N/A              0.198967E+03     N/A
1971     0.677056E+03     0.343968E+03     0.677206E+00
1972     0.101558E+04     0.104649E+04    -0.299780E-01
1973     N/A              0.100820E+03     N/A
1974     0.522300E+04     0.211853E+04     0.902352E+00
1975     0.319184E+04     0.408042E+04    -0.245603E+00
1976     0.232133E+04     0.348635E+04    -0.406714E+00
1977     0.169264E+04     0.270530E+04    -0.468923E+00
1978     0.608029E+05     0.301388E+05     0.701825E+00
1979     0.337132E+04     0.496859E+04    -0.387832E+00
1980     0.119118E+03     0.233608E+04    -0.297612E+01
1981     0.412887E+05     0.162468E+05     0.932692E+00
1982     0.674265E+04     0.328820E+04     0.718112E+00
1983     0.430414E+04     0.222055E+04     0.661825E+00
1984     0.677056E+03     0.878354E+03    -0.260296E+00
1985     0.285331E+04     0.121139E+04     0.856712E+00
1986     0.496594E+04     0.566785E+04    -0.132206E+00
1987     0.292114E+03     0.938122E+03    -0.116673E+01
1988     0.256411E+04     0.539146E+04    -0.743203E+00
1989     0.584229E+03     0.976916E+03    -0.514109E+00
1990     0.878290E+04     0.692282E+04     0.237984E+00
1991     0.798446E+02     0.517276E+03    -0.186849E+01
1992     0.771831E+03     0.103322E+04    -0.291666E+00
1993     0.746514E+03     0.905811E+03    -0.193416E+00
1994     0.652064E+04     0.392505E+04     0.507594E+00
1995     0.262189E+04     0.573007E+04    -0.781832E+00
1996     0.159170E+05     0.591756E+04     0.989462E+00
1997     0.300521E+04     0.489383E+04    -0.487628E+00
1998     0.476211E+04     0.450365E+04     0.558020E-01
1999     0.802763E+04     0.901789E+04    -0.116322E+00
2000     0.109342E+05     0.570892E+04     0.649862E+00
2001     0.177907E+05     0.191663E+05    -0.744770E-01
2002     0.545864E+04     0.452145E+04     0.188367E+00
2003     0.722756E+05     0.373292E+05     0.660710E+00
2004     0.146414E+04     0.220671E+04    -0.410232E+00
2005     0.710811E+03     0.108760E+04    -0.425318E+00
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2006     0.250707E+06     0.189278E+06     0.281069E+00
2007     0.237424E+04     0.307007E+04    -0.257024E+00
2008     N/A              0.998820E+04     N/A

Survey Index:   20 Tag:         US_Au3   AGE =  4
Time = JAN-1           Type = NUMBER
Catchability =    0.653808E+00   % Variance Contribution =     3.6457
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_____________________________________________________________________________

1931     N/A              0.115495E+05     N/A
1932     N/A              0.633563E+04     N/A
1933     N/A              0.158720E+05     N/A
1934     N/A              0.909200E+04     N/A
1935     N/A              0.895270E+04     N/A
1936     N/A              0.110989E+05     N/A
1937     N/A              0.880811E+04     N/A
1938     N/A              0.810548E+04     N/A
1939     N/A              0.102961E+05     N/A
1940     N/A              0.160761E+05     N/A
1941     N/A              0.136667E+05     N/A
1942     N/A              0.118526E+05     N/A
1943     N/A              0.182328E+05     N/A
1944     N/A              0.233832E+05     N/A
1945     N/A              0.150962E+05     N/A
1946     N/A              0.679241E+04     N/A
1947     N/A              0.103509E+05     N/A
1948     N/A              0.889284E+04     N/A
1949     N/A              0.143557E+05     N/A
1950     N/A              0.848588E+04     N/A
1951     N/A              0.626691E+04     N/A
1952     N/A              0.150389E+05     N/A
1953     N/A              0.112926E+05     N/A
1954     N/A              0.146191E+05     N/A
1955     N/A              0.112954E+05     N/A
1956     N/A              0.206259E+05     N/A
1957     N/A              0.128758E+05     N/A
1958     N/A              0.182193E+05     N/A
1959     N/A              0.142537E+05     N/A
1960     N/A              0.139961E+05     N/A
1961     N/A              0.146443E+05     N/A
1962     N/A              0.300572E+05     N/A
1963     N/A              0.290545E+05     N/A
1964     0.221010E+05     0.129535E+05     0.534260E+00
1965     0.189092E+05     0.935209E+04     0.704049E+00
1966     0.314831E+05     0.326765E+05    -0.372052E-01
1967     0.596777E+05     0.422867E+05     0.344484E+00
1968     0.324020E+04     0.291566E+04     0.105539E+00
1969     0.435250E+03     0.948422E+03    -0.778878E+00
1970     0.918862E+03     0.213835E+04    -0.844655E+00
1971     0.483611E+02     0.176635E+03    -0.129539E+01
1972     0.241806E+03     0.191108E+03     0.235294E+00
1973     0.169264E+04     0.708235E+03     0.871268E+00
1974     N/A              0.924584E+02     N/A
1975     0.101558E+04     0.158029E+04    -0.442146E+00
1976     0.157657E+05     0.268401E+04     0.177053E+01
1977     0.174100E+04     0.292422E+04    -0.518568E+00
1978     0.182442E+04     0.241814E+04    -0.281740E+00
1979     0.301040E+05     0.196681E+05     0.425659E+00
1980     0.293510E+04     0.362183E+04    -0.210238E+00
1981     0.146739E+04     0.197902E+04    -0.299117E+00
1982     0.120179E+05     0.871236E+04     0.321655E+00
1983     0.111231E+04     0.210963E+04    -0.640075E+00
1984     0.870501E+03     0.159387E+04    -0.604852E+00
1985     0.773778E+03     0.644629E+03     0.182611E+00
1986     0.714057E+03     0.802180E+03    -0.116371E+00
1987     0.392731E+04     0.362897E+04     0.790058E-01
1988     0.324571E+03     0.799742E+03    -0.901784E+00
1989     0.421943E+04     0.360960E+04     0.156103E+00
1990     0.638757E+03     0.841377E+03    -0.275517E+00
1991     0.385915E+04     0.547486E+04    -0.349719E+00
1992     0.159689E+03     0.411433E+03    -0.946418E+00
1993     0.778971E+03     0.726744E+03     0.694004E-01
1994     0.984750E+03     0.589350E+03     0.513367E+00
1995     0.216587E+04     0.296954E+04    -0.315586E+00
1996     0.751902E+04     0.499646E+04     0.408706E+00
1997     0.336970E+04     0.520008E+04    -0.433851E+00
1998     0.243072E+04     0.441565E+04    -0.596969E+00
1999     0.234763E+04     0.393409E+04    -0.516275E+00
2000     0.261299E+05     0.789917E+04     0.119632E+01
2001     0.100766E+05     0.497003E+04     0.706794E+00
2002     0.241468E+05     0.165131E+05     0.380000E+00
2003     0.176729E+05     0.402477E+04     0.147957E+01
2004     0.277606E+05     0.337641E+05    -0.195780E+00
2005     0.274068E+04     0.199191E+04     0.319111E+00
2006     0.904256E+03     0.992460E+03    -0.930746E-01
2007     0.156979E+06     0.175147E+06    -0.109516E+00
2008     N/A              0.272956E+04     N/A

Survey Index:   21 Tag:         US_Au4   AGE =  5
Time = JAN-1           Type = NUMBER
Catchability =    0.571735E+00   % Variance Contribution =     4.0993
Residual = LN(Observed) - LN(Predicted)
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Year      Observed        Predicted         Residual
_____________________________________________________________________________

1931     N/A             0.980210E+04     N/A
1932     N/A             0.530305E+04     N/A
1933     N/A             0.329229E+04     N/A
1934     N/A             0.622646E+04     N/A
1935     N/A             0.459211E+04     N/A
1936     N/A             0.450685E+04     N/A
1937     N/A             0.516135E+04     N/A
1938     N/A             0.342812E+04     N/A
1939     N/A             0.387675E+04     N/A
1940     N/A             0.472460E+04     N/A
1941     N/A             0.727957E+04     N/A
1942     N/A             0.567314E+04     N/A
1943     N/A             0.514076E+04     N/A
1944     N/A             0.876259E+04     N/A
1945     N/A             0.915144E+04     N/A
1946     N/A             0.752979E+04     N/A
1947     N/A             0.345695E+04     N/A
1948     N/A             0.374350E+04     N/A
1949     N/A             0.374768E+04     N/A
1950     N/A             0.536864E+04     N/A
1951     N/A             0.388544E+04     N/A
1952     N/A             0.336782E+04     N/A
1953     N/A             0.642222E+04     N/A
1954     N/A             0.514972E+04     N/A
1955     N/A             0.758420E+04     N/A
1956     N/A             0.638114E+04     N/A
1957     N/A             0.859109E+04     N/A
1958     N/A             0.689374E+04     N/A
1959     N/A             0.961929E+04     N/A
1960     N/A             0.754871E+04     N/A
1961     N/A             0.767484E+04     N/A
1962     N/A             0.832486E+04     N/A
1963     N/A             0.161533E+05     N/A
1964     0.270822E+05    0.150728E+05     0.585986E+00
1965     0.580334E+04    0.682002E+04    -0.161429E+00
1966     0.348200E+04    0.395348E+04    -0.126988E+00
1967     0.108813E+05    0.135843E+05    -0.221875E+00
1968     0.219560E+05    0.196775E+05     0.109562E+00
1969     0.106395E+04    0.110569E+04    -0.384851E-01
1970     0.435250E+03    0.449229E+03    -0.316116E-01
1971     0.918862E+03    0.123762E+04    -0.297807E+00
1972     0.483611E+02    0.105865E+03    -0.783470E+00
1973     0.290167E+03    0.942736E+02     0.112425E+01
1974     0.628695E+03    0.305734E+03     0.720932E+00
1975     N/A             0.651118E+02     N/A
1976     0.299839E+04    0.931726E+03     0.116879E+01
1977     0.265986E+04    0.145249E+04     0.604996E+00
1978     0.186401E+04    0.173860E+04     0.696495E-01
1979     0.594939E+03    0.157277E+04    -0.972135E+00
1980     0.123746E+05    0.103625E+05     0.177449E+00
1981     0.594939E+03    0.208854E+04    -0.125576E+01
1982     0.674135E+03    0.987239E+03    -0.381482E+00
1983     0.454595E+04    0.430727E+04     0.539319E-01
1984     0.967223E+03    0.115209E+04    -0.174900E+00
1985     0.918862E+03    0.763645E+03     0.185032E+00
1986     0.162286E+03    0.359329E+03    -0.794880E+00
1987     0.194743E+03    0.458042E+03    -0.855280E+00
1988     0.249920E+04    0.175386E+04     0.354154E+00
1989     0.389486E+03    0.501927E+03    -0.253627E+00
1990     0.215580E+04    0.206016E+04     0.453777E-01
1991     0.159689E+03    0.464111E+03    -0.106689E+01
1992     0.718601E+03    0.270320E+04    -0.132488E+01
1993     N/A             0.193428E+03     N/A
1994     N/A             0.345698E+03     N/A
1995     0.401819E+03    0.297939E+03     0.299113E+00
1996     0.122169E+04    0.188339E+04    -0.432841E+00
1997     0.158261E+04    0.310393E+04    -0.673595E+00
1998     0.177670E+04    0.333890E+04    -0.630882E+00
1999     0.133756E+04    0.287388E+04    -0.764816E+00
2000     0.114295E+05    0.253765E+04     0.150495E+01
2001     0.356185E+04    0.484621E+04    -0.307918E+00
2002     0.687734E+04    0.304519E+04     0.814668E+00
2003     0.277093E+05    0.101857E+05     0.100079E+01
2004     0.575887E+04    0.264375E+04     0.778544E+00
2005     0.442063E+05    0.215366E+05     0.719114E+00
2006     0.226032E+04    0.125142E+04     0.591227E+00
2007     0.128206E+04    0.673971E+03     0.643034E+00
2008     N/A             0.119609E+06     N/A

Survey Index:   22 Tag:         US_Au5   AGE =  6
Time = JAN-1           Type = NUMBER
Catchability =    0.560770E+00   % Variance Contribution =     5.0763
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_____________________________________________________________________________

1931     N/A             0.571844E+04     N/A
1932     N/A             0.332626E+04     N/A
1933     N/A             0.241376E+04     N/A
1934     N/A             0.159292E+04     N/A
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1935     N/A              0.341492E+04     N/A
1936     N/A              0.220886E+04     N/A
1937     N/A              0.254093E+04     N/A
1938     N/A              0.206989E+04     N/A
1939     N/A              0.169111E+04     N/A
1940     N/A              0.203071E+04     N/A
1941     N/A              0.253102E+04     N/A
1942     N/A              0.295846E+04     N/A
1943     N/A              0.255077E+04     N/A
1944     N/A              0.256911E+04     N/A
1945     N/A              0.417951E+04     N/A
1946     N/A              0.443774E+04     N/A
1947     N/A              0.314755E+04     N/A
1948     N/A              0.170721E+04     N/A
1949     N/A              0.163010E+04     N/A
1950     N/A              0.183034E+04     N/A
1951     N/A              0.264544E+04     N/A
1952     N/A              0.189030E+04     N/A
1953     N/A              0.201837E+04     N/A
1954     N/A              0.326840E+04     N/A
1955     N/A              0.296911E+04     N/A
1956     N/A              0.443852E+04     N/A
1957     N/A              0.341099E+04     N/A
1958     N/A              0.397643E+04     N/A
1959     N/A              0.363238E+04     N/A
1960     N/A              0.574154E+04     N/A
1961     N/A              0.451578E+04     N/A
1962     N/A              0.469215E+04     N/A
1963     N/A              0.494718E+04     N/A
1964     0.192961E+05     0.884507E+04     0.780042E+00
1965     0.123805E+05     0.771846E+04     0.472503E+00
1966     0.261150E+04     0.327124E+04    -0.225243E+00
1967     0.169264E+04     0.178585E+04    -0.536073E-01
1968     0.527136E+04     0.572712E+04    -0.829237E-01
1969     0.125255E+05     0.852140E+04     0.385189E+00
1970     0.531973E+03     0.559136E+03    -0.498011E-01
1971     0.870501E+03     0.266993E+03     0.118185E+01
1972     0.725417E+03     0.847831E+03    -0.155935E+00
1973     N/A              0.685075E+02     N/A
1974     0.145083E+03     0.485506E+02     0.109470E+01
1975     0.483611E+02     0.208835E+03    -0.146285E+01
1976     N/A              0.502111E+02     N/A
1977     0.967223E+03     0.635041E+03     0.420739E+00
1978     0.206233E+04     0.902986E+03     0.825883E+00
1979     0.832850E+03     0.110776E+04    -0.285241E+00
1980     0.832850E+03     0.995563E+03    -0.178454E+00
1981     0.551317E+04     0.526115E+04     0.467905E-01
1982     0.134859E+04     0.120175E+04     0.115281E+00
1983     0.435250E+03     0.594200E+03    -0.311294E+00
1984     0.304675E+04     0.232088E+04     0.272132E+00
1985     0.193445E+03     0.722456E+03    -0.131767E+01
1986     0.324571E+03     0.376009E+03    -0.147108E+00
1987     0.421943E+03     0.213952E+03     0.679120E+00
1988     0.194743E+03     0.304950E+03    -0.448467E+00
1989     0.129829E+04     0.929210E+03     0.334465E+00
1990     0.292763E+03     0.293563E+03    -0.272834E-02
1991     0.558912E+03     0.108888E+04    -0.666912E+00
1992     0.532297E+02     0.299861E+03    -0.172870E+01
1993     0.152549E+04     0.118767E+04     0.250320E+00
1994     0.186304E+03     0.949832E+02     0.673680E+00
1995     0.147031E+03     0.205979E+03    -0.337130E+00
1996     0.386240E+02     0.209483E+03    -0.169077E+01
1997     0.462839E+03     0.128493E+04    -0.102108E+01
1998     0.105648E+04     0.220878E+04    -0.737500E+00
1999     0.570921E+03     0.229361E+04    -0.139063E+01
2000     0.753557E+04     0.200171E+04     0.132564E+01
2001     0.214315E+04     0.174073E+04     0.207970E+00
2002     0.377412E+04     0.324490E+04     0.151082E+00
2003     0.607468E+04     0.197785E+04     0.112212E+01
2004     0.108926E+05     0.682280E+04     0.467816E+00
2005     0.381404E+04     0.175469E+04     0.776398E+00
2006     0.153704E+05     0.130063E+05     0.167008E+00
2007     0.140410E+04     0.815521E+03     0.543322E+00
2008     N/A              0.443170E+03     N/A

Survey Index:   23 Tag:         Can_Sp   AGE =  1
Time = JAN-1           Type = NUMBER
Catchability =    0.282518E+00   % Variance Contribution =     4.8049
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_____________________________________________________________________________

1931     N/A              0.112833E+05     N/A
1932     N/A              0.128022E+05     N/A
1933     N/A              0.145822E+05     N/A
1934     N/A              0.168294E+05     N/A
1935     N/A              0.164464E+05     N/A
1936     N/A              0.161450E+05     N/A
1937     N/A              0.297522E+05     N/A
1938     N/A              0.220507E+05     N/A
1939     N/A              0.168060E+05     N/A
1940     N/A              0.314235E+05     N/A
1941     N/A              0.322825E+05     N/A
1942     N/A              0.174807E+05     N/A
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1943     N/A              0.658448E+04     N/A
1944     N/A              0.184062E+05     N/A
1945     N/A              0.146363E+05     N/A
1946     N/A              0.265282E+05     N/A
1947     N/A              0.167069E+05     N/A
1948     N/A              0.931032E+04     N/A
1949     N/A              0.350722E+05     N/A
1950     N/A              0.161635E+05     N/A
1951     N/A              0.293199E+05     N/A
1952     N/A              0.119476E+05     N/A
1953     N/A              0.375157E+05     N/A
1954     N/A              0.147702E+05     N/A
1955     N/A              0.253985E+05     N/A
1956     N/A              0.170249E+05     N/A
1957     N/A              0.168466E+05     N/A
1958     N/A              0.165769E+05     N/A
1959     N/A              0.366840E+05     N/A
1960     N/A              0.345365E+05     N/A
1961     N/A              0.153441E+05     N/A
1962     N/A              0.110323E+05     N/A
1963     N/A              0.531816E+05     N/A
1964     N/A              0.130189E+06     N/A
1965     N/A              0.918553E+04     N/A
1966     N/A              0.117388E+04     N/A
1967     N/A              0.395893E+04     N/A
1968     N/A              0.153188E+03     N/A
1969     N/A              0.313847E+03     N/A
1970     N/A              0.130398E+04     N/A
1971     N/A              0.753121E+02     N/A
1972     N/A              0.240872E+04     N/A
1973     N/A              0.550861E+04     N/A
1974     N/A              0.298824E+04     N/A
1975     N/A              0.224039E+04     N/A
1976     N/A              0.297630E+05     N/A
1977     N/A              0.395066E+04     N/A
1978     N/A              0.173046E+04     N/A
1979     N/A              0.237002E+05     N/A
1980     N/A              0.308939E+04     N/A
1981     N/A              0.208048E+04     N/A
1982     N/A              0.729199E+03     N/A
1983     N/A              0.927902E+03     N/A
1984     N/A              0.510887E+04     N/A
1985     N/A              0.711673E+03     N/A
1986     0.571399E+04     0.474443E+04     0.185946E+00
1987     0.422216E+02     0.739672E+03    -0.286327E+01
1988     0.206886E+04     0.565463E+04    -0.100548E+01
1989     0.422216E+02     0.385904E+03    -0.221266E+01
1990     0.130887E+04     0.964812E+03     0.304985E+00
1991     0.105554E+04     0.769870E+03     0.315585E+00
1992     0.464437E+04     0.305447E+04     0.419049E+00
1993     0.557325E+04     0.443410E+04     0.228653E+00
1994     0.467252E+04     0.440150E+04     0.597535E-01
1995     0.273033E+04     0.363034E+04    -0.284904E+00
1996     0.859913E+04     0.337293E+04     0.935879E+00
1997     0.244885E+04     0.673243E+04    -0.101132E+01
1998     0.339180E+04     0.422208E+04    -0.218967E+00
1999     0.277959E+05     0.142693E+05     0.666775E+00
2000     0.257974E+05     0.338510E+04     0.203089E+01
2001     0.313566E+05     0.276428E+05     0.126060E+00
2002     0.278662E+04     0.163255E+04     0.534687E+00
2003     0.192207E+04     0.814815E+03     0.858195E+00
2004     0.207872E+06     0.139809E+06     0.396644E+00
2005     N/A              0.227373E+04     N/A
2006     N/A              0.747252E+04     N/A
2007     0.421513E+04     0.209650E+04     0.698410E+00
2008     0.392321E+04     0.462661E+04    -0.164913E+00

Survey Index:   24 Tag:         Can_Sp   AGE =  2
Time = JAN-1           Type = NUMBER
Catchability =    0.399130E+00   % Variance Contribution =     3.8554
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
____________________________________________________________________________

1931     N/A              0.320850E+05     N/A
1932     N/A              0.124187E+05     N/A
1933     N/A              0.147654E+05     N/A
1934     N/A              0.167788E+05     N/A
1935     N/A              0.193430E+05     N/A
1936     N/A              0.185916E+05     N/A
1937     N/A              0.183572E+05     N/A
1938     N/A              0.339491E+05     N/A
1939     N/A              0.251341E+05     N/A
1940     N/A              0.192201E+05     N/A
1941     N/A              0.356113E+05     N/A
1942     N/A              0.370590E+05     N/A
1943     N/A              0.201077E+05     N/A
1944     N/A              0.760921E+04     N/A
1945     N/A              0.212668E+05     N/A
1946     N/A              0.168857E+05     N/A
1947     N/A              0.306089E+05     N/A
1948     N/A              0.192919E+05     N/A
1949     N/A              0.107401E+05     N/A
1950     N/A              0.404486E+05     N/A
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1951     N/A              0.186641E+05     N/A
1952     N/A              0.336809E+05     N/A
1953     N/A              0.138180E+05     N/A
1954     N/A              0.430028E+05     N/A
1955     N/A              0.170453E+05     N/A
1956     N/A              0.293452E+05     N/A
1957     N/A              0.196734E+05     N/A
1958     N/A              0.194734E+05     N/A
1959     N/A              0.191289E+05     N/A
1960     N/A              0.423973E+05     N/A
1961     N/A              0.398542E+05     N/A
1962     N/A              0.177257E+05     N/A
1963     N/A              0.127340E+05     N/A
1964     N/A              0.604646E+05     N/A
1965     N/A              0.146945E+06     N/A
1966     N/A              0.718538E+04     N/A
1967     N/A              0.131671E+04     N/A
1968     N/A              0.416520E+04     N/A
1969     N/A              0.174304E+03     N/A
1970     N/A              0.362295E+03     N/A
1971     N/A              0.149169E+04     N/A
1972     N/A              0.867506E+02     N/A
1973     N/A              0.272857E+04     N/A
1974     N/A              0.543414E+04     N/A
1975     N/A              0.343920E+04     N/A
1976     N/A              0.251982E+04     N/A
1977     N/A              0.343721E+05     N/A
1978     N/A              0.456915E+04     N/A
1979     N/A              0.200121E+04     N/A
1980     N/A              0.274105E+05     N/A
1981     N/A              0.357052E+04     N/A
1982     N/A              0.240607E+04     N/A
1983     N/A              0.843081E+03     N/A
1984     N/A              0.107317E+04     N/A
1985     N/A              0.590868E+04     N/A
1986     0.309625E+03     0.823087E+03    -0.977700E+00
1987     0.427845E+04     0.548553E+04    -0.248522E+00
1988     0.703693E+02     0.855469E+03    -0.249789E+01
1989     0.751544E+04     0.653906E+04     0.139166E+00
1990     0.154812E+03     0.445678E+03    -0.105738E+01
1991     0.235033E+04     0.109330E+04     0.765360E+00
1992     0.415179E+04     0.887961E+03     0.154237E+01
1993     0.303995E+04     0.350288E+04    -0.141742E+00
1994     0.162131E+05     0.511689E+04     0.115327E+01
1995     0.368735E+04     0.508123E+04    -0.320646E+00
1996     0.406735E+04     0.419297E+04    -0.304192E-01
1997     0.163257E+04     0.389891E+04    -0.870543E+00
1998     0.115124E+05     0.778196E+04     0.391617E+00
1999     0.479919E+04     0.488139E+04    -0.169828E-01
2000     0.965467E+05     0.165032E+05     0.176647E+01
2001     0.398290E+04     0.391486E+04     0.172310E-01
2002     0.446141E+05     0.319685E+05     0.333301E+00
2003     0.358236E+04     0.188728E+04     0.640887E+00
2004     0.579843E+03     0.940849E+03    -0.484025E+00
2005     N/A              0.161480E+06     N/A
2006     N/A              0.262293E+04     N/A
2007     0.150013E+05     0.858396E+04     0.558241E+00
2008     0.124835E+04     0.242027E+04    -0.662057E+00

Survey Index:   25 Tag:         Can_Sp   AGE =  3
Time = JAN-1           Type = NUMBER
Catchability =    0.655467E+00   % Variance Contribution =     1.4135
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_____________________________________________________________________________

1931     N/A              0.922977E+04     N/A
1932     N/A              0.379400E+05     N/A
1933     N/A              0.154653E+05     N/A
1934     N/A              0.148583E+05     N/A
1935     N/A              0.199281E+05     N/A
1936     N/A              0.190147E+05     N/A
1937     N/A              0.177399E+05     N/A
1938     N/A              0.181820E+05     N/A
1939     N/A              0.337463E+05     N/A
1940     N/A              0.255800E+05     N/A
1941     N/A              0.215603E+05     N/A
1942     N/A              0.340664E+05     N/A
1943     N/A              0.413827E+05     N/A
1944     N/A              0.245582E+05     N/A
1945     N/A              0.978072E+04     N/A
1946     N/A              0.235646E+05     N/A
1947     N/A              0.182989E+05     N/A
1948     N/A              0.313583E+05     N/A
1949     N/A              0.193238E+05     N/A
1950     N/A              0.106280E+05     N/A
1951     N/A              0.373381E+05     N/A
1952     N/A              0.202181E+05     N/A
1953     N/A              0.305091E+05     N/A
1954     N/A              0.175102E+05     N/A
1955     N/A              0.390784E+05     N/A
1956     N/A              0.205889E+05     N/A
1957     N/A              0.324048E+05     N/A
1958     N/A              0.225579E+05     N/A
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1959     N/A             0.228917E+05     N/A
1960     N/A             0.223433E+05     N/A
1961     N/A             0.475544E+05     N/A
1962     N/A             0.472703E+05     N/A
1963     N/A             0.212004E+05     N/A
1964     N/A             0.147313E+05     N/A
1965     N/A             0.718819E+05     N/A
1966     N/A             0.123654E+06     N/A
1967     N/A             0.564518E+04     N/A
1968     N/A             0.167100E+04     N/A
1969     N/A             0.383864E+04     N/A
1970     N/A             0.227851E+03     N/A
1971     N/A             0.393902E+03     N/A
1972     N/A             0.119841E+04     N/A
1973     N/A             0.115457E+03     N/A
1974     N/A             0.242608E+04     N/A
1975     N/A             0.467278E+04     N/A
1976     N/A             0.399247E+04     N/A
1977     N/A             0.309803E+04     N/A
1978     N/A             0.345141E+05     N/A
1979     N/A             0.568990E+04     N/A
1980     N/A             0.267522E+04     N/A
1981     N/A             0.186054E+05     N/A
1982     N/A             0.376555E+04     N/A
1983     N/A             0.254291E+04     N/A
1984     N/A             0.100587E+04     N/A
1985     N/A             0.138725E+04     N/A
1986     0.851469E+04    0.649066E+04     0.271428E+00
1987     0.971096E+03    0.107431E+04    -0.101009E+00
1988     0.120050E+05    0.617415E+04     0.664953E+00
1989     0.101332E+04    0.111874E+04    -0.989705E-01
1990     0.138909E+05    0.792782E+04     0.560856E+00
1991     0.197034E+03    0.592370E+03    -0.110075E+01
1992     0.159035E+04    0.118321E+04     0.295721E+00
1993     0.774062E+03    0.103731E+04    -0.292733E+00
1994     0.574214E+04    0.449485E+04     0.244898E+00
1995     0.605176E+04    0.656191E+04    -0.809330E-01
1996     0.681175E+04    0.677663E+04     0.516942E-02
1997     0.139331E+04    0.560428E+04    -0.139185E+01
1998     0.433475E+04    0.515746E+04    -0.173781E+00
1999     0.100769E+05    0.103270E+05    -0.245214E-01
2000     0.131168E+05    0.653770E+04     0.696312E+00
2001     0.153124E+05    0.219487E+05    -0.360049E+00
2002     0.935912E+04    0.517784E+04     0.591963E+00
2003     0.975669E+05    0.427484E+05     0.825207E+00
2004     0.280689E+04    0.252706E+04     0.105021E+00
2005     N/A             0.124549E+04     N/A
2006     N/A             0.216756E+06     N/A
2007     0.441898E+04    0.351576E+04     0.228653E+00
2008     0.481327E+04    0.114382E+05    -0.865583E+00

Survey Index:   26 Tag:         Can_Sp   AGE =  4
Time = JAN-1           Type = NUMBER
Catchability =    0.620509E+00   % Variance Contribution =     1.5804
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_____________________________________________________________________________

1931     N/A             0.109612E+05     N/A
1932     N/A             0.601294E+04     N/A
1933     N/A             0.150636E+05     N/A
1934     N/A             0.862892E+04     N/A
1935     N/A             0.849672E+04     N/A
1936     N/A             0.105336E+05     N/A
1937     N/A             0.835950E+04     N/A
1938     N/A             0.769265E+04     N/A
1939     N/A             0.977169E+04     N/A
1940     N/A             0.152573E+05     N/A
1941     N/A             0.129706E+05     N/A
1942     N/A             0.112490E+05     N/A
1943     N/A             0.173042E+05     N/A
1944     N/A             0.221922E+05     N/A
1945     N/A             0.143274E+05     N/A
1946     N/A             0.644645E+04     N/A
1947     N/A             0.982369E+04     N/A
1948     N/A             0.843991E+04     N/A
1949     N/A             0.136245E+05     N/A
1950     N/A             0.805368E+04     N/A
1951     N/A             0.594773E+04     N/A
1952     N/A             0.142729E+05     N/A
1953     N/A             0.107174E+05     N/A
1954     N/A             0.138745E+05     N/A
1955     N/A             0.107201E+05     N/A
1956     N/A             0.195754E+05     N/A
1957     N/A             0.122200E+05     N/A
1958     N/A             0.172913E+05     N/A
1959     N/A             0.135277E+05     N/A
1960     N/A             0.132832E+05     N/A
1961     N/A             0.138985E+05     N/A
1962     N/A             0.285263E+05     N/A
1963     N/A             0.275747E+05     N/A
1964     N/A             0.122937E+05     N/A
1965     N/A             0.887577E+04     N/A
1966     N/A             0.310122E+05     N/A
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1967     N/A              0.401330E+05     N/A
1968     N/A              0.276715E+04     N/A
1969     N/A              0.900117E+03     N/A
1970     N/A              0.202944E+04     N/A
1971     N/A              0.167639E+03     N/A
1972     N/A              0.181375E+03     N/A
1973     N/A              0.672163E+03     N/A
1974     N/A              0.877493E+02     N/A
1975     N/A              0.149980E+04     N/A
1976     N/A              0.254731E+04     N/A
1977     N/A              0.277528E+04     N/A
1978     N/A              0.229498E+04     N/A
1979     N/A              0.186664E+05     N/A
1980     N/A              0.343736E+04     N/A
1981     N/A              0.187822E+04     N/A
1982     N/A              0.826862E+04     N/A
1983     N/A              0.200218E+04     N/A
1984     N/A              0.151269E+04     N/A
1985     N/A              0.611796E+03     N/A
1986     0.150590E+04     0.761324E+03     0.682089E+00
1987     0.353254E+04     0.344414E+04     0.253419E-01
1988     0.239256E+03     0.759010E+03    -0.115448E+01
1989     0.298366E+04     0.342576E+04    -0.138172E+00
1990     0.182960E+03     0.798524E+03    -0.147350E+01
1991     0.126524E+05     0.519602E+04     0.889955E+00
1992     0.239256E+03     0.390478E+03    -0.489839E+00
1993     0.633324E+03     0.689729E+03    -0.853172E-01
1994     0.591102E+03     0.559333E+03     0.552437E-01
1995     0.312440E+04     0.281829E+04     0.103111E+00
1996     0.709323E+04     0.474198E+04     0.402685E+00
1997     0.329328E+04     0.493523E+04    -0.404515E+00
1998     0.361698E+04     0.419075E+04    -0.147239E+00
1999     0.311032E+04     0.373372E+04    -0.182678E+00
2000     0.125398E+05     0.749685E+04     0.514426E+00
2001     0.434882E+04     0.471690E+04    -0.812458E-01
2002     0.216174E+05     0.156720E+05     0.321623E+00
2003     0.722862E+04     0.381978E+04     0.637856E+00
2004     0.556924E+05     0.320444E+05     0.552721E+00
2005     N/A              0.189046E+04     N/A
2006     N/A              0.941912E+03     N/A
2007     0.804604E+05     0.166226E+06    -0.725586E+00
2008     0.520377E+04     0.259053E+04     0.697519E+00

Survey Index:   27 Tag:         Can_Sp   AGE =  5
Time = JAN-1           Type = NUMBER
Catchability =    0.707918E+00   % Variance Contribution =     1.7340
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
____________________________________________________________________________

1931     N/A              0.121369E+05     N/A
1932     N/A              0.656620E+04     N/A
1933     N/A              0.407649E+04     N/A
1934     N/A              0.770956E+04     N/A
1935     N/A              0.568591E+04     N/A
1936     N/A              0.558035E+04     N/A
1937     N/A              0.639074E+04     N/A
1938     N/A              0.424467E+04     N/A
1939     N/A              0.480016E+04     N/A
1940     N/A              0.584996E+04     N/A
1941     N/A              0.901351E+04     N/A
1942     N/A              0.702444E+04     N/A
1943     N/A              0.636525E+04     N/A
1944     N/A              0.108498E+05     N/A
1945     N/A              0.113312E+05     N/A
1946     N/A              0.932333E+04     N/A
1947     N/A              0.428037E+04     N/A
1948     N/A              0.463517E+04     N/A
1949     N/A              0.464035E+04     N/A
1950     N/A              0.664741E+04     N/A
1951     N/A              0.481092E+04     N/A
1952     N/A              0.417001E+04     N/A
1953     N/A              0.795195E+04     N/A
1954     N/A              0.637634E+04     N/A
1955     N/A              0.939069E+04     N/A
1956     N/A              0.790108E+04     N/A
1957     N/A              0.106374E+05     N/A
1958     N/A              0.853578E+04     N/A
1959     N/A              0.119105E+05     N/A
1960     N/A              0.934675E+04     N/A
1961     N/A              0.950293E+04     N/A
1962     N/A              0.103078E+05     N/A
1963     N/A              0.200009E+05     N/A
1964     N/A              0.186630E+05     N/A
1965     N/A              0.844449E+04     N/A
1966     N/A              0.489516E+04     N/A
1967     N/A              0.168200E+05     N/A
1968     N/A              0.243645E+05     N/A
1969     N/A              0.136906E+04     N/A
1970     N/A              0.556232E+03     N/A
1971     N/A              0.153241E+04     N/A
1972     N/A              0.131081E+03     N/A
1973     N/A              0.116729E+03     N/A
1974     N/A              0.378557E+03     N/A
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1975     N/A              0.806209E+02     N/A
1976     N/A              0.115366E+04     N/A
1977     N/A              0.179846E+04     N/A
1978     N/A              0.215273E+04     N/A
1979     N/A              0.194739E+04     N/A
1980     N/A              0.128308E+05     N/A
1981     N/A              0.258602E+04     N/A
1982     N/A              0.122239E+04     N/A
1983     N/A              0.533323E+04     N/A
1984     N/A              0.142650E+04     N/A
1985     N/A              0.945540E+03     N/A
1986     0.267403E+03     0.444918E+03    -0.509132E+00
1987     0.942949E+03     0.567143E+03     0.508400E+00
1988     0.401105E+04     0.217161E+04     0.613584E+00
1989     0.267403E+03     0.621482E+03    -0.843348E+00
1990     0.472882E+04     0.255088E+04     0.617237E+00
1991     0.154812E+03     0.574658E+03    -0.131156E+01
1992     0.537621E+04     0.334708E+04     0.473897E+00
1993     0.562954E+02     0.239501E+03    -0.144794E+01
1994     0.337773E+03     0.428040E+03    -0.236845E+00
1995     0.788136E+03     0.368906E+03     0.759129E+00
1996     0.410957E+04     0.233200E+04     0.566592E+00
1997     0.333550E+04     0.384327E+04    -0.141699E+00
1998     0.529177E+04     0.413420E+04     0.246859E+00
1999     0.197034E+04     0.355841E+04    -0.591108E+00
2000     0.296958E+04     0.314210E+04    -0.564704E-01
2001     0.581250E+04     0.600054E+04    -0.318380E-01
2002     0.607991E+04     0.377054E+04     0.477772E+00
2003     0.186403E+05     0.126118E+05     0.390691E+00
2004     0.554130E+04     0.327347E+04     0.526379E+00
2005     N/A              0.266664E+05     N/A
2006     N/A              0.154950E+04     N/A
2007     0.112062E+04     0.834506E+03     0.294800E+00
2008     0.109124E+06     0.148099E+06    -0.305394E+00

Survey Index:   28 Tag:         Can_Sp   AGE =  6
Time = JAN-1           Type = NUMBER
Catchability =    0.523142E+00   % Variance Contribution =     3.1484
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_____________________________________________________________________________

1931     N/A              0.533473E+04     N/A
1932     N/A              0.310307E+04     N/A
1933     N/A              0.225180E+04     N/A
1934     N/A              0.148604E+04     N/A
1935     N/A              0.318577E+04     N/A
1936     N/A              0.206065E+04     N/A
1937     N/A              0.237043E+04     N/A
1938     N/A              0.193100E+04     N/A
1939     N/A              0.157763E+04     N/A
1940     N/A              0.189445E+04     N/A
1941     N/A              0.236119E+04     N/A
1942     N/A              0.275994E+04     N/A
1943     N/A              0.237961E+04     N/A
1944     N/A              0.239672E+04     N/A
1945     N/A              0.389906E+04     N/A
1946     N/A              0.413996E+04     N/A
1947     N/A              0.293635E+04     N/A
1948     N/A              0.159266E+04     N/A
1949     N/A              0.152072E+04     N/A
1950     N/A              0.170752E+04     N/A
1951     N/A              0.246793E+04     N/A
1952     N/A              0.176345E+04     N/A
1953     N/A              0.188294E+04     N/A
1954     N/A              0.304909E+04     N/A
1955     N/A              0.276988E+04     N/A
1956     N/A              0.414069E+04     N/A
1957     N/A              0.318211E+04     N/A
1958     N/A              0.370960E+04     N/A
1959     N/A              0.338864E+04     N/A
1960     N/A              0.535628E+04     N/A
1961     N/A              0.421277E+04     N/A
1962     N/A              0.437731E+04     N/A
1963     N/A              0.461522E+04     N/A
1964     N/A              0.825156E+04     N/A
1965     N/A              0.720055E+04     N/A
1966     N/A              0.305173E+04     N/A
1967     N/A              0.166602E+04     N/A
1968     N/A              0.534283E+04     N/A
1969     N/A              0.794961E+04     N/A
1970     N/A              0.521618E+03     N/A
1971     N/A              0.249077E+03     N/A
1972     N/A              0.790941E+03     N/A
1973     N/A              0.639106E+02     N/A
1974     N/A              0.452928E+02     N/A
1975     N/A              0.194822E+03     N/A
1976     N/A              0.468419E+02     N/A
1977     N/A              0.592430E+03     N/A
1978     N/A              0.842395E+03     N/A
1979     N/A              0.103343E+04     N/A
1980     N/A              0.928759E+03     N/A
1981     N/A              0.490812E+04     N/A
1982     N/A              0.112111E+04     N/A
```

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1983     N/A              0.554328E+03     N/A
1984     N/A              0.216514E+04     N/A
1985     N/A              0.673979E+03     N/A
1986     0.408142E+03     0.350779E+03     0.151459E+00
1987     0.112591E+03     0.199595E+03    -0.572531E+00
1988     0.253329E+03     0.284487E+03    -0.115998E+00
1989     0.591102E+03     0.866859E+03    -0.382888E+00
1990     0.323699E+03     0.273865E+03     0.167178E+00
1991     0.225182E+04     0.101581E+04     0.796048E+00
1992     0.422216E+02     0.279740E+03    -0.189093E+01
1993     0.180145E+04     0.110798E+04     0.486060E+00
1994     0.281477E+02     0.886098E+02    -0.114678E+01
1995     0.422216E+02     0.192157E+03    -0.151538E+01
1996     0.365920E+03     0.195427E+03     0.627231E+00
1997     0.239256E+04     0.119871E+04     0.691118E+00
1998     0.516511E+04     0.206057E+04     0.918942E+00
1999     0.189997E+04     0.213970E+04    -0.118829E+00
2000     0.218145E+04     0.186739E+04     0.155448E+00
2001     0.181553E+04     0.162392E+04     0.111530E+00
2002     0.748729E+04     0.302716E+04     0.905581E+00
2003     0.413293E+04     0.184514E+04     0.806433E+00
2004     0.103840E+05     0.636498E+04     0.489453E+00
2005     N/A              0.163695E+04     N/A
2006     N/A              0.121336E+05     N/A
2007     0.177506E+03     0.760799E+03    -0.145536E+01
2008     0.100900E+04     0.413433E+03     0.892218E+00

Survey Index:   29 Tag:         Can_Sp   AGE =  7
Time = JAN-1           Type = NUMBER
Catchability =    0.679959E+00   % Variance Contribution =     2.5699
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_____________________________________________________________________________

1931     N/A              0.373337E+04     N/A
1932     N/A              0.202576E+04     N/A
1933     N/A              0.154659E+04     N/A
1934     N/A              0.143459E+04     N/A
1935     N/A              0.941333E+03     N/A
1936     N/A              0.189482E+04     N/A
1937     N/A              0.135378E+04     N/A
1938     N/A              0.138221E+04     N/A
1939     N/A              0.108245E+04     N/A
1940     N/A              0.108913E+04     N/A
1941     N/A              0.111636E+04     N/A
1942     N/A              0.142888E+04     N/A
1943     N/A              0.152069E+04     N/A
1944     N/A              0.905630E+03     N/A
1945     N/A              0.116730E+04     N/A
1946     N/A              0.273703E+04     N/A
1947     N/A              0.207592E+04     N/A
1948     N/A              0.146321E+04     N/A
1949     N/A              0.990454E+03     N/A
1950     N/A              0.972057E+03     N/A
1951     N/A              0.112784E+04     N/A
1952     N/A              0.132771E+04     N/A
1953     N/A              0.130027E+04     N/A
1954     N/A              0.138593E+04     N/A
1955     N/A              0.194679E+04     N/A
1956     N/A              0.194170E+04     N/A
1957     N/A              0.235283E+04     N/A
1958     N/A              0.195165E+04     N/A
1959     N/A              0.250523E+04     N/A
1960     N/A              0.253254E+04     N/A
1961     N/A              0.460312E+04     N/A
1962     N/A              0.334854E+04     N/A
1963     N/A              0.338181E+04     N/A
1964     N/A              0.356413E+04     N/A
1965     N/A              0.525222E+04     N/A
1966     N/A              0.360395E+04     N/A
1967     N/A              0.167335E+04     N/A
1968     N/A              0.103686E+04     N/A
1969     N/A              0.355307E+04     N/A
1970     N/A              0.483613E+04     N/A
1971     N/A              0.424223E+03     N/A
1972     N/A              0.115991E+03     N/A
1973     N/A              0.766374E+03     N/A
1974     N/A              0.493154E+02     N/A
1975     N/A              0.469093E+02     N/A
1976     N/A              0.180724E+03     N/A
1977     N/A              0.498420E+02     N/A
1978     N/A              0.409668E+03     N/A
1979     N/A              0.578677E+03     N/A
1980     N/A              0.846601E+03     N/A
1981     N/A              0.624246E+03     N/A
1982     N/A              0.364145E+04     N/A
1983     N/A              0.842987E+03     N/A
1984     N/A              0.422097E+03     N/A
1985     N/A              0.139043E+04     N/A
1986     0.478511E+03     0.574324E+03    -0.182514E+00
1987     0.422216E+03     0.266150E+03     0.461455E+00
1988     0.239256E+03     0.166824E+03     0.360596E+00
1989     0.422216E+02     0.209698E+03    -0.160274E+01
1990     0.153405E+04     0.630838E+03     0.888619E+00
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1991     0.126665E+03     0.197270E+03    -0.443032E+00
1992     0.149183E+04     0.764878E+03     0.668042E+00
1993     0.281477E+02     0.187240E+03    -0.189492E+01
1994     0.985170E+03     0.727295E+03     0.303482E+00
1995     N/A              0.496840E+02     N/A
1996     0.337773E+03     0.186454E+03     0.594186E+00
1997     0.323699E+03     0.167570E+03     0.658410E+00
1998     0.278662E+04     0.114202E+04     0.892035E+00
1999     0.177331E+04     0.184324E+04    -0.386785E-01
2000     0.273033E+04     0.193058E+04     0.346601E+00
2001     0.161849E+04     0.166402E+04    -0.277391E-01
2002     0.223774E+04     0.132718E+04     0.522411E+00
2003     0.377939E+04     0.254506E+04     0.395411E+00
2004     0.173897E+04     0.159325E+04     0.875131E-01
2005     N/A              0.497950E+04     N/A
2006     N/A              0.126680E+04     N/A
2007     0.417721E+04     0.960028E+04    -0.832149E+00
2008     0.194692E+03     0.619187E+03    -0.115699E+01

Survey Index:   30 Tag:         Can_Sp   AGE =  8
Time = JAN-1           Type = NUMBER
Catchability =    0.620286E+00   % Variance Contribution =     2.2809
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_____________________________________________________________________________

1931     N/A              0.191396E+04     N/A
1932     N/A              0.928022E+03     N/A
1933     N/A              0.781384E+03     N/A
1934     N/A              0.486658E+03     N/A
1935     N/A              0.726851E+03     N/A
1936     N/A              0.425771E+03     N/A
1937     N/A              0.661519E+03     N/A
1938     N/A              0.484105E+03     N/A
1939     N/A              0.508964E+03     N/A
1940     N/A              0.345945E+03     N/A
1941     N/A              0.397030E+03     N/A
1942     N/A              0.314839E+03     N/A
1943     N/A              0.494007E+03     N/A
1944     N/A              0.696681E+03     N/A
1945     N/A              0.400320E+03     N/A
1946     N/A              0.366907E+03     N/A
1947     N/A              0.103198E+04     N/A
1948     N/A              0.719949E+03     N/A
1949     N/A              0.659423E+03     N/A
1950     N/A              0.393726E+03     N/A
1951     N/A              0.437076E+03     N/A
1952     N/A              0.432253E+03     N/A
1953     N/A              0.696401E+03     N/A
1954     N/A              0.669322E+03     N/A
1955     N/A              0.634936E+03     N/A
1956     N/A              0.860759E+03     N/A
1957     N/A              0.703832E+03     N/A
1958     N/A              0.854722E+03     N/A
1959     N/A              0.955204E+03     N/A
1960     N/A              0.121905E+04     N/A
1961     N/A              0.145246E+04     N/A
1962     N/A              0.273131E+04     N/A
1963     N/A              0.162969E+04     N/A
1964     N/A              0.174338E+04     N/A
1965     N/A              0.150630E+04     N/A
1966     N/A              0.183546E+04     N/A
1967     N/A              0.139906E+04     N/A
1968     N/A              0.698705E+03     N/A
1969     N/A              0.404651E+03     N/A
1970     N/A              0.177760E+04     N/A
1971     N/A              0.232815E+04     N/A
1972     N/A              0.158955E+03     N/A
1973     N/A              0.424396E+02     N/A
1974     N/A              0.528518E+03     N/A
1975     N/A              0.356566E+02     N/A
1976     N/A              0.327408E+02     N/A
1977     N/A              0.121611E+03     N/A
1978     N/A              0.349311E+02     N/A
1979     N/A              0.227855E+03     N/A
1980     N/A              0.255560E+03     N/A
1981     N/A              0.328001E+03     N/A
1982     N/A              0.280983E+03     N/A
1983     N/A              0.209083E+04     N/A
1984     N/A              0.524643E+03     N/A
1985     N/A              0.183750E+03     N/A
1986     0.520733E+03     0.738397E+03    -0.349244E+00
1987     0.140739E+03     0.344093E+03    -0.894008E+00
1988     0.154812E+03     0.148153E+03     0.439719E-01
1989     0.422216E+02     0.932026E+02    -0.791844E+00
1990     0.182960E+03     0.122190E+03     0.403693E+00
1991     0.619250E+03     0.349835E+03     0.571049E+00
1992     0.562954E+02     0.764428E+02    -0.305929E+00
1993     0.450364E+03     0.334839E+03     0.296404E+00
1994     0.140739E+02     0.104936E+03    -0.200903E+01
1995     0.675545E+03     0.368721E+03     0.605480E+00
1996     0.562954E+02     0.323560E+02     0.553813E+00
1997     0.126665E+03     0.126895E+03    -0.181633E-02
1998     0.337773E+03     0.115362E+03     0.107429E+01
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1999     0.464437E+03     0.758495E+03    -0.490509E+00
2000     0.160442E+04     0.116240E+04     0.322278E+00
2001     0.198441E+04     0.123122E+04     0.477315E+00
2002     0.185775E+04     0.998514E+03     0.620853E+00
2003     0.169745E+04     0.767174E+03     0.794167E+00
2004     0.102345E+04     0.149951E+04    -0.381956E+00
2005     N/A              0.807658E+03     N/A
2006     N/A              0.269216E+04     N/A
2007     0.299037E+03     0.763849E+03    -0.937801E+00
2008     0.859467E+04     0.576797E+04     0.398822E+00


Plus Group Diagnostic Report

Calculation Method Selected = Backward

         Population  Population    F            F
Year     Backward     Forward    Forward     Backward    Ratio

1931        961.        961.    0.997338    0.997338    1.000000
1932        881.       1222.    0.431489    0.662343    1.535018
1933       1515.       1282.    0.797975    0.628024    0.787022
1934        527.       1023.    0.199216    0.429368    2.155290
1935        289.       1104.    0.115073    0.531930    4.622531
1936        329.       1369.    0.105061    0.532164    5.065289
1937        492.       1339.    0.201204    0.677471    3.367082
1938        413.       1340.    0.153215    0.611821    3.993205
1939        602.       1288.    0.228104    0.569606    2.497133
1940        342.       1220.    0.130993    0.571032    4.359253
1941        801.       1134.    0.463332    0.739804    1.596702
1942        394.        834.    0.263676    0.669485    2.539046
1943        400.        737.    0.307844    0.663752    2.156132
1944        259.        780.    0.165397    0.609012    3.682115
1945        499.       1041.    0.243833    0.595311    2.441468
1946         50.        959.    0.026798    0.696294   25.982882
1947       1021.       1006.    0.684379    0.670668    0.979966
1948        952.       1112.    0.451606    0.551452    1.221091
1949        918.       1127.    0.420336    0.545878    1.298672
1950        705.       1110.    0.284028    0.490916    1.728409
1951        510.       1002.    0.268664    0.616813    2.295855
1952        410.        939.    0.134093    0.337640    2.517965
1953        506.       1079.    0.168389    0.398986    2.369426
1954        300.       1363.    0.082512    0.443634    5.376612
1955        553.       1595.    0.127195    0.419358    3.296968
1956        495.       1701.    0.139372    0.585777    4.202980
1957        878.       1844.    0.246063    0.607592    2.469251
1958        443.       1686.    0.097350    0.432913    4.446967
1959       1213.       1984.    0.204673    0.359507    1.756495
1960       1685.       2204.    0.190751    0.257421    1.349512
1961       3182.       2735.    0.315374    0.264856    0.839813
1962       3337.       3105.    0.381446    0.349849    0.917164
1963       3994.       4277.    0.330192    0.358086    1.084478
1964       3642.       4020.    0.450717    0.511085    1.133936
1965       3032.       3478.    0.561041    0.676381    1.205583
1966       2023.       2636.    0.446717    0.630925    1.412359
1967       1717.       2670.    0.338098    0.587421    1.737430
1968       2094.       2585.    0.441266    0.578910    1.311930
1969       1653.       1878.    0.404375    0.474116    1.172465
1970       1782.       1359.    0.468203    0.336330    0.718342
1971       2371.       2373.    0.557867    0.558371    1.000903
1972       4801.       2870.    0.655735    0.341057    0.520114
1973       2036.       1369.    0.452785    0.281800    0.622371
1974       4002.        755.    0.469353    0.073789    0.157215
1975       1276.       1035.    0.101909    0.081847    0.803140
1976       1495.        808.    0.172004    0.089460    0.520102
1977        558.        597.    0.232196    0.250219    1.077616
1978        270.        512.    0.156647    0.321284    2.051003
1979        176.        392.    0.139579    0.341648    2.447705
1980        218.        493.    0.200414    0.524776    2.618460
1981        315.        530.    0.218758    0.400135    1.829126
1982        470.        639.    0.211610    0.299537    1.415513
1983        320.        698.    0.129109    0.305359    2.365130
1984       1720.       2536.    0.271873    0.430723    1.584282
1985        577.       2032.    0.088132    0.350782    3.980209
1986        268.       1694.    0.040374    0.285942    7.082384
1987        707.       2064.    0.076342    0.240983    3.156647
1988        395.       1923.    0.064146    0.357793    5.577774
1989        230.       1613.    0.039524    0.315082    7.972007
1990        174.       1359.    0.040470    0.368750    9.111686
1991        213.       1180.    0.062614    0.406510    6.492349
1992        263.       1215.    0.094522    0.533648    5.645729
1993        262.        964.    0.098590    0.420721    4.267376
1994        336.       1006.    0.127947    0.442203    3.456140
1995        157.        813.    0.022209    0.120740    5.436524
1996        591.       1083.    0.082924    0.157314    1.897093
1997        543.        852.    0.065176    0.104321    1.600621
1998        386.        805.    0.068873    0.149052    2.164142
1999        357.        746.    0.072888    0.158837    2.179195
2000        715.       1422.    0.079388    0.164339    2.070067
2001       1451.       2377.    0.129461    0.221529    1.711162
2002       2896.       3012.    0.224577    0.234696    1.045057
2003       2265.       3012.    0.153201    0.209156    1.365239
2004       1753.       2937.    0.165935    0.295248    1.779301
2005       1418.       3511.    0.113909    0.308869    2.711543
2006       1173.       3348.    0.077874    0.239744    3.078605
```

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 2007       3036.       5331.    0.123935    0.228544    1.844055
 2008        300.       4658.       N/A         N/A


 Warning **** Infeasible Mass Balance in Plus Group
 Year =  1947
 Year =  1974
 Year =  1976
```

## YPR input GB haddock

```
##
##    YPR Version 2.6
##
TITLE
Georges_Bank_Haddock_vpa_Garm3_rev flat5
AGES
1  9  100  1
FMORT
2.0  0.01  0.0001
MMORT
0.2000
TSPAWN
0.2500  0.2500
REFMSP
0.4000
BIODATA
1  0.0139  1.0000  0.1126  0.1883  0.1126  0.0630
2  0.0298  1.0000  0.3633  0.5937  0.3633  0.4690
3  0.1484  1.0000  0.8029  1.0900  0.8029  0.9200
4  0.3958  1.0000  1.2505  1.3772  1.2505  0.9930
5  1.0000  1.0000  1.5597  1.6560  1.5597  0.9990
6  1.0000  1.0000  1.8176  1.8887  1.8176  1.0000
7  1.0000  1.0000  2.0522  2.0880  2.0522  1.0000
8  1.0000  1.0000  2.3401  2.3539  2.3401  1.0000
9  1.0000  1.0000  2.6388  2.6388  2.6388  1.0000
```

## YPR output  GB haddock

```
##  Yield per Recruit and Spawning Stock Biomass per Recruit
##
##  YPR  Version 2.7
##
##  Date of Run: 12 Jul 2008   15:57
##
##  Input Data File: C:\X-APPS\YPR_TOOLBOX\V27\GARM3-REVIEW\VPA_GARM3_BRP.DAT
##

 Model Title:  Georges_Bank_Haddock_vpa_Garm3_rev flat5


 Start Age = 1
 End Age   = 9   - Includes Plus Group with Maximum Age = 100

 Fishing Mortality Upper Bound               =     2.0000
 Fishing Mortality Calculation Increment     =     0.0001
 Fishing Mortality Printing Increment        =       0.01

 Natural Mortality                           =     0.2000

 Proportion Fishing Mortality Before Spawning =     0.2500
 Proportion Natural Mortality Before Spawning =     0.2500

 Age      Selectivity F  Selectivity M    Stock Weight   Catch Weight     SSB Weight     Maturity
   1            0.0139         1.0000         0.1126         0.1883         0.1126         0.0630
   2            0.0298         1.0000         0.3633         0.5937         0.3633         0.4690
   3            0.1484         1.0000         0.8029         1.0900         0.8029         0.9200
   4            0.3958         1.0000         1.2505         1.3772         1.2505         0.9930
   5            1.0000         1.0000         1.5597         1.6560         1.5597         0.9990
   6            1.0000         1.0000         1.8176         1.8887         1.8176         1.0000
   7            1.0000         1.0000         2.0522         2.0880         2.0522         1.0000
   8            1.0000         1.0000         2.3401         2.3539         2.3401         1.0000
   9            1.0000         1.0000         2.6388         2.6388         2.6388         1.0000


 Reference Point       F           YPR          SSBR         TSBR       Mean Age     Mean GT     Exp Spawn
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    F Zero          0.00000     0.00000     6.49333     7.13826     5.51666     8.88918     2.59955
    F-01            0.28970     0.54506     2.85170     3.46297     3.30445     5.50255     1.76341
    F-Max           1.52030     0.65903     1.20326     1.78159     2.38118     3.79528     0.94428
    F at   40 %MSP  0.34910     0.57249     2.59751     3.20484     3.15940     5.23708     1.66433

  FMORT        CTHN        CTHW        STKN        STKW     SPNSTKN     SPNSTKW         MSP       MNAGE        MNGT        EXSP
0.00000     0.00000     0.00000     5.51666     7.13826     3.88767     6.49333   100.00000     5.51666     8.88918     2.59955
0.01000     0.02448     0.05149     5.39468     6.83336     3.76537     6.19018    95.33137     5.32408     8.62790     2.55561
0.02000     0.04677     0.09755     5.28365     6.55704     3.65402     5.91555    91.10190     5.15075     8.38904     2.51317
0.03000     0.06716     0.13891     5.18213     6.30553     3.55219     5.66567    87.25373     4.99402     8.16974     2.47218
0.04000     0.08588     0.17620     5.08894     6.07570     3.45869     5.43743    83.73871     4.85171     7.96764     2.43257
0.05000     0.10314     0.20994     5.00307     5.86493     3.37251     5.22819    80.51636     4.72197     7.78074     2.39429
0.06000     0.11909     0.24055     4.92369     5.67099     3.29282     5.03574    77.55248     4.60328     7.60734     2.35729
0.07000     0.13390     0.26840     4.85007     5.49199     3.21890     4.85818    74.81794     4.49434     7.44601     2.32150
0.08000     0.14768     0.29382     4.78160     5.32630     3.15012     4.69388    72.28779     4.39403     7.29551     2.28689
0.09000     0.16053     0.31708     4.71773     5.17254     3.08596     4.54147    69.94052     4.30140     7.15476     2.25340
0.10000     0.17255     0.33840     4.65802     5.02948     3.02596     4.39972    67.75752     4.21563     7.02283     2.22099
0.11000     0.18382     0.35800     4.60206     4.89608     2.96970     4.26759    65.72260     4.13602     6.89890     2.18962
0.12000     0.19441     0.37605     4.54950     4.77141     2.91685     4.14414    63.82156     4.06195     6.78228     2.15925
0.13000     0.20438     0.39270     4.50003     4.65467     2.86710     4.02859    62.04199     3.99287     6.67231     2.12983
0.14000     0.21379     0.40809     4.45338     4.54513     2.82016     3.92021    60.37291     3.92832     6.56846     2.10133
0.15000     0.22268     0.42234     4.40930     4.44218     2.77580     3.81838    58.80461     3.86788     6.47023     2.07371
0.16000     0.23110     0.43556     4.36758     4.34525     2.73381     3.72253    57.32848     3.81117     6.37716     2.04694
0.17000     0.23909     0.44784     4.32804     4.25383     2.69399     3.63216    55.93684     3.75788     6.28888     2.02098
0.18000     0.24667     0.45926     4.29050     4.16749     2.65617     3.54684    54.62282     3.70771     6.20501     1.99581
0.19000     0.25388     0.46990     4.25480     4.08582     2.62020     3.46616    53.38028     3.66041     6.12525     1.97140
0.20000     0.26076     0.47983     4.22081     4.00846     2.58594     3.38976    52.20368     3.61573     6.04931     1.94770
0.21000     0.26731     0.48911     4.18840     3.93509     2.55327     3.31731    51.08804     3.57348     5.97692     1.92471
0.22000     0.27357     0.49778     4.15746     3.86541     2.52207     3.24854    50.02885     3.53347     5.90784     1.90238
0.23000     0.27956     0.50590     4.12789     3.79916     2.49224     3.18316    49.02204     3.49552     5.84187     1.88070
0.24000     0.28529     0.51351     4.09959     3.73609     2.46368     3.12095    48.06389     3.45949     5.77879     1.85964
0.25000     0.29078     0.52066     4.07249     3.67599     2.43632     3.06167    47.15105     3.42524     5.71843     1.83917
0.26000     0.29605     0.52737     4.04649     3.61866     2.41007     3.00514    46.28043     3.39263     5.66062     1.81929
0.27000     0.30111     0.53368     4.02154     3.56391     2.38487     2.95117    45.44923     3.36156     5.60521     1.79995
0.28000     0.30597     0.53962     3.99757     3.51158     2.36065     2.89959    44.65488     3.33192     5.55207     1.78115
0.29000     0.31065     0.54522     3.97451     3.46150     2.33735     2.85025    43.89503     3.30362     5.50105     1.76287
0.30000     0.31516     0.55050     3.95231     3.41355     2.31491     2.80301    43.16751     3.27657     5.45204     1.74507
0.31000     0.31951     0.55548     3.93093     3.36759     2.29328     2.75774    42.47033     3.25069     5.40492     1.72776
0.32000     0.32370     0.56019     3.91031     3.32350     2.27242     2.71432    41.80165     3.22590     5.35961     1.71091
0.33000     0.32774     0.56464     3.89041     3.28116     2.25229     2.67264    41.15980     3.20214     5.31599     1.69450
0.34000     0.33165     0.56885     3.87119     3.24049     2.23284     2.63260    40.54319     3.17935     5.27398     1.67851
0.35000     0.33543     0.57284     3.85262     3.20138     2.21404     2.59411    39.95038     3.15747     5.23349     1.66294
0.36000     0.33909     0.57662     3.83466     3.16374     2.19585     2.55708    39.38003     3.13644     5.19446     1.64777
0.37000     0.34263     0.58020     3.81727     3.12750     2.17824     2.52142    38.83090     3.11622     5.15680     1.63298
0.38000     0.34606     0.58360     3.80044     3.09258     2.16118     2.48706    38.30182     3.09676     5.12046     1.61856
0.39000     0.34939     0.58683     3.78412     3.05890     2.14465     2.45394    37.79172     3.07801     5.08535     1.60450
0.40000     0.35262     0.58990     3.76830     3.02641     2.12861     2.42199    37.29960     3.05995     5.05144     1.59079
0.41000     0.35575     0.59282     3.75295     2.99503     2.11305     2.39114    36.82453     3.04253     5.01865     1.57740
0.42000     0.35879     0.59559     3.73805     2.96472     2.09793     2.36134    36.36561     3.02572     4.98694     1.56434
0.43000     0.36175     0.59824     3.72358     2.93542     2.08325     2.33254    35.92206     3.00949     4.95626     1.55159
0.44000     0.36462     0.60075     3.70951     2.90709     2.06897     2.30468    35.49309     2.99380     4.92656     1.53915
0.45000     0.36742     0.60315     3.69583     2.87966     2.05509     2.27773    35.07799     2.97863     4.89780     1.52699
0.46000     0.37014     0.60544     3.68252     2.85310     2.04157     2.25163    34.67610     2.96396     4.86993     1.51511
0.47000     0.37279     0.60763     3.66957     2.82737     2.02842     2.22635    34.28679     2.94976     4.84293     1.50350
0.48000     0.37537     0.60971     3.65695     2.80244     2.01560     2.20185    33.90946     2.93601     4.81674     1.49216
0.49000     0.37789     0.61170     3.64466     2.77825     2.00311     2.17809    33.54356     2.92268     4.79134     1.48107
0.50000     0.38035     0.61361     3.63268     2.75478     1.99094     2.15504    33.18857     2.90976     4.76670     1.47023
0.51000     0.38274     0.61543     3.62100     2.73200     1.97906     2.13267    32.84400     2.89722     4.74277     1.45962
0.52000     0.38508     0.61717     3.60960     2.70988     1.96747     2.11094    32.50938     2.88506     4.71954     1.44925
0.53000     0.38736     0.61883     3.59847     2.68838     1.95616     2.08983    32.18428     2.87325     4.69697     1.43909
0.54000     0.38959     0.62043     3.58761     2.66748     1.94511     2.06931    31.86829     2.86178     4.67504     1.42915
0.55000     0.39177     0.62195     3.57700     2.64716     1.93431     2.04936    31.56101     2.85063     4.65372     1.41943
0.56000     0.39390     0.62342     3.56663     2.62739     1.92376     2.02995    31.26209     2.83978     4.63299     1.40990
0.57000     0.39598     0.62482     3.55649     2.60814     1.91345     2.01106    30.97116     2.82924     4.61283     1.40057
0.58000     0.39802     0.62617     3.54658     2.58941     1.90336     1.99267    30.68791     2.81898     4.59321     1.39143
0.59000     0.40001     0.62746     3.53689     2.57115     1.89348     1.97475    30.41202     2.80898     4.57411     1.38247
0.60000     0.40196     0.62869     3.52740     2.55337     1.88382     1.95730    30.14319     2.79925     4.55552     1.37369
0.61000     0.40388     0.62988     3.51811     2.53603     1.87436     1.94028    29.88115     2.78977     4.53741     1.36509
0.62000     0.40575     0.63102     3.50901     2.51912     1.86510     1.92369    29.62563     2.78053     4.51976     1.35665
0.63000     0.40758     0.63212     3.50010     2.50262     1.85602     1.90751    29.37638     2.77152     4.50257     1.34838
0.64000     0.40938     0.63317     3.49137     2.48653     1.84712     1.89171    29.13316     2.76273     4.48581     1.34026
0.65000     0.41115     0.63419     3.48281     2.47081     1.83840     1.87630    28.89573     2.75416     4.46947     1.33230
0.66000     0.41288     0.63516     3.47442     2.45547     1.82985     1.86124    28.66389     2.74579     4.45353     1.32448
0.67000     0.41457     0.63610     3.46619     2.44048     1.82146     1.84654    28.43743     2.73761     4.43798     1.31681
0.68000     0.41624     0.63700     3.45812     2.42583     1.81323     1.83217    28.21614     2.72963     4.42280     1.30928
0.69000     0.41787     0.63786     3.45019     2.41151     1.80515     1.81812    27.99986     2.72183     4.40799     1.30189
0.70000     0.41948     0.63870     3.44242     2.39750     1.79722     1.80439    27.78838     2.71420     4.39352     1.29463
0.71000     0.42106     0.63950     3.43478     2.38381     1.78944     1.79096    27.58155     2.70674     4.37940     1.28749
0.72000     0.42260     0.64027     3.42728     2.37041     1.78179     1.77782    27.37921     2.69945     4.36560     1.28049
0.73000     0.42413     0.64102     3.41992     2.35730     1.77427     1.76496    27.18119     2.69232     4.35211     1.27360
0.74000     0.42562     0.64173     3.41268     2.34446     1.76689     1.75238    26.98736     2.68534     4.33893     1.26683
0.75000     0.42709     0.64242     3.40556     2.33189     1.75963     1.74005    26.79756     2.67850     4.32605     1.26018
0.76000     0.42854     0.64309     3.39857     2.31957     1.75250     1.72798    26.61167     2.67181     4.31345     1.25364
0.77000     0.42996     0.64373     3.39169     2.30751     1.74548     1.71616    26.42955     2.66526     4.30112     1.24720
0.78000     0.43136     0.64435     3.38493     2.29568     1.73858     1.70457    26.25109     2.65884     4.28907     1.24088
0.79000     0.43274     0.64494     3.37827     2.28409     1.73179     1.69321    26.07616     2.65255     4.27727     1.23465
0.80000     0.43410     0.64552     3.37173     2.27273     1.72511     1.68207    25.90465     2.64638     4.26572     1.22853
0.81000     0.43543     0.64607     3.36528     2.26158     1.71854     1.67115    25.73645     2.64033     4.25441     1.22250
0.82000     0.43675     0.64660     3.35894     2.25065     1.71206     1.66044    25.57146     2.63440     4.24335     1.21657
0.83000     0.43804     0.64712     3.35269     2.23992     1.70569     1.64993    25.40957     2.62858     4.23250     1.21073
0.84000     0.43932     0.64761     3.34654     2.22938     1.69941     1.63961    25.25070     2.62287     4.22188     1.20498
0.85000     0.44057     0.64809     3.34048     2.21905     1.69323     1.62949    25.09475     2.61727     4.21148     1.19932
0.86000     0.44181     0.64856     3.33452     2.20889     1.68714     1.61954    24.94164     2.61177     4.20128     1.19374
0.87000     0.44303     0.64900     3.32863     2.19892     1.68114     1.60978    24.79127     2.60636     4.19128     1.18825
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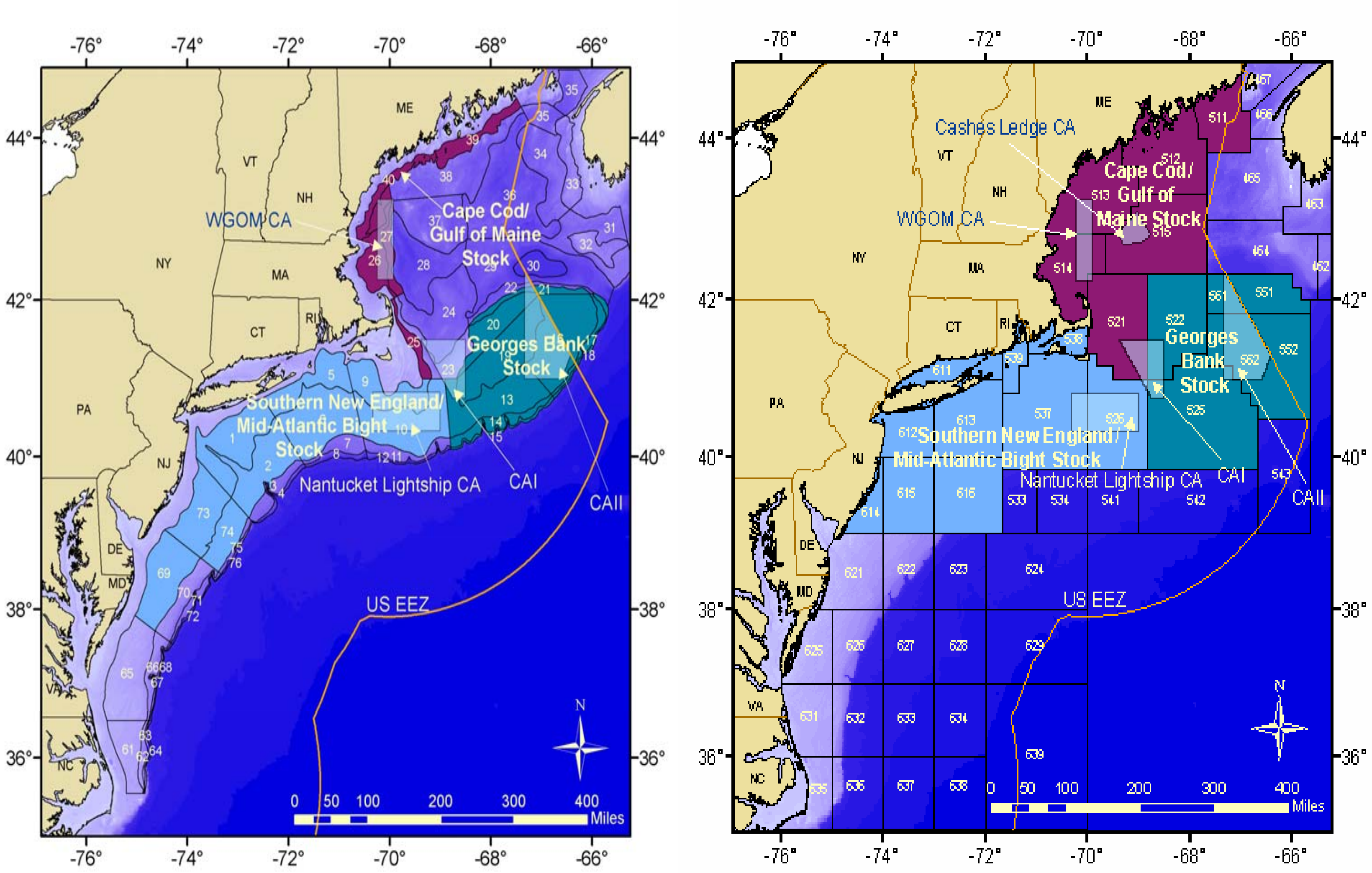
| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 0.88000 | 0.44423 | 0.64943 | 3.32284 | 2.18913 | 1.67522 | 1.60019 | 24.64356 | 2.60106 | 4.18148 | 1.18284 |
| 0.89000 | 0.44542 | 0.64984 | 3.31712 | 2.17950 | 1.66939 | 1.59077 | 24.49845 | 2.59585 | 4.17186 | 1.17751 |
| 0.90000 | 0.44659 | 0.65024 | 3.31149 | 2.17004 | 1.66364 | 1.58151 | 24.35585 | 2.59073 | 4.16244 | 1.17225 |
| 0.91000 | 0.44774 | 0.65063 | 3.30594 | 2.16075 | 1.65797 | 1.57240 | 24.21569 | 2.58570 | 4.15319 | 1.16707 |
| 0.92000 | 0.44888 | 0.65100 | 3.30046 | 2.15160 | 1.65238 | 1.56346 | 24.07791 | 2.58075 | 4.14411 | 1.16196 |
| 0.93000 | 0.45000 | 0.65136 | 3.29505 | 2.14261 | 1.64687 | 1.55466 | 23.94243 | 2.57589 | 4.13520 | 1.15693 |
| 0.94000 | 0.45111 | 0.65171 | 3.28972 | 2.13377 | 1.64143 | 1.54601 | 23.80919 | 2.57110 | 4.12646 | 1.15196 |
| 0.95000 | 0.45220 | 0.65204 | 3.28446 | 2.12507 | 1.63606 | 1.53750 | 23.67813 | 2.56640 | 4.11788 | 1.14707 |
| 0.96000 | 0.45328 | 0.65236 | 3.27927 | 2.11651 | 1.63077 | 1.52913 | 23.54919 | 2.56177 | 4.10945 | 1.14224 |
| 0.97000 | 0.45435 | 0.65267 | 3.27415 | 2.10809 | 1.62554 | 1.52089 | 23.42231 | 2.55722 | 4.10117 | 1.13747 |
| 0.98000 | 0.45540 | 0.65297 | 3.26909 | 2.09980 | 1.62038 | 1.51278 | 23.29744 | 2.55274 | 4.09304 | 1.13277 |
| 0.99000 | 0.45644 | 0.65326 | 3.26409 | 2.09163 | 1.61528 | 1.50480 | 23.17452 | 2.54833 | 4.08505 | 1.12814 |
| 1.00000 | 0.45747 | 0.65354 | 3.25916 | 2.08360 | 1.61025 | 1.49694 | 23.05351 | 2.54398 | 4.07720 | 1.12356 |
| 1.01000 | 0.45848 | 0.65380 | 3.25429 | 2.07568 | 1.60528 | 1.48920 | 22.93434 | 2.53971 | 4.06948 | 1.11904 |
| 1.02000 | 0.45948 | 0.65406 | 3.24947 | 2.06788 | 1.60038 | 1.48158 | 22.81698 | 2.53550 | 4.06190 | 1.11458 |
| 1.03000 | 0.46047 | 0.65431 | 3.24472 | 2.06020 | 1.59553 | 1.47408 | 22.70138 | 2.53135 | 4.05444 | 1.11017 |
| 1.04000 | 0.46145 | 0.65455 | 3.24002 | 2.05263 | 1.59074 | 1.46668 | 22.58749 | 2.52726 | 4.04710 | 1.10582 |
| 1.05000 | 0.46241 | 0.65478 | 3.23538 | 2.04517 | 1.58601 | 1.45939 | 22.47528 | 2.52324 | 4.03989 | 1.10153 |
| 1.06000 | 0.46337 | 0.65500 | 3.23079 | 2.03782 | 1.58133 | 1.45221 | 22.36469 | 2.51927 | 4.03280 | 1.09729 |
| 1.07000 | 0.46431 | 0.65522 | 3.22626 | 2.03057 | 1.57671 | 1.44514 | 22.25569 | 2.51535 | 4.02582 | 1.09310 |
| 1.08000 | 0.46525 | 0.65542 | 3.22178 | 2.02342 | 1.57214 | 1.43816 | 22.14823 | 2.51150 | 4.01895 | 1.08896 |
| 1.09000 | 0.46617 | 0.65562 | 3.21734 | 2.01637 | 1.56762 | 1.43128 | 22.04229 | 2.50770 | 4.01219 | 1.08487 |
| 1.10000 | 0.46709 | 0.65581 | 3.21296 | 2.00942 | 1.56316 | 1.42450 | 21.93783 | 2.50395 | 4.00554 | 1.08083 |
| 1.11000 | 0.46799 | 0.65599 | 3.20863 | 2.00257 | 1.55874 | 1.41781 | 21.83480 | 2.50025 | 3.99899 | 1.07684 |
| 1.12000 | 0.46888 | 0.65617 | 3.20434 | 1.99580 | 1.55438 | 1.41121 | 21.73318 | 2.49660 | 3.99254 | 1.07289 |
| 1.13000 | 0.46977 | 0.65633 | 3.20010 | 1.98913 | 1.55006 | 1.40470 | 21.63294 | 2.49300 | 3.98619 | 1.06899 |
| 1.14000 | 0.47064 | 0.65650 | 3.19590 | 1.98254 | 1.54579 | 1.39828 | 21.53403 | 2.48945 | 3.97994 | 1.06513 |
| 1.15000 | 0.47151 | 0.65665 | 3.19175 | 1.97604 | 1.54156 | 1.39194 | 21.43643 | 2.48595 | 3.97378 | 1.06132 |
| 1.16000 | 0.47236 | 0.65680 | 3.18764 | 1.96962 | 1.53738 | 1.38568 | 21.34012 | 2.48249 | 3.96771 | 1.05755 |
| 1.17000 | 0.47321 | 0.65694 | 3.18358 | 1.96329 | 1.53324 | 1.37951 | 21.24505 | 2.47907 | 3.96173 | 1.05382 |
| 1.18000 | 0.47405 | 0.65708 | 3.17955 | 1.95703 | 1.52915 | 1.37342 | 21.15121 | 2.47570 | 3.95584 | 1.05013 |
| 1.19000 | 0.47488 | 0.65721 | 3.17557 | 1.95086 | 1.52510 | 1.36740 | 21.05856 | 2.47237 | 3.95003 | 1.04648 |
| 1.20000 | 0.47570 | 0.65733 | 3.17163 | 1.94476 | 1.52109 | 1.36146 | 20.96708 | 2.46908 | 3.94430 | 1.04287 |
| 1.21000 | 0.47652 | 0.65745 | 3.16773 | 1.93873 | 1.51712 | 1.35560 | 20.87675 | 2.46584 | 3.93866 | 1.03930 |
| 1.22000 | 0.47733 | 0.65757 | 3.16386 | 1.93278 | 1.51319 | 1.34980 | 20.78753 | 2.46263 | 3.93309 | 1.03577 |
| 1.23000 | 0.47812 | 0.65767 | 3.16003 | 1.92690 | 1.50930 | 1.34408 | 20.69941 | 2.45946 | 3.92761 | 1.03228 |
| 1.24000 | 0.47892 | 0.65778 | 3.15624 | 1.92109 | 1.50545 | 1.33843 | 20.61235 | 2.45633 | 3.92219 | 1.02882 |
| 1.25000 | 0.47970 | 0.65788 | 3.15249 | 1.91535 | 1.50163 | 1.33284 | 20.52635 | 2.45324 | 3.91686 | 1.02540 |
| 1.26000 | 0.48048 | 0.65797 | 3.14877 | 1.90967 | 1.49785 | 1.32733 | 20.44137 | 2.45018 | 3.91159 | 1.02201 |
| 1.27000 | 0.48124 | 0.65806 | 3.14509 | 1.90406 | 1.49411 | 1.32187 | 20.35740 | 2.44716 | 3.90639 | 1.01866 |
| 1.28000 | 0.48201 | 0.65814 | 3.14144 | 1.89852 | 1.49041 | 1.31648 | 20.27441 | 2.44417 | 3.90126 | 1.01534 |
| 1.29000 | 0.48276 | 0.65822 | 3.13782 | 1.89304 | 1.48674 | 1.31116 | 20.19238 | 2.44122 | 3.89620 | 1.01205 |
| 1.30000 | 0.48351 | 0.65830 | 3.13424 | 1.88761 | 1.48310 | 1.30589 | 20.11130 | 2.43830 | 3.89121 | 1.00880 |
| 1.31000 | 0.48425 | 0.65837 | 3.13069 | 1.88225 | 1.47950 | 1.30069 | 20.03114 | 2.43541 | 3.88628 | 1.00557 |
| 1.32000 | 0.48499 | 0.65843 | 3.12717 | 1.87695 | 1.47593 | 1.29554 | 19.95189 | 2.43256 | 3.88141 | 1.00238 |
| 1.33000 | 0.48571 | 0.65850 | 3.12368 | 1.87171 | 1.47239 | 1.29045 | 19.87352 | 2.42973 | 3.87661 | 0.99922 |
| 1.34000 | 0.48644 | 0.65856 | 3.12022 | 1.86652 | 1.46888 | 1.28542 | 19.79603 | 2.42694 | 3.87186 | 0.99609 |
| 1.35000 | 0.48715 | 0.65861 | 3.11680 | 1.86139 | 1.46541 | 1.28045 | 19.71939 | 2.42418 | 3.86717 | 0.99299 |
| 1.36000 | 0.48786 | 0.65866 | 3.11340 | 1.85632 | 1.46197 | 1.27552 | 19.64359 | 2.42144 | 3.86254 | 0.98992 |
| 1.37000 | 0.48857 | 0.65871 | 3.11003 | 1.85129 | 1.45855 | 1.27065 | 19.56861 | 2.41874 | 3.85797 | 0.98688 |
| 1.38000 | 0.48926 | 0.65875 | 3.10669 | 1.84632 | 1.45517 | 1.26584 | 19.49443 | 2.41606 | 3.85345 | 0.98387 |
| 1.39000 | 0.48996 | 0.65879 | 3.10338 | 1.84140 | 1.45181 | 1.26107 | 19.42104 | 2.41341 | 3.84899 | 0.98088 |
| 1.40000 | 0.49064 | 0.65883 | 3.10009 | 1.83653 | 1.44849 | 1.25636 | 19.34843 | 2.41079 | 3.84458 | 0.97792 |
| 1.41000 | 0.49132 | 0.65886 | 3.09683 | 1.83172 | 1.44519 | 1.25169 | 19.27658 | 2.40819 | 3.84022 | 0.97499 |
| 1.42000 | 0.49200 | 0.65889 | 3.09360 | 1.82694 | 1.44192 | 1.24707 | 19.20547 | 2.40562 | 3.83591 | 0.97208 |
| 1.43000 | 0.49267 | 0.65892 | 3.09040 | 1.82222 | 1.43868 | 1.24250 | 19.13509 | 2.40308 | 3.83165 | 0.96920 |
| 1.44000 | 0.49333 | 0.65894 | 3.08722 | 1.81754 | 1.43546 | 1.23798 | 19.06544 | 2.40056 | 3.82744 | 0.96634 |
| 1.45000 | 0.49399 | 0.65896 | 3.08406 | 1.81291 | 1.43228 | 1.23350 | 18.99649 | 2.39806 | 3.82328 | 0.96351 |
| 1.46000 | 0.49464 | 0.65898 | 3.08093 | 1.80833 | 1.42911 | 1.22907 | 18.92823 | 2.39559 | 3.81916 | 0.96071 |
| 1.47000 | 0.49529 | 0.65900 | 3.07783 | 1.80379 | 1.42597 | 1.22468 | 18.86066 | 2.39315 | 3.81509 | 0.95792 |
| 1.48000 | 0.49594 | 0.65901 | 3.07475 | 1.79929 | 1.42286 | 1.22034 | 18.79375 | 2.39072 | 3.81107 | 0.95516 |
| 1.49000 | 0.49658 | 0.65902 | 3.07169 | 1.79483 | 1.41978 | 1.21604 | 18.72750 | 2.38832 | 3.80709 | 0.95243 |
| 1.50000 | 0.49721 | 0.65902 | 3.06865 | 1.79042 | 1.41671 | 1.21178 | 18.66190 | 2.38594 | 3.80315 | 0.94972 |
| 1.51000 | 0.49784 | 0.65903 | 3.06564 | 1.78605 | 1.41367 | 1.20756 | 18.59692 | 2.38359 | 3.79925 | 0.94703 |
| 1.52000 | 0.49846 | 0.65903 | 3.06265 | 1.78172 | 1.41066 | 1.20338 | 18.53258 | 2.38125 | 3.79540 | 0.94436 |
| 1.53000 | 0.49908 | 0.65903 | 3.05969 | 1.77742 | 1.40767 | 1.19924 | 18.46884 | 2.37894 | 3.79159 | 0.94171 |
| 1.54000 | 0.49970 | 0.65902 | 3.05674 | 1.77317 | 1.40470 | 1.19514 | 18.40571 | 2.37665 | 3.78781 | 0.93909 |
| 1.55000 | 0.50031 | 0.65902 | 3.05382 | 1.76896 | 1.40175 | 1.19108 | 18.34317 | 2.37437 | 3.78408 | 0.93649 |
| 1.56000 | 0.50092 | 0.65901 | 3.05091 | 1.76478 | 1.39883 | 1.18706 | 18.28121 | 2.37212 | 3.78038 | 0.93391 |
| 1.57000 | 0.50152 | 0.65900 | 3.04803 | 1.76064 | 1.39592 | 1.18307 | 18.21982 | 2.36989 | 3.77672 | 0.93134 |
| 1.58000 | 0.50212 | 0.65899 | 3.04517 | 1.75653 | 1.39304 | 1.17912 | 18.15899 | 2.36768 | 3.77310 | 0.92880 |
| 1.59000 | 0.50271 | 0.65897 | 3.04233 | 1.75247 | 1.39018 | 1.17521 | 18.09872 | 2.36548 | 3.76951 | 0.92628 |
| 1.60000 | 0.50330 | 0.65895 | 3.03951 | 1.74843 | 1.38734 | 1.17133 | 18.03899 | 2.36331 | 3.76596 | 0.92378 |
| 1.61000 | 0.50389 | 0.65893 | 3.03671 | 1.74443 | 1.38453 | 1.16749 | 17.97980 | 2.36115 | 3.76245 | 0.92130 |
| 1.62000 | 0.50447 | 0.65891 | 3.03392 | 1.74047 | 1.38173 | 1.16368 | 17.92114 | 2.35901 | 3.75897 | 0.91883 |
| 1.63000 | 0.50505 | 0.65889 | 3.03116 | 1.73654 | 1.37895 | 1.15990 | 17.86299 | 2.35689 | 3.75552 | 0.91639 |
| 1.64000 | 0.50562 | 0.65886 | 3.02842 | 1.73264 | 1.37619 | 1.15616 | 17.80536 | 2.35479 | 3.75210 | 0.91396 |
| 1.65000 | 0.50619 | 0.65884 | 3.02569 | 1.72878 | 1.37346 | 1.15245 | 17.74822 | 2.35270 | 3.74872 | 0.91156 |
| 1.66000 | 0.50675 | 0.65881 | 3.02298 | 1.72494 | 1.37074 | 1.14877 | 17.69158 | 2.35064 | 3.74537 | 0.90917 |
| 1.67000 | 0.50732 | 0.65877 | 3.02029 | 1.72114 | 1.36804 | 1.14513 | 17.63543 | 2.34858 | 3.74205 | 0.90679 |
| 1.68000 | 0.50787 | 0.65874 | 3.01762 | 1.71737 | 1.36536 | 1.14151 | 17.57976 | 2.34655 | 3.73876 | 0.90444 |
| 1.69000 | 0.50843 | 0.65871 | 3.01497 | 1.71363 | 1.36269 | 1.13793 | 17.52456 | 2.34453 | 3.73551 | 0.90210 |
| 1.70000 | 0.50898 | 0.65867 | 3.01233 | 1.70992 | 1.36005 | 1.13437 | 17.46982 | 2.34252 | 3.73228 | 0.89978 |
| 1.71000 | 0.50953 | 0.65863 | 3.00971 | 1.70624 | 1.35742 | 1.13085 | 17.41554 | 2.34054 | 3.72908 | 0.89748 |
| 1.72000 | 0.51007 | 0.65859 | 3.00710 | 1.70259 | 1.35481 | 1.12735 | 17.36171 | 2.33856 | 3.72591 | 0.89519 |
| 1.73000 | 0.51061 | 0.65855 | 3.00452 | 1.69897 | 1.35222 | 1.12389 | 17.30833 | 2.33661 | 3.72276 | 0.89292 |
| 1.74000 | 0.51115 | 0.65851 | 3.00195 | 1.69537 | 1.34965 | 1.12045 | 17.25538 | 2.33466 | 3.71965 | 0.89066 |
| 1.75000 | 0.51168 | 0.65846 | 2.99939 | 1.69180 | 1.34709 | 1.11704 | 17.20287 | 2.33273 | 3.71656 | 0.88842 |
| 1.76000 | 0.51221 | 0.65841 | 2.99685 | 1.68826 | 1.34455 | 1.11366 | 17.15078 | 2.33082 | 3.71350 | 0.88620 |
| 1.77000 | 0.51274 | 0.65837 | 2.99433 | 1.68475 | 1.34203 | 1.11030 | 17.09910 | 2.32892 | 3.71047 | 0.88399 |
| 1.78000 | 0.51326 | 0.65832 | 2.99182 | 1.68126 | 1.33952 | 1.10697 | 17.04784 | 2.32704 | 3.70746 | 0.88180 |
| 1.79000 | 0.51379 | 0.65826 | 2.98933 | 1.67780 | 1.33703 | 1.10367 | 16.99699 | 2.32517 | 3.70447 | 0.87962 |
| 1.80000 | 0.51430 | 0.65821 | 2.98685 | 1.67437 | 1.33455 | 1.10039 | 16.94653 | 2.32331 | 3.70151 | 0.87746 |
| 1.81000 | 0.51482 | 0.65816 | 2.98439 | 1.67096 | 1.33209 | 1.09714 | 16.89648 | 2.32146 | 3.69858 | 0.87531 |
| 1.82000 | 0.51533 | 0.65810 | 2.98194 | 1.66758 | 1.32965 | 1.09392 | 16.84681 | 2.31963 | 3.69567 | 0.87317 |

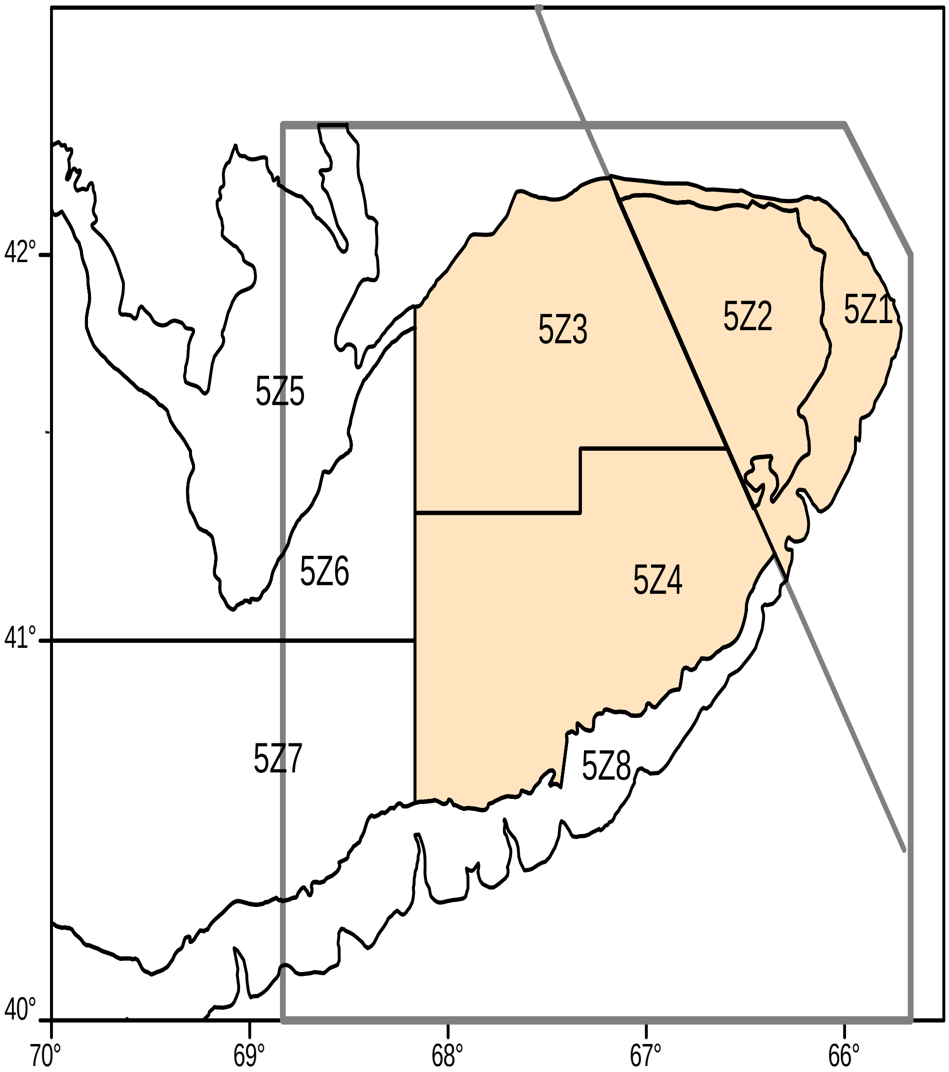
```
1.83000    0.51584    0.65805    2.97950    1.66422    1.32722    1.09072   16.79752    2.31781    3.69278    0.87105
1.84000    0.51634    0.65799    2.97708    1.66088    1.32481    1.08754   16.74861    2.31601    3.68992    0.86895
1.85000    0.51684    0.65793    2.97468    1.65757    1.32241    1.08439   16.70008    2.31422    3.68708    0.86685
1.86000    0.51734    0.65787    2.97229    1.65429    1.32002    1.08126   16.65192    2.31244    3.68426    0.86477
1.87000    0.51784    0.65781    2.96991    1.65102    1.31765    1.07816   16.60411    2.31067    3.68147    0.86271
1.88000    0.51833    0.65774    2.96754    1.64778    1.31530    1.07508   16.55667    2.30891    3.67870    0.86066
1.89000    0.51882    0.65768    2.96519    1.64456    1.31296    1.07202   16.50958    2.30717    3.67594    0.85862
1.90000    0.51931    0.65761    2.96285    1.64137    1.31063    1.06899   16.46284    2.30544    3.67321    0.85659
1.91000    0.51980    0.65755    2.96053    1.63819    1.30832    1.06597   16.41644    2.30372    3.67051    0.85458
1.92000    0.52028    0.65748    2.95822    1.63504    1.30602    1.06298   16.37038    2.30201    3.66782    0.85258
1.93000    0.52076    0.65741    2.95592    1.63191    1.30374    1.06001   16.32466    2.30031    3.66515    0.85059
1.94000    0.52124    0.65734    2.95363    1.62880    1.30146    1.05707   16.27927    2.29862    3.66250    0.84862
1.95000    0.52171    0.65727    2.95136    1.62572    1.29920    1.05414   16.23420    2.29695    3.65987    0.84665
1.96000    0.52218    0.65720    2.94910    1.62265    1.29696    1.05123   16.18946    2.29528    3.65726    0.84470
1.97000    0.52265    0.65713    2.94685    1.61960    1.29473    1.04835   16.14503    2.29363    3.65467    0.84276
1.98000    0.52312    0.65705    2.94461    1.61657    1.29251    1.04549   16.10092    2.29198    3.65210    0.84084
1.99000    0.52359    0.65698    2.94238    1.61357    1.29030    1.04264   16.05712    2.29035    3.64955    0.83892
2.00000    0.52405    0.65690    2.94017    1.61058    1.28811    1.03982   16.01362    2.28873    3.64701    0.83702
```

# Appendix C. Georges Bank yellowtail flounder

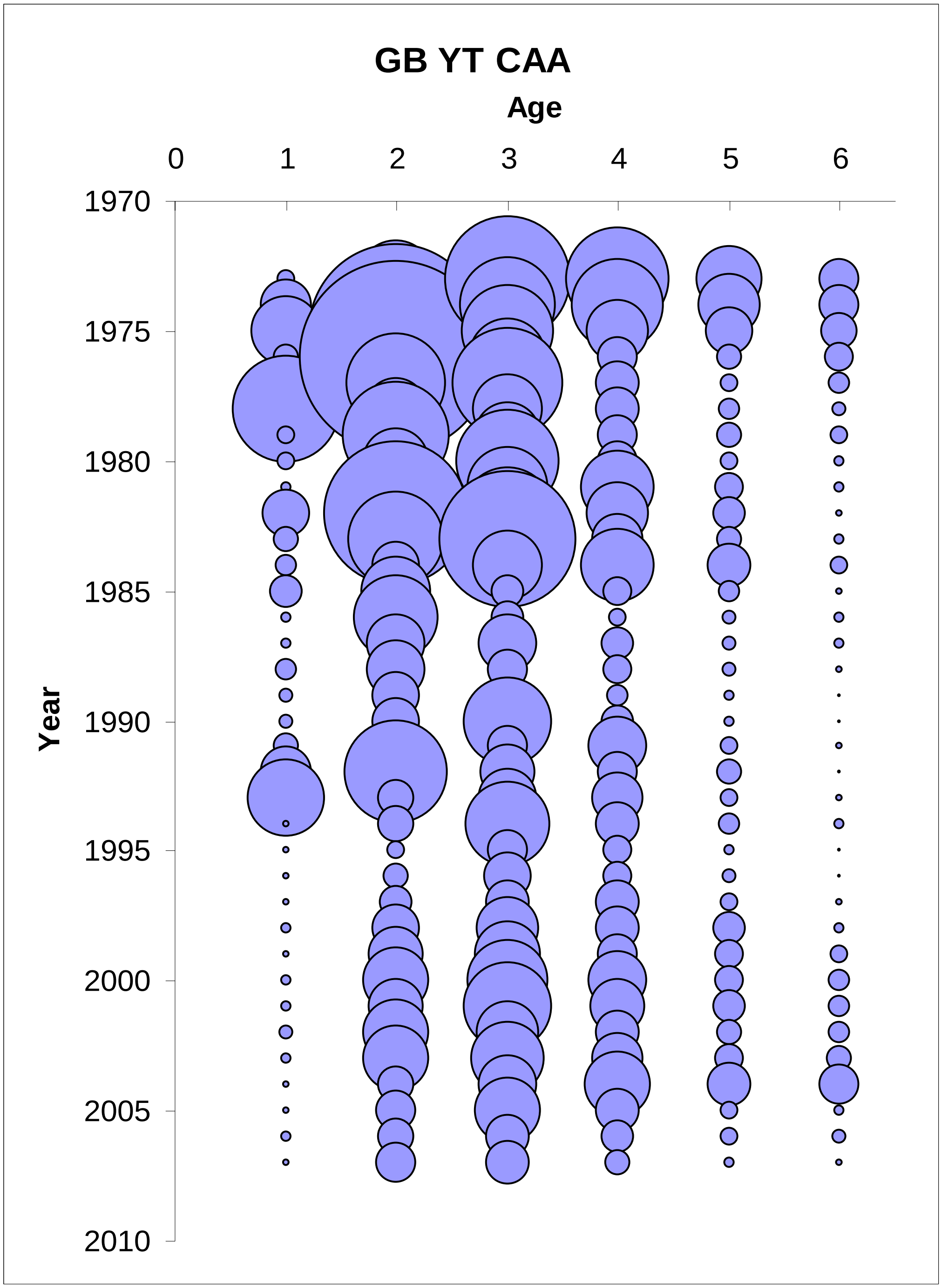
by Chris Legault, Larry Alade, Heath Stone, Stratis Gavaris, and Christa Waters



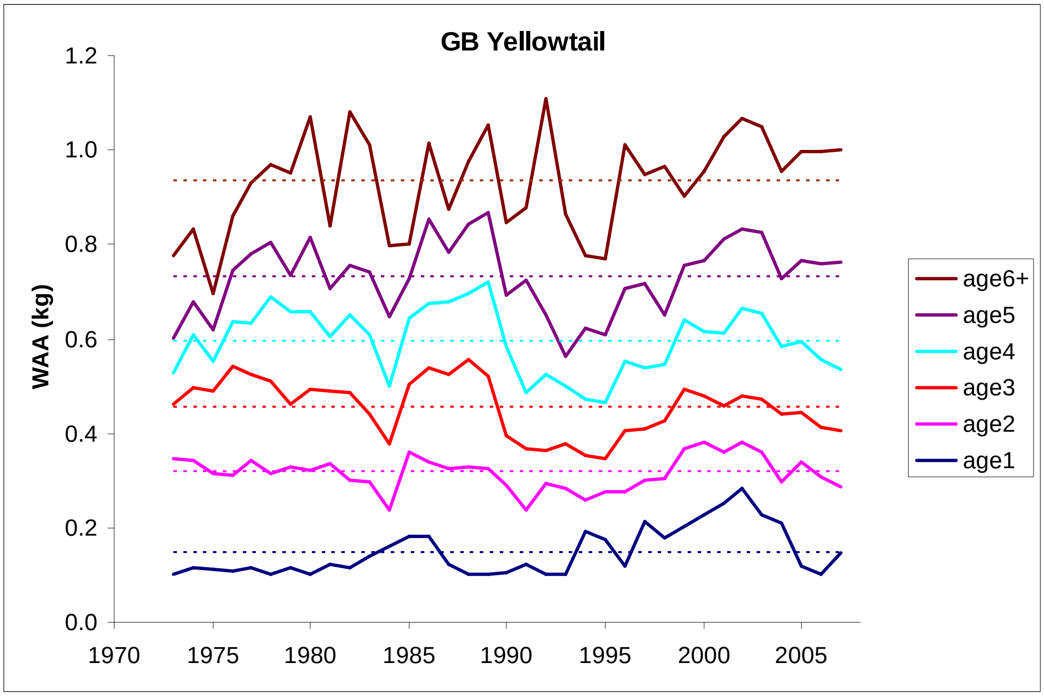
Appendix Figure C.1. Offshore Survey strata (13-21) used by NEFSC to estimate spring and fall survey indices [Left] for Georges Bank yellowtail flounder and commercial statistical areas [Right] for all three yellowtail flounder stocks.



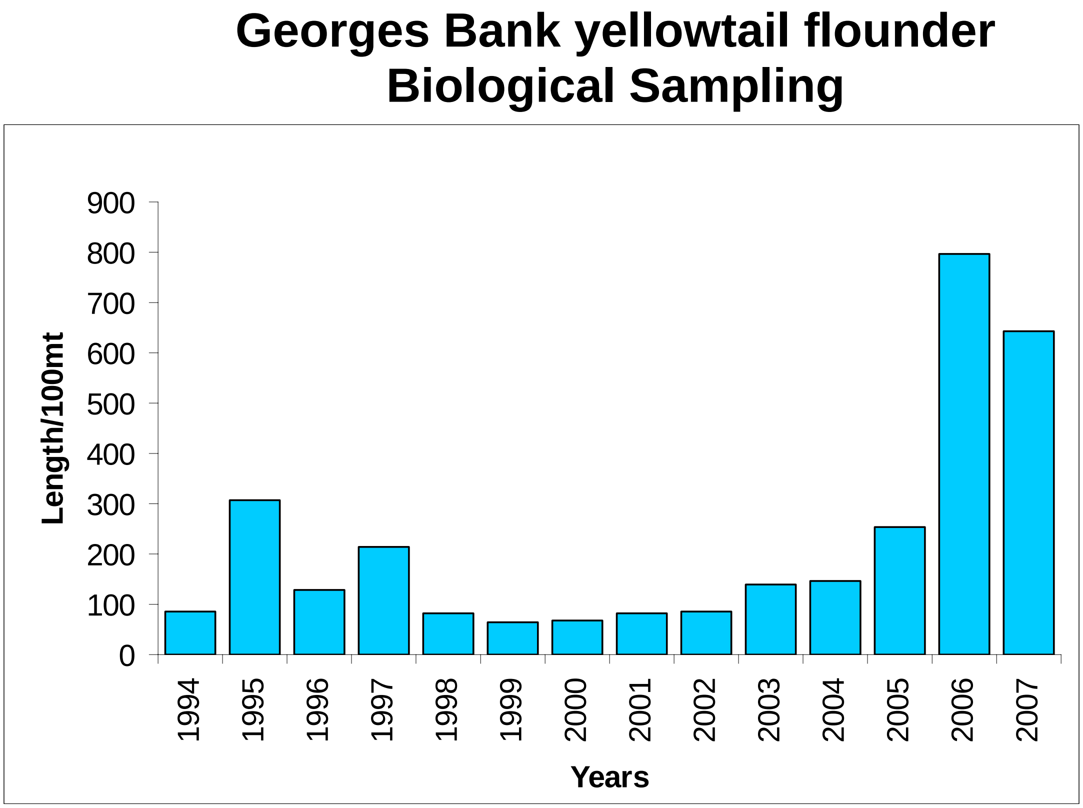
Appendix Figure C.2 Canadian Department of Fisheries and Oceans (DFO) winter survey strata , 5Z1-5Z4 for Georges Bank yellowtail flounder.



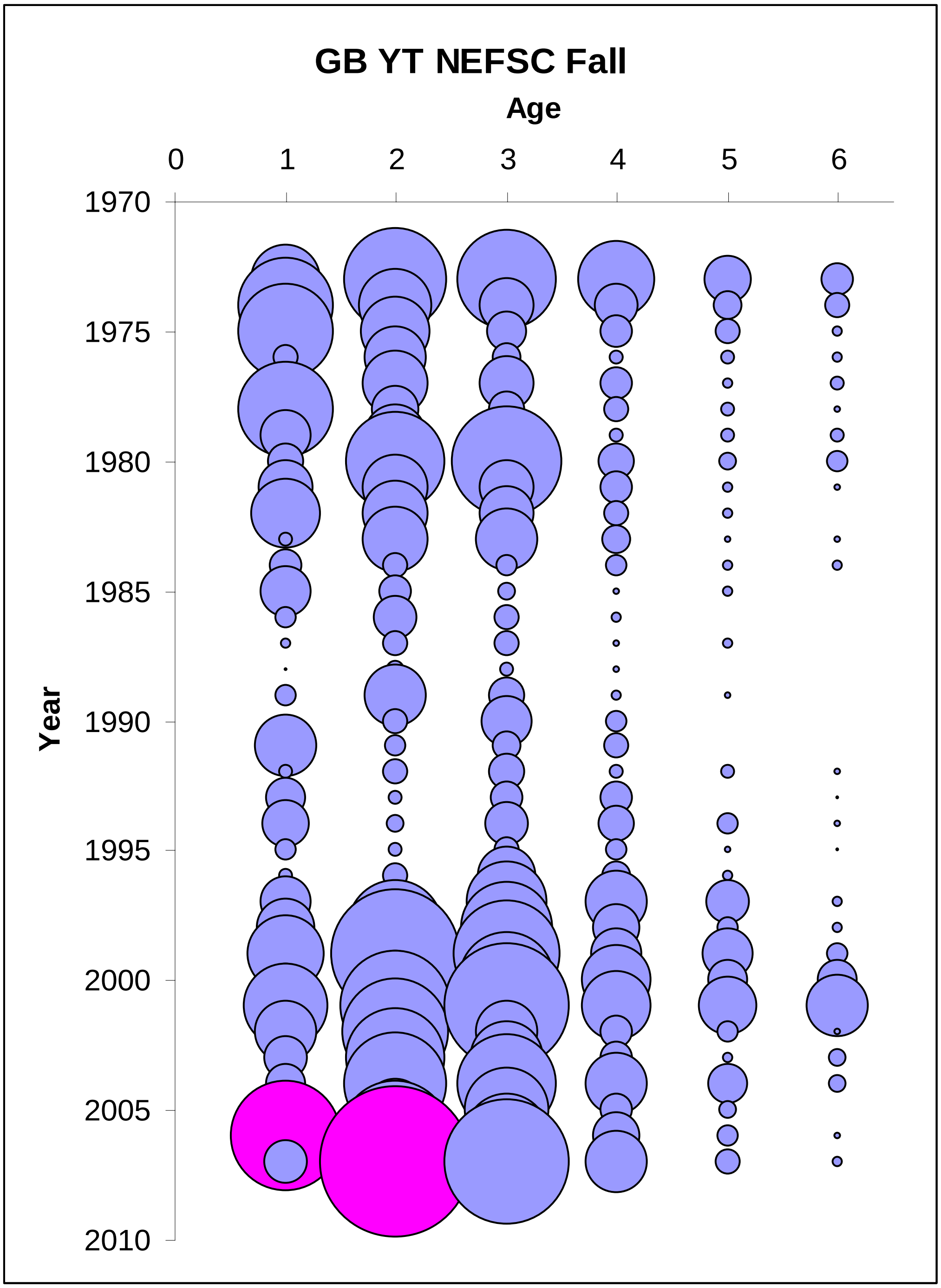
Appendix Figure C.3 Catch at age bubble plot for Georges Bank yellowtail flounder.



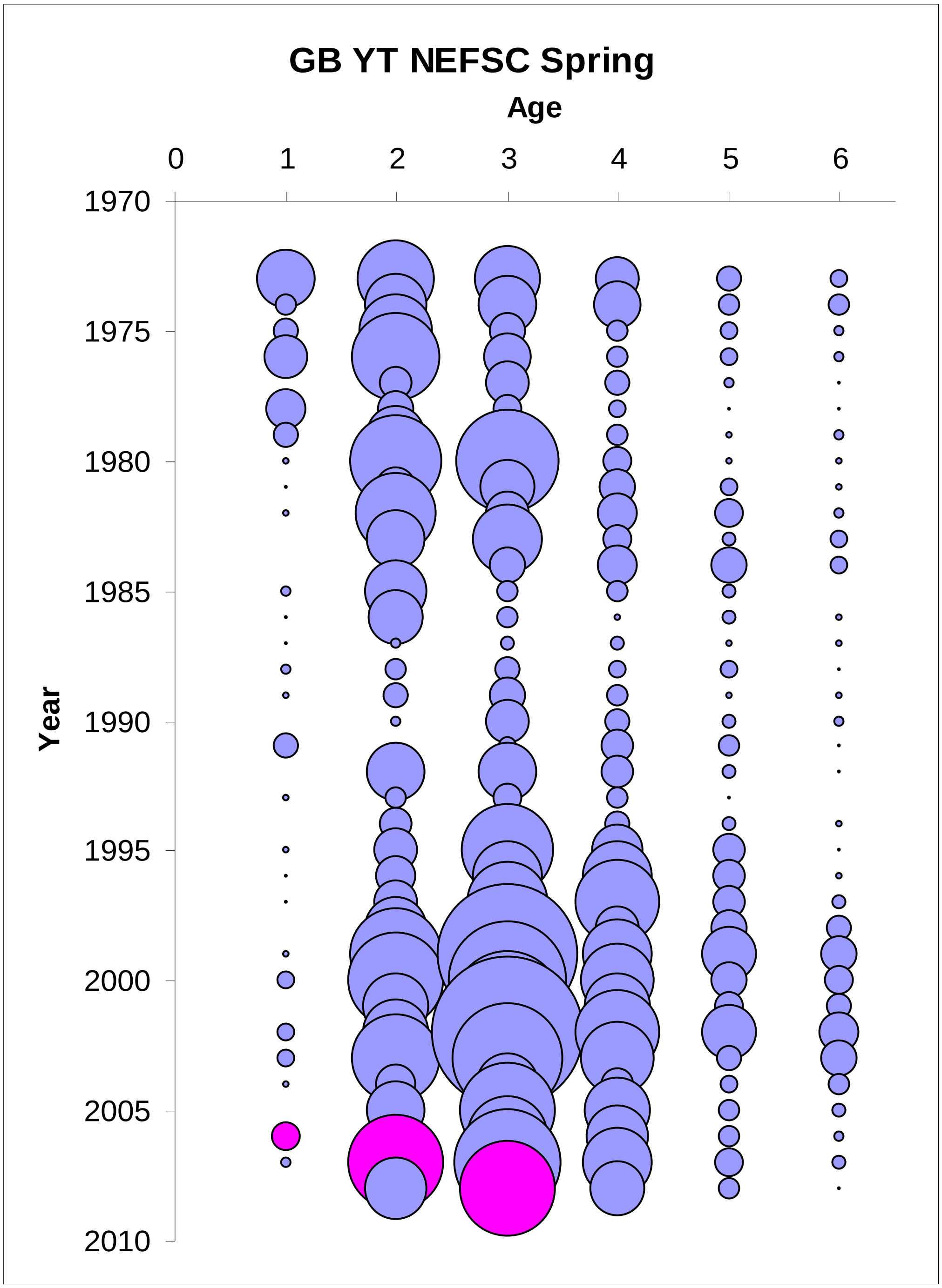
Appendix Figure C.4 Catch weight at age (kg) for Georges Bank yellowtail flounder.



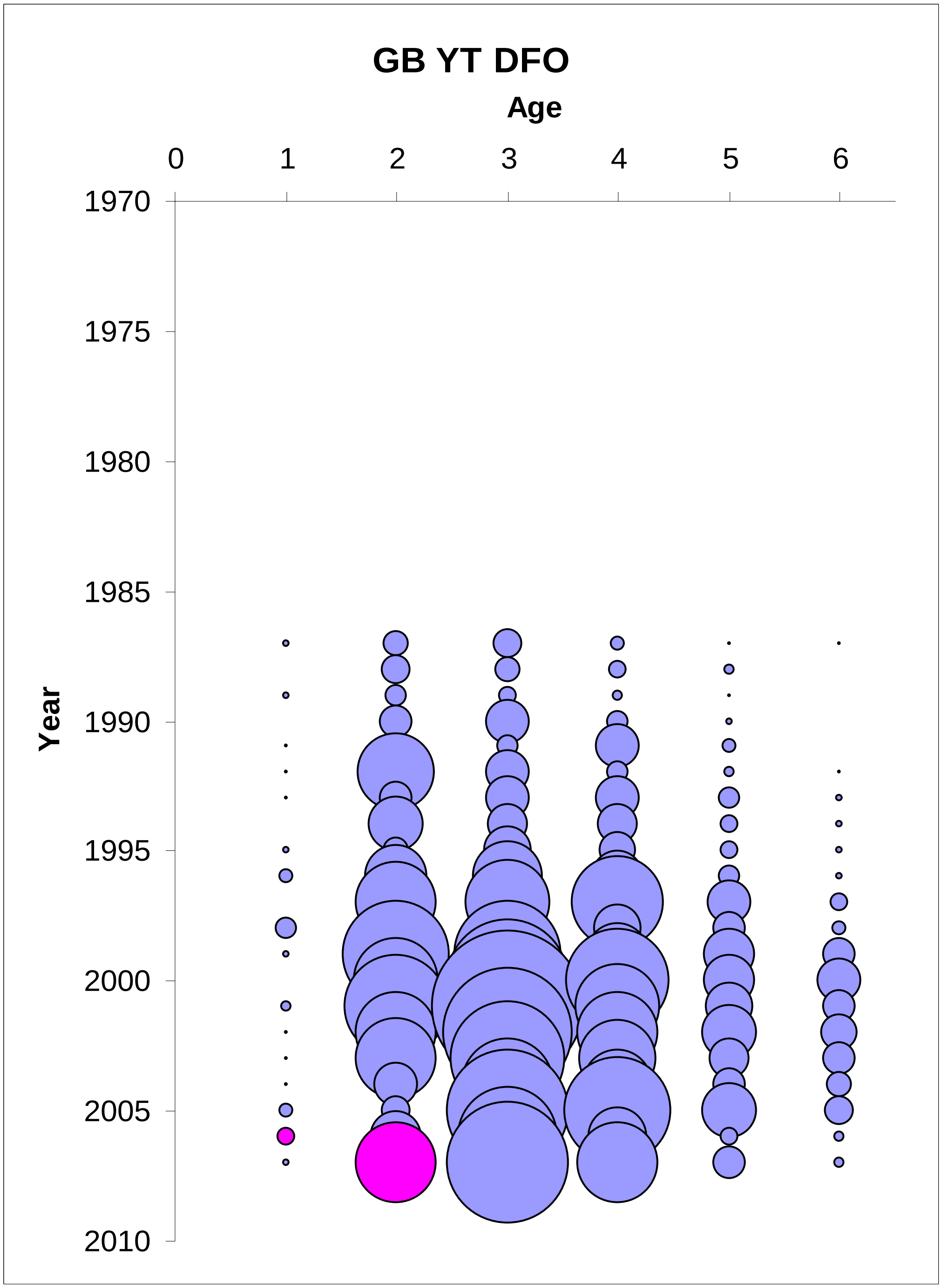
Appendix Figure C.5. Biological sampling for Georges Bank yellowtail flounder.



Appendix Figure C.6.a Survey bubble plot for GB yellowtail NEFSC Fall survey. Note the 2005 year class is highlighted in pink.

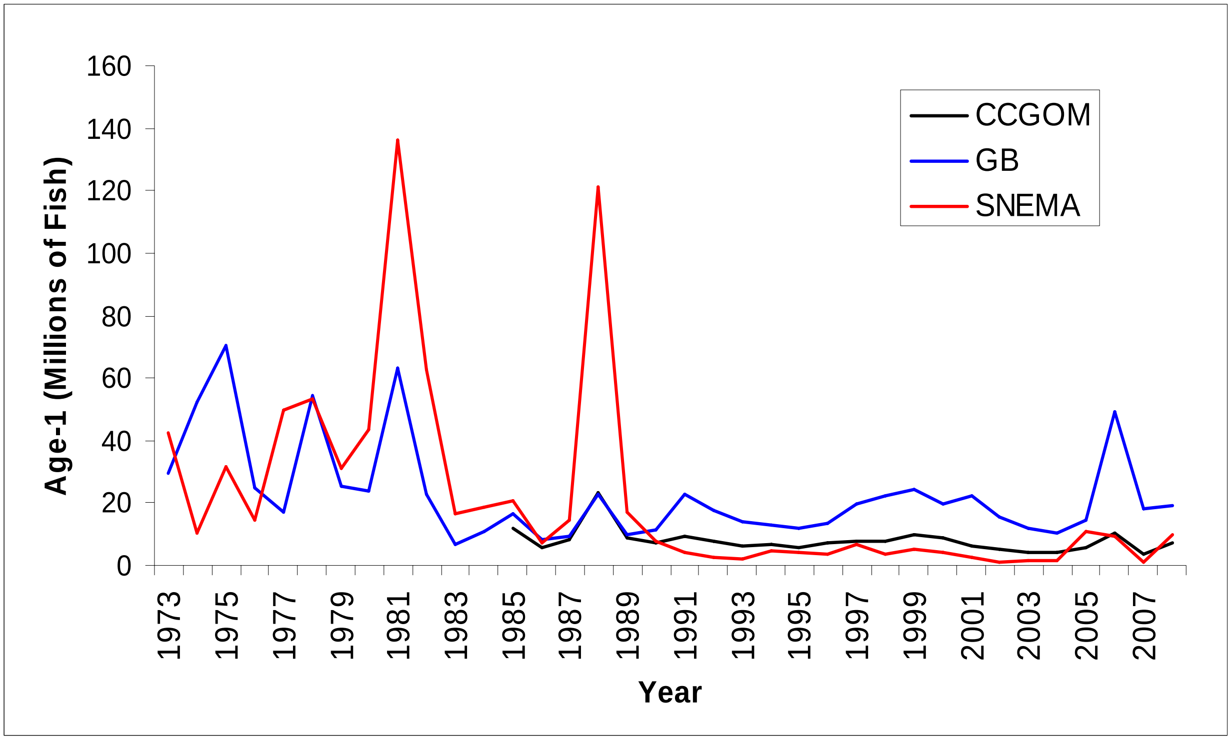


Appendix Figure C.6.b Survey bubble plot for GB yellowtail NEFSC Spring survey. Note the 2005 year class is highlighted in pink.

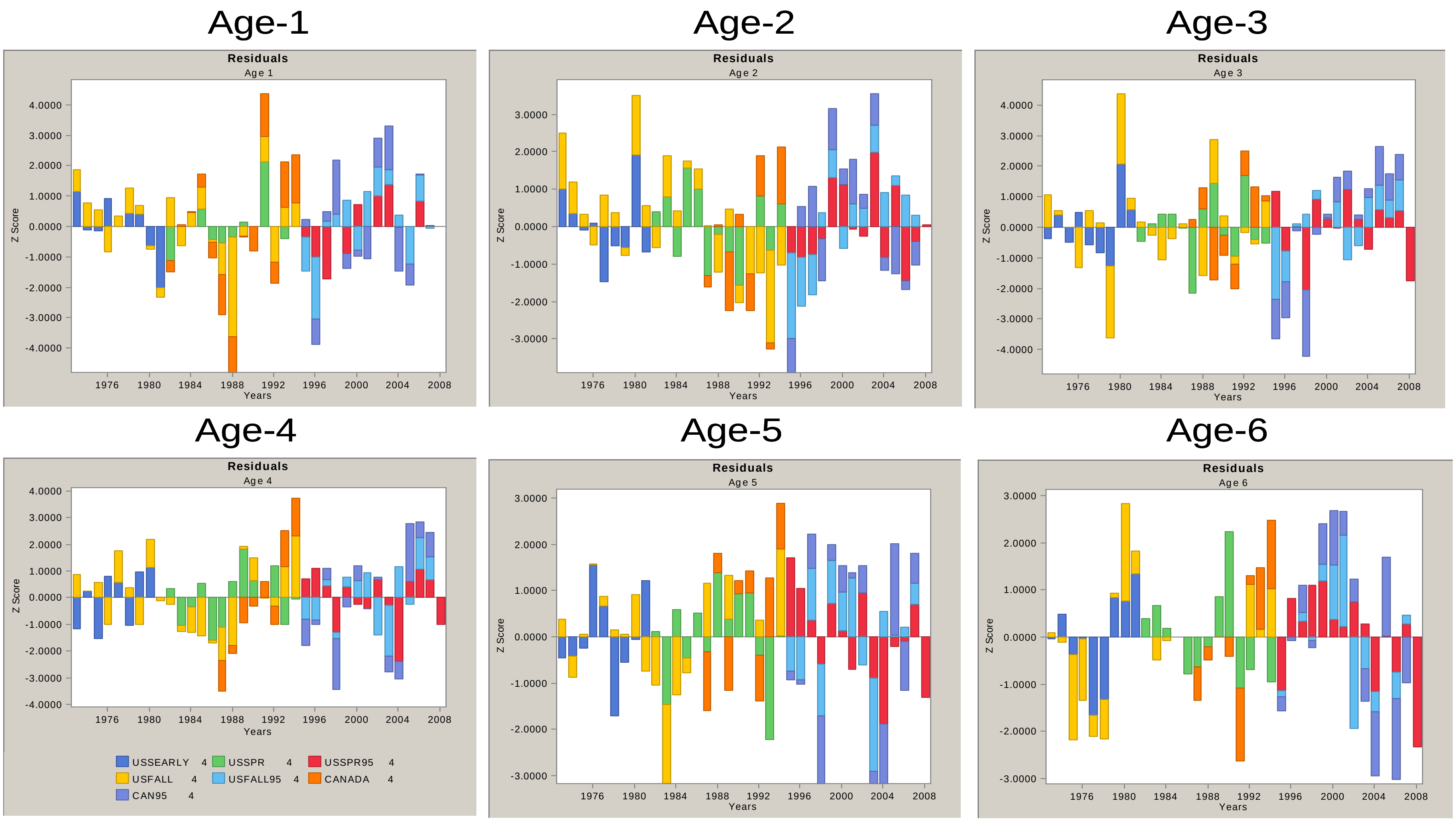


Appendix Figure C.6.c Survey bubble plot for GB yellowtail DFO survey. Note the 2005 year class is highlighted in pink.

## Age-1 Recruitment



Appendix Figure C.7. Comparison of recruitment trends from the three yellowtail flounder stocks.


Age-1

Age-2

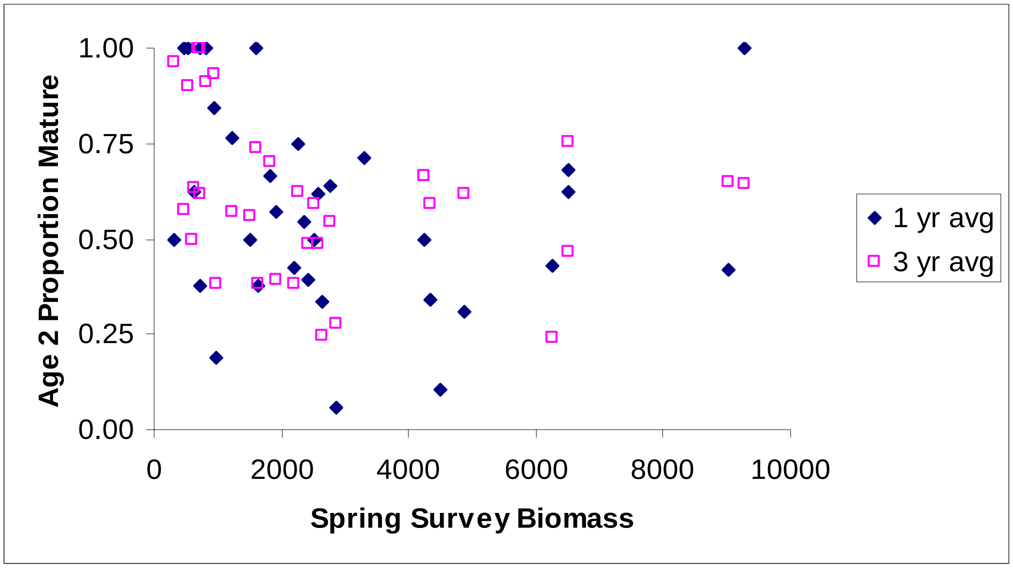
Age-3

Age-4

Age-5

Age-6

Appendix Figure C.8. Standardized residuals for all indices by age



Appendix Figure C.9. Comparison of age-2 maturity to total spring biomass index showing an independence between abundance and maturity. The solid diamonds are annual estimates of age-2 maturity while the open squares are three year averages of age-2 maturity.

## Appendix VPA Output Report

```
VPA Version 2.8.0

Model ID: Georges Bank yellowtail flounder Major Change model  DFO 2008 survey not
include


Input File:
C:\WORKING\ASSESSMENTS\GARM3THEFINALE\YTASSESSMENTS\GB\VPA\MAJORCHANGE_NO2008DFO
Date of Run: 10-JUL-2008                         Time of Run: 01:27


Levenburg-Marquardt Algorithm Completed    24 Iterations
Residual Sum of Squares =     304.527

Number of Residuals     =    527
Number of Parameters    =      4
Degrees of Freedom      =    523
Mean Squared Residual   =     0.582269
Standard Deviation      =     0.763066


Number of Years =    35
Number of Ages  =     6
First Year      =  1973
Youngest Age    =     1
Oldest True Age =     5

Number of Survey Indices Available        =    44
Number of Survey Indices Used in Estimate =    42


VPA Classic Method - Auto Estimated Q's


Stock Numbers Predicted in Terminal Year Plus One (2008)
Age    Stock Predicted     Std. Error      CV

  2          14994.456   0.692698E+04   0.461969E+00
  3          31703.890   0.989341E+04   0.312057E+00
  4           5338.999   0.184456E+04   0.345489E+00
  5           1875.118   0.475791E+03   0.253739E+00

Catchability Values for Each Survey Used in Estimate
INDEX     Catchability    Std. Error      CV

  1       0.746089E-02   0.488991E-02   0.655406E+00
  2       0.755206E-01   0.140767E-01   0.186396E+00
  3       0.956073E-01   0.168706E-01   0.176457E+00
  4       0.926548E-01   0.115114E-01   0.124240E+00
  5       0.760134E-01   0.154063E-01   0.202679E+00
  6       0.720239E-01   0.226512E-01   0.314496E+00
  7       0.423531E-02   0.103998E-02   0.245551E+00
  8       0.455643E-01   0.144064E-01   0.316177E+00
  9       0.954470E-01   0.152217E-01   0.159478E+00
 10       0.152428E+00   0.200966E-01   0.131843E+00
 11       0.228532E+00   0.460786E-01   0.201629E+00
 12       0.422932E+00   0.931600E-01   0.220272E+00
 13       0.458156E-02   0.135354E-02   0.295431E+00
 14       0.143683E+00   0.165030E-01   0.114857E+00
 15       0.499530E+00   0.884174E-01   0.177001E+00
 16       0.593361E+00   0.988542E-01   0.166600E+00
 17       0.480729E+00   0.108514E+00   0.225728E+00
 18       0.391240E+00   0.921357E-01   0.235497E+00
 19       0.396438E-01   0.100565E-01   0.253671E+00
```

```
 20       0.875114E-01   0.142533E-01   0.162874E+00
 21       0.150362E+00   0.158113E-01   0.105155E+00
 22       0.156082E+00   0.215926E-01   0.138341E+00
 23       0.204982E+00   0.410944E-01   0.200478E+00
 24       0.306257E+00   0.653913E-01   0.213518E+00
 25       0.654075E-01   0.150808E-01   0.230567E+00
 26       0.212258E+00   0.737061E-01   0.347248E+00
 27       0.556137E+00   0.108427E+00   0.194965E+00
 28       0.471055E+00   0.826395E-01   0.175435E+00
 29       0.490130E+00   0.127709E+00   0.260561E+00
 30       0.361645E+00   0.131052E+00   0.362377E+00
 32       0.229939E-03   0.738135E-04   0.321013E+00
 33       0.369401E-03   0.535163E-04   0.144873E+00
 34       0.619069E-03   0.114554E-03   0.185042E+00
 35       0.693342E-03   0.154791E-03   0.223253E+00
 36       0.402918E-03   0.101179E-03   0.251116E+00
 38       0.496646E-03   0.106388E-03   0.214214E+00
 39       0.206205E-02   0.317553E-03   0.153999E+00
 40       0.263975E-02   0.360480E-03   0.136558E+00
 41       0.240473E-02   0.440468E-03   0.183167E+00
 42       0.186002E-02   0.338706E-03   0.182098E+00
 43       0.233364E-04   0.687469E-05   0.294590E+00
 44       0.539497E-04   0.469360E-05   0.869995E-01


-- Non-Linear Least Squares Fit --

Default Tolerances Used

Scaled Gradient Tolerance      =    6.055454E-06
Scaled Step Tolerance          =    3.666853E-11
Relative Function Tolerance    =    3.666853E-11
Absolute Function Tolerance    =    4.930381E-32


VPA Method Options

- Catchability Values Estimated as an Analytic Function of N
- Catch Equation Used in Cohort Solution
- Plus Group Backward Calculation Method Used
- Rivard Weights Used for JAN-1 Biomass
- Rivard Weights Calculation Used  3 Years for Terminal Year Plus One

- Heincke Rule Used in F-Oldest Calculation
- F-Oldest Calculation in Years Prior to Terminal Year
  Uses Stock Sizes in Ages  4 to  5
- Calculation of Population of Age 1 In Year 2008
  =  Geometric Mean of First Age Populations
     Year Range Applied =  1973 to  2007

Stock Estimates

Age   2
Age   3
Age   4
Age   5

Full F in Terminal Year               =   0.2892

F in Oldest True Age in Terminal Year =   0.2892

Full F Calculated Using Classic Method

Age  Input Partial  Calc Partial   Fishing     Used In
     Recruitment    Recruitment    Mortality   Full F    Comments

  1      0.000          0.011       0.0032      NO      Stock Estimate in T+1
```

```
  2      0.030          0.141       0.0408      NO      Stock Estimate in T+1
  3      0.630          0.900       0.2603      NO      Stock Estimate in T+1
  4      1.000          1.000       0.2892      YES     Stock Estimate in T+1
  5      1.000          1.000       0.2892              Input PR * Full F


Catch At Age - Input Data


  AGE        1973        1974        1975        1976        1977
 ____________________________________________________________________

   1        359.3      2367.5      4636.2       635.1       377.9
   2       5175.0      9500.0     26393.9     31938.1      9094.2
   3      13565.3      8294.2      7375.1      5501.9     10567.1
   4       9473.0      7657.9      3540.2      1425.7      1846.2
   5       3814.6      3642.6      2175.2       574.2       418.6
   6       1649.7      1519.6      1207.2       918.1       495.0

  AGE        1978        1979        1980        1981        1982
 ____________________________________________________________________

   1       9962.0       320.6       317.8       107.4      2163.5
   2       3542.1     10516.6      3994.4      1097.1     18091.3
   3       4579.7      3789.4      9685.3      5963.4      7480.3
   4       1913.8      1432.1      1538.4      4920.2      3400.5
   5        539.5       623.0       351.9       854.4      1095.2
   6        210.8       324.6       112.6       145.3        95.8

  AGE        1983        1984        1985        1986        1987
 ____________________________________________________________________

   1        702.8       514.3       970.3       178.8       156.4
   2       7998.1      2017.7      4373.6      6402.1      3284.2
   3      16660.9      4534.6      1057.6      1127.5      3136.7
   4       2475.9      5043.0       818.4       388.8       983.3
   5        679.6      1796.3       516.6       203.6       192.3
   6        154.6       379.5        80.7       113.4       137.3

  AGE        1988        1989        1990        1991        1992
 ____________________________________________________________________

   1        499.0       189.8       230.6       663.3      2413.9
   2       3002.6      2175.4      2114.4       147.3      9167.4
   3       1544.1      1120.6      6995.7      1491.2      2971.5
   4        846.1       428.2       978.3      3011.1      1473.0
   5        227.0       110.1       140.2       383.2       603.1
   6         53.3        30.4        26.1        71.2        42.0

  AGE        1993        1994        1995        1996        1997
 ____________________________________________________________________

   1       5233.5        71.2        46.9       100.6        81.8
   2       1385.8      1336.3       312.7       680.9      1132.3
   3       3326.9      6302.4      1435.3      2064.3      1832.4
   4       2325.5      1819.3       878.6       885.0      1856.8
   5        411.0       476.7       170.1       201.2       378.2
   6         90.5       143.9        36.9        27.6        89.6
```

**Catch At Age - Input Data**

| AGE | 1998 | 1999 | 2000 | 2001 | 2002 |
|---|---|---|---|---|---|
| 1 | 168.5 | 60.1 | 131.8 | 175.9 | 211.9 |
| 2 | 1991.4 | 2752.9 | 3863.5 | 2883.5 | 4168.9 |
| 3 | 3387.8 | 4195.0 | 5713.9 | 6956.4 | 3446.3 |
| 4 | 1884.9 | 1547.6 | 3173.0 | 2893.2 | 1915.8 |
| 5 | 1121.3 | 793.5 | 826.3 | 1003.9 | 683.0 |
| 6 | 146.2 | 301.4 | 528.5 | 525.1 | 485.3 |

| AGE | 2003 | 2004 | 2005 | 2006 | 2007 |
|---|---|---|---|---|---|
| 1 | 159.7 | 63.9 | 59.9 | 153.9 | 53.0 |
| 2 | 3919.1 | 1201.3 | 1528.8 | 1300.2 | 1463.5 |
| 3 | 4710.0 | 3170.8 | 4086.2 | 1697.7 | 1764.9 |
| 4 | 2319.9 | 3803.8 | 1712.5 | 1003.0 | 699.5 |
| 5 | 782.4 | 1970.1 | 411.3 | 373.2 | 142.2 |
| 6 | 693.5 | 1450.7 | 178.1 | 214.0 | 57.6 |

**Weight At Age - Input Data**

| AGE | 1973 | 1974 | 1975 | 1976 | 1977 |
|---|---|---|---|---|---|
| 1 | 0.1010 | 0.1150 | 0.1130 | 0.1080 | 0.1160 |
| 2 | 0.3480 | 0.3440 | 0.3160 | 0.3120 | 0.3420 |
| 3 | 0.4620 | 0.4960 | 0.4890 | 0.5440 | 0.5240 |
| 4 | 0.5270 | 0.6070 | 0.5540 | 0.6350 | 0.6330 |
| 5 | 0.6030 | 0.6780 | 0.6190 | 0.7440 | 0.7800 |
| 6 | 0.7780 | 0.8320 | 0.6950 | 0.8610 | 0.9310 |

| AGE | 1978 | 1979 | 1980 | 1981 | 1982 |
|---|---|---|---|---|---|
| 1 | 0.1020 | 0.1140 | 0.1010 | 0.1220 | 0.1150 |
| 2 | 0.3140 | 0.3290 | 0.3220 | 0.3350 | 0.3010 |
| 3 | 0.5100 | 0.4620 | 0.4930 | 0.4890 | 0.4850 |
| 4 | 0.6900 | 0.6560 | 0.6560 | 0.6040 | 0.6500 |
| 5 | 0.8030 | 0.7360 | 0.8160 | 0.7070 | 0.7540 |
| 6 | 0.9700 | 0.9500 | 1.0720 | 0.8400 | 1.0820 |

| AGE | 1983 | 1984 | 1985 | 1986 | 1987 |
|---|---|---|---|---|---|
| 1 | 0.1400 | 0.1620 | 0.1810 | 0.1810 | 0.1210 |
| 2 | 0.2960 | 0.2390 | 0.3610 | 0.3410 | 0.3240 |
| 3 | 0.4410 | 0.3790 | 0.5050 | 0.5400 | 0.5240 |
| 4 | 0.6070 | 0.5000 | 0.6420 | 0.6740 | 0.6800 |
| 5 | 0.7400 | 0.6470 | 0.7290 | 0.8540 | 0.7840 |
| 6 | 1.0100 | 0.7970 | 0.8000 | 1.0150 | 0.8750 |

| AGE | 1988 | 1989 | 1990 | 1991 | 1992 |
|---|---|---|---|---|---|
| 1 | 0.1030 | 0.1000 | 0.1050 | 0.1210 | 0.1010 |
| 2 | 0.3280 | 0.3270 | 0.2900 | 0.2370 | 0.2930 |
| 3 | 0.5570 | 0.5200 | 0.3950 | 0.3690 | 0.3650 |
| 4 | 0.6960 | 0.7200 | 0.5850 | 0.4860 | 0.5260 |
| 5 | 0.8440 | 0.8660 | 0.6930 | 0.7230 | 0.6510 |
| 6 | 0.9750 | 1.0530 | 0.8450 | 0.8770 | 1.1100 |

| AGE | 1993 | 1994 | 1995 | 1996 | 1997 |
|---|---|---|---|---|---|
| 1 | 0.1000 | 0.1930 | 0.1740 | 0.1190 | 0.2140 |
| 2 | 0.2850 | 0.2600 | 0.2750 | 0.2760 | 0.3020 |
| 3 | 0.3790 | 0.3530 | 0.3470 | 0.4070 | 0.4080 |
| 4 | 0.5010 | 0.4720 | 0.4650 | 0.5520 | 0.5380 |
| 5 | 0.5640 | 0.6210 | 0.6070 | 0.7070 | 0.7180 |
| 6 | 0.8630 | 0.7750 | 0.7680 | 1.0120 | 0.9470 |

### Weight At Age - Input Data

| AGE | 1998 | 1999 | 2000 | 2001 | 2002 |
|---|---|---|---|---|---|
| 1 | 0.1780 | 0.2020 | 0.2290 | 0.2510 | 0.2820 |
| 2 | 0.3050 | 0.3680 | 0.3830 | 0.3620 | 0.3810 |
| 3 | 0.4280 | 0.4950 | 0.4800 | 0.4600 | 0.4800 |
| 4 | 0.5460 | 0.6400 | 0.6150 | 0.6120 | 0.6650 |
| 5 | 0.6490 | 0.7550 | 0.7660 | 0.8120 | 0.8330 |
| 6 | 0.9660 | 0.9010 | 0.9540 | 1.0270 | 1.0680 |

| AGE | 2003 | 2004 | 2005 | 2006 | 2007 |
|---|---|---|---|---|---|
| 1 | 0.2280 | 0.2110 | 0.1190 | 0.1000 | 0.1480 |
| 2 | 0.3590 | 0.2960 | 0.3410 | 0.3090 | 0.2880 |
| 3 | 0.4740 | 0.4400 | 0.4450 | 0.4110 | 0.4060 |
| 4 | 0.6530 | 0.5860 | 0.5940 | 0.5550 | 0.5360 |
| 5 | 0.8240 | 0.7280 | 0.7670 | 0.7600 | 0.7640 |
| 6 | 1.0480 | 0.9560 | 0.9970 | 0.9980 | 1.0020 |

### JAN-1 Weights at Age - Input Data

| AGE | 1973 | 1974 | 1975 | 1976 | 1977 |
|---|---|---|---|---|---|
| 1 | 0.0547 | 0.0694 | 0.0680 | 0.0607 | 0.0705 |
| 2 | 0.2915 | 0.1864 | 0.1906 | 0.1878 | 0.1922 |
| 3 | 0.4031 | 0.4155 | 0.4101 | 0.4146 | 0.4043 |
| 4 | 0.4646 | 0.5296 | 0.5242 | 0.5572 | 0.5868 |
| 5 | 0.5637 | 0.5978 | 0.6130 | 0.6420 | 0.7038 |
| 6 | 0.7780 | 0.8320 | 0.6950 | 0.8610 | 0.9310 |

| AGE | 1978 | 1979 | 1980 | 1981 | 1982 |
|---|---|---|---|---|---|
| 1 | 0.0568 | 0.0678 | 0.0555 | 0.0777 | 0.0717 |
| 2 | 0.1909 | 0.1832 | 0.1916 | 0.1839 | 0.1916 |
| 3 | 0.4176 | 0.3809 | 0.4027 | 0.3968 | 0.4031 |
| 4 | 0.6013 | 0.5784 | 0.5505 | 0.5457 | 0.5638 |
| 5 | 0.7130 | 0.7126 | 0.7316 | 0.6810 | 0.6748 |
| 6 | 0.9700 | 0.9500 | 1.0720 | 0.8400 | 1.0820 |

| AGE | 1983 | 1984 | 1985 | 1986 | 1987 |
|---|---|---|---|---|---|
| 1 | 0.1072 | 0.1085 | 0.1319 | 0.1353 | 0.0735 |
| 2 | 0.1845 | 0.1829 | 0.2418 | 0.2484 | 0.2422 |
| 3 | 0.3643 | 0.3349 | 0.3474 | 0.4415 | 0.4227 |
| 4 | 0.5426 | 0.4696 | 0.4933 | 0.5834 | 0.6060 |
| 5 | 0.6935 | 0.6267 | 0.6037 | 0.7405 | 0.7269 |
| 6 | 1.0100 | 0.7970 | 0.8000 | 1.0150 | 0.8750 |

```
 AGE      1988      1989      1990      1991      1992
────────────────────────────────────────────────────────

  1      0.0578    0.0587    0.0699    0.0778    0.0601
  2      0.1992    0.1835    0.1703    0.1577    0.1883
  3      0.4248    0.4130    0.3594    0.3271    0.2941
  4      0.6039    0.6333    0.5515    0.4381    0.4406
  5      0.7576    0.7764    0.7064    0.6503    0.5625
  6      0.9750    1.0530    0.8450    0.8770    1.1100

 AGE      1993      1994      1995      1996      1997
────────────────────────────────────────────────────────

  1      0.0620    0.1617    0.1382    0.0747    0.1793
  2      0.1697    0.1612    0.2304    0.2191    0.1896
  3      0.3332    0.3172    0.3004    0.3346    0.3356
  4      0.4276    0.4230    0.4051    0.4377    0.4679
  5      0.5447    0.5578    0.5353    0.5734    0.6296
  6      0.8630    0.7750    0.7680    1.0120    0.9470


JAN-1 Weights at Age - Input Data


 AGE      1998      1999      2000      2001      2002
────────────────────────────────────────────────────────

  1      0.1238    0.1467    0.1821    0.2037    0.2499
  2      0.2555    0.2559    0.2781    0.2879    0.3092
  3      0.3595    0.3886    0.4203    0.4197    0.4168
  4      0.4720    0.5234    0.5517    0.5420    0.5531
  5      0.5909    0.6421    0.7002    0.7067    0.7140
  6      0.9660    0.9010    0.9540    1.0270    1.0680

 AGE      2003      2004      2005      2006      2007
────────────────────────────────────────────────────────

  1      0.2001    0.1660    0.0738    0.0589    0.1291
  2      0.3182    0.2598    0.2682    0.1918    0.1697
  3      0.4250    0.3974    0.3629    0.3744    0.3542
  4      0.5599    0.5270    0.5112    0.4970    0.4694
  5      0.7402    0.6895    0.6704    0.6719    0.6512
  6      1.0480    0.9560    0.9970    0.9980    1.0020

 AGE      2008
────────────────────────────────────────────────────────

  1      0.0873
  2      0.2099
  3      0.3638
  4      0.4925
  5      0.6645
  6      0.9990
```

```
SSB Weight At Age - Input Data

  AGE       1973        1974        1975        1976        1977
---------------------------------------------------------------------

   1       0.1010      0.1150      0.1130      0.1080      0.1160
   2       0.3480      0.3440      0.3160      0.3120      0.3420
   3       0.4620      0.4960      0.4890      0.5440      0.5240
   4       0.5270      0.6070      0.5540      0.6350      0.6330
   5       0.6030      0.6780      0.6190      0.7440      0.7800
   6       0.7780      0.8320      0.6950      0.8610      0.9310

  AGE       1978        1979        1980        1981        1982
---------------------------------------------------------------------

   1       0.1020      0.1140      0.1010      0.1220      0.1150
   2       0.3140      0.3290      0.3220      0.3350      0.3010
   3       0.5100      0.4620      0.4930      0.4890      0.4850
   4       0.6900      0.6560      0.6560      0.6040      0.6500
   5       0.8030      0.7360      0.8160      0.7070      0.7540
   6       0.9700      0.9500      1.0720      0.8400      1.0820

  AGE       1983        1984        1985        1986        1987
---------------------------------------------------------------------

   1       0.1400      0.1620      0.1810      0.1810      0.1210
   2       0.2960      0.2390      0.3610      0.3410      0.3240
   3       0.4410      0.3790      0.5050      0.5400      0.5240
   4       0.6070      0.5000      0.6420      0.6740      0.6800
   5       0.7400      0.6470      0.7290      0.8540      0.7840
   6       1.0100      0.7970      0.8000      1.0150      0.8750

  AGE       1988        1989        1990        1991        1992
---------------------------------------------------------------------

   1       0.1030      0.1000      0.1050      0.1210      0.1010
   2       0.3280      0.3270      0.2900      0.2370      0.2930
   3       0.5570      0.5200      0.3950      0.3690      0.3650
   4       0.6960      0.7200      0.5850      0.4860      0.5260
   5       0.8440      0.8660      0.6930      0.7230      0.6510
   6       0.9750      1.0530      0.8450      0.8770      1.1100

  AGE       1993        1994        1995        1996        1997
---------------------------------------------------------------------

   1       0.1000      0.1930      0.1740      0.1190      0.2140
   2       0.2850      0.2600      0.2750      0.2760      0.3020
   3       0.3790      0.3530      0.3470      0.4070      0.4080
   4       0.5010      0.4720      0.4650      0.5520      0.5380
   5       0.5640      0.6210      0.6070      0.7070      0.7180
   6       0.8630      0.7750      0.7680      1.0120      0.9470
```

```
SSB Weight At Age - Input Data

  AGE      1998        1999        2000        2001        2002
_____________________________________________________________________

   1      0.1780      0.2020      0.2290      0.2510      0.2820
   2      0.3050      0.3680      0.3830      0.3620      0.3810
   3      0.4280      0.4950      0.4800      0.4600      0.4800
   4      0.5460      0.6400      0.6150      0.6120      0.6650
   5      0.6490      0.7550      0.7660      0.8120      0.8330
   6      0.9660      0.9010      0.9540      1.0270      1.0680

  AGE      2003        2004        2005        2006        2007
_____________________________________________________________________

   1      0.2280      0.2110      0.1190      0.1000      0.1480
   2      0.3590      0.2960      0.3410      0.3090      0.2880
   3      0.4740      0.4400      0.4450      0.4110      0.4060
   4      0.6530      0.5860      0.5940      0.5550      0.5360
   5      0.8240      0.7280      0.7670      0.7600      0.7640
   6      1.0480      0.9560      0.9970      0.9980      1.0020


Natural Mortality - Input Data

  AGE      1973        1974        1975        1976        1977
_____________________________________________________________________

   1      0.2000      0.2000      0.2000      0.2000      0.2000
   2      0.2000      0.2000      0.2000      0.2000      0.2000
   3      0.2000      0.2000      0.2000      0.2000      0.2000
   4      0.2000      0.2000      0.2000      0.2000      0.2000
   5      0.2000      0.2000      0.2000      0.2000      0.2000
   6      0.2000      0.2000      0.2000      0.2000      0.2000

  AGE      1978        1979        1980        1981        1982
_____________________________________________________________________

   1      0.2000      0.2000      0.2000      0.2000      0.2000
   2      0.2000      0.2000      0.2000      0.2000      0.2000
   3      0.2000      0.2000      0.2000      0.2000      0.2000
   4      0.2000      0.2000      0.2000      0.2000      0.2000
   5      0.2000      0.2000      0.2000      0.2000      0.2000
   6      0.2000      0.2000      0.2000      0.2000      0.2000

  AGE      1983        1984        1985        1986        1987
_____________________________________________________________________

   1      0.2000      0.2000      0.2000      0.2000      0.2000
   2      0.2000      0.2000      0.2000      0.2000      0.2000
   3      0.2000      0.2000      0.2000      0.2000      0.2000
   4      0.2000      0.2000      0.2000      0.2000      0.2000
   5      0.2000      0.2000      0.2000      0.2000      0.2000
   6      0.2000      0.2000      0.2000      0.2000      0.2000

  AGE      1988        1989        1990        1991        1992
_____________________________________________________________________

   1      0.2000      0.2000      0.2000      0.2000      0.2000
   2      0.2000      0.2000      0.2000      0.2000      0.2000
   3      0.2000      0.2000      0.2000      0.2000      0.2000
   4      0.2000      0.2000      0.2000      0.2000      0.2000
   5      0.2000      0.2000      0.2000      0.2000      0.2000
   6      0.2000      0.2000      0.2000      0.2000      0.2000
```

```
  AGE      1993      1994      1995      1996      1997
 ---------------------------------------------------------

   1      0.2000    0.2000    0.2000    0.2000    0.2000
   2      0.2000    0.2000    0.2000    0.2000    0.2000
   3      0.2000    0.2000    0.2000    0.2000    0.2000
   4      0.2000    0.2000    0.2000    0.2000    0.2000
   5      0.2000    0.2000    0.2000    0.2000    0.2000
   6      0.2000    0.2000    0.2000    0.2000    0.2000


Natural Mortality - Input Data


  AGE      1998      1999      2000      2001      2002
 ---------------------------------------------------------

   1      0.2000    0.2000    0.2000    0.2000    0.2000
   2      0.2000    0.2000    0.2000    0.2000    0.2000
   3      0.2000    0.2000    0.2000    0.2000    0.2000
   4      0.2000    0.2000    0.2000    0.2000    0.2000
   5      0.2000    0.2000    0.2000    0.2000    0.2000
   6      0.2000    0.2000    0.2000    0.2000    0.2000

  AGE      2003      2004      2005      2006      2007
 ---------------------------------------------------------

   1      0.2000    0.2000    0.2000    0.2000    0.2000
   2      0.2000    0.2000    0.2000    0.2000    0.2000
   3      0.2000    0.2000    0.2000    0.2000    0.2000
   4      0.2000    0.2000    0.2000    0.2000    0.2000
   5      0.2000    0.2000    0.2000    0.2000    0.2000
   6      0.2000    0.2000    0.2000    0.2000    0.2000

Proportion of Natural Mortality Before Spawning =       0.4167
Proportion of Fishing Mortality Before Spawning =       0.4167


Maturity - Input Data


  AGE      1973      1974      1975      1976      1977
 ---------------------------------------------------------

   1      0.0000    0.0000    0.0000    0.0000    0.0000
   2      0.4620    0.4620    0.4620    0.4620    0.4620
   3      0.9670    0.9670    0.9670    0.9670    0.9670
   4      1.0000    1.0000    1.0000    1.0000    1.0000
   5      1.0000    1.0000    1.0000    1.0000    1.0000
   6      1.0000    1.0000    1.0000    1.0000    1.0000

  AGE      1978      1979      1980      1981      1982
 ---------------------------------------------------------

   1      0.0000    0.0000    0.0000    0.0000    0.0000
   2      0.4620    0.4620    0.4620    0.4620    0.4620
   3      0.9670    0.9670    0.9670    0.9670    0.9670
   4      1.0000    1.0000    1.0000    1.0000    1.0000
   5      1.0000    1.0000    1.0000    1.0000    1.0000
   6      1.0000    1.0000    1.0000    1.0000    1.0000

  AGE      1983      1984      1985      1986      1987
 ---------------------------------------------------------

   1      0.0000    0.0000    0.0000    0.0000    0.0000
   2      0.4620    0.4620    0.4620    0.4620    0.4620
   3      0.9670    0.9670    0.9670    0.9670    0.9670
```

```
   4       1.0000      1.0000      1.0000      1.0000      1.0000
   5       1.0000      1.0000      1.0000      1.0000      1.0000
   6       1.0000      1.0000      1.0000      1.0000      1.0000

  AGE       1988        1989        1990        1991        1992
------------------------------------------------------------------

   1       0.0000      0.0000      0.0000      0.0000      0.0000
   2       0.4620      0.4620      0.4620      0.4620      0.4620
   3       0.9670      0.9670      0.9670      0.9670      0.9670
   4       1.0000      1.0000      1.0000      1.0000      1.0000
   5       1.0000      1.0000      1.0000      1.0000      1.0000
   6       1.0000      1.0000      1.0000      1.0000      1.0000

  AGE       1993        1994        1995        1996        1997
------------------------------------------------------------------

   1       0.0000      0.0000      0.0000      0.0000      0.0000
   2       0.4620      0.4620      0.4620      0.4620      0.4620
   3       0.9670      0.9670      0.9670      0.9670      0.9670
   4       1.0000      1.0000      1.0000      1.0000      1.0000
   5       1.0000      1.0000      1.0000      1.0000      1.0000
   6       1.0000      1.0000      1.0000      1.0000      1.0000


Maturity - Input Data


  AGE       1998        1999        2000        2001        2002
------------------------------------------------------------------

   1       0.0000      0.0000      0.0000      0.0000      0.0000
   2       0.4620      0.4620      0.4620      0.4620      0.4620
   3       0.9670      0.9670      0.9670      0.9670      0.9670
   4       1.0000      1.0000      1.0000      1.0000      1.0000
   5       1.0000      1.0000      1.0000      1.0000      1.0000
   6       1.0000      1.0000      1.0000      1.0000      1.0000

  AGE       2003        2004        2005        2006        2007
------------------------------------------------------------------

   1       0.0000      0.0000      0.0000      0.0000      0.0000
   2       0.4620      0.4620      0.4620      0.4620      0.4620
   3       0.9670      0.9670      0.9670      0.9670      0.9670
   4       1.0000      1.0000      1.0000      1.0000      1.0000
   5       1.0000      1.0000      1.0000      1.0000      1.0000
   6       1.0000      1.0000      1.0000      1.0000      1.0000
```

```
Input Partial Recruitment

  AGE

   1       0.0000
   2       0.0300
   3       0.6300
   4       1.0000
   5       1.0000


Input F-Plus Ratio

  YEAR

  1973       1.0000
  1974       1.0000
  1975       1.0000
  1976       1.0000
  1977       1.0000
  1978       1.0000
  1979       1.0000
  1980       1.0000
  1981       1.0000
  1982       1.0000
  1983       1.0000
  1984       1.0000
  1985       1.0000
  1986       1.0000
  1987       1.0000
  1988       1.0000
  1989       1.0000
  1990       1.0000
  1991       1.0000
  1992       1.0000
  1993       1.0000
  1994       1.0000
  1995       1.0000
  1996       1.0000
  1997       1.0000
  1998       1.0000
  1999       1.0000
  2000       1.0000
  2001       1.0000
  2002       1.0000
  2003       1.0000
  2004       1.0000
  2005       1.0000
  2006       1.0000
  2007       1.0000
```

```
SURVEY - INPUT DATA

INDEX             1           2           3           4           5

SURVEY TAG     USsearly    USsearly    USsearly    USsearly    USsearly

AGE                1           2           3           4           5
TIME           JAN-1       JAN-1       JAN-1       JAN-1       JAN-1
TYPE          NUMBERS     NUMBERS     NUMBERS     NUMBERS     NUMBERS
RETRO FLAG       0           0           0           0           0
 ------------------------------------------------------------------------

    1973     1882.9150   3184.3290   2309.4080   1036.7250    399.4120
    1974      308.1730   2168.4730   1795.4620   1225.0260    336.9040
    1975      409.2160   2917.9900    809.1130    262.5540    201.5020
    1976     1008.3820   4259.0050   1215.9990    302.4470    191.2130
    1977        0.0000    654.0070   1097.6800    363.6930     81.9210
    1978      912.1930    778.4410    494.4360    213.9260     25.7220
    1979      393.9770   1956.7800    395.2390    328.2650     58.7230
    1980       55.3260   4528.6450   5617.2010    460.5620     55.0340
    1981       11.3560    995.8610   1724.2180    698.8500    206.9370
    1982        0.0000      0.0000      0.0000      0.0000      0.0000
    1983        0.0000      0.0000      0.0000      0.0000      0.0000
    1984        0.0000      0.0000      0.0000      0.0000      0.0000
    1985        0.0000      0.0000      0.0000      0.0000      0.0000
    1986        0.0000      0.0000      0.0000      0.0000      0.0000
    1987        0.0000      0.0000      0.0000      0.0000      0.0000
    1988        0.0000      0.0000      0.0000      0.0000      0.0000
    1989        0.0000      0.0000      0.0000      0.0000      0.0000
    1990        0.0000      0.0000      0.0000      0.0000      0.0000
    1991        0.0000      0.0000      0.0000      0.0000      0.0000
    1992        0.0000      0.0000      0.0000      0.0000      0.0000
    1993        0.0000      0.0000      0.0000      0.0000      0.0000
    1994        0.0000      0.0000      0.0000      0.0000      0.0000
    1995        0.0000      0.0000      0.0000      0.0000      0.0000
    1996        0.0000      0.0000      0.0000      0.0000      0.0000
    1997        0.0000      0.0000      0.0000      0.0000      0.0000
    1998        0.0000      0.0000      0.0000      0.0000      0.0000
    1999        0.0000      0.0000      0.0000      0.0000      0.0000
    2000        0.0000      0.0000      0.0000      0.0000      0.0000
    2001        0.0000      0.0000      0.0000      0.0000      0.0000
    2002        0.0000      0.0000      0.0000      0.0000      0.0000
    2003        0.0000      0.0000      0.0000      0.0000      0.0000
    2004        0.0000      0.0000      0.0000      0.0000      0.0000
    2005        0.0000      0.0000      0.0000      0.0000      0.0000
    2006        0.0000      0.0000      0.0000      0.0000      0.0000
    2007        0.0000      0.0000      0.0000      0.0000      0.0000
    2008        0.0000      0.0000      0.0000      0.0000      0.0000
```

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SURVEY - INPUT DATA

INDEX              6           7           8           9          10

SURVEY TAG     USsearly    USspr       USspr       USspr       USspr

AGE                6           1           2           3           4
TIME            JAN-1       JAN-1       JAN-1       JAN-1       JAN-1
TYPE           NUMBERS     NUMBERS     NUMBERS     NUMBERS     NUMBERS
RETRO FLAG        0           1           1           1           1
_________________________________________________________________________

    1973     210.2370      0.0000      0.0000      0.0000      0.0000
    1974     273.8130      0.0000      0.0000      0.0000      0.0000
    1975      86.2890      0.0000      0.0000      0.0000      0.0000
    1976     108.4190      0.0000      0.0000      0.0000      0.0000
    1977      12.8120      0.0000      0.0000      0.0000      0.0000
    1978       7.6680      0.0000      0.0000      0.0000      0.0000
    1979      88.7150      0.0000      0.0000      0.0000      0.0000
    1980      35.3310      0.0000      0.0000      0.0000      0.0000
    1981      56.8790      0.0000      0.0000      0.0000      0.0000
    1982       0.0000     44.0660   3656.5390   1096.5150    992.4640
    1983       0.0000      0.0000   1810.0220   2647.7680    514.4310
    1984       0.0000      0.0000     90.2680    806.0070    837.9410
    1985       0.0000    106.3810   2134.2100    254.4010    273.4250
    1986       0.0000     26.5950   1753.0460    282.6460     54.6460
    1987       0.0000     26.5950     73.2820    132.9760    129.2870
    1988       0.0000     75.5150    266.9220    355.2490    234.6970
    1989       0.0000     45.2310    391.2590    737.6750    280.9960
    1990       0.0000      0.0000     63.6730   1074.6760    358.3550
    1991       0.0000    422.5130      0.0000    246.9270    665.0720
    1992       0.0000      0.0000   1987.7430   1840.6930    621.7820
    1993       0.0000     44.7460    281.0930    485.7980    307.8820
    1994       0.0000      0.0000    602.2730    614.6970    343.6010
    1995       0.0000      0.0000      0.0000      0.0000      0.0000
    1996       0.0000      0.0000      0.0000      0.0000      0.0000
    1997       0.0000      0.0000      0.0000      0.0000      0.0000
    1998       0.0000      0.0000      0.0000      0.0000      0.0000
    1999       0.0000      0.0000      0.0000      0.0000      0.0000
    2000       0.0000      0.0000      0.0000      0.0000      0.0000
    2001       0.0000      0.0000      0.0000      0.0000      0.0000
    2002       0.0000      0.0000      0.0000      0.0000      0.0000
    2003       0.0000      0.0000      0.0000      0.0000      0.0000
    2004       0.0000      0.0000      0.0000      0.0000      0.0000
    2005       0.0000      0.0000      0.0000      0.0000      0.0000
    2006       0.0000      0.0000      0.0000      0.0000      0.0000
    2007       0.0000      0.0000      0.0000      0.0000      0.0000
    2008       0.0000      0.0000      0.0000      0.0000      0.0000
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SURVEY - INPUT DATA

INDEX            11          12          13          14          15

SURVEY TAG     USspr       USspr       USspr95     USspr95     USspr95

AGE                5           6           1           2           3
TIME           JAN-1       JAN-1       JAN-1       JAN-1       JAN-1
TYPE          NUMBERS     NUMBERS     NUMBERS     NUMBERS     NUMBERS
RETRO FLAG       1           1           1           1           1
 ________________________________________________________________________

    1973        0.0000      0.0000      0.0000      0.0000      0.0000
    1974        0.0000      0.0000      0.0000      0.0000      0.0000
    1975        0.0000      0.0000      0.0000      0.0000      0.0000
    1976        0.0000      0.0000      0.0000      0.0000      0.0000
    1977        0.0000      0.0000      0.0000      0.0000      0.0000
    1978        0.0000      0.0000      0.0000      0.0000      0.0000
    1979        0.0000      0.0000      0.0000      0.0000      0.0000
    1980        0.0000      0.0000      0.0000      0.0000      0.0000
    1981        0.0000      0.0000      0.0000      0.0000      0.0000
    1982      444.5460     88.3270      0.0000      0.0000      0.0000
    1983      119.5810    237.3180      0.0000      0.0000      0.0000
    1984      810.3750    236.5410      0.0000      0.0000      0.0000
    1985      143.3610      0.0000      0.0000      0.0000      0.0000
    1986      132.8790     53.1900      0.0000      0.0000      0.0000
    1987       50.9580     53.1900      0.0000      0.0000      0.0000
    1988      193.1540     26.5950      0.0000      0.0000      0.0000
    1989       59.3050     43.4840      0.0000      0.0000      0.0000
    1990      112.2040    100.7510      0.0000      0.0000      0.0000
    1991      255.4690     19.9950      0.0000      0.0000      0.0000
    1992      159.9590     16.6950      0.0000      0.0000      0.0000
    1993       26.0130      0.0000      0.0000      0.0000      0.0000
    1994      140.4490     38.7280      0.0000      0.0000      0.0000
    1995        0.0000      0.0000     39.0190   1144.5610   4670.3560
    1996        0.0000      0.0000     24.3630    958.1040   2548.5700
    1997        0.0000      0.0000     18.1510   1134.4670   3623.0520
    1998        0.0000      0.0000      0.0000   2020.0650   1022.1650
    1999        0.0000      0.0000     48.7250   4606.2950  10501.6770
    2000        0.0000      0.0000    177.3330   4677.6360   7440.5200
    2001        0.0000      0.0000      0.0000   2246.7060   6370.5030
    2002        0.0000      0.0000    182.3800   2341.5360  11971.1060
    2003        0.0000      0.0000    196.0660   4241.4370   6564.9190
    2004        0.0000      0.0000     47.0750    957.3270   2114.4100
    2005        0.0000      0.0000      0.0000   1953.4800   4930.9690
    2006        0.0000      0.0000    493.4660    907.8260   3419.2210
    2007        0.0000      0.0000     87.0650   4899.7150   6079.1210
    2008        0.0000      0.0000      0.0000   2206.7110   4921.4560
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SURVEY - INPUT DATA

INDEX            16          17          18          19          20

SURVEY TAG     USspr95     USspr95     USspr95     USfall      USfall

AGE                4           5           6           1           2
TIME           JAN-1       JAN-1       JAN-1       MEAN        MEAN
TYPE          NUMBERS     NUMBERS     NUMBERS     NUMBERS     NUMBERS
RETRO FLAG       1           1           1           0           0
 ------------------------------------------------------------------------

    1973        0.0000      0.0000      0.0000   2420.4480   5336.0110
    1974        0.0000      0.0000      0.0000   4486.7140   2779.4820
    1975        0.0000      0.0000      0.0000   4548.6400   2437.3360
    1976        0.0000      0.0000      0.0000    333.5070   1863.8910
    1977        0.0000      0.0000      0.0000    906.6610   2147.1200
    1978        0.0000      0.0000      0.0000   4620.5630   1243.2740
    1979        0.0000      0.0000      0.0000   1282.0020   2008.5140
    1980        0.0000      0.0000      0.0000    743.5960   4969.9880
    1981        0.0000      0.0000      0.0000   1548.2440   2279.4160
    1982        0.0000      0.0000      0.0000   2353.2800   2120.3300
    1983        0.0000      0.0000      0.0000    105.7010   2216.4220
    1984        0.0000      0.0000      0.0000    641.5830    388.0560
    1985        0.0000      0.0000      0.0000   1310.2470    527.5350
    1986        0.0000      0.0000      0.0000    273.4250   1075.0640
    1987        0.0000      0.0000      0.0000     98.7130    388.8320
    1988        0.0000      0.0000      0.0000     18.1510    206.7430
    1989        0.0000      0.0000      0.0000    241.0060   1934.0670
    1990        0.0000      0.0000      0.0000      0.0000    359.2280
    1991        0.0000      0.0000      0.0000   2038.7980    267.0190
    1992        0.0000      0.0000      0.0000    146.7590    383.8820
    1993        0.0000      0.0000      0.0000    814.6460    135.2080
    1994        0.0000      0.0000      0.0000   1159.8000    214.6050
    1995     1441.6690    621.4910      9.5120      0.0000      0.0000
    1996     2621.7550    591.5960     56.1990      0.0000      0.0000
    1997     3960.7320    682.3490    129.6760      0.0000      0.0000
    1998     1123.4010    737.0930    339.6220      0.0000      0.0000
    1999     2640.4880   1575.2270    756.3110      0.0000      0.0000
    2000     2828.4980    789.2150    508.4130      0.0000      0.0000
    2001     2339.9830    469.2000    439.6930      0.0000      0.0000
    2002     3958.4030   1690.3430    845.4140      0.0000      0.0000
    2003     2791.9060    428.6280    836.8730      0.0000      0.0000
    2004      659.9280    247.7040    263.8160      0.0000      0.0000
    2005     2332.7030    261.7780    111.4280      0.0000      0.0000
    2006     2112.6620    307.6880     79.7850      0.0000      0.0000
    2007     2762.3020    539.9590    125.2110      0.0000      0.0000
    2008     1681.1040    300.3020     26.6070      0.0000      0.0000
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SURVEY - INPUT DATA

INDEX            21          22          23          24          25

SURVEY TAG     USfall      USfall      USfall      USfall      USfall95

AGE                3           4           5           6           1
TIME           MEAN        MEAN        MEAN        MEAN        MEAN
TYPE          NUMBERS     NUMBERS     NUMBERS     NUMBERS     NUMBERS
RETRO FLAG       0           0           0           0           0
 ------------------------------------------------------------------------

    1973     4954.4580   2857.4230   1181.1540    599.9430      0.0000
    1974     1471.5650   1029.0570    444.2550    368.0610      0.0000
    1975      851.7230    555.1980    324.3830     61.1490      0.0000
    1976      460.2700    113.5630    118.5130     97.2570      0.0000
    1977     1572.8010    615.3760    102.3040    105.7010      0.0000
    1978      757.1850    399.2180    131.6170     34.9430      0.0000
    1979      253.7210    116.6690    134.3350    108.6130      0.0000
    1980     5911.9800    661.9660    212.2760    250.9070      0.0000
    1981     1592.7960    570.5330     76.3880     52.8020      0.0000
    1982     1543.3910    410.3800     86.5800      0.0000      0.0000
    1983     1858.4560    495.6980     29.8950     47.6580      0.0000
    1984      296.7200    235.9590     72.7000     60.6640      0.0000
    1985      165.8800     49.1140     78.3290      0.0000      0.0000
    1986      338.6510     71.9230      0.0000      0.0000      0.0000
    1987      384.5620     51.4430     77.0680      0.0000      0.0000
    1988      103.9540     26.5950      0.0000      0.0000      0.0000
    1989      750.3900     76.5820     53.9670      0.0000      0.0000
    1990     1429.9250    285.8490      0.0000      0.0000      0.0000
    1991      426.2010    347.1930      0.0000      0.0000      0.0000
    1992      690.9880    157.1440    139.3820     26.5950      0.0000
    1993      568.7860    520.3520      0.0000     21.3540      0.0000
    1994      954.1240    692.1530    254.8860     54.8400      0.0000
    1995        0.0000      0.0000      0.0000      0.0000    267.6980
    1996        0.0000      0.0000      0.0000      0.0000    144.3320
    1997        0.0000      0.0000      0.0000      0.0000   1351.7890
    1998        0.0000      0.0000      0.0000      0.0000   1844.3820
    1999        0.0000      0.0000      0.0000      0.0000   2998.7460
    2000        0.0000      0.0000      0.0000      0.0000    610.8140
    2001        0.0000      0.0000      0.0000      0.0000   3414.1730
    2002        0.0000      0.0000      0.0000      0.0000   2031.4210
    2003        0.0000      0.0000      0.0000      0.0000   1045.2660
    2004        0.0000      0.0000      0.0000      0.0000    850.2680
    2005        0.0000      0.0000      0.0000      0.0000    304.0000
    2006        0.0000      0.0000      0.0000      0.0000   6012.0510
    2007        0.0000      0.0000      0.0000      0.0000   1026.5330
    2008        0.0000      0.0000      0.0000      0.0000      0.0000
```

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SURVEY - INPUT DATA

INDEX            26          27          28          29          30

SURVEY TAG     USfall95    USfall95    USfall95    USfall95    USfall95

AGE                2           3           4           5           6
TIME           MEAN        MEAN        MEAN        MEAN        MEAN
TYPE          NUMBERS     NUMBERS     NUMBERS     NUMBERS     NUMBERS
RETRO FLAG       0           0           0           0           0
 ------------------------------------------------------------------------

    1973        0.0000      0.0000      0.0000      0.0000      0.0000
    1974        0.0000      0.0000      0.0000      0.0000      0.0000
    1975        0.0000      0.0000      0.0000      0.0000      0.0000
    1976        0.0000      0.0000      0.0000      0.0000      0.0000
    1977        0.0000      0.0000      0.0000      0.0000      0.0000
    1978        0.0000      0.0000      0.0000      0.0000      0.0000
    1979        0.0000      0.0000      0.0000      0.0000      0.0000
    1980        0.0000      0.0000      0.0000      0.0000      0.0000
    1981        0.0000      0.0000      0.0000      0.0000      0.0000
    1982        0.0000      0.0000      0.0000      0.0000      0.0000
    1983        0.0000      0.0000      0.0000      0.0000      0.0000
    1984        0.0000      0.0000      0.0000      0.0000      0.0000
    1985        0.0000      0.0000      0.0000      0.0000      0.0000
    1986        0.0000      0.0000      0.0000      0.0000      0.0000
    1987        0.0000      0.0000      0.0000      0.0000      0.0000
    1988        0.0000      0.0000      0.0000      0.0000      0.0000
    1989        0.0000      0.0000      0.0000      0.0000      0.0000
    1990        0.0000      0.0000      0.0000      0.0000      0.0000
    1991        0.0000      0.0000      0.0000      0.0000      0.0000
    1992        0.0000      0.0000      0.0000      0.0000      0.0000
    1993        0.0000      0.0000      0.0000      0.0000      0.0000
    1994        0.0000      0.0000      0.0000      0.0000      0.0000
    1995      115.4070    335.1570    267.2130     44.6490     12.1330
    1996      341.2720   1813.8070    433.4810     72.7000      0.0000
    1997      517.7310   3340.9880   2028.5090   1039.8310     79.7850
    1998     4675.3070   4078.8570   1154.5580    289.5370     71.7290
    1999     8175.8660   5558.8660   1390.3230   1394.2060    252.7510
    2000     1647.5390   4672.4920   2350.2710    919.6670    802.6100
    2001     6083.5860   7853.7150   2524.7900   1667.8250   1988.2280
    2002     5581.7730   2064.5190    576.0660    295.5550     26.5950
    2003     4882.8260   2725.9030    548.0150     96.9650    185.6810
    2004     5346.1050   4862.4430   2044.4270    897.0520    170.7330
    2005     2033.5560   3652.0740    595.8670    179.2740      0.0000
    2006     6067.1830   3556.6610   1132.9140    247.7040     44.3580
    2007    11110.9390   7634.7420   1939.6000    371.2640     90.8510
    2008        0.0000      0.0000      0.0000      0.0000      0.0000
```

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SURVEY - INPUT DATA

INDEX            31          32          33          34          35

SURVEY TAG     Canada      Canada      Canada      Canada      Canada

AGE               1           2           3           4           5
TIME           JAN-1       JAN-1       JAN-1       JAN-1       JAN-1
TYPE          NUMBERS     NUMBERS     NUMBERS     NUMBERS     NUMBERS
RETRO FLAG       1           1           1           1           1
 ________________________________________________________________________

    1973        0.0000      0.0000      0.0000      0.0000      0.0000
    1974        0.0000      0.0000      0.0000      0.0000      0.0000
    1975        0.0000      0.0000      0.0000      0.0000      0.0000
    1976        0.0000      0.0000      0.0000      0.0000      0.0000
    1977        0.0000      0.0000      0.0000      0.0000      0.0000
    1978        0.0000      0.0000      0.0000      0.0000      0.0000
    1979        0.0000      0.0000      0.0000      0.0000      0.0000
    1980        0.0000      0.0000      0.0000      0.0000      0.0000
    1981        0.0000      0.0000      0.0000      0.0000      0.0000
    1982        0.0000      0.0000      0.0000      0.0000      0.0000
    1983        0.0000      0.0000      0.0000      0.0000      0.0000
    1984        0.0000      0.0000      0.0000      0.0000      0.0000
    1985        0.0000      0.0000      0.0000      0.0000      0.0000
    1986        0.0000      0.0000      0.0000      0.0000      0.0000
    1987        0.1200      1.1940      1.9700      0.4920      0.0870
    1988        0.0000      1.7760      1.2750      0.6100      0.2780
    1989        0.1140      1.0270      0.6090      0.2940      0.0660
    1990        0.0000      2.3870      3.6280      0.9140      0.2090
    1991        0.0240      0.8580      1.1860      3.7590      0.5250
    1992        0.0550     11.0390      3.6770      0.9900      0.3500
    1993        0.0790      2.4310      4.0850      4.0760      0.8870
    1994        0.0000      6.0560      3.4640      3.0060      0.7810
    1995        0.0000      0.0000      0.0000      0.0000      0.0000
    1996        0.0000      0.0000      0.0000      0.0000      0.0000
    1997        0.0000      0.0000      0.0000      0.0000      0.0000
    1998        0.0000      0.0000      0.0000      0.0000      0.0000
    1999        0.0000      0.0000      0.0000      0.0000      0.0000
    2000        0.0000      0.0000      0.0000      0.0000      0.0000
    2001        0.0000      0.0000      0.0000      0.0000      0.0000
    2002        0.0000      0.0000      0.0000      0.0000      0.0000
    2003        0.0000      0.0000      0.0000      0.0000      0.0000
    2004        0.0000      0.0000      0.0000      0.0000      0.0000
    2005        0.0000      0.0000      0.0000      0.0000      0.0000
    2006        0.0000      0.0000      0.0000      0.0000      0.0000
    2007        0.0000      0.0000      0.0000      0.0000      0.0000
    2008        0.0000      0.0000      0.0000      0.0000      0.0000
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SURVEY - INPUT DATA

INDEX            36          37          38          39          40

SURVEY TAG     Canada       Can95       Can95       Can95       Can95

AGE                6           1           2           3           4
TIME           JAN-1       JAN-1       JAN-1       JAN-1       JAN-1
TYPE          NUMBERS     NUMBERS     NUMBERS     NUMBERS     NUMBERS
RETRO FLAG       1           1           1           1           1

    1973        0.0000      0.0000      0.0000      0.0000      0.0000
    1974        0.0000      0.0000      0.0000      0.0000      0.0000
    1975        0.0000      0.0000      0.0000      0.0000      0.0000
    1976        0.0000      0.0000      0.0000      0.0000      0.0000
    1977        0.0000      0.0000      0.0000      0.0000      0.0000
    1978        0.0000      0.0000      0.0000      0.0000      0.0000
    1979        0.0000      0.0000      0.0000      0.0000      0.0000
    1980        0.0000      0.0000      0.0000      0.0000      0.0000
    1981        0.0000      0.0000      0.0000      0.0000      0.0000
    1982        0.0000      0.0000      0.0000      0.0000      0.0000
    1983        0.0000      0.0000      0.0000      0.0000      0.0000
    1984        0.0000      0.0000      0.0000      0.0000      0.0000
    1985        0.0000      0.0000      0.0000      0.0000      0.0000
    1986        0.0000      0.0000      0.0000      0.0000      0.0000
    1987        0.0490      0.0000      0.0000      0.0000      0.0000
    1988        0.0240      0.0000      0.0000      0.0000      0.0000
    1989        0.0220      0.0000      0.0000      0.0000      0.0000
    1990        0.0140      0.0000      0.0000      0.0000      0.0000
    1991        0.0140      0.0000      0.0000      0.0000      0.0000
    1992        0.0300      0.0000      0.0000      0.0000      0.0000
    1993        0.1300      0.0000      0.0000      0.0000      0.0000
    1994        0.2070      0.0000      0.0000      0.0000      0.0000
    1995        0.0000      0.2100      1.2510      4.3530      2.5460
    1996        0.0000      0.4460      7.1420      9.1740      5.4060
    1997        0.0000      0.0220     12.4820     13.9020     16.3690
    1998        0.0000      0.8930      3.3300      4.9070      4.3340
    1999        0.0000      0.1590     20.8610     20.8340      7.6690
    2000        0.0000      0.0110     13.7650     27.4420     19.2430
    2001        0.0000      0.2910     19.8960     42.1240     13.3070
    2002        0.0000      0.0880     11.9620     31.0150     12.2340
    2003        0.0000      0.0890     11.8890     24.6180     11.0860
    2004        0.0000      0.0330      3.5990     16.2600      9.2050
    2005        0.0000      0.6000      1.6020     27.9590     20.5640
    2006        0.0000      0.6230      4.8930     18.6000      6.5720
    2007        0.0000      0.1730     12.1590     27.7080     12.7990
    2008        0.0000      0.0000      0.0000      0.0000      0.0000
```

```
SURVEY - INPUT DATA


INDEX           41          42          43          44

SURVEY TAG     Can95       Can95       Scall       Scall95

AGE               5           6           1           1      NUMBERS
TIME           JAN-1       JAN-1       MEAN        MEAN      NUMBERS
TYPE          NUMBERS     NUMBERS     NUMBERS     NUMBERS    NUMBERS
RETRO FLAG      1           1           0           0
 _________________________________________________________________________

    1973       0.0000      0.0000      0.0000      0.0000
    1974       0.0000      0.0000      0.0000      0.0000
    1975       0.0000      0.0000      0.0000      0.0000
    1976       0.0000      0.0000      0.0000      0.0000
    1977       0.0000      0.0000      0.0000      0.0000
    1978       0.0000      0.0000      0.0000      0.0000
    1979       0.0000      0.0000      0.0000      0.0000
    1980       0.0000      0.0000      0.0000      0.0000
    1981       0.0000      0.0000      0.0000      0.0000
    1982       0.0000      0.0000      0.3130      0.0000
    1983       0.0000      0.0000      0.1400      0.0000
    1984       0.0000      0.0000      0.2330      0.0000
    1985       0.0000      0.0000      0.5490      0.0000
    1986       0.0000      0.0000      0.1030      0.0000
    1987       0.0000      0.0000      0.0470      0.0000
    1988       0.0000      0.0000      0.1160      0.0000
    1989       0.0000      0.0000      0.1950      0.0000
    1990       0.0000      0.0000      0.1000      0.0000
    1991       0.0000      0.0000      2.1170      0.0000
    1992       0.0000      0.0000      0.1670      0.0000
    1993       0.0000      0.0000      1.1290      0.0000
    1994       0.0000      0.0000      1.5030      0.0000
    1995       0.6470      0.1010      0.0000      0.6090
    1996       1.1550      0.1230      0.0000      0.5080
    1997       4.0440      0.6700      0.0000      1.0620
    1998       1.9880      0.5580      0.0000      1.8720
    1999       5.3500      2.2000      0.0000      1.0380
    2000       5.0690      3.6890      0.0000      0.9120
    2001       4.5810      2.3970      0.0000      0.7890
    2002       5.5530      2.8330      0.0000      1.0050
    2003       3.4210      1.9880      0.0000      0.8800
    2004       2.2730      1.4160      0.0000      0.3300
    2005       5.6960      1.5650      0.0000      0.5730
    2006       0.8200      0.2380      0.0000      2.4220
    2007       2.2880      0.2480      0.0000      0.0000
    2008       0.0000      0.0000      0.0000      0.0000

     Additional Output Files

Population File C:\WORKING\ASSESSMENTS\GARM3THEFINALE\YTASSESSMENTS\GB\VPA\MAJOR
Auxilliary File C:\WORKING\ASSESSMENTS\GARM3THEFINALE\YTASSESSMENTS\GB\VPA\MAJOR
Covariance File C:\WORKING\ASSESSMENTS\GARM3THEFINALE\YTASSESSMENTS\GB\VPA\MAJOR
Residuals File  C:\WORKING\ASSESSMENTS\GARM3THEFINALE\YTASSESSMENTS\GB\VPA\MAJOR
Log File        C:\WORKING\ASSESSMENTS\GARM3THEFINALE\YTASSESSMENTS\GB\VPA\MAJOR
```

```
                      Estimation Results

JAN-1 Population Numbers


  AGE      1973        1974        1975        1976        1977
_____________________________________________________________________________

   1      29384.      52184.      70632.      24731.      17283.
   2      24172.      23733.      40588.      53646.      19674.
   3      29516.      15136.      10930.       9852.      15554.
   4      17300.      12051.       5010.       2425.       3171.
   5       6966.       5732.       3079.        977.        719.
   6       3013.       2391.       1709.       1562.        850.
===================================================================
Total    110351.     111229.     131948.      93193.      57252.

  AGE      1978        1979        1980        1981        1982
_____________________________________________________________________________

   1      54437.      25508.      24034.      62997.      22846.
   2      13809.      35604.      20595.      19390.      51480.
   3       7987.       8124.      19711.      13268.      14885.
   4       3390.       2468.       3268.       7499.       5535.
   5        956.       1073.        747.       1302.       1783.
   6        373.        559.        239.        221.        156.
===================================================================
Total     80953.      73336.      68594.     104677.      96685.

  AGE      1983        1984        1985        1986        1987
_____________________________________________________________________________

   1       6581.      10843.      16749.       8473.       9193.
   2      16754.       4755.       8414.      12837.       6776.
   3      25937.       6579.       2089.       2991.       4801.
   4       5517.       6472.       1379.        767.       1440.
   5       1514.       2305.        870.        402.        282.
   6        345.        487.        136.        224.        201.
===================================================================
Total     56648.      31441.      29636.      25695.      22692.

  AGE      1988        1989        1990        1991        1992
_____________________________________________________________________________

   1      22841.       9661.      11217.      22557.      17518.
   2       7386.      18250.       7738.       8975.      17869.
   3       2617.       3361.      12981.       4437.       7215.
   4       1153.        771.       1747.       4399.       2296.
   5        309.        198.        250.        560.        940.
   6         73.         55.         47.        104.         65.
===================================================================
Total     34379.      32296.      33980.      41032.      45904.

  AGE      1993        1994        1995        1996        1997
_____________________________________________________________________________

   1      13938.      13180.      11672.      13470.      19801.
   2      12168.       6725.      10726.       9514.      10938.
   3       6459.       8713.       4304.       8500.       7175.
   4       3250.       2323.       1576.       2237.       5104.
   5        574.        609.        305.        509.       1040.
   6        126.        184.         66.         70.        246.
===================================================================
Total     36516.      31734.      28650.      34299.      44303.
```

```
JAN-1 Population Numbers

  AGE       1998        1999        2000        2001        2002
_____________________________________________________________________________

   1       22402.      24564.      19880.      22331.      15547.
   2       16138.      18189.      20057.      16157.      18124.
   3        7934.      11418.      12412.      12945.      10633.
   4        4228.       3467.       5591.       5060.       4404.
   5        2515.       1778.       1456.       1756.       1570.
   6         328.        675.        931.        918.       1116.
====================================================================
Total      53545.      60091.      60327.      59167.      51394.

  AGE       2003        2004        2005        2006        2007
_____________________________________________________________________________

   1       11770.      10472.      14435.      49437.      18373.
   2       12537.       9492.       8516.      11764.      40337.
   3       11091.       6749.       6689.       5596.       8460.
   4        5615.       4870.       2695.       1850.       3058.
   5        1894.       2522.        647.        688.        622.
   6        1678.       1857.        280.        395.        252.
====================================================================
Total      44585.      35962.      33263.      69731.      71101.

  AGE       2008
_____________________________________________________________________________

   1       19120.
   2       14994.
   3       31704.
   4        5339.
   5        1875.
   6         536.
====================================================================
Total      73568.
```

```
Fishing Mortality Calculated

   AGE       1973        1974        1975        1976        1977
___________________________________________________________________________

    1       0.0136      0.0513      0.0751      0.0287      0.0244
    2       0.2681      0.5753      1.2158      1.0381      0.7015
    3       0.6958      0.9056      1.3055      0.9335      1.3234
    4       0.9046      1.1647      1.4350      1.0158      0.9995
    5       0.9046      1.1647      1.4350      1.0158      0.9995
    6       0.9046      1.1647      1.4350      1.0158      0.9995

   AGE       1978        1979        1980        1981        1982
___________________________________________________________________________

    1       0.2246      0.0140      0.0147      0.0019      0.1101
    2       0.3305      0.3913      0.2397      0.0644      0.4855
    3       0.9746      0.7107      0.7665      0.6742      0.7925
    4       0.9500      0.9943      0.7201      1.2366      1.0961
    5       0.9500      0.9943      0.7201      1.2366      1.0961
    6       0.9500      0.9943      0.7201      1.2366      1.0961

   AGE       1983        1984        1985        1986        1987
___________________________________________________________________________

    1       0.1251      0.0537      0.0660      0.0235      0.0189
    2       0.7348      0.6226      0.8341      0.7835      0.7512
    3       1.1882      1.3628      0.8015      0.5314      1.2266
    4       0.6727      1.8064      1.0330      0.8025      1.3378
    5       0.6727      1.8064      1.0330      0.8025      1.3378
    6       0.6727      1.8064      1.0330      0.8025      1.3378

   AGE       1988        1989        1990        1991        1992
___________________________________________________________________________

    1       0.0244      0.0219      0.0229      0.0330      0.1644
    2       0.5874      0.1407      0.3562      0.0183      0.8176
    3       1.0221      0.4544      0.8820      0.4589      0.5977
    4       1.5603      0.9250      0.9378      1.3434      1.1856
    5       1.5603      0.9250      0.9378      1.3434      1.1856
    6       1.5603      0.9250      0.9378      1.3434      1.1856

   AGE       1993        1994        1995        1996        1997
___________________________________________________________________________

    1       0.5288      0.0060      0.0044      0.0083      0.0046
    2       0.1340      0.2463      0.0327      0.0821      0.1210
    3       0.8225      1.5100      0.4544      0.3100      0.3288
    4       1.4749      1.8301      0.9310      0.5664      0.5076
    5       1.4749      1.8301      0.9310      0.5664      0.5076
    6       1.4749      1.8301      0.9310      0.5664      0.5076
```

```
Fishing Mortality Calculated

   AGE       1998        1999        2000        2001        2002
 ________________________________________________________________________________

    1       0.0083      0.0027      0.0073      0.0087      0.0151
    2       0.1460      0.1821      0.2379      0.2184      0.2911
    3       0.6278      0.5141      0.6974      0.8781      0.4385
    4       0.6665      0.6677      0.9583      0.9701      0.6441
    5       0.6665      0.6677      0.9583      0.9701      0.6441
    6       0.6665      0.6677      0.9583      0.9701      0.6441

   AGE       2003        2004        2005        2006        2007
 ________________________________________________________________________________

    1       0.0151      0.0068      0.0046      0.0034      0.0032
    2       0.4193      0.1500      0.2198      0.1297      0.0408
    3       0.6232      0.7180      1.0853      0.4042      0.2603
    4       0.6003      1.8180      1.1648      0.8904      0.2892
    5       0.6003      1.8180      1.1648      0.8904      0.2892
    6       0.6003      1.8180      1.1648      0.8904      0.2892


 Average Fishing Mortality For Ages   4-  5

 Year      Average F   N Weighted  Biomass Wtd  Catch Wtd

 ________________________________________________________________________________


 1973       0.9046      0.9046      0.9046      0.9046
 1974       1.1647      1.1647      1.1647      1.1647
 1975       1.4350      1.4350      1.4350      1.4350
 1976       1.0158      1.0158      1.0158      1.0158
 1977       0.9995      0.9995      0.9995      0.9995
 1978       0.9500      0.9500      0.9500      0.9500
 1979       0.9943      0.9943      0.9943      0.9943
 1980       0.7201      0.7201      0.7201      0.7201
 1981       1.2366      1.2366      1.2366      1.2366
 1982       1.0961      1.0961      1.0961      1.0961
 1983       0.6727      0.6727      0.6727      0.6727
 1984       1.8064      1.8064      1.8064      1.8064
 1985       1.0330      1.0330      1.0330      1.0330
 1986       0.8025      0.8025      0.8025      0.8025
 1987       1.3378      1.3378      1.3378      1.3378
 1988       1.5603      1.5603      1.5603      1.5603
 1989       0.9250      0.9250      0.9250      0.9250
 1990       0.9378      0.9378      0.9378      0.9378
 1991       1.3434      1.3434      1.3434      1.3434
 1992       1.1856      1.1856      1.1856      1.1856
 1993       1.4749      1.4749      1.4749      1.4749
 1994       1.8301      1.8301      1.8301      1.8301
 1995       0.9310      0.9310      0.9310      0.9310
 1996       0.5664      0.5664      0.5664      0.5664
 1997       0.5076      0.5076      0.5076      0.5076
 1998       0.6665      0.6665      0.6665      0.6665
 1999       0.6677      0.6677      0.6677      0.6677
 2000       0.9583      0.9583      0.9583      0.9583
 2001       0.9701      0.9701      0.9701      0.9701
 2002       0.6441      0.6441      0.6441      0.6441
 2003       0.6003      0.6003      0.6003      0.6003
 2004       1.8180      1.8180      1.8180      1.8180
 2005       1.1648      1.1648      1.1648      1.1648
 2006       0.8904      0.8904      0.8904      0.8904
 2007       0.2892      0.2892      0.2892      0.2892
```

```
Back Calculated Partial Recruitment

  AGE      1973       1974       1975       1976       1977
_____________________________________________________________________________

   1      0.0150     0.0441     0.0523     0.0277     0.0184
   2      0.2964     0.4940     0.8473     1.0000     0.5300
   3      0.7692     0.7775     0.9098     0.8993     1.0000
   4      1.0000     1.0000     1.0000     0.9786     0.7552
   5      1.0000     1.0000     1.0000     0.9786     0.7552
   6      1.0000     1.0000     1.0000     0.9786     0.7552

  AGE      1978       1979       1980       1981       1982
_____________________________________________________________________________

   1      0.2305     0.0140     0.0192     0.0015     0.1005
   2      0.3392     0.3935     0.3127     0.0521     0.4429
   3      1.0000     0.7147     1.0000     0.5452     0.7230
   4      0.9748     1.0000     0.9395     1.0000     1.0000
   5      0.9748     1.0000     0.9395     1.0000     1.0000
   6      0.9748     1.0000     0.9395     1.0000     1.0000

  AGE      1983       1984       1985       1986       1987
_____________________________________________________________________________

   1      0.1053     0.0297     0.0639     0.0293     0.0142
   2      0.6184     0.3446     0.8075     0.9763     0.5615
   3      1.0000     0.7544     0.7759     0.6622     0.9169
   4      0.5661     1.0000     1.0000     1.0000     1.0000
   5      0.5661     1.0000     1.0000     1.0000     1.0000
   6      0.5661     1.0000     1.0000     1.0000     1.0000

  AGE      1988       1989       1990       1991       1992
_____________________________________________________________________________

   1      0.0156     0.0237     0.0245     0.0245     0.1387
   2      0.3765     0.1521     0.3799     0.0136     0.6896
   3      0.6550     0.4912     0.9405     0.3416     0.5041
   4      1.0000     1.0000     1.0000     1.0000     1.0000
   5      1.0000     1.0000     1.0000     1.0000     1.0000
   6      1.0000     1.0000     1.0000     1.0000     1.0000

  AGE      1993       1994       1995       1996       1997
_____________________________________________________________________________

   1      0.3585     0.0033     0.0048     0.0146     0.0090
   2      0.0908     0.1346     0.0351     0.1450     0.2384
   3      0.5577     0.8251     0.4881     0.5474     0.6479
   4      1.0000     1.0000     1.0000     1.0000     1.0000
   5      1.0000     1.0000     1.0000     1.0000     1.0000
   6      1.0000     1.0000     1.0000     1.0000     1.0000


Back Calculated Partial Recruitment

  AGE      1998       1999       2000       2001       2002
_____________________________________________________________________________

   1      0.0125     0.0040     0.0077     0.0090     0.0235
   2      0.2190     0.2727     0.2482     0.2251     0.4520
   3      0.9421     0.7699     0.7277     0.9052     0.6809
   4      1.0000     1.0000     1.0000     1.0000     1.0000
   5      1.0000     1.0000     1.0000     1.0000     1.0000
   6      1.0000     1.0000     1.0000     1.0000     1.0000
```

```
  AGE       2003        2004        2005        2006        2007
-----------------------------------------------------------------------------

   1       0.0242      0.0037      0.0039      0.0039      0.0110
   2       0.6729      0.0825      0.1887      0.1457      0.1412
   3       1.0000      0.3949      0.9317      0.4539      0.9001
   4       0.9634      1.0000      1.0000      1.0000      1.0000
   5       0.9634      1.0000      1.0000      1.0000      1.0000
   6       0.9634      1.0000      1.0000      1.0000      1.0000


JAN-1 Biomass


  AGE       1973        1974        1975        1976        1977
-----------------------------------------------------------------------------

   1        1607.       3622.       4803.       1501.       1218.
   2        7046.       4424.       7736.      10075.       3781.
   3       11898.       6289.       4483.       4085.       6289.
   4        8038.       6382.       2626.       1351.       1861.
   5        3927.       3427.       1887.        627.        506.
   6        2344.       1990.       1187.       1345.        792.
====================================================================
Total      34860.      26134.      22723.      18984.      14447.

  AGE       1978        1979        1980        1981        1982
-----------------------------------------------------------------------------

   1        3092.       1729.       1334.       4895.       1638.
   2        2636.       6523.       3946.       3566.       9864.
   3        3335.       3094.       7938.       5265.       6000.
   4        2039.       1427.       1799.       4092.       3121.
   5         681.        765.        547.        887.       1203.
   6         362.        531.        256.        186.        169.
====================================================================
Total      12146.      14070.      15820.      18890.      21994.

  AGE       1983        1984        1985        1986        1987
-----------------------------------------------------------------------------

   1         705.       1177.       2209.       1146.        676.
   2        3091.        870.       2034.       3189.       1641.
   3        9449.       2203.        726.       1321.       2029.
   4        2994.       3039.        680.        448.        872.
   5        1050.       1445.        525.        298.        205.
   6         348.        388.        109.        227.        176.
====================================================================
Total      17637.       9121.       6283.       6628.       5599.

  AGE       1988        1989        1990        1991        1992
-----------------------------------------------------------------------------

   1        1320.        567.        784.       1755.       1053.
   2        1471.       3349.       1318.       1415.       3365.
   3        1112.       1388.       4665.       1451.       2122.
   4         696.        488.        963.       1927.       1012.
   5         234.        154.        177.        364.        529.
   6          71.         58.         39.         91.         73.
====================================================================
Total       4905.       6004.       7947.       7004.       8153.

  AGE       1993        1994        1995        1996        1997
-----------------------------------------------------------------------------

   1         864.       2131.       1613.       1006.       3550.
   2        2065.       1084.       2471.       2085.       2074.
```

```
   3       2152.       2764.       1293.       2844.       2408.
   4       1390.        983.        638.        979.       2388.
   5        313.        340.        163.        292.        655.
   6        109.        142.         51.         71.        233.
 ====================================================================
Total      6893.       7444.       6230.       7276.      11308.


JAN-1 Biomass


  AGE      1998        1999        2000        2001        2002
 ______________________________________________________________________________

   1       2773.       3604.       3620.       4549.       3885.
   2       4123.       4655.       5578.       4652.       5604.
   3       2852.       4437.       5217.       5433.       4432.
   4       1996.       1815.       3085.       2742.       2436.
   5       1486.       1141.       1019.       1241.       1121.
   6        317.        608.        888.        943.       1192.
 ====================================================================
Total     13548.      16260.      19407.      19560.      18670.

  AGE      2003        2004        2005        2006        2007
 ______________________________________________________________________________

   1       2355.       1738.       1065.       2912.       2372.
   2       3989.       2466.       2284.       2256.       6845.
   3       4714.       2682.       2428.       2095.       2997.
   4       3144.       2566.       1378.        919.       1436.
   5       1402.       1739.        434.        463.        405.
   6       1759.       1775.        279.        394.        252.
 ====================================================================
Total     17363.      12967.       7868.       9039.      14306.

  AGE      2008
 ______________________________________________________________________________

   1       1669.
   2       3147.
   3      11534.
   4       2629.
   5       1246.
   6        535.
 ====================================================================
Total     20761.


Mean Biomass


  AGE      1973        1974        1975        1976        1977
 ______________________________________________________________________________

   1       2672.       5306.       6978.       2387.       1796.
   2       6717.       5680.       6860.       9599.       4434.
   3       9008.       4543.       2762.       3206.       4184.
   4       5519.       3991.       1367.        891.       1169.
   5       2543.       2120.        938.        421.        327.
   6       1419.       1086.        585.        778.        461.
 ====================================================================
Total     27878.      22727.      19490.      17283.      12371.

  AGE      1978        1979        1980        1981        1982
 ______________________________________________________________________________

   1       4524.       2618.       2185.       6959.       2259.
```

```
   2        3365.       8843.       5366.       5708.      11215.
   3        2397.       2464.       6230.       4325.       4578.
   4        1390.        945.       1401.       2403.       2016.
   5         456.        461.        399.        488.        753.
   6         215.        310.        168.         99.         95.
====================================================================
Total      12347.      15641.      15748.      19983.      20917.

  AGE       1983        1984        1985        1986        1987
_____________________________________________________________________________

   1         787.       1552.       2662.       1374.        999.
   2        3222.        775.       1893.       2786.       1416.
   3        6183.       1261.        666.       1146.       1340.
   4        2234.       1396.        509.        327.        500.
   5         748.        643.        365.        217.        113.
   6         232.        167.         62.        143.         90.
====================================================================
Total      13406.       5794.       6157.       5993.       4458.

  AGE       1988        1989        1990        1991        1992
_____________________________________________________________________________

   1        2107.        866.       1056.       2435.       1483.
   2        1677.       5058.       1721.       1911.       3285.
   3         841.       1283.       3133.       1199.       1815.
   4         377.        333.        610.       1089.        653.
   5         123.        103.        104.        206.        331.
   6          33.         35.         24.         46.         39.
====================================================================
Total       5159.       7677.       6647.       6887.       7607.

  AGE       1993        1994        1995        1996        1997
_____________________________________________________________________________

   1         990.       2299.       1837.       1447.       3832.
   2        2948.       1410.       2632.       2288.       2825.
   3        1533.       1473.       1096.       2710.       2274.
   4         790.        469.        439.        863.       1968.
   5         157.        162.        111.        251.        535.
   6          53.         61.         30.         49.        167.
====================================================================
Total       6471.       5875.       6145.       7608.      11601.


Mean Biomass


  AGE       1998        1999        2000        2001        2002
_____________________________________________________________________________

   1        3600.       4491.       4111.       5059.       3945.
   2        4161.       5563.       6221.       4779.       5456.
   3        2309.       4040.       3933.       3644.       3772.
   4        1544.       1483.       2036.       1825.       1978.
   5        1092.        897.        661.        840.        883.
   6         212.        407.        526.        556.        805.
====================================================================
Total      12918.      16881.      17488.      16704.      16839.

  AGE       2003        2004        2005        2006        2007
_____________________________________________________________________________

   1        2415.       1996.       1553.       4473.       2461.
   2        3355.       2371.       2371.       3097.      10324.
   3        3583.       1943.       1675.       1726.       2753.
   4        2523.       1226.        873.        625.       1296.
```

```
   5        1074.       789.       271.       319.       376.
   6        1211.       763.       152.       240.       200.
====================================================================
Total      14160.      9088.      6897.     10480.     17409.

Spawning Stock Biomass


  AGE        1973        1974        1975        1976        1977
_____________________________________________________________________________

   1           0.         0.         0.         0.         0.
   2        3198.      2730.      3285.      4616.      2135.
   3        9079.      4580.      2760.      3232.      4177.
   4        5754.      4142.      1404.       928.      1218.
   5        2651.      2201.       964.       438.       340.
   6        1479.      1127.       601.       810.       480.
====================================================================
Total      22161.     14780.      9014.     10024.      8351.

  AGE        1978        1979        1980        1981        1982
_____________________________________________________________________________

   1           0.         0.         0.         0.         0.
   2        1606.      4230.      2551.      2688.      5380.
   3        2415.      2483.      6282.      4358.      4616.
   4        1449.       984.      1461.      2489.      2096.
   5         475.       480.       416.       506.       783.
   6         224.       323.       175.       102.        98.
====================================================================
Total       6169.      8501.     10884.     10144.     12975.

  AGE        1983        1984        1985        1986        1987
_____________________________________________________________________________

   1           0.         0.         0.         0.         0.
   2        1552.       373.       912.      1342.       682.
   3        6202.      1257.       672.      1152.      1342.
   4        2328.      1402.       529.       341.       516.
   5         779.       646.       380.       226.       116.
   6         242.       168.        65.       150.        93.
====================================================================
Total      11103.      3847.      2558.      3210.      2750.

  AGE        1988        1989        1990        1991        1992
_____________________________________________________________________________

   1           0.         0.         0.         0.         0.
   2         806.      2392.       822.       897.      1583.
   3         847.      1287.      3159.      1203.      1827.
   4         385.       347.       636.      1124.       678.
   5         125.       107.       108.       213.       344.
   6          34.        36.        25.        48.        41.
====================================================================
Total       2198.      4170.      4750.      3485.      4472.

  AGE        1993        1994        1995        1996        1997
_____________________________________________________________________________

   1           0.         0.         0.         0.         0.
   2        1394.       671.      1237.      1079.      1335.
   3        1546.      1459.      1100.      2705.      2271.
   4         810.       471.       457.       897.      2045.
   5         161.       162.       116.       261.       556.
   6          54.        61.        32.        51.       174.
====================================================================
Total       3966.      2823.      2941.      4993.      6380.
```

```
Spawning Stock Biomass


  AGE       1998        1999        2000        2001        2002
_____________________________________________________________________________

   1           0.          0.          0.          0.          0.
   2        1969.       2637.       2957.       2270.       2600.
   3        2326.       4059.       3964.       3674.       3782.
   4        1609.       1546.       2122.       1902.       2060.
   5        1138.        935.        688.        875.        920.
   6         221.        424.        548.        579.        838.
====================================================================
Total       7262.       9600.      10280.       9300.      10201.

  AGE       2003        2004        2005        2006        2007
_____________________________________________________________________________

   1           0.          0.          0.          0.          0.
   2        1606.       1122.       1126.       1464.       4855.
   3        3608.       1959.       1685.       1729.       2742.
   4        2627.       1231.        906.        652.       1337.
   5        1118.        792.        281.        332.        387.
   6        1260.        766.        158.        250.        206.
====================================================================
Total      10219.       5869.       4157.       4427.       9526.

Catch Biomass


  AGE       1973        1974        1975        1976        1977
_____________________________________________________________________________

   1          36.        272.        524.         69.         44.
   2        1801.       3268.       8340.       9965.       3110.
   3        6267.       4114.       3606.       2993.       5537.
   4        4992.       4648.       1961.        905.       1169.
   5        2300.       2470.       1346.        427.        327.
   6        1283.       1264.        839.        790.        461.
====================================================================
Total      16680.      16037.      16618.      15149.      10647.

  AGE       1978        1979        1980        1981        1982
_____________________________________________________________________________

   1        1016.         37.         32.         13.        249.
   2        1112.       3460.       1286.        368.       5445.
   3        2336.       1751.       4775.       2916.       3628.
   4        1321.        939.       1009.       2972.       2210.
   5         433.        459.        287.        604.        826.
   6         204.        308.        121.        122.        104.
====================================================================
Total       6422.       6954.       7510.       6995.      12462.

  AGE       1983        1984        1985        1986        1987
_____________________________________________________________________________

   1          98.         83.        176.         32.         19.
   2        2367.        482.       1579.       2183.       1064.
   3        7347.       1719.        534.        609.       1644.
   4        1503.       2522.        525.        262.        669.
   5         503.       1162.        377.        174.        151.
   6         156.        302.         65.        115.        120.
====================================================================
Total      11975.       6270.       3255.       3375.       3666.

  AGE       1988        1989        1990        1991        1992
```

```
_____________________________________________________________________________

   1         51.         19.         24.         80.        244.
   2        985.        711.        613.         35.       2686.
   3        860.        583.       2763.        550.       1085.
   4        589.        308.        572.       1463.        775.
   5        192.         95.         97.        277.        393.
   6         52.         32.         22.         62.         47.
====================================================================
Total      2729.       1749.       4092.       2468.       5228.

  AGE       1993        1994        1995        1996        1997
_____________________________________________________________________________

   1        523.         14.          8.         12.         18.
   2        395.        347.         86.        188.        342.
   3       1261.       2225.        498.        840.        748.
   4       1165.        859.        409.        489.        999.
   5        232.        296.        103.        142.        272.
   6         78.        112.         28.         28.         85.
====================================================================
Total      3654.       3852.       1132.       1699.       2462.


Catch Biomass


  AGE       1998        1999        2000        2001        2002
_____________________________________________________________________________

   1         30.         12.         30.         44.         60.
   2        607.       1013.       1480.       1044.       1588.
   3       1450.       2077.       2743.       3200.       1654.
   4       1029.        990.       1951.       1771.       1274.
   5        728.        599.        633.        815.        569.
   6        141.        272.        504.        539.        518.
====================================================================
Total      3985.       4963.       7341.       7413.       5664.

  AGE       2003        2004        2005        2006        2007
_____________________________________________________________________________

   1         36.         13.          7.         15.          8.
   2       1407.        356.        521.        402.        421.
   3       2233.       1395.       1818.        698.        717.
   4       1515.       2229.       1017.        557.        375.
   5        645.       1434.        315.        284.        109.
   6        727.       1387.        178.        214.         58.
====================================================================
Total      6562.       6814.       3857.       2169.       1687.
```

```
Catch Numbers

  AGE      1973        1974        1975        1976        1977
_____________________________________________________________________________

   1       359.3      2367.5      4636.2       635.1       377.9
   2      5175.0      9500.0     26393.9     31938.1      9094.2
   3     13565.3      8294.2      7375.1      5501.9     10567.1
   4      9473.0      7657.9      3540.2      1425.7      1846.2
   5      3814.6      3642.6      2175.2       574.2       418.6
   6      1649.7      1519.6      1207.2       918.1       495.0
====================================================================
Total    34036.9     32981.8     45327.8     40993.1     22799.0

  AGE      1978        1979        1980        1981        1982
_____________________________________________________________________________

   1      9962.0       320.6       317.8       107.4      2163.5
   2      3542.1     10516.6      3994.4      1097.1     18091.3
   3      4579.7      3789.4      9685.3      5963.4      7480.3
   4      1913.8      1432.1      1538.4      4920.2      3400.5
   5       539.5       623.0       351.9       854.4      1095.2
   6       210.8       324.6       112.6       145.3        95.8
====================================================================
Total    20747.9     17006.3     16000.4     13087.8     32326.6

  AGE      1983        1984        1985        1986        1987
_____________________________________________________________________________

   1       702.8       514.3       970.3       178.8       156.4
   2      7998.1      2017.7      4373.6      6402.1      3284.2
   3     16660.9      4534.6      1057.6      1127.5      3136.7
   4      2475.9      5043.0       818.4       388.8       983.3
   5       679.6      1796.3       516.6       203.6       192.3
   6       154.6       379.5        80.7       113.4       137.3
====================================================================
Total    28671.9     14285.4      7817.2      8414.2      7890.2

  AGE      1988        1989        1990        1991        1992
_____________________________________________________________________________

   1       499.0       189.8       230.6       663.3      2413.9
   2      3002.6      2175.4      2114.4       147.3      9167.4
   3      1544.1      1120.6      6995.7      1491.2      2971.5
   4       846.1       428.2       978.3      3011.1      1473.0
   5       227.0       110.1       140.2       383.2       603.1
   6        53.3        30.4        26.1        71.2        42.0
====================================================================
Total     6172.1      4054.5     10485.3      5767.3     16670.9

  AGE      1993        1994        1995        1996        1997
_____________________________________________________________________________

   1      5233.5        71.2        46.9       100.6        81.8
   2      1385.8      1336.3       312.7       680.9      1132.3
   3      3326.9      6302.4      1435.3      2064.3      1832.4
   4      2325.5      1819.3       878.6       885.0      1856.8
   5       411.0       476.7       170.1       201.2       378.2
   6        90.5       143.9        36.9        27.6        89.6
====================================================================
Total    12773.2     10149.8      2880.5      3959.6      5371.1
```

```
 Catch Numbers

   AGE       1998        1999        2000        2001        2002
 ______________________________________________________________________________

    1        168.5        60.1       131.8       175.9       211.9
    2       1991.4      2752.9      3863.5      2883.5      4168.9
    3       3387.8      4195.0      5713.9      6956.4      3446.3
    4       1884.9      1547.6      3173.0      2893.2      1915.8
    5       1121.3       793.5       826.3      1003.9       683.0
    6        146.2       301.4       528.5       525.1       485.3
 =====================================================================
 Total      8700.1      9650.5     14237.0     14438.0     10911.2

   AGE       2003        2004        2005        2006        2007
 ______________________________________________________________________________

    1        159.7        63.9        59.9       153.9        53.0
    2       3919.1      1201.3      1528.8      1300.2      1463.5
    3       4710.0      3170.8      4086.2      1697.7      1764.9
    4       2319.9      3803.8      1712.5      1003.0       699.5
    5        782.4      1970.1       411.3       373.2       142.2
    6        693.5      1450.7       178.1       214.0        57.6
 =====================================================================
 Total     12584.6     11660.6      7976.8      4742.0      4180.7Surplus Production

Average Adjustment Factor (Delta) =   1.0000

 Year        Biomass  Delta Biomass  Catch Biomass  Surplus Production

 1973      34859.870      -8726.293      16680.299       7954.006
 1974      26133.577      -3410.933      16036.521      12625.588
 1975      22722.644      -3738.801      16617.511      12878.709
 1976      18983.843      -4536.768      15149.320      10612.552
 1977      14447.075      -2301.286      10647.211       8345.925
 1978      12145.789       1924.223       6422.207       8346.430
 1979      14070.012       1749.816       6953.568       8703.384
 1980      15819.828       3070.339       7510.196      10580.534
 1981      18890.167       3104.265       6994.648      10098.913
 1982      21994.432      -4357.319      12461.991       8104.672
 1983      17637.113      -8515.924      11975.208       3459.283
 1984       9121.189      -2837.769       6270.328       3432.559
 1985       6283.420        344.755       3255.156       3599.912
 1986       6628.176      -1029.041       3375.356       2346.315
 1987       5599.135       -694.543       3666.181       2971.637
 1988       4904.592       1099.276       2728.755       3828.030
 1989       6003.867       1943.108       1748.710       3691.818
 1990       7946.975       -942.640       4092.209       3149.569
 1991       7004.335       1148.206       2468.313       3616.519
 1992       8152.541      -1259.826       5228.486       3968.660
 1993       6892.715        551.072       3654.179       4205.251
 1994       7443.787      -1213.834       3852.190       2638.355
 1995       6229.953       1046.155       1132.341       2178.496
 1996       7276.108       4031.751       1698.769       5730.520
 1997      11307.859       2239.872       2462.436       4702.308
 1998      13547.731       2711.938       3985.457       6697.395
 1999      16259.669       3147.577       4962.850       8110.428
 2000      19407.246        152.524       7341.104       7493.629
 2001      19559.771       -890.153       7413.005       6522.852
 2002      18669.618      -1306.869       5663.577       4356.708
 2003      17362.749      -4395.720       6562.289       2166.569
 2004      12967.029      -5099.305       6814.349       1715.043
 2005       7867.723       1171.626       3857.066       5028.692
 2006       9039.350       5267.047       2168.776       7435.822
 2007      14306.396       6454.480       1687.169       8141.650
 2008      20760.877
```

```
Summary of Survey Indices Used in the Estimate

INDEX    Survey Tag    Age   Time  Type  Catchability Std. Error   CV
_____________________________________________________________________________

  1         USsearly    1   JAN-1 NUMBER  0.7461E-02  0.4890E-02  0.6554E+00
  2         USsearly    2   JAN-1 NUMBER  0.7552E-01  0.1408E-01  0.1864E+00
  3         USsearly    3   JAN-1 NUMBER  0.9561E-01  0.1687E-01  0.1765E+00
  4         USsearly    4   JAN-1 NUMBER  0.9265E-01  0.1151E-01  0.1242E+00
  5         USsearly    5   JAN-1 NUMBER  0.7601E-01  0.1541E-01  0.2027E+00
  6         USsearly    6   JAN-1 NUMBER  0.7202E-01  0.2265E-01  0.3145E+00
  7         USspr       1   JAN-1 NUMBER  0.4235E-02  0.1040E-02  0.2456E+00
  8         USspr       2   JAN-1 NUMBER  0.4556E-01  0.1441E-01  0.3162E+00
  9         USspr       3   JAN-1 NUMBER  0.9545E-01  0.1522E-01  0.1595E+00
 10         USspr       4   JAN-1 NUMBER  0.1524E+00  0.2010E-01  0.1318E+00
 11         USspr       5   JAN-1 NUMBER  0.2285E+00  0.4608E-01  0.2016E+00
 12         USspr       6   JAN-1 NUMBER  0.4229E+00  0.9316E-01  0.2203E+00
 13         USspr95     1   JAN-1 NUMBER  0.4582E-02  0.1354E-02  0.2954E+00
 14         USspr95     2   JAN-1 NUMBER  0.1437E+00  0.1650E-01  0.1149E+00
 15         USspr95     3   JAN-1 NUMBER  0.4995E+00  0.8842E-01  0.1770E+00
 16         USspr95     4   JAN-1 NUMBER  0.5934E+00  0.9885E-01  0.1666E+00
 17         USspr95     5   JAN-1 NUMBER  0.4807E+00  0.1085E+00  0.2257E+00
 18         USspr95     6   JAN-1 NUMBER  0.3912E+00  0.9214E-01  0.2355E+00
 19         USfall      1   MEAN  NUMBER  0.3964E-01  0.1006E-01  0.2537E+00
 20         USfall      2   MEAN  NUMBER  0.8751E-01  0.1425E-01  0.1629E+00
 21         USfall      3   MEAN  NUMBER  0.1504E+00  0.1581E-01  0.1052E+00
 22         USfall      4   MEAN  NUMBER  0.1561E+00  0.2159E-01  0.1383E+00
 23         USfall      5   MEAN  NUMBER  0.2050E+00  0.4109E-01  0.2005E+00
 24         USfall      6   MEAN  NUMBER  0.3063E+00  0.6539E-01  0.2135E+00
 25         USfall95    1   MEAN  NUMBER  0.6541E-01  0.1508E-01  0.2306E+00
 26         USfall95    2   MEAN  NUMBER  0.2123E+00  0.7371E-01  0.3472E+00
 27         USfall95    3   MEAN  NUMBER  0.5561E+00  0.1084E+00  0.1950E+00
 28         USfall95    4   MEAN  NUMBER  0.4711E+00  0.8264E-01  0.1754E+00
 29         USfall95    5   MEAN  NUMBER  0.4901E+00  0.1277E+00  0.2606E+00
 30         USfall95    6   MEAN  NUMBER  0.3616E+00  0.1311E+00  0.3624E+00
 32         Canada      2   JAN-1 NUMBER  0.2299E-03  0.7381E-04  0.3210E+00
 33         Canada      3   JAN-1 NUMBER  0.3694E-03  0.5352E-04  0.1449E+00
 34         Canada      4   JAN-1 NUMBER  0.6191E-03  0.1146E-03  0.1850E+00
 35         Canada      5   JAN-1 NUMBER  0.6933E-03  0.1548E-03  0.2233E+00
 36         Canada      6   JAN-1 NUMBER  0.4029E-03  0.1012E-03  0.2511E+00
 38         Can95       2   JAN-1 NUMBER  0.4966E-03  0.1064E-03  0.2142E+00
 39         Can95       3   JAN-1 NUMBER  0.2062E-02  0.3176E-03  0.1540E+00
 40         Can95       4   JAN-1 NUMBER  0.2640E-02  0.3605E-03  0.1366E+00
 41         Can95       5   JAN-1 NUMBER  0.2405E-02  0.4405E-03  0.1832E+00
 42         Can95       6   JAN-1 NUMBER  0.1860E-02  0.3387E-03  0.1821E+00
 43         Scall       1   MEAN  NUMBER  0.2334E-04  0.6875E-05  0.2946E+00
 44         Scall95     1   MEAN  NUMBER  0.5395E-04  0.4694E-05  0.8700E-01
```

```
Survey Index:    1 Tag:         USsearly AGE =  1
Time = JAN-1           Type = NUMBER
Catchability =    0.746089E-02   % Variance Contribution =     7.8992
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_____________________________________________________________________________

1973     0.188291E+04     0.219229E+03     0.215046E+01
1974     0.308173E+03     0.389338E+03    -0.233787E+00
1975     0.409216E+03     0.526977E+03    -0.252913E+00
1976     0.100838E+04     0.184512E+03     0.169839E+01
1977     N/A              0.128948E+03     N/A
1978     0.912193E+03     0.406148E+03     0.809134E+00
1979     0.393977E+03     0.190315E+03     0.727612E+00
1980     0.553260E+02     0.179312E+03    -0.117588E+01
1981     0.113560E+02     0.470010E+03    -0.372301E+01
1982     N/A              0.170450E+03     N/A
1983     N/A              0.491009E+02     N/A
1984     N/A              0.809021E+02     N/A
1985     N/A              0.124961E+03     N/A
1986     N/A              0.632187E+02     N/A
1987     N/A              0.685904E+02     N/A
1988     N/A              0.170414E+03     N/A
1989     N/A              0.720800E+02     N/A
1990     N/A              0.836881E+02     N/A
1991     N/A              0.168293E+03     N/A
1992     N/A              0.130699E+03     N/A
1993     N/A              0.103993E+03     N/A
1994     N/A              0.983325E+02     N/A
1995     N/A              0.870844E+02     N/A
1996     N/A              0.100499E+03     N/A
1997     N/A              0.147734E+03     N/A
1998     N/A              0.167137E+03     N/A
1999     N/A              0.183270E+03     N/A
2000     N/A              0.148319E+03     N/A
2001     N/A              0.166610E+03     N/A
2002     N/A              0.115993E+03     N/A
2003     N/A              0.878157E+02     N/A
2004     N/A              0.781275E+02     N/A
2005     N/A              0.107699E+03     N/A
2006     N/A              0.368846E+03     N/A
2007     N/A              0.137077E+03     N/A
2008     N/A              0.000000E+00     N/A
```

```
Survey Index:    2 Tag:         USsearly AGE =  2
Time = JAN-1           Type = NUMBER
Catchability =    0.755206E-01   % Variance Contribution =     0.8214
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_____________________________________________________________________________


1973     0.318433E+04     0.182549E+04     0.556392E+00
1974     0.216847E+04     0.179232E+04     0.190510E+00
1975     0.291799E+04     0.306521E+04    -0.492211E-01
1976     0.425901E+04     0.405136E+04     0.499838E-01
1977     0.654007E+03     0.148581E+04    -0.820601E+00
1978     0.778441E+03     0.104287E+04    -0.292435E+00
1979     0.195678E+04     0.268882E+04    -0.317801E+00
1980     0.452865E+04     0.155534E+04     0.106873E+01
1981     0.995861E+03     0.146434E+04    -0.385555E+00
1982     N/A              0.388781E+04     N/A
1983     N/A              0.126526E+04     N/A
1984     N/A              0.359072E+03     N/A
1985     N/A              0.635410E+03     N/A
1986     N/A              0.969476E+03     N/A
1987     N/A              0.511723E+03     N/A
1988     N/A              0.557767E+03     N/A
1989     N/A              0.137825E+04     N/A
1990     N/A              0.584409E+03     N/A
1991     N/A              0.677828E+03     N/A
1992     N/A              0.134948E+04     N/A
1993     N/A              0.918920E+03     N/A
1994     N/A              0.507906E+03     N/A
1995     N/A              0.810059E+03     N/A
1996     N/A              0.718501E+03     N/A
1997     N/A              0.826012E+03     N/A
1998     N/A              0.121874E+04     N/A
1999     N/A              0.137363E+04     N/A
2000     N/A              0.151472E+04     N/A
2001     N/A              0.122018E+04     N/A
2002     N/A              0.136876E+04     N/A
2003     N/A              0.946821E+03     N/A
2004     N/A              0.716868E+03     N/A
2005     N/A              0.643112E+03     N/A
2006     N/A              0.888458E+03     N/A
2007     N/A              0.304626E+04     N/A
2008     N/A              0.113239E+04     N/A
```

```
Survey Index:    3 Tag:         USsearly AGE =  3
Time = JAN-1           Type = NUMBER
Catchability =    0.956073E-01   % Variance Contribution =     0.7362
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_____________________________________________________________________________

1973     0.230941E+04     0.282197E+04    -0.200443E+00
1974     0.179546E+04     0.144716E+04     0.215660E+00
1975     0.809113E+03     0.104502E+04    -0.255857E+00
1976     0.121600E+04     0.941922E+03     0.255399E+00
1977     0.109768E+04     0.148710E+04    -0.303628E+00
1978     0.494436E+03     0.763635E+03    -0.434673E+00
1979     0.395239E+03     0.776685E+03    -0.675544E+00
1980     0.561720E+04     0.188455E+04     0.109215E+01
1981     0.172422E+04     0.126850E+04     0.306940E+00
1982     N/A              0.142313E+04     N/A
1983     N/A              0.247975E+04     N/A
1984     N/A              0.628975E+03     N/A
1985     N/A              0.199697E+03     N/A
1986     N/A              0.286004E+03     N/A
1987     N/A              0.459008E+03     N/A
1988     N/A              0.250239E+03     N/A
1989     N/A              0.321305E+03     N/A
1990     N/A              0.124111E+04     N/A
1991     N/A              0.424202E+03     N/A
1992     N/A              0.689847E+03     N/A
1993     N/A              0.617535E+03     N/A
1994     N/A              0.833036E+03     N/A
1995     N/A              0.411503E+03     N/A
1996     N/A              0.812630E+03     N/A
1997     N/A              0.685996E+03     N/A
1998     N/A              0.758562E+03     N/A
1999     N/A              0.109165E+04     N/A
2000     N/A              0.118672E+04     N/A
2001     N/A              0.123765E+04     N/A
2002     N/A              0.101658E+04     N/A
2003     N/A              0.106040E+04     N/A
2004     N/A              0.645245E+03     N/A
2005     N/A              0.639538E+03     N/A
2006     N/A              0.535028E+03     N/A
2007     N/A              0.808832E+03     N/A
2008     N/A              0.303112E+04     N/A
```

```
Survey Index:    4 Tag:         USsearly AGE =  4
Time = JAN-1           Type = NUMBER
Catchability =    0.926548E-01   % Variance Contribution =     0.3649
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_____________________________________________________________________________

1973     0.103672E+04     0.160292E+04    -0.435763E+00
1974     0.122503E+04     0.111663E+04     0.926513E-01
1975     0.262554E+03     0.464244E+03    -0.569954E+00
1976     0.302447E+03     0.224730E+03     0.297008E+00
1977     0.363693E+03     0.293840E+03     0.213276E+00
1978     0.213926E+03     0.314119E+03    -0.384143E+00
1979     0.328265E+03     0.228641E+03     0.361669E+00
1980     0.460562E+03     0.302781E+03     0.419437E+00
1981     0.698850E+03     0.694795E+03     0.581989E-02
1982     N/A              0.512874E+03     N/A
1983     N/A              0.511190E+03     N/A
1984     N/A              0.599622E+03     N/A
1985     N/A              0.127736E+03     N/A
1986     N/A              0.710874E+02     N/A
1987     N/A              0.133385E+03     N/A
1988     N/A              0.106814E+03     N/A
1989     N/A              0.714474E+02     N/A
1990     N/A              0.161850E+03     N/A
1991     N/A              0.407623E+03     N/A
1992     N/A              0.212716E+03     N/A
1993     N/A              0.301090E+03     N/A
1994     N/A              0.215258E+03     N/A
1995     N/A              0.146018E+03     N/A
1996     N/A              0.207275E+03     N/A
1997     N/A              0.472888E+03     N/A
1998     N/A              0.391768E+03     N/A
1999     N/A              0.321248E+03     N/A
2000     N/A              0.518025E+03     N/A
2001     N/A              0.468817E+03     N/A
2002     N/A              0.408081E+03     N/A
2003     N/A              0.520241E+03     N/A
2004     N/A              0.451183E+03     N/A
2005     N/A              0.249695E+03     N/A
2006     N/A              0.171412E+03     N/A
2007     N/A              0.283371E+03     N/A
2008     N/A              0.494684E+03     N/A
```

```
Survey Index:    5 Tag:         USsearly AGE =  5
Time = JAN-1           Type = NUMBER
Catchability =    0.760134E-01   % Variance Contribution =     0.9712
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual


1973     0.399412E+03     0.529538E+03    -0.282011E+00
1974     0.336904E+03     0.435744E+03    -0.257257E+00
1975     0.201502E+03     0.234013E+03    -0.149578E+00
1976     0.191213E+03     0.742537E+02     0.945901E+00
1977     0.819210E+02     0.546579E+02     0.404661E+00
1978     0.257220E+02     0.726461E+02    -0.103825E+01
1979     0.587230E+02     0.816001E+02    -0.328999E+00
1980     0.550340E+02     0.568200E+02    -0.319373E-01
1981     0.206937E+03     0.989822E+02     0.737474E+00
1982     N/A              0.135514E+03     N/A
1983     N/A              0.115113E+03     N/A
1984     N/A              0.175223E+03     N/A
1985     N/A              0.661493E+02     N/A
1986     N/A              0.305398E+02     N/A
1987     N/A              0.214004E+02     N/A
1988     N/A              0.235102E+02     N/A
1989     N/A              0.150713E+02     N/A
1990     N/A              0.190288E+02     N/A
1991     N/A              0.425580E+02     N/A
1992     N/A              0.714511E+02     N/A
1993     N/A              0.436560E+02     N/A
1994     N/A              0.462725E+02     N/A
1995     N/A              0.231922E+02     N/A
1996     N/A              0.386593E+02     N/A
1997     N/A              0.790200E+02     N/A
1998     N/A              0.191199E+03     N/A
1999     N/A              0.135130E+03     N/A
2000     N/A              0.110673E+03     N/A
2001     N/A              0.133456E+03     N/A
2002     N/A              0.119355E+03     N/A
2003     N/A              0.143942E+03     N/A
2004     N/A              0.191710E+03     N/A
2005     N/A              0.491995E+02     N/A
2006     N/A              0.523244E+02     N/A
2007     N/A              0.472596E+02     N/A
2008     N/A              0.142534E+03     N/A
```

```
Survey Index:    6 Tag:         USsearly AGE =  6
Time = JAN-1           Type = NUMBER
Catchability =    0.720239E-01   % Variance Contribution =     2.3385
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_____________________________________________________________________________

1973     0.210237E+03     0.216990E+03    -0.316145E-01
1974     0.273813E+03     0.172241E+03     0.463553E+00
1975     0.862890E+02     0.123057E+03    -0.354946E+00
1976     0.108419E+03     0.112494E+03    -0.369004E-01
1977     0.128120E+02     0.612415E+02    -0.156444E+01
1978     0.766800E+01     0.268954E+02    -0.125490E+01
1979     0.887150E+02     0.402845E+02     0.789463E+00
1980     0.353310E+02     0.172269E+02     0.718290E+00
1981     0.568790E+02     0.159495E+02     0.127150E+01
1982     N/A              0.112316E+02     N/A
1983     N/A              0.248123E+02     N/A
1984     N/A              0.350759E+02     N/A
1985     N/A              0.979108E+01     N/A
1986     N/A              0.161171E+02     N/A
1987     N/A              0.144777E+02     N/A
1988     N/A              0.523051E+01     N/A
1989     N/A              0.394296E+01     N/A
1990     N/A              0.335652E+01     N/A
1991     N/A              0.749242E+01     N/A
1992     N/A              0.471472E+01     N/A
1993     N/A              0.910829E+01     N/A
1994     N/A              0.132350E+02     N/A
1995     N/A              0.476705E+01     N/A
1996     N/A              0.502483E+01     N/A
1997     N/A              0.177382E+02     N/A
1998     N/A              0.236209E+02     N/A
1999     N/A              0.486333E+02     N/A
2000     N/A              0.670709E+02     N/A
2001     N/A              0.661418E+02     N/A
2002     N/A              0.803555E+02     N/A
2003     N/A              0.120890E+03     N/A
2004     N/A              0.133758E+03     N/A
2005     N/A              0.201861E+02     N/A
2006     N/A              0.284291E+02     N/A
2007     N/A              0.181384E+02     N/A
2008     N/A              0.385756E+02     N/A
```

```
Survey Index:    7 Tag:         USspr    AGE =  1
Time = JAN-1           Type = NUMBER
Catchability =    0.423531E-02   % Variance Contribution =     1.1088
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_____________________________________________________________________________

1973     N/A              0.124450E+03     N/A
1974     N/A              0.221015E+03     N/A
1975     N/A              0.299148E+03     N/A
1976     N/A              0.104742E+03     N/A
1977     N/A              0.731996E+02     N/A
1978     N/A              0.230557E+03     N/A
1979     N/A              0.108036E+03     N/A
1980     N/A              0.101790E+03     N/A
1981     N/A              0.266810E+03     N/A
1982     0.440660E+02     0.967593E+02    -0.786538E+00
1983     N/A              0.278731E+02     N/A
1984     N/A              0.459256E+02     N/A
1985     0.106381E+03     0.709365E+02     0.405242E+00
1986     0.265950E+02     0.358873E+02    -0.299660E+00
1987     0.265950E+02     0.389366E+02    -0.381212E+00
1988     0.755150E+02     0.967385E+02    -0.247680E+00
1989     0.452310E+02     0.409175E+02     0.100224E+00
1990     N/A              0.475071E+02     N/A
1991     0.422513E+03     0.955348E+02     0.148673E+01
1992     N/A              0.741935E+02     N/A
1993     0.447460E+02     0.590336E+02    -0.277106E+00
1994     N/A              0.558203E+02     N/A
1995     N/A              0.494351E+02     N/A
1996     N/A              0.570503E+02     N/A
1997     N/A              0.838638E+02     N/A
1998     N/A              0.948782E+02     N/A
1999     N/A              0.104037E+03     N/A
2000     N/A              0.841959E+02     N/A
2001     N/A              0.945791E+02     N/A
2002     N/A              0.658454E+02     N/A
2003     N/A              0.498502E+02     N/A
2004     N/A              0.443506E+02     N/A
2005     N/A              0.611376E+02     N/A
2006     N/A              0.209383E+03     N/A
2007     N/A              0.778143E+02     N/A
2008     N/A              0.000000E+00     N/A
```

```
Survey Index:    8 Tag:         USspr    AGE =  2
Time = JAN-1           Type = NUMBER
Catchability =    0.455643E-01   % Variance Contribution =     4.3332
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_____________________________________________________________________________

1973     N/A              0.110138E+04     N/A
1974     N/A              0.108137E+04     N/A
1975     N/A              0.184935E+04     N/A
1976     N/A              0.244433E+04     N/A
1977     N/A              0.896445E+03     N/A
1978     N/A              0.629198E+03     N/A
1979     N/A              0.162226E+04     N/A
1980     N/A              0.938393E+03     N/A
1981     N/A              0.883491E+03     N/A
1982     0.365654E+04     0.234566E+04     0.443952E+00
1983     0.181002E+04     0.763376E+03     0.863344E+00
1984     0.902680E+02     0.216641E+03    -0.875457E+00
1985     0.213421E+04     0.383365E+03     0.171686E+01
1986     0.175305E+04     0.584919E+03     0.109764E+01
1987     0.732820E+02     0.308741E+03    -0.143819E+01
1988     0.266922E+03     0.336521E+03    -0.231703E+00
1989     0.391259E+03     0.831547E+03    -0.753919E+00
1990     0.636730E+02     0.352595E+03    -0.171156E+01
1991     N/A              0.408957E+03     N/A
1992     0.198774E+04     0.814190E+03     0.892562E+00
1993     0.281093E+03     0.554417E+03    -0.679231E+00
1994     0.602273E+03     0.306438E+03     0.675696E+00
1995     N/A              0.488738E+03     N/A
1996     N/A              0.433497E+03     N/A
1997     N/A              0.498362E+03     N/A
1998     N/A              0.735311E+03     N/A
1999     N/A              0.828757E+03     N/A
2000     N/A              0.913885E+03     N/A
2001     N/A              0.736178E+03     N/A
2002     N/A              0.825819E+03     N/A
2003     N/A              0.571251E+03     N/A
2004     N/A              0.432512E+03     N/A
2005     N/A              0.388012E+03     N/A
2006     N/A              0.536038E+03     N/A
2007     N/A              0.183792E+04     N/A
2008     N/A              0.683211E+03     N/A
```

```
Survey Index:    9 Tag:         USspr    AGE =  3
Time = JAN-1           Type = NUMBER
Catchability =    0.954470E-01   % Variance Contribution =     1.3029
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_____________________________________________________________________________

1973     N/A             0.281723E+04     N/A
1974     N/A             0.144473E+04     N/A
1975     N/A             0.104327E+04     N/A
1976     N/A             0.940343E+03     N/A
1977     N/A             0.148461E+04     N/A
1978     N/A             0.762355E+03     N/A
1979     N/A             0.775383E+03     N/A
1980     N/A             0.188139E+04     N/A
1981     N/A             0.126637E+04     N/A
1982     0.109652E+04    0.142075E+04    -0.259047E+00
1983     0.264777E+04    0.247559E+04     0.672392E-01
1984     0.806007E+03    0.627920E+03     0.249679E+00
1985     0.254401E+03    0.199363E+03     0.243786E+00
1986     0.282646E+03    0.285524E+03    -0.101319E-01
1987     0.132976E+03    0.458238E+03    -0.123722E+01
1988     0.355249E+03    0.249819E+03     0.352081E+00
1989     0.737675E+03    0.320767E+03     0.832789E+00
1990     0.107468E+04    0.123903E+04    -0.142308E+00
1991     0.246927E+03    0.423491E+03    -0.539439E+00
1992     0.184069E+04    0.688690E+03     0.983106E+00
1993     0.485798E+03    0.616500E+03    -0.238265E+00
1994     0.614697E+03    0.831640E+03    -0.302270E+00
1995     N/A             0.410814E+03     N/A
1996     N/A             0.811268E+03     N/A
1997     N/A             0.684846E+03     N/A
1998     N/A             0.757290E+03     N/A
1999     N/A             0.108982E+04     N/A
2000     N/A             0.118473E+04     N/A
2001     N/A             0.123557E+04     N/A
2002     N/A             0.101487E+04     N/A
2003     N/A             0.105862E+04     N/A
2004     N/A             0.644163E+03     N/A
2005     N/A             0.638466E+03     N/A
2006     N/A             0.534131E+03     N/A
2007     N/A             0.807476E+03     N/A
2008     N/A             0.302604E+04     N/A
```

```
Survey Index:   10 Tag:         USspr    AGE =  4
Time = JAN-1           Type = NUMBER
Catchability =    0.152428E+00   % Variance Contribution =     0.8905
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_____________________________________________________________________________


1973     N/A              0.263699E+04     N/A
1974     N/A              0.183697E+04     N/A
1975     N/A              0.763734E+03     N/A
1976     N/A              0.369706E+03     N/A
1977     N/A              0.483399E+03     N/A
1978     N/A              0.516762E+03     N/A
1979     N/A              0.376140E+03     N/A
1980     N/A              0.498109E+03     N/A
1981     N/A              0.114302E+04     N/A
1982     0.992464E+03     0.843737E+03     0.162350E+00
1983     0.514431E+03     0.840965E+03    -0.491489E+00
1984     0.837941E+03     0.986447E+03    -0.163161E+00
1985     0.273425E+03     0.210140E+03     0.263251E+00
1986     0.546460E+02     0.116947E+03    -0.760843E+00
1987     0.129287E+03     0.219433E+03    -0.529013E+00
1988     0.234697E+03     0.175722E+03     0.289393E+00
1989     0.280996E+03     0.117539E+03     0.871569E+00
1990     0.358355E+03     0.266261E+03     0.297046E+00
1991     0.665072E+03     0.670586E+03    -0.825684E-02
1992     0.621782E+03     0.349942E+03     0.574822E+00
1993     0.307882E+03     0.495327E+03    -0.475501E+00
1994     0.343601E+03     0.354124E+03    -0.301674E-01
1995     N/A              0.240216E+03     N/A
1996     N/A              0.340991E+03     N/A
1997     N/A              0.777954E+03     N/A
1998     N/A              0.644502E+03     N/A
1999     N/A              0.528489E+03     N/A
2000     N/A              0.852210E+03     N/A
2001     N/A              0.771257E+03     N/A
2002     N/A              0.671340E+03     N/A
2003     N/A              0.855855E+03     N/A
2004     N/A              0.742247E+03     N/A
2005     N/A              0.410777E+03     N/A
2006     N/A              0.281992E+03     N/A
2007     N/A              0.466178E+03     N/A
2008     N/A              0.813811E+03     N/A
```

```
Survey Index:   11 Tag:         USspr    AGE =  5
Time = JAN-1           Type = NUMBER
Catchability =    0.228532E+00   % Variance Contribution =     2.0826
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_____________________________________________________________________________

1973     N/A             0.159204E+04     N/A
1974     N/A             0.131005E+04     N/A
1975     N/A             0.703553E+03     N/A
1976     N/A             0.223241E+03     N/A
1977     N/A             0.164327E+03     N/A
1978     N/A             0.218408E+03     N/A
1979     N/A             0.245328E+03     N/A
1980     N/A             0.170828E+03     N/A
1981     N/A             0.297587E+03     N/A
1982     0.444546E+03    0.407418E+03     0.872126E-01
1983     0.119581E+03    0.346084E+03    -0.106269E+01
1984     0.810375E+03    0.526801E+03     0.430674E+00
1985     0.143361E+03    0.198876E+03    -0.327314E+00
1986     0.132879E+03    0.918170E+02     0.369642E+00
1987     0.509580E+02    0.643396E+02    -0.233174E+00
1988     0.193154E+03    0.706827E+02     0.100529E+01
1989     0.593050E+02    0.453113E+02     0.269138E+00
1990     0.112204E+03    0.572094E+02     0.673600E+00
1991     0.255469E+03    0.127949E+03     0.691466E+00
1992     0.159959E+03    0.214816E+03    -0.294863E+00
1993     0.260130E+02    0.131250E+03    -0.161851E+01
1994     0.140449E+03    0.139117E+03     0.952951E-02
1995     N/A             0.697265E+02     N/A
1996     N/A             0.116228E+03     N/A
1997     N/A             0.237571E+03     N/A
1998     N/A             0.574832E+03     N/A
1999     N/A             0.406263E+03     N/A
2000     N/A             0.332734E+03     N/A
2001     N/A             0.401231E+03     N/A
2002     N/A             0.358836E+03     N/A
2003     N/A             0.432756E+03     N/A
2004     N/A             0.576371E+03     N/A
2005     N/A             0.147917E+03     N/A
2006     N/A             0.157312E+03     N/A
2007     N/A             0.142085E+03     N/A
2008     N/A             0.428524E+03     N/A
```

```
Survey Index:   12 Tag:         USspr    AGE =  6
Time = JAN-1           Type = NUMBER
Catchability =    0.422932E+00   % Variance Contribution =     1.7526
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_____________________________________________________________________________

1973     N/A             0.127419E+04     N/A
1974     N/A             0.101142E+04     N/A
1975     N/A             0.722605E+03     N/A
1976     N/A             0.660580E+03     N/A
1977     N/A             0.359617E+03     N/A
1978     N/A             0.157933E+03     N/A
1979     N/A             0.236555E+03     N/A
1980     N/A             0.101158E+03     N/A
1981     N/A             0.936574E+02     N/A
1982     0.883270E+02     0.659533E+02     0.292099E+00
1983     0.237318E+03     0.145701E+03     0.487846E+00
1984     0.236541E+03     0.205970E+03     0.138392E+00
1985     N/A             0.574943E+02     N/A
1986     0.531900E+02     0.946416E+02    -0.576227E+00
1987     0.531900E+02     0.850147E+02    -0.468953E+00
1988     0.265950E+02     0.307142E+02    -0.144000E+00
1989     0.434840E+02     0.231535E+02     0.630248E+00
1990     0.100751E+03     0.197099E+02     0.163153E+01
1991     0.199950E+02     0.439963E+02    -0.788624E+00
1992     0.166950E+02     0.276853E+02    -0.505793E+00
1993     N/A             0.534849E+02     N/A
1994     0.387280E+02     0.777176E+02    -0.696519E+00
1995     N/A             0.279926E+02     N/A
1996     N/A             0.295064E+02     N/A
1997     N/A             0.104161E+03     N/A
1998     N/A             0.138705E+03     N/A
1999     N/A             0.285580E+03     N/A
2000     N/A             0.393848E+03     N/A
2001     N/A             0.388392E+03     N/A
2002     N/A             0.471856E+03     N/A
2003     N/A             0.709879E+03     N/A
2004     N/A             0.785444E+03     N/A
2005     N/A             0.118535E+03     N/A
2006     N/A             0.166939E+03     N/A
2007     N/A             0.106511E+03     N/A
2008     N/A             0.226520E+03     N/A
```

```
Survey Index:   13 Tag:         USspr95  AGE =  1
Time = JAN-1           Type = NUMBER
Catchability =    0.458156E-02   % Variance Contribution =     2.5795
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_____________________________________________________________________________

1973     N/A              0.134624E+03     N/A
1974     N/A              0.239084E+03     N/A
1975     N/A              0.323604E+03     N/A
1976     N/A              0.113305E+03     N/A
1977     N/A              0.791839E+02     N/A
1978     N/A              0.249406E+03     N/A
1979     N/A              0.116868E+03     N/A
1980     N/A              0.110111E+03     N/A
1981     N/A              0.288623E+03     N/A
1982     N/A              0.104670E+03     N/A
1983     N/A              0.301518E+02     N/A
1984     N/A              0.496801E+02     N/A
1985     N/A              0.767358E+02     N/A
1986     N/A              0.388212E+02     N/A
1987     N/A              0.421198E+02     N/A
1988     N/A              0.104647E+03     N/A
1989     N/A              0.442627E+02     N/A
1990     N/A              0.513910E+02     N/A
1991     N/A              0.103345E+03     N/A
1992     N/A              0.802591E+02     N/A
1993     N/A              0.638598E+02     N/A
1994     N/A              0.603837E+02     N/A
1995     0.390190E+02     0.534766E+02    -0.315195E+00
1996     0.243630E+02     0.617144E+02    -0.929451E+00
1997     0.181510E+02     0.907200E+02    -0.160905E+01
1998     N/A              0.102635E+03     N/A
1999     0.487250E+02     0.112542E+03    -0.837133E+00
2000     0.177333E+03     0.910792E+02     0.666300E+00
2001     N/A              0.102311E+03     N/A
2002     0.182380E+03     0.712285E+02     0.940199E+00
2003     0.196066E+03     0.539257E+02     0.129084E+01
2004     0.470750E+02     0.479764E+02    -0.189662E-01
2005     N/A              0.661358E+02     N/A
2006     0.493466E+03     0.226500E+03     0.778708E+00
2007     0.870650E+02     0.841759E+02     0.337463E-01
2008     N/A              0.000000E+00     N/A
```

```
Survey Index:   14 Tag:         USspr95  AGE =  2
Time = JAN-1           Type = NUMBER
Catchability =    0.143683E+00   % Variance Contribution =     0.7884
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_____________________________________________________________________________

1973     N/A              0.347311E+04     N/A
1974     N/A              0.341001E+04     N/A
1975     N/A              0.583176E+04     N/A
1976     N/A              0.770796E+04     N/A
1977     N/A              0.282686E+04     N/A
1978     N/A              0.198412E+04     N/A
1979     N/A              0.511564E+04     N/A
1980     N/A              0.295914E+04     N/A
1981     N/A              0.278601E+04     N/A
1982     N/A              0.739681E+04     N/A
1983     N/A              0.240723E+04     N/A
1984     N/A              0.683156E+03     N/A
1985     N/A              0.120891E+04     N/A
1986     N/A              0.184449E+04     N/A
1987     N/A              0.973585E+03     N/A
1988     N/A              0.106119E+04     N/A
1989     N/A              0.262221E+04     N/A
1990     N/A              0.111187E+04     N/A
1991     N/A              0.128961E+04     N/A
1992     N/A              0.256747E+04     N/A
1993     N/A              0.174830E+04     N/A
1994     N/A              0.966323E+03     N/A
1995     0.114456E+04     0.154119E+04    -0.297533E+00
1996     0.958104E+03     0.136699E+04    -0.355412E+00
1997     0.113447E+04     0.157154E+04    -0.325893E+00
1998     0.202007E+04     0.231873E+04    -0.137892E+00
1999     0.460630E+04     0.261341E+04     0.566768E+00
2000     0.467764E+04     0.288185E+04     0.484359E+00
2001     0.224671E+04     0.232147E+04    -0.327356E-01
2002     0.234154E+04     0.260414E+04    -0.106297E+00
2003     0.424144E+04     0.180139E+04     0.856345E+00
2004     0.957327E+03     0.136389E+04    -0.353949E+00
2005     0.195348E+04     0.122356E+04     0.467847E+00
2006     0.907826E+03     0.169035E+04    -0.621637E+00
2007     0.489972E+04     0.579571E+04    -0.167941E+00
2008     0.220671E+04     0.215444E+04     0.239702E-01
```

```
Survey Index:   15 Tag:         USspr95  AGE =  3
Time = JAN-1           Type = NUMBER
Catchability =    0.499530E+00   % Variance Contribution =     1.8724
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_____________________________________________________________________________

1973     N/A              0.147442E+05     N/A
1974     N/A              0.756112E+04     N/A
1975     N/A              0.546005E+04     N/A
1976     N/A              0.492136E+04     N/A
1977     N/A              0.776980E+04     N/A
1978     N/A              0.398984E+04     N/A
1979     N/A              0.405803E+04     N/A
1980     N/A              0.984639E+04     N/A
1981     N/A              0.662765E+04     N/A
1982     N/A              0.743560E+04     N/A
1983     N/A              0.129562E+05     N/A
1984     N/A              0.328627E+04     N/A
1985     N/A              0.104338E+04     N/A
1986     N/A              0.149431E+04     N/A
1987     N/A              0.239822E+04     N/A
1988     N/A              0.130745E+04     N/A
1989     N/A              0.167876E+04     N/A
1990     N/A              0.648455E+04     N/A
1991     N/A              0.221637E+04     N/A
1992     N/A              0.360431E+04     N/A
1993     N/A              0.322650E+04     N/A
1994     N/A              0.435245E+04     N/A
1995     0.467036E+04     0.215002E+04     0.775756E+00
1996     0.254857E+04     0.424583E+04    -0.510405E+00
1997     0.362305E+04     0.358419E+04     0.107832E-01
1998     0.102216E+04     0.396334E+04    -0.135516E+01
1999     0.105017E+05     0.570365E+04     0.610428E+00
2000     0.744052E+04     0.620038E+04     0.182330E+00
2001     0.637050E+04     0.646645E+04    -0.149494E-01
2002     0.119711E+05     0.531142E+04     0.812636E+00
2003     0.656492E+04     0.554036E+04     0.169680E+00
2004     0.211441E+04     0.337128E+04    -0.466516E+00
2005     0.493097E+04     0.334146E+04     0.389128E+00
2006     0.341922E+04     0.279542E+04     0.201431E+00
2007     0.607912E+04     0.422599E+04     0.363607E+00
2008     0.492146E+04     0.158370E+05    -0.116875E+01
```

```
Survey Index:   16 Tag:         USspr95  AGE =  4
Time = JAN-1           Type = NUMBER
Catchability =    0.593361E+00   % Variance Contribution =     1.6588
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_____________________________________________________________________________


1973     N/A              0.102651E+05     N/A
1974     N/A              0.715087E+04     N/A
1975     N/A              0.297302E+04     N/A
1976     N/A              0.143917E+04     N/A
1977     N/A              0.188175E+04     N/A
1978     N/A              0.201162E+04     N/A
1979     N/A              0.146422E+04     N/A
1980     N/A              0.193901E+04     N/A
1981     N/A              0.444947E+04     N/A
1982     N/A              0.328445E+04     N/A
1983     N/A              0.327366E+04     N/A
1984     N/A              0.383998E+04     N/A
1985     N/A              0.818023E+03     N/A
1986     N/A              0.455244E+03     N/A
1987     N/A              0.854197E+03     N/A
1988     N/A              0.684040E+03     N/A
1989     N/A              0.457549E+03     N/A
1990     N/A              0.103649E+04     N/A
1991     N/A              0.261042E+04     N/A
1992     N/A              0.136223E+04     N/A
1993     N/A              0.192818E+04     N/A
1994     N/A              0.137852E+04     N/A
1995     0.144167E+04     0.935099E+03     0.432905E+00
1996     0.262176E+04     0.132739E+04     0.680630E+00
1997     0.396073E+04     0.302838E+04     0.268403E+00
1998     0.112340E+04     0.250888E+04    -0.803476E+00
1999     0.264049E+04     0.205727E+04     0.249583E+00
2000     0.282850E+04     0.331743E+04    -0.159446E+00
2001     0.233998E+04     0.300231E+04    -0.249237E+00
2002     0.395840E+04     0.261335E+04     0.415206E+00
2003     0.279191E+04     0.333162E+04    -0.176735E+00
2004     0.659928E+03     0.288937E+04    -0.147666E+01
2005     0.233270E+04     0.159905E+04     0.377619E+00
2006     0.211266E+04     0.109772E+04     0.654710E+00
2007     0.276230E+04     0.181471E+04     0.420138E+00
2008     0.168110E+04     0.316796E+04    -0.633636E+00
```

```
Survey Index:   17 Tag:          USspr95  AGE =  5
Time = JAN-1           Type = NUMBER
Catchability =    0.480729E+00   % Variance Contribution =     3.0452
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_____________________________________________________________________________

1973     N/A              0.334894E+04     N/A
1974     N/A              0.275576E+04     N/A
1975     N/A              0.147996E+04     N/A
1976     N/A              0.469600E+03     N/A
1977     N/A              0.345672E+03     N/A
1978     N/A              0.459433E+03     N/A
1979     N/A              0.516061E+03     N/A
1980     N/A              0.359345E+03     N/A
1981     N/A              0.625990E+03     N/A
1982     N/A              0.857027E+03     N/A
1983     N/A              0.728007E+03     N/A
1984     N/A              0.110815E+04     N/A
1985     N/A              0.418346E+03     N/A
1986     N/A              0.193142E+03     N/A
1987     N/A              0.135342E+03     N/A
1988     N/A              0.148685E+03     N/A
1989     N/A              0.953147E+02     N/A
1990     N/A              0.120343E+03     N/A
1991     N/A              0.269148E+03     N/A
1992     N/A              0.451876E+03     N/A
1993     N/A              0.276092E+03     N/A
1994     N/A              0.292640E+03     N/A
1995     0.621491E+03     0.146674E+03     0.144391E+01
1996     0.591596E+03     0.244492E+03     0.883642E+00
1997     0.682349E+03     0.499744E+03     0.311446E+00
1998     0.737093E+03     0.120919E+04    -0.494993E+00
1999     0.157523E+04     0.854597E+03     0.611525E+00
2000     0.789215E+03     0.699924E+03     0.120066E+00
2001     0.469200E+03     0.844011E+03    -0.587137E+00
2002     0.169034E+04     0.754831E+03     0.806192E+00
2003     0.428628E+03     0.910325E+03    -0.753212E+00
2004     0.247704E+03     0.121243E+04    -0.158815E+01
2005     0.261778E+03     0.311151E+03    -0.172781E+00
2006     0.307688E+03     0.330914E+03    -0.727716E-01
2007     0.539959E+03     0.298882E+03     0.591443E+00
2008     0.300302E+03     0.901424E+03    -0.109919E+01
```

```
Survey Index:   18 Tag:         USspr95  AGE =  6
Time = JAN-1           Type = NUMBER
Catchability =    0.391240E+00   % Variance Contribution =     3.3145
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_____________________________________________________________________________


1973     N/A              0.117871E+04     N/A
1974     N/A              0.935626E+03     N/A
1975     N/A              0.668457E+03     N/A
1976     N/A              0.611079E+03     N/A
1977     N/A              0.332669E+03     N/A
1978     N/A              0.146098E+03     N/A
1979     N/A              0.218829E+03     N/A
1980     N/A              0.935779E+02     N/A
1981     N/A              0.866392E+02     N/A
1982     N/A              0.610111E+02     N/A
1983     N/A              0.134783E+03     N/A
1984     N/A              0.190535E+03     N/A
1985     N/A              0.531860E+02     N/A
1986     N/A              0.875497E+02     N/A
1987     N/A              0.786441E+02     N/A
1988     N/A              0.284126E+02     N/A
1989     N/A              0.214185E+02     N/A
1990     N/A              0.182329E+02     N/A
1991     N/A              0.406995E+02     N/A
1992     N/A              0.256107E+02     N/A
1993     N/A              0.494770E+02     N/A
1994     N/A              0.718939E+02     N/A
1995     0.951200E+01     0.258950E+02    -0.100150E+01
1996     0.561990E+02     0.272953E+02     0.722184E+00
1997     0.129676E+03     0.963555E+02     0.296995E+00
1998     0.339622E+03     0.128311E+03     0.973378E+00
1999     0.756311E+03     0.264180E+03     0.105182E+01
2000     0.508413E+03     0.364335E+03     0.333220E+00
2001     0.439693E+03     0.359288E+03     0.201953E+00
2002     0.845414E+03     0.436498E+03     0.661043E+00
2003     0.836873E+03     0.656684E+03     0.242469E+00
2004     0.263816E+03     0.726587E+03    -0.101311E+01
2005     0.111428E+03     0.109653E+03     0.160620E-01
2006     0.797850E+02     0.154429E+03    -0.660400E+00
2007     0.125211E+03     0.985294E+02     0.239645E+00
2008     0.266070E+02     0.209546E+03    -0.206377E+01
```

```
Survey Index:   19 Tag:         USfall   AGE =  1
Time = MEAN           Type = NUMBER
Catchability =    0.396438E-01   % Variance Contribution =     8.8749
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_____________________________________________________________________________

1973     0.242045E+04     0.104889E+04     0.836221E+00
1974     0.448671E+04     0.182929E+04     0.897192E+00
1975     0.454864E+04     0.244800E+04     0.619557E+00
1976     0.333507E+03     0.876372E+03    -0.966127E+00
1977     0.906661E+03     0.613733E+03     0.390209E+00
1978     0.462056E+04     0.175844E+04     0.966091E+00
1979     0.128200E+04     0.910384E+03     0.342312E+00
1980     0.743596E+03     0.857446E+03    -0.142460E+00
1981     0.154824E+04     0.226147E+04    -0.378893E+00
1982     0.235328E+04     0.778708E+03     0.110593E+01
1983     0.105701E+03     0.222737E+03    -0.745379E+00
1984     0.641583E+03     0.379680E+03     0.524609E+00
1985     0.131025E+04     0.583018E+03     0.809752E+00
1986     0.273425E+03     0.301017E+03    -0.961395E-01
1987     0.987130E+02     0.327320E+03    -0.119872E+01
1988     0.181510E+02     0.811099E+03    -0.379966E+01
1989     0.241006E+03     0.343481E+03    -0.354311E+00
1990     N/A              0.398600E+03     N/A
1991     0.203880E+04     0.797711E+03     0.938370E+00
1992     0.146759E+03     0.581998E+03    -0.137768E+01
1993     0.814646E+03     0.392382E+03     0.730517E+00
1994     0.115980E+04     0.472195E+03     0.898611E+00
1995     N/A              0.418492E+03     N/A
1996     N/A              0.482066E+03     N/A
1997     N/A              0.709904E+03     N/A
1998     N/A              0.801682E+03     N/A
1999     N/A              0.881459E+03     N/A
2000     N/A              0.711762E+03     N/A
2001     N/A              0.799003E+03     N/A
2002     N/A              0.554541E+03     N/A
2003     N/A              0.419846E+03     N/A
2004     N/A              0.375030E+03     N/A
2005     N/A              0.517523E+03     N/A
2006     N/A              0.177338E+04     N/A
2007     N/A              0.659135E+03     N/A
2008     N/A              0.000000E+00     N/A
```

```
Survey Index:   20 Tag:         USfall   AGE =  2
Time = MEAN            Type = NUMBER
Catchability =    0.875114E-01   % Variance Contribution =     4.0246
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_____________________________________________________________________________

1973     0.533601E+04     0.168924E+04     0.115020E+01
1974     0.277948E+04     0.144504E+04     0.654125E+00
1975     0.243734E+04     0.189980E+04     0.249156E+00
1976     0.186389E+04     0.269245E+04    -0.367785E+00
1977     0.214712E+04     0.113454E+04     0.637903E+00
1978     0.124327E+04     0.937787E+03     0.281980E+00
1979     0.200851E+04     0.235222E+04    -0.157964E+00
1980     0.496999E+04     0.145827E+04     0.122617E+01
1981     0.227942E+04     0.149106E+04     0.424433E+00
1982     0.212033E+04     0.326072E+04    -0.430376E+00
1983     0.221642E+04     0.952557E+03     0.844499E+00
1984     0.388056E+03     0.283621E+03     0.313511E+00
1985     0.527535E+03     0.458860E+03     0.139469E+00
1986     0.107506E+04     0.715039E+03     0.407798E+00
1987     0.388832E+03     0.382589E+03     0.161869E-01
1988     0.206743E+03     0.447335E+03    -0.771832E+00
1989     0.193407E+04     0.135348E+04     0.356943E+00
1990     0.359228E+03     0.519416E+03    -0.368747E+00
1991     0.267019E+03     0.705641E+03    -0.971786E+00
1992     0.383882E+03     0.981248E+03    -0.938490E+00
1993     0.135208E+03     0.905260E+03    -0.190141E+01
1994     0.214605E+03     0.474748E+03    -0.793985E+00
1995     N/A              0.837472E+03     N/A
1996     N/A              0.725437E+03     N/A
1997     N/A              0.818725E+03     N/A
1998     N/A              0.119384E+04     N/A
1999     N/A              0.132292E+04     N/A
2000     N/A              0.142139E+04     N/A
2001     N/A              0.115540E+04     N/A
2002     N/A              0.125325E+04     N/A
2003     N/A              0.817901E+03     N/A
2004     N/A              0.700895E+03     N/A
2005     N/A              0.608559E+03     N/A
2006     N/A              0.876999E+03     N/A
2007     N/A              0.313704E+04     N/A
2008     N/A              0.000000E+00     N/A
```

```
Survey Index:   21 Tag:         USfall   AGE =  3
Time = MEAN            Type = NUMBER
Catchability =    0.150362E+00   % Variance Contribution =     1.6776
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_____________________________________________________________________________

1973     0.495446E+04     0.293164E+04     0.524725E+00
1974     0.147157E+04     0.137717E+04     0.662987E-01
1975     0.851723E+03     0.849413E+03     0.271566E-02
1976     0.460270E+03     0.886190E+03    -0.655118E+00
1977     0.157280E+04     0.120057E+04     0.270058E+00
1978     0.757185E+03     0.706581E+03     0.691704E-01
1979     0.253721E+03     0.801768E+03    -0.115058E+01
1980     0.591198E+04     0.190004E+04     0.113511E+01
1981     0.159280E+04     0.132999E+04     0.180316E+00
1982     0.154339E+04     0.141923E+04     0.838664E-01
1983     0.185846E+04     0.210829E+04    -0.126132E+00
1984     0.296720E+03     0.500332E+03    -0.522483E+00
1985     0.165880E+03     0.198400E+03    -0.179021E+00
1986     0.338651E+03     0.319032E+03     0.596788E-01
1987     0.384562E+03     0.384508E+03     0.139552E-03
1988     0.103954E+03     0.227157E+03    -0.781691E+00
1989     0.750390E+03     0.370846E+03     0.704806E+00
1990     0.142992E+04     0.119255E+04     0.181530E+00
1991     0.426201E+03     0.488621E+03    -0.136675E+00
1992     0.690988E+03     0.747543E+03    -0.786689E-01
1993     0.568786E+03     0.608172E+03    -0.669538E-01
1994     0.954124E+03     0.627584E+03     0.418915E+00
1995     N/A              0.474941E+03     N/A
1996     N/A              0.100111E+04     N/A
1997     N/A              0.837880E+03     N/A
1998     N/A              0.811343E+03     N/A
1999     N/A              0.122705E+04     N/A
2000     N/A              0.123199E+04     N/A
2001     N/A              0.119114E+04     N/A
2002     N/A              0.118164E+04     N/A
2003     N/A              0.113648E+04     N/A
2004     N/A              0.664002E+03     N/A
2005     N/A              0.566115E+03     N/A
2006     N/A              0.631553E+03     N/A
2007     N/A              0.101948E+04     N/A
2008     N/A              0.000000E+00     N/A
```

```
Survey Index:   22 Tag:         USfall   AGE =  4
Time = MEAN            Type = NUMBER
Catchability =    0.156082E+00   % Variance Contribution =     2.9035
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_____________________________________________________________________________

1973     0.285742E+04     0.163457E+04     0.558540E+00
1974     0.102906E+04     0.102622E+04     0.275752E-02
1975     0.555198E+03     0.385073E+03     0.365892E+00
1976     0.113563E+03     0.219058E+03    -0.656978E+00
1977     0.615376E+03     0.288313E+03     0.758186E+00
1978     0.399218E+03     0.314441E+03     0.238712E+00
1979     0.116669E+03     0.224808E+03    -0.655906E+00
1980     0.661966E+03     0.333449E+03     0.685723E+00
1981     0.570533E+03     0.621036E+03    -0.848179E-01
1982     0.410380E+03     0.484203E+03    -0.165421E+00
1983     0.495698E+03     0.574455E+03    -0.147454E+00
1984     0.235959E+03     0.435737E+03    -0.613380E+00
1985     0.491140E+02     0.123661E+03    -0.923400E+00
1986     0.719230E+02     0.756168E+02    -0.500827E-01
1987     0.514430E+02     0.114719E+03    -0.802016E+00
1988     0.265950E+02     0.846364E+02    -0.115764E+01
1989     0.765820E+02     0.722503E+02     0.582258E-01
1990     0.285849E+03     0.162817E+03     0.562834E+00
1991     0.347193E+03     0.349853E+03    -0.763365E-02
1992     0.157144E+03     0.193910E+03    -0.210232E+00
1993     0.520352E+03     0.246099E+03     0.748772E+00
1994     0.692153E+03     0.155165E+03     0.149532E+01
1995     N/A              0.147302E+03     N/A
1996     N/A              0.243889E+03     N/A
1997     N/A              0.570976E+03     N/A
1998     N/A              0.441433E+03     N/A
1999     N/A              0.361787E+03     N/A
2000     N/A              0.516809E+03     N/A
2001     N/A              0.465475E+03     N/A
2002     N/A              0.464256E+03     N/A
2003     N/A              0.603154E+03     N/A
2004     N/A              0.326567E+03     N/A
2005     N/A              0.229472E+03     N/A
2006     N/A              0.175812E+03     N/A
2007     N/A              0.377514E+03     N/A
2008     N/A              0.000000E+00     N/A
```

```
Survey Index:   23 Tag:         USfall   AGE =  5
Time = MEAN           Type = NUMBER
Catchability =    0.204982E+00   % Variance Contribution =     3.5899
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_____________________________________________________________________________

1973     0.118115E+04     0.864424E+03     0.312184E+00
1974     0.444255E+03     0.641070E+03    -0.366740E+00
1975     0.324383E+03     0.310725E+03     0.430163E-01
1976     0.118513E+03     0.115866E+03     0.225893E-01
1977     0.102304E+03     0.858513E+02     0.175332E+00
1978     0.131617E+03     0.116411E+03     0.122766E+00
1979     0.134335E+03     0.128436E+03     0.449021E-01
1980     0.212276E+03     0.100171E+03     0.751009E+00
1981     0.763880E+02     0.141631E+03    -0.617397E+00
1982     0.865800E+02     0.204805E+03    -0.860989E+00
1983     0.298950E+02     0.207080E+03    -0.193541E+01
1984     0.727000E+02     0.203834E+03    -0.103096E+01
1985     0.783290E+02     0.102514E+03    -0.269082E+00
1986     N/A              0.520034E+02     N/A
1987     0.770680E+02     0.294640E+02     0.961518E+00
1988     N/A              0.298211E+02     N/A
1989     0.539670E+02     0.243973E+02     0.793899E+00
1990     N/A              0.306435E+02     N/A
1991     N/A              0.584721E+02     N/A
1992     0.139382E+03     0.104267E+03     0.290259E+00
1993     N/A              0.571212E+02     N/A
1994     0.254886E+03     0.533944E+02     0.156311E+01
1995     N/A              0.374527E+02     N/A
1996     N/A              0.728180E+02     N/A
1997     N/A              0.152734E+03     N/A
1998     N/A              0.344874E+03     N/A
1999     N/A              0.243615E+03     N/A
2000     N/A              0.176750E+03     N/A
2001     N/A              0.212114E+03     N/A
2002     N/A              0.217365E+03     N/A
2003     N/A              0.267147E+03     N/A
2004     N/A              0.222129E+03     N/A
2005     N/A              0.723802E+02     N/A
2006     N/A              0.859112E+02     N/A
2007     N/A              0.100788E+03     N/A
2008     N/A              0.000000E+00     N/A
```

```
Survey Index:   24 Tag:         USfall   AGE =  6
Time = MEAN            Type = NUMBER
Catchability =    0.306257E+00   % Variance Contribution =     2.7247
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_____________________________________________________________________________

1973     0.599943E+03     0.558540E+03     0.715090E-01
1974     0.368061E+03     0.399572E+03    -0.821441E-01
1975     0.611490E+02     0.257648E+03    -0.143828E+01
1976     0.972570E+02     0.276792E+03    -0.104591E+01
1977     0.105701E+03     0.151678E+03    -0.361149E+00
1978     0.349430E+02     0.679588E+02    -0.665184E+00
1979     0.108613E+03     0.999816E+02     0.828049E-01
1980     0.250907E+03     0.478886E+02     0.165621E+01
1981     0.528020E+02     0.359859E+02     0.383421E+00
1982     N/A              0.267660E+02     N/A
1983     0.476580E+02     0.703826E+02    -0.389896E+00
1984     0.606640E+02     0.643399E+02    -0.588291E-01
1985     N/A              0.239262E+02     N/A
1986     N/A              0.432751E+02     N/A
1987     N/A              0.314308E+02     N/A
1988     N/A              0.104615E+02     N/A
1989     N/A              0.100647E+02     N/A
1990     N/A              0.852319E+01     N/A
1991     N/A              0.162321E+02     N/A
1992     0.265950E+02     0.108488E+02     0.896673E+00
1993     0.213540E+02     0.187921E+02     0.127803E+00
1994     0.548400E+02     0.240815E+02     0.822977E+00
1995     N/A              0.121388E+02     N/A
1996     N/A              0.149242E+02     N/A
1997     N/A              0.540622E+02     N/A
1998     N/A              0.671827E+02     N/A
1999     N/A              0.138252E+03     N/A
2000     N/A              0.168903E+03     N/A
2001     N/A              0.165765E+03     N/A
2002     N/A              0.230755E+03     N/A
2003     N/A              0.353784E+03     N/A
2004     N/A              0.244380E+03     N/A
2005     N/A              0.468270E+02     N/A
2006     N/A              0.736026E+02     N/A
2007     N/A              0.609960E+02     N/A
2008     N/A              0.000000E+00     N/A
```

```
Survey Index:   25 Tag:          USfall95 AGE =  1
Time = MEAN            Type = NUMBER
Catchability =    0.654075E-01   % Variance Contribution =     2.7233
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_____________________________________________________________________________

1973     N/A              0.173054E+04     N/A
1974     N/A              0.301811E+04     N/A
1975     N/A              0.403890E+04     N/A
1976     N/A              0.144591E+04     N/A
1977     N/A              0.101258E+04     N/A
1978     N/A              0.290121E+04     N/A
1979     N/A              0.150202E+04     N/A
1980     N/A              0.141468E+04     N/A
1981     N/A              0.373115E+04     N/A
1982     N/A              0.128477E+04     N/A
1983     N/A              0.367490E+03     N/A
1984     N/A              0.626426E+03     N/A
1985     N/A              0.961910E+03     N/A
1986     N/A              0.496642E+03     N/A
1987     N/A              0.540038E+03     N/A
1988     N/A              0.133822E+04     N/A
1989     N/A              0.566703E+03     N/A
1990     N/A              0.657642E+03     N/A
1991     N/A              0.131613E+04     N/A
1992     N/A              0.960227E+03     N/A
1993     N/A              0.647383E+03     N/A
1994     N/A              0.779065E+03     N/A
1995     0.267698E+03     0.690461E+03    -0.947500E+00
1996     0.144332E+03     0.795351E+03    -0.170667E+01
1997     0.135179E+04     0.117126E+04     0.143352E+00
1998     0.184438E+04     0.132268E+04     0.332485E+00
1999     0.299875E+04     0.145430E+04     0.723669E+00
2000     0.610814E+03     0.117432E+04    -0.653653E+00
2001     0.341417E+04     0.131826E+04     0.951624E+00
2002     0.203142E+04     0.914926E+03     0.797648E+00
2003     0.104527E+04     0.692695E+03     0.411438E+00
2004     0.850268E+03     0.618754E+03     0.317844E+00
2005     0.304000E+03     0.853850E+03    -0.103273E+01
2006     0.601205E+04     0.292587E+04     0.720176E+00
2007     0.102653E+04     0.108749E+04    -0.576878E-01
2008     N/A              0.000000E+00     N/A
```

```
Survey Index:   26 Tag:         USfall95 AGE =  2
Time = MEAN            Type = NUMBER
Catchability =    0.212258E+00   % Variance Contribution =     6.1770
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_____________________________________________________________________________

1973     N/A              0.409724E+04     N/A
1974     N/A              0.350494E+04     N/A
1975     N/A              0.460796E+04     N/A
1976     N/A              0.653051E+04     N/A
1977     N/A              0.275181E+04     N/A
1978     N/A              0.227460E+04     N/A
1979     N/A              0.570529E+04     N/A
1980     N/A              0.353702E+04     N/A
1981     N/A              0.361655E+04     N/A
1982     N/A              0.790885E+04     N/A
1983     N/A              0.231042E+04     N/A
1984     N/A              0.687921E+03     N/A
1985     N/A              0.111296E+04     N/A
1986     N/A              0.173432E+04     N/A
1987     N/A              0.927966E+03     N/A
1988     N/A              0.108501E+04     N/A
1989     N/A              0.328286E+04     N/A
1990     N/A              0.125984E+04     N/A
1991     N/A              0.171153E+04     N/A
1992     N/A              0.238001E+04     N/A
1993     N/A              0.219570E+04     N/A
1994     N/A              0.115150E+04     N/A
1995     0.115407E+03     0.203128E+04    -0.286796E+01
1996     0.341272E+03     0.175954E+04    -0.164013E+01
1997     0.517731E+03     0.198581E+04    -0.134433E+01
1998     0.467531E+04     0.289566E+04     0.479082E+00
1999     0.817587E+04     0.320873E+04     0.935311E+00
2000     0.164754E+04     0.344758E+04    -0.738390E+00
2001     0.608359E+04     0.280241E+04     0.775114E+00
2002     0.558177E+04     0.303976E+04     0.607729E+00
2003     0.488283E+04     0.198381E+04     0.900703E+00
2004     0.534610E+04     0.170002E+04     0.114573E+01
2005     0.203356E+04     0.147606E+04     0.320412E+00
2006     0.606718E+04     0.212716E+04     0.104811E+01
2007     0.111109E+05     0.760888E+04     0.378614E+00
2008     N/A              0.000000E+00     N/A
```

```
Survey Index:   27 Tag:         USfall95 AGE =  3
Time = MEAN            Type = NUMBER
Catchability =    0.556137E+00   % Variance Contribution =     1.9472
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_____________________________________________________________________________

1973     N/A              0.108431E+05     N/A
1974     N/A              0.509367E+04     N/A
1975     N/A              0.314169E+04     N/A
1976     N/A              0.327771E+04     N/A
1977     N/A              0.444051E+04     N/A
1978     N/A              0.261340E+04     N/A
1979     N/A              0.296547E+04     N/A
1980     N/A              0.702759E+04     N/A
1981     N/A              0.491920E+04     N/A
1982     N/A              0.524925E+04     N/A
1983     N/A              0.779785E+04     N/A
1984     N/A              0.185056E+04     N/A
1985     N/A              0.733814E+03     N/A
1986     N/A              0.117999E+04     N/A
1987     N/A              0.142217E+04     N/A
1988     N/A              0.840175E+03     N/A
1989     N/A              0.137163E+04     N/A
1990     N/A              0.441083E+04     N/A
1991     N/A              0.180724E+04     N/A
1992     N/A              0.276491E+04     N/A
1993     N/A              0.224942E+04     N/A
1994     N/A              0.232122E+04     N/A
1995     0.335157E+03     0.175664E+04    -0.165656E+01
1996     0.181381E+04     0.370275E+04    -0.713649E+00
1997     0.334099E+04     0.309903E+04     0.751767E-01
1998     0.407886E+04     0.300088E+04     0.306910E+00
1999     0.555887E+04     0.453844E+04     0.202811E+00
2000     0.467249E+04     0.455673E+04     0.250876E-01
2001     0.785372E+04     0.440562E+04     0.578106E+00
2002     0.206452E+04     0.437047E+04    -0.749972E+00
2003     0.272590E+04     0.420344E+04    -0.433104E+00
2004     0.486244E+04     0.245592E+04     0.683040E+00
2005     0.365207E+04     0.209387E+04     0.556283E+00
2006     0.355666E+04     0.233590E+04     0.420425E+00
2007     0.763474E+04     0.377070E+04     0.705448E+00
2008     N/A              0.000000E+00     N/A
```

```
Survey Index:   28 Tag:         USfall95 AGE =  4
Time = MEAN            Type = NUMBER
Catchability =    0.471055E+00   % Variance Contribution =     1.5766
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_____________________________________________________________________________

1973     N/A              0.493313E+04     N/A
1974     N/A              0.309714E+04     N/A
1975     N/A              0.116215E+04     N/A
1976     N/A              0.661116E+03     N/A
1977     N/A              0.870128E+03     N/A
1978     N/A              0.948981E+03     N/A
1979     N/A              0.678470E+03     N/A
1980     N/A              0.100635E+04     N/A
1981     N/A              0.187428E+04     N/A
1982     N/A              0.146132E+04     N/A
1983     N/A              0.173370E+04     N/A
1984     N/A              0.131505E+04     N/A
1985     N/A              0.373208E+03     N/A
1986     N/A              0.228211E+03     N/A
1987     N/A              0.346223E+03     N/A
1988     N/A              0.255432E+03     N/A
1989     N/A              0.218051E+03     N/A
1990     N/A              0.491382E+03     N/A
1991     N/A              0.105586E+04     N/A
1992     N/A              0.585220E+03     N/A
1993     N/A              0.742726E+03     N/A
1994     N/A              0.468287E+03     N/A
1995     0.267213E+03     0.444556E+03    -0.509031E+00
1996     0.433481E+03     0.736056E+03    -0.529459E+00
1997     0.202851E+04     0.172320E+04     0.163117E+00
1998     0.115456E+04     0.133224E+04    -0.143147E+00
1999     0.139032E+04     0.109187E+04     0.241642E+00
2000     0.235027E+04     0.155973E+04     0.410020E+00
2001     0.252479E+04     0.140480E+04     0.586263E+00
2002     0.576066E+03     0.140112E+04    -0.888807E+00
2003     0.548015E+03     0.182032E+04    -0.120046E+01
2004     0.204443E+04     0.985578E+03     0.729644E+00
2005     0.595867E+03     0.692546E+03    -0.150357E+00
2006     0.113291E+04     0.530599E+03     0.758543E+00
2007     0.193960E+04     0.113934E+04     0.532036E+00
2008     N/A              0.000000E+00     N/A
```

```
Survey Index:   29 Tag:         USfall95 AGE =  5
Time = MEAN            Type = NUMBER
Catchability =    0.490130E+00   % Variance Contribution =     3.4779
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_____________________________________________________________________________

1973     N/A              0.206692E+04     N/A
1974     N/A              0.153286E+04     N/A
1975     N/A              0.742972E+03     N/A
1976     N/A              0.277046E+03     N/A
1977     N/A              0.205278E+03     N/A
1978     N/A              0.278350E+03     N/A
1979     N/A              0.307104E+03     N/A
1980     N/A              0.239518E+03     N/A
1981     N/A              0.338652E+03     N/A
1982     N/A              0.489707E+03     N/A
1983     N/A              0.495147E+03     N/A
1984     N/A              0.487385E+03     N/A
1985     N/A              0.245121E+03     N/A
1986     N/A              0.124345E+03     N/A
1987     N/A              0.704512E+02     N/A
1988     N/A              0.713049E+02     N/A
1989     N/A              0.583362E+02     N/A
1990     N/A              0.732715E+02     N/A
1991     N/A              0.139812E+03     N/A
1992     N/A              0.249313E+03     N/A
1993     N/A              0.136582E+03     N/A
1994     N/A              0.127671E+03     N/A
1995     0.446490E+02     0.895528E+02    -0.695997E+00
1996     0.727000E+02     0.174115E+03    -0.873373E+00
1997     0.103983E+04     0.365201E+03     0.104636E+01
1998     0.289537E+03     0.824626E+03    -0.104665E+01
1999     0.139421E+04     0.582505E+03     0.872742E+00
2000     0.919667E+03     0.422626E+03     0.777525E+00
2001     0.166783E+04     0.507185E+03     0.119040E+01
2002     0.295555E+03     0.519740E+03    -0.564474E+00
2003     0.969650E+02     0.638772E+03    -0.188520E+01
2004     0.897052E+03     0.531130E+03     0.524106E+00
2005     0.179274E+03     0.173068E+03     0.352326E-01
2006     0.247704E+03     0.205422E+03     0.187170E+00
2007     0.371264E+03     0.240992E+03     0.432148E+00
2008     N/A              0.000000E+00     N/A
```

```
Survey Index:   30 Tag:         USfall95 AGE =  6
Time = MEAN            Type = NUMBER
Catchability =    0.361645E+00   % Variance Contribution =     4.7434
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_____________________________________________________________________________

1973     N/A              0.659554E+03     N/A
1974     N/A              0.471835E+03     N/A
1975     N/A              0.304245E+03     N/A
1976     N/A              0.326851E+03     N/A
1977     N/A              0.179110E+03     N/A
1978     N/A              0.802494E+02     N/A
1979     N/A              0.118064E+03     N/A
1980     N/A              0.565494E+02     N/A
1981     N/A              0.424941E+02     N/A
1982     N/A              0.316067E+02     N/A
1983     N/A              0.831115E+02     N/A
1984     N/A              0.759760E+02     N/A
1985     N/A              0.282533E+02     N/A
1986     N/A              0.511016E+02     N/A
1987     N/A              0.371151E+02     N/A
1988     N/A              0.123536E+02     N/A
1989     N/A              0.118849E+02     N/A
1990     N/A              0.100646E+02     N/A
1991     N/A              0.191677E+02     N/A
1992     N/A              0.128108E+02     N/A
1993     N/A              0.221907E+02     N/A
1994     N/A              0.284367E+02     N/A
1995     0.121330E+02     0.143342E+02    -0.166717E+00
1996     N/A              0.176233E+02     N/A
1997     0.797850E+02     0.638395E+02     0.222963E+00
1998     0.717290E+02     0.793329E+02    -0.100758E+00
1999     0.252751E+03     0.163255E+03     0.437090E+00
2000     0.802610E+03     0.199450E+03     0.139231E+01
2001     0.198823E+04     0.195744E+03     0.231819E+01
2002     0.265950E+02     0.272488E+03    -0.232687E+01
2003     0.185681E+03     0.417768E+03    -0.810895E+00
2004     0.170733E+03     0.288577E+03    -0.524860E+00
2005     N/A              0.552958E+02     N/A
2006     0.443580E+02     0.869139E+02    -0.672625E+00
2007     0.908510E+02     0.720273E+02     0.232175E+00
2008     N/A              0.000000E+00     N/A
```

```
Survey Index:   32 Tag:         Canada   AGE =  2
Time = JAN-1           Type = NUMBER
Catchability =    0.229939E-03   % Variance Contribution =     1.8950
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_____________________________________________________________________________

1973     N/A              0.555811E+01     N/A
1974     N/A              0.545712E+01     N/A
1975     N/A              0.933271E+01     N/A
1976     N/A              0.123352E+02     N/A
1977     N/A              0.452389E+01     N/A
1978     N/A              0.317524E+01     N/A
1979     N/A              0.818669E+01     N/A
1980     N/A              0.473558E+01     N/A
1981     N/A              0.445852E+01     N/A
1982     N/A              0.118373E+02     N/A
1983     N/A              0.385236E+01     N/A
1984     N/A              0.109327E+01     N/A
1985     N/A              0.193465E+01     N/A
1986     N/A              0.295178E+01     N/A
1987     0.119400E+01     0.155805E+01    -0.266128E+00
1988     0.177600E+01     0.169824E+01     0.447687E-01
1989     0.102700E+01     0.419639E+01    -0.140758E+01
1990     0.238700E+01     0.177936E+01     0.293783E+00
1991     0.858000E+00     0.206379E+01    -0.877698E+00
1992     0.110390E+02     0.410879E+01     0.988306E+00
1993     0.243100E+01     0.279785E+01    -0.140549E+00
1994     0.605600E+01     0.154643E+01     0.136510E+01
1995     N/A              0.246640E+01     N/A
1996     N/A              0.218763E+01     N/A
1997     N/A              0.251497E+01     N/A
1998     N/A              0.371073E+01     N/A
1999     N/A              0.418231E+01     N/A
2000     N/A              0.461190E+01     N/A
2001     N/A              0.371511E+01     N/A
2002     N/A              0.416748E+01     N/A
2003     N/A              0.288280E+01     N/A
2004     N/A              0.218266E+01     N/A
2005     N/A              0.195810E+01     N/A
2006     N/A              0.270511E+01     N/A
2007     N/A              0.927502E+01     N/A
2008     N/A              0.344781E+01     N/A
```

```
Survey Index:   33 Tag:         Canada   AGE =  3
Time = JAN-1           Type = NUMBER
Catchability =    0.369401E-03   % Variance Contribution =     0.3860
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_____________________________________________________________________________

1973     N/A              0.109033E+02     N/A
1974     N/A              0.559143E+01     N/A
1975     N/A              0.403769E+01     N/A
1976     N/A              0.363933E+01     N/A
1977     N/A              0.574575E+01     N/A
1978     N/A              0.295048E+01     N/A
1979     N/A              0.300090E+01     N/A
1980     N/A              0.728139E+01     N/A
1981     N/A              0.490114E+01     N/A
1982     N/A              0.549861E+01     N/A
1983     N/A              0.958107E+01     N/A
1984     N/A              0.243019E+01     N/A
1985     N/A              0.771577E+00     N/A
1986     N/A              0.110504E+01     N/A
1987     0.197000E+01     0.177348E+01     0.105088E+00
1988     0.127500E+01     0.966856E+00     0.276652E+00
1989     0.609000E+00     0.124144E+01    -0.712207E+00
1990     0.362800E+01     0.479531E+01    -0.278957E+00
1991     0.118600E+01     0.163900E+01    -0.323502E+00
1992     0.367700E+01     0.266538E+01     0.321750E+00
1993     0.408500E+01     0.238599E+01     0.537708E+00
1994     0.346400E+01     0.321863E+01     0.734685E-01
1995     N/A              0.158994E+01     N/A
1996     N/A              0.313978E+01     N/A
1997     N/A              0.265050E+01     N/A
1998     N/A              0.293088E+01     N/A
1999     N/A              0.421784E+01     N/A
2000     N/A              0.458517E+01     N/A
2001     N/A              0.478193E+01     N/A
2002     N/A              0.392779E+01     N/A
2003     N/A              0.409709E+01     N/A
2004     N/A              0.249305E+01     N/A
2005     N/A              0.247100E+01     N/A
2006     N/A              0.206721E+01     N/A
2007     N/A              0.312511E+01     N/A
2008     N/A              0.117115E+02     N/A
```

```
Survey Index:   34 Tag:         Canada   AGE =  4
Time = JAN-1           Type = NUMBER
Catchability =    0.619069E-03   % Variance Contribution =     0.6297
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_____________________________________________________________________________

1973     N/A              0.107099E+02     N/A
1974     N/A              0.746068E+01     N/A
1975     N/A              0.310183E+01     N/A
1976     N/A              0.150152E+01     N/A
1977     N/A              0.196328E+01     N/A
1978     N/A              0.209878E+01     N/A
1979     N/A              0.152765E+01     N/A
1980     N/A              0.202302E+01     N/A
1981     N/A              0.464224E+01     N/A
1982     N/A              0.342675E+01     N/A
1983     N/A              0.341549E+01     N/A
1984     N/A              0.400635E+01     N/A
1985     N/A              0.853464E+00     N/A
1986     N/A              0.474967E+00     N/A
1987     0.492000E+00     0.891205E+00    -0.594095E+00
1988     0.610000E+00     0.713676E+00    -0.156970E+00
1989     0.294000E+00     0.477373E+00    -0.484718E+00
1990     0.914000E+00     0.108139E+01    -0.168175E+00
1991     0.375900E+01     0.272352E+01     0.322229E+00
1992     0.990000E+00     0.142125E+01    -0.361589E+00
1993     0.407600E+01     0.201172E+01     0.706127E+00
1994     0.300600E+01     0.143824E+01     0.737190E+00
1995     N/A              0.975612E+00     N/A
1996     N/A              0.138490E+01     N/A
1997     N/A              0.315958E+01     N/A
1998     N/A              0.261758E+01     N/A
1999     N/A              0.214640E+01     N/A
2000     N/A              0.346116E+01     N/A
2001     N/A              0.313238E+01     N/A
2002     N/A              0.272658E+01     N/A
2003     N/A              0.347596E+01     N/A
2004     N/A              0.301456E+01     N/A
2005     N/A              0.166833E+01     N/A
2006     N/A              0.114528E+01     N/A
2007     N/A              0.189333E+01     N/A
2008     N/A              0.330521E+01     N/A
```

```
Survey Index:   35 Tag:         Canada   AGE =  5
Time = JAN-1           Type = NUMBER
Catchability =    0.693342E-03   % Variance Contribution =     0.9166
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_____________________________________________________________________________

1973     N/A              0.483008E+01     N/A
1974     N/A              0.397456E+01     N/A
1975     N/A              0.213451E+01     N/A
1976     N/A              0.677291E+00     N/A
1977     N/A              0.498552E+00     N/A
1978     N/A              0.662628E+00     N/A
1979     N/A              0.744300E+00     N/A
1980     N/A              0.518273E+00     N/A
1981     N/A              0.902848E+00     N/A
1982     N/A              0.123607E+01     N/A
1983     N/A              0.104998E+01     N/A
1984     N/A              0.159826E+01     N/A
1985     N/A              0.603368E+00     N/A
1986     N/A              0.278563E+00     N/A
1987     0.870000E-01     0.195200E+00    -0.808116E+00
1988     0.278000E+00     0.214444E+00     0.259572E+00
1989     0.660000E-01     0.137470E+00    -0.733749E+00
1990     0.209000E+00     0.173567E+00     0.185768E+00
1991     0.525000E+00     0.388185E+00     0.301916E+00
1992     0.350000E+00     0.651728E+00    -0.621695E+00
1993     0.887000E+00     0.398200E+00     0.800890E+00
1994     0.781000E+00     0.422066E+00     0.615412E+00
1995     N/A              0.211543E+00     N/A
1996     N/A              0.352624E+00     N/A
1997     N/A              0.720766E+00     N/A
1998     N/A              0.174398E+01     N/A
1999     N/A              0.123256E+01     N/A
2000     N/A              0.100948E+01     N/A
2001     N/A              0.121729E+01     N/A
2002     N/A              0.108867E+01     N/A
2003     N/A              0.131294E+01     N/A
2004     N/A              0.174865E+01     N/A
2005     N/A              0.448764E+00     N/A
2006     N/A              0.477268E+00     N/A
2007     N/A              0.431070E+00     N/A
2008     N/A              0.130010E+01     N/A
```

```
Survey Index:   36 Tag:         Canada   AGE =  6
Time = JAN-1           Type = NUMBER
Catchability =    0.402918E-03   % Variance Contribution =     1.1596
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_____________________________________________________________________________


1973     N/A             0.121389E+01     N/A
1974     N/A             0.963555E+00     N/A
1975     N/A             0.688410E+00     N/A
1976     N/A             0.629320E+00     N/A
1977     N/A             0.342599E+00     N/A
1978     N/A             0.150459E+00     N/A
1979     N/A             0.225361E+00     N/A
1980     N/A             0.963712E-01     N/A
1981     N/A             0.892254E-01     N/A
1982     N/A             0.628323E-01     N/A
1983     N/A             0.138806E+00     N/A
1984     N/A             0.196223E+00     N/A
1985     N/A             0.547736E-01     N/A
1986     N/A             0.901630E-01     N/A
1987     0.490000E-01     0.809917E-01    -0.502526E+00
1988     0.240000E-01     0.292607E-01    -0.198192E+00
1989     0.220000E-01     0.220578E-01    -0.262525E-02
1990     0.140000E-01     0.187772E-01    -0.293585E+00
1991     0.140000E-01     0.419144E-01    -0.109657E+01
1992     0.300000E-01     0.263752E-01     0.128772E+00
1993     0.130000E+00     0.509539E-01     0.936613E+00
1994     0.207000E+00     0.740399E-01     0.102811E+01
1995     N/A             0.266680E-01     N/A
1996     N/A             0.281101E-01     N/A
1997     N/A             0.992317E-01     N/A
1998     N/A             0.132141E+00     N/A
1999     N/A             0.272066E+00     N/A
2000     N/A             0.375211E+00     N/A
2001     N/A             0.370013E+00     N/A
2002     N/A             0.449527E+00     N/A
2003     N/A             0.676287E+00     N/A
2004     N/A             0.748276E+00     N/A
2005     N/A             0.112926E+00     N/A
2006     N/A             0.159039E+00     N/A
2007     N/A             0.101471E+00     N/A
2008     N/A             0.215801E+00     N/A
```

```
Survey Index:   38 Tag:         Can95    AGE =  2
Time = JAN-1          Type = NUMBER
Catchability =    0.496646E-03   % Variance Contribution =     2.3507
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_____________________________________________________________________________

1973     N/A              0.120050E+02     N/A
1974     N/A              0.117869E+02     N/A
1975     N/A              0.201577E+02     N/A
1976     N/A              0.266429E+02     N/A
1977     N/A              0.977116E+01     N/A
1978     N/A              0.685820E+01     N/A
1979     N/A              0.176825E+02     N/A
1980     N/A              0.102284E+02     N/A
1981     N/A              0.962996E+01     N/A
1982     N/A              0.255674E+02     N/A
1983     N/A              0.832072E+01     N/A
1984     N/A              0.236136E+01     N/A
1985     N/A              0.417864E+01     N/A
1986     N/A              0.637556E+01     N/A
1987     N/A              0.336524E+01     N/A
1988     N/A              0.366804E+01     N/A
1989     N/A              0.906378E+01     N/A
1990     N/A              0.384324E+01     N/A
1991     N/A              0.445759E+01     N/A
1992     N/A              0.887458E+01     N/A
1993     N/A              0.604309E+01     N/A
1994     N/A              0.334014E+01     N/A
1995     0.125100E+01     0.532719E+01    -0.144888E+01
1996     0.714200E+01     0.472507E+01     0.413110E+00
1997     0.124820E+02     0.543210E+01     0.831962E+00
1998     0.333000E+01     0.801481E+01    -0.878319E+00
1999     0.208610E+02     0.903337E+01     0.836956E+00
2000     0.137650E+02     0.996126E+01     0.323426E+00
2001     0.198960E+02     0.802427E+01     0.908048E+00
2002     0.119620E+02     0.900134E+01     0.284361E+00
2003     0.118890E+02     0.622657E+01     0.646787E+00
2004     0.359900E+01     0.471434E+01    -0.269952E+00
2005     0.160200E+01     0.422929E+01    -0.970782E+00
2006     0.489300E+01     0.584276E+01    -0.177398E+00
2007     0.121590E+02     0.200331E+02    -0.499318E+00
2008     N/A              0.744694E+01     N/A
```

```
Survey Index:   39 Tag:         Can95    AGE =  3
Time = JAN-1           Type = NUMBER
Catchability =    0.206205E-02   % Variance Contribution =     1.2149
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_____________________________________________________________________________


1973     N/A             0.608639E+02     N/A
1974     N/A             0.312122E+02     N/A
1975     N/A             0.225390E+02     N/A
1976     N/A             0.203153E+02     N/A
1977     N/A             0.320736E+02     N/A
1978     N/A             0.164700E+02     N/A
1979     N/A             0.167515E+02     N/A
1980     N/A             0.406457E+02     N/A
1981     N/A             0.273588E+02     N/A
1982     N/A             0.306940E+02     N/A
1983     N/A             0.534829E+02     N/A
1984     N/A             0.135657E+02     N/A
1985     N/A             0.430706E+01     N/A
1986     N/A             0.616850E+01     N/A
1987     N/A             0.989983E+01     N/A
1988     N/A             0.539713E+01     N/A
1989     N/A             0.692988E+01     N/A
1990     N/A             0.267681E+02     N/A
1991     N/A             0.914915E+01     N/A
1992     N/A             0.148785E+02     N/A
1993     N/A             0.133189E+02     N/A
1994     N/A             0.179668E+02     N/A
1995     0.435300E+01     0.887527E+01    -0.712403E+00
1996     0.917400E+01     0.175267E+02    -0.647353E+00
1997     0.139020E+02     0.147955E+02    -0.622898E-01
1998     0.490700E+01     0.163606E+02    -0.120421E+01
1999     0.208340E+02     0.235446E+02    -0.122309E+00
2000     0.274420E+02     0.255951E+02     0.696753E-01
2001     0.421240E+02     0.266934E+02     0.456201E+00
2002     0.310150E+02     0.219255E+02     0.346822E+00
2003     0.246180E+02     0.228705E+02     0.736289E-01
2004     0.162600E+02     0.139166E+02     0.155627E+00
2005     0.279590E+02     0.137935E+02     0.706543E+00
2006     0.186000E+02     0.115394E+02     0.477391E+00
2007     0.277080E+02     0.174448E+02     0.462680E+00
2008     N/A             0.653750E+02     N/A
```

```
Survey Index:   40 Tag:         Can95    AGE =  4
Time = JAN-1           Type = NUMBER
Catchability =    0.263975E-02   % Variance Contribution =     0.9553
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_____________________________________________________________________________

1973     N/A              0.456676E+02     N/A
1974     N/A              0.318129E+02     N/A
1975     N/A              0.132264E+02     N/A
1976     N/A              0.640259E+01     N/A
1977     N/A              0.837155E+01     N/A
1978     N/A              0.894932E+01     N/A
1979     N/A              0.651402E+01     N/A
1980     N/A              0.862629E+01     N/A
1981     N/A              0.197948E+02     N/A
1982     N/A              0.146119E+02     N/A
1983     N/A              0.145639E+02     N/A
1984     N/A              0.170834E+02     N/A
1985     N/A              0.363923E+01     N/A
1986     N/A              0.202529E+01     N/A
1987     N/A              0.380016E+01     N/A
1988     N/A              0.304317E+01     N/A
1989     N/A              0.203555E+01     N/A
1990     N/A              0.461113E+01     N/A
1991     N/A              0.116133E+02     N/A
1992     N/A              0.606032E+01     N/A
1993     N/A              0.857811E+01     N/A
1994     N/A              0.613275E+01     N/A
1995     0.254600E+01     0.416008E+01    -0.491010E+00
1996     0.540600E+01     0.590530E+01    -0.883415E-01
1997     0.163690E+02     0.134727E+02     0.194726E+00
1998     0.433400E+01     0.111615E+02    -0.945983E+00
1999     0.766900E+01     0.915242E+01    -0.176832E+00
2000     0.192430E+02     0.147586E+02     0.265319E+00
2001     0.133070E+02     0.133567E+02    -0.372748E-02
2002     0.122340E+02     0.116263E+02     0.509478E-01
2003     0.110860E+02     0.148218E+02    -0.290413E+00
2004     0.920500E+01     0.128543E+02    -0.333930E+00
2005     0.205640E+02     0.711386E+01     0.106150E+01
2006     0.657200E+01     0.488356E+01     0.296943E+00
2007     0.127990E+02     0.807330E+01     0.460804E+00
2008     N/A              0.140936E+02     N/A
```

```
Survey Index:   41 Tag:         Can95    AGE =  5
Time = JAN-1           Type = NUMBER
Catchability =    0.240473E-02   % Variance Contribution =     1.7187
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_____________________________________________________________________________

1973     N/A              0.167523E+02     N/A
1974     N/A              0.137850E+02     N/A
1975     N/A              0.740316E+01     N/A
1976     N/A              0.234906E+01     N/A
1977     N/A              0.172914E+01     N/A
1978     N/A              0.229821E+01     N/A
1979     N/A              0.258147E+01     N/A
1980     N/A              0.179754E+01     N/A
1981     N/A              0.313137E+01     N/A
1982     N/A              0.428707E+01     N/A
1983     N/A              0.364168E+01     N/A
1984     N/A              0.554328E+01     N/A
1985     N/A              0.209268E+01     N/A
1986     N/A              0.966147E+00     N/A
1987     N/A              0.677016E+00     N/A
1988     N/A              0.743761E+00     N/A
1989     N/A              0.476789E+00     N/A
1990     N/A              0.601987E+00     N/A
1991     N/A              0.134635E+01     N/A
1992     N/A              0.226040E+01     N/A
1993     N/A              0.138109E+01     N/A
1994     N/A              0.146386E+01     N/A
1995     0.647000E+00     0.733699E+00    -0.125753E+00
1996     0.115500E+01     0.122301E+01    -0.572161E-01
1997     0.404400E+01     0.249985E+01     0.481004E+00
1998     0.198800E+01     0.604869E+01    -0.111271E+01
1999     0.535000E+01     0.427492E+01     0.224332E+00
2000     0.506900E+01     0.350121E+01     0.370036E+00
2001     0.458100E+01     0.422197E+01     0.816166E-01
2002     0.555300E+01     0.377586E+01     0.385709E+00
2003     0.342100E+01     0.455368E+01    -0.286003E+00
2004     0.227300E+01     0.606488E+01    -0.981414E+00
2005     0.569600E+01     0.155646E+01     0.129735E+01
2006     0.820000E+00     0.165532E+01    -0.702444E+00
2007     0.228800E+01     0.149509E+01     0.425493E+00
2008     N/A              0.450916E+01     N/A
```

```
Survey Index:   42 Tag:         Can95    AGE =  6
Time = JAN-1           Type = NUMBER
Catchability =    0.186002E-02   % Variance Contribution =     1.6987
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_____________________________________________________________________________

1973     N/A              0.560378E+01     N/A
1974     N/A              0.444813E+01     N/A
1975     N/A              0.317796E+01     N/A
1976     N/A              0.290518E+01     N/A
1977     N/A              0.158157E+01     N/A
1978     N/A              0.694575E+00     N/A
1979     N/A              0.104035E+01     N/A
1980     N/A              0.444886E+00     N/A
1981     N/A              0.411898E+00     N/A
1982     N/A              0.290058E+00     N/A
1983     N/A              0.640780E+00     N/A
1984     N/A              0.905839E+00     N/A
1985     N/A              0.252855E+00     N/A
1986     N/A              0.416226E+00     N/A
1987     N/A              0.373888E+00     N/A
1988     N/A              0.135078E+00     N/A
1989     N/A              0.101827E+00     N/A
1990     N/A              0.866825E-01     N/A
1991     N/A              0.193492E+00     N/A
1992     N/A              0.121758E+00     N/A
1993     N/A              0.235222E+00     N/A
1994     N/A              0.341796E+00     N/A
1995     0.101000E+00     0.123109E+00    -0.197953E+00
1996     0.123000E+00     0.129767E+00    -0.535533E-01
1997     0.670000E+00     0.458091E+00     0.380211E+00
1998     0.558000E+00     0.610012E+00    -0.891191E-01
1999     0.220000E+01     0.125596E+01     0.560558E+00
2000     0.368900E+01     0.173211E+01     0.756014E+00
2001     0.239700E+01     0.170812E+01     0.338827E+00
2002     0.283300E+01     0.207519E+01     0.311285E+00
2003     0.198800E+01     0.312199E+01    -0.451342E+00
2004     0.141600E+01     0.345432E+01    -0.891790E+00
2005     0.156500E+01     0.521307E+00     0.109930E+01
2006     0.238000E+00     0.734184E+00    -0.112649E+01
2007     0.248000E+00     0.468426E+00    -0.635949E+00
2008     N/A              0.996218E+00     N/A
```

```
Survey Index:   43 Tag:         Scall    AGE =  1
Time = MEAN            Type = NUMBER
Catchability =    0.233364E-04   % Variance Contribution =     4.4457
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_____________________________________________________________________________

1973     N/A              0.617432E+00     N/A
1974     N/A              0.107682E+01     N/A
1975     N/A              0.144102E+01     N/A
1976     N/A              0.515879E+00     N/A
1977     N/A              0.361276E+00     N/A
1978     N/A              0.103511E+01     N/A
1979     N/A              0.535901E+00     N/A
1980     N/A              0.504738E+00     N/A
1981     N/A              0.133122E+01     N/A
1982     0.313000E+00     0.458389E+00    -0.381516E+00
1983     0.140000E+00     0.131115E+00     0.655667E-01
1984     0.233000E+00     0.223500E+00     0.416271E-01
1985     0.549000E+00     0.343196E+00     0.469798E+00
1986     0.103000E+00     0.177195E+00    -0.542520E+00
1987     0.470000E-01     0.192678E+00    -0.141087E+01
1988     0.116000E+00     0.477456E+00    -0.141488E+01
1989     0.195000E+00     0.202191E+00    -0.362157E-01
1990     0.100000E+00     0.234637E+00    -0.852871E+00
1991     0.211700E+01     0.469575E+00     0.150593E+01
1992     0.167000E+00     0.342595E+00    -0.718556E+00
1993     0.112900E+01     0.230977E+00     0.158677E+01
1994     0.150300E+01     0.277959E+00     0.168774E+01
1995     N/A              0.246347E+00     N/A
1996     N/A              0.283770E+00     N/A
1997     N/A              0.417888E+00     N/A
1998     N/A              0.471913E+00     N/A
1999     N/A              0.518874E+00     N/A
2000     N/A              0.418981E+00     N/A
2001     N/A              0.470336E+00     N/A
2002     N/A              0.326432E+00     N/A
2003     N/A              0.247143E+00     N/A
2004     N/A              0.220762E+00     N/A
2005     N/A              0.304641E+00     N/A
2006     N/A              0.104391E+01     N/A
2007     N/A              0.388002E+00     N/A
2008     N/A              0.000000E+00     N/A
```

```
Survey Index:   44 Tag:         Scall95  AGE =  1
Time = MEAN            Type = NUMBER
Catchability =    0.539497E-04   % Variance Contribution =     0.3281
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_____________________________________________________________________________

1973     N/A              0.142739E+01     N/A
1974     N/A              0.248941E+01     N/A
1975     N/A              0.333139E+01     N/A
1976     N/A              0.119262E+01     N/A
1977     N/A              0.835206E+00     N/A
1978     N/A              0.239299E+01     N/A
1979     N/A              0.123891E+01     N/A
1980     N/A              0.116687E+01     N/A
1981     N/A              0.307755E+01     N/A
1982     N/A              0.105972E+01     N/A
1983     N/A              0.303115E+00     N/A
1984     N/A              0.516693E+00     N/A
1985     N/A              0.793408E+00     N/A
1986     N/A              0.409643E+00     N/A
1987     N/A              0.445437E+00     N/A
1988     N/A              0.110379E+01     N/A
1989     N/A              0.467431E+00     N/A
1990     N/A              0.542440E+00     N/A
1991     N/A              0.108557E+01     N/A
1992     N/A              0.792020E+00     N/A
1993     N/A              0.533978E+00     N/A
1994     N/A              0.642592E+00     N/A
1995     0.609000E+00     0.569510E+00     0.670423E-01
1996     0.508000E+00     0.656025E+00    -0.255718E+00
1997     0.106200E+01     0.966082E+00     0.946601E-01
1998     0.187200E+01     0.109098E+01     0.539932E+00
1999     0.103800E+01     0.119954E+01    -0.144646E+00
2000     0.912000E+00     0.968610E+00    -0.602223E-01
2001     0.789000E+00     0.108733E+01    -0.320717E+00
2002     0.100500E+01     0.754654E+00     0.286483E+00
2003     0.880000E+00     0.571352E+00     0.431916E+00
2004     0.330000E+00     0.510364E+00    -0.436031E+00
2005     0.573000E+00     0.704277E+00    -0.206286E+00
2006     0.242200E+01     0.241333E+01     0.358668E-02
2007     N/A              0.896992E+00     N/A
2008     N/A              0.000000E+00     N/A
```

```
                   Retrospective Summary

                   Average Fishing Mortality
                    Ages =  4 -  5


              1973        1974        1975        1976        1977


  2000      0.9046      1.1647      1.4350      1.0158      0.9995
  2001      0.9046      1.1647      1.4350      1.0158      0.9995
  2002      0.9046      1.1647      1.4350      1.0158      0.9995
  2003      0.9046      1.1647      1.4350      1.0158      0.9995
  2004      0.9046      1.1647      1.4350      1.0158      0.9995
  2005      0.9046      1.1647      1.4350      1.0158      0.9995
  2006      0.9046      1.1647      1.4350      1.0158      0.9995
  2007      0.9046      1.1647      1.4350      1.0158      0.9995

              1978        1979        1980        1981        1982


  2000      0.9500      0.9943      0.7201      1.2366      1.0961
  2001      0.9500      0.9943      0.7201      1.2366      1.0961
  2002      0.9500      0.9943      0.7201      1.2366      1.0961
  2003      0.9500      0.9943      0.7201      1.2366      1.0961
  2004      0.9500      0.9943      0.7201      1.2366      1.0961
  2005      0.9500      0.9943      0.7201      1.2366      1.0961
  2006      0.9500      0.9943      0.7201      1.2366      1.0961
  2007      0.9500      0.9943      0.7201      1.2366      1.0961

              1983        1984        1985        1986        1987


  2000      0.6727      1.8064      1.0330      0.8025      1.3378
  2001      0.6727      1.8064      1.0330      0.8025      1.3378
  2002      0.6727      1.8064      1.0330      0.8025      1.3378
  2003      0.6727      1.8064      1.0330      0.8025      1.3378
  2004      0.6727      1.8064      1.0330      0.8025      1.3378
  2005      0.6727      1.8064      1.0330      0.8025      1.3378
  2006      0.6727      1.8064      1.0330      0.8025      1.3378
  2007      0.6727      1.8064      1.0330      0.8025      1.3378

              1988        1989        1990        1991        1992


  2000      1.5603      0.9250      0.9378      1.3432      1.1853
  2001      1.5603      0.9250      0.9378      1.3432      1.1853
  2002      1.5603      0.9250      0.9378      1.3434      1.1857
  2003      1.5603      0.9250      0.9378      1.3434      1.1857
  2004      1.5603      0.9250      0.9378      1.3434      1.1856
  2005      1.5603      0.9250      0.9378      1.3434      1.1856
  2006      1.5603      0.9250      0.9378      1.3434      1.1856
  2007      1.5603      0.9250      0.9378      1.3434      1.1856

              1993        1994        1995        1996        1997


  2000      1.4731      1.8188      0.9109      0.5418      0.4712
  2001      1.4733      1.8201      0.9132      0.5445      0.4751
  2002      1.4749      1.8304      0.9317      0.5673      0.5089
  2003      1.4750      1.8311      0.9328      0.5687      0.5111
  2004      1.4749      1.8301      0.9310      0.5664      0.5076
  2005      1.4749      1.8301      0.9310      0.5664      0.5076
  2006      1.4749      1.8301      0.9310      0.5664      0.5076
  2007      1.4749      1.8301      0.9310      0.5664      0.5076
```

```
             1998        1999        2000        2001        2002


2000       0.5854      0.5269      0.6011
2001       0.5938      0.5401      0.6280      0.4138
2002       0.6696      0.6738      0.9785      1.0250      0.7292
2003       0.6748      0.6840      1.0130      1.1286      0.9286
2004       0.6666      0.6680      0.9592      0.9727      0.6477
2005       0.6665      0.6678      0.9586      0.9710      0.6453
2006       0.6664      0.6676      0.9581      0.9698      0.6436
2007       0.6665      0.6677      0.9583      0.9701      0.6441

             2003        2004        2005        2006        2007


2000
2001
2002
2003       1.4185
2004       0.6067      1.8883
2005       0.6025      1.8412      1.2270
2006       0.5994      1.8085      1.1407      0.8425
2007       0.6003      1.8180      1.1648      0.8904      0.2892


                   Spawning Stock Biomass


             1973        1974        1975        1976        1977


2000       22161.      14780.       9014.      10024.       8351.
2001       22161.      14780.       9014.      10024.       8351.
2002       22161.      14780.       9014.      10024.       8351.
2003       22161.      14780.       9014.      10024.       8351.
2004       22161.      14780.       9014.      10024.       8351.
2005       22161.      14780.       9014.      10024.       8351.
2006       22161.      14780.       9014.      10024.       8351.
2007       22161.      14780.       9014.      10024.       8351.

             1978        1979        1980        1981        1982


2000        6169.       8501.      10884.      10144.      12975.
2001        6169.       8501.      10884.      10144.      12975.
2002        6169.       8501.      10884.      10144.      12975.
2003        6169.       8501.      10884.      10144.      12975.
2004        6169.       8501.      10884.      10144.      12975.
2005        6169.       8501.      10884.      10144.      12975.
2006        6169.       8501.      10884.      10144.      12975.
2007        6169.       8501.      10884.      10144.      12975.

             1983        1984        1985        1986        1987


2000       11103.       3847.       2558.       3210.       2750.
2001       11103.       3847.       2558.       3210.       2750.
2002       11103.       3847.       2558.       3210.       2750.
2003       11103.       3847.       2558.       3210.       2750.
2004       11103.       3847.       2558.       3210.       2750.
2005       11103.       3847.       2558.       3210.       2750.
2006       11103.       3847.       2558.       3210.       2750.
2007       11103.       3847.       2558.       3210.       2750.

             1988        1989        1990        1991        1992
```

```
2000        2198.       4170.       4750.       3486.       4474.
2001        2198.       4170.       4750.       3486.       4474.
2002        2198.       4170.       4750.       3485.       4472.
2003        2198.       4170.       4750.       3485.       4471.
2004        2198.       4170.       4750.       3485.       4472.
2005        2198.       4170.       4750.       3485.       4472.
2006        2198.       4170.       4750.       3485.       4472.
2007        2198.       4170.       4750.       3485.       4472.

             1993        1994        1995        1996        1997


2000        3973.       2852.       3038.       5258.       6909.
2001        3972.       2849.       3026.       5227.       6847.
2002        3965.       2822.       2938.       4984.       6362.
2003        3965.       2821.       2933.       4970.       6333.
2004        3966.       2823.       2941.       4993.       6379.
2005        3966.       2823.       2941.       4993.       6380.
2006        3966.       2823.       2941.       4993.       6380.
2007        3966.       2823.       2941.       4993.       6380.

             1998        1999        2000        2001        2002


2000        8398.      13633.      19462.
2001        8266.      12307.      15883.      19972.
2002        7223.       9496.      10026.       9529.      12523.
2003        7161.       9328.       9618.       7742.       7425.
2004        7260.       9595.      10267.       9272.      10140.
2005        7261.       9599.      10275.       9291.      10180.
2006        7262.       9601.      10281.       9305.      10210.
2007        7262.       9600.      10280.       9300.      10201.

             2003        2004        2005        2006        2007


2000
2001
2002
2003        7709.
2004       11316.       9201.
2005       10171.       6307.       5645.
2006       10239.       5915.       4452.       5001.
2007       10219.       5869.       4157.       4427.       9526.


                   Total Population Numbers


             1973        1974        1975        1976        1977


2000      110351.     111229.     131948.      93193.      57252.
2001      110351.     111229.     131948.      93193.      57252.
2002      110351.     111229.     131948.      93193.      57252.
2003      110351.     111229.     131948.      93193.      57252.
2004      110351.     111229.     131948.      93193.      57252.
2005      110351.     111229.     131948.      93193.      57252.
2006      110351.     111229.     131948.      93193.      57252.
2007      110351.     111229.     131948.      93193.      57252.

             1978        1979        1980        1981        1982


2000       80953.      73336.      68594.     104677.      96685.
2001       80953.      73336.      68594.     104677.      96685.
2002       80953.      73336.      68594.     104677.      96685.
```

```
2003       80953.      73336.      68594.     104677.      96685.
2004       80953.      73336.      68594.     104677.      96685.
2005       80953.      73336.      68594.     104677.      96685.
2006       80953.      73336.      68594.     104677.      96685.
2007       80953.      73336.      68594.     104677.      96685.

             1983        1984        1985        1986        1987


2000       56648.      31441.      29636.      25695.      22692.
2001       56648.      31441.      29636.      25695.      22692.
2002       56648.      31441.      29636.      25695.      22692.
2003       56648.      31441.      29636.      25695.      22692.
2004       56648.      31441.      29636.      25695.      22692.
2005       56648.      31441.      29636.      25695.      22692.
2006       56648.      31441.      29636.      25695.      22692.
2007       56648.      31441.      29636.      25695.      22692.

             1988        1989        1990        1991        1992


2000       34379.      32297.      33985.      41046.      45955.
2001       34379.      32297.      33984.      41044.      45949.
2002       34379.      32296.      33980.      41032.      45902.
2003       34379.      32296.      33980.      41031.      45899.
2004       34379.      32296.      33980.      41032.      45903.
2005       34379.      32296.      33980.      41032.      45903.
2006       34379.      32296.      33980.      41032.      45904.
2007       34379.      32296.      33980.      41032.      45904.

             1993        1994        1995        1996        1997


2000       36699.      32442.      29994.      36618.      50007.
2001       36677.      32360.      29838.      36348.      49343.
2002       36509.      31710.      28604.      34220.      44110.
2003       36499.      31671.      28531.      34094.      43799.
2004       36515.      31733.      28648.      34295.      44294.
2005       36516.      31734.      28649.      34298.      44300.
2006       36516.      31734.      28650.      34300.      44305.
2007       36516.      31734.      28650.      34299.      44303.

             1998        1999        2000        2001        2002


2000       74662.      94898.     106568.      95461.
2001       65513.      81056.     100947.     107644.      96358.
2002       53087.      59035.      64338.      72549.      84526.
2003       52350.      57340.      53839.      51205.      54271.
2004       53523.      60040.      60206.      58943.      60591.
2005       53538.      60074.      60286.      59091.      51195.
2006       53548.      60098.      60344.      59199.      51478.
2007       53545.      60091.      60327.      59167.      51394.

             2003        2004        2005        2006        2007


2000
2001
2002       79767.
2003       50873.      49695.
2004       61118.      49021.      49140.
2005       49419.      41036.      31650.      37349.
2006       44779.      38032.      35214.      82324.      82517.
2007       44585.      35962.      33263.      69731.      71101.

             2008
```

```
2000
2001
2002
2003
2004
2005
2006
2007       73568.

                   Age  1 Population


             1973        1974        1975        1976        1977


2000       29384.      52184.      70632.      24731.      17283.
2001       29384.      52184.      70632.      24731.      17283.
2002       29384.      52184.      70632.      24731.      17283.
2003       29384.      52184.      70632.      24731.      17283.
2004       29384.      52184.      70632.      24731.      17283.
2005       29384.      52184.      70632.      24731.      17283.
2006       29384.      52184.      70632.      24731.      17283.
2007       29384.      52184.      70632.      24731.      17283.

             1978        1979        1980        1981        1982


2000       54437.      25508.      24034.      62997.      22846.
2001       54437.      25508.      24034.      62997.      22846.
2002       54437.      25508.      24034.      62997.      22846.
2003       54437.      25508.      24034.      62997.      22846.
2004       54437.      25508.      24034.      62997.      22846.
2005       54437.      25508.      24034.      62997.      22846.
2006       54437.      25508.      24034.      62997.      22846.
2007       54437.      25508.      24034.      62997.      22846.

             1983        1984        1985        1986        1987


2000        6581.      10843.      16749.       8473.       9193.
2001        6581.      10843.      16749.       8473.       9193.
2002        6581.      10843.      16749.       8473.       9193.
2003        6581.      10843.      16749.       8473.       9193.
2004        6581.      10843.      16749.       8473.       9193.
2005        6581.      10843.      16749.       8473.       9193.
2006        6581.      10843.      16749.       8473.       9193.
2007        6581.      10843.      16749.       8473.       9193.

             1988        1989        1990        1991        1992


2000       22841.       9662.      11220.      22567.      17559.
2001       22841.       9662.      11220.      22566.      17554.
2002       22841.       9661.      11217.      22556.      17516.
2003       22841.       9661.      11217.      22556.      17514.
2004       22841.       9661.      11217.      22557.      17518.
2005       22841.       9661.      11217.      22557.      17518.
2006       22841.       9661.      11217.      22557.      17518.
2007       22841.       9661.      11217.      22557.      17518.

             1993        1994        1995        1996        1997


2000       14079.      13739.      12438.      14691.      23608.
```

```
2001        14063.      13674.      12349.      14549.      23165.
2002        13934.      13161.      11646.      13429.      19672.
2003        13926.      13130.      11604.      13362.      19464.
2004        13938.      13179.      11671.      13468.      19795.
2005        13938.      13179.      11672.      13469.      19799.
2006        13938.      13180.      11672.      13470.      19802.
2007        13938.      13180.      11672.      13470.      19801.

             1998        1999        2000        2001        2002


2000        38882.      42191.      37675.      20997.
2001        30272.      35826.      43381.      37456.      21188.
2002        22100.      23880.      24753.      32432.      37740.
2003        21617.      22782.      15639.      19687.      24978.
2004        22387.      24531.      19800.      22206.      24928.
2005        22397.      24553.      19853.      22289.      15410.
2006        22404.      24569.      19891.      22349.      15604.
2007        22402.      24564.      19880.      22331.      15547.

             2003        2004        2005        2006        2007


2000
2001
2002        20357.
2003        15892.      19265.
2004        20776.      10009.      19332.
2005        16768.      11590.       8658.      18561.
2006        11895.      12383.      14697.      60429.      19370.
2007        11770.      10472.      14435.      49437.      18373.

             2008


2000
2001
2002
2003
2004
2005
2006
2007        19120.
```

```
In the Retrospective Analysis
The Following Survey Indices Have Predicted
Index Value Set to Zero in Terminal Year + 1

   1     USsearly    1
   2     USsearly    2
   3     USsearly    3
   4     USsearly    4
   5     USsearly    5
   6     USsearly    6
  19     USfall      1
  20     USfall      2
  21     USfall      3
  22     USfall      4
  23     USfall      5
  24     USfall      6
  25     USfall95    1
  26     USfall95    2
  27     USfall95    3
  28     USfall95    4
  29     USfall95    5
  30     USfall95    6
  43     Scall       1
  44     Scall95     1


Plus Group Diagnostic Report

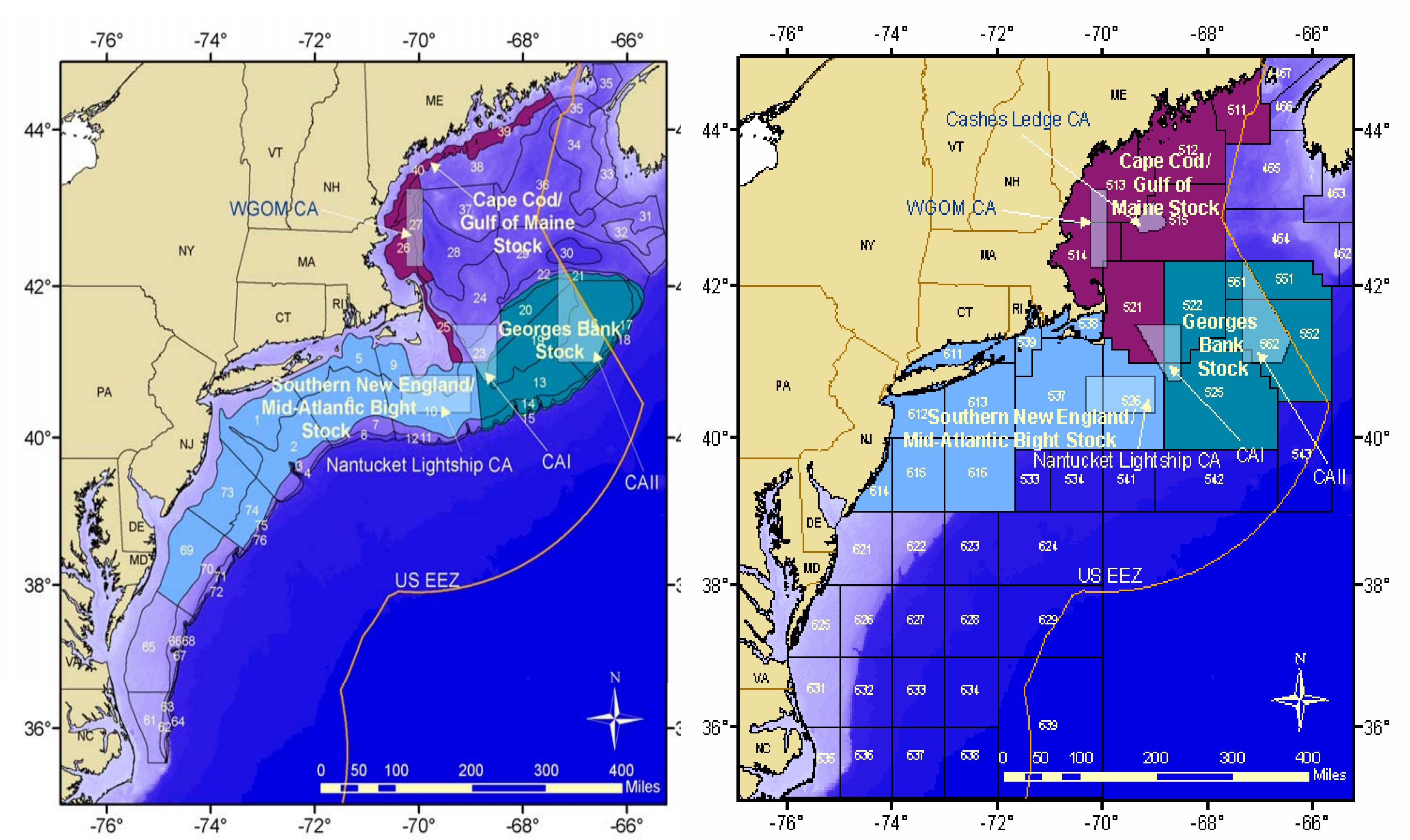
Calculation Method Selected = Backward

         Population  Population    F            F
Year     Backward     Forward    Forward     Backward    Ratio

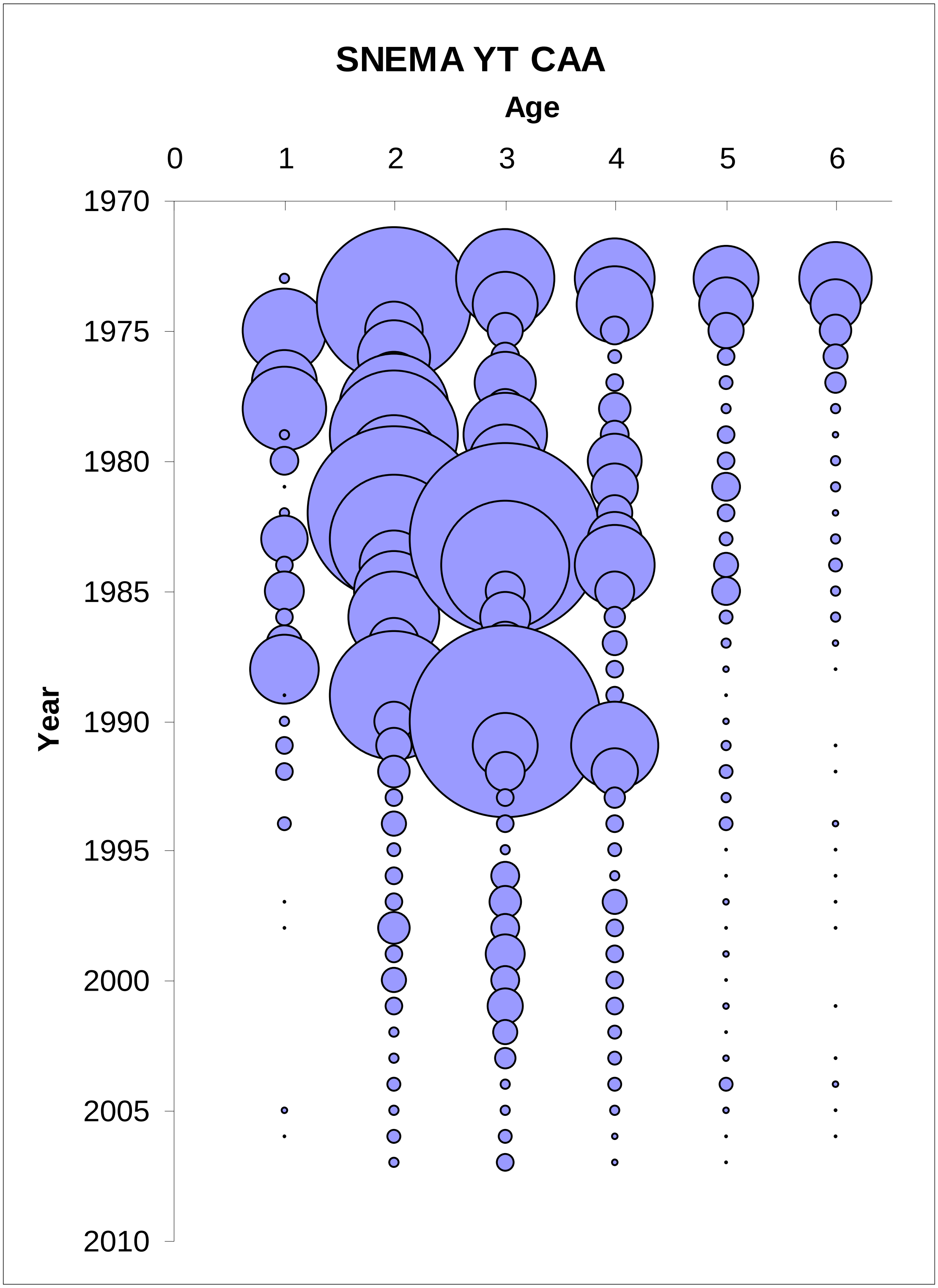
1973       3013.       3013.    0.904553    0.904559    1.000007
1974       2391.       3307.    0.695689    1.164718    1.674194
1975       1709.       2815.    0.631724    1.434953    2.271487
1976       1562.       1825.    0.793523    1.015833    1.280156
1977        850.        965.    0.816769    0.999464    1.223680
1978        373.        566.    0.523246    0.949972    1.815536
1979        559.        577.    0.944090    0.994293    1.053177
1980        239.        509.    0.278307    0.720099    2.587425
1981        221.        613.    0.301185    1.236571    4.105689
1982        156.        681.    0.168110    1.096145    6.520394
1983        345.        959.    0.195123    0.672714    3.447641
1984        487.       1279.    0.393483    1.806415    4.590832
1985        136.       1016.    0.091534    1.032965   11.284990
1986        224.       1013.    0.131529    0.802529    6.101535
1987        201.        875.    0.189551    1.337831    7.057877
1988         73.        653.    0.094237    1.560327   16.557517
1989         55.        540.    0.064098    0.925028   14.431503
1990         47.        479.    0.061967    0.937802   15.133953
1991        104.        449.    0.191804    1.343232    7.003139
1992         65.        423.    0.115829    1.185267   10.232886
1993        127.        544.    0.202189    1.473117    7.285851
1994        184.        471.    0.407228    1.818787    4.466256
1995         67.        338.    0.128092    0.910906    7.111332
1996         72.        345.    0.092195    0.541761    5.876269
1997        261.        508.    0.215425    0.471187    2.187239
1998        361.        899.    0.197115    0.585412    2.969895
1999        805.       1865.    0.195705    0.526857    2.692103
2000       1278.       2280.    0.293725    0.601070    2.046370
2001       1470.       2288.       N/A         N/A
```

## Appendix D. Southern New England/ Mid-Atlantic yellowtal flounder

**Appendix Tables and Figures** by Larry Alade, Chris Legault and Steven Cadrin

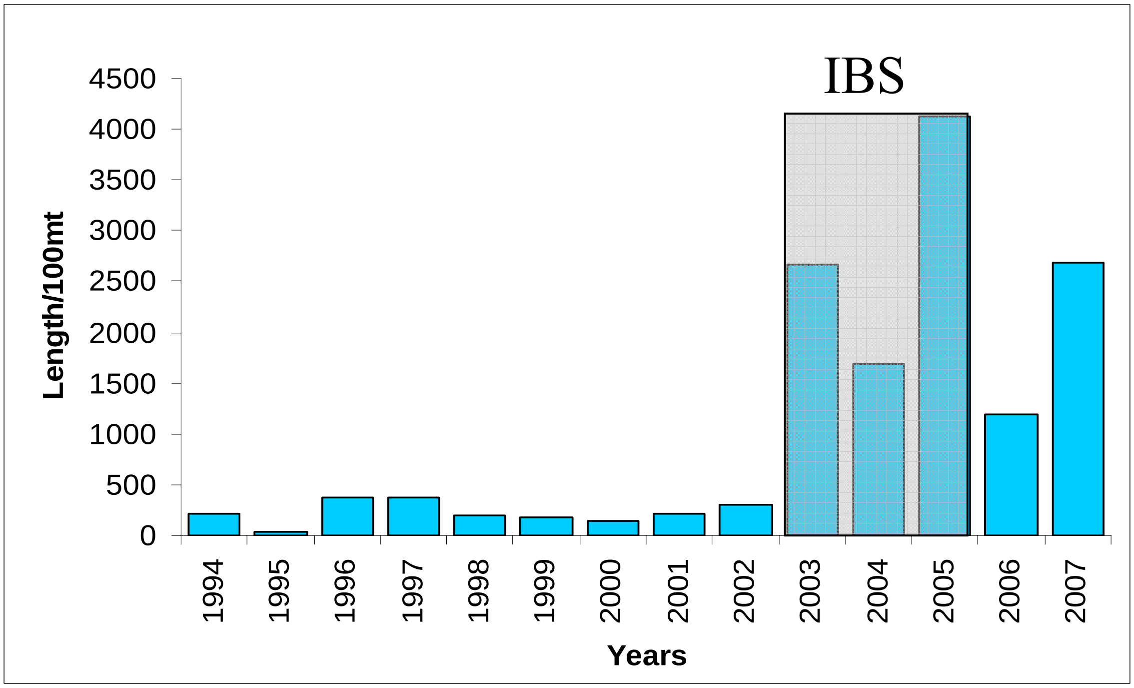


Appendix Figure D.1. Offshore Survey strata (1, 2, 5, 6, 9, 10, 69, 73, 74) used by NEFSC to estimate the autumn, spring and fall (Strata 69, 73 and 74 excluded from the fall series) survey indices [Left] and commercial statistical areas [Right] for all three yellowtail flounder stocks.

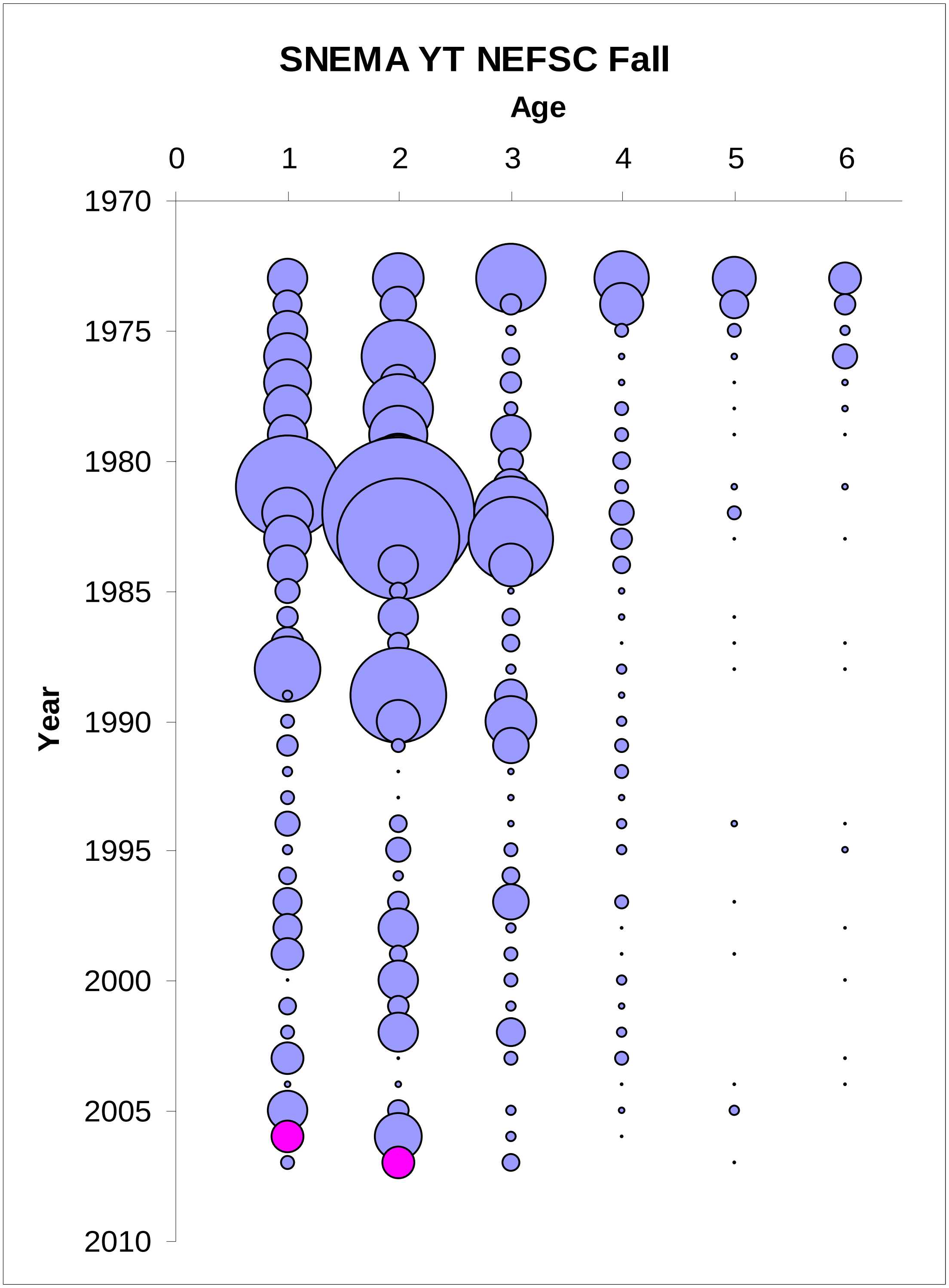


Appendix Figure D.2 Catch at age bubble plot for Southern New England-Mid Altantic yellowtail flounder.

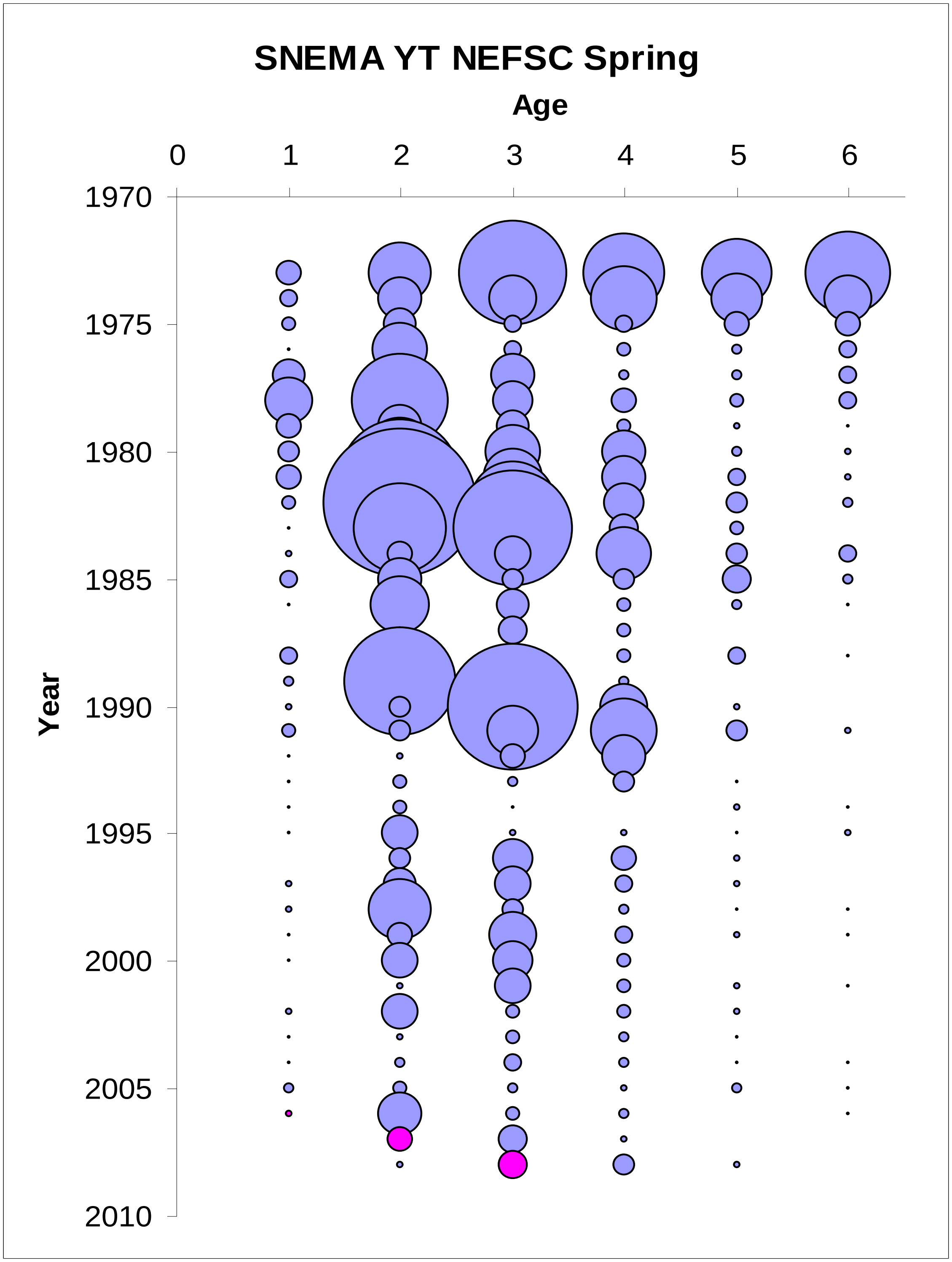
# SouthernNew England-Mid Atlantic Yellowtail flounder Biological Sampling



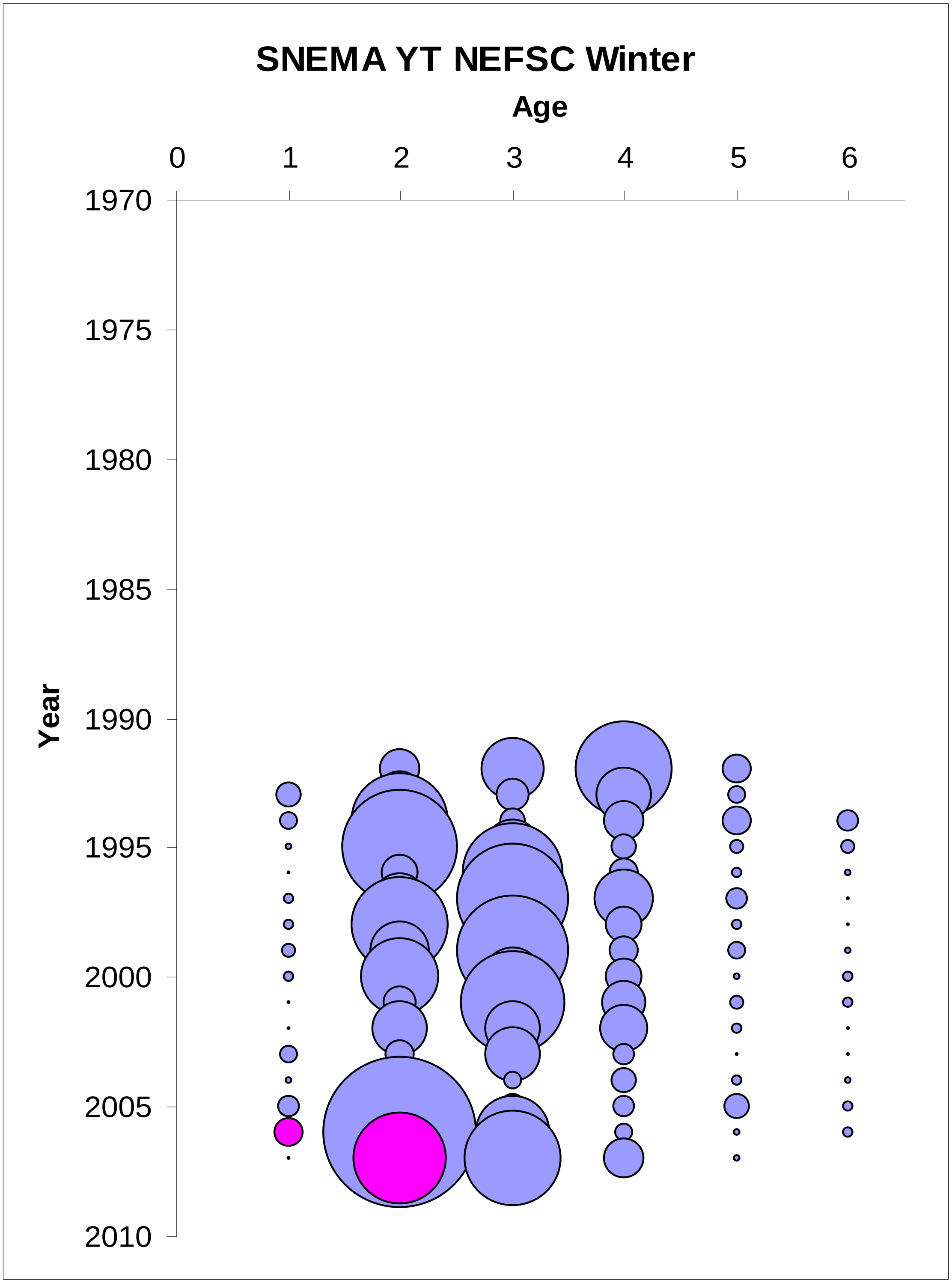
Appendix Figure D.3. Biological sampling for Southern New England-Mid Altantic yellowtail flounder. Note: 2003 -2005 was heavily supplemented by the Industry based survey (IBS – shaded in Grey).



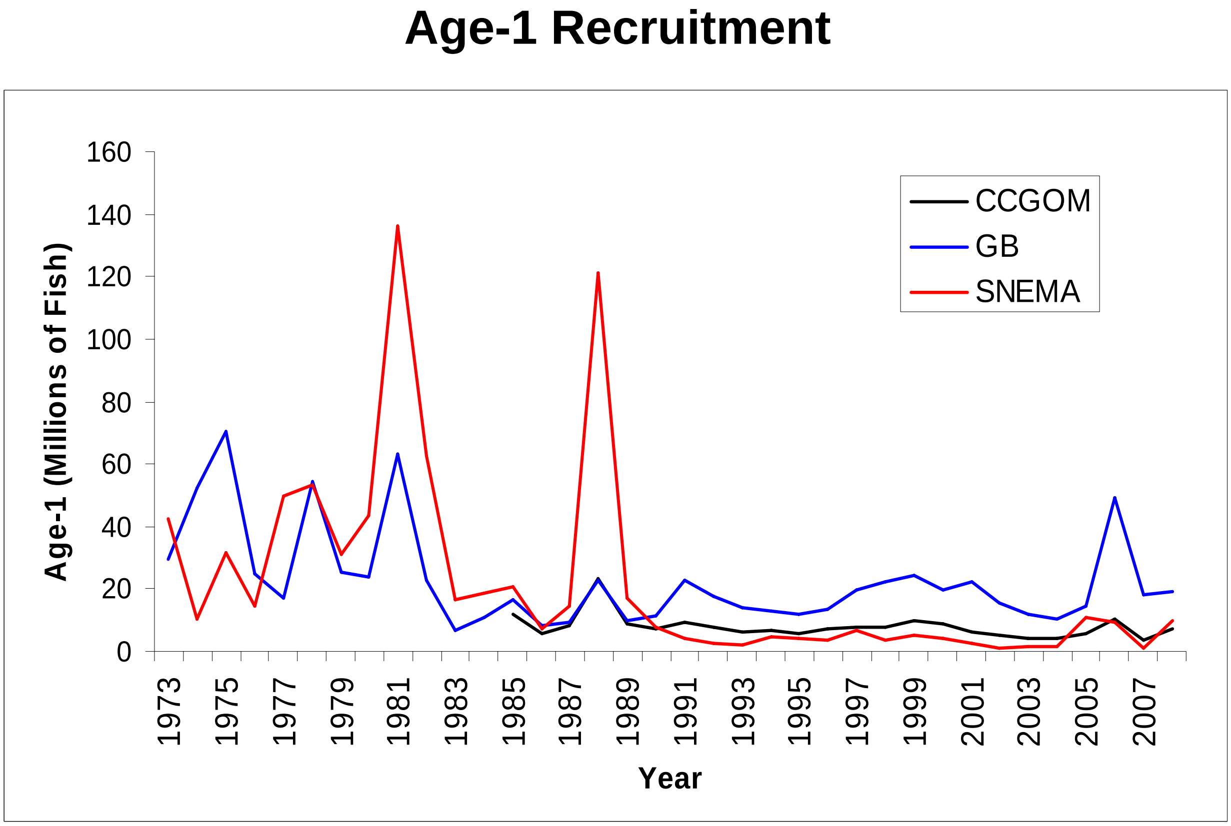
Appendix Figure D.4.a Survey bubble plot for SNEMA yellowtail NEFSC Fall survey. Note the 2005 year class is highlighted in pink.



Appendix Figure D.4.b Survey bubble plot for SNEMA yellowtail NEFSC Spring survey. Note the 2005 year class is highlighted in pink.



Appendix Figure D.4.c Survey bubble plot for SNEMA yellowtail NEFSC Winter survey. Note the 2005 year class is highlighted in pink.



Appendix Figure D.5. Comparison of recruitment trends from the three yellowtail flounder stocks.

Appendix Figure D.6. Standardized residuals for all indices by age.

## Appendix VPA Output Report

```
VPA Version 2.8.0

 Model ID: snema 6 plus for GARM2008_Retro


 Input File:
L:\YELLOWTAILFLOUNDER\ASSESSMENTS\SNEMA\VPA\SNEMA_VPA_6PLUS_JULY_2008_RETRO.DAT
 Date of Run: 17-JUL-2008                         Time of Run: 14:24


 Levenburg-Marquardt Algorithm Completed    15 Iterations
 Residual Sum of Squares =     337.729

 Number of Residuals     =    457
 Number of Parameters    =      4
 Degrees of Freedom      =    453
 Mean Squared Residual   =     0.745539
 Standard Deviation      =     0.863446


 Number of Years =    35
 Number of Ages  =     6
 First Year      =  1973
 Youngest Age    =     1
 Oldest True Age =     5

 Number of Survey Indices Available        =    18
 Number of Survey Indices Used in Estimate =    18


 VPA Classic Method - Auto Estimated Q's


 Stock Numbers Predicted in Terminal Year Plus One (2008)
 Age    Stock Predicted     Std. Error      CV

   2           952.892   0.486501E+03   0.510552E+00
   3          6071.373   0.208250E+04   0.343003E+00
   4          5190.411   0.160161E+04   0.308571E+00
   5           236.964   0.900044E+02   0.379823E+00

 Catchability Values for Each Survey Used in Estimate
 INDEX     Catchability    Std. Error      CV

   1       0.453675E-01   0.125163E-01   0.275888E+00
   2       0.142556E+01   0.258922E+00   0.181628E+00
   3       0.229197E+01   0.418383E+00   0.182543E+00
   4       0.254824E+01   0.320159E+00   0.125639E+00
   5       0.189483E+01   0.439295E+00   0.231838E+00
   6       0.234050E+01   0.826870E+00   0.353288E+00
   7       0.141979E-01   0.237835E-02   0.167514E+00
   8       0.182963E+00   0.273950E-01   0.149730E+00
   9       0.283400E+00   0.369888E-01   0.130518E+00
  10       0.419285E+00   0.435372E-01   0.103837E+00
  11       0.550028E+00   0.953396E-01   0.173336E+00
  12       0.568391E+00   0.113931E+00   0.200446E+00
  13       0.100583E+00   0.159129E-01   0.158206E+00
  14       0.175600E+00   0.286112E-01   0.162934E+00
  15       0.199593E+00   0.246573E-01   0.123538E+00
  16       0.217045E+00   0.281861E-01   0.129863E+00
  17       0.221817E+00   0.420359E-01   0.189507E+00
  18       0.449687E+00   0.132708E+00   0.295111E+00
```

```
-- Non-Linear Least Squares Fit --

Default Tolerances Used

Scaled Gradient Tolerance      =    6.055454E-06
Scaled Step Tolerance          =    3.666853E-11
Relative Function Tolerance    =    3.666853E-11
Absolute Function Tolerance    =    4.930381E-32


VPA Method Options

- Catchability Values Estimated as an Analytic Function of N
- Catch Equation Used in Cohort Solution
- Plus Group Backward Calculation Method Used
- Rivard Weights Used for JAN-1 Biomass
- Rivard Weights Calculation Used  3 Years for Terminal Year Plus One

- Heincke Rule Used in F-Oldest Calculation
- F-Oldest Calculation in Years Prior to Terminal Year
  Uses Stock Sizes in Ages  4 to  5
- Calculation of Population of Age 1 In Year 2008
  =  Geometric Mean of First Age Populations
     Year Range Applied =  1973 to  2007

Stock Estimates

Age   2
Age   3
Age   4
Age   5

Full F in Terminal Year               =   0.4129

F in Oldest True Age in Terminal Year =   0.4129

Full F Calculated Using Classic Method

Age  Input Partial  Calc Partial   Fishing     Used In
     Recruitment    Recruitment    Mortality   Full F    Comments

  1      0.010          0.014       0.0057      NO      Stock Estimate in T+1
  2      0.120          0.087       0.0358      NO      Stock Estimate in T+1
  3      0.580          0.226       0.0935      NO      Stock Estimate in T+1
  4      1.000          1.000       0.4129      YES     Stock Estimate in T+1
  5      1.000          1.000       0.4129              Input PR * Full F
```

```
Catch At Age - Input Data

  AGE      1973        1974        1975        1976        1977
--------------------------------------------------------------------

   1      220.0       861.0      8910.0       214.0      5513.0
   2     5632.0     28519.0      4129.0      6677.0      5027.0
   3    11951.0      5556.0      1884.0      1181.0      4891.0
   4     7978.0      7370.0      1130.0       327.0       507.0
   5     5226.0      3687.0      1597.0       449.0       278.0
   6     6286.0      3347.0      1452.0       896.0       649.0

  AGE      1978        1979        1980        1981        1982
--------------------------------------------------------------------

   1     8698.0       205.0      1006.0        38.0       169.0
   2    14191.0     19419.0     10215.0      7029.0     35696.0
   3     2164.0      8667.0      6595.0      7578.0     14358.0
   4     1470.0      1062.0      3829.0      2926.0      1858.0
   5      247.0       438.0       512.0      1111.0       415.0
   6      179.0       131.0       167.0       183.0        86.0

  AGE      1983        1984        1985        1986        1987
--------------------------------------------------------------------

   1     2668.0       517.0      2239.0       463.0      1594.0
   2    19288.0      6200.0      8074.0      9970.0      3437.0
   3    42837.0     19990.0      2175.0      3326.0      2368.0
   4     3601.0      8129.0      1968.0       635.0       926.0
   5      385.0       878.0      1109.0       356.0       167.0
   6      192.0       276.0       246.0       149.0        65.0

  AGE      1988        1989        1990        1991        1992
--------------------------------------------------------------------

   1     5899.0        24.0       192.0       446.0       477.0
   2     2109.0     19920.0      2056.0      1610.0      1453.0
   3      536.0      3347.0     42644.0      5169.0      2097.0
   4      506.0       462.0      2209.0      9703.0      2739.0
   5      134.0        48.0        90.0       168.0       297.0
   6       32.0         3.0         5.0        51.0        18.0

  AGE      1993        1994        1995        1996        1997
--------------------------------------------------------------------

   1       13.0       362.0         1.0         3.0        22.0
   2      457.0       851.0       373.0       519.0       485.0
   3      447.0       399.0       198.0      1117.0      1512.0
   4      711.0       404.0       288.0       232.0       789.0
   5      145.0       297.0        51.0        32.0       110.0
   6        4.0        86.0        36.0        30.0        42.0
```

```
 Catch At Age - Input Data

   AGE       1998        1999        2000        2001        2002
 ------------------------------------------------------------------

    1        19.0        10.0         4.0         0.0         1.0
    2      1463.0       475.0       905.0       405.0       250.0
    3      1136.0      2217.0      1190.0      1683.0       966.0
    4       396.0       407.0       514.0       477.0       388.0
    5        52.0       125.0        55.0       126.0        25.0
    6        31.0         8.0        13.0        39.0         1.0

   AGE       2003        2004        2005        2006        2007
 ------------------------------------------------------------------

    1         2.0         4.0        66.0        19.0         6.0
    2       155.0       280.0       226.0       312.0       245.0
    3       594.0       243.0       217.0       344.0       564.0
    4       344.0       311.0       150.0       139.0       135.0
    5        89.0       313.0       118.0        44.0        44.0
    6        23.0       124.0        52.0        57.0        15.0


Weight At Age - Input Data

   AGE       1973        1974        1975        1976        1977
 ------------------------------------------------------------------

    1      0.2100      0.2030      0.2180      0.2280      0.2150
    2      0.2960      0.3080      0.2890      0.3030      0.2830
    3      0.3480      0.3520      0.3760      0.4080      0.3810
    4      0.3750      0.3960      0.4320      0.4980      0.5040
    5      0.3820      0.4390      0.4350      0.4990      0.5130
    6      0.4280      0.4570      0.4810      0.5570      0.5420

   AGE       1978        1979        1980        1981        1982
 ------------------------------------------------------------------

    1      0.2340      0.1890      0.2060      0.1400      0.2260
    2      0.2930      0.3010      0.2810      0.2620      0.2630
    3      0.3830      0.3640      0.3840      0.3420      0.3530
    4      0.5360      0.4750      0.5000      0.4740      0.4990
    5      0.6620      0.5900      0.6820      0.5960      0.6600
    6      0.6560      0.6620      0.9250      0.6500      0.8330

   AGE       1983        1984        1985        1986        1987
 ------------------------------------------------------------------

    1      0.1750      0.1820      0.1830      0.1860      0.2470
    2      0.2610      0.2370      0.2600      0.2840      0.2680
    3      0.3390      0.2950      0.3650      0.3310      0.3530
    4      0.4960      0.3880      0.4080      0.4630      0.4040
    5      0.6680      0.4870      0.5040      0.5870      0.5200
    6      0.8190      0.6560      0.6080      0.6420      0.6310

   AGE       1988        1989        1990        1991        1992
 ------------------------------------------------------------------

    1      0.2700      0.3110      0.3010      0.2060      0.1670
    2      0.2930      0.3380      0.3270      0.2620      0.3160
    3      0.3960      0.3940      0.3780      0.3370      0.3680
    4      0.4930      0.5530      0.4550      0.4140      0.4340
    5      0.6110      0.7350      0.7630      0.6780      0.5990
    6      0.8210      0.9570      0.8840      0.8000      0.9180
```

```
  AGE      1993        1994        1995        1996        1997
________________________________________________________________

   1      0.1220      0.1230      0.0720      0.1050      0.1920
   2      0.3540      0.1980      0.2270      0.3440      0.2540
   3      0.4300      0.3530      0.3560      0.3810      0.4020
   4      0.4510      0.4160      0.4460      0.4690      0.5120
   5      0.6410      0.5040      0.5970      0.6130      0.6650
   6      1.0400      0.6720      0.8490      0.7340      0.8410

Weight At Age - Input Data

  AGE      1998        1999        2000        2001        2002
________________________________________________________________

   1      0.1680      0.2000      0.1440      0.1530      0.1650
   2      0.2800      0.3610      0.3480      0.3780      0.3740
   3      0.3840      0.4300      0.4790      0.4440      0.4730
   4      0.5190      0.6090      0.6250      0.6140      0.6280
   5      0.5870      0.7690      0.7480      0.7530      0.8380
   6      0.6930      1.1140      0.8880      0.9170      0.7970
  AGE      2003        2004        2005        2006        2007
________________________________________________________________

   1      0.1000      0.1580      0.0960      0.1180      0.1240
   2      0.3470      0.3200      0.2980      0.2550      0.2730
   3      0.4360      0.4030      0.4220      0.3910      0.3820
   4      0.6200      0.4930      0.5280      0.5340      0.5010
   5      0.6390      0.5760      0.6690      0.6750      0.7370
   6      0.8460      0.7440      0.8410      0.8520      0.8690

JAN-1 Weights at Age - Input Data

  AGE      1973        1974        1975        1976        1977
________________________________________________________________

   1      0.1734      0.1701      0.1849      0.2046      0.1842
   2      0.2714      0.2543      0.2422      0.2570      0.2540
   3      0.3262      0.3228      0.3403      0.3434      0.3398
   4      0.3466      0.3712      0.3900      0.4327      0.4535
   5      0.3785      0.4057      0.4150      0.4643      0.5054
   6      0.4280      0.4570      0.4810      0.5570      0.5420
  AGE      1978        1979        1980        1981        1982
________________________________________________________________

   1      0.2063      0.1550      0.1827      0.1021      0.2103
   2      0.2510      0.2654      0.2305      0.2323      0.1919
   3      0.3292      0.3266      0.3400      0.3100      0.3041
   4      0.4519      0.4265      0.4266      0.4266      0.4131
   5      0.5776      0.5624      0.5692      0.5459      0.5593
   6      0.6560      0.6620      0.9250      0.6500      0.8330
  AGE      1983        1984        1985        1986        1987
________________________________________________________________

   1      0.1504      0.1523      0.1469      0.1550      0.2268
   2      0.2429      0.2037      0.2175      0.2280      0.2233
   3      0.2986      0.2775      0.2941      0.2934      0.3166
   4      0.4184      0.3627      0.3469      0.4111      0.3657
   5      0.5773      0.4915      0.4422      0.4894      0.4907
   6      0.8190      0.6560      0.6080      0.6420      0.6310
```

```
  AGE      1988      1989      1990      1991      1992
 ----------------------------------------------------------

   1      0.2413    0.3033    0.3226    0.1663    0.1147
   2      0.2690    0.3021    0.3189    0.2808    0.2551
   3      0.3258    0.3398    0.3574    0.3320    0.3105
   4      0.4172    0.4680    0.4234    0.3956    0.3824
   5      0.4968    0.6020    0.6496    0.5554    0.4980
   6      0.8210    0.9570    0.8840    0.8000    0.9180

  AGE      1993      1994      1995      1996      1997
 ----------------------------------------------------------

   1      0.0958    0.0905    0.0329    0.0675    0.1590
   2      0.2431    0.1554    0.1671    0.1574    0.1633
   3      0.3686    0.3535    0.2655    0.2941    0.3719
   4      0.4074    0.4229    0.3968    0.4086    0.4417
   5      0.5274    0.4768    0.4983    0.5229    0.5585
   6      1.0400    0.6720    0.8490    0.7340    0.8410


JAN-1 Weights at Age - Input Data


  AGE      1998      1999      2000      2001      2002
 ----------------------------------------------------------

   1      0.1146    0.1516    0.0889    0.0979    0.1138
   2      0.2319    0.2463    0.2638    0.2333    0.2392
   3      0.3123    0.3470    0.4158    0.3931    0.4228
   4      0.4568    0.4836    0.5184    0.5423    0.5280
   5      0.5482    0.6318    0.6749    0.6860    0.7173
   6      0.6930    1.1140    0.8880    0.9170    0.7970

  AGE      2003      2004      2005      2006      2007
 ----------------------------------------------------------

   1      0.0559    0.1150    0.0589    0.0776    0.0857
   2      0.2393    0.1789    0.2170    0.1565    0.1795
   3      0.4038    0.3740    0.3675    0.3413    0.3121
   4      0.5415    0.4636    0.4613    0.4747    0.4426
   5      0.6335    0.5976    0.5743    0.5970    0.6273
   6      0.8460    0.7440    0.8410    0.8520    0.8690

  AGE      2008
 ----------------------------------------------------------

   1      0.0740
   2      0.1843
   3      0.3403
   4      0.4595
   5      0.5995
   6      0.8540
```

```
SSB Weight At Age - Input Data

  AGE       1973        1974        1975        1976        1977
 ____________________________________________________________________

   1       0.1240      0.2030      0.2180      0.2280      0.2150
   2       0.2730      0.3080      0.2890      0.3030      0.2830
   3       0.3820      0.3520      0.3760      0.4080      0.3810
   4       0.5010      0.3960      0.4320      0.4980      0.5040
   5       0.7370      0.4390      0.4350      0.4990      0.5130
   6       0.8690      0.4570      0.4810      0.5570      0.5420

  AGE       1978        1979        1980        1981        1982
 ____________________________________________________________________

   1       0.2340      0.1890      0.2060      0.1400      0.2260
   2       0.2930      0.3010      0.2810      0.2620      0.2630
   3       0.3830      0.3640      0.3840      0.3420      0.3530
   4       0.5360      0.4750      0.5000      0.4740      0.4990
   5       0.6620      0.5900      0.6820      0.5960      0.6600
   6       0.6560      0.6620      0.9250      0.6500      0.8330

  AGE       1983        1984        1985        1986        1987
 ____________________________________________________________________

   1       0.1750      0.1820      0.1830      0.1860      0.2470
   2       0.2610      0.2370      0.2600      0.2840      0.2680
   3       0.3390      0.2950      0.3650      0.3310      0.3530
   4       0.4960      0.3880      0.4080      0.4630      0.4040
   5       0.6680      0.4870      0.5040      0.5870      0.5200
   6       0.8190      0.6560      0.6080      0.6420      0.6310

  AGE       1988        1989        1990        1991        1992
 ____________________________________________________________________

   1       0.2700      0.3110      0.3010      0.2060      0.1670
   2       0.2930      0.3380      0.3270      0.2620      0.3160
   3       0.3960      0.3940      0.3780      0.3370      0.3680
   4       0.4930      0.5530      0.4550      0.4140      0.4340
   5       0.6110      0.7350      0.7630      0.6780      0.5990
   6       0.8210      0.9570      0.8840      0.8000      0.9180

  AGE       1993        1994        1995        1996        1997
 ____________________________________________________________________

   1       0.1220      0.1230      0.0720      0.1050      0.1920
   2       0.3540      0.1980      0.2270      0.3440      0.2540
   3       0.4300      0.3530      0.3560      0.3810      0.4020
   4       0.4510      0.4160      0.4460      0.4690      0.5120
   5       0.6410      0.5040      0.5970      0.6130      0.6650
   6       1.0400      0.6720      0.8490      0.7340      0.8410
```

```
SSB Weight At Age - Input Data

  AGE       1998        1999        2000        2001        2002
____________________________________________________________________

   1       0.1680      0.2000      0.1440      0.1530      0.1650
   2       0.2800      0.3610      0.3480      0.3780      0.3740
   3       0.3840      0.4300      0.4790      0.4440      0.4730
   4       0.5190      0.6090      0.6250      0.6140      0.6280
   5       0.5870      0.7690      0.7480      0.7530      0.8380
   6       0.6930      1.1140      0.8880      0.9170      0.7970

  AGE       2003        2004        2005        2006        2007
____________________________________________________________________

   1       0.1000      0.1580      0.0960      0.1180      0.1240
   2       0.3470      0.3200      0.2980      0.2550      0.2730
   3       0.4360      0.4030      0.4220      0.3910      0.3820
   4       0.6200      0.4930      0.5280      0.5340      0.5010
   5       0.6390      0.5760      0.6690      0.6750      0.7370
   6       0.8460      0.7440      0.8410      0.8520      0.8690


Natural Mortality - Input Data

  AGE       1973        1974        1975        1976        1977
____________________________________________________________________

   1       0.2000      0.2000      0.2000      0.2000      0.2000
   2       0.2000      0.2000      0.2000      0.2000      0.2000
   3       0.2000      0.2000      0.2000      0.2000      0.2000
   4       0.2000      0.2000      0.2000      0.2000      0.2000
   5       0.2000      0.2000      0.2000      0.2000      0.2000
   6       0.2000      0.2000      0.2000      0.2000      0.2000

  AGE       1978        1979        1980        1981        1982
____________________________________________________________________

   1       0.2000      0.2000      0.2000      0.2000      0.2000
   2       0.2000      0.2000      0.2000      0.2000      0.2000
   3       0.2000      0.2000      0.2000      0.2000      0.2000
   4       0.2000      0.2000      0.2000      0.2000      0.2000
   5       0.2000      0.2000      0.2000      0.2000      0.2000
   6       0.2000      0.2000      0.2000      0.2000      0.2000

  AGE       1983        1984        1985        1986        1987
____________________________________________________________________

   1       0.2000      0.2000      0.2000      0.2000      0.2000
   2       0.2000      0.2000      0.2000      0.2000      0.2000
   3       0.2000      0.2000      0.2000      0.2000      0.2000
   4       0.2000      0.2000      0.2000      0.2000      0.2000
   5       0.2000      0.2000      0.2000      0.2000      0.2000
   6       0.2000      0.2000      0.2000      0.2000      0.2000

  AGE       1988        1989        1990        1991        1992
____________________________________________________________________

   1       0.2000      0.2000      0.2000      0.2000      0.2000
   2       0.2000      0.2000      0.2000      0.2000      0.2000
   3       0.2000      0.2000      0.2000      0.2000      0.2000
   4       0.2000      0.2000      0.2000      0.2000      0.2000
   5       0.2000      0.2000      0.2000      0.2000      0.2000
   6       0.2000      0.2000      0.2000      0.2000      0.2000
```

```
  AGE      1993       1994       1995       1996       1997
 ___________________________________________________________

   1      0.2000     0.2000     0.2000     0.2000     0.2000
   2      0.2000     0.2000     0.2000     0.2000     0.2000
   3      0.2000     0.2000     0.2000     0.2000     0.2000
   4      0.2000     0.2000     0.2000     0.2000     0.2000
   5      0.2000     0.2000     0.2000     0.2000     0.2000
   6      0.2000     0.2000     0.2000     0.2000     0.2000

Natural Mortality - Input Data

  AGE      1998       1999       2000       2001       2002
 ___________________________________________________________

   1      0.2000     0.2000     0.2000     0.2000     0.2000
   2      0.2000     0.2000     0.2000     0.2000     0.2000
   3      0.2000     0.2000     0.2000     0.2000     0.2000
   4      0.2000     0.2000     0.2000     0.2000     0.2000
   5      0.2000     0.2000     0.2000     0.2000     0.2000
   6      0.2000     0.2000     0.2000     0.2000     0.2000
  AGE      2003       2004       2005       2006       2007
 ___________________________________________________________

   1      0.2000     0.2000     0.2000     0.2000     0.2000
   2      0.2000     0.2000     0.2000     0.2000     0.2000
   3      0.2000     0.2000     0.2000     0.2000     0.2000
   4      0.2000     0.2000     0.2000     0.2000     0.2000
   5      0.2000     0.2000     0.2000     0.2000     0.2000
   6      0.2000     0.2000     0.2000     0.2000     0.2000

Proportion of Natural Mortality Before Spawning =       0.4167
Proportion of Fishing Mortality Before Spawning =       0.4167

Maturity - Input Data

  AGE      1973       1974       1975       1976       1977
 ___________________________________________________________

   1      0.0000     0.0000     0.0000     0.0000     0.0000
   2      0.4900     0.4900     0.4900     0.4900     0.4900
   3      0.9740     0.9740     0.9740     0.9740     0.9740
   4      1.0000     1.0000     1.0000     1.0000     1.0000
   5      1.0000     1.0000     1.0000     1.0000     1.0000
   6      1.0000     1.0000     1.0000     1.0000     1.0000
  AGE      1978       1979       1980       1981       1982
 ___________________________________________________________

   1      0.0000     0.0000     0.0000     0.0000     0.0000
   2      0.4900     0.4900     0.4900     0.4900     0.4900
   3      0.9740     0.9740     0.9740     0.9740     0.9740
   4      1.0000     1.0000     1.0000     1.0000     1.0000
   5      1.0000     1.0000     1.0000     1.0000     1.0000
   6      1.0000     1.0000     1.0000     1.0000     1.0000
  AGE      1983       1984       1985       1986       1987
 ___________________________________________________________

   1      0.0000     0.0000     0.0000     0.0000     0.0000
   2      0.4900     0.4900     0.4900     0.4900     0.4900
   3      0.9740     0.9740     0.9740     0.9740     0.9740
```

```
  4      1.0000     1.0000     1.0000     1.0000     1.0000
  5      1.0000     1.0000     1.0000     1.0000     1.0000
  6      1.0000     1.0000     1.0000     1.0000     1.0000

 AGE      1988       1989       1990       1991       1992
----------------------------------------------------------

  1      0.0000     0.0000     0.0000     0.0000     0.0000
  2      0.4900     0.4900     0.4900     0.4900     0.4900
  3      0.9740     0.9740     0.9740     0.9740     0.9740
  4      1.0000     1.0000     1.0000     1.0000     1.0000
  5      1.0000     1.0000     1.0000     1.0000     1.0000
  6      1.0000     1.0000     1.0000     1.0000     1.0000

 AGE      1993       1994       1995       1996       1997
----------------------------------------------------------

  1      0.0000     0.0000     0.0000     0.0000     0.0000
  2      0.4900     0.4900     0.4900     0.4900     0.4900
  3      0.9740     0.9740     0.9740     0.9740     0.9740
  4      1.0000     1.0000     1.0000     1.0000     1.0000
  5      1.0000     1.0000     1.0000     1.0000     1.0000
  6      1.0000     1.0000     1.0000     1.0000     1.0000


Maturity - Input Data


 AGE      1998       1999       2000       2001       2002
----------------------------------------------------------

  1      0.0000     0.0000     0.0000     0.0000     0.0000
  2      0.4900     0.4900     0.4900     0.4900     0.4900
  3      0.9740     0.9740     0.9740     0.9740     0.9740
  4      1.0000     1.0000     1.0000     1.0000     1.0000
  5      1.0000     1.0000     1.0000     1.0000     1.0000
  6      1.0000     1.0000     1.0000     1.0000     1.0000

 AGE      2003       2004       2005       2006       2007
----------------------------------------------------------

  1      0.0000     0.0000     0.0000     0.0000     0.0000
  2      0.4900     0.4900     0.4900     0.4900     0.4900
  3      0.9740     0.9740     0.9740     0.9740     0.9740
  4      1.0000     1.0000     1.0000     1.0000     1.0000
  5      1.0000     1.0000     1.0000     1.0000     1.0000
  6      1.0000     1.0000     1.0000     1.0000     1.0000
```

```
Input Partial Recruitment

  AGE

   1       0.0100
   2       0.1200
   3       0.5800
   4       1.0000
   5       1.0000


Input F-Plus Ratio

  YEAR

  1973       1.0000
  1974       1.0000
  1975       1.0000
  1976       1.0000
  1977       1.0000
  1978       1.0000
  1979       1.0000
  1980       1.0000
  1981       1.0000
  1982       1.0000
  1983       1.0000
  1984       1.0000
  1985       1.0000
  1986       1.0000
  1987       1.0000
  1988       1.0000
  1989       1.0000
  1990       1.0000
  1991       1.0000
  1992       1.0000
  1993       1.0000
  1994       1.0000
  1995       1.0000
  1996       1.0000
  1997       1.0000
  1998       1.0000
  1999       1.0000
  2000       1.0000
  2001       1.0000
  2002       1.0000
  2003       1.0000
  2004       1.0000
  2005       1.0000
  2006       1.0000
  2007       1.0000
```

```
SURVEY - INPUT DATA

INDEX            1           2           3           4           5

SURVEY TAG     NEFSC_W     NEFSC_W     NEFSC_W     NEFSC_W     NEFSC_W

AGE               1           2           3           4           5
TIME           JAN-1       JAN-1       JAN-1       JAN-1       JAN-1
TYPE          NUMBERS     NUMBERS     NUMBERS     NUMBERS     NUMBERS
RETRO FLAG       1           1           1           1           1
 ________________________________________________________________________

    1973       0.0000      0.0000      0.0000      0.0000      0.0000
    1974       0.0000      0.0000      0.0000      0.0000      0.0000
    1975       0.0000      0.0000      0.0000      0.0000      0.0000
    1976       0.0000      0.0000      0.0000      0.0000      0.0000
    1977       0.0000      0.0000      0.0000      0.0000      0.0000
    1978       0.0000      0.0000      0.0000      0.0000      0.0000
    1979       0.0000      0.0000      0.0000      0.0000      0.0000
    1980       0.0000      0.0000      0.0000      0.0000      0.0000
    1981       0.0000      0.0000      0.0000      0.0000      0.0000
    1982       0.0000      0.0000      0.0000      0.0000      0.0000
    1983       0.0000      0.0000      0.0000      0.0000      0.0000
    1984       0.0000      0.0000      0.0000      0.0000      0.0000
    1985       0.0000      0.0000      0.0000      0.0000      0.0000
    1986       0.0000      0.0000      0.0000      0.0000      0.0000
    1987       0.0000      0.0000      0.0000      0.0000      0.0000
    1988       0.0000      0.0000      0.0000      0.0000      0.0000
    1989       0.0000      0.0000      0.0000      0.0000      0.0000
    1990       0.0000      0.0000      0.0000      0.0000      0.0000
    1991       0.0000      0.0000      0.0000      0.0000      0.0000
    1992      13.7170   2098.7020   4591.9110  10616.2490   1235.3880
    1993     852.0260   2749.1170   1510.7280   3553.2770    417.3690
    1994     444.8030  10510.8000    901.3220   2009.1130   1173.5190
    1995     128.3110  15261.3140   3854.9080    853.1690    361.3570
    1996      58.1540   1835.7930  11767.1920   1216.5270    200.4680
    1997     222.7580   3400.9610  13981.6320   4226.8390    755.4360
    1998     168.8910  11203.2230   2280.3100   1654.6140    160.4600
    1999     347.0690   4155.9680  14540.0280   1109.9350    444.5170
    2000     155.1740   7025.3940   4294.7090   1658.0430    103.8780
    2001      40.1510   1278.6820  12204.8500   2307.4580    362.2150
    2002      17.2890   3907.7750   3683.5880   2924.8660    143.0280
    2003     473.8080    996.4830   3710.4510    756.1500     60.8690
    2004      72.1570   1373.8440    455.9480    841.5960    204.6120
    2005     559.3970   1112.7920    880.3180    741.8610    837.8810
    2006     993.9120  26771.0270   6512.5780    493.6690    127.3110
    2007      46.1520   9756.6500  10771.2800   1909.3790    135.1700
    2008       0.0000      0.0000      0.0000      0.0000      0.0000
```

```
 SURVEY - INPUT DATA

INDEX            6           7           8           9          10

SURVEY TAG     NEFSC_W     NEFSC_S     NEFSC_S     NEFSC_S     NEFSC_S

AGE                6           1           2           3           4
TIME           JAN-1       JAN-1       JAN-1       JAN-1       JAN-1
TYPE          NUMBERS     NUMBERS     NUMBERS     NUMBERS     NUMBERS
RETRO FLAG       1           1           1           1           1
 ________________________________________________________________________

    1973        0.0000    912.6700   5523.6480  15096.9030   8491.1200
    1974        0.0000    592.2910   2507.7110   2956.9430   5712.1650
    1975        0.0000    414.4700   1512.9830    454.9140    588.2800
    1976        0.0000     49.8030   4269.7100    580.0910    278.4300
    1977        0.0000   1572.9810   1642.1700   2881.7360    263.2220
    1978        0.0000   3105.5170  11899.1330   2109.7860    900.9710
    1979        0.0000    986.7060   2921.8460   1548.4130    278.2630
    1980        0.0000    708.6100   6520.0480   4418.4510   2786.1410
    1981        0.0000    849.1620  18261.4150   4743.5090   2497.5160
    1982        0.0000    340.0990  29950.6380   9722.8310   2437.8520
    1983        0.0000     66.3490  10831.8730  17948.5570   1220.1800
    1984        0.0000     78.3820    924.0340   1838.2080   4301.2960
    1985        0.0000    446.0570   2695.8930    677.8590    802.8690
    1986        0.0000     27.2410   4834.4250   1530.0290    395.2510
    1987        0.0000      0.0000    144.3960   1170.7110    278.4300
    1988        0.0000    476.4730    595.8010    208.0710    290.1290
    1989        0.0000    229.7970  15925.5080    761.9230    160.6070
    1990        0.0000    127.0150    689.5580  21804.6320   3115.7110
    1991        0.0000    346.4500    844.4830   3564.6090   5903.6910
    1992        0.0000     60.1650     84.7320    954.6180   2669.4880
    1993        0.0000     27.2410    423.3280    187.1800    827.1020
    1994      571.9710     22.3950    382.0480     23.2300      0.0000
    1995      286.7710     26.4060   1952.8560    114.1460    154.0890
    1996      136.7410      0.0000    664.3220   2178.1400    946.5960
    1997       53.5820     87.9080   1479.2230   1911.5760    546.1650
    1998       26.0050    113.4780   5040.4900    644.6010    269.2380
    1999      112.8800     59.3290   1087.1480   3225.5130    583.2660
    2000      142.4570     32.0880   1935.8090   2478.2970    355.1410
    2001      202.4690      0.0000    115.6510   1934.6390    400.5990
    2002       28.0060     81.5570   1990.2920    393.0780    333.9160
    2003       37.0070     51.6420    125.6780    339.4310    179.4920
    2004       62.1550     27.2410    227.1230    488.1720    169.4650
    2005      148.0290    245.5070    343.2750    161.4430    112.4750
    2006      205.0410     83.8970   2646.9260    374.3600    176.8180
    2007        0.0000      0.0000    962.9740   1320.6220    145.9000
    2008        0.0000      0.0000     83.0610   1144.8060    802.3670
```

```
 SURVEY - INPUT DATA

INDEX            11          12          13          14          15

SURVEY TAG     NEFSC_S     NEFSC_S     NEFSC_F     NEFSC_F     NEFSC_F

AGE                 5           6           1           2           3
TIME         JAN-1       JAN-1         MEAN        MEAN        MEAN
TYPE          NUMBERS     NUMBERS     NUMBERS     NUMBERS     NUMBERS
RETRO FLAG       1           1           0           0           0
 _________________________________________________________________________

    1973     6586.5630   9407.4660   2006.1030   2935.3990   5725.9300
    1974     3454.9750   3114.5420    949.6310   1735.0920    582.0020
    1975      866.0420   1020.2980   1994.1550    553.2810    180.0230
    1976      264.5590    499.8710   2752.2740   5892.5120    490.4390
    1977      164.7850    457.9230   2726.5400   1714.0680    618.0760
    1978      292.6360    483.1580   2477.5870   5684.2270    352.5790
    1979      121.1660     61.0010   1778.2880   3910.8790   1880.5350
    1980      274.4190    109.3000   1373.6670   3464.0950    901.6090
    1981      554.3540     94.7600  11330.7720  11315.2630   1490.7340
    1982      799.0250    273.5840   2858.5420  24940.2670   6155.2510
    1983      389.2340      0.0000   2691.1560  15806.6500   7839.9090
    1984      800.0270    456.0840   2023.7950   1786.5600   2142.9300
    1985     1192.9380    258.5420    848.7620    365.7900    106.0380
    1986      207.4020     26.4060    604.5190   1832.2840    511.1190
    1987        0.0000      0.0000   1226.3860    518.8160    411.9740
    1988      491.3480     48.1320   5019.8530    373.9470    153.2550
    1989        0.0000      0.0000    134.9890  10303.7100   1337.3640
    1990      112.4750      0.0000    240.7970   2089.2790   3043.2750
    1991      765.4330     85.2340    574.0750    237.2350   1480.2790
    1992        0.0000      0.0000    192.4310     27.4570     82.2570
    1993       28.5780      0.0000    324.4320     27.2270    126.9470
    1994       97.2670     27.2410    841.0650    514.4500    122.8110
    1995       31.2520    115.3160    159.6890    741.0010    295.4810
    1996      119.8290      0.0000    514.9100    184.7330    367.0540
    1997      112.1410      0.0000    944.6910    596.2480   1676.5010
    1998       60.6660     34.2610   1022.4670   1861.4640    141.8820
    1999      124.3410     38.2720   1422.1480    450.0000    320.5260
    2000        0.0000      0.0000     56.7530   1917.4130    348.0980
    2001      137.3770     38.2720    448.5070    701.7110    181.9760
    2002      111.8070      0.0000    291.2310   1977.9570    982.3720
    2003       54.1490      0.0000   1344.1420     28.4910    289.5080
    2004       58.4940     32.0880     80.6490    112.4710      0.0000
    2005      254.5310     26.4060   2031.1480    532.8320    212.8800
    2006        0.0000     52.8120   1369.9910   2472.0720    196.2220
    2007        0.0000      0.0000    257.4550   1286.3550    409.3310
    2008       82.3930      0.0000      0.0000      0.0000      0.0000
```

```
 SURVEY - INPUT DATA


INDEX            16          17          18

SURVEY TAG     NEFSC_F     NEFSC_F     NEFSC_F

AGE                4           5           6      NUMBERS     NUMBERS
TIME           MEAN        MEAN        MEAN       NUMBERS     NUMBERS
TYPE          NUMBERS     NUMBERS     NUMBERS     NUMBERS     NUMBERS
RETRO FLAG       0           0           0
 ________________________________________________________________________

    1973     3248.4580   2191.6410   1302.4390
    1974     2273.7830    962.8420    698.9540
    1975      290.3120    289.8520    146.4770
    1976       64.7950    102.2470    714.3480
    1977       93.7450     33.4310     92.8260
    1978      280.7760     28.6060     88.6900
    1979      286.5210     31.2480     30.3290
    1980      372.4540      0.0000      0.0000
    1981      235.3970    108.3360     57.7870
    1982      749.6180    301.8000      0.0000
    1983      642.3160     53.6510     37.1080
    1984      468.1520      0.0000      0.0000
    1985      103.1660      0.0000      0.0000
    1986      114.7690     39.7500      0.0000
    1987       34.5800     27.4570     27.4570
    1988      161.7570     15.1650     56.7530
    1989       70.7690      0.0000      0.0000
    1990      189.2140      0.0000      0.0000
    1991      358.0930      0.0000      0.0000
    1992      326.8450      0.0000      0.0000
    1993      101.2130      0.0000      0.0000
    1994      163.7100     60.6590     28.6060
    1995      132.5760      0.0000     60.5440
    1996        0.0000      0.0000      0.0000
    1997      311.4500     27.2270      0.0000
    1998       55.8340      0.0000     26.3080
    1999       32.0530     32.0530      0.0000
    2000      196.5660      0.0000     26.3080
    2001       81.5680      0.0000      0.0000
    2002      191.7410      0.0000      0.0000
    2003      263.1990      0.0000     56.9820
    2004       26.4230     55.0290     28.4910
    2005       84.3250    164.7440      0.0000
    2006       22.0580      0.0000      0.0000
    2007        0.0000     30.3290      0.0000
    2008        0.0000      0.0000      0.0000

     Additional Output Files

Population File L:\YELLOWTAILFLOUNDER\ASSESSMENTS\SNEMA\VPA\SNEMA_VPA_6PLUS_JULY
Auxilliary File L:\YELLOWTAILFLOUNDER\ASSESSMENTS\SNEMA\VPA\SNEMA_VPA_6PLUS_JULY
Covariance File L:\YELLOWTAILFLOUNDER\ASSESSMENTS\SNEMA\VPA\SNEMA_VPA_6PLUS_JULY
Residuals File  L:\YELLOWTAILFLOUNDER\ASSESSMENTS\SNEMA\VPA\SNEMA_VPA_6PLUS_JULY
Log File        L:\YELLOWTAILFLOUNDER\ASSESSMENTS\SNEMA\VPA\SNEMA_VPA_6PLUS_JULY
```

```
                          Estimation Results

JAN-1 Population Numbers


  AGE       1973        1974        1975        1976        1977
_____________________________________________________________________________

   1       42491.      10362.      31479.      14339.      49917.
   2       18128.      34590.       7707.      17773.      11547.
   3       29322.       9789.       3386.       2633.       8572.
   4       16834.      13316.       3074.       1096.       1101.
   5       11027.       6662.       4344.       1504.        604.
   6       13264.       6047.       3950.       3002.       1409.
====================================================================
Total     131067.      80766.      53939.      40348.      73150.

  AGE       1978        1979        1980        1981        1982
_____________________________________________________________________________

   1       53116.      30998.      43355.     136011.      62906.
   2       35899.      35657.      25194.      34588.     111322.
   3        4961.      16692.      11907.      11488.      21995.
   4        2670.       2127.       5943.       3880.       2697.
   5         449.        877.        795.       1473.        602.
   6         325.        262.        259.        243.        125.
====================================================================
Total      97420.      86614.      87453.     187683.     199647.

  AGE       1983        1984        1985        1986        1987
_____________________________________________________________________________

   1       16407.      18836.      20560.       7067.      14717.
   2       51350.      11031.      14955.      14815.       5369.
   3       59128.      24770.       3516.       5055.       3309.
   4        5292.      10637.       2772.        949.       1194.
   5         566.       1149.       1562.        532.        215.
   6         282.        361.        346.        223.         84.
====================================================================
Total     133026.      66784.      43711.      28641.      24888.

  AGE       1988        1989        1990        1991        1992
_____________________________________________________________________________

   1      121166.      17049.       8019.       4092.       2476.
   2       10612.      93879.      13937.       6392.       2948.
   3        1349.       6791.      58946.       9559.       3787.
   4         620.        625.       2575.      10656.       3224.
   5         164.         65.        105.        184.        350.
   6          39.          4.          6.         56.         21.
====================================================================
Total     133952.     118413.      83587.      30939.      12806.

  AGE       1993        1994        1995        1996        1997
_____________________________________________________________________________

   1        2223.       4434.       4288.       3465.       6904.
   2        1598.       1809.       3304.       3510.       2834.
   3        1118.        898.        721.       2369.       2406.
   4        1234.        515.        379.        413.        942.
   5         252.        379.         67.         57.        131.
   6           7.        110.         47.         53.         50.
====================================================================
Total       6432.       8144.       8806.       9866.      13268.
```

```
JAN-1 Population Numbers

  AGE       1998        1999        2000        2001        2002

   1        3624.       5372.       4192.       2428.       1133.
   2        5633.       2950.       4389.       3429.       1987.
   3        1884.       3298.       1987.       2779.       2442.
   4         629.        534.        739.        570.        781.
   5          83.        164.         79.        151.         50.
   6          49.         10.         19.         47.          2.
====================================================================
Total      11901.      12327.      11404.       9403.       6396.

  AGE       2003        2004        2005        2006        2007

   1        1326.       1666.      10877.       9408.       1170.
   2         926.       1084.       1360.       8846.       7686.
   3        1402.        619.        636.        910.       6961.
   4        1135.        617.        289.        326.        437.
   5         294.        621.        228.        103.        143.
   6          76.        246.        100.        134.         49.
====================================================================
Total       5158.       4852.      13491.      19728.      16446.

  AGE       2008

   1        9744.
   2         953.
   3        6071.
   4        5190.
   5         237.
   6         104.
====================================================================
Total      22299.
```

```
Fishing Mortality Calculated

   AGE       1973        1974        1975        1976        1977
 ------------------------------------------------------------------------

    1       0.0057      0.0960      0.3716      0.0166      0.1296
    2       0.4162      2.1240      0.8739      0.5291      0.6449
    3       0.5894      0.9584      0.9282      0.6721      0.9667
    4       0.7271      0.9201      0.5145      0.3962      0.6978
    5       0.7271      0.9201      0.5145      0.3962      0.6978
    6       0.7271      0.9201      0.5145      0.3962      0.6978

   AGE       1978        1979        1980        1981        1982
 ------------------------------------------------------------------------

    1       0.1985      0.0073      0.0259      0.0003      0.0030
    2       0.5658      0.8968      0.5853      0.2527      0.4327
    3       0.6466      0.8327      0.9212      1.2492      1.2246
    4       0.9127      0.7847      1.1947      1.6628      1.3615
    5       0.9127      0.7847      1.1947      1.6628      1.3615
    6       0.9127      0.7847      1.1947      1.6628      1.3615

   AGE       1983        1984        1985        1986        1987
 ------------------------------------------------------------------------

    1       0.1970      0.0307      0.1277      0.0749      0.1270
    2       0.5290      0.9433      0.8846      1.2989      1.1809
    3       1.5154      1.9902      1.1095      1.2431      1.4745
    4       1.3275      1.7185      1.4502      1.2835      1.7838
    5       1.3275      1.7185      1.4502      1.2835      1.7838
    6       1.3275      1.7185      1.4502      1.2835      1.7838

   AGE       1988        1989        1990        1991        1992
 ------------------------------------------------------------------------

    1       0.0552      0.0016      0.0268      0.1278      0.2379
    2       0.2464      0.2654      0.1771      0.3235      0.7699
    3       0.5694      0.7699      1.5105      0.8869      0.9209
    4       2.0563      1.5850      2.4359      3.2171      2.3499
    5       2.0563      1.5850      2.4359      3.2171      2.3499
    6       2.0563      1.5850      2.4359      3.2171      2.3499

   AGE       1993        1994        1995        1996        1997
 ------------------------------------------------------------------------

    1       0.0065      0.0942      0.0003      0.0010      0.0035
    2       0.3762      0.7196      0.1327      0.1775      0.2085
    3       0.5747      0.6632      0.3584      0.7219      1.1415
    4       0.9818      1.8382      1.6959      0.9443      2.2342
    5       0.9818      1.8382      1.6959      0.9443      2.2342
    6       0.9818      1.8382      1.6959      0.9443      2.2342


Fishing Mortality Calculated

   AGE       1998        1999        2000        2001        2002
 ------------------------------------------------------------------------

    1       0.0058      0.0021      0.0011      0.0001      0.0010
    2       0.3354      0.1949      0.2569      0.1393      0.1490
    3       1.0613      1.2962      1.0485      1.0689      0.5663
    4       1.1450      1.7099      1.3900      2.2271      0.7786
    5       1.1450      1.7099      1.3900      2.2271      0.7786
    6       1.1450      1.7099      1.3900      2.2271      0.7786
```

```
  AGE       2003        2004        2005        2006        2007
_____________________________________________________________________________

   1       0.0017      0.0027      0.0067      0.0022      0.0057
   2       0.2033      0.3334      0.2017      0.0397      0.0358
   3       0.6213      0.5607      0.4680      0.5331      0.0935
   4       0.4037      0.7969      0.8310      0.6269      0.4129
   5       0.4037      0.7969      0.8310      0.6269      0.4129
   6       0.4037      0.7969      0.8310      0.6269      0.4129


Average Fishing Mortality For Ages   4-  5

 Year      Average F   N Weighted  Biomass Wtd  Catch Wtd

_____________________________________________________________________________

 1973      0.7271      0.7271      0.7271      0.7271
 1974      0.9201      0.9201      0.9201      0.9201
 1975      0.5145      0.5145      0.5145      0.5145
 1976      0.3962      0.3962      0.3962      0.3962
 1977      0.6978      0.6978      0.6978      0.6978
 1978      0.9127      0.9127      0.9127      0.9127
 1979      0.7847      0.7847      0.7847      0.7847
 1980      1.1947      1.1947      1.1947      1.1947
 1981      1.6628      1.6628      1.6628      1.6628
 1982      1.3615      1.3615      1.3615      1.3615
 1983      1.3275      1.3275      1.3275      1.3275
 1984      1.7185      1.7185      1.7185      1.7185
 1985      1.4502      1.4502      1.4502      1.4502
 1986      1.2835      1.2835      1.2835      1.2835
 1987      1.7838      1.7838      1.7838      1.7838
 1988      2.0563      2.0563      2.0563      2.0563
 1989      1.5850      1.5850      1.5850      1.5850
 1990      2.4359      2.4359      2.4359      2.4359
 1991      3.2171      3.2171      3.2171      3.2171
 1992      2.3499      2.3499      2.3499      2.3499
 1993      0.9818      0.9818      0.9818      0.9818
 1994      1.8382      1.8382      1.8382      1.8382
 1995      1.6959      1.6959      1.6959      1.6959
 1996      0.9443      0.9443      0.9443      0.9443
 1997      2.2342      2.2342      2.2342      2.2342
 1998      1.1450      1.1450      1.1450      1.1450
 1999      1.7099      1.7099      1.7099      1.7099
 2000      1.3900      1.3900      1.3900      1.3900
 2001      2.2271      2.2271      2.2271      2.2271
 2002      0.7786      0.7786      0.7786      0.7786
 2003      0.4037      0.4037      0.4037      0.4037
 2004      0.7969      0.7969      0.7969      0.7969
 2005      0.8310      0.8310      0.8310      0.8310
 2006      0.6269      0.6269      0.6269      0.6269
 2007      0.4129      0.4129      0.4129      0.4129
```

```
Back Calculated Partial Recruitment

  AGE       1973        1974        1975        1976        1977
 ----------------------------------------------------------------------------

   1       0.0079      0.0452      0.4004      0.0247      0.1341
   2       0.5724      1.0000      0.9416      0.7872      0.6671
   3       0.8107      0.4512      1.0000      1.0000      1.0000
   4       1.0000      0.4332      0.5543      0.5894      0.7219
   5       1.0000      0.4332      0.5543      0.5894      0.7219
   6       1.0000      0.4332      0.5543      0.5894      0.7219

  AGE       1978        1979        1980        1981        1982
 ----------------------------------------------------------------------------

   1       0.2175      0.0082      0.0217      0.0002      0.0022
   2       0.6199      1.0000      0.4899      0.1520      0.3178
   3       0.7085      0.9285      0.7711      0.7513      0.8994
   4       1.0000      0.8750      1.0000      1.0000      1.0000
   5       1.0000      0.8750      1.0000      1.0000      1.0000
   6       1.0000      0.8750      1.0000      1.0000      1.0000

  AGE       1983        1984        1985        1986        1987
 ----------------------------------------------------------------------------

   1       0.1300      0.0154      0.0881      0.0577      0.0712
   2       0.3491      0.4740      0.6100      1.0000      0.6620
   3       1.0000      1.0000      0.7651      0.9570      0.8266
   4       0.8760      0.8635      1.0000      0.9882      1.0000
   5       0.8760      0.8635      1.0000      0.9882      1.0000
   6       0.8760      0.8635      1.0000      0.9882      1.0000

  AGE       1988        1989        1990        1991        1992
 ----------------------------------------------------------------------------

   1       0.0268      0.0010      0.0110      0.0397      0.1012
   2       0.1198      0.1674      0.0727      0.1006      0.3277
   3       0.2769      0.4857      0.6201      0.2757      0.3919
   4       1.0000      1.0000      1.0000      1.0000      1.0000
   5       1.0000      1.0000      1.0000      1.0000      1.0000
   6       1.0000      1.0000      1.0000      1.0000      1.0000

  AGE       1993        1994        1995        1996        1997
 ----------------------------------------------------------------------------

   1       0.0066      0.0513      0.0002      0.0010      0.0016
   2       0.3832      0.3915      0.0783      0.1880      0.0933
   3       0.5853      0.3608      0.2113      0.7645      0.5109
   4       1.0000      1.0000      1.0000      1.0000      1.0000
   5       1.0000      1.0000      1.0000      1.0000      1.0000
   6       1.0000      1.0000      1.0000      1.0000      1.0000
```

```
 Back Calculated Partial Recruitment

   AGE       1998        1999        2000        2001        2002
 ______________________________________________________________________________

    1       0.0051      0.0012      0.0008      0.0000      0.0013
    2       0.2929      0.1140      0.1848      0.0625      0.1914
    3       0.9269      0.7581      0.7543      0.4800      0.7273
    4       1.0000      1.0000      1.0000      1.0000      1.0000
    5       1.0000      1.0000      1.0000      1.0000      1.0000
    6       1.0000      1.0000      1.0000      1.0000      1.0000

   AGE       2003        2004        2005        2006        2007
 ______________________________________________________________________________

    1       0.0027      0.0033      0.0081      0.0036      0.0137
    2       0.3272      0.4184      0.2427      0.0633      0.0867
    3       1.0000      0.7036      0.5632      0.8504      0.2265
    4       0.6498      1.0000      1.0000      1.0000      1.0000
    5       0.6498      1.0000      1.0000      1.0000      1.0000
    6       0.6498      1.0000      1.0000      1.0000      1.0000


JAN-1 Biomass

   AGE       1973        1974        1975        1976        1977
 ______________________________________________________________________________

    1        7368.       1763.       5820.       2934.       9195.
    2        4920.       8796.       1867.       4568.       2933.
    3        9565.       3160.       1152.        904.       2913.
    4        5835.       4943.       1199.        474.        499.
    5        4174.       2703.       1803.        699.        305.
    6        5677.       2764.       1900.       1672.        764.
 ===================================================================
 Total      37538.      24128.      13741.      11251.      16609.

   AGE       1978        1979        1980        1981        1982
 ______________________________________________________________________________

    1       10958.       4805.       7921.      13887.      13229.
    2        9011.       9463.       5807.       8035.      21363.
    3        1633.       5452.       4048.       3561.       6689.
    4        1206.        907.       2535.       1655.       1114.
    5         259.        493.        452.        804.        337.
    6         213.        174.        240.        158.        104.
 ===================================================================
 Total      23280.      21294.      21004.      28100.      42835.

   AGE       1983        1984        1985        1986        1987
 ______________________________________________________________________________

    1        2468.       2869.       3020.       1095.       3338.
    2       12473.       2247.       3253.       3378.       1199.
    3       17656.       6874.       1034.       1483.       1048.
    4        2214.       3858.        961.        390.        437.
    5         327.        565.        691.        260.        106.
    6         231.        237.        211.        143.         53.
 ===================================================================
 Total      35368.      16649.       9170.       6750.       6180.

   AGE       1988        1989        1990        1991        1992
 ______________________________________________________________________________

    1       29237.       5171.       2587.        680.        284.
```

```
   2        2855.      28361.       4444.       1795.        752.
   3         440.       2308.      21067.       3173.       1176.
   4         259.        293.       1090.       4215.       1233.
   5          82.         39.         68.        102.        174.
   6          32.          4.          5.         45.         19.
====================================================================
Total      32904.      36175.      29262.      10012.       3638.

  AGE       1993        1994        1995        1996        1997
_____________________________________________________________________________

   1         213.        401.        141.        234.       1098.
   2         389.        281.        552.        552.        463.
   3         412.        318.        191.        697.        895.
   4         503.        218.        150.        169.        416.
   5         133.        181.         33.         30.         73.
   6           7.         74.         40.         39.         42.
====================================================================
Total       1656.       1472.       1109.       1720.       2987.


JAN-1 Biomass


  AGE       1998        1999        2000        2001        2002
_____________________________________________________________________________

   1         415.        814.        373.        238.        129.
   2        1306.        726.       1158.        800.        475.
   3         588.       1144.        826.       1093.       1033.
   4         287.        258.        383.        309.        413.
   5          45.        104.         53.        103.         36.
   6          34.         12.         17.         43.          2.
====================================================================
Total       2677.       3058.       2810.       2585.       2087.

  AGE       2003        2004        2005        2006        2007
_____________________________________________________________________________

   1          74.        192.        641.        730.        100.
   2         222.        194.        295.       1384.       1380.
   3         566.        231.        234.        311.       2172.
   4         615.        286.        133.        155.        194.
   5         186.        371.        131.         62.         89.
   6          64.        183.         84.        114.         42.
====================================================================
Total       1727.       1457.       1518.       2755.       3978.

  AGE       2008
_____________________________________________________________________________

   1         721.
   2         176.
   3        2066.
   4        2385.
   5         142.
   6          88.
====================================================================
Total       5578.
```

```
Mean Biomass

  AGE       1973        1974        1975        1976        1977
_____________________________________________________________________________

   1        8065.       1821.       5227.       2940.       9143.
   2        4006.       4135.       1365.       3823.       2206.
   3        7056.       2041.        763.        717.       1928.
   4        4115.       3172.        949.        411.        366.
   5        2746.       1759.       1350.        566.        204.
   6        3700.       1662.       1358.       1260.        504.
====================================================================
Total      29688.      14590.      11012.       9716.      14351.

  AGE       1978        1979        1980        1981        1982
_____________________________________________________________________________

   1       10251.       5291.       7994.      17256.      12867.
   2        7349.       6518.       4904.       7288.      21695.
   3        1282.       3789.       2749.       2075.       4139.
   4         863.        643.       1602.        834.        681.
   5         179.        329.        292.        398.        201.
   6         129.        111.        129.         72.         53.
====================================================================
Total      20053.      16680.      17672.      27922.      39636.

  AGE       1983        1984        1985        1986        1987
_____________________________________________________________________________

   1        2370.       3061.       3208.       1149.       3101.
   2        9516.       1558.       2373.       2180.        780.
   3        9583.       2963.        716.        886.        567.
   4        1345.       1835.        554.        229.        210.
   5         194.        249.        385.        163.         49.
   6         118.        105.        103.         75.         23.
====================================================================
Total      23126.       9772.       7339.       4681.       4729.

  AGE       1988        1989        1990        1991        1992
_____________________________________________________________________________

   1       28875.       4802.       2160.        719.        335.
   2        2508.      25371.       3797.       1304.        596.
   3         373.       1713.      10671.       1964.        838.
   4         121.        161.        413.       1249.        506.
   5          40.         22.         28.         35.         76.
   6          13.          2.          2.         13.          7.
====================================================================
Total      31929.      32071.      17070.       5283.       2358.

  AGE       1993        1994        1995        1996        1997
_____________________________________________________________________________

   1         245.        472.        280.        330.       1199.
   2         430.        234.        638.       1006.        591.
   3         334.        212.        197.        590.        532.
   4         327.         91.         76.        115.        181.
   5          95.         81.         18.         21.         33.
   6           4.         31.         18.         23.         16.
====================================================================
Total       1435.       1123.       1226.       2084.       2552.
```

```
Mean Biomass

  AGE       1998        1999        2000        2001        2002
_____________________________________________________________________________

   1         550.        973.        547.        337.        169.
   2        1221.        880.       1226.       1099.        627.
   3         411.        735.        544.        699.        807.
   4         179.        145.        231.        132.        313.
   5          27.         56.         30.         43.         27.
   6          19.          5.          8.         16.          1.
====================================================================
Total       2407.       2794.       2585.       2325.       1944.

  AGE       2003        2004        2005        2006        2007
_____________________________________________________________________________

   1         120.        238.        943.       1005.        131.
   2         265.        269.        334.       2006.       1869.
   3         417.        175.        196.        252.       2304.
   4         528.        192.         95.        118.        164.
   5         141.        226.         95.         47.         79.
   6          48.        116.         53.         77.         32.
====================================================================
Total       1519.       1216.       1716.       3506.       4579.


Spawning Stock Biomass

  AGE       1973        1974        1975        1976        1977
_____________________________________________________________________________

   1           0.          0.          0.          0.          0.
   2        1876.       1982.        698.       1947.       1126.
   3        7852.       2071.        775.        728.       1956.
   4        5731.       3306.        986.        426.        382.
   5        5523.       1834.       1403.        586.        213.
   6        7833.       1733.       1411.       1304.        525.
====================================================================
Total      28815.      10926.       5272.       4991.       4203.

  AGE       1978        1979        1980        1981        1982
_____________________________________________________________________________

   1           0.          0.          0.          0.          0.
   2        3746.       3330.       2501.       3677.      11021.
   3        1300.       3848.       2791.       2092.       4177.
   4         900.        670.       1662.        846.        702.
   5         187.        343.        303.        404.        207.
   6         134.        115.        134.         73.         54.
====================================================================
Total       6267.       8307.       7391.       7092.      16162.

  AGE       1983        1984        1985        1986        1987
_____________________________________________________________________________

   1           0.          0.          0.          0.          0.
   2        4847.        796.       1212.       1104.        397.
   3        9553.       2857.        724.        893.        566.
   4        1389.       1856.        569.        237.        211.
   5         200.        252.        396.        168.         49.
   6         122.        107.        106.         77.         23.
====================================================================
Total      16111.       5866.       3007.       2480.       1246.
```

```
  AGE       1988        1989        1990        1991        1992
______________________________________________________________________________

   1           0.          0.          0.          0.          0.
   2        1265.      12807.       1908.        660.        305.
   3         378.       1740.      10640.       1995.        851.
   4         119.        164.        391.       1062.        484.
   5          39.         23.         27.         30.         72.
   6          13.          2.          2.         11.          7.
====================================================================
Total       1814.      14736.      12968.       3758.       1718.

  AGE       1993        1994        1995        1996        1997
______________________________________________________________________________

   1           0.          0.          0.          0.          0.
   2         218.        120.        320.        505.        298.
   3         339.        216.        198.        599.        539.
   4         340.         92.         77.        120.        175.
   5          99.         82.         18.         22.         32.
   6           4.         32.         18.         24.         15.
====================================================================
Total       1000.        540.        631.       1270.       1058.


Spawning Stock Biomass


  AGE       1998        1999        2000        2001        2002
______________________________________________________________________________

   1           0.          0.          0.          0.          0.
   2         618.        443.        619.        551.        315.
   3         417.        740.        551.        708.        818.
   4         186.        147.        238.        127.        326.
   5          28.         57.         30.         41.         28.
   6          19.          5.          9.         16.          1.
====================================================================
Total       1268.       1392.       1447.       1444.       1488.

  AGE       2003        2004        2005        2006        2007
______________________________________________________________________________

   1           0.          0.          0.          0.          0.
   2         133.        136.        168.       1000.        932.
   3         423.        177.        198.        255.       2292.
   4         547.        201.         99.        123.        170.
   5         146.        236.         99.         49.         81.
   6          50.        121.         55.         81.         33.
====================================================================
Total       1299.        870.        619.       1509.       3508.
```

```
Catch Biomass

  AGE       1973        1974        1975        1976        1977
_____________________________________________________________________________

   1          46.        175.       1942.         49.       1185.
   2        1667.       8784.       1193.       2023.       1423.
   3        4159.       1956.        708.        482.       1863.
   4        2992.       2919.        488.        163.        256.
   5        1996.       1619.        695.        224.        143.
   6        2690.       1530.        698.        499.        352.
====================================================================
Total      13551.      16981.       5725.       3440.       5221.

  AGE       1978        1979        1980        1981        1982
_____________________________________________________________________________

   1        2035.         39.        207.          5.         38.
   2        4158.       5845.       2870.       1842.       9388.
   3         829.       3155.       2532.       2592.       5068.
   4         788.        504.       1914.       1387.        927.
   5         164.        258.        349.        662.        274.
   6         117.         87.        154.        119.         72.
====================================================================
Total       8091.       9888.       8028.       6607.      15767.

  AGE       1983        1984        1985        1986        1987
_____________________________________________________________________________

   1         467.         94.        410.         86.        394.
   2        5034.       1469.       2099.       2831.        921.
   3       14522.       5897.        794.       1101.        836.
   4        1786.       3154.        803.        294.        374.
   5         257.        428.        559.        209.         87.
   6         157.        181.        150.         96.         41.
====================================================================
Total      22223.      11223.       4814.       4617.       2653.

  AGE       1988        1989        1990        1991        1992
_____________________________________________________________________________

   1        1593.          7.         58.         92.         80.
   2         618.       6733.        672.        422.        459.
   3         212.       1319.      16119.       1742.        772.
   4         249.        255.       1005.       4017.       1189.
   5          82.         35.         69.        114.        178.
   6          26.          3.          4.         41.         17.
====================================================================
Total       2781.       8353.      17928.       6427.       2694.

  AGE       1993        1994        1995        1996        1997
_____________________________________________________________________________

   1           2.         45.          0.          0.          4.
   2         162.        168.         85.        179.        123.
   3         192.        141.         70.        426.        608.
   4         321.        168.        128.        109.        404.
   5          93.        150.         30.         20.         73.
   6           4.         58.         31.         22.         35.
====================================================================
Total        773.        729.        345.        755.       1248.
```

```
Catch Biomass

  AGE       1998        1999        2000        2001        2002
_____________________________________________________________________________

   1           3.           2.           1.           0.           0.
   2         410.         171.         315.         153.          94.
   3         436.         953.         570.         747.         457.
   4         206.         248.         321.         293.         244.
   5          31.          96.          41.          95.          21.
   6          21.           9.          12.          36.           1.
====================================================================
Total       1107.        1480.        1259.        1324.         816.

  AGE       2003        2004        2005        2006        2007
_____________________________________________________________________________

   1           0.           1.           6.           2.           1.
   2          54.          90.          67.          80.          67.
   3         259.          98.          92.         135.         215.
   4         213.         153.          79.          74.          68.
   5          57.         180.          79.          30.          32.
   6          19.          92.          44.          49.          13.
====================================================================
Total        603.         614.         367.         369.         396.


Catch Numbers

  AGE       1973        1974        1975        1976        1977
_____________________________________________________________________________

   1        220.0        861.0       8910.0        214.0       5513.0
   2       5632.0      28519.0       4129.0       6677.0       5027.0
   3      11951.0       5556.0       1884.0       1181.0       4891.0
   4       7978.0       7370.0       1130.0        327.0        507.0
   5       5226.0       3687.0       1597.0        449.0        278.0
   6       6286.0       3347.0       1452.0        896.0        649.0
====================================================================
Total     37293.0      49340.0      19102.0       9744.0      16865.0

  AGE       1978        1979        1980        1981        1982
_____________________________________________________________________________

   1       8698.0        205.0       1006.0         38.0        169.0
   2      14191.0      19419.0      10215.0       7029.0      35696.0
   3       2164.0       8667.0       6595.0       7578.0      14358.0
   4       1470.0       1062.0       3829.0       2926.0       1858.0
   5        247.0        438.0        512.0       1111.0        415.0
   6        179.0        131.0        167.0        183.0         86.0
====================================================================
Total     26949.0      29922.0      22324.0      18865.0      52582.0

  AGE       1983        1984        1985        1986        1987
_____________________________________________________________________________

   1       2668.0        517.0       2239.0        463.0       1594.0
   2      19288.0       6200.0       8074.0       9970.0       3437.0
   3      42837.0      19990.0       2175.0       3326.0       2368.0
   4       3601.0       8129.0       1968.0        635.0        926.0
   5        385.0        878.0       1109.0        356.0        167.0
   6        192.0        276.0        246.0        149.0         65.0
====================================================================
Total     68971.0      35990.0      15811.0      14899.0       8557.0
```

```
  AGE       1988        1989        1990        1991        1992
_____________________________________________________________________________

   1       5899.0        24.0       192.0       446.0       477.0
   2       2109.0     19920.0      2056.0      1610.0      1453.0
   3        536.0      3347.0     42644.0      5169.0      2097.0
   4        506.0       462.0      2209.0      9703.0      2739.0
   5        134.0        48.0        90.0       168.0       297.0
   6         32.0         3.0         5.0        51.0        18.0
====================================================================
Total      9216.0     23804.0     47196.0     17147.0      7081.0
  AGE       1993        1994        1995        1996        1997
_____________________________________________________________________________

   1         13.0       362.0         1.0         3.0        22.0
   2        457.0       851.0       373.0       519.0       485.0
   3        447.0       399.0       198.0      1117.0      1512.0
   4        711.0       404.0       288.0       232.0       789.0
   5        145.0       297.0        51.0        32.0       110.0
   6          4.0        86.0        36.0        30.0        42.0
====================================================================
Total      1777.0      2399.0       947.0      1933.0      2960.0


Catch Numbers


  AGE       1998        1999        2000        2001        2002
_____________________________________________________________________________

   1         19.0        10.0         4.0         0.0         1.0
   2       1463.0       475.0       905.0       405.0       250.0
   3       1136.0      2217.0      1190.0      1683.0       966.0
   4        396.0       407.0       514.0       477.0       388.0
   5         52.0       125.0        55.0       126.0        25.0
   6         31.0         8.0        13.0        39.0         1.0
====================================================================
Total      3097.0      3242.0      2681.0      2730.0      1631.0
  AGE       2003        2004        2005        2006        2007
_____________________________________________________________________________

   1          2.0         4.0        66.0        19.0         6.0
   2        155.0       280.0       226.0       312.0       245.0
   3        594.0       243.0       217.0       344.0       564.0
   4        344.0       311.0       150.0       139.0       135.0
   5         89.0       313.0       118.0        44.0        44.0
   6         23.0       124.0        52.0        57.0        15.0
====================================================================
Total      1207.0      1275.0       829.0       915.0      1009.0
```

```
Surplus Production

Average Adjustment Factor (Delta) =   1.0000

 Year        Biomass  Delta Biomass  Catch Biomass  Surplus Production

 1973      37538.414     -13410.443      13550.710        140.267
 1974      24127.971     -10387.375      16981.039       6593.664
 1975      13740.596      -2489.861       5725.312       3235.451
 1976      11250.735       5357.928       3439.740       8797.668
 1977      16608.663       6671.761       5221.307      11893.068
 1978      23280.425      -1986.343       8090.965       6104.622
 1979      21294.082       -289.976       9888.244       9598.268
 1980      21004.106       7096.031       8028.290      15124.321
 1981      28100.138      14735.348       6606.624      21341.972
 1982      42835.486      -7467.205      15767.296       8300.091
 1983      35368.281     -18719.190      22223.335       3504.145
 1984      16649.091      -7479.310      11223.238       3743.928
 1985       9169.781      -2419.701       4814.300       2394.599
 1986       6750.080       -570.480       4617.139       4046.659
 1987       6179.600      26724.703       2652.697      29377.400
 1988      32904.303       3270.575       2780.527       6051.102
 1989      36174.879      -6912.690       8352.779       1440.089
 1990      29262.189     -19250.658      17927.721      -1322.937
 1991      10011.531      -6373.294       6427.395         54.101
 1992       3638.237      -1981.873       2693.656        711.783
 1993       1656.364       -184.511        773.340        588.829
 1994       1471.854       -363.330        729.415        366.085
 1995       1108.524        611.855        344.690        956.545
 1996       1720.379       1266.733        754.872       2021.605
 1997       2987.111       -310.526       1247.678        937.152
 1998       2676.586        381.778       1106.587       1488.365
 1999       3058.364       -248.852       1479.685       1230.833
 2000       2809.512       -224.160       1259.460       1035.300
 2001       2585.352       -498.293       1323.861        825.568
 2002       2087.059       -360.390        815.994        455.604
 2003       1726.669       -270.103        602.578        332.475
 2004       1456.566         61.383        614.028        675.411
 2005       1517.950       1237.421        367.132       1604.553
 2006       2755.370       1222.253        368.796       1591.049
 2007       3977.623       1600.631        396.175       1996.806
 2008       5578.254


 Summary of Survey Indices Used in the Estimate

 INDEX    Survey Tag    Age   Time  Type  Catchability Std. Error   CV
 ___________________________________________________________________________

   1         NEFSC_W     1   JAN-1 NUMBER  0.4537E-01  0.1252E-01  0.2759E+00
   2         NEFSC_W     2   JAN-1 NUMBER  0.1426E+01  0.2589E+00  0.1816E+00
   3         NEFSC_W     3   JAN-1 NUMBER  0.2292E+01  0.4184E+00  0.1825E+00
   4         NEFSC_W     4   JAN-1 NUMBER  0.2548E+01  0.3202E+00  0.1256E+00
   5         NEFSC_W     5   JAN-1 NUMBER  0.1895E+01  0.4393E+00  0.2318E+00
   6         NEFSC_W     6   JAN-1 NUMBER  0.2341E+01  0.8269E+00  0.3533E+00
   7         NEFSC_S     1   JAN-1 NUMBER  0.1420E-01  0.2378E-02  0.1675E+00
   8         NEFSC_S     2   JAN-1 NUMBER  0.1830E+00  0.2739E-01  0.1497E+00
   9         NEFSC_S     3   JAN-1 NUMBER  0.2834E+00  0.3699E-01  0.1305E+00
  10         NEFSC_S     4   JAN-1 NUMBER  0.4193E+00  0.4354E-01  0.1038E+00
  11         NEFSC_S     5   JAN-1 NUMBER  0.5500E+00  0.9534E-01  0.1733E+00
  12         NEFSC_S     6   JAN-1 NUMBER  0.5684E+00  0.1139E+00  0.2004E+00
  13         NEFSC_F     1   MEAN  NUMBER  0.1006E+00  0.1591E-01  0.1582E+00
  14         NEFSC_F     2   MEAN  NUMBER  0.1756E+00  0.2861E-01  0.1629E+00
  15         NEFSC_F     3   MEAN  NUMBER  0.1996E+00  0.2466E-01  0.1235E+00
  16         NEFSC_F     4   MEAN  NUMBER  0.2170E+00  0.2819E-01  0.1299E+00
  17         NEFSC_F     5   MEAN  NUMBER  0.2218E+00  0.4204E-01  0.1895E+00
  18         NEFSC_F     6   MEAN  NUMBER  0.4497E+00  0.1327E+00  0.2951E+00
```

```
Survey Index:    1 Tag:         NEFSC_W  AGE =  1
Time = JAN-1           Type = NUMBER
Catchability =    0.453675E-01   % Variance Contribution =     5.4089
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_____________________________________________________________________________

1973     N/A              0.192771E+04     N/A
1974     N/A              0.470100E+03     N/A
1975     N/A              0.142810E+04     N/A
1976     N/A              0.650540E+03     N/A
1977     N/A              0.226462E+04     N/A
1978     N/A              0.240976E+04     N/A
1979     N/A              0.140629E+04     N/A
1980     N/A              0.196693E+04     N/A
1981     N/A              0.617046E+04     N/A
1982     N/A              0.285388E+04     N/A
1983     N/A              0.744357E+03     N/A
1984     N/A              0.854531E+03     N/A
1985     N/A              0.932740E+03     N/A
1986     N/A              0.320631E+03     N/A
1987     N/A              0.667675E+03     N/A
1988     N/A              0.549700E+04     N/A
1989     N/A              0.773458E+03     N/A
1990     N/A              0.363809E+03     N/A
1991     N/A              0.185634E+03     N/A
1992     0.137170E+02     0.112338E+03    -0.210287E+01
1993     0.852026E+03     0.100864E+03     0.213385E+01
1994     0.444803E+03     0.201161E+03     0.793525E+00
1995     0.128311E+03     0.194525E+03    -0.416101E+00
1996     0.581540E+02     0.157190E+03    -0.994359E+00
1997     0.222758E+03     0.313234E+03    -0.340865E+00
1998     0.168891E+03     0.164389E+03     0.270156E-01
1999     0.347069E+03     0.243692E+03     0.353620E+00
2000     0.155174E+03     0.190190E+03    -0.203478E+00
2001     0.401510E+02     0.110133E+03    -0.100904E+01
2002     0.172890E+02     0.513845E+02    -0.108927E+01
2003     0.473808E+03     0.601433E+02     0.206407E+01
2004     0.721570E+02     0.755879E+02    -0.464525E-01
2005     0.559397E+03     0.493481E+03     0.125375E+00
2006     0.993912E+03     0.426833E+03     0.845255E+00
2007     0.461520E+02     0.531019E+02    -0.140272E+00
2008     N/A              0.000000E+00     N/A
```

```
Survey Index:    2 Tag:         NEFSC_W  AGE =  2
 Time = JAN-1           Type = NUMBER
 Catchability =    0.142556E+01   % Variance Contribution =     2.3443
 Residual = LN(Observed) - LN(Predicted)

 Year      Observed        Predicted         Residual
 _____________________________________________________________________________

 1973     N/A              0.258425E+05     N/A
 1974     N/A              0.493104E+05     N/A
 1975     N/A              0.109871E+05     N/A
 1976     N/A              0.253369E+05     N/A
 1977     N/A              0.164607E+05     N/A
 1978     N/A              0.511770E+05     N/A
 1979     N/A              0.508310E+05     N/A
 1980     N/A              0.359151E+05     N/A
 1981     N/A              0.493075E+05     N/A
 1982     N/A              0.158696E+06     N/A
 1983     N/A              0.732033E+05     N/A
 1984     N/A              0.157253E+05     N/A
 1985     N/A              0.213188E+05     N/A
 1986     N/A              0.211191E+05     N/A
 1987     N/A              0.765328E+04     N/A
 1988     N/A              0.151287E+05     N/A
 1989     N/A              0.133830E+06     N/A
 1990     N/A              0.198676E+05     N/A
 1991     N/A              0.911244E+04     N/A
 1992     0.209870E+04     0.420261E+04    -0.694388E+00
 1993     0.274912E+04     0.227824E+04     0.187877E+00
 1994     0.105108E+05     0.257814E+04     0.140533E+01
 1995     0.152613E+05     0.470977E+04     0.117568E+01
 1996     0.183579E+04     0.500318E+04    -0.100260E+01
 1997     0.340096E+04     0.404011E+04    -0.172213E+00
 1998     0.112032E+05     0.803014E+04     0.333000E+00
 1999     0.415597E+04     0.420473E+04    -0.116635E-01
 2000     0.702539E+04     0.625649E+04     0.115911E+00
 2001     0.127868E+04     0.488781E+04    -0.134091E+01
 2002     0.390778E+04     0.283308E+04     0.321604E+00
 2003     0.996483E+03     0.132066E+04    -0.281657E+00
 2004     0.137384E+04     0.154471E+04    -0.117224E+00
 2005     0.111279E+04     0.193947E+04    -0.555545E+00
 2006     0.267710E+05     0.126106E+05     0.752779E+00
 2007     0.975665E+04     0.109565E+05    -0.115986E+00
 2008     N/A              0.135841E+04     N/A
```

```
Survey Index:    3 Tag:         NEFSC_W  AGE =  3
 Time = JAN-1           Type = NUMBER
 Catchability =    0.229197E+01   % Variance Contribution =     2.3680
 Residual = LN(Observed) - LN(Predicted)

 Year      Observed        Predicted         Residual
 ____________________________________________________________________________

 1973     N/A              0.672061E+05     N/A
 1974     N/A              0.224367E+05     N/A
 1975     N/A              0.775984E+04     N/A
 1976     N/A              0.603540E+04     N/A
 1977     N/A              0.196478E+05     N/A
 1978     N/A              0.113698E+05     N/A
 1979     N/A              0.382577E+05     N/A
 1980     N/A              0.272906E+05     N/A
 1981     N/A              0.263301E+05     N/A
 1982     N/A              0.504128E+05     N/A
 1983     N/A              0.135519E+06     N/A
 1984     N/A              0.567731E+05     N/A
 1985     N/A              0.805941E+04     N/A
 1986     N/A              0.115863E+05     N/A
 1987     N/A              0.758495E+04     N/A
 1988     N/A              0.309295E+04     N/A
 1989     N/A              0.155656E+05     N/A
 1990     N/A              0.135103E+06     N/A
 1991     N/A              0.219079E+05     N/A
 1992     0.459191E+04     0.867943E+04    -0.636660E+00
 1993     0.151073E+04     0.256152E+04    -0.528010E+00
 1994     0.901322E+03     0.205861E+04    -0.825924E+00
 1995     0.385491E+04     0.165250E+04     0.847059E+00
 1996     0.117672E+05     0.542902E+04     0.773556E+00
 1997     0.139816E+05     0.551443E+04     0.930376E+00
 1998     0.228031E+04     0.431742E+04    -0.638346E+00
 1999     0.145400E+05     0.755808E+04     0.654289E+00
 2000     0.429471E+04     0.455452E+04    -0.587366E-01
 2001     0.122049E+05     0.636984E+04     0.650259E+00
 2002     0.368359E+04     0.559737E+04    -0.418409E+00
 2003     0.371045E+04     0.321293E+04     0.143970E+00
 2004     0.455948E+03     0.141859E+04    -0.113504E+01
 2005     0.880318E+03     0.145683E+04    -0.503732E+00
 2006     0.651258E+04     0.208663E+04     0.113818E+01
 2007     0.107713E+05     0.159541E+05    -0.392836E+00
 2008     N/A              0.139154E+05     N/A
```

```
Survey Index:    4 Tag:         NEFSC_W  AGE =  4
Time = JAN-1           Type = NUMBER
Catchability =    0.254824E+01   % Variance Contribution =     1.1217
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_____________________________________________________________________________

1973     N/A             0.428976E+05     N/A
1974     N/A             0.339324E+05     N/A
1975     N/A             0.783276E+04     N/A
1976     N/A             0.279211E+04     N/A
1977     N/A             0.280526E+04     N/A
1978     N/A             0.680259E+04     N/A
1979     N/A             0.542113E+04     N/A
1980     N/A             0.151450E+05     N/A
1981     N/A             0.988786E+04     N/A
1982     N/A             0.687201E+04     N/A
1983     N/A             0.134863E+05     N/A
1984     N/A             0.271054E+05     N/A
1985     N/A             0.706274E+04     N/A
1986     N/A             0.241902E+04     N/A
1987     N/A             0.304274E+04     N/A
1988     N/A             0.158034E+04     N/A
1989     N/A             0.159316E+04     N/A
1990     N/A             0.656137E+04     N/A
1991     N/A             0.271535E+05     N/A
1992     0.106162E+05     0.821519E+04     0.256401E+00
1993     0.355328E+04     0.314572E+04     0.121829E+00
1994     0.200911E+04     0.131246E+04     0.425792E+00
1995     0.853169E+03     0.965426E+03    -0.123612E+00
1996     0.121653E+04     0.105115E+04     0.146113E+00
1997     0.422684E+04     0.240103E+04     0.565555E+00
1998     0.165461E+04     0.160300E+04     0.316914E-01
1999     0.110993E+04     0.135983E+04    -0.203057E+00
2000     0.165804E+04     0.188205E+04    -0.126724E+00
2001     0.230746E+04     0.145295E+04     0.462552E+00
2002     0.292487E+04     0.199096E+04     0.384631E+00
2003     0.756150E+03     0.289221E+04    -0.134154E+01
2004     0.841596E+03     0.157126E+04    -0.624334E+00
2005     0.741861E+03     0.737102E+03     0.643498E-02
2006     0.493669E+03     0.830453E+03    -0.520106E+00
2007     0.190938E+04     0.111450E+04     0.538370E+00
2008     N/A             0.132264E+05     N/A
```

```
Survey Index:    5 Tag:         NEFSC_W  AGE =  5
Time = JAN-1          Type = NUMBER
Catchability =    0.189483E+01   % Variance Contribution =     3.8196
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_____________________________________________________________________________

1973     N/A              0.208949E+05     N/A
1974     N/A              0.126227E+05     N/A
1975     N/A              0.823138E+04     N/A
1976     N/A              0.285077E+04     N/A
1977     N/A              0.114378E+04     N/A
1978     N/A              0.849935E+03     N/A
1979     N/A              0.166254E+04     N/A
1980     N/A              0.150586E+04     N/A
1981     N/A              0.279173E+04     N/A
1982     N/A              0.114135E+04     N/A
1983     N/A              0.107217E+04     N/A
1984     N/A              0.217693E+04     N/A
1985     N/A              0.295945E+04     N/A
1986     N/A              0.100843E+04     N/A
1987     N/A              0.408039E+03     N/A
1988     N/A              0.311198E+03     N/A
1989     N/A              0.123081E+03     N/A
1990     N/A              0.198780E+03     N/A
1991     N/A              0.349591E+03     N/A
1992     0.123539E+04     0.662390E+03     0.623286E+00
1993     0.417369E+03     0.477034E+03    -0.133617E+00
1994     0.117352E+04     0.717450E+03     0.492058E+00
1995     0.361357E+03     0.127124E+03     0.104470E+01
1996     0.200468E+03     0.107810E+03     0.620284E+00
1997     0.755436E+03     0.248912E+03     0.111020E+01
1998     0.160460E+03     0.156521E+03     0.248534E-01
1999     0.444517E+03     0.310550E+03     0.358643E+00
2000     0.103878E+03     0.149748E+03    -0.365740E+00
2001     0.362215E+03     0.285387E+03     0.238392E+00
2002     0.143028E+03     0.953900E+02     0.405067E+00
2003     0.608690E+02     0.556407E+03    -0.221278E+01
2004     0.204612E+03     0.117588E+04    -0.174866E+01
2005     0.837881E+03     0.431172E+03     0.664370E+00
2006     0.127311E+03     0.195472E+03    -0.428785E+00
2007     0.135170E+03     0.270104E+03    -0.692275E+00
2008     N/A              0.449007E+03     N/A
```

```
Survey Index:    6 Tag:         NEFSC_W  AGE =  6
Time = JAN-1           Type = NUMBER
Catchability =    0.234050E+01   % Variance Contribution =     5.7652
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_____________________________________________________________________________

1973     N/A              0.310444E+05     N/A
1974     N/A              0.141538E+05     N/A
1975     N/A              0.924425E+04     N/A
1976     N/A              0.702686E+04     N/A
1977     N/A              0.329821E+04     N/A
1978     N/A              0.760815E+03     N/A
1979     N/A              0.614194E+03     N/A
1980     N/A              0.606693E+03     N/A
1981     N/A              0.568000E+03     N/A
1982     N/A              0.292150E+03     N/A
1983     N/A              0.660450E+03     N/A
1984     N/A              0.845273E+03     N/A
1985     N/A              0.810872E+03     N/A
1986     N/A              0.521340E+03     N/A
1987     N/A              0.196172E+03     N/A
1988     N/A              0.917952E+02     N/A
1989     N/A              0.950186E+01     N/A
1990     N/A              0.136407E+02     N/A
1991     N/A              0.131087E+03     N/A
1992     N/A              0.495869E+02     N/A
1993     N/A              0.162547E+02     N/A
1994     0.571971E+03     0.256609E+03     0.801536E+00
1995     0.286771E+03     0.110840E+03     0.950593E+00
1996     0.136741E+03     0.124844E+03     0.910233E-01
1997     0.535820E+02     0.117392E+03    -0.784308E+00
1998     0.260050E+02     0.115257E+03    -0.148888E+01
1999     0.112880E+03     0.245499E+02     0.152562E+01
2000     0.142457E+03     0.437200E+02     0.118123E+01
2001     0.202469E+03     0.109110E+03     0.618228E+00
2002     0.280060E+02     0.471303E+01     0.178209E+01
2003     0.370070E+02     0.177610E+03    -0.156848E+01
2004     0.621550E+02     0.575412E+03    -0.222546E+01
2005     0.148029E+03     0.234698E+03    -0.460891E+00
2006     0.205041E+03     0.312784E+03    -0.422302E+00
2007     N/A              0.113739E+03     N/A
2008     N/A              0.242387E+03     N/A
```

```
Survey Index:    7 Tag:         NEFSC_S  AGE =  1
Time = JAN-1           Type = NUMBER
Catchability =    0.141979E-01   % Variance Contribution =     7.7271
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_____________________________________________________________________________

1973     0.912670E+03     0.603285E+03     0.413984E+00
1974     0.592291E+03     0.147120E+03     0.139275E+01
1975     0.414470E+03     0.446930E+03    -0.754006E-01
1976     0.498030E+02     0.203589E+03    -0.140803E+01
1977     0.157298E+04     0.708721E+03     0.797266E+00
1978     0.310552E+04     0.754143E+03     0.141535E+01
1979     0.986706E+03     0.440102E+03     0.807365E+00
1980     0.708610E+03     0.615557E+03     0.140777E+00
1981     0.849162E+03     0.193107E+04    -0.821579E+00
1982     0.340099E+03     0.893134E+03    -0.965500E+00
1983     0.663490E+02     0.232949E+03    -0.125589E+01
1984     0.783820E+02     0.267429E+03    -0.122726E+01
1985     0.446057E+03     0.291904E+03     0.424020E+00
1986     0.272410E+02     0.100343E+03    -0.130387E+01
1987     N/A              0.208951E+03     N/A
1988     0.476473E+03     0.172031E+04    -0.128385E+01
1989     0.229797E+03     0.242057E+03    -0.519750E-01
1990     0.127015E+03     0.113855E+03     0.109376E+00
1991     0.346450E+03     0.580948E+02     0.178566E+01
1992     0.601650E+02     0.351565E+02     0.537280E+00
1993     0.272410E+02     0.315656E+02    -0.147346E+00
1994     0.223950E+02     0.629542E+02    -0.103357E+01
1995     0.264060E+02     0.608772E+02    -0.835267E+00
1996     N/A              0.491931E+02     N/A
1997     0.879080E+02     0.980278E+02    -0.108960E+00
1998     0.113478E+03     0.514463E+02     0.791071E+00
1999     0.593290E+02     0.762642E+02    -0.251106E+00
2000     0.320880E+02     0.595208E+02    -0.617843E+00
2001     N/A              0.344666E+02     N/A
2002     0.815570E+02     0.160810E+02     0.162367E+01
2003     0.516420E+02     0.188221E+02     0.100931E+01
2004     0.272410E+02     0.236555E+02     0.141126E+00
2005     0.245507E+03     0.154437E+03     0.463540E+00
2006     0.838970E+02     0.133579E+03    -0.465104E+00
2007     N/A              0.166184E+02     N/A
2008     N/A              0.000000E+00     N/A
```

```
Survey Index:    8 Tag:         NEFSC_S  AGE =  2
 Time = JAN-1           Type = NUMBER
 Catchability =    0.182963E+00   % Variance Contribution =     8.3641
 Residual = LN(Observed) - LN(Predicted)

 Year      Observed        Predicted         Residual
 ____________________________________________________________________________

 1973     0.552365E+04     0.331673E+04     0.510060E+00
 1974     0.250771E+04     0.632870E+04    -0.925724E+00
 1975     0.151298E+04     0.141013E+04     0.703988E-01
 1976     0.426971E+04     0.325184E+04     0.272326E+00
 1977     0.164217E+04     0.211264E+04    -0.251918E+00
 1978     0.118991E+05     0.656826E+04     0.594216E+00
 1979     0.292185E+04     0.652386E+04    -0.803251E+00
 1980     0.652005E+04     0.460949E+04     0.346765E+00
 1981     0.182614E+05     0.632833E+04     0.105975E+01
 1982     0.299506E+05     0.203678E+05     0.385598E+00
 1983     0.108319E+05     0.939522E+04     0.142292E+00
 1984     0.924034E+03     0.201825E+04    -0.781239E+00
 1985     0.269589E+04     0.273614E+04    -0.148198E-01
 1986     0.483443E+04     0.271051E+04     0.578624E+00
 1987     0.144396E+03     0.982254E+03    -0.191729E+01
 1988     0.595801E+03     0.194168E+04    -0.118140E+01
 1989     0.159255E+05     0.171763E+05    -0.756077E-01
 1990     0.689558E+03     0.254989E+04    -0.130775E+01
 1991     0.844483E+03     0.116953E+04    -0.325632E+00
 1992     0.847320E+02     0.539381E+03    -0.185093E+01
 1993     0.423328E+03     0.292399E+03     0.370029E+00
 1994     0.382048E+03     0.330890E+03     0.143761E+00
 1995     0.195286E+04     0.604471E+03     0.117269E+01
 1996     0.664322E+03     0.642129E+03     0.339782E-01
 1997     0.147922E+04     0.518524E+03     0.104829E+01
 1998     0.504049E+04     0.103062E+04     0.158734E+01
 1999     0.108715E+04     0.539652E+03     0.700389E+00
 2000     0.193581E+04     0.802984E+03     0.879945E+00
 2001     0.115651E+03     0.627322E+03    -0.169088E+01
 2002     0.199029E+04     0.363609E+03     0.169996E+01
 2003     0.125678E+03     0.169499E+03    -0.299126E+00
 2004     0.227123E+03     0.198255E+03     0.135940E+00
 2005     0.343275E+03     0.248920E+03     0.321399E+00
 2006     0.264693E+04     0.161850E+04     0.491898E+00
 2007     0.962974E+03     0.140621E+04    -0.378624E+00
 2008     0.830610E+02     0.174344E+03    -0.741454E+00
```

```
Survey Index:    9 Tag:         NEFSC_S  AGE =  3
Time = JAN-1          Type = NUMBER
Catchability =    0.283400E+00   % Variance Contribution =     6.3554
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_____________________________________________________________________________

1973     0.150969E+05     0.830998E+04     0.597033E+00
1974     0.295694E+04     0.277427E+04     0.637668E-01
1975     0.454914E+03     0.959497E+03    -0.746301E+00
1976     0.580091E+03     0.746271E+03    -0.251904E+00
1977     0.288174E+04     0.242944E+04     0.170733E+00
1978     0.210979E+04     0.140586E+04     0.405935E+00
1979     0.154841E+04     0.473053E+04    -0.111681E+01
1980     0.441845E+04     0.337446E+04     0.269554E+00
1981     0.474351E+04     0.325569E+04     0.376372E+00
1982     0.972283E+04     0.623350E+04     0.444540E+00
1983     0.179486E+05     0.167568E+05     0.687083E-01
1984     0.183821E+04     0.701994E+04    -0.133996E+01
1985     0.677859E+03     0.996539E+03    -0.385349E+00
1986     0.153003E+04     0.143264E+04     0.657680E-01
1987     0.117071E+04     0.937872E+03     0.221753E+00
1988     0.208071E+03     0.382440E+03    -0.608693E+00
1989     0.761923E+03     0.192468E+04    -0.926667E+00
1990     0.218046E+05     0.167053E+05     0.266396E+00
1991     0.356461E+04     0.270890E+04     0.274513E+00
1992     0.954618E+03     0.107320E+04    -0.117092E+00
1993     0.187180E+03     0.316730E+03    -0.525978E+00
1994     0.232300E+02     0.254545E+03    -0.239403E+01
1995     0.114146E+03     0.204330E+03    -0.582258E+00
1996     0.217814E+04     0.671294E+03     0.117702E+01
1997     0.191158E+04     0.681854E+03     0.103087E+01
1998     0.644601E+03     0.533844E+03     0.188527E+00
1999     0.322551E+04     0.934549E+03     0.123878E+01
2000     0.247830E+04     0.563162E+03     0.148176E+01
2001     0.193464E+04     0.787624E+03     0.898655E+00
2002     0.393078E+03     0.692109E+03    -0.565736E+00
2003     0.339431E+03     0.397276E+03    -0.157360E+00
2004     0.488172E+03     0.175407E+03     0.102356E+01
2005     0.161443E+03     0.180135E+03    -0.109555E+00
2006     0.374360E+03     0.258010E+03     0.372219E+00
2007     0.132062E+04     0.197272E+04    -0.401308E+00
2008     0.114481E+04     0.172063E+04    -0.407453E+00
```

```
Survey Index:   10 Tag:         NEFSC_S  AGE =  4
Time = JAN-1           Type = NUMBER
Catchability =    0.419285E+00   % Variance Contribution =     3.7991
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_____________________________________________________________________________

1973     0.849112E+04     0.705835E+04     0.184810E+00
1974     0.571216E+04     0.558321E+04     0.228341E-01
1975     0.588280E+03     0.128880E+04    -0.784260E+00
1976     0.278430E+03     0.459411E+03    -0.500778E+00
1977     0.263222E+03     0.461575E+03    -0.561647E+00
1978     0.900971E+03     0.111929E+04    -0.216980E+00
1979     0.278263E+03     0.891989E+03    -0.116489E+01
1980     0.278614E+04     0.249194E+04     0.111595E+00
1981     0.249752E+04     0.162694E+04     0.428595E+00
1982     0.243785E+04     0.113071E+04     0.768268E+00
1983     0.122018E+04     0.221903E+04    -0.598070E+00
1984     0.430130E+04     0.445990E+04    -0.362110E-01
1985     0.802869E+03     0.116210E+04    -0.369791E+00
1986     0.395251E+03     0.398024E+03    -0.699105E-02
1987     0.278430E+03     0.500650E+03    -0.586741E+00
1988     0.290129E+03     0.260028E+03     0.109535E+00
1989     0.160607E+03     0.262138E+03    -0.489910E+00
1990     0.311571E+04     0.107960E+04     0.105986E+01
1991     0.590369E+04     0.446781E+04     0.278680E+00
1992     0.266949E+04     0.135172E+04     0.680508E+00
1993     0.827102E+03     0.517594E+03     0.468738E+00
1994     N/A              0.215951E+03     N/A
1995     0.154089E+03     0.158850E+03    -0.304329E-01
1996     0.946596E+03     0.172956E+03     0.169984E+01
1997     0.546165E+03     0.395064E+03     0.323873E+00
1998     0.269238E+03     0.263756E+03     0.205704E-01
1999     0.583266E+03     0.223745E+03     0.958135E+00
2000     0.355141E+03     0.309671E+03     0.137004E+00
2001     0.400599E+03     0.239067E+03     0.516217E+00
2002     0.333916E+03     0.327591E+03     0.191226E-01
2003     0.179492E+03     0.475881E+03    -0.975038E+00
2004     0.169465E+03     0.258534E+03    -0.422382E+00
2005     0.112475E+03     0.121282E+03    -0.753896E-01
2006     0.176818E+03     0.136642E+03     0.257756E+00
2007     0.145900E+03     0.183379E+03    -0.228635E+00
2008     0.802367E+03     0.217626E+04    -0.997797E+00
```

```
Survey Index:   11 Tag:         NEFSC_S  AGE =  5
 Time = JAN-1           Type = NUMBER
 Catchability =    0.550028E+00   % Variance Contribution =     7.7397
 Residual = LN(Observed) - LN(Predicted)

 Year      Observed        Predicted         Residual
 _____________________________________________________________________________

 1973     0.658656E+04     0.606533E+04     0.824430E-01
 1974     0.345497E+04     0.366409E+04    -0.587638E-01
 1975     0.866042E+03     0.238939E+04    -0.101486E+01
 1976     0.264559E+03     0.827515E+03    -0.114036E+01
 1977     0.164785E+03     0.332013E+03    -0.700533E+00
 1978     0.292636E+03     0.246717E+03     0.170687E+00
 1979     0.121166E+03     0.482598E+03    -0.138202E+01
 1980     0.274419E+03     0.437118E+03    -0.465547E+00
 1981     0.554354E+03     0.810378E+03    -0.379697E+00
 1982     0.799025E+03     0.331308E+03     0.880345E+00
 1983     0.389234E+03     0.311226E+03     0.223661E+00
 1984     0.800027E+03     0.631915E+03     0.235890E+00
 1985     0.119294E+04     0.859063E+03     0.328332E+00
 1986     0.207402E+03     0.292726E+03    -0.344578E+00
 1987     N/A              0.118445E+03     N/A
 1988     0.491348E+03     0.903339E+02     0.169364E+01
 1989     N/A              0.357277E+02     N/A
 1990     0.112475E+03     0.577014E+02     0.667449E+00
 1991     0.765433E+03     0.101478E+03     0.202060E+01
 1992     N/A              0.192277E+03     N/A
 1993     0.285780E+02     0.138472E+03    -0.157803E+01
 1994     0.972670E+02     0.208260E+03    -0.761327E+00
 1995     0.312520E+02     0.369013E+02    -0.166165E+00
 1996     0.119829E+03     0.312949E+02     0.134261E+01
 1997     0.112141E+03     0.722536E+02     0.439575E+00
 1998     0.606660E+02     0.454346E+02     0.289109E+00
 1999     0.124341E+03     0.901458E+02     0.321600E+00
 2000     N/A              0.434687E+02     N/A
 2001     0.137377E+03     0.828415E+02     0.505800E+00
 2002     0.111807E+03     0.276896E+02     0.139572E+01
 2003     0.541490E+02     0.161513E+03    -0.109284E+01
 2004     0.584940E+02     0.341333E+03    -0.176393E+01
 2005     0.254531E+03     0.125160E+03     0.709833E+00
 2006     N/A              0.567412E+02     N/A
 2007     N/A              0.784053E+02     N/A
 2008     0.823930E+02     0.130337E+03    -0.458622E+00
```

```
Survey Index:   12 Tag:         NEFSC_S  AGE =  6
Time = JAN-1           Type = NUMBER
Catchability =    0.568391E+00   % Variance Contribution =     6.0197
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_____________________________________________________________________________

1973     0.940747E+04     0.753913E+04     0.221397E+00
1974     0.311454E+04     0.343724E+04    -0.985870E-01
1975     0.102030E+04     0.224497E+04    -0.788596E+00
1976     0.499871E+03     0.170647E+04    -0.122783E+01
1977     0.457923E+03     0.800971E+03    -0.559124E+00
1978     0.483158E+03     0.184764E+03     0.961264E+00
1979     0.610010E+02     0.149157E+03    -0.894110E+00
1980     0.109300E+03     0.147335E+03    -0.298615E+00
1981     0.947600E+02     0.137939E+03    -0.375463E+00
1982     0.273584E+03     0.709485E+02     0.134965E+01
1983     N/A              0.160390E+03     N/A
1984     0.456084E+03     0.205275E+03     0.798328E+00
1985     0.258542E+03     0.196920E+03     0.272259E+00
1986     0.264060E+02     0.126607E+03    -0.156750E+01
1987     N/A              0.476403E+02     N/A
1988     0.481320E+02     0.222925E+02     0.769699E+00
1989     N/A              0.230753E+01     N/A
1990     N/A              0.331265E+01     N/A
1991     0.852340E+02     0.318344E+02     0.984853E+00
1992     N/A              0.120422E+02     N/A
1993     N/A              0.394745E+01     N/A
1994     0.272410E+02     0.623174E+02    -0.827518E+00
1995     0.115316E+03     0.269176E+02     0.145490E+01
1996     N/A              0.303184E+02     N/A
1997     N/A              0.285087E+02     N/A
1998     0.342610E+02     0.279903E+02     0.202151E+00
1999     0.382720E+02     0.596193E+01     0.185932E+01
2000     N/A              0.106174E+02     N/A
2001     0.382720E+02     0.264974E+02     0.367671E+00
2002     N/A              0.114456E+01     N/A
2003     N/A              0.431326E+02     N/A
2004     0.320880E+02     0.139739E+03    -0.147129E+01
2005     0.264060E+02     0.569964E+02    -0.769396E+00
2006     0.528120E+02     0.759596E+02    -0.363463E+00
2007     N/A              0.276214E+02     N/A
2008     N/A              0.588636E+02     N/A
```

```
Survey Index:   13 Tag:         NEFSC_F  AGE =  1
Time = MEAN            Type = NUMBER
Catchability =    0.100583E+00   % Variance Contribution =     8.8191
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_____________________________________________________________________________

1973     0.200610E+04     0.386292E+04    -0.655229E+00
1974     0.949631E+03     0.902156E+03     0.512864E-01
1975     0.199415E+04     0.241164E+04    -0.190086E+00
1976     0.275227E+04     0.129679E+04     0.752535E+00
1977     0.272654E+04     0.427720E+04    -0.450264E+00
1978     0.247759E+04     0.440637E+04    -0.575767E+00
1979     0.177829E+04     0.281587E+04    -0.459620E+00
1980     0.137367E+04     0.390332E+04    -0.104434E+01
1981     0.113308E+05     0.123973E+05    -0.899583E-01
1982     0.285854E+04     0.572649E+04    -0.694791E+00
1983     0.269116E+04     0.136207E+04     0.680967E+00
1984     0.202380E+04     0.169187E+04     0.179138E+00
1985     0.848762E+03     0.176327E+04    -0.731148E+00
1986     0.604519E+03     0.621517E+03    -0.277308E-01
1987     0.122639E+04     0.126263E+04    -0.291253E-01
1988     0.501985E+04     0.107566E+05    -0.762123E+00
1989     0.134989E+03     0.155305E+04    -0.244278E+01
1990     0.240797E+03     0.721679E+03    -0.109763E+01
1991     0.574075E+03     0.350906E+03     0.492241E+00
1992     0.192431E+03     0.201691E+03    -0.469991E-01
1993     0.324432E+03     0.202047E+03     0.473577E+00
1994     0.841065E+03     0.386364E+03     0.777888E+00
1995     0.159689E+03     0.390837E+03    -0.895062E+00
1996     0.514910E+03     0.315718E+03     0.489144E+00
1997     0.944691E+03     0.628355E+03     0.407753E+00
1998     0.102247E+04     0.329406E+03     0.113268E+01
1999     0.142215E+04     0.489197E+03     0.106716E+01
2000     0.567530E+02     0.381981E+03    -0.190666E+01
2001     0.448507E+03     0.221296E+03     0.706425E+00
2002     0.291231E+03     0.103205E+03     0.103740E+01
2003     0.134414E+04     0.120757E+03     0.240973E+01
2004     0.806490E+02     0.151695E+03    -0.631765E+00
2005     0.203115E+04     0.988409E+03     0.720260E+00
2006     0.136999E+04     0.856772E+03     0.469388E+00
2007     0.257455E+03     0.106413E+03     0.883516E+00
2008     N/A              0.000000E+00     N/A
```

```
Survey Index:   14 Tag:         NEFSC_F  AGE =  2
 Time = MEAN            Type = NUMBER
 Catchability =    0.175600E+00   % Variance Contribution =     9.3541
 Residual = LN(Observed) - LN(Predicted)

 Year      Observed        Predicted        Residual
 ____________________________________________________________________________

 1973     0.293540E+04     0.237641E+04     0.211251E+00
 1974     0.173509E+04     0.235777E+04    -0.306657E+00
 1975     0.553281E+03     0.829651E+03    -0.405139E+00
 1976     0.589251E+04     0.221584E+04     0.978049E+00
 1977     0.171407E+04     0.136889E+04     0.224870E+00
 1978     0.568423E+04     0.440438E+04     0.255097E+00
 1979     0.391088E+04     0.380236E+04     0.281407E-01
 1980     0.346409E+04     0.306474E+04     0.122487E+00
 1981     0.113153E+05     0.488490E+04     0.840003E+00
 1982     0.249403E+05     0.144854E+05     0.543342E+00
 1983     0.158066E+05     0.640234E+04     0.903767E+00
 1984     0.178656E+04     0.115419E+04     0.436890E+00
 1985     0.365790E+03     0.160274E+04    -0.147741E+01
 1986     0.183228E+04     0.134791E+04     0.307011E+00
 1987     0.518816E+03     0.511104E+03     0.149766E-01
 1988     0.373947E+03     0.150318E+04    -0.139122E+01
 1989     0.103037E+05     0.131810E+05    -0.246271E+00
 1990     0.208928E+04     0.203878E+04     0.244672E-01
 1991     0.237235E+03     0.873854E+03    -0.130386E+01
 1992     0.274570E+02     0.331382E+03    -0.249065E+01
 1993     0.272270E+02     0.213307E+03    -0.205852E+01
 1994     0.514450E+03     0.207658E+03     0.907206E+00
 1995     0.741001E+03     0.493502E+03     0.406474E+00
 1996     0.184733E+03     0.513307E+03    -0.102196E+01
 1997     0.596248E+03     0.408555E+03     0.378030E+00
 1998     0.186146E+04     0.765896E+03     0.888072E+00
 1999     0.450000E+03     0.427894E+03     0.503720E-01
 2000     0.191741E+04     0.618626E+03     0.113123E+01
 2001     0.701711E+03     0.510573E+03     0.317989E+00
 2002     0.197796E+04     0.294584E+03     0.190425E+01
 2003     0.284910E+02     0.133873E+03    -0.154730E+01
 2004     0.112471E+03     0.147466E+03    -0.270901E+00
 2005     0.532832E+03     0.196747E+03     0.996287E+00
 2006     0.247207E+04     0.138125E+04     0.582069E+00
 2007     0.128636E+04     0.120231E+04     0.675663E-01
 2008     N/A              0.000000E+00     N/A
```

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Survey Index:   15 Tag:         NEFSC_F  AGE =  3
Time = MEAN            Type = NUMBER
Catchability =    0.199593E+00   % Variance Contribution =     5.0702
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_____________________________________________________________________________

1973     0.572593E+04     0.404716E+04     0.346989E+00
1974     0.582002E+03     0.115710E+04    -0.687202E+00
1975     0.180023E+03     0.405140E+03    -0.811147E+00
1976     0.490439E+03     0.350702E+03     0.335365E+00
1977     0.618076E+03     0.100988E+04    -0.490979E+00
1978     0.352579E+03     0.667938E+03    -0.638921E+00
1979     0.188054E+04     0.207751E+04    -0.996133E-01
1980     0.901609E+03     0.142887E+04    -0.460461E+00
1981     0.149073E+04     0.121074E+04     0.208036E+00
1982     0.615525E+04     0.234023E+04     0.967056E+00
1983     0.783991E+04     0.564217E+04     0.328958E+00
1984     0.214293E+04     0.200473E+04     0.666625E-01
1985     0.106038E+03     0.391282E+03    -0.130563E+01
1986     0.511119E+03     0.534042E+03    -0.438729E-01
1987     0.411974E+03     0.320536E+03     0.250964E+00
1988     0.153255E+03     0.187887E+03    -0.203738E+00
1989     0.133736E+04     0.867743E+03     0.432561E+00
1990     0.304328E+04     0.563477E+04    -0.616023E+00
1991     0.148028E+04     0.116332E+04     0.240952E+00
1992     0.822570E+02     0.454494E+03    -0.170934E+01
1993     0.126947E+03     0.155245E+03    -0.201237E+00
1994     0.122811E+03     0.120079E+03     0.224940E-01
1995     0.295481E+03     0.110269E+03     0.985686E+00
1996     0.367054E+03     0.308853E+03     0.172645E+00
1997     0.167650E+04     0.264379E+03     0.184708E+01
1998     0.141882E+03     0.213644E+03    -0.409314E+00
1999     0.320526E+03     0.341369E+03    -0.629994E-01
2000     0.348098E+03     0.226525E+03     0.429627E+00
2001     0.181976E+03     0.314248E+03    -0.546309E+00
2002     0.982372E+03     0.340487E+03     0.105959E+01
2003     0.289508E+03     0.190824E+03     0.416830E+00
2004     N/A              0.865036E+02     N/A
2005     0.212880E+03     0.925396E+02     0.833092E+00
2006     0.196222E+03     0.128786E+03     0.421098E+00
2007     0.409331E+03     0.120403E+04    -0.107890E+01
2008     N/A              0.000000E+00     N/A
```

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Survey Index:   16 Tag:         NEFSC_F  AGE =  4
Time = MEAN            Type = NUMBER
Catchability =    0.217045E+00   % Variance Contribution =     5.2731
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_____________________________________________________________________________

1973     0.324846E+04     0.238165E+04     0.310386E+00
1974     0.227378E+04     0.173844E+04     0.268456E+00
1975     0.290312E+03     0.476738E+03    -0.496012E+00
1976     0.647950E+02     0.179140E+03    -0.101694E+01
1977     0.937450E+02     0.157693E+03    -0.520073E+00
1978     0.280776E+03     0.349578E+03    -0.219169E+00
1979     0.286521E+03     0.293756E+03    -0.249378E-01
1980     0.372454E+03     0.695605E+03    -0.624668E+00
1981     0.235397E+03     0.381923E+03    -0.483946E+00
1982     0.749618E+03     0.296194E+03     0.928550E+00
1983     0.642316E+03     0.588765E+03     0.870528E-01
1984     0.468152E+03     0.102671E+04    -0.785321E+00
1985     0.103166E+03     0.294549E+03    -0.104911E+01
1986     0.114769E+03     0.107382E+03     0.665265E-01
1987     0.345800E+02     0.112671E+03    -0.118119E+01
1988     0.161757E+03     0.534093E+02     0.110811E+01
1989     0.707690E+02     0.632645E+02     0.112097E+00
1990     0.189214E+03     0.196826E+03    -0.394405E-01
1991     0.358093E+03     0.654615E+03    -0.603255E+00
1992     0.326845E+03     0.252985E+03     0.256154E+00
1993     0.101213E+03     0.157176E+03    -0.440139E+00
1994     0.163710E+03     0.477016E+02     0.123313E+01
1995     0.132576E+03     0.368582E+02     0.128008E+01
1996     N/A              0.533261E+02     N/A
1997     0.311450E+03     0.766489E+02     0.140200E+01
1998     0.558340E+02     0.750642E+02    -0.295961E+00
1999     0.320530E+02     0.516626E+02    -0.477344E+00
2000     0.196566E+03     0.802597E+02     0.895731E+00
2001     0.815680E+02     0.464865E+02     0.562275E+00
2002     0.191741E+03     0.108160E+03     0.572538E+00
2003     0.263199E+03     0.184934E+03     0.352912E+00
2004     0.264230E+02     0.847089E+02    -0.116499E+01
2005     0.843250E+02     0.391759E+02     0.766616E+00
2006     0.220580E+02     0.481250E+02    -0.780126E+00
2007     N/A              0.709719E+02     N/A
2008     N/A              0.000000E+00     N/A
```

```
Survey Index:   17 Tag:         NEFSC_F  AGE =  5
 Time = MEAN            Type = NUMBER
 Catchability =    0.221817E+00   % Variance Contribution =     3.6367
 Residual = LN(Observed) - LN(Predicted)

 Year      Observed        Predicted         Residual
 _____________________________________________________________________________

 1973     0.219164E+04     0.159441E+04     0.318149E+00
 1974     0.962842E+03     0.888814E+03     0.800019E-01
 1975     0.289852E+03     0.688576E+03    -0.865255E+00
 1976     0.102247E+03     0.251384E+03    -0.899590E+00
 1977     0.334310E+02     0.883680E+02    -0.972026E+00
 1978     0.286060E+02     0.600300E+02    -0.741229E+00
 1979     0.312480E+02     0.123817E+03    -0.137685E+01
 1980     N/A              0.950588E+02     N/A
 1981     0.108336E+03     0.148204E+03    -0.313355E+00
 1982     0.301800E+03     0.676119E+02     0.149598E+01
 1983     0.536510E+02     0.643317E+02    -0.181552E+00
 1984     N/A              0.113331E+03     N/A
 1985     N/A              0.169632E+03     N/A
 1986     0.397500E+02     0.615253E+02    -0.436839E+00
 1987     0.274570E+02     0.207664E+02     0.279284E+00
 1988     0.151650E+02     0.144549E+02     0.479537E-01
 1989     N/A              0.671745E+01     N/A
 1990     N/A              0.819547E+01     N/A
 1991     N/A              0.115834E+02     N/A
 1992     N/A              0.280353E+02     N/A
 1993     N/A              0.327589E+02     N/A
 1994     0.606590E+02     0.358388E+02     0.526238E+00
 1995     N/A              0.667048E+01     N/A
 1996     N/A              0.751704E+01     N/A
 1997     0.272270E+02     0.109211E+02     0.913512E+00
 1998     N/A              0.100736E+02     N/A
 1999     0.320530E+02     0.162158E+02     0.681407E+00
 2000     N/A              0.877692E+01     N/A
 2001     N/A              0.125494E+02     N/A
 2002     N/A              0.712227E+01     N/A
 2003     N/A              0.488982E+02     N/A
 2004     0.550290E+02     0.871280E+02    -0.459518E+00
 2005     0.164744E+03     0.314960E+02     0.165453E+01
 2006     N/A              0.155687E+02     N/A
 2007     0.303290E+02     0.236402E+02     0.249157E+00
 2008     N/A              0.000000E+00     N/A
```

```
Survey Index:   18 Tag:         NEFSC_F  AGE =  6
Time = MEAN            Type = NUMBER
Catchability =    0.449687E+00   % Variance Contribution =     7.0141
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_____________________________________________________________________________


1973     0.130244E+04     0.388794E+04    -0.109364E+01
1974     0.698954E+03     0.163572E+04    -0.850253E+00
1975     0.146477E+03     0.126920E+04    -0.215927E+01
1976     0.714348E+03     0.101699E+04    -0.353228E+00
1977     0.928260E+02     0.418226E+03    -0.150529E+01
1978     0.886900E+02     0.881943E+02     0.560509E-02
1979     0.303290E+02     0.750748E+02    -0.906381E+00
1980     N/A              0.628571E+02     N/A
1981     0.577870E+02     0.494896E+02     0.155002E+00
1982     N/A              0.284047E+02     N/A
1983     0.371080E+02     0.650401E+02    -0.561171E+00
1984     N/A              0.722238E+02     N/A
1985     N/A              0.762831E+02     N/A
1986     N/A              0.522043E+02     N/A
1987     0.274570E+02     0.163860E+02     0.516191E+00
1988     0.567530E+02     0.699805E+01     0.209308E+01
1989     N/A              0.851138E+00     N/A
1990     N/A              0.923033E+00     N/A
1991     N/A              0.712871E+01     N/A
1992     N/A              0.344458E+01     N/A
1993     N/A              0.183205E+01     N/A
1994     0.286060E+02     0.210383E+02     0.307271E+00
1995     0.605440E+02     0.954564E+01     0.184729E+01
1996     N/A              0.142868E+02     N/A
1997     N/A              0.845354E+01     N/A
1998     0.263080E+02     0.121748E+02     0.770509E+00
1999     N/A              0.210394E+01     N/A
2000     0.263080E+02     0.420570E+01     0.183343E+01
2001     N/A              0.787470E+01     N/A
2002     N/A              0.577556E+00     N/A
2003     0.569820E+02     0.256181E+02     0.799437E+00
2004     0.284910E+02     0.699763E+02    -0.898568E+00
2005     N/A              0.281379E+02     N/A
2006     N/A              0.408876E+02     N/A
2007     N/A              0.163382E+02     N/A
2008     N/A              0.000000E+00     N/A
```

```
                   Retrospective Summary

                   Average Fishing Mortality
                    Ages =  4 -  5


              1973        1974        1975        1976        1977


2000        0.7271      0.9201      0.5145      0.3962      0.6978
2001        0.7271      0.9201      0.5145      0.3962      0.6978
2002        0.7271      0.9201      0.5145      0.3962      0.6978
2003        0.7271      0.9201      0.5145      0.3962      0.6978
2004        0.7271      0.9201      0.5145      0.3962      0.6978
2005        0.7271      0.9201      0.5145      0.3962      0.6978
2006        0.7271      0.9201      0.5145      0.3962      0.6978
2007        0.7271      0.9201      0.5145      0.3962      0.6978

              1978        1979        1980        1981        1982


2000        0.9127      0.7847      1.1947      1.6628      1.3615
2001        0.9127      0.7847      1.1947      1.6628      1.3615
2002        0.9127      0.7847      1.1947      1.6628      1.3615
2003        0.9127      0.7847      1.1947      1.6628      1.3615
2004        0.9127      0.7847      1.1947      1.6628      1.3615
2005        0.9127      0.7847      1.1947      1.6628      1.3615
2006        0.9127      0.7847      1.1947      1.6628      1.3615
2007        0.9127      0.7847      1.1947      1.6628      1.3615

              1983        1984        1985        1986        1987


2000        1.3275      1.7185      1.4502      1.2835      1.7838
2001        1.3275      1.7185      1.4502      1.2835      1.7838
2002        1.3275      1.7185      1.4502      1.2835      1.7838
2003        1.3275      1.7185      1.4502      1.2835      1.7838
2004        1.3275      1.7185      1.4502      1.2835      1.7838
2005        1.3275      1.7185      1.4502      1.2835      1.7838
2006        1.3275      1.7185      1.4502      1.2835      1.7838
2007        1.3275      1.7185      1.4502      1.2835      1.7838

              1988        1989        1990        1991        1992


2000        2.0563      1.5850      2.4359      3.2171      2.3499
2001        2.0563      1.5850      2.4359      3.2171      2.3499
2002        2.0563      1.5850      2.4359      3.2171      2.3499
2003        2.0563      1.5850      2.4359      3.2171      2.3499
2004        2.0563      1.5850      2.4359      3.2171      2.3499
2005        2.0563      1.5850      2.4359      3.2171      2.3499
2006        2.0563      1.5850      2.4359      3.2171      2.3499
2007        2.0563      1.5850      2.4359      3.2171      2.3499

              1993        1994        1995        1996        1997


2000        0.9818      1.8380      1.6948      0.9421      2.2080
2001        0.9818      1.8382      1.6959      0.9442      2.2327
2002        0.9818      1.8382      1.6959      0.9443      2.2346
2003        0.9818      1.8382      1.6959      0.9443      2.2346
2004        0.9818      1.8382      1.6959      0.9443      2.2344
2005        0.9818      1.8382      1.6959      0.9443      2.2342
2006        0.9818      1.8382      1.6959      0.9443      2.2342
2007        0.9818      1.8382      1.6959      0.9443      2.2342
```

```
              1998        1999        2000        2001        2002


 2000       1.0859      1.3978      0.7097
 2001       1.1416      1.6886      1.3175      1.6830
 2002       1.1459      1.7155      1.4102      2.4534      1.1794
 2003       1.1460      1.7161      1.4126      2.4848      1.2591
 2004       1.1454      1.7122      1.3983      2.3144      0.9056
 2005       1.1451      1.7103      1.3916      2.2431      0.8000
 2006       1.1451      1.7101      1.3909      2.2360      0.7904
 2007       1.1450      1.7099      1.3900      2.2271      0.7786

              2003        2004        2005        2006        2007


 2000
 2001
 2002
 2003       1.2274
 2004       0.5366      1.5025
 2005       0.4238      0.8730      1.0341
 2006       0.4147      0.8375      0.9324      0.8054
 2007       0.4037      0.7969      0.8310      0.6269      0.4129


                         Spawning Stock Biomass


              1973        1974        1975        1976        1977


 2000       28815.      10926.       5272.       4991.       4203.
 2001       28815.      10926.       5272.       4991.       4203.
 2002       28815.      10926.       5272.       4991.       4203.
 2003       28815.      10926.       5272.       4991.       4203.
 2004       28815.      10926.       5272.       4991.       4203.
 2005       28815.      10926.       5272.       4991.       4203.
 2006       28815.      10926.       5272.       4991.       4203.
 2007       28815.      10926.       5272.       4991.       4203.

              1978        1979        1980        1981        1982


 2000        6267.       8307.       7391.       7092.      16162.
 2001        6267.       8307.       7391.       7092.      16162.
 2002        6267.       8307.       7391.       7092.      16162.
 2003        6267.       8307.       7391.       7092.      16162.
 2004        6267.       8307.       7391.       7092.      16162.
 2005        6267.       8307.       7391.       7092.      16162.
 2006        6267.       8307.       7391.       7092.      16162.
 2007        6267.       8307.       7391.       7092.      16162.

              1983        1984        1985        1986        1987


 2000       16111.       5866.       3007.       2480.       1246.
 2001       16111.       5866.       3007.       2480.       1246.
 2002       16111.       5866.       3007.       2480.       1246.
 2003       16111.       5866.       3007.       2480.       1246.
 2004       16111.       5866.       3007.       2480.       1246.
 2005       16111.       5866.       3007.       2480.       1246.
 2006       16111.       5866.       3007.       2480.       1246.
 2007       16111.       5866.       3007.       2480.       1246.

              1988        1989        1990        1991        1992
```

```
 2000        1814.      14736.      12968.       3758.       1718.
 2001        1814.      14736.      12968.       3758.       1718.
 2002        1814.      14736.      12968.       3758.       1718.
 2003        1814.      14736.      12968.       3758.       1718.
 2004        1814.      14736.      12968.       3758.       1718.
 2005        1814.      14736.      12968.       3758.       1718.
 2006        1814.      14736.      12968.       3758.       1718.
 2007        1814.      14736.      12968.       3758.       1718.

              1993        1994        1995        1996        1997


 2000        1000.        540.        632.       1277.       1080.
 2001        1000.        540.        631.       1271.       1059.
 2002        1000.        540.        631.       1270.       1058.
 2003        1000.        540.        631.       1270.       1058.
 2004        1000.        540.        631.       1270.       1058.
 2005        1000.        540.        631.       1270.       1058.
 2006        1000.        540.        631.       1270.       1058.
 2007        1000.        540.        631.       1270.       1058.

              1998        1999        2000        2001        2002


 2000        1376.       1847.       2815.
 2001        1274.       1421.       1643.       1554.
 2002        1267.       1384.       1391.       1128.       1183.
 2003        1267.       1383.       1384.       1150.       1062.
 2004        1268.       1389.       1423.       1335.       1266.
 2005        1268.       1391.       1442.       1423.       1446.
 2006        1268.       1391.       1444.       1432.       1464.
 2007        1268.       1392.       1447.       1444.       1488.

              2003        2004        2005        2006        2007


 2000
 2001
 2002
 2003         890.
 2004        1015.        695.
 2005        1237.        860.        744.
 2006        1265.        822.        603.       1890.
 2007        1299.        870.        619.       1509.       3508.


                    Total Population Numbers


              1973        1974        1975        1976        1977


 2000      131067.      80766.      53939.      40348.      73150.
 2001      131067.      80766.      53939.      40348.      73150.
 2002      131067.      80766.      53939.      40348.      73150.
 2003      131067.      80766.      53939.      40348.      73150.
 2004      131067.      80766.      53939.      40348.      73150.
 2005      131067.      80766.      53939.      40348.      73150.
 2006      131067.      80766.      53939.      40348.      73150.
 2007      131067.      80766.      53939.      40348.      73150.

              1978        1979        1980        1981        1982


 2000       97420.      86614.      87453.     187683.     199647.
 2001       97420.      86614.      87453.     187683.     199647.
 2002       97420.      86614.      87453.     187683.     199647.
```

```
2003         97420.      86614.      87453.     187683.     199647.
2004         97420.      86614.      87453.     187683.     199647.
2005         97420.      86614.      87453.     187683.     199647.
2006         97420.      86614.      87453.     187683.     199647.
2007         97420.      86614.      87453.     187683.     199647.

             1983        1984        1985        1986        1987


2000       133026.      66784.      43711.      28641.      24888.
2001       133026.      66784.      43711.      28641.      24888.
2002       133026.      66784.      43711.      28641.      24888.
2003       133026.      66784.      43711.      28641.      24888.
2004       133026.      66784.      43711.      28641.      24888.
2005       133026.      66784.      43711.      28641.      24888.
2006       133026.      66784.      43711.      28641.      24888.
2007       133026.      66784.      43711.      28641.      24888.

             1988        1989        1990        1991        1992


2000       133952.     118413.      83587.      30939.      12806.
2001       133952.     118413.      83587.      30939.      12806.
2002       133952.     118413.      83587.      30939.      12806.
2003       133952.     118413.      83587.      30939.      12806.
2004       133952.     118413.      83587.      30939.      12806.
2005       133952.     118413.      83587.      30939.      12806.
2006       133952.     118413.      83587.      30939.      12806.
2007       133952.     118413.      83587.      30939.      12806.

             1993        1994        1995        1996        1997


2000         6433.       8151.       8847.       9992.      14051.
2001         6432.       8144.       8808.       9873.      13311.
2002         6432.       8144.       8805.       9864.      13257.
2003         6432.       8144.       8805.       9864.      13256.
2004         6432.       8144.       8806.       9865.      13264.
2005         6432.       8144.       8806.       9866.      13267.
2006         6432.       8144.       8806.       9866.      13268.
2007         6432.       8144.       8806.       9866.      13268.

             1998        1999        2000        2001        2002


2000        14049.      18983.      14098.      22776.
2001        12046.      13568.      10372.      10169.      18743.
2002        11864.      11970.       9724.       9777.       7106.
2003        11859.      11928.       9958.       8581.       5668.
2004        11886.      12178.      10862.       8618.       5702.
2005        11898.      12298.      11300.       9252.       6206.
2006        11899.      12311.      11347.       9319.       6290.
2007        11901.      12327.      11404.       9403.       6396.

             2003        2004        2005        2006        2007


2000
2001
2002        16338.
2003         7468.      16363.
2004         5466.       4905.      13288.
2005         5466.       5607.      22375.      28303.
2006         4975.       5035.      17447.      23839.      29200.
2007         5158.       4852.      13491.      19728.      16446.

             2008
```

```
2000
2001
2002
2003
2004
2005
2006
2007       22299.



                   Age  1 Population


             1973        1974        1975        1976        1977


2000       42491.      10362.      31479.      14339.      49917.
2001       42491.      10362.      31479.      14339.      49917.
2002       42491.      10362.      31479.      14339.      49917.
2003       42491.      10362.      31479.      14339.      49917.
2004       42491.      10362.      31479.      14339.      49917.
2005       42491.      10362.      31479.      14339.      49917.
2006       42491.      10362.      31479.      14339.      49917.
2007       42491.      10362.      31479.      14339.      49917.

             1978        1979        1980        1981        1982


2000       53116.      30998.      43355.     136011.      62906.
2001       53116.      30998.      43355.     136011.      62906.
2002       53116.      30998.      43355.     136011.      62906.
2003       53116.      30998.      43355.     136011.      62906.
2004       53116.      30998.      43355.     136011.      62906.
2005       53116.      30998.      43355.     136011.      62906.
2006       53116.      30998.      43355.     136011.      62906.
2007       53116.      30998.      43355.     136011.      62906.

             1983        1984        1985        1986        1987


2000       16407.      18836.      20560.       7067.      14717.
2001       16407.      18836.      20560.       7067.      14717.
2002       16407.      18836.      20560.       7067.      14717.
2003       16407.      18836.      20560.       7067.      14717.
2004       16407.      18836.      20560.       7067.      14717.
2005       16407.      18836.      20560.       7067.      14717.
2006       16407.      18836.      20560.       7067.      14717.
2007       16407.      18836.      20560.       7067.      14717.

             1988        1989        1990        1991        1992


2000      121166.      17049.       8019.       4092.       2476.
2001      121166.      17049.       8019.       4092.       2476.
2002      121166.      17049.       8019.       4092.       2476.
2003      121166.      17049.       8019.       4092.       2476.
2004      121166.      17049.       8019.       4092.       2476.
2005      121166.      17049.       8019.       4092.       2476.
2006      121166.      17049.       8019.       4092.       2476.
2007      121166.      17049.       8019.       4092.       2476.
```

```
             1993        1994        1995        1996        1997


2000        2224.       4440.       4323.       3557.       7584.
2001        2223.       4434.       4290.       3470.       6941.
2002        2223.       4434.       4287.       3464.       6895.
2003        2223.       4434.       4287.       3463.       6894.
2004        2223.       4434.       4288.       3464.       6900.
2005        2223.       4434.       4288.       3465.       6904.
2006        2223.       4434.       4288.       3465.       6904.
2007        2223.       4434.       4288.       3465.       6904.

             1998        1999        2000        2001        2002


2000        5130.      10273.       1451.      13637.
2001        3733.       6494.       2144.       4038.      12849.
2002        3595.       5045.       2804.       4177.       1527.
2003        3592.       5007.       3073.       2790.       1067.
2004        3612.       5235.       3772.       2086.       1078.
2005        3621.       5345.       4112.       2362.       1065.
2006        3622.       5357.       4147.       2391.       1095.
2007        3624.       5372.       4192.       2428.       1133.

             2003        2004        2005        2006        2007


2000
2001
2002       11970.
2003        4253.      11326.
2004        2211.       1479.      10405.
2005        1791.       2172.      19115.      10726.
2006        1230.       2001.      14667.      10284.      10504.
2007        1326.       1666.      10877.       9408.       1170.

             2008


2000
2001
2002
2003
2004
2005
2006
2007        9744.


In the Retrospective Analysis
The Following Survey Indices Have Predicted
Index Value Set to Zero in Terminal Year + 1

  13     NEFSC_F     1
  14     NEFSC_F     2
  15     NEFSC_F     3
  16     NEFSC_F     4
  17     NEFSC_F     5
  18     NEFSC_F     6
```

```
Plus Group Diagnostic Report

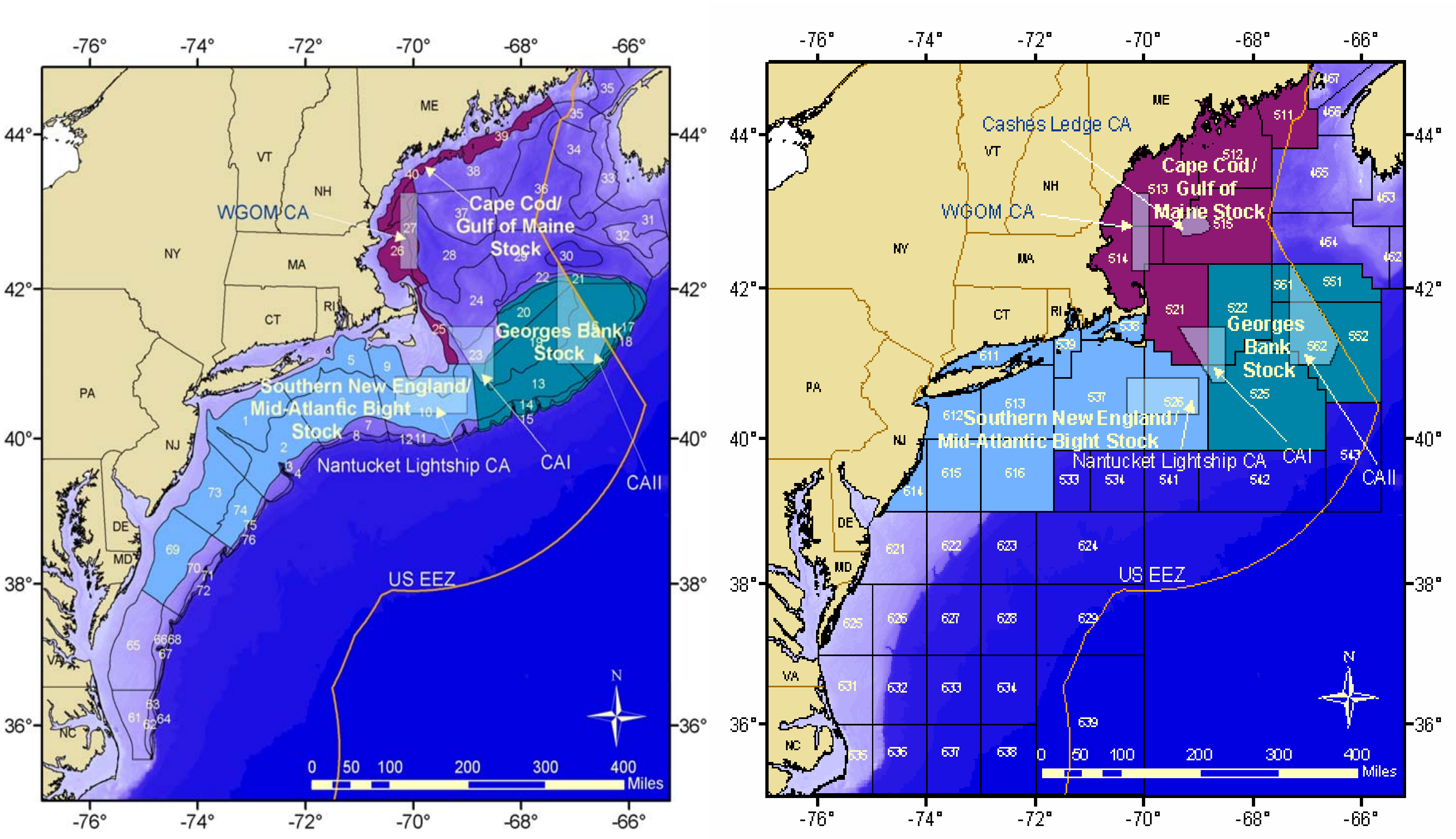
Calculation Method Selected = Backward

         Population  Population    F            F
Year     Backward     Forward    Forward     Backward    Ratio

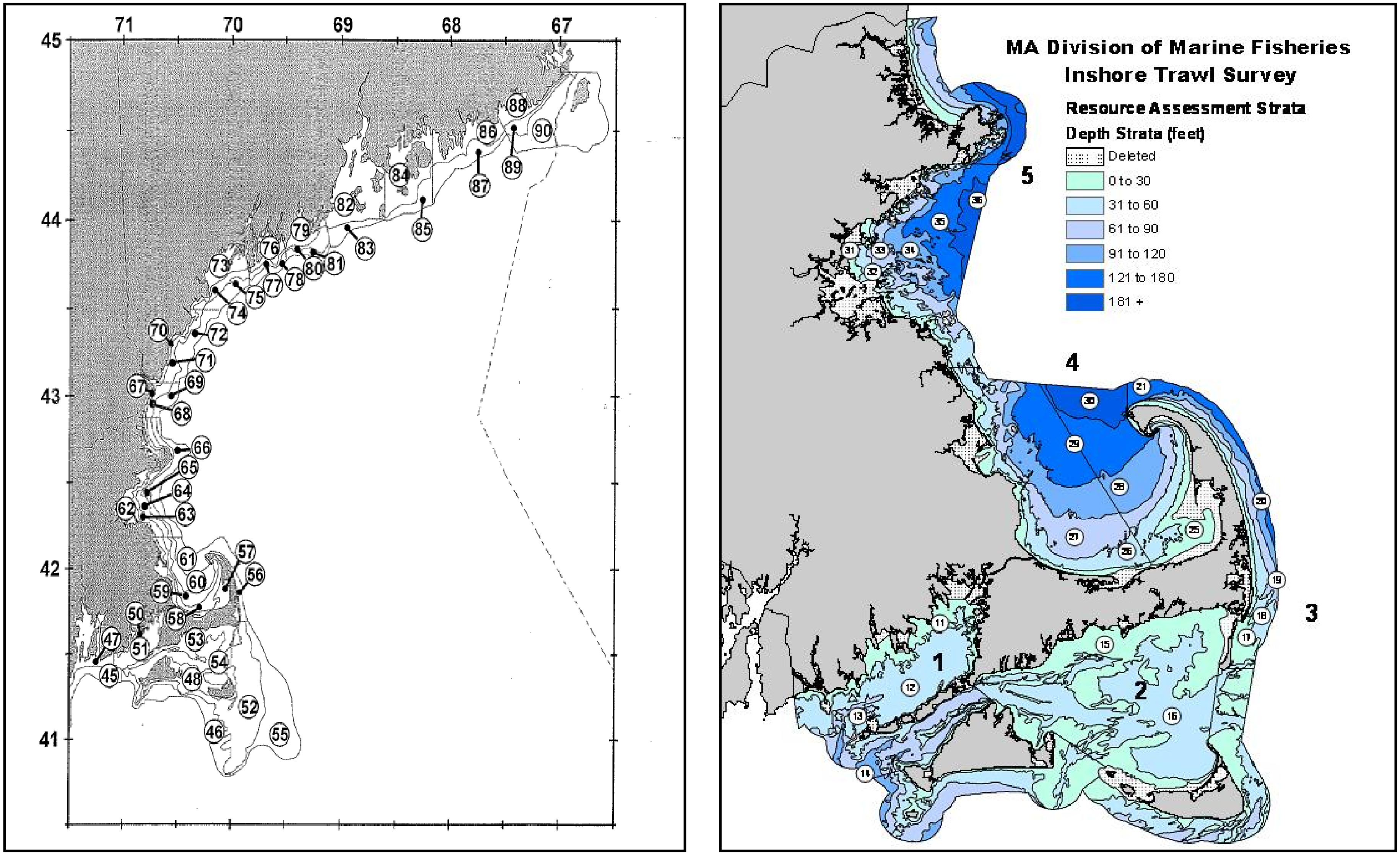
1973      13264.      13264.    0.727051    0.727051    1.000000
1974       6047.       9613.    0.479862    0.920147    1.917523
1975       3950.       7044.    0.256792    0.514455    2.003390
1976       3002.       6587.    0.162134    0.396190    2.443590
1977       1409.       5415.    0.141485    0.697821    4.932119
1978        325.       4094.    0.049398    0.912689   18.476409
1979        262.       3338.    0.044233    0.784670   17.739643
1980        259.       2942.    0.064595    1.194737   18.495734
1981        243.       2455.    0.085683    1.662829   19.406822
1982        125.       2074.    0.046794    1.361505   29.095421
1983        282.       1747.    0.128989    1.327487   10.291440
1984        361.       1380.    0.248175    1.718460    6.924374
1985        346.       1050.    0.297308    1.450164    4.877644
1986        223.        939.    0.191885    1.283485    6.688813
1987         84.        755.    0.099635    1.783814   17.903536
1988         39.        589.    0.061735    2.056284   33.308392
1989          4.        471.    0.007057    1.585008  224.616151
1990          6.        394.    0.014114    2.435921  172.592017
1991         56.        325.    0.189328    3.217134   16.992423
1992         21.        226.    0.091669    2.349867   25.634148
1993          7.        196.    0.022717    0.981795   43.217715
1994        110.        234.    0.513086    1.837998    3.582242
1995         47.        164.    0.275427    1.694802    6.153360
1996         53.        112.    0.347251    0.942136    2.713131
1997         50.         83.    0.799587    2.207958    2.761375
1998         51.         42.    1.543348    1.085870    0.703581
1999         11.         31.    0.333578    1.397762    4.190211
2000         28.         54.    0.304279    0.709683    2.332340
2001         59.         80.       N/A         N/A
```

# Appendix E. Cape Cod-Gulf of Maine yellowtail flounder

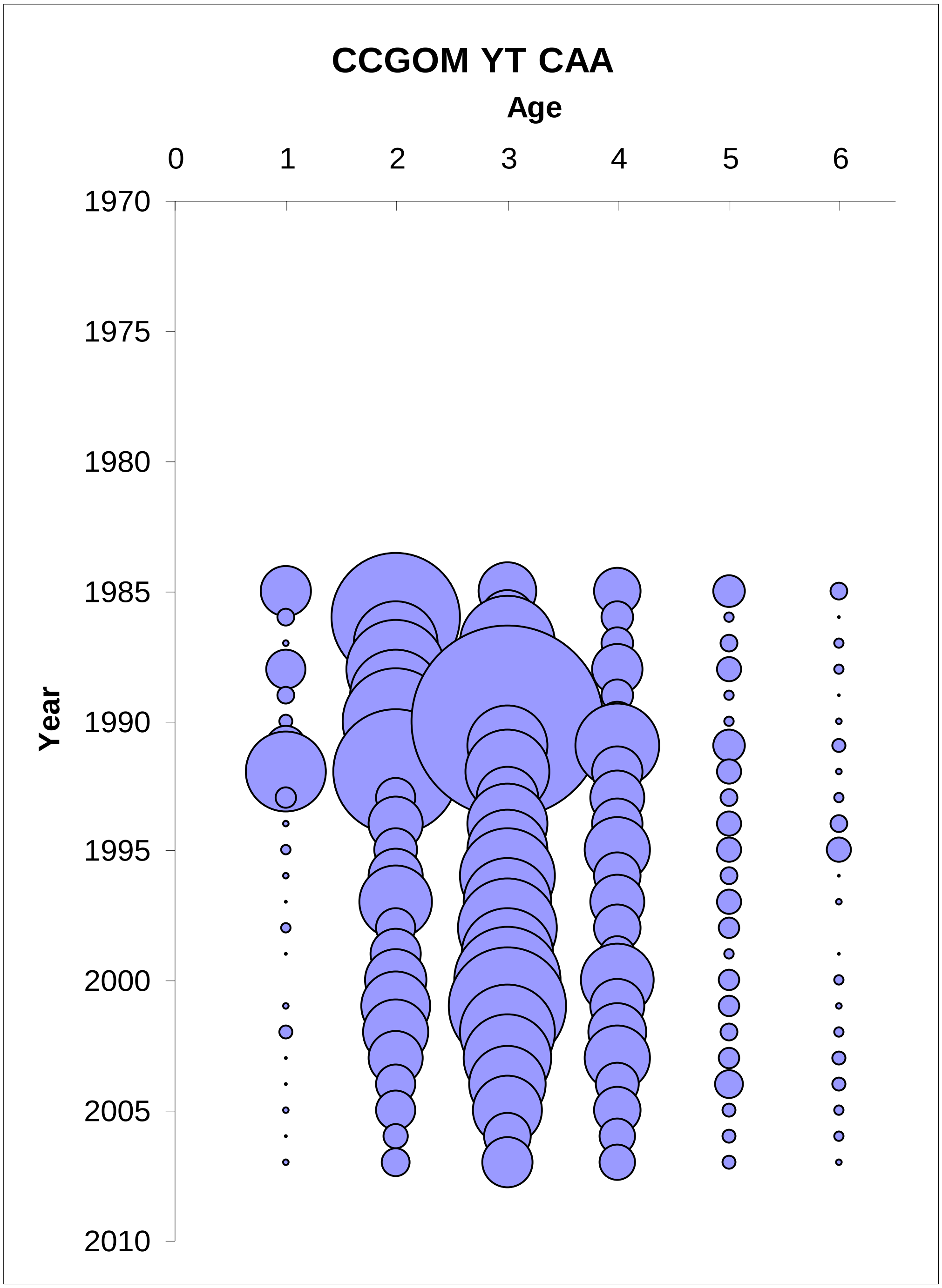
by Chris Legault, Larry Alade, Steve Cadrin, Jeremy King, and Sally Sherman



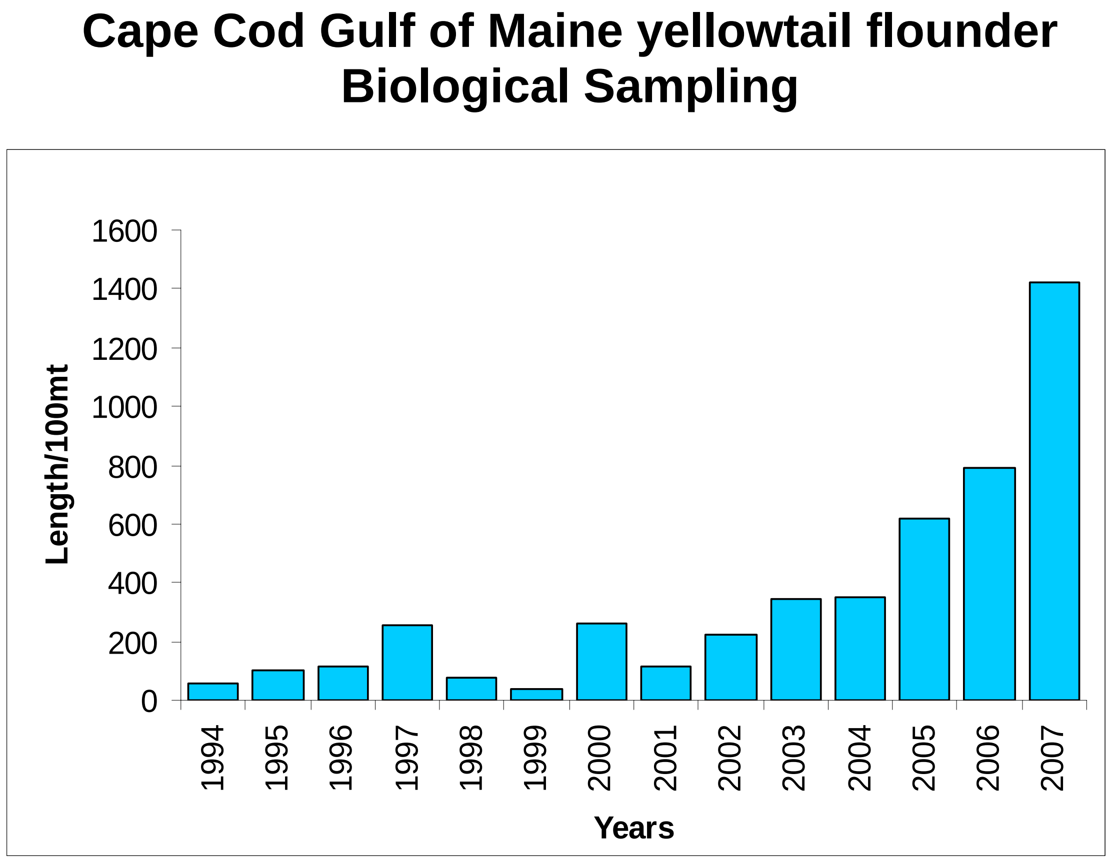
Appendix Figure E.1. Offshore Survey strata (25-27, 39, 40) used by NEFSC to estimate spring and fall (Stratum 27 excluded from the fall series) survey indices [Left] and the commercial statistical areas [Right] for all three yellowtail flounder stocks.



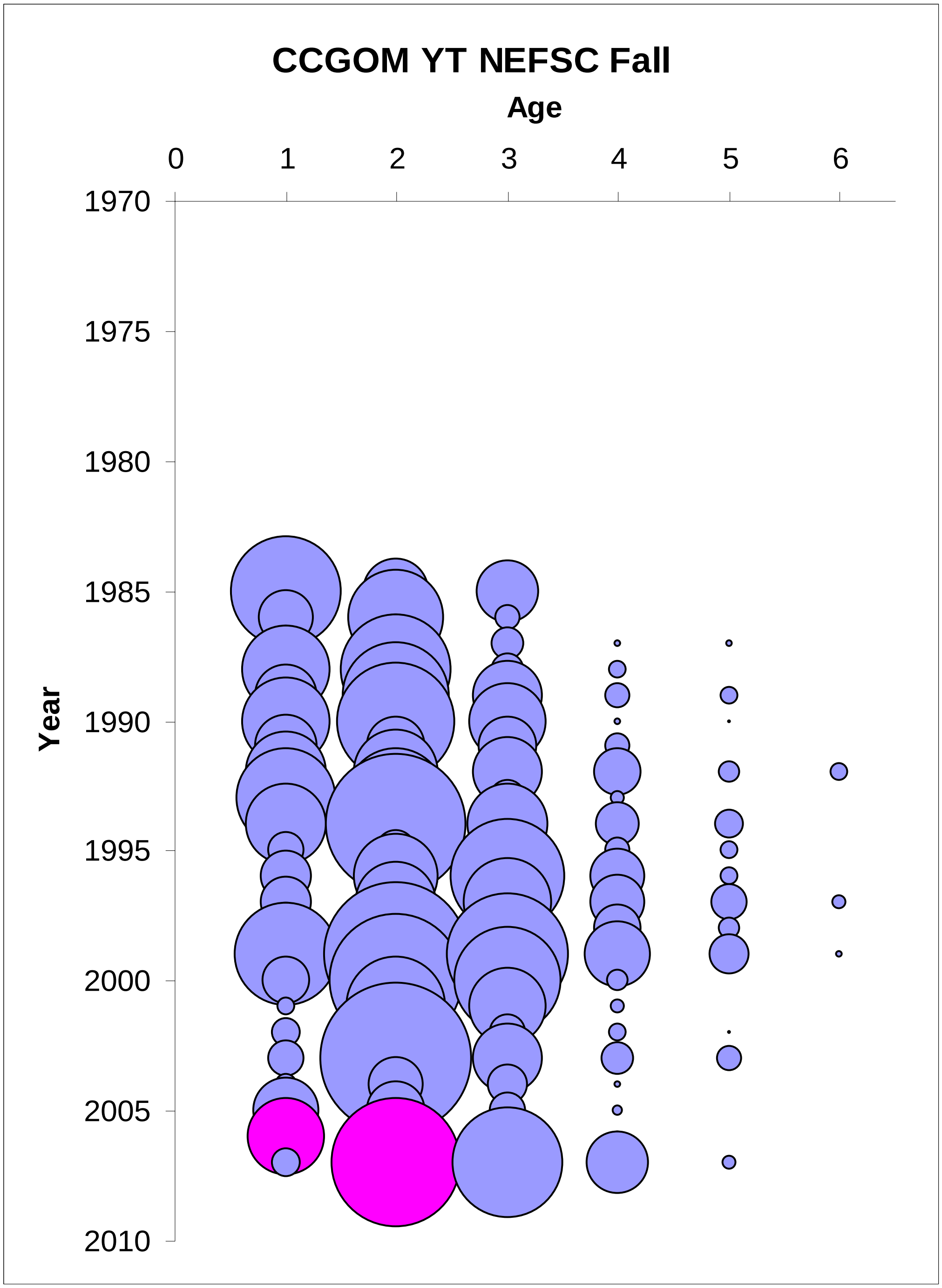
Appendix Figure E.2. Northeast Fisheries Science Center (NEFSC) Inshore Survey strata (56-66) to the left and Massachusetts Division of Marine Fisheries (MADMF) survey strata (17-36) to the right, used for estimating both spring and fall survey indices for the Cape Cod-Gulf of Maine yellowtail flounder stock.



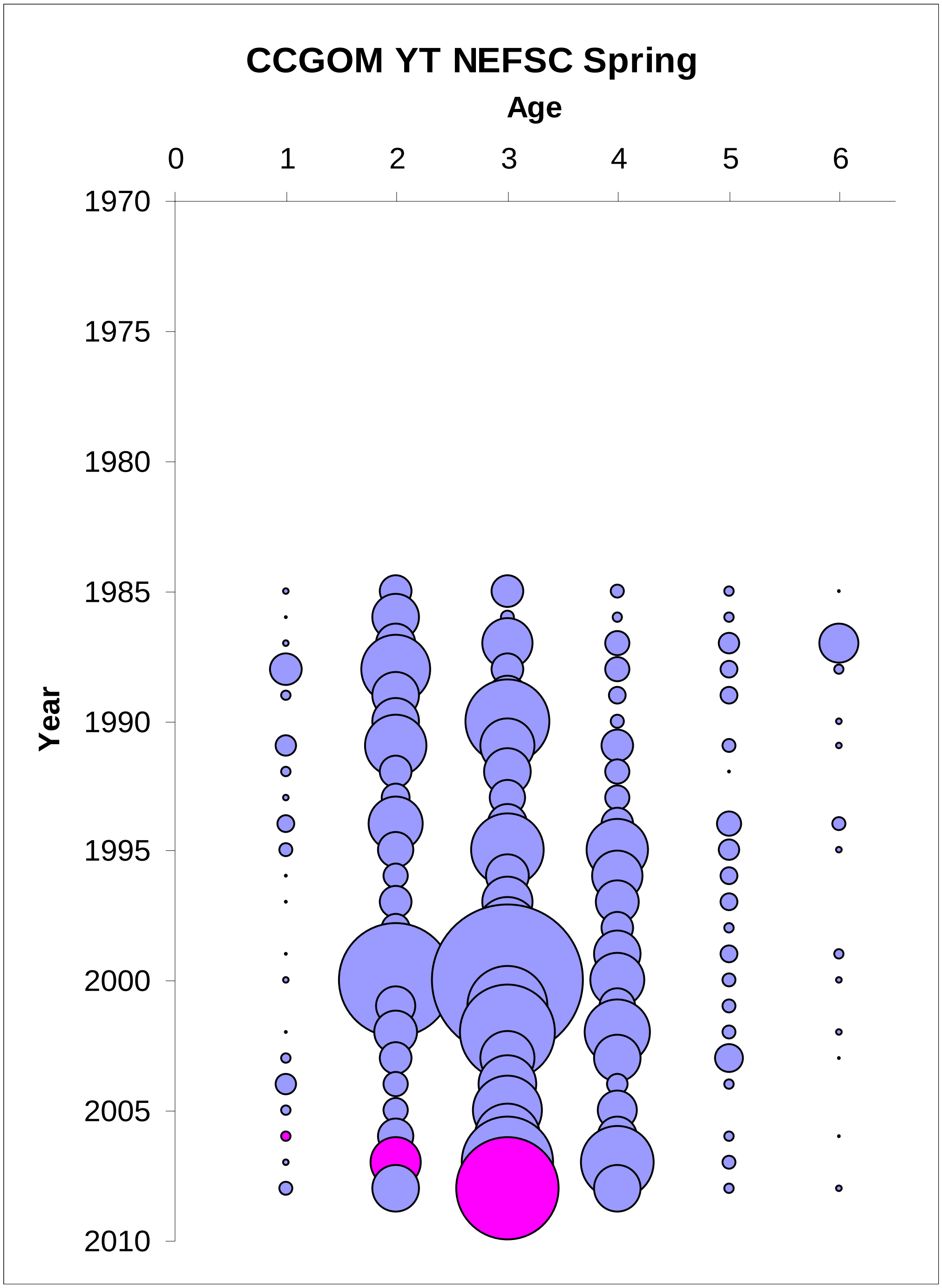
Appendix Figure E.3 Catch at age bubble plot for Cape Cod-Gulf of Maine yellowtail flounder.



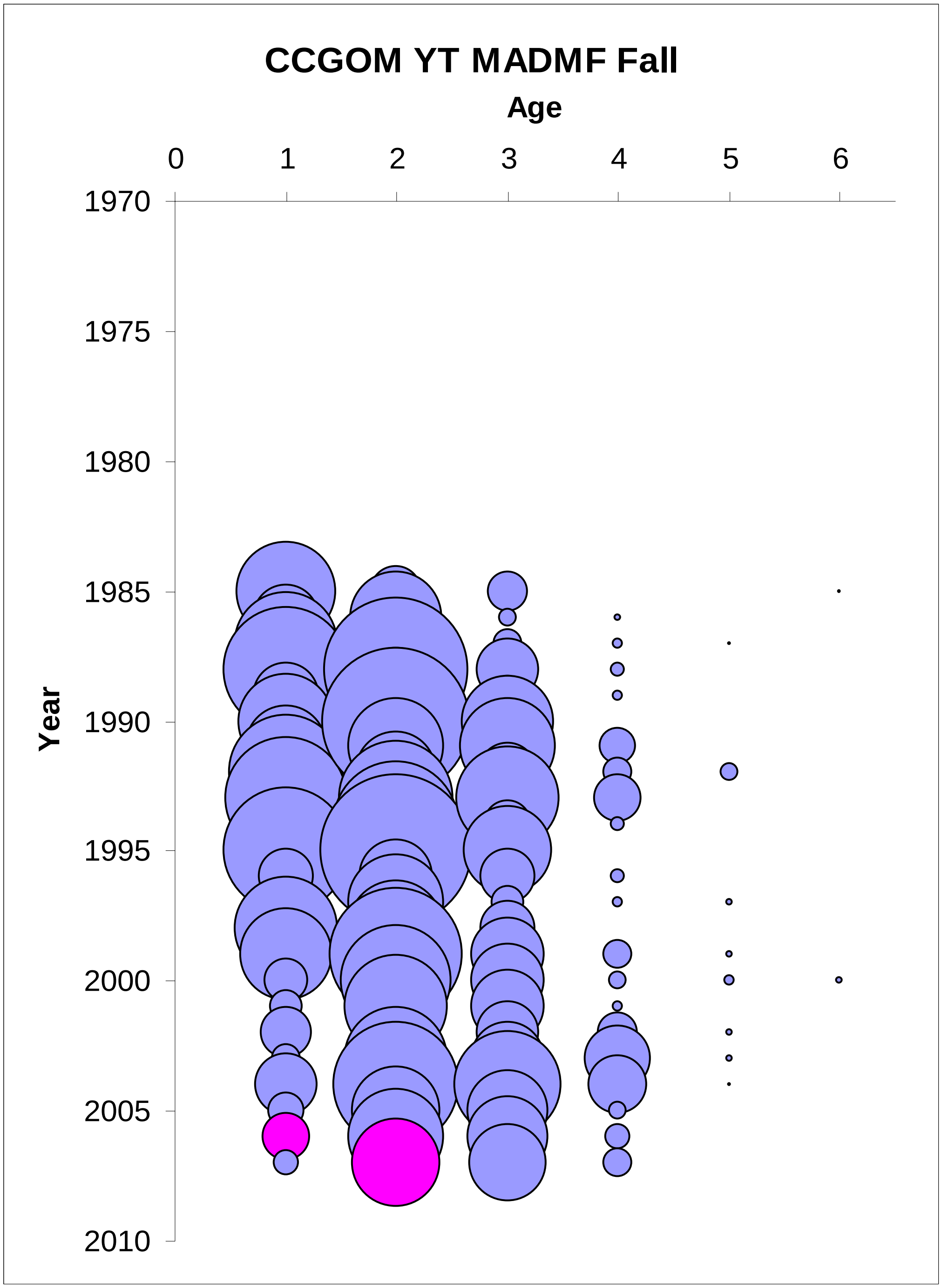
Appendix Figure E.4. Biological sampling for Cape Cod-Gulf of Maine yellowtail flounder.



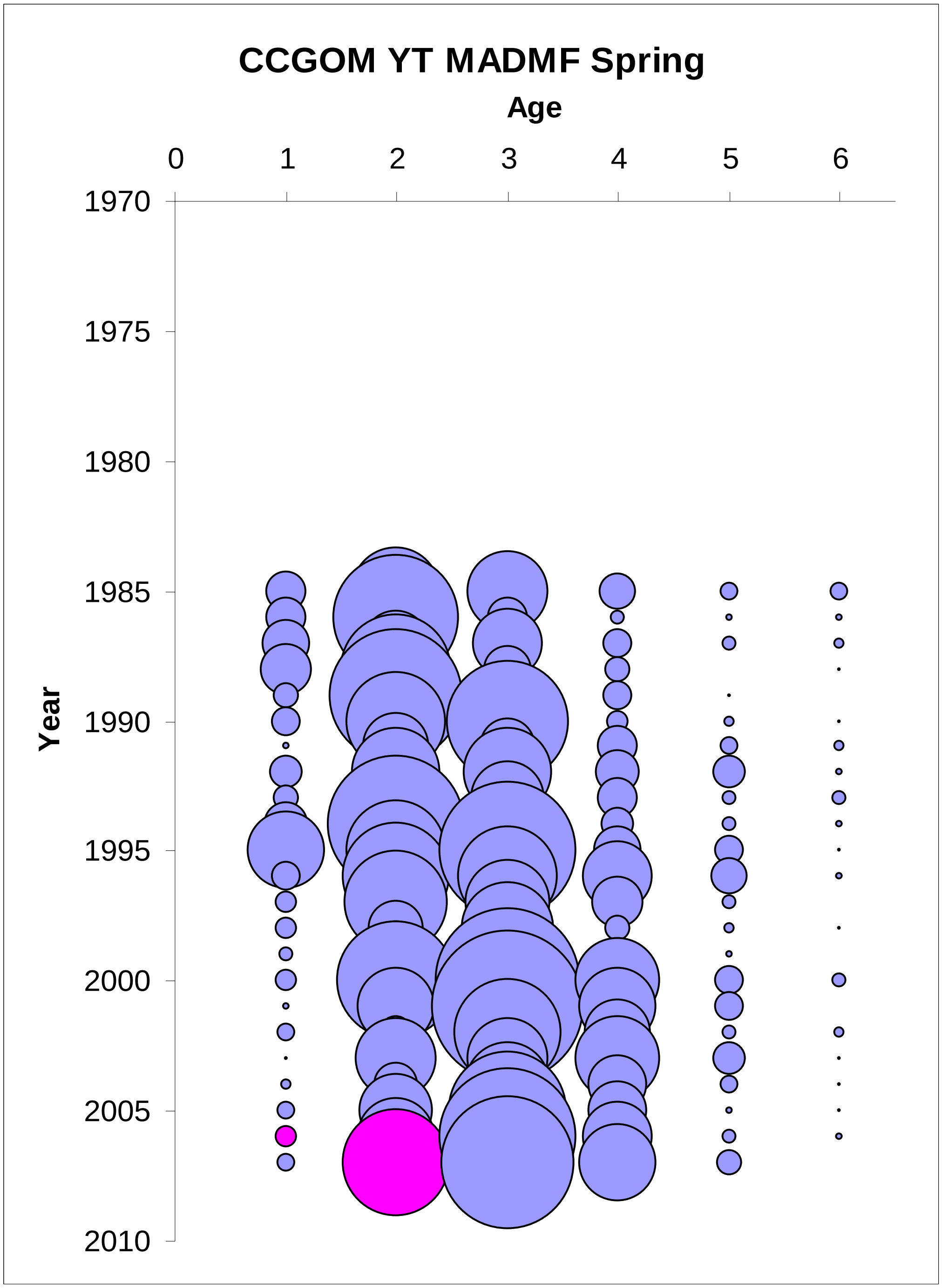
Appendix Figure E.5.a Survey bubble plot for CCGOM yellowtail NEFSC Fall survey. Note the 2005 year class is highlighted in pink.



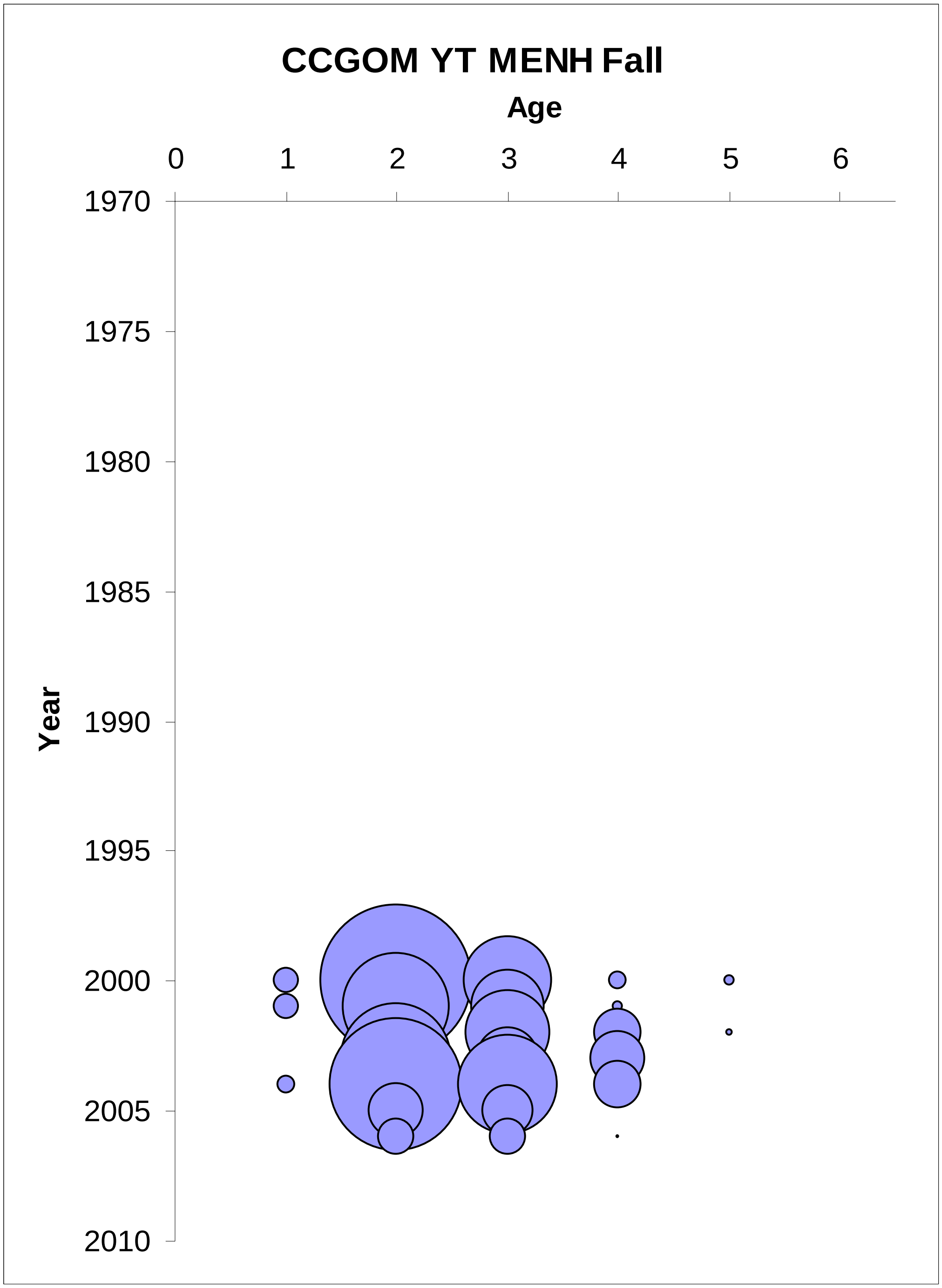
Appendix Figure E.5.b Survey bubble plot for CCGOM yellowtail NEFSC Spring survey. Note the 2005 year class is highlighted in pink.



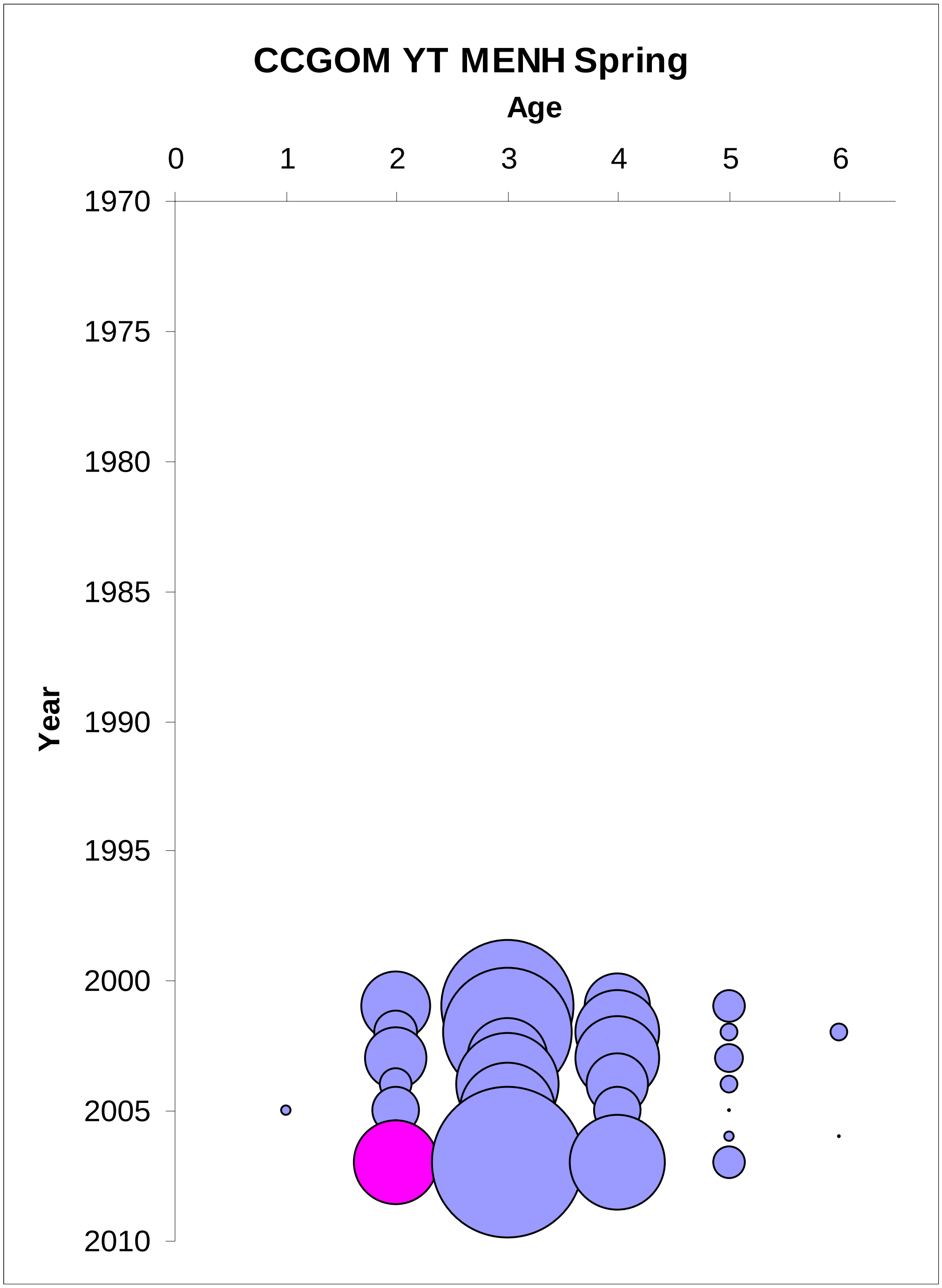
Appendix Figure E.5.c Survey bubble plot for CCGOM yellowtail MADMF Fall survey. Note the 2005 year class is highlighted in pink.



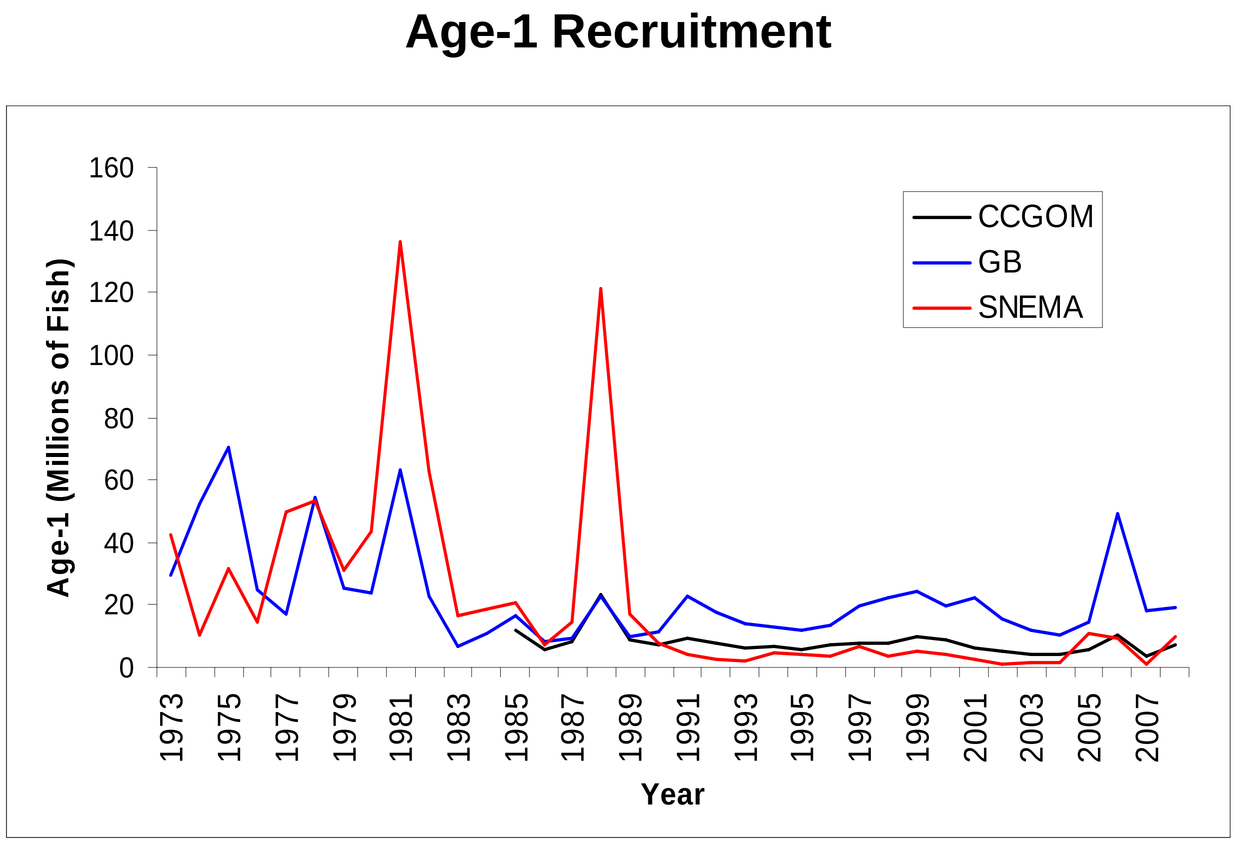
Appendix Figure E.5.d Survey bubble plot for CCGOM yellowtail MADMF Spring survey. Note the 2005 year class is highlighted in pink.



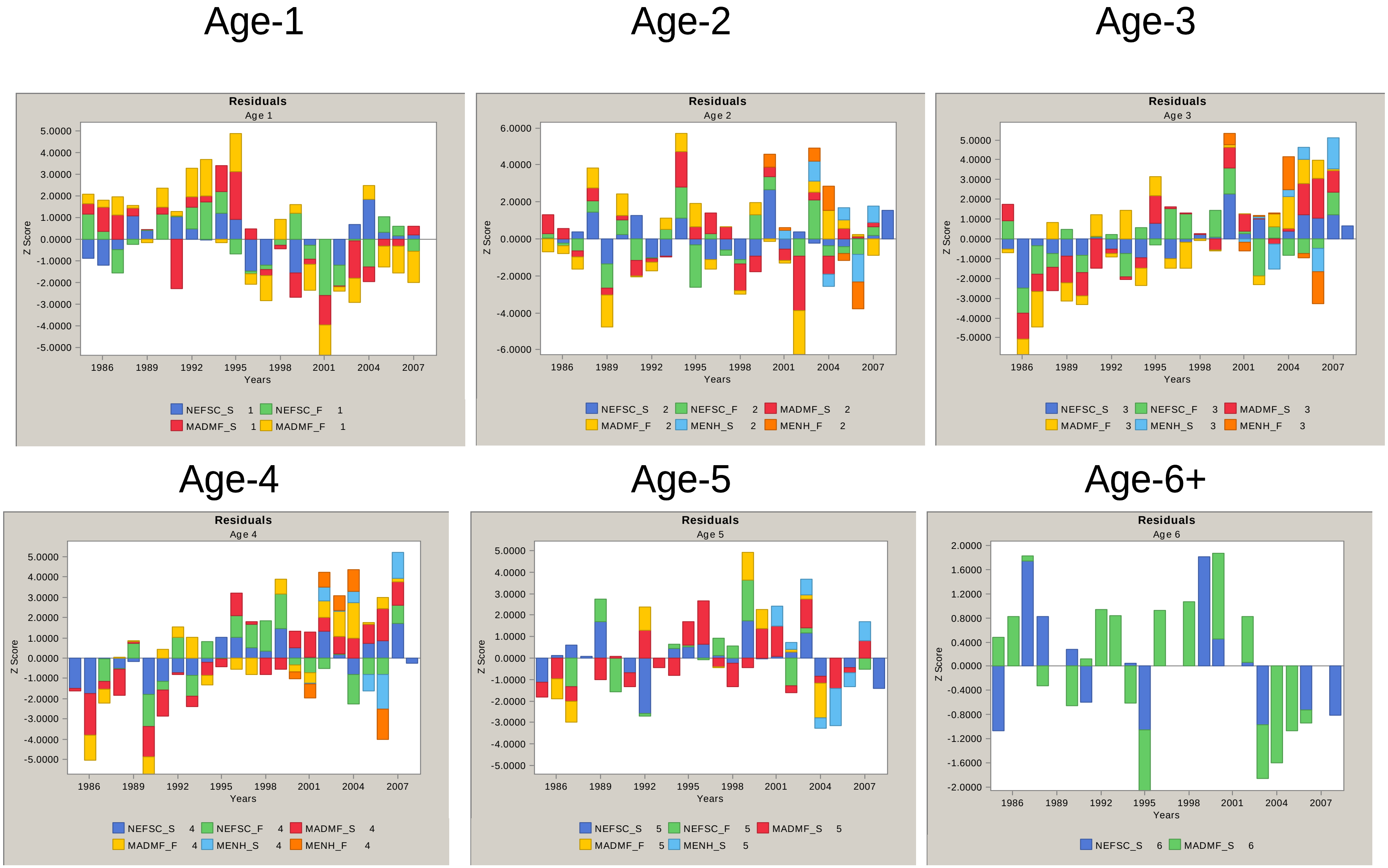
Appendix Figure E.5.e Survey bubble plot for CCGOM yellowtail MENH Fall survey. Note the 2005 year class is highlighted in pink.



Appendix Figure E.5.f Survey bubble plot for CCGOM yellowtail MENH Spring survey. Note the 2005 year class is highlighted in pink.



Appendix Figure E.6. Comparison of recruitment trends from the three yellowtail flounder stocks.



Appendix Figure E.7. Standardized residuals for all indices by age.

## Appendix VPA Output Report

```
VPA Version 2.8.0

Model ID: ccgom using new data for GARM2008 Biological Reference Points Meeting


Input File:
C:\WORKING\ASSESSMENTS\GARM3THEFINALE\YTASSESSMENTS\CCGOM\VPA\6PLUS\CCGOM6PLUS_R
Date of Run: 08-JUL-2008                         Time of Run: 21:04


Levenburg-Marquardt Algorithm Completed     4 Iterations
Residual Sum of Squares =     427.053

Number of Residuals     =    507
Number of Parameters    =      4
Degrees of Freedom      =    503
Mean Squared Residual   =     0.849013
Standard Deviation      =     0.921419


Number of Years =    23
Number of Ages  =     6
First Year      =  1985
Youngest Age    =     1
Oldest True Age =     5

Number of Survey Indices Available        =    36
Number of Survey Indices Used in Estimate =    29


VPA Classic Method - Auto Estimated Q's


Stock Numbers Predicted in Terminal Year Plus One (2008)
Age    Stock Predicted     Std. Error      CV

  2           2885.567   0.122086E+04   0.423091E+00
  3           6574.688   0.203245E+04   0.309132E+00
  4           2295.446   0.692206E+03   0.301556E+00
  5            615.057   0.189449E+03   0.308019E+00

Catchability Values for Each Survey Used in Estimate
INDEX     Catchability    Std. Error      CV

  1       0.428830E-02   0.110359E-02   0.257350E+00
  2       0.904027E-01   0.113937E-01   0.126032E+00
  3       0.282809E+00   0.412935E-01   0.146012E+00
  4       0.348440E+00   0.571812E-01   0.164106E+00
  5       0.413448E+00   0.950862E-01   0.229983E+00
  6       0.392500E+00   0.154293E+00   0.393104E+00
  7       0.586332E-01   0.963225E-02   0.164280E+00
  8       0.205993E+00   0.280670E-01   0.136252E+00
  9       0.231381E+00   0.344197E-01   0.148758E+00
 10       0.165885E+00   0.485054E-01   0.292403E+00
 11       0.548869E+00   0.215644E+00   0.392888E+00
 13       0.234298E-01   0.560606E-02   0.239271E+00
 14       0.340915E+00   0.440577E-01   0.129234E+00
 15       0.662967E+00   0.872223E-01   0.131564E+00
 16       0.587346E+00   0.978967E-01   0.166677E+00
 17       0.503147E+00   0.835408E-01   0.166037E+00
 18       0.349937E+00   0.992091E-01   0.283505E+00
 19       0.105901E+00   0.182217E-01   0.172064E+00
 20       0.305596E+00   0.447090E-01   0.146301E+00
 21       0.301859E+00   0.511952E-01   0.169600E+00
```

```
  22       0.134206E+00   0.426887E-01   0.318084E+00
  23       0.122468E+00   0.499577E-01   0.407925E+00
  26       0.661209E-04   0.121755E-04   0.184140E+00
  27       0.403312E-03   0.581534E-04   0.144190E+00
  28       0.500465E-03   0.864105E-04   0.172661E+00
  29       0.220345E-03   0.101714E-03   0.461614E+00
  32       0.134794E-03   0.521699E-04   0.387034E+00
  33       0.189250E-03   0.416766E-04   0.220220E+00
  34       0.805163E-04   0.601412E-04   0.746945E+00


-- Non-Linear Least Squares Fit --

 Default Tolerances Used

 Scaled Gradient Tolerance      =    6.055454E-06
 Scaled Step Tolerance          =    3.666853E-11
 Relative Function Tolerance    =    3.666853E-11
 Absolute Function Tolerance    =    4.930381E-32


 VPA Method Options

 - Catchability Values Estimated as an Analytic Function of N
 - Catch Equation Used in Cohort Solution
 - Plus Group Backward Calculation Method Used
 - Rivard Weights Used for JAN-1 Biomass
 - Rivard Weights Calculation Used  3 Years for Terminal Year Plus One

 - Heincke Rule Used in F-Oldest Calculation
 - F-Oldest Calculation in Years Prior to Terminal Year
   Uses Stock Sizes in Ages  4 to  5
 - Calculation of Population of Age 1 In Year 2008
   =  Geometric Mean of First Age Populations
      Year Range Applied =  1985 to  2007

 Stock Estimates

 Age   2
 Age   3
 Age   4
 Age   5

 Full F in Terminal Year               =   0.3603

 F in Oldest True Age in Terminal Year =   0.3603

 Full F Calculated Using Classic Method

 Age  Input Partial  Calc Partial   Fishing     Used In
      Recruitment    Recruitment    Mortality   Full F    Comments

   1      0.010          0.009       0.0044      NO      Stock Estimate in T+1
   2      0.100          0.079       0.0369      NO      Stock Estimate in T+1
   3      1.000          0.538       0.2522      YES     Stock Estimate in T+1
   4      1.000          1.000       0.4684      YES     Stock Estimate in T+1
   5      1.000          0.769       0.3603              Input PR * Full F
```

```
Catch At Age - Input Data

  AGE       1985        1986        1987        1988        1989
 ---------------------------------------------------------------------

   1       686.0        95.0        19.0       452.0       118.0
   2      1245.0      4225.0      1885.0      2582.0      2297.0
   3       907.0       785.0      2331.0      1503.0      1812.0
   4       635.0       304.0       309.0       744.0       298.0
   5       329.0        40.0       116.0       199.0        38.0
   6       121.0         8.0        53.0        41.0         9.0

  AGE       1990        1991        1992        1993        1994
 ---------------------------------------------------------------------

   1        84.0       465.0      1709.0       159.0        19.0
   2      2897.0      1372.0      3979.0       425.0       817.0
   3      9400.0      1765.0      1961.0      1074.0      1697.0
   4       493.0      1953.0       731.0       795.0       716.0
   5        35.0       298.0       191.0       111.0       210.0
   6        28.0        74.0        14.0        54.0       109.0

  AGE       1995        1996        1997        1998        1999
 ---------------------------------------------------------------------

   1        37.0        26.0         8.0        38.0         9.0
   2       526.0       787.0      1480.0       495.0       743.0
   3      1777.0      2428.0      2007.0      2512.0      2292.0
   4      1188.0       645.0       847.0       650.0       397.0
   5       178.0       104.0       180.0       152.0        32.0
   6       170.0         9.0        20.0         3.0         7.0

  AGE       2000        2001        2002        2003        2004
 ---------------------------------------------------------------------

   1         2.0        20.0        58.0        10.0        13.0
   2      1114.0      1342.0      1204.0       859.0       475.0
   3      2981.0      3721.0      2449.0      2122.0      1594.0
   4      1408.0       849.0       905.0      1200.0       571.0
   5       133.0       145.0       109.0       152.0       243.0
   6        35.0        24.0        34.0        70.0        75.0

  AGE       2005        2006        2007
 ---------------------------------------------------------------------

   1        15.0         7.0        14.0
   2       494.0       189.0       274.0
   3      1262.0       662.0       732.0
   4       585.0       390.0       410.0
   5        82.0        84.0        71.0
   6        48.0        54.0        14.0
```

```
Weight At Age - Input Data

  AGE      1985        1986        1987        1988        1989
---------------------------------------------------------------------

   1      0.1320      0.1030      0.0560      0.1230      0.1290
   2      0.2660      0.2500      0.2320      0.2060      0.2700
   3      0.3570      0.4280      0.3930      0.3380      0.3830
   4      0.4890      0.5340      0.5480      0.5230      0.6500
   5      0.6000      0.7300      0.6520      0.6960      0.9280
   6      0.7860      0.9960      0.9160      0.8410      1.3170

  AGE      1990        1991        1992        1993        1994
---------------------------------------------------------------------

   1      0.0790      0.1240      0.0530      0.0890      0.0890
   2      0.2540      0.2360      0.1350      0.1600      0.1740
   3      0.3700      0.3420      0.3250      0.3580      0.3540
   4      0.5500      0.5170      0.4980      0.4180      0.5120
   5      0.8240      0.7370      0.6020      0.7370      0.6740
   6      0.9700      1.0210      1.1690      0.9990      0.9040

  AGE      1995        1996        1997        1998        1999
---------------------------------------------------------------------

   1      0.0550      0.1090      0.1450      0.0790      0.1480
   2      0.3070      0.2660      0.2780      0.2090      0.3440
   3      0.3400      0.3830      0.3690      0.3930      0.4060
   4      0.4220      0.4620      0.4780      0.6090      0.6040
   5      0.6430      0.6090      0.6150      0.8560      0.6010
   6      0.7900      1.2660      0.8650      0.7070      0.8010

  AGE      2000        2001        2002        2003        2004
---------------------------------------------------------------------

   1      0.1010      0.2260      0.2180      0.0870      0.0770
   2      0.3490      0.3440      0.3620      0.3220      0.2510
   3      0.4320      0.4120      0.4400      0.4150      0.3720
   4      0.5660      0.5730      0.5650      0.5350      0.4600
   5      0.6230      0.7650      0.7740      0.6720      0.6090
   6      0.8350      0.8980      1.0420      0.9450      0.8310

  AGE      2005        2006        2007
---------------------------------------------------------------------

   1      0.0620      0.1060      0.0360
   2      0.2610      0.3050      0.2820
   3      0.3690      0.3920      0.3970
   4      0.5140      0.4780      0.4920
   5      0.6940      0.7810      0.6300
   6      0.9210      0.9260      0.8550
```

```
JAN-1 Weights at Age - Input Data

  AGE       1985        1986        1987        1988        1989
 ---------------------------------------------------------------------

   1       0.0959      0.0686      0.0292      0.0830      0.0919
   2       0.2097      0.1817      0.1546      0.1074      0.1822
   3       0.2919      0.3374      0.3134      0.2800      0.2809
   4       0.4002      0.4366      0.4843      0.4534      0.4687
   5       0.5417      0.5975      0.5901      0.6176      0.6967
   6       0.7860      0.9960      0.9160      0.8410      1.3170

  AGE       1990        1991        1992        1993        1994
 ---------------------------------------------------------------------

   1       0.0457      0.1188      0.0305      0.0637      0.0479
   2       0.1810      0.1365      0.1294      0.0921      0.1244
   3       0.3161      0.2947      0.2769      0.2198      0.2380
   4       0.4590      0.4374      0.4127      0.3686      0.4281
   5       0.7318      0.6367      0.5579      0.6058      0.5308
   6       0.9700      1.0210      1.1690      0.9990      0.9040

  AGE       1995        1996        1997        1998        1999
 ---------------------------------------------------------------------

   1       0.0250      0.0683      0.1208      0.0379      0.0964
   2       0.1653      0.1210      0.1741      0.1741      0.1649
   3       0.2432      0.3429      0.3133      0.3305      0.2913
   4       0.3865      0.3963      0.4279      0.4740      0.4872
   5       0.5738      0.5069      0.5330      0.6397      0.6050
   6       0.7900      1.2660      0.8650      0.7070      0.8010

  AGE       2000        2001        2002        2003        2004
 ---------------------------------------------------------------------

   1       0.0547      0.1786      0.1794      0.0512      0.0418
   2       0.2273      0.1864      0.2860      0.2649      0.1478
   3       0.3855      0.3792      0.3891      0.3876      0.3461
   4       0.4794      0.4975      0.4825      0.4852      0.4369
   5       0.6134      0.6580      0.6660      0.6162      0.5708
   6       0.8350      0.8980      1.0420      0.9450      0.8310

  AGE       2005        2006        2007        2008
 ---------------------------------------------------------------------

   1       0.0280      0.0650      0.0075      0.0335
   2       0.1418      0.1375      0.1729      0.1507
   3       0.3043      0.3199      0.3480      0.3241
   4       0.4373      0.4200      0.4392      0.4321
   5       0.5650      0.6336      0.5488      0.5825
   6       0.9210      0.9260      0.8550      0.9007
```

```
SSB Weight At Age - Input Data

  AGE      1985       1986       1987       1988       1989
----------------------------------------------------------------------

   1      0.1320     0.1030     0.0560     0.1230     0.1290
   2      0.2660     0.2500     0.2320     0.2060     0.2700
   3      0.3570     0.4280     0.3930     0.3380     0.3830
   4      0.4890     0.5340     0.5480     0.5230     0.6500
   5      0.6000     0.7300     0.6520     0.6960     0.9280
   6      0.7860     0.9960     0.9160     0.8410     1.3170

  AGE      1990       1991       1992       1993       1994
----------------------------------------------------------------------

   1      0.0790     0.1240     0.0530     0.0890     0.0890
   2      0.2540     0.2360     0.1350     0.1600     0.1740
   3      0.3700     0.3420     0.3250     0.3580     0.3540
   4      0.5500     0.5170     0.4980     0.4180     0.5120
   5      0.8240     0.7370     0.6020     0.7370     0.6740
   6      0.9700     1.0210     1.1690     0.9990     0.9040

  AGE      1995       1996       1997       1998       1999
----------------------------------------------------------------------

   1      0.0550     0.1090     0.1450     0.0790     0.1480
   2      0.3070     0.2660     0.2780     0.2090     0.3440
   3      0.3400     0.3830     0.3690     0.3930     0.4060
   4      0.4220     0.4620     0.4780     0.6090     0.6040
   5      0.6430     0.6090     0.6150     0.8560     0.6010
   6      0.7900     1.2660     0.8650     0.7070     0.8010

  AGE      2000       2001       2002       2003       2004
----------------------------------------------------------------------

   1      0.1010     0.2260     0.2180     0.0870     0.0770
   2      0.3490     0.3440     0.3620     0.3220     0.2510
   3      0.4320     0.4120     0.4400     0.4150     0.3720
   4      0.5660     0.5730     0.5650     0.5350     0.4600
   5      0.6230     0.7650     0.7740     0.6720     0.6090
   6      0.8350     0.8980     1.0420     0.9450     0.8310

  AGE      2005       2006       2007
----------------------------------------------------------------------

   1      0.0620     0.1060     0.0360
   2      0.2610     0.3050     0.2820
   3      0.3690     0.3920     0.3970
   4      0.5140     0.4780     0.4920
   5      0.6940     0.7810     0.6300
   6      0.9210     0.9260     0.8550
```

```
Natural Mortality - Input Data

  AGE       1985        1986        1987        1988        1989
 ______________________________________________________________________

   1       0.2000      0.2000      0.2000      0.2000      0.2000
   2       0.2000      0.2000      0.2000      0.2000      0.2000
   3       0.2000      0.2000      0.2000      0.2000      0.2000
   4       0.2000      0.2000      0.2000      0.2000      0.2000
   5       0.2000      0.2000      0.2000      0.2000      0.2000
   6       0.2000      0.2000      0.2000      0.2000      0.2000

  AGE       1990        1991        1992        1993        1994
 ______________________________________________________________________

   1       0.2000      0.2000      0.2000      0.2000      0.2000
   2       0.2000      0.2000      0.2000      0.2000      0.2000
   3       0.2000      0.2000      0.2000      0.2000      0.2000
   4       0.2000      0.2000      0.2000      0.2000      0.2000
   5       0.2000      0.2000      0.2000      0.2000      0.2000
   6       0.2000      0.2000      0.2000      0.2000      0.2000

  AGE       1995        1996        1997        1998        1999
 ______________________________________________________________________

   1       0.2000      0.2000      0.2000      0.2000      0.2000
   2       0.2000      0.2000      0.2000      0.2000      0.2000
   3       0.2000      0.2000      0.2000      0.2000      0.2000
   4       0.2000      0.2000      0.2000      0.2000      0.2000
   5       0.2000      0.2000      0.2000      0.2000      0.2000
   6       0.2000      0.2000      0.2000      0.2000      0.2000

  AGE       2000        2001        2002        2003        2004
 ______________________________________________________________________

   1       0.2000      0.2000      0.2000      0.2000      0.2000
   2       0.2000      0.2000      0.2000      0.2000      0.2000
   3       0.2000      0.2000      0.2000      0.2000      0.2000
   4       0.2000      0.2000      0.2000      0.2000      0.2000
   5       0.2000      0.2000      0.2000      0.2000      0.2000
   6       0.2000      0.2000      0.2000      0.2000      0.2000

  AGE       2005        2006        2007
 ______________________________________________________________________

   1       0.2000      0.2000      0.2000
   2       0.2000      0.2000      0.2000
   3       0.2000      0.2000      0.2000
   4       0.2000      0.2000      0.2000
   5       0.2000      0.2000      0.2000
   6       0.2000      0.2000      0.2000

Proportion of Natural Mortality Before Spawning =       0.4167
Proportion of Fishing Mortality Before Spawning =       0.4167
```

```
Maturity - Input Data

  AGE      1985        1986        1987        1988        1989
--------------------------------------------------------------------

   1      0.0000      0.0000      0.0000      0.0000      0.0000
   2      0.1710      0.1710      0.1710      0.1710      0.1710
   3      0.8330      0.8330      0.8330      0.8330      0.8330
   4      0.9770      0.9770      0.9770      0.9770      0.9770
   5      1.0000      1.0000      1.0000      1.0000      1.0000
   6      1.0000      1.0000      1.0000      1.0000      1.0000

  AGE      1990        1991        1992        1993        1994
--------------------------------------------------------------------

   1      0.0000      0.0000      0.0000      0.0000      0.0000
   2      0.1710      0.1710      0.1710      0.1710      0.1710
   3      0.8330      0.8330      0.8330      0.8330      0.8330
   4      0.9770      0.9770      0.9770      0.9770      0.9770
   5      1.0000      1.0000      1.0000      1.0000      1.0000
   6      1.0000      1.0000      1.0000      1.0000      1.0000

  AGE      1995        1996        1997        1998        1999
--------------------------------------------------------------------

   1      0.0000      0.0000      0.0000      0.0000      0.0000
   2      0.1710      0.1710      0.1710      0.1710      0.1710
   3      0.8330      0.8330      0.8330      0.8330      0.8330
   4      0.9770      0.9770      0.9770      0.9770      0.9770
   5      1.0000      1.0000      1.0000      1.0000      1.0000
   6      1.0000      1.0000      1.0000      1.0000      1.0000

  AGE      2000        2001        2002        2003        2004
--------------------------------------------------------------------

   1      0.0000      0.0000      0.0000      0.0000      0.0000
   2      0.1710      0.1710      0.1710      0.1710      0.1710
   3      0.8330      0.8330      0.8330      0.8330      0.8330
   4      0.9770      0.9770      0.9770      0.9770      0.9770
   5      1.0000      1.0000      1.0000      1.0000      1.0000
   6      1.0000      1.0000      1.0000      1.0000      1.0000

  AGE      2005        2006        2007
--------------------------------------------------------------------

   1      0.0000      0.0000      0.0000
   2      0.1710      0.1710      0.1710
   3      0.8330      0.8330      0.8330
   4      0.9770      0.9770      0.9770
   5      1.0000      1.0000      1.0000
   6      1.0000      1.0000      1.0000
```

```
 Input Partial Recruitment

   AGE

    1       0.0100
    2       0.1000
    3       1.0000
    4       1.0000
    5       1.0000


 Input F-Plus Ratio

   YEAR

   1985       1.0000
   1986       1.0000
   1987       1.0000
   1988       1.0000
   1989       1.0000
   1990       1.0000
   1991       1.0000
   1992       1.0000
   1993       1.0000
   1994       1.0000
   1995       1.0000
   1996       1.0000
   1997       1.0000
   1998       1.0000
   1999       1.0000
   2000       1.0000
   2001       1.0000
   2002       1.0000
   2003       1.0000
   2004       1.0000
   2005       1.0000
   2006       1.0000
   2007       1.0000


SURVEY - INPUT DATA


INDEX            1           2           3           4           5

SURVEY TAG     NEFSC_S     NEFSC_S     NEFSC_S     NEFSC_S     NEFSC_S

AGE               1           2           3           4           5
TIME           JAN-1       JAN-1       JAN-1       JAN-1       JAN-1
TYPE          NUMBERS     NUMBERS     NUMBERS     NUMBERS     NUMBERS
RETRO FLAG       1           1           1           1           1
 ------------------------------------------------------------------------

    1985      18.1030    310.9470    333.9900     80.6700     49.9070
    1986       6.2530    692.5290     76.4630     52.8020     38.4050
    1987      20.4570    524.5110    773.5080    208.8550    177.0110
    1988     345.6470   1459.2440    355.9140    197.8160    103.5980
    1989      58.1680    714.8390    473.2140    122.1250    127.2580
    1990       0.0000    727.5380   2025.3260     81.7120      0.0000
    1991     136.7150   1167.4030    945.6560    327.1200     74.1090
    1992      59.6730    352.9810    708.2390    192.3740      7.0250
    1993      24.5480    253.0500    403.3900    217.3080      0.0000
    1994     113.8260    863.0170    517.7180    310.4070    197.9320
    1995      70.3650    401.2280   1535.4760   1163.6200    157.3260
    1996       5.7130    211.0550    552.1090    775.2840    129.2650
    1997       8.1440    360.3530    781.4210    596.4580    111.2010
    1998       0.0000    279.7210   1135.6370    347.9240     55.3880
```

```
    1999      6.7930    327.1580   1402.3500    715.2640    128.1850
    2000     26.8640   3717.7030   6558.6090    911.5350     64.3050
    2001      0.0000    463.4490   1882.7820    397.4070     83.3340
    2002      5.7510    603.2900   2729.2800   1258.9580     82.2530
    2003     36.0890    333.2570    928.3640    678.6340    303.8840
    2004    141.6940    230.3540   1010.0770    138.3750     54.1920
    2005     34.2750    224.6800   1474.6060    495.6400      0.0000
    2006     51.9920    429.4440   1319.6730    465.9580     36.6300
    2007     19.4540    836.8090   2410.1880   1648.8390     82.4840
    2008     90.0500    670.6830   3017.4540    656.2080     56.8940


 SURVEY - INPUT DATA


INDEX             6           7           8           9          10

SURVEY TAG     NEFSC_S     NEFSC_F     NEFSC_F     NEFSC_F     NEFSC_F

AGE                6           1           2           3           4
TIME           JAN-1       MEAN        MEAN        MEAN        MEAN
TYPE          NUMBERS     NUMBERS     NUMBERS     NUMBERS     NUMBERS
RETRO FLAG       1           0           0           0           0
 ________________________________________________________________________

    1985     12.7370   1481.9910    568.3090    483.1240      0.0000
    1986      0.0000    398.4850   1108.1160     97.4740      0.0000
    1987    487.2250    181.5650    436.4130    160.7840     14.6050
    1988     59.4030   1006.1060   1475.7180    142.5120     43.2040
    1989      0.0000    474.0200   1408.5800    609.2610     83.7700
    1990     32.6150    957.0150   1695.7260    785.8080     12.4500
    1991     15.4390    503.0050    449.1530    448.2520     90.7830
    1992      0.0000    810.3210    887.2390    604.1460    304.9680
    1993      0.0000   1215.5620   1232.5160    164.1940     27.0550
    1994     66.6210    795.3300   2370.1630    835.2530    265.0780
    1995     18.4500    179.3460    218.1750    345.6950     91.1040
    1996      0.0000    340.4840    935.0750   1585.1910    379.3440
    1997      0.0000    337.4920    799.7690    950.4520    403.1180
    1998      0.0000    328.6130    959.8460    385.0060    317.0960
    1999     56.7010   1324.0380   2602.5560   1777.7590    543.9890
    2000     32.1520    287.8540   2183.9010   1443.3550     73.5720
    2001      0.0000     43.3330   1227.9470    730.0580     30.4000
    2002     19.9940    128.4530    458.0310    180.3430     48.8980
    2003      9.7650    192.0210   2822.8220    593.9480    139.6160
    2004      0.0000     76.1780    371.3020    202.0580      7.8490
    2005      0.0000    533.6620    425.2180    174.6170     21.2000
    2006     12.9300    780.3070    487.2410    273.8280     21.9720
    2007      0.0000    119.8640   2095.6590   1539.5100    490.7480
    2008     17.7550      0.0000      0.0000      0.0000      0.0000
```

```
 SURVEY - INPUT DATA

INDEX            11          12          13          14          15

SURVEY TAG     NEFSC_F     NEFSC_F     MADMF_S     MADMF_S     MADMF_S

AGE                5           6           1           2           3
TIME           MEAN        MEAN        JAN-1       JAN-1       JAN-1
TYPE          NUMBERS     NUMBERS     NUMBERS     NUMBERS     NUMBERS
RETRO FLAG       0           0           1           1           1
 ------------------------------------------------------------------------

    1985        0.0000      0.0000    497.0250   2105.0030   1908.8820
    1986        0.0000      0.0000    501.8520   4329.5450    464.1090
    1987       11.8710      0.0000    680.9680   1275.2300   1346.4370
    1988        0.0000      0.0000    813.9460   3487.8670    665.1130
    1989       57.9050      0.0000    203.3910   4952.9930    910.6080
    1990        2.6700      0.0000    260.0330   2752.1500   4106.4600
    1991        0.0000      0.0000     15.7170   1211.2920    822.4220
    1992       58.9030     45.8100    323.1760   2204.7650   2112.4920
    1993        0.0000      0.0000    188.2490   1625.2320   1489.0710
    1994      114.0090      0.0000    607.6480   5237.6300   1739.8600
    1995       55.0740      0.0000   1659.0530   2801.7700   5042.3860
    1996       42.9140      0.0000    290.0960   3230.8240   2758.7060
    1997      187.6780     37.0270    133.0880   2988.6480   2082.4010
    1998       75.2130      0.0000    157.7480    841.1020   2369.4250
    1999      228.1470      8.7180     65.0630   1290.6180   2134.1890
    2000        0.0000      0.0000    158.4610   3766.1960   5789.4590
    2001        0.0000      0.0000     32.1750   1681.2430   6305.2450
    2002        6.2090      0.0000    115.7800    296.3500   3236.0910
    2003       81.2280      0.0000     12.6720   1873.4150   1796.0640
    2004        0.0000      0.0000     42.3510    608.1690   1987.8790
    2005        0.0000      0.0000     92.1360   1537.7320   3878.1360
    2006        0.0000      0.0000    167.2660   1648.8760   5099.9610
    2007       40.1160      0.0000    127.1360   3237.1610   4743.1840
    2008        0.0000      0.0000      0.0000      0.0000      0.0000

 SURVEY - INPUT DATA

INDEX            16          17          18          19          20

SURVEY TAG     MADMF_S     MADMF_S     MADMF_S     MADMF_F     MADMF_F

AGE                4           5           6           1           2
TIME           JAN-1       JAN-1       JAN-1       MEAN        MEAN
TYPE          NUMBERS     NUMBERS     NUMBERS     NUMBERS     NUMBERS
RETRO FLAG       1           1           1           0           0
 ------------------------------------------------------------------------

    1985      411.8830    120.1970     92.1910   1564.3110    447.5140
    1986       68.4920     19.2010     15.2510    712.4570   1357.0800
    1987      267.2470     69.3420     40.6780   1605.8940    629.5920
    1988      183.7780      0.0000     11.1910   2457.5290   3083.3080
    1989      252.1060     12.0420      0.0000    723.3600   1431.1860
    1990      176.7290     37.9630      8.9970   1425.3250   3273.5870
    1991      509.6970    111.9130     36.8650   1030.9690   1409.6080
    1992      559.5370    359.5750     20.7370   1968.5960    993.4730
    1993      495.4610     62.1560     79.9020   2301.7830   1998.6590
    1994      357.3800     81.9870     26.5240    562.1700   2375.2950
    1995      635.8460    253.8890      5.7330   2356.2310   3484.5480
    1996     1418.9890    393.6150     14.6470    468.3060    815.5100
    1997      724.2240     87.2260      0.0000    274.7080   1410.2660
    1998      228.6260     38.6760      4.4160   1617.7710   1438.8480
```

```
    1999      239.7620     17.8290      0.0000   1296.7350   2669.8890
    2000     1941.1660    238.9120     82.7000    317.0860   1825.2490
    2001     1739.2570    280.3030      0.0000    188.3590   1638.2610
    2002     1244.8380     58.5070     40.7060    427.2710    178.8690
    2003     1977.8950    301.6710     11.9040    151.0820   1612.4220
    2004      978.5240    124.1460      5.0740    638.1770   2381.7410
    2005     1018.2970     19.0090      6.3640    242.0940   1165.0450
    2006     1370.3840     60.4820     25.1530    343.2540   1370.3840
    2007     1731.2200    182.7090      0.0000    105.0550   1206.4640
    2008        0.0000      0.0000      0.0000      0.0000      0.0000


 SURVEY - INPUT DATA


INDEX            21          22          23          24          25

SURVEY TAG     MADMF_F     MADMF_F     MADMF_F     MADMF_F     MENH_S

AGE                3           4           5           6           1
TIME            MEAN        MEAN        MEAN        MEAN       JAN-1
TYPE           NUMBERS     NUMBERS     NUMBERS     NUMBERS     NUMBERS
RETRO FLAG        0           0           0           0           1
 ________________________________________________________________________

    1985      282.6900      0.0000      0.0000      4.8820   -999.0000
    1986       55.5450      9.1070      1.9750      0.0000   -999.0000
    1987      135.1180     19.3930      5.4580      0.0000   -999.0000
    1988      622.6800     41.2820      0.0000      0.0000   -999.0000
    1989      263.3520     28.3350      0.0000      0.0000   -999.0000
    1990     1327.7580      1.5910      0.0000      0.0000   -999.0000
    1991     1379.0510    235.1270      0.0000      0.0000   -999.0000
    1992      569.5490    129.3310     55.5720      0.0000   -999.0000
    1993     1591.3700    393.0120      0.0000      0.0000   -999.0000
    1994      349.2340     36.0700      0.0000      0.0000   -999.0000
    1995     1235.5120      0.0000      0.0000      0.0000   -999.0000
    1996      463.4230     32.8330      0.0000      0.0000   -999.0000
    1997      171.2710     21.6970     12.5900      0.0000   -999.0000
    1998      464.0270      0.0000      0.0000      0.0000   -999.0000
    1999      846.4780    134.7890     16.5130      0.0000   -999.0000
    2000      808.5150     56.1480     23.8640      8.5850   -999.0000
    2001      868.5860     29.6790      0.0000      0.0000      0.0000
    2002      626.3550    250.7340      9.9300      0.0000      0.0000
    2003      856.7370    655.8150     15.9910      0.0000      0.0000
    2004     1743.5910    522.5620      2.5240      0.0000      0.0000
    2005     1046.9880     56.2310      0.0000      0.0000      0.0210
    2006     1044.4370    111.9950      0.0000      0.0000      0.0000
    2007      931.7840    155.7180      0.0000      0.0000      0.0000
    2008        0.0000      0.0000      0.0000      0.0000      0.0000
```

```
 SURVEY - INPUT DATA


INDEX           26          27          28          29          30

SURVEY TAG     MENH_S      MENH_S      MENH_S      MENH_S      MENH_S

AGE               2           3           4           5           6
TIME           JAN-1       JAN-1       JAN-1       JAN-1       JAN-1
TYPE          NUMBERS     NUMBERS     NUMBERS     NUMBERS     NUMBERS
RETRO FLAG       1           1           1           1           1
 ________________________________________________________________________

    1985     -999.0000   -999.0000   -999.0000   -999.0000   -999.0000
    1986     -999.0000   -999.0000   -999.0000   -999.0000   -999.0000
    1987     -999.0000   -999.0000   -999.0000   -999.0000   -999.0000
    1988     -999.0000   -999.0000   -999.0000   -999.0000   -999.0000
    1989     -999.0000   -999.0000   -999.0000   -999.0000   -999.0000
    1990     -999.0000   -999.0000   -999.0000   -999.0000   -999.0000
    1991     -999.0000   -999.0000   -999.0000   -999.0000   -999.0000
    1992     -999.0000   -999.0000   -999.0000   -999.0000   -999.0000
    1993     -999.0000   -999.0000   -999.0000   -999.0000   -999.0000
    1994     -999.0000   -999.0000   -999.0000   -999.0000   -999.0000
    1995     -999.0000   -999.0000   -999.0000   -999.0000   -999.0000
    1996     -999.0000   -999.0000   -999.0000   -999.0000   -999.0000
    1997     -999.0000   -999.0000   -999.0000   -999.0000   -999.0000
    1998     -999.0000   -999.0000   -999.0000   -999.0000   -999.0000
    1999     -999.0000   -999.0000   -999.0000   -999.0000   -999.0000
    2000     -999.0000   -999.0000   -999.0000   -999.0000   -999.0000
    2001        0.5990      2.0870      0.5350      0.1320      0.0000
    2002        0.2260      1.9810      0.8450      0.0480      0.0410
    2003        0.4730      0.8050      0.8500      0.1140      0.0000
    2004        0.1510      1.2410      0.4920      0.0390      0.0000
    2005        0.2870      1.1070      0.2800      0.0030      0.0000
    2006        0.1480      0.5600      0.1520      0.0140      0.0030
    2007        0.8590      2.6610      1.0710      0.1290      0.0000
    2008        0.0000      0.0000      0.0000      0.0000      0.0000

 SURVEY - INPUT DATA


INDEX           31          32          33          34          35

SURVEY TAG     MENH_F      MENH_F      MENH_F      MENH_F      MENH_F

AGE               1           2           3           4           5
TIME           MEAN        MEAN        MEAN        MEAN        MEAN
TYPE          NUMBERS     NUMBERS     NUMBERS     NUMBERS     NUMBERS
RETRO FLAG       0           0           0           0           0
 ________________________________________________________________________

    1985     -999.0000   -999.0000   -999.0000   -999.0000   -999.0000
    1986     -999.0000   -999.0000   -999.0000   -999.0000   -999.0000
    1987     -999.0000   -999.0000   -999.0000   -999.0000   -999.0000
    1988     -999.0000   -999.0000   -999.0000   -999.0000   -999.0000
    1989     -999.0000   -999.0000   -999.0000   -999.0000   -999.0000
    1990     -999.0000   -999.0000   -999.0000   -999.0000   -999.0000
    1991     -999.0000   -999.0000   -999.0000   -999.0000   -999.0000
    1992     -999.0000   -999.0000   -999.0000   -999.0000   -999.0000
    1993     -999.0000   -999.0000   -999.0000   -999.0000   -999.0000
    1994     -999.0000   -999.0000   -999.0000   -999.0000   -999.0000
    1995     -999.0000   -999.0000   -999.0000   -999.0000   -999.0000
    1996     -999.0000   -999.0000   -999.0000   -999.0000   -999.0000
    1997     -999.0000   -999.0000   -999.0000   -999.0000   -999.0000
    1998     -999.0000   -999.0000   -999.0000   -999.0000   -999.0000
```

```
    1999     -999.0000   -999.0000   -999.0000   -999.0000   -999.0000
    2000        0.0530      1.7990      0.6400      0.0300      0.0100
    2001        0.0620      0.9070      0.4190      0.0110      0.0000
    2002        0.0000      0.2020      0.5600      0.1770      0.0050
    2003        0.0000      0.9500      0.3340      0.2580      0.0000
    2004        0.0320      1.3740      0.7800      0.1840      0.0000
    2005        0.0000      0.2520      0.2120      0.0000      0.0000
    2006        0.0000      0.1210      0.1200      0.0020      0.0000
    2007     -999.0000   -999.0000   -999.0000   -999.0000   -999.0000
    2008        0.0000      0.0000      0.0000      0.0000      0.0000

INDEX            36

SURVEY TAG     MENH_F

AGE                6      NUMBERS     NUMBERS     NUMBERS     NUMBERS
TIME           MEAN       NUMBERS     NUMBERS     NUMBERS     NUMBERS
TYPE          NUMBERS     NUMBERS     NUMBERS     NUMBERS     NUMBERS
RETRO FLAG       0
 _________________________________________________________________________

    1985     -999.0000
    1986     -999.0000
    1987     -999.0000
    1988     -999.0000
    1989     -999.0000
    1990     -999.0000
    1991     -999.0000
    1992     -999.0000
    1993     -999.0000
    1994     -999.0000
    1995     -999.0000
    1996     -999.0000
    1997     -999.0000
    1998     -999.0000
    1999     -999.0000
    2000        0.0000
    2001        0.0000
    2002        0.0000
    2003        0.0000
    2004        0.0000
    2005        0.0000
    2006        0.0000
    2007     -999.0000
    2008        0.0000

     Additional Output Files

Population File C:\WORKING\ASSESSMENTS\GARM3THEFINALE\YTASSESSMENTS\CCGOM\VPA\6P
Auxilliary File C:\WORKING\ASSESSMENTS\GARM3THEFINALE\YTASSESSMENTS\CCGOM\VPA\6P
Covariance File C:\WORKING\ASSESSMENTS\GARM3THEFINALE\YTASSESSMENTS\CCGOM\VPA\6P
Residuals File  C:\WORKING\ASSESSMENTS\GARM3THEFINALE\YTASSESSMENTS\CCGOM\VPA\6P
Log File        C:\WORKING\ASSESSMENTS\GARM3THEFINALE\YTASSESSMENTS\CCGOM\VPA\6P
```

```
                         Estimation Results

JAN-1 Population Numbers


  AGE      1985        1986        1987        1988        1989
_____________________________________________________________________________

   1      11698.       5778.       8201.      23080.       8673.
   2       3324.       8959.       4645.       6697.      18488.
   3       1736.       1607.       3563.       2116.       3172.
   4        777.        613.        615.        853.        406.
   5        403.         81.        231.        228.         52.
   6        148.         16.        106.         47.         12.
=====================================================================
Total     18086.      17053.      17360.      33021.      30803.

  AGE      1990        1991        1992        1993        1994
_____________________________________________________________________________

   1       7361.       9443.       7880.       5956.       6707.
   2       6994.       5951.       7311.       4915.       4733.
   3      13067.       3135.       3639.       2444.       3640.
   4        985.       2407.        997.       1233.       1041.
   5         70.        367.        261.        172.        305.
   6         56.         91.         19.         84.        158.
=====================================================================
Total     28534.      21394.      20107.      14804.      16585.

  AGE      1995        1996        1997        1998        1999
_____________________________________________________________________________

   1       5709.       7197.       7558.       7842.       9755.
   2       5474.       4641.       5869.       6181.       6386.
   3       3139.       4007.       3091.       3475.       4614.
   4       1465.        990.       1125.        753.        630.
   5        220.        160.        239.        176.         51.
   6        210.         14.         27.          3.         11.
=====================================================================
Total     16217.      17008.      17909.      18430.      21446.

  AGE      2000        2001        2002        2003        2004
_____________________________________________________________________________

   1       8849.       6428.       5264.       3905.       3947.
   2       7978.       7243.       5245.       4257.       3188.
   3       4559.       5528.       4722.       3212.       2713.
   4       1733.       1092.       1235.       1684.        751.
   5        164.        187.        149.        213.        320.
   6         43.         31.         46.         98.         99.
=====================================================================
Total     23325.      20509.      16661.      13370.      11018.

  AGE      2005        2006        2007        2008
_____________________________________________________________________________

   1       5653.      10185.       3540.       7211.
   2       3220.       4615.       8332.       2886.
   3       2182.       2191.       3608.       6575.
   4        805.        665.       1200.       2295.
   5        113.        143.        198.        615.
   6         66.         92.         51.        142.
=====================================================================
Total     12040.      17892.      16929.      19724.
```

```
Fishing Mortality Calculated

  AGE       1985        1986        1987        1988        1989
 ------------------------------------------------------------------

   1       0.0668      0.0183      0.0026      0.0218      0.0151
   2       0.5270      0.7220      0.5860      0.5474      0.1470
   3       0.8406      0.7600      1.2296      1.4506      0.9688
   4       2.0651      0.7766      0.7919      2.6014      1.5589
   5       2.0651      0.7766      0.7919      2.6014      1.5589
   6       2.0651      0.7766      0.7919      2.6014      1.5589

  AGE       1990        1991        1992        1993        1994
 ------------------------------------------------------------------

   1       0.0127      0.0558      0.2721      0.0299      0.0031
   2       0.6023      0.2919      0.8958      0.1001      0.2105
   3       1.4919      0.9456      0.8820      0.6533      0.7100
   4       0.7872      2.0232      1.5562      1.1960      1.3564
   5       0.7872      2.0232      1.5562      1.1960      1.3564
   6       0.7872      2.0232      1.5562      1.1960      1.3564

  AGE       1995        1996        1997        1998        1999
 ------------------------------------------------------------------

   1       0.0072      0.0040      0.0012      0.0054      0.0010
   2       0.1119      0.2064      0.3240      0.0924      0.1371
   3       0.9542      1.0700      1.2124      1.5078      0.7790
   4       2.0172      1.2204      1.6551      2.4965      1.1474
   5       2.0172      1.2204      1.6551      2.4965      1.1474
   6       2.0172      1.2204      1.6551      2.4965      1.1474

  AGE       2000        2001        2002        2003        2004
 ------------------------------------------------------------------

   1       0.0002      0.0034      0.0122      0.0028      0.0036
   2       0.1668      0.2277      0.2904      0.2506      0.1790
   3       1.2287      1.2991      0.8312      1.2530      1.0151
   4       2.0291      1.7941      1.5559      1.4616      1.6958
   5       2.0291      1.7941      1.5559      1.4616      1.6958
   6       2.0291      1.7941      1.5559      1.4616      1.6958

  AGE       2005        2006        2007
 ------------------------------------------------------------------

   1       0.0029      0.0008      0.0044
   2       0.1848      0.0462      0.0369
   3       0.9883      0.4021      0.2522
   4       1.5262      1.0118      0.4684
   5       1.5262      1.0118      0.3603
   6       1.5262      1.0118      0.3603
```

```
Average Fishing Mortality For Ages   4-  5

Year      Average F   N Weighted  Biomass Wtd  Catch Wtd

_____________________________________________________________________________

1985       2.0651      2.0651      2.0651      2.0651
1986       0.7766      0.7766      0.7766      0.7766
1987       0.7919      0.7919      0.7919      0.7919
1988       2.6014      2.6014      2.6014      2.6014
1989       1.5589      1.5589      1.5589      1.5589
1990       0.7872      0.7872      0.7872      0.7872
1991       2.0232      2.0232      2.0232      2.0232
1992       1.5562      1.5562      1.5562      1.5562
1993       1.1960      1.1960      1.1960      1.1960
1994       1.3564      1.3564      1.3564      1.3564
1995       2.0172      2.0172      2.0172      2.0172
1996       1.2204      1.2204      1.2204      1.2204
1997       1.6551      1.6551      1.6551      1.6551
1998       2.4965      2.4965      2.4965      2.4965
1999       1.1474      1.1474      1.1474      1.1474
2000       2.0291      2.0291      2.0291      2.0291
2001       1.7941      1.7941      1.7941      1.7941
2002       1.5559      1.5559      1.5559      1.5559
2003       1.4616      1.4616      1.4616      1.4616
2004       1.6958      1.6958      1.6958      1.6958
2005       1.5262      1.5262      1.5262      1.5262
2006       1.0118      1.0118      1.0118      1.0118
2007       0.4144      0.4531      0.4500      0.4525
```

```
Back Calculated Partial Recruitment

 AGE      1985        1986        1987        1988        1989
_____________________________________________________________________

  1      0.0324      0.0236      0.0021      0.0084      0.0097
  2      0.2552      0.9297      0.4766      0.2104      0.0943
  3      0.4071      0.9787      1.0000      0.5576      0.6215
  4      1.0000      1.0000      0.6440      1.0000      1.0000
  5      1.0000      1.0000      0.6440      1.0000      1.0000
  6      1.0000      1.0000      0.6440      1.0000      1.0000

 AGE      1990        1991        1992        1993        1994
_____________________________________________________________________

  1      0.0085      0.0276      0.1748      0.0250      0.0023
  2      0.4037      0.1443      0.5756      0.0837      0.1552
  3      1.0000      0.4674      0.5667      0.5463      0.5234
  4      0.5276      1.0000      1.0000      1.0000      1.0000
  5      0.5276      1.0000      1.0000      1.0000      1.0000
  6      0.5276      1.0000      1.0000      1.0000      1.0000

 AGE      1995        1996        1997        1998        1999
_____________________________________________________________________

  1      0.0036      0.0033      0.0007      0.0021      0.0009
  2      0.0555      0.1691      0.1958      0.0370      0.1195
  3      0.4730      0.8767      0.7325      0.6040      0.6789
  4      1.0000      1.0000      1.0000      1.0000      1.0000
  5      1.0000      1.0000      1.0000      1.0000      1.0000
  6      1.0000      1.0000      1.0000      1.0000      1.0000

 AGE      2000        2001        2002        2003        2004
_____________________________________________________________________

  1      0.0001      0.0019      0.0079      0.0019      0.0021
  2      0.0822      0.1269      0.1867      0.1715      0.1056
  3      0.6055      0.7241      0.5342      0.8573      0.5986
  4      1.0000      1.0000      1.0000      1.0000      1.0000
  5      1.0000      1.0000      1.0000      1.0000      1.0000
  6      1.0000      1.0000      1.0000      1.0000      1.0000

 AGE      2005        2006        2007
_____________________________________________________________________

  1      0.0019      0.0007      0.0093
  2      0.1211      0.0457      0.0788
  3      0.6476      0.3974      0.5384
  4      1.0000      1.0000      1.0000
  5      1.0000      1.0000      0.7692
  6      1.0000      1.0000      0.7692
```

```
JAN-1 Biomass

  AGE       1985        1986        1987        1988        1989
_____________________________________________________________________________

   1        1122.        396.        239.       1916.        797.
   2         697.       1628.        718.        719.       3369.
   3         507.        542.       1117.        593.        891.
   4         311.        268.        298.        387.        190.

   5         218.         48.        136.        141.         36.
   6         116.         16.         97.         40.         16.
====================================================================
Total       2971.       2898.       2605.       3795.       5299.

  AGE       1990        1991        1992        1993        1994
_____________________________________________________________________________

   1         336.       1122.        240.        379.        321.
   2        1266.        812.        946.        453.        589.
   3        4130.        924.       1008.        537.        866.
   4         452.       1053.        412.        455.        446.
   5          51.        234.        145.        104.        162.
   6          54.         93.         22.         84.        143.
====================================================================
Total       6291.       4238.       2773.       2012.       2527.

  AGE       1995        1996        1997        1998        1999
_____________________________________________________________________________

   1         143.        492.        913.        297.        940.
   2         905.        562.       1022.       1076.       1053.
   3         763.       1374.        968.       1149.       1344.
   4         566.        392.        482.        357.        307.
   5         126.         81.        127.        113.         31.
   6         166.         17.         23.          2.          9.
====================================================================
Total       2669.       2918.       3535.       2994.       3684.

  AGE       2000        2001        2002        2003        2004
_____________________________________________________________________________

   1         484.       1148.        944.        200.        165.
   2        1813.       1350.       1500.       1128.        471.
   3        1757.       2096.       1837.       1245.        939.
   4         831.        543.        596.        817.        328.
   5         100.        123.         99.        131.        182.
   6          36.         28.         48.         93.         82.
====================================================================
Total       5022.       5288.       5025.       3614.       2168.

  AGE       2005        2006        2007        2008
_____________________________________________________________________________

   1         158.        662.         27.        242.
   2         457.        635.       1441.        435.
   3         664.        701.       1256.       2131.
   4         352.        279.        527.        992.
   5          64.         91.        109.        358.
   6          61.         85.         43.        128.
====================================================================
Total       1756.       2453.       3402.       4285.
```

```
Mean Biomass

  AGE      1985        1986        1987        1988        1989
_____________________________________________________________________________

   1       1355.        535.        416.       2546.       1007.
   2        628.       1463.        746.        972.       4218.
   3        385.        442.        745.        350.        716.
   4        150.        209.        214.        150.        124.
   5         96.         38.         96.         53.         23.
   6         46.         10.         61.         13.          8.
====================================================================
Total      2661.       2697.       2278.       4084.       6095.

  AGE      1990        1991        1992        1993        1994
_____________________________________________________________________________

   1        524.       1033.        333.        474.        540.
   2       1222.       1109.        600.        679.        675.
   3       2331.        638.        723.        589.        846.
   4        344.        499.        234.        278.        270.
   5         37.        109.         74.         68.        104.
   6         35.         37.         11.         45.         73.
====================================================================
Total      4492.       3426.       1973.       2133.       2509.

  AGE      1995        1996        1997        1998        1999
_____________________________________________________________________________

   1        284.        710.        993.        560.       1308.
   2       1444.       1014.       1270.       1120.       1865.
   3        633.        869.        611.        655.       1195.
   4        249.        244.        245.        159.        209.
   5         57.         52.         67.         52.         17.
   6         67.          9.         10.          1.          5.
====================================================================
Total      2732.       2899.       3195.       2546.       4598.

  AGE      2000        2001        2002        2003        2004
_____________________________________________________________________________

   1        810.       1315.       1034.        308.        275.
   2       2331.       2027.       1501.       1104.        666.
   3       1048.       1180.       1296.        703.        584.
   4        393.        271.        329.        439.        155.
   5         41.         62.         54.         70.         87.
   6         14.         12.         23.         45.         37.
====================================================================
Total      4637.       4867.       4237.       2668.       1804.

  AGE      2005        2006        2007
_____________________________________________________________________________

   1        317.        978.        115.
   2        698.       1248.       2092.
   3        471.        645.       1152.
   4        197.        184.        431.
   5         37.         65.         95.
   6         29.         49.         33.
====================================================================
Total      1749.       3170.       3919.
```

```
Spawning Stock Biomass

  AGE       1985        1986        1987        1988        1989


   1           0.          0.          0.          0.          0.
   2         112.        261.        133.        173.        739.
   3         335.        384.        643.        300.        622.
   4         144.        213.        218.        136.        124.
   5          94.         39.        100.         49.         23.
   6          45.         11.         64.         12.          8.
====================================================================
Total        730.        908.       1157.        670.       1515.

  AGE       1990        1991        1992        1993        1994


   1           0.          0.          0.          0.          0.
   2         217.        196.        107.        119.        119.
   3        1990.        554.        628.        511.        735.
   4         351.        481.        233.        282.        272.
   5          38.        107.         75.         71.        108.
   6          36.         37.         11.         47.         75.
====================================================================
Total       2633.       1375.       1054.       1029.       1308.

  AGE       1995        1996        1997        1998        1999


   1           0.          0.          0.          0.          0.
   2         252.        178.        224.        196.        326.
   3         550.        753.        527.        558.       1038.
   4         240.        247.        243.        146.        212.
   5          56.         54.         68.         49.         17.
   6          66.         10.         11.          1.          5.
====================================================================
Total       1164.       1242.       1073.        949.       1599.

  AGE       2000        2001        2002        2003        2004


   1           0.          0.          0.          0.          0.
   2         409.        356.        265.        194.        117.
   3         904.       1016.       1126.        606.        507.
   4         379.        266.        328.        440.        153.
   5          40.         62.         55.         72.         88.
   6          14.         12.         23.         46.         37.
====================================================================
Total       1746.       1713.       1797.       1359.        902.

  AGE       2005        2006        2007


   1           0.          0.          0.
   2         122.        217.        364.
   3         409.        557.        988.
   4         197.        187.        437.
   5          38.         68.         99.
   6          30.         51.         34.
====================================================================
Total        796.       1080.       1922.
```

```
Catch Biomass

  AGE       1985        1986        1987        1988        1989
_____________________________________________________________________________

   1          91.         10.          1.         56.         15.
   2         331.       1056.        437.        532.        620.
   3         324.        336.        916.        508.        694.
   4         311.        162.        169.        389.        194.
   5         197.         29.         76.        139.         35.
   6          95.          8.         49.         34.         12.
====================================================================
Total       1349.       1602.       1648.       1658.       1570.

  AGE       1990        1991        1992        1993        1994
_____________________________________________________________________________

   1           7.         58.         91.         14.          2.
   2         736.        324.        537.         68.        142.
   3        3478.        604.        637.        384.        601.
   4         271.       1010.        364.        332.        367.
   5          29.        220.        115.         82.        142.
   6          27.         76.         16.         54.         99.
====================================================================
Total       4548.       2290.       1760.        935.       1351.

  AGE       1995        1996        1997        1998        1999
_____________________________________________________________________________

   1           2.          3.          1.          3.          1.
   2         161.        209.        411.        103.        256.
   3         604.        930.        741.        987.        931.
   4         501.        298.        405.        396.        240.
   5         114.         63.        111.        130.         19.
   6         134.         11.         17.          2.          6.
====================================================================
Total       1518.       1515.       1686.       1622.       1452.

  AGE       2000        2001        2002        2003        2004
_____________________________________________________________________________

   1           0.          5.         13.          1.          1.
   2         389.        462.        436.        277.        119.
   3        1288.       1533.       1078.        881.        593.
   4         797.        486.        511.        642.        263.
   5          83.        111.         84.        102.        148.
   6          29.         22.         35.         66.         62.
====================================================================
Total       2586.       2618.       2157.       1968.       1186.

  AGE       2005        2006        2007
_____________________________________________________________________________

   1           1.          1.          1.
   2         129.         58.         77.
   3         466.        260.        291.
   4         301.        186.        202.
   5          57.         66.         45.
   6          44.         50.         12.
====================================================================
Total        997.        620.        627.
```

```
Catch Numbers


  AGE       1985        1986        1987        1988        1989
_____________________________________________________________________________

   1        686.0        95.0        19.0       452.0       118.0
   2       1245.0      4225.0      1885.0      2582.0      2297.0
   3        907.0       785.0      2331.0      1503.0      1812.0
   4        635.0       304.0       309.0       744.0       298.0
   5        329.0        40.0       116.0       199.0        38.0
   6        121.0         8.0        53.0        41.0         9.0
====================================================================
Total      3923.0      5457.0      4713.0      5521.0      4572.0

  AGE       1990        1991        1992        1993        1994
_____________________________________________________________________________

   1         84.0       465.0      1709.0       159.0        19.0
   2       2897.0      1372.0      3979.0       425.0       817.0
   3       9400.0      1765.0      1961.0      1074.0      1697.0
   4        493.0      1953.0       731.0       795.0       716.0
   5         35.0       298.0       191.0       111.0       210.0
   6         28.0        74.0        14.0        54.0       109.0
====================================================================
Total     12937.0      5927.0      8585.0      2618.0      3568.0

  AGE       1995        1996        1997        1998        1999
_____________________________________________________________________________

   1         37.0        26.0         8.0        38.0         9.0
   2        526.0       787.0      1480.0       495.0       743.0
   3       1777.0      2428.0      2007.0      2512.0      2292.0
   4       1188.0       645.0       847.0       650.0       397.0
   5        178.0       104.0       180.0       152.0        32.0
   6        170.0         9.0        20.0         3.0         7.0
====================================================================
Total      3876.0      3999.0      4542.0      3850.0      3480.0

  AGE       2000        2001        2002        2003        2004
_____________________________________________________________________________

   1          2.0        20.0        58.0        10.0        13.0
   2       1114.0      1342.0      1204.0       859.0       475.0
   3       2981.0      3721.0      2449.0      2122.0      1594.0
   4       1408.0       849.0       905.0      1200.0       571.0
   5        133.0       145.0       109.0       152.0       243.0
   6         35.0        24.0        34.0        70.0        75.0
====================================================================
Total      5673.0      6101.0      4759.0      4413.0      2971.0

  AGE       2005        2006        2007
_____________________________________________________________________________

   1         15.0         7.0        14.0
   2        494.0       189.0       274.0
   3       1262.0       662.0       732.0
   4        585.0       390.0       410.0
   5         82.0        84.0        71.0
   6         48.0        54.0        14.0
====================================================================
Total      2486.0      1386.0      1515.0


              Surplus Production

    Average Adjustment Factor (Delta) =   1.0000
```

```
Year        Biomass  Delta Biomass  Catch Biomass  Surplus Production

1985       2971.240        -72.963       1348.542       1275.579
1986       2898.276       -293.185       1601.519       1308.334
1987       2605.091       1189.554       1647.979       2837.533
1988       3794.645       1504.423       1657.599       3162.022
1989       5299.069        991.551       1570.225       2561.776
1990       6290.620      -2052.948       4547.624       2494.676
1991       4237.672      -1464.426       2289.963        825.537
1992       2773.245       -761.449       1760.453        999.004
1993       2011.796        515.692        934.706       1450.398
1994       2527.488        141.546       1351.255       1492.801
1995       2669.034        248.779       1517.787       1766.566
1996       2917.813        617.328       1514.820       2132.148
1997       3535.141       -541.443       1686.049       1144.606
1998       2993.698        690.167       1621.756       2311.923
1999       3683.865       1338.299       1452.103       2790.402
2000       5022.164        266.308       2585.792       2852.100
2001       5288.471       -263.555       2618.174       2354.619
2002       5024.917      -1410.978       2157.171        746.193
2003       3613.938      -1446.130       1968.392        522.262
2004       2167.808       -412.252       1186.166        773.914
2005       1755.557        697.422        997.348       1694.770
2006       2452.978        948.936        619.919       1568.855
2007       3401.915        883.430        626.796       1510.226
2008       4285.345
```

```
Summary of Survey Indices Used in the Estimate

INDEX    Survey Tag    Age   Time  Type  Catchability Std. Error   CV
_____________________________________________________________________________

  1         NEFSC_S     1   JAN-1 NUMBER  0.4288E-02  0.1104E-02  0.2573E+00
  2         NEFSC_S     2   JAN-1 NUMBER  0.9040E-01  0.1139E-01  0.1260E+00
  3         NEFSC_S     3   JAN-1 NUMBER  0.2828E+00  0.4129E-01  0.1460E+00
  4         NEFSC_S     4   JAN-1 NUMBER  0.3484E+00  0.5718E-01  0.1641E+00
  5         NEFSC_S     5   JAN-1 NUMBER  0.4134E+00  0.9509E-01  0.2300E+00
  6         NEFSC_S     6   JAN-1 NUMBER  0.3925E+00  0.1543E+00  0.3931E+00
  7         NEFSC_F     1   MEAN  NUMBER  0.5863E-01  0.9632E-02  0.1643E+00
  8         NEFSC_F     2   MEAN  NUMBER  0.2060E+00  0.2807E-01  0.1363E+00
  9         NEFSC_F     3   MEAN  NUMBER  0.2314E+00  0.3442E-01  0.1488E+00
 10         NEFSC_F     4   MEAN  NUMBER  0.1659E+00  0.4851E-01  0.2924E+00
 11         NEFSC_F     5   MEAN  NUMBER  0.5489E+00  0.2156E+00  0.3929E+00
 13         MADMF_S     1   JAN-1 NUMBER  0.2343E-01  0.5606E-02  0.2393E+00
 14         MADMF_S     2   JAN-1 NUMBER  0.3409E+00  0.4406E-01  0.1292E+00
 15         MADMF_S     3   JAN-1 NUMBER  0.6630E+00  0.8722E-01  0.1316E+00
 16         MADMF_S     4   JAN-1 NUMBER  0.5873E+00  0.9790E-01  0.1667E+00
 17         MADMF_S     5   JAN-1 NUMBER  0.5031E+00  0.8354E-01  0.1660E+00
 18         MADMF_S     6   JAN-1 NUMBER  0.3499E+00  0.9921E-01  0.2835E+00
 19         MADMF_F     1   MEAN  NUMBER  0.1059E+00  0.1822E-01  0.1721E+00
 20         MADMF_F     2   MEAN  NUMBER  0.3056E+00  0.4471E-01  0.1463E+00
 21         MADMF_F     3   MEAN  NUMBER  0.3019E+00  0.5120E-01  0.1696E+00
 22         MADMF_F     4   MEAN  NUMBER  0.1342E+00  0.4269E-01  0.3181E+00
 23         MADMF_F     5   MEAN  NUMBER  0.1225E+00  0.4996E-01  0.4079E+00
 26         MENH_S      2   JAN-1 NUMBER  0.6612E-04  0.1218E-04  0.1841E+00
 27         MENH_S      3   JAN-1 NUMBER  0.4033E-03  0.5815E-04  0.1442E+00
 28         MENH_S      4   JAN-1 NUMBER  0.5005E-03  0.8641E-04  0.1727E+00
 29         MENH_S      5   JAN-1 NUMBER  0.2203E-03  0.1017E-03  0.4616E+00
 32         MENH_F      2   MEAN  NUMBER  0.1348E-03  0.5217E-04  0.3870E+00
 33         MENH_F      3   MEAN  NUMBER  0.1893E-03  0.4168E-04  0.2202E+00
 34         MENH_F      4   MEAN  NUMBER  0.8052E-04  0.6014E-04  0.7469E+00
```

```
Survey Index:    1 Tag:         NEFSC_S  AGE =  1
Time = JAN-1          Type = NUMBER
Catchability =    0.428830E-02   % Variance Contribution =     5.8932
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
-----------------------------------------------------------------------------

1985     0.181030E+02     0.501646E+02    -0.101923E+01
1986     0.625300E+01     0.247773E+02    -0.137687E+01
1987     0.204570E+02     0.351662E+02    -0.541761E+00
1988     0.345647E+03     0.989729E+02     0.125057E+01
1989     0.581680E+02     0.371928E+02     0.447220E+00
1990     N/A              0.315677E+02     N/A
1991     0.136715E+03     0.404927E+02     0.121678E+01
1992     0.596730E+02     0.337908E+02     0.568692E+00
1993     0.245480E+02     0.255403E+02    -0.396282E-01
1994     0.113826E+03     0.287599E+02     0.137569E+01
1995     0.703650E+02     0.244814E+02     0.105578E+01
1996     0.571300E+01     0.308618E+02    -0.168677E+01
1997     0.814400E+01     0.324103E+02    -0.138119E+01
1998     N/A              0.336267E+02     N/A
1999     0.679300E+01     0.418302E+02    -0.181773E+01
2000     0.268640E+02     0.379451E+02    -0.345353E+00
2001     N/A              0.275666E+02     N/A
2002     0.575100E+01     0.225738E+02    -0.136742E+01
2003     0.360890E+02     0.167461E+02     0.767821E+00
2004     0.141694E+03     0.169265E+02     0.212479E+01
2005     0.342750E+02     0.242436E+02     0.346262E+00
2006     0.519920E+02     0.436764E+02     0.174282E+00
2007     0.194540E+02     0.151801E+02     0.248069E+00
2008     N/A              0.000000E+00     N/A

Survey Index:    2 Tag:         NEFSC_S  AGE =  2
Time = JAN-1          Type = NUMBER
Catchability =    0.904027E-01   % Variance Contribution =     2.0532
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
-----------------------------------------------------------------------------

1985     0.310947E+03     0.300519E+03     0.341103E-01
1986     0.692529E+03     0.809877E+03    -0.156532E+00
1987     0.524511E+03     0.419897E+03     0.222456E+00
1988     0.145924E+04     0.605413E+03     0.879763E+00
1989     0.714839E+03     0.167136E+04    -0.849336E+00
1990     0.727538E+03     0.632309E+03     0.140288E+00
1991     0.116740E+04     0.537996E+03     0.774685E+00
1992     0.352981E+03     0.660960E+03    -0.627279E+00
1993     0.253050E+03     0.444291E+03    -0.562893E+00
1994     0.863017E+03     0.427845E+03     0.701674E+00
1995     0.401228E+03     0.494840E+03    -0.209706E+00
1996     0.211055E+03     0.419525E+03    -0.687005E+00
1997     0.360353E+03     0.530548E+03    -0.386826E+00
1998     0.279721E+03     0.558744E+03    -0.691898E+00
1999     0.327158E+03     0.577290E+03    -0.567902E+00
2000     0.371770E+04     0.721250E+03     0.163988E+01
2001     0.463449E+03     0.654764E+03    -0.345579E+00
2002     0.603290E+03     0.474164E+03     0.240845E+00
2003     0.333257E+03     0.384886E+03    -0.144032E+00
2004     0.230354E+03     0.288220E+03    -0.224105E+00
2005     0.224680E+03     0.291088E+03    -0.258950E+00
2006     0.429444E+03     0.417217E+03     0.288839E-01
2007     0.836809E+03     0.753278E+03     0.105162E+00
2008     0.670683E+03     0.260863E+03     0.944301E+00

Survey Index:    3 Tag:         NEFSC_S  AGE =  3
```

```
Time = JAN-1           Type = NUMBER
Catchability =    0.282809E+00   % Variance Contribution =     2.7557
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_____________________________________________________________________________

1985     0.333990E+03     0.490966E+03    -0.385263E+00
1986     0.764630E+02     0.454406E+03    -0.178218E+01
1987     0.773508E+03     0.100768E+04    -0.264474E+00
1988     0.355914E+03     0.598540E+03    -0.519804E+00
1989     0.473214E+03     0.896934E+03    -0.639434E+00
1990     0.202533E+04     0.369540E+04    -0.601357E+00
1991     0.945656E+03     0.886729E+03     0.643400E-01
1992     0.708239E+03     0.102913E+04    -0.373691E+00
1993     0.403390E+03     0.691164E+03    -0.538473E+00
1994     0.517718E+03     0.102955E+04    -0.687443E+00
1995     0.153548E+04     0.887828E+03     0.547817E+00
1996     0.552109E+03     0.113328E+04    -0.719129E+00
1997     0.781421E+03     0.874144E+03    -0.112131E+00
1998     0.113564E+04     0.982799E+03     0.144544E+00
1999     0.140235E+04     0.130482E+04     0.720842E-01
2000     0.655861E+04     0.128920E+04     0.162675E+01
2001     0.188278E+04     0.156350E+04     0.185825E+00
2002     0.272928E+04     0.133547E+04     0.714754E+00
2003     0.928364E+03     0.908347E+03     0.217973E-01
2004     0.101008E+04     0.767252E+03     0.274966E+00
2005     0.147461E+04     0.617215E+03     0.870928E+00
2006     0.131967E+04     0.619736E+03     0.755846E+00
2007     0.241019E+04     0.102035E+04     0.859557E+00
2008     0.301745E+04     0.185938E+04     0.484171E+00

Survey Index:    4 Tag:         NEFSC_S  AGE =  4
Time = JAN-1           Type = NUMBER
Catchability =    0.348440E+00   % Variance Contribution =     3.4810
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_____________________________________________________________________________

1985     0.806700E+02     0.270804E+03    -0.121103E+01
1986     0.528020E+02     0.213677E+03    -0.139792E+01
1987     0.208855E+03     0.214358E+03    -0.260054E-01
1988     0.197816E+03     0.297218E+03    -0.407129E+00
1989     0.122125E+03     0.141535E+03    -0.147499E+00
1990     0.817120E+02     0.343377E+03    -0.143563E+01
1991     0.327120E+03     0.838555E+03    -0.941353E+00
1992     0.192374E+03     0.347444E+03    -0.591162E+00
1993     0.217308E+03     0.429734E+03    -0.681850E+00
1994     0.310407E+03     0.362773E+03    -0.155892E+00
1995     0.116362E+04     0.510602E+03     0.823700E+00
1996     0.775284E+03     0.344909E+03     0.809949E+00
1997     0.596458E+03     0.392134E+03     0.419404E+00
1998     0.347924E+03     0.262323E+03     0.282408E+00
1999     0.715264E+03     0.219494E+03     0.118133E+01
2000     0.911535E+03     0.603967E+03     0.411611E+00
2001     0.397407E+03     0.380616E+03     0.431705E-01
2002     0.125896E+04     0.430193E+03     0.107381E+01
2003     0.678634E+03     0.586732E+03     0.145514E+00
2004     0.138375E+03     0.261737E+03    -0.637373E+00
2005     0.495640E+03     0.280462E+03     0.569412E+00
2006     0.465958E+03     0.231735E+03     0.698499E+00
2007     0.164884E+04     0.418164E+03     0.137195E+01
2008     0.656208E+03     0.799825E+03    -0.197916E+00

Survey Index:    5 Tag:         NEFSC_S  AGE =  5
Time = JAN-1           Type = NUMBER
```

```
Catchability =    0.413448E+00   % Variance Contribution =     5.2019
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted        Residual
_____________________________________________________________________________

1985     0.499070E+02     0.166483E+03    -0.120473E+01
1986     0.384050E+02     0.333609E+02     0.140804E+00
1987     0.177011E+03     0.954842E+02     0.617251E+00
1988     0.103598E+03     0.943297E+02     0.937219E-01
1989     0.127258E+03     0.214153E+02     0.178211E+01
1990     N/A              0.289258E+02     N/A
1991     0.741090E+02     0.151823E+03    -0.717181E+00
1992     0.702500E+01     0.107719E+03    -0.273005E+01
1993     N/A              0.711949E+02     N/A
1994     0.197932E+03     0.126251E+03     0.449653E+00
1995     0.157326E+03     0.907778E+02     0.549905E+00
1996     0.129265E+03     0.659889E+02     0.672377E+00
1997     0.111201E+03     0.988820E+02     0.117412E+00
1998     0.553880E+02     0.727880E+02    -0.273188E+00
1999     0.128185E+03     0.209930E+02     0.180928E+01
2000     0.643050E+02     0.676948E+02    -0.513715E-01
2001     0.833340E+02     0.771330E+02     0.773252E-01
2002     0.822530E+02     0.614801E+02     0.291086E+00
2003     0.303884E+03     0.881851E+02     0.123721E+01
2004     0.541920E+02     0.132169E+03    -0.891545E+00
2005     N/A              0.466472E+02     N/A
2006     0.366300E+02     0.592244E+02    -0.480466E+00
2007     0.824840E+02     0.818512E+02     0.770083E-02
2008     0.568940E+02     0.254294E+03    -0.149730E+01

Survey Index:    6 Tag:         NEFSC_S  AGE =  6
Time = JAN-1           Type = NUMBER
Catchability =    0.392500E+00   % Variance Contribution =     5.6449
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted        Residual
_____________________________________________________________________________

1985     0.127370E+02     0.581269E+02    -0.151812E+01
1986     N/A              0.633411E+01     N/A
1987     0.487225E+03     0.414159E+02     0.246506E+01
1988     0.594030E+02     0.184500E+02     0.116928E+01
1989     N/A              0.481504E+01     N/A
1990     0.326150E+02     0.219682E+02     0.395177E+00
1991     0.154390E+02     0.357909E+02    -0.840796E+00
1992     N/A              0.749561E+01     N/A
1993     N/A              0.328804E+02     N/A
1994     0.666210E+02     0.622099E+02     0.685058E-01
1995     0.184500E+02     0.823051E+02    -0.149537E+01
1996     N/A              0.542124E+01     N/A
1997     N/A              0.104302E+02     N/A
1998     N/A              0.136381E+01     N/A
1999     0.567010E+02     0.435955E+01     0.256542E+01
2000     0.321520E+02     0.169118E+02     0.642464E+00
2001     N/A              0.121200E+02     N/A
2002     0.199940E+02     0.182056E+02     0.937026E-01
2003     0.976500E+01     0.385539E+02    -0.137325E+01
2004     N/A              0.387259E+02     N/A
2005     N/A              0.259221E+02     N/A
2006     0.129300E+02     0.361437E+02    -0.102795E+01
2007     N/A              0.199195E+02     N/A
2008     0.177550E+02     0.557452E+02    -0.114412E+01

Survey Index:    7 Tag:         NEFSC_F  AGE =  1
Time = MEAN            Type = NUMBER
Catchability =    0.586332E-01   % Variance Contribution =     3.1977
```

```
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_____________________________________________________________________________

1985     0.148199E+04     0.602014E+03     0.900862E+00
1986     0.398485E+03     0.304348E+03     0.269497E+00
1987     0.181565E+03     0.435253E+03    -0.874313E+00
1988     0.100611E+04     0.121365E+04    -0.187546E+00
1989     0.474020E+03     0.457553E+03     0.353561E-01
1990     0.957015E+03     0.388812E+03     0.900723E+00
1991     0.503005E+03     0.488506E+03     0.292487E-01
1992     0.810321E+03     0.368272E+03     0.788608E+00
1993     0.121556E+04     0.311977E+03     0.136003E+01
1994     0.795330E+03     0.355863E+03     0.804211E+00
1995     0.179346E+03     0.302332E+03    -0.522210E+00
1996     0.340484E+03     0.381712E+03    -0.114299E+00
1997     0.337492E+03     0.401412E+03    -0.173446E+00
1998     0.328613E+03     0.415636E+03    -0.234929E+00
1999     0.132404E+04     0.518119E+03     0.938236E+00
2000     0.287854E+03     0.470172E+03    -0.490644E+00
2001     0.433330E+02     0.341048E+03    -0.206311E+01
2002     0.128453E+03     0.278095E+03    -0.772400E+00
2003     0.192021E+03     0.207240E+03    -0.762730E-01
2004     0.761780E+02     0.209391E+03    -0.101113E+01
2005     0.533662E+03     0.300010E+03     0.575947E+00
2006     0.780307E+03     0.541054E+03     0.366168E+00
2007     0.119864E+03     0.187720E+03    -0.448591E+00
2008     N/A              0.000000E+00     N/A

Survey Index:    8 Tag:         NEFSC_F  AGE =  2
Time = MEAN            Type = NUMBER
Catchability =    0.205993E+00   % Variance Contribution =     2.1997
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_____________________________________________________________________________

1985     0.568309E+03     0.486626E+03     0.155169E+00
1986     0.110812E+04     0.120548E+04    -0.842183E-01
1987     0.436413E+03     0.662607E+03    -0.417593E+00
1988     0.147572E+04     0.971591E+03     0.417965E+00
1989     0.140858E+04     0.321779E+04    -0.826113E+00
1990     0.169573E+04     0.990745E+03     0.537409E+00
1991     0.449153E+03     0.968300E+03    -0.768178E+00
1992     0.887239E+03     0.914974E+03    -0.307815E-01
1993     0.123252E+04     0.874581E+03     0.343068E+00
1994     0.237016E+04     0.799590E+03     0.108662E+01
1995     0.218175E+03     0.968669E+03    -0.149063E+01
1996     0.935075E+03     0.785542E+03     0.174252E+00
1997     0.799769E+03     0.940951E+03    -0.162568E+00
1998     0.959846E+03     0.110393E+04    -0.139861E+00
1999     0.260256E+04     0.111668E+04     0.846138E+00
2000     0.218390E+04     0.137575E+04     0.462116E+00
2001     0.122795E+04     0.121389E+04     0.115111E-01
2002     0.458031E+03     0.853982E+03    -0.622973E+00
2003     0.282282E+04     0.706022E+03     0.138585E+01
2004     0.371302E+03     0.546627E+03    -0.386751E+00
2005     0.425218E+03     0.550563E+03    -0.258340E+00
2006     0.487241E+03     0.842689E+03    -0.547839E+00
2007     0.209566E+04     0.152824E+04     0.315751E+00
2008     N/A              0.000000E+00     N/A
```

```
Survey Index:    9 Tag:         NEFSC_F  AGE =  3
Time = MEAN           Type = NUMBER
Catchability =    0.231381E+00   % Variance Contribution =     2.6220
Residual = LN(Observed) - LN(Predicted)
Year      Observed        Predicted         Residual
_____________________________________________________________________________


1985     0.483124E+03     0.249656E+03     0.660188E+00
1986     0.974740E+02     0.238979E+03    -0.896791E+00
1987     0.160784E+03     0.438623E+03    -0.100358E+01
1988     0.142512E+03     0.239732E+03    -0.520094E+00
1989     0.609261E+03     0.432743E+03     0.342104E+00
1990     0.785808E+03     0.145790E+04    -0.618039E+00
1991     0.448252E+03     0.431867E+03     0.372376E-01
1992     0.604146E+03     0.514440E+03     0.160737E+00
1993     0.164194E+03     0.380383E+03    -0.840131E+00
1994     0.835253E+03     0.553049E+03     0.412288E+00
1995     0.345695E+03     0.430901E+03    -0.220322E+00
1996     0.158519E+04     0.525057E+03     0.110495E+01
1997     0.950452E+03     0.383038E+03     0.908805E+00
1998     0.385006E+03     0.385487E+03    -0.124917E-02
1999     0.177776E+04     0.680778E+03     0.959872E+00
2000     0.144336E+04     0.561369E+03     0.944347E+00
2001     0.730058E+03     0.662720E+03     0.967711E-01
2002     0.180343E+03     0.681754E+03    -0.132981E+01
2003     0.593948E+03     0.391857E+03     0.415895E+00
2004     0.202058E+03     0.363344E+03    -0.586796E+00
2005     0.174617E+03     0.295454E+03    -0.525919E+00
2006     0.273828E+03     0.380921E+03    -0.330091E+00
2007     0.153951E+04     0.671558E+03     0.829619E+00
2008     N/A              0.000000E+00     N/A
```

```
Survey Index:   10 Tag:         NEFSC_F  AGE =  4
Time = MEAN           Type = NUMBER
Catchability =    0.165885E+00   % Variance Contribution =     8.4087
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_____________________________________________________________________________


1985     N/A              0.510089E+02     N/A
1986     N/A              0.649383E+02     N/A
1987     0.146050E+02     0.647273E+02    -0.148882E+01
1988     0.432040E+02     0.474427E+02    -0.935895E-01
1989     0.837700E+02     0.317112E+02     0.971404E+00
1990     0.124500E+02     0.103892E+03    -0.212163E+01
1991     0.907830E+02     0.160128E+03    -0.567504E+00
1992     0.304968E+03     0.779196E+02     0.136453E+01
1993     0.270550E+02     0.110270E+03    -0.140506E+01
1994     0.265078E+03     0.875638E+02     0.110766E+01
1995     0.911040E+02     0.976972E+02    -0.698714E-01
1996     0.379344E+03     0.876716E+02     0.146485E+01
1997     0.403118E+03     0.848911E+02     0.155786E+01
1998     0.317096E+03     0.431915E+02     0.199356E+01
1999     0.543989E+03     0.573972E+02     0.224893E+01
2000     0.735720E+02     0.115111E+03    -0.447634E+00
2001     0.304000E+02     0.784981E+02    -0.948631E+00
2002     0.488980E+02     0.964908E+02    -0.679711E+00
2003     0.139616E+03     0.136199E+03     0.247783E-01
2004     0.784900E+01     0.558562E+02    -0.196239E+01
2005     0.212000E+02     0.635859E+02    -0.109839E+01
2006     0.219720E+02     0.639434E+02    -0.106823E+01
2007     0.490748E+03     0.145188E+03     0.121790E+01
2008     N/A              0.000000E+00     N/A
```

```
 Survey Index:   11 Tag:         NEFSC_F  AGE =  5
 Time = MEAN            Type = NUMBER
 Catchability =    0.548869E+00   % Variance Contribution =     5.6387
 Residual = LN(Observed) - LN(Predicted)

 Year      Observed        Predicted         Residual
 _____________________________________________________________________________

 1985     N/A              0.874437E+02     N/A
 1986     N/A              0.282714E+02     N/A
 1987     0.118710E+02     0.803984E+02    -0.191290E+01
 1988     N/A              0.419865E+02     N/A
 1989     0.579050E+02     0.133795E+02     0.146508E+01
 1990     0.267000E+01     0.244042E+02    -0.221268E+01
 1991     N/A              0.808430E+02     N/A
 1992     0.589030E+02     0.673632E+02    -0.134207E+00
 1993     N/A              0.509418E+02     N/A
 1994     0.114009E+03     0.849750E+02     0.293921E+00
 1995     0.550740E+02     0.484335E+02     0.128485E+00
 1996     0.429140E+02     0.467728E+02    -0.861029E-01
 1997     0.187678E+03     0.596914E+02     0.114554E+01
 1998     0.752130E+02     0.334187E+02     0.811210E+00
 1999     0.228147E+03     0.153077E+02     0.270163E+01
 2000     N/A              0.359771E+02     N/A
 2001     N/A              0.443588E+02     N/A
 2002     0.620900E+01     0.384524E+02    -0.182342E+01
 2003     0.812280E+02     0.570817E+02     0.352777E+00
 2004     N/A              0.786505E+02     N/A
 2005     N/A              0.294903E+02     N/A
 2006     N/A              0.455691E+02     N/A
 2007     0.401160E+02     0.831890E+02    -0.729340E+00
 2008     N/A              0.000000E+00     N/A
```

```
Survey Index:   13 Tag:         MADMF_S  AGE =  1
 Time = JAN-1           Type = NUMBER
 Catchability =    0.234298E-01   % Variance Contribution =     6.7834
 Residual = LN(Observed) - LN(Predicted)

 Year      Observed        Predicted         Residual
 _____________________________________________________________________________

 1985     0.497025E+03     0.274082E+03     0.595212E+00
 1986     0.501852E+03     0.135375E+03     0.131026E+01
 1987     0.680968E+03     0.192136E+03     0.126531E+01
 1988     0.813946E+03     0.540753E+03     0.408931E+00
 1989     0.203391E+03     0.203209E+03     0.897570E-03
 1990     0.260033E+03     0.172475E+03     0.410556E+00
 1991     0.157170E+02     0.221238E+03    -0.264450E+01
 1992     0.323176E+03     0.184621E+03     0.559892E+00
 1993     0.188249E+03     0.139543E+03     0.299389E+00
 1994     0.607648E+03     0.157134E+03     0.135250E+01
 1995     0.165905E+04     0.133758E+03     0.251797E+01
 1996     0.290096E+03     0.168618E+03     0.542575E+00
 1997     0.133088E+03     0.177078E+03    -0.285582E+00
 1998     0.157748E+03     0.183725E+03    -0.152441E+00
 1999     0.650630E+02     0.228546E+03    -0.125638E+01
 2000     0.158461E+03     0.207319E+03    -0.268750E+00
 2001     0.321750E+02     0.150615E+03    -0.154353E+01
 2002     0.115780E+03     0.123335E+03    -0.632160E-01
 2003     0.126720E+02     0.914951E+02    -0.197689E+01
 2004     0.423510E+02     0.924808E+02    -0.781009E+00
 2005     0.921360E+02     0.132459E+03    -0.363006E+00
 2006     0.167266E+03     0.238633E+03    -0.355340E+00
 2007     0.127136E+03     0.829387E+02     0.427156E+00
 2008     N/A              0.000000E+00     N/A
```

```
Survey Index:   14 Tag:         MADMF_S  AGE =  2
Time = JAN-1          Type = NUMBER
Catchability =    0.340915E+00   % Variance Contribution =     1.9789
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_____________________________________________________________________________

1985     0.210500E+04     0.113328E+04     0.619200E+00
1986     0.432955E+04     0.305410E+04     0.348976E+00
1987     0.127523E+04     0.158346E+04    -0.216488E+00
1988     0.348787E+04     0.228306E+04     0.423775E+00
1989     0.495299E+04     0.630282E+04    -0.241006E+00
1990     0.275215E+04     0.238448E+04     0.143400E+00
1991     0.121129E+04     0.202882E+04    -0.515769E+00
1992     0.220476E+04     0.249253E+04    -0.122677E+00
1993     0.162523E+04     0.167545E+04    -0.304335E-01
1994     0.523763E+04     0.161343E+04     0.117750E+01
1995     0.280177E+04     0.186608E+04     0.406412E+00
1996     0.323082E+04     0.158206E+04     0.714009E+00
1997     0.298865E+04     0.200073E+04     0.401307E+00
1998     0.841102E+03     0.210706E+04    -0.918338E+00
1999     0.129062E+04     0.217700E+04    -0.522829E+00
2000     0.376620E+04     0.271989E+04     0.325475E+00
2001     0.168124E+04     0.246917E+04    -0.384347E+00
2002     0.296350E+03     0.178811E+04    -0.179737E+01
2003     0.187341E+04     0.145143E+04     0.255213E+00
2004     0.608169E+03     0.108690E+04    -0.580629E+00
2005     0.153773E+04     0.109772E+04     0.337077E+00
2006     0.164888E+04     0.157336E+04     0.468819E-01
2007     0.323716E+04     0.284067E+04     0.130658E+00
2008     N/A              0.983734E+03     N/A


Survey Index:   15 Tag:         MADMF_S  AGE =  3
Time = JAN-1          Type = NUMBER
Catchability =    0.662967E+00   % Variance Contribution =     2.0509
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_____________________________________________________________________________

1985     0.190888E+04     0.115093E+04     0.505943E+00
1986     0.464109E+03     0.106523E+04    -0.830826E+00
1987     0.134644E+04     0.236224E+04    -0.562148E+00
1988     0.665113E+03     0.140311E+04    -0.746491E+00
1989     0.910608E+03     0.210262E+04    -0.836825E+00
1990     0.410646E+04     0.866284E+04    -0.746481E+00
1991     0.822422E+03     0.207869E+04    -0.927240E+00
1992     0.211249E+04     0.241252E+04    -0.132805E+00
1993     0.148907E+04     0.162024E+04    -0.844244E-01
1994     0.173986E+04     0.241349E+04    -0.327269E+00
1995     0.504239E+04     0.208127E+04     0.884901E+00
1996     0.275871E+04     0.265667E+04     0.376873E-01
1997     0.208240E+04     0.204919E+04     0.160768E-01
1998     0.236943E+04     0.230390E+04     0.280426E-01
1999     0.213419E+04     0.305879E+04    -0.359934E+00
2000     0.578946E+04     0.302219E+04     0.650058E+00
2001     0.630524E+04     0.366519E+04     0.542501E+00
2002     0.323609E+04     0.313065E+04     0.331266E-01
2003     0.179606E+04     0.212937E+04    -0.170229E+00
2004     0.198788E+04     0.179861E+04     0.100053E+00
2005     0.387814E+04     0.144689E+04     0.985937E+00
2006     0.509996E+04     0.145280E+04     0.125574E+01
2007     0.474318E+04     0.239194E+04     0.684606E+00
2008     N/A              0.435880E+04     N/A
```

```
 Survey Index:   16 Tag:         MADMF_S  AGE =  4
 Time = JAN-1           Type = NUMBER
 Catchability =    0.587346E+00   % Variance Contribution =     3.2917
 Residual = LN(Observed) - LN(Predicted)

 Year      Observed        Predicted         Residual
 ______________________________________________________________________________

 1985     0.411883E+03     0.456478E+03    -0.102802E+00
 1986     0.684920E+02     0.360183E+03    -0.165990E+01
 1987     0.267247E+03     0.361330E+03    -0.301620E+00
 1988     0.183778E+03     0.501004E+03    -0.100288E+01
 1989     0.252106E+03     0.238577E+03     0.551578E-01
 1990     0.176729E+03     0.578812E+03    -0.118636E+01
 1991     0.509697E+03     0.141351E+04    -0.102001E+01
 1992     0.559537E+03     0.585667E+03    -0.456414E-01
 1993     0.495461E+03     0.724378E+03    -0.379825E+00
 1994     0.357380E+03     0.611506E+03    -0.537124E+00
 1995     0.635846E+03     0.860693E+03    -0.302782E+00
 1996     0.141899E+04     0.581393E+03     0.892273E+00
 1997     0.724224E+03     0.660999E+03     0.913486E-01
 1998     0.228626E+03     0.442183E+03    -0.659636E+00
 1999     0.239762E+03     0.369989E+03    -0.433825E+00
 2000     0.194117E+04     0.101807E+04     0.645378E+00
 2001     0.173926E+04     0.641582E+03     0.997276E+00
 2002     0.124484E+04     0.725152E+03     0.540379E+00
 2003     0.197789E+04     0.989021E+03     0.693073E+00
 2004     0.978524E+03     0.441195E+03     0.796558E+00
 2005     0.101830E+04     0.472759E+03     0.767301E+00
 2006     0.137038E+04     0.390623E+03     0.125510E+01
 2007     0.173122E+04     0.704876E+03     0.898560E+00
 2008     N/A              0.134822E+04     N/A


Survey Index:   17 Tag:         MADMF_S  AGE =  5
 Time = JAN-1           Type = NUMBER
 Catchability =    0.503147E+00   % Variance Contribution =     2.9824
 Residual = LN(Observed) - LN(Predicted)

 Year      Observed        Predicted         Residual
 ______________________________________________________________________________

 1985     0.120197E+03     0.202602E+03    -0.522110E+00
 1986     0.192010E+02     0.405986E+02    -0.748771E+00
 1987     0.693420E+02     0.116200E+03    -0.516259E+00
 1988     N/A              0.114795E+03     N/A
 1989     0.120420E+02     0.260613E+02    -0.772052E+00
 1990     0.379630E+02     0.352014E+02     0.755275E-01
 1991     0.111913E+03     0.184762E+03    -0.501346E+00
 1992     0.359575E+03     0.131089E+03     0.100904E+01
 1993     0.621560E+02     0.866407E+02    -0.332123E+00
 1994     0.819870E+02     0.153641E+03    -0.628059E+00
 1995     0.253889E+03     0.110472E+03     0.832133E+00
 1996     0.393615E+03     0.803054E+02     0.158954E+01
 1997     0.872260E+02     0.120335E+03    -0.321774E+00
 1998     0.386760E+02     0.885795E+02    -0.828681E+00
 1999     0.178290E+02     0.255475E+02    -0.359714E+00
 2000     0.238912E+03     0.823813E+02     0.106474E+01
 2001     0.280303E+03     0.938672E+02     0.109399E+01
 2002     0.585070E+02     0.748183E+02    -0.245917E+00
 2003     0.301671E+03     0.107317E+03     0.103355E+01
 2004     0.124146E+03     0.160843E+03    -0.258970E+00
 2005     0.190090E+02     0.567673E+02    -0.109405E+01
 2006     0.604820E+02     0.720732E+02    -0.175337E+00
 2007     0.182709E+03     0.996090E+02     0.606642E+00
 2008     N/A              0.309464E+03     N/A
```

```
Survey Index:   18 Tag:         MADMF_S  AGE =  6
Time = JAN-1           Type = NUMBER
Catchability =    0.349937E+00   % Variance Contribution =     5.7592
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_____________________________________________________________________________


1985     0.921910E+02     0.518236E+02     0.576016E+00
1986     0.152510E+02     0.564724E+01     0.993479E+00
1987     0.406780E+02     0.369248E+02     0.968040E-01
1988     0.111910E+02     0.164493E+02    -0.385174E+00
1989     N/A              0.429290E+01     N/A
1990     0.899700E+01     0.195859E+02    -0.777921E+00
1991     0.368650E+02     0.319097E+02     0.144352E+00
1992     0.207370E+02     0.668278E+01     0.113238E+01
1993     0.799020E+02     0.293149E+02     0.100271E+01
1994     0.265240E+02     0.554639E+02    -0.737682E+00
1995     0.573300E+01     0.733799E+02    -0.254941E+01
1996     0.146470E+02     0.483336E+01     0.110869E+01
1997     N/A              0.929916E+01     N/A
1998     0.441600E+01     0.121592E+01     0.128973E+01
1999     N/A              0.388680E+01     N/A
2000     0.827000E+02     0.150779E+02     0.170199E+01
2001     N/A              0.108057E+02     N/A
2002     0.407060E+02     0.162314E+02     0.919428E+00
2003     0.119040E+02     0.343731E+02    -0.106040E+01
2004     0.507400E+01     0.345265E+02    -0.191760E+01
2005     0.636400E+01     0.231111E+02    -0.128966E+01
2006     0.251530E+02     0.322243E+02    -0.247744E+00
2007     N/A              0.177594E+02     N/A
2008     N/A              0.497002E+02     N/A


Survey Index:   19 Tag:         MADMF_F  AGE =  1
Time = MEAN            Type = NUMBER
Catchability =    0.105901E+00   % Variance Contribution =     3.5079
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_____________________________________________________________________________


1985     0.156431E+04     0.108733E+04     0.363722E+00
1986     0.712457E+03     0.549700E+03     0.259348E+00
1987     0.160589E+04     0.786133E+03     0.714310E+00
1988     0.245753E+04     0.219204E+04     0.114324E+00
1989     0.723360E+03     0.826411E+03    -0.133185E+00
1990     0.142533E+04     0.702254E+03     0.707860E+00
1991     0.103097E+04     0.882316E+03     0.155704E+00
1992     0.196860E+04     0.665156E+03     0.108505E+01
1993     0.230178E+04     0.563478E+03     0.140731E+01
1994     0.562170E+03     0.642743E+03    -0.133941E+00
1995     0.235623E+04     0.546058E+03     0.146209E+01
1996     0.468306E+03     0.689431E+03    -0.386744E+00
1997     0.274708E+03     0.725011E+03    -0.970478E+00
1998     0.161777E+04     0.750702E+03     0.767796E+00
1999     0.129673E+04     0.935802E+03     0.326201E+00
2000     0.317086E+03     0.849201E+03    -0.985123E+00
2001     0.188359E+03     0.615984E+03    -0.118487E+01
2002     0.427271E+03     0.502282E+03    -0.161744E+00
2003     0.151082E+03     0.374307E+03    -0.907254E+00
2004     0.638177E+03     0.378191E+03     0.523215E+00
2005     0.242094E+03     0.541864E+03    -0.805688E+00
2006     0.343254E+03     0.977226E+03    -0.104625E+01
2007     0.105055E+03     0.339050E+03    -0.117166E+01
2008     N/A              0.000000E+00     N/A
```

```
Survey Index:   20 Tag:         MADMF_F  AGE =  2
Time = MEAN            Type = NUMBER
Catchability =    0.305596E+00   % Variance Contribution =     2.5361
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_____________________________________________________________________________

1985     0.447514E+03     0.721923E+03    -0.478211E+00
1986     0.135708E+04     0.178836E+04    -0.275966E+00
1987     0.629592E+03     0.982994E+03    -0.445532E+00
1988     0.308331E+04     0.144138E+04     0.760402E+00
1989     0.143119E+04     0.477368E+04    -0.120461E+01
1990     0.327359E+04     0.146980E+04     0.800762E+00
1991     0.140961E+04     0.143650E+04    -0.188966E-01
1992     0.993473E+03     0.135739E+04    -0.312111E+00
1993     0.199866E+04     0.129746E+04     0.432065E+00
1994     0.237530E+04     0.118621E+04     0.694356E+00
1995     0.348455E+04     0.143705E+04     0.885749E+00
1996     0.815510E+03     0.116537E+04    -0.356983E+00
1997     0.141027E+04     0.139593E+04     0.102209E-01
1998     0.143885E+04     0.163771E+04    -0.129457E+00
1999     0.266989E+04     0.165662E+04     0.477259E+00
2000     0.182525E+04     0.204096E+04    -0.111702E+00
2001     0.163826E+04     0.180084E+04    -0.946191E-01
2002     0.178869E+03     0.126690E+04    -0.195768E+01
2003     0.161242E+04     0.104740E+04     0.431425E+00
2004     0.238174E+04     0.810936E+03     0.107740E+01
2005     0.116505E+04     0.816775E+03     0.355151E+00
2006     0.137038E+04     0.125015E+04     0.918261E-01
2007     0.120646E+04     0.226718E+04    -0.630845E+00
2008     N/A              0.000000E+00     N/A
```

```
Survey Index:   21 Tag:         MADMF_F  AGE =  3
Time = MEAN            Type = NUMBER
Catchability =    0.301859E+00   % Variance Contribution =     3.4082
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_____________________________________________________________________________

1985     0.282690E+03     0.325701E+03    -0.141629E+00
1986     0.555450E+02     0.311772E+03    -0.172508E+01
1987     0.135118E+03     0.572227E+03    -0.144339E+01
1988     0.622680E+03     0.312753E+03     0.688618E+00
1989     0.263352E+03     0.564555E+03    -0.762546E+00
1990     0.132776E+04     0.190197E+04    -0.359399E+00
1991     0.137905E+04     0.563413E+03     0.895138E+00
1992     0.569549E+03     0.671137E+03    -0.164129E+00
1993     0.159137E+04     0.496247E+03     0.116528E+01
1994     0.349234E+03     0.721506E+03    -0.725599E+00
1995     0.123551E+04     0.562153E+03     0.787467E+00
1996     0.463423E+03     0.684987E+03    -0.390760E+00
1997     0.171271E+03     0.499710E+03    -0.107078E+01
1998     0.464027E+03     0.502906E+03    -0.804600E-01
1999     0.846478E+03     0.888142E+03    -0.480471E-01
2000     0.808515E+03     0.732360E+03     0.989266E-01
2001     0.868586E+03     0.864583E+03     0.461909E-02
2002     0.626355E+03     0.889414E+03    -0.350646E+00
2003     0.856737E+03     0.511216E+03     0.516339E+00
2004     0.174359E+04     0.474018E+03     0.130246E+01
2005     0.104699E+04     0.385449E+03     0.999264E+00
2006     0.104444E+04     0.496948E+03     0.742748E+00
2007     0.931784E+03     0.876113E+03     0.616059E-01
2008     N/A              0.000000E+00     N/A
```

```
 Survey Index:   22 Tag:         MADMF_F  AGE =  4
 Time = MEAN            Type = NUMBER
 Catchability =    0.134206E+00   % Variance Contribution =     9.0029
 Residual = LN(Observed) - LN(Predicted)

 Year      Observed        Predicted         Residual
 _____________________________________________________________________________

 1985     N/A              0.412676E+02     N/A
 1986     0.910700E+01     0.525369E+02    -0.175247E+01
 1987     0.193930E+02     0.523662E+02    -0.993349E+00
 1988     0.412820E+02     0.383825E+02     0.728261E-01
 1989     0.283350E+02     0.256553E+02     0.993490E-01
 1990     0.159100E+01     0.840516E+02    -0.396707E+01
 1991     0.235127E+03     0.129548E+03     0.596072E+00
 1992     0.129331E+03     0.630391E+02     0.718620E+00
 1993     0.393012E+03     0.892116E+02     0.148283E+01
 1994     0.360700E+02     0.708415E+02    -0.674984E+00
 1995     N/A              0.790398E+02     N/A
 1996     0.328330E+02     0.709288E+02    -0.770242E+00
 1997     0.216970E+02     0.686793E+02    -0.115227E+01
 1998     N/A              0.349431E+02     N/A
 1999     0.134789E+03     0.464359E+02     0.106564E+01
 2000     0.561480E+02     0.931281E+02    -0.505985E+00
 2001     0.296790E+02     0.635071E+02    -0.760712E+00
 2002     0.250734E+03     0.780637E+02     0.116687E+01
 2003     0.655815E+03     0.110189E+03     0.178368E+01
 2004     0.522562E+03     0.451892E+02     0.244789E+01
 2005     0.562310E+02     0.514428E+02     0.889985E-01
 2006     0.111995E+03     0.517320E+02     0.772378E+00
 2007     0.155718E+03     0.117461E+03     0.281939E+00
 2008     N/A              0.000000E+00     N/A
```

```
Survey Index:   23 Tag:         MADMF_F  AGE =  5
 Time = MEAN            Type = NUMBER
 Catchability =    0.122468E+00   % Variance Contribution =     2.8055
 Residual = LN(Observed) - LN(Predicted)

 Year      Observed        Predicted         Residual
 _____________________________________________________________________________

 1985     N/A              0.195111E+02     N/A
 1986     0.197500E+01     0.630813E+01    -0.116127E+01
 1987     0.545800E+01     0.179391E+02    -0.118990E+01
 1988     N/A              0.936834E+01     N/A
 1989     N/A              0.298534E+01     N/A
 1990     N/A              0.544524E+01     N/A
 1991     N/A              0.180383E+02     N/A
 1992     0.555720E+02     0.150306E+02     0.130759E+01
 1993     N/A              0.113665E+02     N/A
 1994     N/A              0.189602E+02     N/A
 1995     N/A              0.108068E+02     N/A
 1996     N/A              0.104363E+02     N/A
 1997     0.125900E+02     0.133188E+02    -0.562724E-01
 1998     N/A              0.745662E+01     N/A
 1999     0.165130E+02     0.341557E+01     0.157580E+01
 2000     0.238640E+02     0.802749E+01     0.108950E+01
 2001     N/A              0.989766E+01     N/A
 2002     0.993000E+01     0.857980E+01     0.146150E+00
 2003     0.159910E+02     0.127365E+02     0.227555E+00
 2004     0.252400E+01     0.175491E+02    -0.193916E+01
 2005     N/A              0.658009E+01     N/A
 2006     N/A              0.101677E+02     N/A
 2007     N/A              0.185617E+02     N/A
 2008     N/A              0.000000E+00     N/A
```

```
Survey Index:   26 Tag:         MENH_S   AGE =  2
Time = JAN-1           Type = NUMBER
Catchability =    0.661209E-04   % Variance Contribution =     0.3335
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_____________________________________________________________________________

1985     N/A              0.219801E+00     N/A
1986     N/A              0.592347E+00     N/A
1987     N/A              0.307114E+00     N/A
1988     N/A              0.442801E+00     N/A
1989     N/A              0.122244E+01     N/A
1990     N/A              0.462473E+00     N/A
1991     N/A              0.393492E+00     N/A
1992     N/A              0.483428E+00     N/A
1993     N/A              0.324956E+00     N/A
1994     N/A              0.312927E+00     N/A
1995     N/A              0.361928E+00     N/A
1996     N/A              0.306842E+00     N/A
1997     N/A              0.388045E+00     N/A
1998     N/A              0.408667E+00     N/A
1999     N/A              0.422232E+00     N/A
2000     N/A              0.527525E+00     N/A
2001     0.599000E+00     0.478897E+00     0.223776E+00
2002     0.226000E+00     0.346805E+00    -0.428228E+00
2003     0.473000E+00     0.281507E+00     0.518939E+00
2004     0.151000E+00     0.210805E+00    -0.333653E+00
2005     0.287000E+00     0.212903E+00     0.298645E+00
2006     0.148000E+00     0.305154E+00    -0.723605E+00
2007     0.859000E+00     0.550950E+00     0.444125E+00
2008     N/A              0.190796E+00     N/A


Survey Index:   27 Tag:         MENH_S   AGE =  3
Time = JAN-1           Type = NUMBER
Catchability =    0.403312E-03   % Variance Contribution =     0.2045
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_____________________________________________________________________________

1985     N/A              0.700164E+00     N/A
1986     N/A              0.648026E+00     N/A
1987     N/A              0.143705E+01     N/A
1988     N/A              0.853575E+00     N/A
1989     N/A              0.127911E+01     N/A
1990     N/A              0.526999E+01     N/A
1991     N/A              0.126456E+01     N/A
1992     N/A              0.146764E+01     N/A
1993     N/A              0.985666E+00     N/A
1994     N/A              0.146823E+01     N/A
1995     N/A              0.126613E+01     N/A
1996     N/A              0.161617E+01     N/A
1997     N/A              0.124661E+01     N/A
1998     N/A              0.140157E+01     N/A
1999     N/A              0.186080E+01     N/A
2000     N/A              0.183853E+01     N/A
2001     0.208700E+01     0.222970E+01    -0.661379E-01
2002     0.198100E+01     0.190451E+01     0.393773E-01
2003     0.805000E+00     0.129539E+01    -0.475724E+00
2004     0.124100E+01     0.109417E+01     0.125917E+00
2005     0.110700E+01     0.880208E+00     0.229251E+00
2006     0.560000E+00     0.883803E+00    -0.456297E+00
2007     0.266100E+01     0.145512E+01     0.603614E+00
2008     N/A              0.265165E+01     N/A
```

```
 Survey Index:   28 Tag:         MENH_S   AGE =  4
 Time = JAN-1           Type = NUMBER
 Catchability =    0.500465E-03   % Variance Contribution =     0.2932

 Residual = LN(Observed) - LN(Predicted)

 Year      Observed        Predicted         Residual
 _____________________________________________________________________________

 1985     N/A              0.388955E+00     N/A
 1986     N/A              0.306904E+00     N/A
 1987     N/A              0.307882E+00     N/A
 1988     N/A              0.426894E+00     N/A
 1989     N/A              0.203286E+00     N/A
 1990     N/A              0.493193E+00     N/A
 1991     N/A              0.120442E+01     N/A
 1992     N/A              0.499034E+00     N/A
 1993     N/A              0.617227E+00     N/A
 1994     N/A              0.521051E+00     N/A
 1995     N/A              0.733378E+00     N/A
 1996     N/A              0.495393E+00     N/A
 1997     N/A              0.563223E+00     N/A
 1998     N/A              0.376775E+00     N/A
 1999     N/A              0.315259E+00     N/A
 2000     N/A              0.867477E+00     N/A
 2001     0.535000E+00     0.546679E+00    -0.215944E-01
 2002     0.845000E+00     0.617887E+00     0.313032E+00
 2003     0.850000E+00     0.842724E+00     0.859729E-02
 2004     0.492000E+00     0.375933E+00     0.269068E+00
 2005     0.280000E+00     0.402828E+00    -0.363719E+00
 2006     0.152000E+00     0.332842E+00    -0.783787E+00
 2007     0.107100E+01     0.600609E+00     0.578403E+00
 2008     N/A              0.114879E+01     N/A


Survey Index:   29 Tag:         MENH_S   AGE =  5
 Time = JAN-1           Type = NUMBER
 Catchability =    0.220345E-03   % Variance Contribution =     2.0957
 Residual = LN(Observed) - LN(Predicted)

 Year      Observed        Predicted         Residual
 _____________________________________________________________________________

 1985     N/A              0.887262E-01     N/A
 1986     N/A              0.177795E-01     N/A
 1987     N/A              0.508878E-01     N/A
 1988     N/A              0.502725E-01     N/A
 1989     N/A              0.114131E-01     N/A
 1990     N/A              0.154159E-01     N/A
 1991     N/A              0.809135E-01     N/A
 1992     N/A              0.574085E-01     N/A
 1993     N/A              0.379429E-01     N/A
 1994     N/A              0.672847E-01     N/A
 1995     N/A              0.483795E-01     N/A
 1996     N/A              0.351684E-01     N/A
 1997     N/A              0.526986E-01     N/A
 1998     N/A              0.387920E-01     N/A
 1999     N/A              0.111881E-01     N/A
 2000     N/A              0.360776E-01     N/A
 2001     0.132000E+00     0.411076E-01     0.116661E+01
 2002     0.480000E-01     0.327655E-01     0.381825E+00
 2003     0.114000E+00     0.469978E-01     0.886098E+00
 2004     0.390000E-01     0.704385E-01    -0.591179E+00
 2005     0.300000E-02     0.248603E-01    -0.211466E+01
 2006     0.140000E-01     0.315633E-01    -0.812938E+00
 2007     0.129000E+00     0.436222E-01     0.108425E+01
 2008     N/A              0.135525E+00     N/A
```

```
Survey Index:   32 Tag:         MENH_F   AGE =  2
Time = MEAN            Type = NUMBER
Catchability =    0.134794E-03   % Variance Contribution =     1.4732
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_____________________________________________________________________________

1985     N/A              0.318431E+00     N/A
1986     N/A              0.788824E+00     N/A
1987     N/A              0.433586E+00     N/A
1988     N/A              0.635774E+00     N/A
1989     N/A              0.210561E+01     N/A
1990     N/A              0.648308E+00     N/A
1991     N/A              0.633620E+00     N/A
1992     N/A              0.598726E+00     N/A
1993     N/A              0.572294E+00     N/A
1994     N/A              0.523223E+00     N/A
1995     N/A              0.633862E+00     N/A
1996     N/A              0.514031E+00     N/A
1997     N/A              0.615724E+00     N/A
1998     N/A              0.722373E+00     N/A
1999     N/A              0.730712E+00     N/A
2000     0.179900E+01     0.900238E+00     0.692327E+00
2001     0.907000E+00     0.794328E+00     0.132646E+00
2002     0.202000E+00     0.558815E+00    -0.101755E+01
2003     0.950000E+00     0.461995E+00     0.720908E+00
2004     0.137400E+01     0.357693E+00     0.134581E+01
2005     0.252000E+00     0.360269E+00    -0.357421E+00
2006     0.121000E+00     0.551425E+00    -0.151672E+01
2007     N/A              0.100003E+01     N/A
2008     N/A              0.000000E+00     N/A
```

```
Survey Index:   33 Tag:         MENH_F   AGE =  3
Time = MEAN            Type = NUMBER
Catchability =    0.189250E-03   % Variance Contribution =     0.4770
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_____________________________________________________________________________

1985     N/A              0.204198E+00     N/A
1986     N/A              0.195465E+00     N/A
1987     N/A              0.358757E+00     N/A
1988     N/A              0.196080E+00     N/A
1989     N/A              0.353947E+00     N/A
1990     N/A              0.119244E+01     N/A
1991     N/A              0.353231E+00     N/A
1992     N/A              0.420769E+00     N/A
1993     N/A              0.311122E+00     N/A
1994     N/A              0.452348E+00     N/A
1995     N/A              0.352441E+00     N/A
1996     N/A              0.429453E+00     N/A
1997     N/A              0.313293E+00     N/A
1998     N/A              0.315296E+00     N/A
1999     N/A              0.556820E+00     N/A
2000     0.640000E+00     0.459153E+00     0.332085E+00
2001     0.419000E+00     0.542050E+00    -0.257487E+00
2002     0.560000E+00     0.557618E+00     0.426276E-02
2003     0.334000E+00     0.320506E+00     0.412388E-01
2004     0.780000E+00     0.297185E+00     0.964938E+00
2005     0.212000E+00     0.241657E+00    -0.130933E+00
2006     0.120000E+00     0.311561E+00    -0.954104E+00
2007     N/A              0.549279E+00     N/A
2008     N/A              0.000000E+00     N/A
```

```
Survey Index:   34 Tag:         MENH_F   AGE =  4
Time = MEAN            Type = NUMBER
Catchability =    0.805163E-04   % Variance Contribution =     3.9194
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_____________________________________________________________________________

1985     N/A              0.247583E-01     N/A
1986     N/A              0.315193E-01     N/A
1987     N/A              0.314169E-01     N/A
1988     N/A              0.230274E-01     N/A
1989     N/A              0.153918E-01     N/A
1990     N/A              0.504264E-01     N/A
1991     N/A              0.777219E-01     N/A
1992     N/A              0.378200E-01     N/A
1993     N/A              0.535221E-01     N/A
1994     N/A              0.425011E-01     N/A
1995     N/A              0.474196E-01     N/A
1996     N/A              0.425534E-01     N/A
1997     N/A              0.412038E-01     N/A
1998     N/A              0.209640E-01     N/A
1999     N/A              0.278590E-01     N/A
2000     0.300000E-01     0.558718E-01    -0.621862E+00
2001     0.110000E-01     0.381008E-01    -0.124234E+01
2002     0.177000E+00     0.468340E-01     0.132954E+01
2003     0.258000E+00     0.661073E-01     0.136168E+01
2004     0.184000E+00     0.271111E-01     0.191499E+01
2005     N/A              0.308629E-01     N/A
2006     0.200000E-02     0.310364E-01    -0.274201E+01
2007     N/A              0.704703E-01     N/A
2008     N/A              0.000000E+00     N/A
```

```
                   Retrospective Summary

                   Average Fishing Mortality
                    Ages =  4 -  5


             1985        1986        1987        1988        1989


2000       2.0651      0.7766      0.7919      2.6014      1.5589
2001       2.0651      0.7766      0.7919      2.6014      1.5589
2002       2.0651      0.7766      0.7919      2.6014      1.5589
2003       2.0651      0.7766      0.7919      2.6014      1.5589
2004       2.0651      0.7766      0.7919      2.6014      1.5589
2005       2.0651      0.7766      0.7919      2.6014      1.5589
2006       2.0651      0.7766      0.7919      2.6014      1.5589
2007       2.0651      0.7766      0.7919      2.6014      1.5589

             1990        1991        1992        1993        1994


2000       0.7872      2.0232      1.5562      1.1959      1.3564
2001       0.7872      2.0232      1.5562      1.1960      1.3564
2002       0.7872      2.0232      1.5562      1.1960      1.3564
2003       0.7872      2.0232      1.5562      1.1960      1.3564
2004       0.7872      2.0232      1.5562      1.1960      1.3564
2005       0.7872      2.0232      1.5562      1.1960      1.3564
2006       0.7872      2.0232      1.5562      1.1960      1.3564
2007       0.7872      2.0232      1.5562      1.1960      1.3564

             1995        1996        1997        1998        1999


2000       2.0165      1.2187      1.6454      2.3832      0.9267
2001       2.0172      1.2205      1.6554      2.4999      1.1553
2002       2.0172      1.2204      1.6551      2.4963      1.1471
2003       2.0172      1.2204      1.6551      2.4966      1.1476
2004       2.0172      1.2204      1.6551      2.4966      1.1478
2005       2.0172      1.2204      1.6551      2.4965      1.1474
2006       2.0172      1.2204      1.6551      2.4965      1.1474
2007       2.0172      1.2204      1.6551      2.4965      1.1474

             2000        2001        2002        2003        2004


2000       0.8876
2001       2.1027      1.4728
2002       2.0263      1.7791      1.2118
2003       2.0313      1.8067      1.6116      1.6662
2004       2.0325      1.8129      1.6408      1.8980      2.6370
2005       2.0295      1.7965      1.5662      1.5045      1.9693
2006       2.0291      1.7946      1.5576      1.4688      1.7367
2007       2.0291      1.7941      1.5559      1.4616      1.6958

             2005        2006        2007


2000
2001
2002
2003
2004
2005       1.7047
2006       1.7192      0.9288
2007       1.5262      1.0118      0.4144
```

```
                   Spawning Stock Biomass


             1985        1986        1987        1988        1989


2000         730.        908.       1157.        670.       1515.
2001         730.        908.       1157.        670.       1515.
2002         730.        908.       1157.        670.       1515.
2003         730.        908.       1157.        670.       1515.
2004         730.        908.       1157.        670.       1515.
2005         730.        908.       1157.        670.       1515.
2006         730.        908.       1157.        670.       1515.
2007         730.        908.       1157.        670.       1515.

             1990        1991        1992        1993        1994


2000        2633.       1375.       1054.       1029.       1308.
2001        2633.       1375.       1054.       1029.       1308.
2002        2633.       1375.       1054.       1029.       1308.
2003        2633.       1375.       1054.       1029.       1308.
2004        2633.       1375.       1054.       1029.       1308.
2005        2633.       1375.       1054.       1029.       1308.
2006        2633.       1375.       1054.       1029.       1308.
2007        2633.       1375.       1054.       1029.       1308.

             1995        1996        1997        1998        1999


2000        1164.       1244.       1085.       1041.       2077.
2001        1164.       1242.       1072.        947.       1592.
2002        1164.       1242.       1073.        949.       1599.
2003        1164.       1242.       1073.        949.       1598.
2004        1164.       1242.       1073.        949.       1598.
2005        1164.       1242.       1073.        949.       1598.
2006        1164.       1242.       1073.        949.       1599.
2007        1164.       1242.       1073.        949.       1599.

             2000        2001        2002        2003        2004


2000        2921.
2001        1813.       2034.
2002        1758.       1743.       1592.
2003        1743.       1693.       1711.       1162.
2004        1741.       1682.       1685.       1190.        936.
2005        1746.       1709.       1781.       1316.        844.
2006        1746.       1712.       1795.       1350.        877.
2007        1746.       1713.       1797.       1359.        902.

             2005        2006        2007


2000
2001
2002
2003
2004
2005         889.
2006         781.       1279.
2007         796.       1080.       1922.
```

```
                   Total Population Numbers


             1985        1986        1987        1988        1989


2000       18086.      17053.      17360.      33021.      30803.
2001       18086.      17053.      17360.      33021.      30803.
2002       18086.      17053.      17360.      33021.      30803.
2003       18086.      17053.      17360.      33021.      30803.
2004       18086.      17053.      17360.      33021.      30803.
2005       18086.      17053.      17360.      33021.      30803.
2006       18086.      17053.      17360.      33021.      30803.
2007       18086.      17053.      17360.      33021.      30803.

             1990        1991        1992        1993        1994


2000       28534.      21394.      20107.      14805.      16591.
2001       28534.      21394.      20107.      14804.      16584.
2002       28534.      21394.      20107.      14804.      16585.
2003       28534.      21394.      20107.      14804.      16585.
2004       28534.      21394.      20107.      14804.      16585.
2005       28534.      21394.      20107.      14804.      16585.
2006       28534.      21394.      20107.      14804.      16585.
2007       28534.      21394.      20107.      14804.      16585.

             1995        1996        1997        1998        1999


2000       16239.      17186.      19520.      21983.      25513.
2001       16216.      17003.      17867.      18472.      22911.
2002       16217.      17008.      17910.      18438.      21659.
2003       16217.      17008.      17907.      18423.      21406.
2004       16217.      17008.      17907.      18420.      21386.
2005       16217.      17008.      17908.      18428.      21438.
2006       16217.      17008.      17909.      18429.      21445.
2007       16217.      17008.      17909.      18430.      21446.

             2000        2001        2002        2003        2004


2000       22722.      21837.
2001       22995.      15440.      14758.
2002       22924.      16949.      12098.      13184.
2003       23109.      19780.      16720.      11858.      13293.
2004       22959.      19974.      16983.      14003.      12377.
2005       23278.      20394.      16411.      13755.      12228.
2006       23317.      20489.      16571.      13213.      11942.
2007       23325.      20509.      16661.      13370.      11018.

             2005        2006        2007        2008


2000
2001
2002
2003
2004       15142.
2005       12473.      15427.
2006       12590.      18200.      21185.
2007       12040.      17892.      16929.      19724.
```

```
                                    Age  1 Population

             1985        1986        1987        1988        1989


2000       11698.       5778.       8201.      23080.       8673.
2001       11698.       5778.       8201.      23080.       8673.
2002       11698.       5778.       8201.      23080.       8673.
2003       11698.       5778.       8201.      23080.       8673.
2004       11698.       5778.       8201.      23080.       8673.
2005       11698.       5778.       8201.      23080.       8673.
2006       11698.       5778.       8201.      23080.       8673.
2007       11698.       5778.       8201.      23080.       8673.

             1990        1991        1992        1993        1994


2000        7361.       9443.       7880.       5957.       6712.
2001        7361.       9443.       7880.       5956.       6706.
2002        7361.       9443.       7880.       5956.       6707.
2003        7361.       9443.       7880.       5956.       6707.
2004        7361.       9443.       7880.       5956.       6707.
2005        7361.       9443.       7880.       5956.       6707.
2006        7361.       9443.       7880.       5956.       6707.
2007        7361.       9443.       7880.       5956.       6707.

             1995        1996        1997        1998        1999


2000        5726.       7356.       9024.      10077.      10916.
2001        5708.       7192.       7521.       7917.      11186.
2002        5709.       7197.       7559.       7848.       9961.
2003        5709.       7197.       7557.       7836.       9720.
2004        5709.       7197.       7556.       7833.       9702.
2005        5709.       7197.       7558.       7840.       9748.
2006        5709.       7197.       7558.       7841.       9753.
2007        5709.       7197.       7558.       7842.       9755.

             2000        2001        2002        2003        2004


2000        4907.       8291.
2001        7318.       1623.       7521.
2002        8273.       3197.       3611.       7499.
2003        8665.       5876.       5919.       2345.       7484.
2004        8531.       6193.       6024.       4278.       4758.
2005        8808.       6351.       5109.       4495.       4842.
2006        8841.       6415.       5191.       3822.       5000.
2007        8849.       6428.       5264.       3905.       3947.

             2005        2006        2007        2008


2000
2001
2002
2003
2004        7559.
2005        5071.       7404.
2006        5446.      10011.       7497.
2007        5653.      10185.       3540.       7211.
```

```
In the Retrospective Analysis
The Following Survey Indices Have Predicted
Index Value Set to Zero in Terminal Year + 1

   7     NEFSC_F     1
   8     NEFSC_F     2
   9     NEFSC_F     3
  10     NEFSC_F     4
  11     NEFSC_F     5
  19     MADMF_F     1
  20     MADMF_F     2
  21     MADMF_F     3
  22     MADMF_F     4
  23     MADMF_F     5
  32     MENH_F      2
  33     MENH_F      3
  34     MENH_F      4


Plus Group Diagnostic Report

Calculation Method Selected = Backward

         Population  Population    F            F
Year     Backward     Forward    Forward     Backward    Ratio

1985        148.        148.    2.065062    2.065076    1.000007
1986         16.         57.    0.167157    0.776571    4.645765
1987        106.         70.    1.679518    0.791916    0.471514
1988         47.         96.    0.625021    2.601429    4.162144
1989         12.         56.    0.194222    1.558876    8.026244
1990         56.         47.    1.049754    0.787178    0.749869
1991         91.         90.    2.078124    2.023215    0.973578
1992         19.         40.    0.479173    1.556243    3.247765
1993         84.         65.    2.133503    1.195943    0.560553
1994        159.        133.    2.078124    1.356350    0.652680
1995        210.        208.    2.078124    2.016532    0.970362
1996         14.         25.    0.498768    1.218703    2.443428
1997         27.         51.    0.558001    1.645354    2.948657
1998          4.         62.    0.054967    2.383208   43.357246
1999         13.         61.    0.134164    0.926671    6.906985
2000         67.         63.    0.935291    0.847839    0.906497
2001        105.        101.       N/A         N/A


Warning **** Infeasible Mass Balance in Plus Group
Year =  1987
```

## Appendix F. Gulf of Maine cod

by R Mayo, G Shepherd, L O"Brien, L Col, M Traver

Appendix 1. Commercial landings at age, discard at age, recreational landings at age and total catch at age, 1982-2007 for the Gulf of Maine stock of Atlantic cod.

| | Total Commercial Landings in Numbers (000's) at Age | | | | | | | | Revised LAA 1994+ | | Jul-08 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11+ | Total |
| 1982 | 30 | 1380 | 1633 | 1143 | 633 | 69 | 91 | 61 | 41 | 4 | 33 | 5118 |
| 1983 | 0 | 866 | 2357 | 1058 | 638 | 422 | 47 | 61 | 23 | 9 | 15 | 5496 |
| 1984 | 4 | 446 | 1240 | 1500 | 437 | 194 | 74 | 19 | 15 | 11 | 17 | 3957 |
| 1985 | 0 | 407 | 1445 | 991 | 630 | 128 | 78 | 32 | 4 | 11 | 11 | 3737 |
| 1986 | 0 | 84 | 2164 | 813 | 250 | 177 | 39 | 24 | 20 | 4 | 8 | 3583 |
| 1987 | 2 | 216 | 595 | 1109 | 277 | 66 | 51 | 9 | 8 | 8 | 3 | 2344 |
| 1988 | 0 | 160 | 1443 | 953 | 406 | 43 | 9 | 17 | 1 | 2 | 1 | 3035 |
| 1989 | 0 | 337 | 1583 | 1454 | 449 | 81 | 35 | 6 | 3 | 5 | 7 | 3960 |
| 1990 | 0 | 205 | 3425 | 2064 | 430 | 157 | 27 | 30 | 10 | 15 | 17 | 6380 |
| 1991 | 0 | 344 | 934 | 4161 | 851 | 143 | 41 | 30 | 6 | 1 | 1 | 6512 |
| 1992 | 0 | 313 | 530 | 484 | 2018 | 202 | 62 | 7 | 12 | 3 | 0 | 3631 |
| 1993 | 0 | 76 | 1487 | 641 | 129 | 457 | 28 | 6 | 2 | 0 | 0 | 2825 |
| 1994 | 0 | 37 | 1094 | 1114 | 305 | 69 | 84 | 29 | 7 | 1 | 1 | 2742 |
| 1995 | 18 | 221 | 885 | 1035 | 222 | 27 | 14 | 18 | 1 | 2 | 0 | 2443 |
| 1996 | 0 | 69 | 513 | 1744 | 365 | 37 | 4 | 0 | 1 | 0 | 0 | 2734 |
| 1997 | 0 | 79 | 445 | 427 | 801 | 68 | 5 | 3 | 0 | 1 | 0 | 1829 |
| 1998 | 0 | 94 | 396 | 530 | 146 | 176 | 25 | 4 | 0 | 1 | 0 | 1373 |
| 1999 | 0 | 3 | 184 | 176 | 81 | 16 | 22 | 2 | 0 | 2 | 0 | 487 |
| 2000 | 0 | 102 | 256 | 501 | 122 | 69 | 11 | 5 | 0 | 0 | 0 | 1067 |
| 2001 | 0 | 46 | 484 | 323 | 212 | 68 | 39 | 6 | 9 | 1 | 0 | 1187 |
| 2002 | 0 | 2 | 115 | 439 | 172 | 106 | 43 | 12 | 4 | 4 | 0 | 898 |
| 2003 | 0 | 7 | 48 | 205 | 393 | 124 | 54 | 21 | 9 | 5 | 3 | 870 |
| 2004 | 0 | 1 | 156 | 133 | 226 | 178 | 54 | 28 | 15 | 8 | 2 | 799 |
| 2005 | 0 | 1 | 40 | 437 | 65 | 181 | 85 | 22 | 13 | 6 | 5 | 856 |
| 2006 | 0 | 1 | 120 | 192 | 307 | 22 | 66 | 31 | 11 | 6 | 5 | 761 |
| 2007 | 0 | 5 | 101 | 643 | 101 | 187 | 6 | 17 | 8 | 4 | 5 | 1077 |

Total Commercial Landings in Weight (Tons) at Age

| Year | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11+ | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1982 | 24 | 1595 | 2717 | 3160 | 3019 | 461 | 813 | 608 | 531 | 41 | 613 | 13582 |
| 1983 | 0 | 1009 | 3913 | 2619 | 2410 | 2518 | 271 | 643 | 227 | 102 | 269 | 13981 |
| 1984 | 3 | 516 | 2071 | 4080 | 1607 | 1145 | 603 | 186 | 193 | 152 | 250 | 10816 |
| 1985 | 0 | 513 | 2523 | 2816 | 2814 | 705 | 615 | 363 | 51 | 141 | 152 | 10693 |
| 1986 | 0 | 110 | 3976 | 2375 | 1153 | 1072 | 296 | 243 | 253 | 54 | 132 | 9664 |
| 1987 | 2 | 283 | 1001 | 3641 | 1340 | 451 | 455 | 88 | 116 | 110 | 40 | 7527 |
| 1988 | 0 | 203 | 2715 | 2311 | 2097 | 295 | 85 | 191 | 11 | 36 | 14 | 7958 |
| 1989 | 0 | 420 | 2811 | 4351 | 1737 | 325 | 323 | 67 | 43 | 87 | 163 | 10397 |
| 1990 | 0 | 219 | 5794 | 4687 | 1834 | 1200 | 290 | 354 | 153 | 214 | 350 | 15095 |
| 1991 | 0 | 388 | 1463 | 10455 | 3520 | 1045 | 399 | 369 | 93 | 32 | 17 | 17781 |
| 1992 | 0 | 480 | 1019 | 1313 | 6175 | 1011 | 594 | 88 | 161 | 49 | 0 | 10891 |
| 1993 | 0 | 99 | 2809 | 1611 | 561 | 2819 | 281 | 79 | 27 | 0 | 0 | 8286 |
| 1994 | 0 | 52 | 2060 | 3379 | 1054 | 440 | 603 | 306 | 68 | 11 | 26 | 7998 |
| 1995 | 5 | 307 | 1641 | 2870 | 1143 | 156 | 150 | 211 | 15 | 31 | 5 | 6535 |
| 1996 | 0 | 106 | 1139 | 4098 | 1295 | 269 | 46 | 6 | 18 | 0 | 0 | 6978 |
| 1997 | 0 | 140 | 997 | 1320 | 2539 | 333 | 42 | 30 | 4 | 12 | 2 | 5420 |
| 1998 | 0 | 124 | 813 | 1527 | 614 | 759 | 132 | 43 | 7 | 16 | 7 | 4045 |
| 1999 | 0 | 4 | 333 | 442 | 300 | 92 | 163 | 24 | 0 | 20 | 0 | 1379 |
| 2000 | 0 | 170 | 643 | 1828 | 566 | 401 | 71 | 47 | 0 | 0 | 0 | 3726 |
| 2001 | 0 | 85 | 1205 | 1087 | 1034 | 432 | 287 | 50 | 82 | 11 | 9 | 4282 |
| 2002 | 0 | 2 | 296 | 1457 | 716 | 646 | 292 | 104 | 38 | 45 | 6 | 3601 |
| 2003 | 0 | 13 | 116 | 653 | 1645 | 664 | 389 | 176 | 97 | 57 | 42 | 3852 |
| 2004 | 0 | 1 | 397 | 478 | 933 | 1024 | 388 | 258 | 171 | 100 | 27 | 3776 |
| 2005 | 0 | 2 | 86 | 1319 | 290 | 838 | 530 | 174 | 137 | 73 | 77 | 3526 |
| 2006 | 0 | 2 | 291 | 627 | 1164 | 107 | 358 | 224 | 102 | 76 | 79 | 3030 |
| 2007 | 0 | 10 | 251 | 2083 | 402 | 902 | 39 | 116 | 78 | 47 | 65 | 3993 |

Total Commercial Landings Mean Weight (kg) at Age

| Year | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11+ | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1982 | 0.801 | 1.156 | 1.664 | 2.764 | 4.770 | 6.739 | 8.944 | 9.931 | 12.922 | 10.618 | 18.456 | 2.654 |
| 1983 | 0.000 | 1.164 | 1.660 | 2.475 | 3.778 | 5.962 | 5.808 | 10.522 | 10.089 | 10.898 | 17.813 | 2.544 |
| 1984 | 0.589 | 1.159 | 1.670 | 2.721 | 3.677 | 5.898 | 8.119 | 9.595 | 12.889 | 13.951 | 15.028 | 2.731 |
| 1985 | 0.000 | 1.260 | 1.746 | 2.840 | 4.466 | 5.525 | 7.901 | 11.218 | 11.420 | 13.386 | 14.523 | 2.861 |
| 1986 | 0.000 | 1.304 | 1.837 | 2.923 | 4.619 | 6.067 | 7.669 | 10.030 | 12.463 | 12.907 | 16.554 | 2.698 |
| 1987 | 1.028 | 1.313 | 1.684 | 3.283 | 4.831 | 6.824 | 8.878 | 10.023 | 13.752 | 14.738 | 14.596 | 3.212 |
| 1988 | 0.000 | 1.268 | 1.881 | 2.426 | 5.166 | 6.767 | 9.932 | 11.126 | 14.960 | 15.763 | 20.356 | 2.622 |
| 1989 | 0.000 | 1.247 | 1.776 | 2.993 | 3.864 | 4.872 | 9.267 | 11.938 | 14.806 | 18.196 | 21.521 | 2.626 |
| 1990 | 0.000 | 1.071 | 1.692 | 2.271 | 4.265 | 7.645 | 10.734 | 11.758 | 15.015 | 14.784 | 20.295 | 2.366 |
| 1991 | 0.000 | 1.130 | 1.568 | 2.512 | 4.136 | 7.309 | 9.642 | 12.322 | 15.547 | 24.328 | 21.885 | 2.731 |
| 1992 | 0.000 | 1.533 | 1.922 | 2.714 | 3.061 | 5.000 | 9.566 | 12.462 | 13.449 | 16.631 |  | 2.999 |
| 1993 | 0.000 | 1.293 | 1.889 | 2.513 | 4.356 | 6.174 | 9.999 | 13.869 | 17.544 |  |  | 2.933 |
| 1994 | 0.000 | 1.401 | 1.882 | 3.034 | 3.452 | 6.324 | 7.159 | 10.464 | 10.362 | 18.542 | 20.637 | 2.915 |
| 1995 | 0.274 | 1.388 | 1.854 | 2.774 | 5.138 | 5.837 | 10.760 | 11.510 | 18.893 | 20.064 | 20.347 | 2.675 |
| 1996 | 0.000 | 1.543 | 2.220 | 2.350 | 3.543 | 7.347 | 10.406 | 14.126 | 14.929 | 0.000 | 0.000 | 2.551 |
| 1997 | 0.000 | 1.777 | 2.242 | 3.090 | 3.171 | 4.880 | 8.409 | 11.560 | 14.726 | 15.814 | 21.874 | 2.964 |
| 1998 | 0.000 | 1.323 | 2.055 | 2.879 | 4.204 | 4.321 | 5.254 | 11.391 | 18.893 | 14.953 | 20.347 | 2.947 |
| 1999 | 0.000 | 1.483 | 1.809 | 2.511 | 3.691 | 5.712 | 7.311 | 10.081 | 0.000 | 13.402 | 0.000 | 2.837 |
| 2000 | 0.000 | 1.673 | 2.513 | 3.646 | 4.637 | 5.813 | 6.394 | 8.580 | 0.000 | 0.000 | 0.000 | 3.488 |
| 2001 | 0.000 | 1.843 | 2.491 | 3.365 | 4.880 | 6.359 | 7.451 | 8.733 | 8.789 | 12.414 | 24.418 | 3.605 |
| 2002 | 0.000 | 1.348 | 2.569 | 3.320 | 4.152 | 6.066 | 6.792 | 8.618 | 9.589 | 10.482 | 14.333 | 4.013 |
| 2003 | 0.000 | 1.810 | 2.415 | 3.179 | 4.183 | 5.343 | 7.247 | 8.480 | 10.295 | 11.771 | 12.638 | 4.426 |
| 2004 | 0.000 | 1.483 | 2.550 | 3.588 | 4.138 | 5.742 | 7.167 | 9.329 | 11.688 | 12.822 | 12.914 | 4.723 |
| 2005 | 0.000 | 1.876 | 2.185 | 3.018 | 4.467 | 4.622 | 6.226 | 7.736 | 10.355 | 13.331 | 14.098 | 4.120 |
| 2006 | 0.000 | 2.394 | 2.430 | 3.271 | 3.790 | 4.789 | 5.453 | 7.284 | 9.245 | 11.974 | 15.718 | 3.980 |
| 2007 | 0.000 | 1.945 | 2.493 | 3.241 | 3.961 | 4.827 | 6.243 | 6.839 | 9.625 | 11.369 | 14.255 | 3.703 |

Total Commercial

Landings Mean Length (cm) at Age

| Year | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11+ | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1982 | 43.2 | 48.3 | 53.8 | 63.4 | 76.8 | 86.1 | 94.6 | 97.9 | 107.4 | 101.0 | 120.7 | 59.9 |
| 1983 | 0.0 | 48.6 | 53.8 | 61.4 | 70.8 | 82.4 | 80.5 | 98.8 | 97.5 | 100.0 | 118.7 | 59.8 |
| 1984 | 39.0 | 48.4 | 54.1 | 63.4 | 69.7 | 81.8 | 91.5 | 96.7 | 106.9 | 109.6 | 112.0 | 61.6 |
| 1985 | 0.0 | 49.8 | 55.1 | 64.6 | 74.9 | 80.3 | 90.8 | 101.9 | 103.1 | 108.2 | 109.7 | 62.8 |
| 1986 | 0.0 | 50.3 | 55.9 | 65.0 | 75.4 | 82.6 | 89.9 | 98.7 | 105.8 | 107.5 | 116.2 | 61.6 |
| 1987 | 47.0 | 50.4 | 54.4 | 67.8 | 76.9 | 86.5 | 93.8 | 98.7 | 109.5 | 111.7 | 111.3 | 65.4 |
| 1988 | 0.0 | 50.1 | 56.4 | 61.1 | 78.7 | 86.4 | 98.6 | 102.3 | 113.0 | 114.8 | 125.0 | 61.4 |
| 1989 | 0.0 | 49.8 | 55.5 | 65.7 | 71.5 | 76.7 | 95.8 | 103.4 | 112.6 | 120.4 | 126.8 | 61.7 |
| 1990 | 0.0 | 47.5 | 54.8 | 60.0 | 73.7 | 90.0 | 100.9 | 104.0 | 111.8 | 112.6 | 124.6 | 59.2 |
| 1991 | 0.0 | 47.7 | 52.6 | 61.8 | 72.6 | 88.6 | 97.2 | 105.0 | 113.3 | 132.5 | 128.0 | 62.2 |
| 1992 | 0.0 | 53.1 | 56.6 | 62.9 | 65.6 | 77.0 | 97.3 | 106.1 | 109.1 | 117.0 |  | 64.3 |
| 1993 | 0.0 | 50.5 | 56.8 | 61.7 | 74.2 | 83.7 | 98.6 | 110.0 | 119.1 |  |  | 63.5 |
| 1994 | 0.0 | 51.8 | 56.6 | 65.8 | 68.3 | 83.3 | 86.8 | 98.3 | 100.0 | 121.2 | 125.5 | 63.8 |
| 1995 | 30.4 | 50.5 | 56.2 | 63.7 | 78.7 | 78.1 | 101.1 | 102.7 | 122.0 | 124.4 | 125.0 | 61.6 |
| 1996 | 0.0 | 52.8 | 59.6 | 60.4 | 68.6 | 88.6 | 100.0 | 110.8 | 112.6 | 0.0 | 0.0 | 61.6 |
| 1997 | 0.0 | 55.4 | 59.8 | 66.0 | 66.3 | 76.2 | 92.3 | 102.9 | 112.1 | 115.0 | 128.0 | 64.7 |
| 1998 | 0.0 | 50.7 | 58.1 | 64.4 | 73.0 | 73.3 | 75.8 | 101.9 | 122.0 | 113.0 | 125.0 | 64.1 |
| 1999 | 0.0 | 53.0 | 55.8 | 62.0 | 69.2 | 78.6 | 87.6 | 99.3 | 0.0 | 109.0 | 0.0 | 62.9 |
| 2000 | 0.0 | 54.6 | 61.7 | 70.1 | 76.1 | 82.3 | 84.3 | 93.9 | 0.0 | 0.0 | 0.0 | 68.4 |
| 2001 | 0.0 | 56.1 | 62.0 | 68.1 | 77.4 | 84.6 | 89.2 | 93.6 | 94.1 | 106.2 | 132.4 | 68.8 |
| 2002 | 0.0 | 51.3 | 62.5 | 68.0 | 72.9 | 83.2 | 86.1 | 93.5 | 96.9 | 99.3 | 110.0 | 71.5 |
| 2003 | 0.0 | 56.3 | 61.5 | 67.0 | 73.2 | 79.5 | 88.2 | 92.7 | 98.7 | 103.5 | 106.3 | 73.8 |
| 2004 | 0.0 | 53.0 | 62.7 | 70.1 | 73.1 | 81.4 | 87.8 | 96.1 | 103.7 | 107.1 | 106.4 | 75.2 |
| 2005 | 0.0 | 57.0 | 59.7 | 66.1 | 75.2 | 75.9 | 83.3 | 89.8 | 99.2 | 108.1 | 109.8 | 71.9 |
| 2006 | 0.0 | 62.0 | 61.7 | 67.9 | 71.0 | 76.3 | 79.7 | 87.1 | 94.7 | 103.6 | 113.8 | 71.2 |
| 2007 | 0.0 | 57.8 | 62.3 | 67.9 | 72.1 | 77.0 | 83.7 | 86.0 | 96.7 | 102.6 | 110.0 | 70.2 |

Total Commercial Discards in Numbers (000's) at Age

Revised Discards 1999+

| Year | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11+ | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1999 | 0 | 6 | 350 | 335 | 155 | 31 | 43 | 4 | 0 | 3 | 0 | 925 |
| 2000 | 0 | 27 | 69 | 134 | 33 | 19 | 3 | 1 | 0 | 0 | 0 | 286 |
| 2001 | 0 | 15 | 155 | 104 | 68 | 22 | 12 | 2 | 3 | 0 | 0 | 382 |
| 2002 | 0 | 1 | 49 | 187 | 74 | 45 | 18 | 5 | 2 | 2 | 0 | 383 |
| 2003 | 0 | 2 | 15 | 65 | 125 | 39 | 17 | 7 | 3 | 2 | 1 | 277 |
| 2004 | 0 | 0 | 19 | 17 | 28 | 22 | 7 | 3 | 2 | 1 | 0 | 99 |
| 2005 | 0 | 0 | 3 | 33 | 5 | 14 | 6 | 2 | 1 | 0 | 0 | 65 |
| 2006 | 0 | 0 | 18 | 29 | 46 | 3 | 10 | 5 | 2 | 1 | 1 | 114 |
| 2007 | 0 | 1 | 13 | 83 | 13 | 24 | 1 | 2 | 1 | 1 | 1 | 139 |

Total Commercial Discards in Weight (Tons) at Age

| Year | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11+ | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1999 | 0 | 8.229152 | 632.3211 | 840.8807 | 570.5593 | 175.6108 | 310.7809 | 44.92337 | 0 | 38.4042 | 0 | 2626.099 |
| 2000 | 0 | 45.69613 | 172.5082 | 490.2897 | 151.7367 | 107.5641 | 18.96529 | 12.59727 | 0 | 0 | 0 | 992.4665 |
| 2001 | 0 | 27.26515 | 387.2823 | 349.5529 | 332.4472 | 138.964 | 92.24515 | 16.02044 | 26.24963 | 3.653747 | 2.836484 | 1375.022 |
| 2002 | 0 | 0.894573 | 126.3784 | 621.6192 | 305.4864 | 275.5153 | 124.4507 | 44.46742 | 16.24992 | 18.99534 | 2.67322 | 1541.092 |
| 2003 | 0 | 4.041596 | 36.94529 | 207.3986 | 522.9986 | 210.9961 | 123.682 | 55.84634 | 30.87597 | 17.99572 | 13.4672 | 1223.025 |
| 2004 | 0 | 0.094445 | 49.38522 | 59.43709 | 116.1658 | 127.4585 | 48.25518 | 32.15067 | 21.24175 | 12.4877 | 3.384399 | 468.9256 |
| 2005 | 0 | 0.171457 | 6.598477 | 100.6273 | 22.12268 | 63.95506 | 40.40933 | 13.25934 | 10.42035 | 5.597503 | 5.891383 | 268.328 |
| 2006 | 0 | 0.362839 | 43.68574 | 94.059 | 174.4595 | 15.98146 | 53.74157 | 33.53138 | 15.2962 | 11.3954 | 11.77911 | 451.9766 |
| 2007 | 0 | 1.345042 | 32.46468 | 268.9374 | 51.85083 | 116.4489 | 5.086826 | 14.94985 | 10.0594 | 6.010341 | 8.426732 | 510.4338 |

Total Recreational Landings in Numbers (000's) at Age Revised Recr Catch 1982+

| Year | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11+ | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1982 | 41 | 601 | 787 | 279 | 114 | 8 | 7 | 5 | 0 | 0 | 0 | 1842 |
| 1983 | 11 | 458 | 561 | 131 | 49 | 31 | 3 | 4 | 2 | 3 | 4 | 1258 |
| 1984 | 21 | 356 | 342 | 137 | 33 | 14 | 4 | 0 | 0 | 1 | 1 | 908 |
| 1985 | 44 | 658 | 743 | 146 | 37 | 5 | 0 | 0 | 0 | 0 | 0 | 1634 |
| 1986 | 13 | 102 | 593 | 117 | 27 | 23 | 7 | 6 | 16 | 4 | 51 | 958 |
| 1987 | 94 | 674 | 726 | 397 | 69 | 25 | 33 | 5 | 6 | 2 | 0 | 2031 |
| 1988 | 2 | 389 | 685 | 164 | 23 | 6 | 2 | 1 | 0 | 0 | 0 | 1273 |
| 1989 | 4 | 183 | 698 | 262 | 39 | 12 | 6 | 0 | 0 | 0 | 0 | 1203 |
| 1990 | 0 | 49 | 701 | 392 | 93 | 20 | 0 | 0 | 0 | 0 | 0 | 1254 |
| 1991 | 0 | 94 | 407 | 750 | 80 | 16 | 6 | 0 | 2 | 0 | 0 | 1355 |
| 1992 | 0 | 25 | 57 | 48 | 170 | 17 | 3 | 0 | 0 | 0 | 0 | 322 |
| 1993 | 0 | 52 | 545 | 142 | 10 | 17 | 1 | 0 | 0 | 0 | 0 | 767 |
| 1994 | 1 | 17 | 394 | 103 | 26 | 2 | 1 | 0 | 0 | 0 | 0 | 543 |
| 1995 | 0 | 56 | 285 | 157 | 10 | 2 | 0 | 0 | 0 | 0 | 0 | 510 |
| 1996 | 0 | 21 | 117 | 193 | 19 | 0 | 0 | 0 | 0 | 0 | 0 | 351 |
| 1997 | 0 | 6 | 51 | 28 | 52 | 3 | 0 | 0 | 0 | 0 | 0 | 140 |
| 1998 | 0 | 14 | 87 | 64 | 13 | 16 | 1 | 0 | 0 | 0 | 0 | 194 |
| 1999 | 1 | 14 | 114 | 57 | 37 | 11 | 14 | 1 | 0 | 0 | 0 | 249 |
| 2000 | 0 | 72 | 209 | 192 | 36 | 11 | 2 | 0 | 0 | 0 | 0 | 523 |
| 2001 | 0 | 86 | 544 | 259 | 98 | 19 | 9 | 1 | 1 | 0 | 0 | 1018 |
| 2002 | 0 | 1 | 95 | 258 | 100 | 52 | 20 | 18 | 4 | 3 | 0 | 551 |
| 2003 | 0 | 7 | 55 | 172 | 248 | 68 | 33 | 13 | 9 | 4 | 3 | 611 |
| 2004 | 0 | 0 | 183 | 100 | 156 | 65 | 14 | 6 | 3 | 3 | 1 | 531 |
| 2005 | 0 | 6 | 92 | 344 | 25 | 70 | 29 | 8 | 5 | 2 | 2 | 584 |
| 2006 | 0 | 0 | 39 | 61 | 96 | 7 | 22 | 13 | 5 | 3 | 3 | 250 |
| 2007 | 0 | 2 | 41 | 182 | 26 | 43 | 1 | 4 | 3 | 2 | 2 | 307 |

Total Recreational Landings in Weight (Tons) at Age

| Year | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11+ | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1982 | 22 | 606 | 1201 | 676 | 506 | 46 | 41 | 32 | 0 | 0 | 0 | 3131 |
| 1983 | 5 | 398 | 785 | 282 | 168 | 209 | 18 | 37 | 24 | 50 | 82 | 2056 |
| 1984 | 10 | 302 | 481 | 336 | 114 | 61 | 30 | 2 | 0 | 11 | 26 | 1371 |
| 1985 | 21 | 546 | 980 | 340 | 113 | 18 | 2 | 1 | 0 | 0 | 0 | 2020 |
| 1986 | 5 | 99 | 976 | 308 | 108 | 131 | 75 | 84 | 230 | 55 | 1033 | 3104 |
| 1987 | 18 | 564 | 1042 | 1073 | 326 | 204 | 342 | 52 | 64 | 25 | 0 | 3709 |
| 1988 | 1 | 326 | 982 | 345 | 89 | 23 | 15 | 7 | 0 | 0 | 0 | 1788 |
| 1989 | 3 | 203 | 1117 | 683 | 139 | 75 | 49 | 4 | 0 | 0 | 0 | 2272 |
| 1990 | 0 | 55 | 1160 | 961 | 357 | 108 | 0 | 0 | 0 | 0 | 0 | 2642 |
| 1991 | 0 | 130 | 605 | 1492 | 208 | 133 | 55 | 0 | 18 | 1 | 0 | 2642 |
| 1992 | 0 | 46 | 126 | 145 | 566 | 83 | 26 | 1 | 0 | 0 | 0 | 993 |
| 1993 | 0 | 53 | 891 | 267 | 28 | 71 | 11 | 0 | 0 | 0 | 0 | 1321 |
| 1994 | 0 | 22 | 630 | 224 | 53 | 7 | 13 | 2 | 1 | 0 | 0 | 953 |
| 1995 | 0 | 85 | 462 | 303 | 31 | 3 | 0 | 0 | 0 | 0 | 0 | 884 |
| 1996 | 0 | 33 | 212 | 376 | 45 | 2 | 1 | 1 | 2 | 0 | 0 | 672 |
| 1997 | 0 | 11 | 101 | 68 | 123 | 9 | 0 | 0 | 0 | 0 | 0 | 311 |
| 1998 | 0 | 24 | 186 | 165 | 42 | 49 | 3 | 0 | 0 | 0 | 0 | 470 |
| 1999 | 0 | 17 | 223 | 174 | 177 | 67 | 96 | 9 | 0 | 0 | 0 | 764 |
| 2000 | 0 | 109 | 404 | 517 | 126 | 56 | 7 | 1 | 0 | 0 | 0 | 1221 |
| 2001 | 0 | 148 | 1233 | 753 | 422 | 116 | 55 | 9 | 7 | 0 | 0 | 2744 |
| 2002 | 0 | 1 | 215 | 813 | 372 | 277 | 127 | 260 | 42 | 37 | 0 | 2144 |
| 2003 | 0 | 15 | 133 | 495 | 894 | 349 | 264 | 118 | 108 | 47 | 42 | 2463 |
| 2004 | 0 | 0 | 391 | 269 | 444 | 247 | 78 | 57 | 36 | 34 | 15 | 1572 |
| 2005 | 0 | 9 | 183 | 886 | 98 | 294 | 184 | 68 | 53 | 30 | 36 | 1842 |
| 2006 | 0 | 1 | 95 | 196 | 347 | 35 | 124 | 108 | 58 | 44 | 47 | 1054 |
| 2007 | 0 | 4 | 107 | 572 | 98 | 199 | 10 | 34 | 39 | 26 | 34 | 1124 |

Total Recreational Landings Mean Weight (kg) at Age

| Year | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11+ | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1982 | 0.531 | 1.009 | 1.526 | 2.423 | 4.431 | 5.686 | 6.100 | 7.050 | 10.522 | 12.655 | 16.456 | 1.700 |
| 1983 | 0.446 | 0.867 | 1.399 | 2.156 | 3.412 | 6.831 | 5.913 | 8.331 | 10.808 | 17.726 | 18.784 | 1.635 |
| 1984 | 0.459 | 0.849 | 1.408 | 2.460 | 3.428 | 4.476 | 6.755 | 6.618 | 5.621 | 16.868 | 17.991 | 1.510 |
| 1985 | 0.466 | 0.830 | 1.320 | 2.326 | 3.021 | 3.370 | 3.798 | 4.458 | 10.522 | 12.655 | 16.456 | 1.236 |
| 1986 | 0.399 | 0.968 | 1.646 | 2.641 | 4.014 | 5.740 | 11.181 | 13.651 | 14.756 | 13.780 | 20.055 | 3.240 |
| 1987 | 0.189 | 0.837 | 1.435 | 2.705 | 4.704 | 8.009 | 10.456 | 10.559 | 11.344 | 10.943 | 16.456 | 1.826 |
| 1988 | 0.318 | 0.838 | 1.434 | 2.104 | 3.881 | 3.669 | 6.773 | 7.109 | 10.522 | 12.655 | 16.456 | 1.405 |
| 1989 | 0.680 | 1.111 | 1.601 | 2.610 | 3.555 | 6.351 | 7.837 | 9.095 | 10.522 | 12.655 | 16.456 | 1.888 |
| 1990 | 0.421 | 1.141 | 1.656 | 2.453 | 3.830 | 5.508 | 7.176 | 8.160 | 10.522 | 12.655 | 16.456 | 2.107 |
| 1991 | 0.421 | 1.378 | 1.485 | 1.990 | 2.609 | 8.450 | 9.387 | 8.160 | 9.387 | 3.468 | 16.456 | 1.950 |
| 1992 | 0.421 | 1.810 | 2.205 | 3.030 | 3.323 | 4.827 | 7.781 | 2.515 | 10.522 | 12.655 | 16.456 | 3.087 |
| 1993 | 0.421 | 1.023 | 1.636 | 1.877 | 2.681 | 4.207 | 9.685 | 8.160 | 10.522 | 12.655 | 16.456 | 1.722 |
| 1994 | 0.131 | 1.342 | 1.601 | 2.182 | 2.086 | 4.300 | 8.623 | 8.476 | 9.095 | 12.655 | 16.456 | 1.755 |
| 1995 | 0.482 | 1.523 | 1.620 | 1.924 | 3.120 | 1.798 | 7.176 | 5.833 | 10.522 | 12.655 | 16.456 | 1.734 |
| 1996 | 0.582 | 1.542 | 1.808 | 1.952 | 2.387 | 8.127 | 12.664 | 12.664 | 12.664 | 12.655 | 16.456 | 1.915 |
| 1997 | 0.421 | 1.733 | 1.992 | 2.381 | 2.388 | 2.806 | 6.275 | 6.501 | 10.522 | 12.655 | 16.456 | 2.224 |
| 1998 | 0.456 | 1.718 | 2.151 | 2.570 | 3.332 | 3.140 | 3.288 | 6.735 | 10.522 | 12.655 | 16.456 | 2.423 |
| 1999 | 0.334 | 1.253 | 1.958 | 3.048 | 4.820 | 6.032 | 6.706 | 8.851 | 10.522 | 12.655 | 16.456 | 3.070 |
| 2000 | 0.421 | 1.521 | 1.929 | 2.688 | 3.543 | 4.898 | 3.419 | 4.826 | 10.522 | 12.655 | 16.456 | 2.334 |
| 2001 | 0.421 | 1.716 | 2.266 | 2.912 | 4.308 | 6.000 | 6.211 | 6.261 | 6.966 | 12.655 | 16.456 | 2.695 |
| 2002 | 0.421 | 1.381 | 2.265 | 3.147 | 3.716 | 5.357 | 6.422 | 14.256 | 11.036 | 10.987 | 16.456 | 3.890 |
| 2003 | 0.421 | 2.083 | 2.402 | 2.869 | 3.611 | 5.159 | 8.120 | 9.367 | 11.555 | 13.161 | 13.712 | 4.031 |
| 2004 | 0.421 | 1.459 | 2.140 | 2.681 | 2.849 | 3.780 | 5.664 | 9.757 | 12.265 | 13.369 | 14.001 | 2.960 |
| 2005 | 0.421 | 1.523 | 1.990 | 2.574 | 3.857 | 4.187 | 6.270 | 8.120 | 10.685 | 13.692 | 15.088 | 3.154 |
| 2006 | 0.421 | 2.053 | 2.409 | 3.222 | 3.610 | 5.054 | 5.727 | 8.514 | 10.601 | 12.556 | 15.562 | 4.217 |
| 2007 | 0.421 | 2.292 | 2.617 | 3.146 | 3.776 | 4.634 | 6.958 | 8.142 | 11.376 | 12.503 | 14.439 | 3.661 |

Total Recreational Landings Mean Length (cm) at Age

| Year | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11+ | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1982 | 36.3 | 44.8 | 51.5 | 60.1 | 74.4 | 81.0 | 83.7 | 88.7 | 99.4 | 104.6 | 115.5 | 52.0 |
| 1983 | 34.5 | 42.8 | 50.2 | 57.9 | 67.4 | 85.4 | 80.6 | 91.6 | 99.2 | 118.0 | 121.0 | 50.4 |
| 1984 | 34.4 | 42.3 | 50.1 | 60.1 | 67.4 | 72.6 | 84.3 | 85.6 | 83.0 | 116.1 | 119.4 | 49.5 |
| 1985 | 35.0 | 42.0 | 48.9 | 59.9 | 65.5 | 68.7 | 72.0 | 77.0 | 99.4 | 104.6 | 115.5 | 47.2 |
| 1986 | 34.0 | 44.3 | 53.2 | 62.0 | 71.5 | 81.2 | 101.6 | 108.7 | 111.9 | 110.0 | 124.1 | 59.9 |
| 1987 | 25.9 | 41.8 | 50.4 | 62.9 | 75.2 | 90.0 | 99.4 | 99.6 | 102.8 | 101.0 | 115.5 | 51.3 |
| 1988 | 32.0 | 42.4 | 50.5 | 57.7 | 70.1 | 67.1 | 85.2 | 86.6 | 99.4 | 104.6 | 115.5 | 49.4 |
| 1989 | 40.0 | 46.6 | 52.7 | 61.9 | 68.3 | 84.3 | 91.8 | 95.0 | 99.4 | 104.6 | 115.5 | 54.8 |
| 1990 | 33.7 | 47.3 | 53.3 | 60.9 | 71.0 | 81.1 | 86.3 | 90.3 | 99.4 | 104.6 | 115.5 | 57.2 |
| 1991 | 33.7 | 50.6 | 51.6 | 56.9 | 61.6 | 93.2 | 98.0 | 90.3 | 98.0 | 71.0 | 115.5 | 55.8 |
| 1992 | 33.7 | 54.9 | 58.1 | 64.6 | 66.7 | 75.6 | 89.7 | 62.0 | 99.4 | 104.6 | 115.5 | 64.6 |
| 1993 | 33.7 | 45.2 | 53.3 | 55.8 | 61.8 | 69.0 | 98.0 | 90.3 | 99.4 | 104.6 | 115.5 | 53.7 |
| 1994 | 23.6 | 49.3 | 52.9 | 58.1 | 57.4 | 70.9 | 93.4 | 93.0 | 95.0 | 104.6 | 115.5 | 54.2 |
| 1995 | 36.0 | 52.1 | 53.1 | 55.9 | 65.5 | 54.6 | 86.3 | 83.0 | 99.4 | 104.6 | 115.5 | 54.1 |
| 1996 | 38.0 | 52.3 | 55.0 | 56.4 | 60.0 | 89.9 | 107.0 | 107.0 | 107.0 | 104.6 | 115.5 | 56.0 |
| 1997 | 33.7 | 54.5 | 57.0 | 60.1 | 60.0 | 62.8 | 85.0 | 86.0 | 99.4 | 104.6 | 115.5 | 58.8 |
| 1998 | 35.0 | 54.2 | 58.4 | 61.7 | 66.9 | 65.3 | 67.2 | 86.0 | 99.4 | 104.6 | 115.5 | 60.3 |
| 1999 | 33.0 | 47.9 | 56.4 | 65.0 | 75.6 | 81.5 | 84.9 | 94.0 | 99.4 | 104.6 | 115.5 | 63.6 |
| 2000 | 33.7 | 52.1 | 56.1 | 62.3 | 68.2 | 76.3 | 67.1 | 77.0 | 99.4 | 104.6 | 115.5 | 59.1 |
| 2001 | 33.7 | 54.1 | 59.2 | 64.0 | 73.6 | 82.6 | 83.2 | 84.0 | 87.8 | 104.6 | 115.5 | 62.1 |
| 2002 | 33.7 | 51.1 | 59.2 | 66.1 | 69.6 | 79.0 | 83.6 | 108.7 | 101.2 | 101.0 | 115.5 | 69.2 |
| 2003 | 33.7 | 58.0 | 60.6 | 64.0 | 68.5 | 76.9 | 90.4 | 95.1 | 102.4 | 107.0 | 108.9 | 70.0 |
| 2004 | 33.7 | 51.6 | 58.5 | 62.9 | 63.9 | 69.2 | 78.7 | 97.0 | 105.2 | 108.4 | 109.9 | 63.8 |
| 2005 | 33.7 | 51.6 | 57.0 | 61.8 | 70.4 | 72.1 | 81.8 | 89.9 | 99.9 | 108.5 | 112.1 | 64.7 |
| 2006 | 33.7 | 57.2 | 60.6 | 66.6 | 68.9 | 76.1 | 79.3 | 90.4 | 98.7 | 105.0 | 113.4 | 70.9 |
| 2007 | 33.7 | 60.1 | 62.6 | 66.4 | 70.0 | 74.7 | 85.7 | 90.5 | 102.2 | 105.9 | 111.1 | 68.8 |

Revised LAA
1994+

Total Catch in Numbers (000's) at Age

| Year | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11+ | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1982 | 71.4 | 1980.9 | 2420.3 | 1422.1 | 747.1 | 77.1 | 97.7 | 65.6 | 41.0 | 4.0 | 33.0 | 6960.1 |
| 1983 | 11.3 | 1324.4 | 2917.6 | 1189.0 | 687.2 | 452.6 | 50.0 | 65.4 | 25.2 | 11.8 | 19.4 | 6754.0 |
| 1984 | 24.7 | 801.5 | 1581.5 | 1636.5 | 470.1 | 207.6 | 78.4 | 19.3 | 15.0 | 11.6 | 18.4 | 4864.9 |
| 1985 | 44.3 | 1064.5 | 2187.8 | 1137.1 | 667.5 | 133.2 | 78.5 | 32.1 | 4.0 | 11.0 | 11.0 | 5371.0 |
| 1986 | 12.8 | 186.0 | 2756.8 | 929.6 | 277.0 | 199.9 | 45.7 | 30.2 | 35.6 | 8.0 | 59.5 | 4541.1 |
| 1987 | 96.3 | 889.6 | 1321.0 | 1505.8 | 346.4 | 91.5 | 83.7 | 13.9 | 13.6 | 10.3 | 3.0 | 4375.0 |
| 1988 | 2.4 | 549.1 | 2128.0 | 1117.1 | 428.8 | 49.3 | 11.2 | 17.9 | 1.0 | 2.0 | 1.0 | 4308.0 |
| 1989 | 3.8 | 519.5 | 2280.6 | 1715.7 | 488.0 | 92.8 | 41.2 | 6.4 | 3.0 | 5.0 | 7.0 | 5163.0 |
| 1990 | 0.0 | 253.6 | 4125.6 | 2455.9 | 523.3 | 176.6 | 27.0 | 30.0 | 10.0 | 15.0 | 17.0 | 7634.0 |
| 1991 | 0.0 | 438.5 | 1341.1 | 4910.7 | 930.6 | 158.8 | 46.8 | 30.0 | 7.9 | 1.3 | 1.0 | 7866.6 |
| 1992 | 0.0 | 338.3 | 587.1 | 531.9 | 2188.4 | 219.1 | 65.3 | 7.4 | 12.0 | 3.0 | 0.0 | 3952.5 |
| 1993 | 0.0 | 127.8 | 2031.8 | 783.0 | 139.4 | 473.8 | 29.2 | 6.0 | 2.0 | 0.0 | 0.0 | 3592.0 |
| 1994 | 0.9 | 54.0 | 1488.2 | 1216.6 | 330.9 | 71.0 | 85.7 | 29.5 | 6.7 | 0.6 | 1.2 | 3285.3 |
| 1995 | 18.1 | 277.0 | 1169.9 | 1192.0 | 232.5 | 28.6 | 13.9 | 18.4 | 0.8 | 1.6 | 0.2 | 2953.2 |
| 1996 | 0.0 | 90.0 | 630.7 | 1936.7 | 384.3 | 36.9 | 4.5 | 0.5 | 1.3 | 0.0 | 0.0 | 3085.0 |
| 1997 | 0.0 | 85.4 | 495.2 | 455.5 | 852.4 | 71.4 | 5.0 | 2.6 | 0.3 | 0.7 | 0.1 | 1968.6 |
| 1998 | 0.0 | 107.5 | 482.4 | 594.8 | 158.7 | 191.4 | 26.2 | 3.9 | 0.4 | 1.1 | 0.4 | 1566.7 |
| 1999 | 1.2 | 22.1 | 647.2 | 568.0 | 272.6 | 58.0 | 79.2 | 7.9 | 0.0 | 4.4 | 0.0 | 1660.7 |
| 2000 | 0.0 | 201.1 | 534.0 | 828.3 | 190.3 | 98.9 | 16.1 | 7.1 | 0.0 | 0.0 | 0.0 | 1875.8 |
| 2001 | 0.0 | 147.2 | 1183.5 | 685.5 | 378.0 | 109.1 | 59.8 | 8.9 | 13.3 | 1.2 | 0.5 | 2587.1 |
| 2002 | 0.0 | 3.0 | 259.5 | 884.3 | 346.0 | 203.5 | 81.0 | 35.5 | 9.5 | 9.4 | 0.6 | 1832.4 |
| 2003 | 0.0 | 16.4 | 118.6 | 442.9 | 766.1 | 231.4 | 103.3 | 39.9 | 21.7 | 9.9 | 7.4 | 1757.5 |
| 2004 | 0.0 | 0.9 | 357.8 | 249.9 | 409.6 | 266.0 | 74.6 | 36.9 | 19.3 | 11.3 | 3.5 | 1429.8 |
| 2005 | 0.0 | 7.5 | 134.1 | 813.8 | 95.2 | 265.3 | 120.9 | 32.5 | 19.2 | 8.1 | 8.3 | 1504.9 |
| 2006 | 0.0 | 1.6 | 177.4 | 281.3 | 449.3 | 32.5 | 97.2 | 48.0 | 18.2 | 10.8 | 8.8 | 1124.9 |
| 2007 | 0.0 | 7.9 | 154.8 | 907.5 | 140.4 | 253.8 | 8.5 | 23.3 | 12.6 | 6.7 | 7.5 | 1523.3 |

Total Catch in Weight (Tons) at Age

| Year | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11+ | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1982 | 46.0 | 2201.2 | 3918.4 | 3836.2 | 3524.6 | 507.1 | 853.8 | 640.4 | 531.0 | 41.0 | 613.0 | 16712.7 |
| 1983 | 5.1 | 1406.6 | 4697.6 | 2901.4 | 2578.0 | 2726.9 | 288.7 | 679.9 | 250.6 | 151.8 | 350.8 | 16037.4 |
| 1984 | 12.5 | 817.8 | 2551.7 | 4415.8 | 1720.6 | 1206.0 | 633.0 | 188.0 | 193.3 | 162.9 | 275.9 | 12187.3 |
| 1985 | 20.6 | 1058.9 | 3503.3 | 3155.7 | 2927.2 | 722.6 | 616.9 | 363.7 | 51.0 | 141.0 | 152.0 | 12712.9 |
| 1986 | 5.1 | 208.7 | 4952.0 | 2682.8 | 1261.2 | 1203.5 | 371.5 | 327.1 | 482.7 | 109.0 | 1164.8 | 12768.4 |
| 1987 | 19.8 | 846.6 | 2042.5 | 4714.2 | 1666.2 | 654.9 | 796.9 | 139.7 | 180.0 | 134.7 | 40.0 | 11235.5 |
| 1988 | 0.8 | 529.1 | 3697.5 | 2656.3 | 2185.6 | 318.3 | 99.9 | 197.6 | 11.0 | 36.0 | 14.0 | 9746.0 |
| 1989 | 2.6 | 622.7 | 3928.2 | 5034.1 | 1875.8 | 399.7 | 371.9 | 70.7 | 43.0 | 87.0 | 163.0 | 12668.7 |
| 1990 | 0.0 | 274.4 | 6954.4 | 5648.2 | 2191.4 | 1307.9 | 290.0 | 354.0 | 153.0 | 214.0 | 350.0 | 17737.3 |
| 1991 | 0.0 | 518.2 | 2067.6 | 11946.7 | 3727.6 | 1178.3 | 453.8 | 369.0 | 111.3 | 33.0 | 17.0 | 20422.5 |
| 1992 | 0.0 | 525.8 | 1144.9 | 1458.3 | 6741.3 | 1093.5 | 619.8 | 89.0 | 161.0 | 49.0 | 0.0 | 11883.6 |
| 1993 | 0.0 | 152.0 | 3700.4 | 1877.6 | 588.9 | 2889.5 | 292.3 | 79.0 | 27.0 | 0.0 | 0.0 | 9606.6 |
| 1994 | 0.1 | 74.7 | 2690.0 | 3603.4 | 1107.2 | 446.1 | 615.4 | 307.9 | 69.6 | 10.7 | 25.8 | 8950.9 |
| 1995 | 5.0 | 392.0 | 2102.4 | 3172.9 | 1174.5 | 159.5 | 150.0 | 211.5 | 15.5 | 31.2 | 5.0 | 7419.3 |
| 1996 | 0.0 | 138.9 | 1351.8 | 4474.6 | 1339.8 | 271.3 | 46.4 | 7.4 | 19.8 | 0.0 | 0.0 | 7650.1 |
| 1997 | 0.0 | 151.5 | 1097.5 | 1387.3 | 2662.5 | 342.1 | 42.4 | 29.7 | 4.3 | 11.7 | 2.1 | 5731.3 |
| 1998 | 0.0 | 147.6 | 999.7 | 1692.7 | 656.2 | 808.3 | 135.8 | 43.7 | 6.9 | 16.4 | 7.4 | 4514.7 |
| 1999 | 0.4 | 29.6 | 1187.7 | 1457.0 | 1047.8 | 335.1 | 570.6 | 78.0 | 0.0 | 58.6 | 0.0 | 4769.2 |
| 2000 | 0.0 | 325.4 | 1219.7 | 2835.7 | 843.7 | 564.7 | 96.7 | 60.1 | 0.0 | 0.0 | 0.0 | 5939.0 |
| 2001 | 0.0 | 260.3 | 2825.3 | 2189.5 | 1788.6 | 687.0 | 434.5 | 74.5 | 115.3 | 15.0 | 11.7 | 8400.2 |
| 2002 | 0.0 | 4.1 | 637.8 | 2891.3 | 1392.9 | 1198.0 | 542.8 | 408.5 | 96.7 | 100.3 | 8.9 | 7285.6 |
| 2003 | 0.0 | 31.7 | 285.7 | 1354.5 | 3062.8 | 1223.8 | 776.7 | 349.1 | 235.5 | 121.3 | 97.4 | 7537.3 |
| 2004 | 0.0 | 1.3 | 837.4 | 805.6 | 1493.6 | 1398.9 | 514.1 | 347.1 | 227.5 | 146.6 | 46.0 | 5817.0 |
| 2005 | 0.0 | 11.8 | 276.1 | 2305.7 | 410.0 | 1196.1 | 754.4 | 255.0 | 199.9 | 108.7 | 118.9 | 5635.9 |
| 2006 | 0.0 | 3.6 | 430.1 | 917.2 | 1685.5 | 157.2 | 535.7 | 365.6 | 175.4 | 131.0 | 137.1 | 4536.1 |
| 2007 | 0.0 | 16.1 | 391.1 | 2924.0 | 551.3 | 1217.0 | 54.4 | 165.1 | 127.4 | 78.5 | 108.1 | 5627.8 |

Total Catch Mean Weight (kg) at Age

| Year | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11+ | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1982 | 0.644 | 1.111 | 1.619 | 2.698 | 4.718 | 6.577 | 8.740 | 9.763 | 12.951 | 10.250 | 18.576 | 2.401 |
| 1983 | 0.446 | 1.062 | 1.610 | 2.440 | 3.751 | 6.025 | 5.775 | 10.391 | 9.951 | 12.855 | 18.125 | 2.375 |
| 1984 | 0.506 | 1.020 | 1.613 | 2.698 | 3.660 | 5.808 | 8.070 | 9.741 | 12.845 | 13.987 | 14.962 | 2.505 |
| 1985 | 0.466 | 0.995 | 1.601 | 2.775 | 4.385 | 5.424 | 7.859 | 11.312 | 12.750 | 12.818 | 13.818 | 2.367 |
| 1986 | 0.399 | 1.122 | 1.796 | 2.886 | 4.554 | 6.020 | 8.120 | 10.845 | 13.572 | 13.640 | 19.578 | 2.812 |
| 1987 | 0.206 | 0.952 | 1.546 | 3.131 | 4.811 | 7.161 | 9.521 | 10.053 | 13.195 | 13.132 | 13.333 | 2.568 |
| 1988 | 0.318 | 0.964 | 1.738 | 2.378 | 5.097 | 6.450 | 8.919 | 11.022 | 11.000 | 18.000 | 14.000 | 2.262 |
| 1989 | 0.680 | 1.199 | 1.722 | 2.934 | 3.844 | 4.309 | 9.018 | 11.034 | 14.333 | 17.400 | 23.286 | 2.454 |
| 1990 | 0.416 | 1.082 | 1.686 | 2.300 | 4.187 | 7.407 | 10.741 | 11.800 | 15.300 | 14.267 | 20.588 | 2.323 |
| 1991 | 0.416 | 1.182 | 1.542 | 2.433 | 4.006 | 7.421 | 9.689 | 12.300 | 14.003 | 25.672 | 17.000 | 2.596 |
| 1992 | 0.416 | 1.554 | 1.950 | 2.741 | 3.080 | 4.991 | 9.489 | 12.027 | 13.417 | 16.333 | 17.576 | 3.007 |
| 1993 | 0.416 | 1.189 | 1.821 | 2.398 | 4.225 | 6.099 | 10.022 | 13.167 | 13.500 | 14.785 | 17.576 | 2.674 |
| 1994 | 0.132 | 1.383 | 1.808 | 2.962 | 3.347 | 6.280 | 7.185 | 10.448 | 10.331 | 18.542 | 20.637 | 2.725 |
| 1995 | 0.274 | 1.415 | 1.797 | 2.662 | 5.051 | 5.578 | 10.760 | 11.492 | 18.893 | 20.064 | 20.347 | 2.512 |
| 1996 | 0.588 | 1.543 | 2.143 | 2.310 | 3.486 | 7.353 | 10.426 | 13.912 | 14.724 | 14.785 | 17.576 | 2.480 |
| 1997 | 0.416 | 1.774 | 2.216 | 3.046 | 3.124 | 4.791 | 8.405 | 11.547 | 14.726 | 15.814 | 21.874 | 2.911 |
| 1998 | 0.417 | 1.373 | 2.072 | 2.846 | 4.135 | 4.224 | 5.177 | 11.313 | 18.893 | 14.953 | 20.347 | 2.882 |
| 1999 | 0.334 | 1.341 | 1.835 | 2.565 | 3.843 | 5.773 | 7.201 | 9.915 | 12.870 | 13.402 | 17.576 | 2.872 |
| 2000 | 0.416 | 1.619 | 2.284 | 3.423 | 4.432 | 5.707 | 6.013 | 8.521 | 12.870 | 14.785 | 17.576 | 3.166 |
| 2001 | 0.416 | 1.768 | 2.387 | 3.194 | 4.732 | 6.296 | 7.266 | 8.351 | 8.643 | 12.414 | 24.418 | 3.247 |
| 2002 | 0.416 | 1.357 | 2.458 | 3.269 | 4.026 | 5.886 | 6.702 | 11.514 | 10.174 | 10.662 | 14.333 | 3.976 |
| 2003 | 0.416 | 1.929 | 2.409 | 3.058 | 3.998 | 5.289 | 7.522 | 8.760 | 10.834 | 12.269 | 13.074 | 4.289 |
| 2004 | 0.416 | 1.474 | 2.340 | 3.224 | 3.647 | 5.259 | 6.889 | 9.396 | 11.775 | 12.944 | 13.260 | 4.068 |
| 2005 | 0.416 | 1.574 | 2.058 | 2.833 | 4.307 | 4.509 | 6.239 | 7.835 | 10.440 | 13.428 | 14.382 | 3.745 |
| 2006 | 0.416 | 2.303 | 2.425 | 3.261 | 3.751 | 4.845 | 5.514 | 7.610 | 9.654 | 12.162 | 15.664 | 4.033 |
| 2007 | 0.416 | 2.027 | 2.526 | 3.222 | 3.927 | 4.794 | 6.362 | 7.075 | 10.106 | 11.721 | 14.314 | 3.695 |

Total

Catch Mean Length (cm) at Age

| Year | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11+ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1982 | 39.2 | 47.2 | 53.0 | 62.8 | 76.4 | 85.6 | 93.9 | 97.3 | 107.4 | 101.0 | 120.7 |
| 1983 | 34.5 | 46.6 | 53.1 | 61.0 | 70.6 | 82.6 | 80.5 | 98.3 | 97.6 | 104.3 | 119.2 |
| 1984 | 35.2 | 45.7 | 53.2 | 63.1 | 69.5 | 81.2 | 91.1 | 96.5 | 106.8 | 110.0 | 112.6 |
| 1985 | 35.0 | 45.0 | 53.0 | 64.0 | 74.4 | 79.8 | 90.7 | 101.8 | 103.1 | 108.2 | 109.7 |
| 1986 | 34.0 | 47.0 | 55.3 | 64.6 | 75.0 | 82.4 | 91.6 | 100.7 | 108.4 | 108.7 | 123.0 |
| 1987 | 26.3 | 43.9 | 52.2 | 66.5 | 76.6 | 87.5 | 96.0 | 99.0 | 106.7 | 109.3 | 111.3 |
| 1988 | 32.0 | 44.6 | 54.5 | 60.6 | 78.2 | 83.9 | 96.0 | 101.5 | 113.0 | 114.8 | 125.0 |
| 1989 | 40.0 | 48.7 | 54.6 | 65.1 | 71.2 | 77.7 | 95.2 | 102.9 | 112.6 | 120.4 | 126.8 |
| 1990 | 33.6 | 47.5 | 54.5 | 60.1 | 73.2 | 89.0 | 100.9 | 104.0 | 111.8 | 112.6 | 124.6 |
| 1991 | 33.6 | 48.3 | 52.3 | 61.0 | 71.7 | 89.1 | 97.3 | 105.0 | 109.6 | 118.9 | 128.0 |
| 1992 | 33.6 | 53.2 | 56.7 | 63.1 | 65.7 | 76.9 | 96.9 | 103.7 | 109.1 | 117.0 | 119.3 |
| 1993 | 33.6 | 48.4 | 55.9 | 60.6 | 73.3 | 83.2 | 98.6 | 110.0 | 119.1 | 110.9 | 119.3 |
| 1994 | 23.6 | 51.0 | 55.6 | 65.1 | 67.4 | 83.0 | 86.9 | 98.3 | 99.9 | 121.2 | 125.5 |
| 1995 | 30.4 | 50.8 | 55.4 | 62.6 | 78.1 | 76.5 | 101.1 | 102.6 | 122.0 | 124.4 | 125.0 |
| 1996 | 38.0 | 52.7 | 58.8 | 60.0 | 68.2 | 88.6 | 100.1 | 110.2 | 112.1 | 110.9 | 119.3 |
| 1997 | 33.6 | 55.3 | 59.5 | 65.6 | 65.9 | 75.6 | 92.3 | 102.9 | 112.1 | 115.0 | 128.0 |
| 1998 | 35.0 | 51.1 | 58.2 | 64.1 | 72.6 | 72.6 | 75.5 | 101.6 | 122.0 | 113.0 | 125.0 |
| 1999 | 33.0 | 49.8 | 55.9 | 62.3 | 70.1 | 79.1 | 87.1 | 98.6 | 107.2 | 109.0 | 119.3 |
| 2000 | 33.6 | 53.7 | 59.5 | 68.3 | 74.6 | 81.6 | 82.1 | 93.6 | 107.2 | 110.9 | 119.3 |
| 2001 | 33.6 | 54.9 | 60.7 | 66.6 | 76.4 | 84.2 | 88.3 | 92.1 | 93.6 | 106.2 | 132.4 |
| 2002 | 33.6 | 51.3 | 61.3 | 67.5 | 71.9 | 82.1 | 85.4 | 101.3 | 98.6 | 99.9 | 110.0 |
| 2003 | 33.6 | 57.0 | 61.1 | 65.8 | 71.7 | 78.7 | 88.9 | 93.4 | 100.3 | 104.7 | 107.4 |
| 2004 | 33.6 | 52.5 | 60.5 | 67.2 | 69.6 | 78.4 | 86.1 | 96.3 | 103.9 | 107.4 | 107.5 |
| 2005 | 33.6 | 52.5 | 57.8 | 64.3 | 73.9 | 74.9 | 83.0 | 89.8 | 99.4 | 108.2 | 110.5 |
| 2006 | 33.6 | 60.7 | 61.5 | 67.6 | 70.6 | 76.3 | 79.6 | 87.9 | 95.9 | 104.0 | 113.7 |
| 2007 | 33.6 | 58.3 | 62.4 | 67.6 | 71.7 | 76.6 | 84.1 | 86.8 | 98.2 | 103.6 | 110.3 |

## Appendix 2. Full VPA Model Output (Terminal Year 2007) for the Gulf of Maine stock of Atlantic cod.

```
VPA Version 2.7.1

 Model ID: GoM Cod 2008 VPA Update GARMIII TY2007 11+


 Input File:
C:\ALLWORK\ASSESS\GARMIIIAUG2008WG\ASSMT_MTG\GOMCOD\VPA\FINALS\GMCOD2008_GARM
III
 Date of Run: 17-JUL-2008                         Time of Run: 13:23


 Levenburg-Marquardt Algorithm Completed    21 Iterations
 Residual Sum of Squares =     279.707

 Number of Residuals     =    508
 Number of Parameters    =      9
 Degrees of Freedom      =    499
 Mean Squared Residual   =     0.560535
 Standard Deviation      =     0.748689


 Number of Years =    26
 Number of Ages  =    11
 First Year      =  1982
 Youngest Age    =     1
 Oldest True Age =    10

 Number of Survey Indices Available        =    25
 Number of Survey Indices Used in Estimate =    23


 VPA Classic Method - Auto Estimated Q's


 Stock Numbers Predicted in Terminal Year Plus One (2008)
 Age    Stock Predicted     Std. Error      CV

   2           3936.752   0.173583E+04   0.440929E+00
   3          16020.398   0.499998E+04   0.312101E+00
   4           3542.738   0.930299E+03   0.262593E+00
   5           3970.448   0.103469E+04   0.260597E+00
   6            201.340   0.776978E+02   0.385903E+00
   7            251.280   0.110401E+03   0.439357E+00
   8             29.920   0.163265E+02   0.545679E+00
   9             46.873   0.324104E+02   0.691456E+00
  10             71.277   0.516470E+02   0.724592E+00

 Catchability Values for Each Survey Used in Estimate
 INDEX     Catchability    Std. Error      CV

   1       0.639060E-04   0.988283E-05   0.154646E+00
   2       0.131940E-03   0.141520E-04   0.107261E+00
   3       0.225008E-03   0.228294E-04   0.101460E+00
   4       0.293998E-03   0.386906E-04   0.131602E+00
```

```
   5       0.382779E-03   0.641901E-04   0.167695E+00
   6       0.566609E-03   0.109588E-03   0.193411E+00
   7       0.511812E-03   0.139644E-03   0.272843E+00
   8       0.533836E-04   0.687041E-05   0.128699E+00
   9       0.113582E-03   0.128656E-04   0.113272E+00
  10       0.223833E-03   0.225992E-04   0.100965E+00
  11       0.370258E-03   0.463840E-04   0.125275E+00
  12       0.478237E-03   0.565335E-04   0.118212E+00
  13       0.451154E-03   0.836411E-04   0.185394E+00
  14       0.566767E-03   0.129170E-03   0.227906E+00
  15       0.710558E-03   0.107424E-03   0.151183E+00
  16       0.544643E-03   0.474923E-04   0.871988E-01
  17       0.453706E-03   0.562280E-04   0.123930E+00
  19       0.122958E-03   0.367937E-04   0.299238E+00
  21       0.245830E-05   0.690050E-06   0.280702E+00
  22       0.140563E-04   0.164576E-05   0.117084E+00
  23       0.231650E-04   0.128111E-05   0.553035E-01
  24       0.229116E-04   0.123947E-05   0.540979E-01
  25       0.218712E-04   0.246650E-05   0.112774E+00
```

```
-- Non-Linear Least Squares Fit --

Default Tolerances Used

Scaled Gradient Tolerance      =    6.055454E-06
Scaled Step Tolerance          =    3.666853E-11
Relative Function Tolerance    =    3.666853E-11
Absolute Function Tolerance    =    4.930381E-32


VPA Method Options

- Catchability Values Estimated as an Analytic Function of N
- Pope Approximation Used in Cohort Solution
- Plus Group Backward Calculation Method Used
- Rivard Weights Used for JAN-1 Biomass
- Rivard Weights Used for SSB Biomass
- Rivard Weights Calculation Used  3 Years for Terminal Year Plus One

- Heincke Rule Used in F-Oldest Calculation
- F-Oldest Calculation in Years Prior to Terminal Year
  Uses Stock Sizes in Ages  5 to  9
- Calculation of Population of Age 1 In Year 2008
  =  Set to Zero

Stock Estimates

Age   2
Age   3
Age   4
Age   5
Age   6
Age   7
Age   8
Age   9
Age  10

Full F in Terminal Year               =   0.6492
F in Oldest True Age in Terminal Year =   0.4888

Full F Calculated Using Classic Method

Age  Input Partial  Calc Partial   Fishing     Used In
     Recruitment    Recruitment    Mortality   Full F    Comments

 1      0.000          0.000       0.0000      NO      Stock Estimate in T+1
 2      0.002          0.001       0.0004      NO      Stock Estimate in T+1
 3      0.162          0.060       0.0388      NO      Stock Estimate in T+1
 4      0.682          0.290       0.1880      NO      Stock Estimate in T+1
 5      0.900          0.754       0.4892      NO      Stock Estimate in T+1
 6      1.000          1.000       0.6492      YES     Stock Estimate in T+1
 7      0.826          0.352       0.2288      NO      Stock Estimate in T+1
 8      0.733          0.572       0.3714      NO      Stock Estimate in T+1
 9      0.772          0.229       0.1484      NO      Stock Estimate in T+1
10      0.753          0.753       0.4888              Input PR * Full F
```

```
Catch At Age - Input Data

 AGE       1982        1983        1984        1985        1986
___________________________________________________________________

  1         71.4        11.3        24.7        44.3        12.8
  2       1980.9      1324.4       801.5      1064.5       186.0
  3       2420.3      2917.6      1581.5      2187.8      2756.8
  4       1422.1      1189.0      1636.5      1137.1       929.6
  5        747.1       687.2       470.1       667.5       277.0
  6         77.1       452.6       207.6       133.2       199.9
  7         97.7        50.0        78.4        78.5        45.7
  8         65.6        65.4        19.3        32.1        30.2
  9         41.0        25.2        15.0         4.0        35.6
 10          4.0        11.8        11.6        11.0         8.0
 11         33.0        19.4        18.4        11.0        59.5

 AGE       1987        1988        1989        1990        1991
___________________________________________________________________

  1         96.3         2.4         3.8         0.0         0.0
  2        889.6       549.1       519.5       253.6       438.5
  3       1321.0      2128.0      2280.6      4125.6      1341.1
  4       1505.8      1117.1      1715.7      2455.9      4910.7
  5        346.4       428.8       488.0       523.3       930.6
  6         91.5        49.3        92.8       176.6       158.8
  7         83.7        11.2        41.2        27.0        46.8
  8         13.9        17.9         6.4        30.0        30.0
  9         13.6         1.0         3.0        10.0         7.9
 10         10.3         2.0         5.0        15.0         1.3
 11          3.0         1.0         7.0        17.0         1.0

 AGE       1992        1993        1994        1995        1996
___________________________________________________________________

  1          0.0         0.0         0.9        18.1         0.0
  2        338.3       127.8        54.0       277.0        90.0
  3        587.1      2031.8      1488.2      1169.9       630.7
  4        531.9       783.0      1216.6      1192.0      1936.7
  5       2188.4       139.4       330.9       232.5       384.3
  6        219.1       473.8        71.0        28.6        36.9
  7         65.3        29.2        85.7        13.9         4.5
  8          7.4         6.0        29.5        18.4         0.5
  9         12.0         2.0         6.7         0.8         1.3
 10          3.0         0.0         0.6         1.6         0.0
 11          0.0         0.0         1.2         0.2         0.0
```

```
Catch At Age - Input Data

  AGE       1997         1998         1999         2000         2001
 -------------------------------------------------------------------

   1         0.0          0.0          1.2          0.0          0.0
   2        85.4        107.5         22.1        201.1        147.2
   3       495.2        482.4        647.2        534.0       1183.5
   4       455.5        594.8        568.0        828.3        685.5
   5       852.4        158.7        272.6        190.3        378.0
   6        71.4        191.4         58.0         98.9        109.1
   7         5.0         26.2         79.2         16.1         59.8
   8         2.6          3.9          7.9          7.1          8.9
   9         0.3          0.4          0.0          0.0         13.3
  10         0.7          1.1          4.4          0.0          1.2
  11         0.1          0.4          0.0          0.0          0.5

  AGE       2002         2003         2004         2005         2006
 -------------------------------------------------------------------

   1         0.0          0.0          0.0          0.0          0.0
   2         3.0         16.4          0.9          7.5          1.6
   3       259.5        118.6        357.8        134.1        177.4
   4       884.3        442.9        249.9        813.8        281.3
   5       346.0        766.1        409.6         95.2        449.3
   6       203.5        231.4        266.0        265.3         32.5
   7        81.0        103.3         74.6        120.9         97.2
   8        35.5         39.9         36.9         32.5         48.0
   9         9.5         21.7         19.3         19.2         18.2
  10         9.4          9.9         11.3          8.1         10.8
  11         0.6          7.4          3.5          8.3          8.8

  AGE       2007
 -------------------------------------------------------------------

   1         0.0
   2         7.9
   3       154.8
   4       907.5
   5       140.4
   6       253.8
   7         8.5
   8        23.3
   9        12.6
  10         6.7
  11         7.5
```

Weight At Age - Input Data

| AGE | 1982 | 1983 | 1984 | 1985 | 1986 |
|---|---|---|---|---|---|
| 1 | 0.6440 | 0.4460 | 0.5060 | 0.4660 | 0.3990 |
| 2 | 1.1110 | 1.0620 | 1.0200 | 0.9950 | 1.1220 |
| 3 | 1.6190 | 1.6100 | 1.6130 | 1.6010 | 1.7960 |
| 4 | 2.6980 | 2.4400 | 2.6980 | 2.7750 | 2.8860 |
| 5 | 4.7180 | 3.7510 | 3.6600 | 4.3850 | 4.5540 |
| 6 | 6.5770 | 6.0250 | 5.8080 | 5.4240 | 6.0200 |
| 7 | 8.7400 | 5.7750 | 8.0700 | 7.8590 | 8.1200 |
| 8 | 9.7630 | 10.3910 | 9.7410 | 11.3120 | 10.8450 |
| 9 | 12.9510 | 9.9510 | 12.8450 | 12.7500 | 13.5720 |
| 10 | 10.2500 | 12.8550 | 13.9870 | 12.8180 | 13.6400 |
| 11 | 18.5760 | 18.1250 | 14.9620 | 13.8180 | 19.5780 |

| AGE | 1987 | 1988 | 1989 | 1990 | 1991 |
|---|---|---|---|---|---|
| 1 | 0.2060 | 0.3180 | 0.6800 | 0.4160 | 0.4160 |
| 2 | 0.9520 | 0.9640 | 1.1990 | 1.0820 | 1.1820 |
| 3 | 1.5460 | 1.7380 | 1.7220 | 1.6860 | 1.5420 |
| 4 | 3.1310 | 2.3780 | 2.9340 | 2.3000 | 2.4330 |
| 5 | 4.8110 | 5.0970 | 3.8440 | 4.1870 | 4.0060 |
| 6 | 7.1610 | 6.4500 | 4.3090 | 7.4070 | 7.4210 |
| 7 | 9.5210 | 8.9190 | 9.0180 | 10.7410 | 9.6890 |
| 8 | 10.0530 | 11.0220 | 11.0340 | 11.8000 | 12.3000 |
| 9 | 13.1950 | 11.0000 | 14.3330 | 15.3000 | 14.0030 |
| 10 | 13.1320 | 18.0000 | 17.4000 | 14.2670 | 25.6720 |
| 11 | 13.3330 | 14.0000 | 23.2860 | 20.5880 | 17.0000 |

| AGE | 1992 | 1993 | 1994 | 1995 | 1996 |
|---|---|---|---|---|---|
| 1 | 0.4160 | 0.4160 | 0.1320 | 0.2740 | 0.5880 |
| 2 | 1.5540 | 1.1890 | 1.3830 | 1.4150 | 1.5430 |
| 3 | 1.9500 | 1.8210 | 1.8080 | 1.7970 | 2.1430 |
| 4 | 2.7410 | 2.3980 | 2.9620 | 2.6620 | 2.3100 |
| 5 | 3.0800 | 4.2250 | 3.3470 | 5.0510 | 3.4860 |
| 6 | 4.9910 | 6.0990 | 6.2800 | 5.5780 | 7.3530 |
| 7 | 9.4890 | 10.0220 | 7.1850 | 10.7600 | 10.4260 |
| 8 | 12.0270 | 13.1670 | 10.4480 | 11.4920 | 13.9120 |
| 9 | 13.4170 | 13.5000 | 10.3310 | 18.8930 | 14.7240 |
| 10 | 16.3330 | 14.7850 | 18.5420 | 20.0640 | 14.7850 |
| 11 | 17.5760 | 17.5760 | 20.6370 | 20.3470 | 17.5760 |

```
Weight At Age - Input Data

  AGE       1997        1998        1999        2000        2001
_____________________________________________________________________

   1       0.4160      0.4170      0.3340      0.4160      0.4160
   2       1.7740      1.3730      1.3410      1.6190      1.7680
   3       2.2160      2.0720      1.8350      2.2840      2.3870
   4       3.0460      2.8460      2.5650      3.4230      3.1940
   5       3.1240      4.1350      3.8430      4.4320      4.7320
   6       4.7910      4.2240      5.7730      5.7070      6.2960
   7       8.4050      5.1770      7.2010      6.0130      7.2660
   8      11.5470     11.3130      9.9150      8.5210      8.3510
   9      14.7260     18.8930     12.8700     12.8700      8.6430
  10      15.8140     14.9530     13.4020     14.7850     12.4140
  11      21.8740     20.3470     17.5760     17.5760     24.4180

  AGE       2002        2003        2004        2005        2006
_____________________________________________________________________

   1       0.4160      0.4160      0.4160      0.4160      0.4160
   2       1.3570      1.9290      1.4740      1.5740      2.3030
   3       2.4580      2.4090      2.3400      2.0580      2.4250
   4       3.2690      3.0580      3.2240      2.8330      3.2610
   5       4.0260      3.9980      3.6470      4.3070      3.7510
   6       5.8860      5.2890      5.2590      4.5090      4.8450
   7       6.7020      7.5220      6.8890      6.2390      5.5140
   8      11.5140      8.7600      9.3960      7.8350      7.6100
   9      10.1740     10.8340     11.7750     10.4400      9.6540
  10      10.6620     12.2690     12.9440     13.4280     12.1620
  11      14.3330     13.0740     13.2600     14.3820     15.6640

  AGE       2007
_____________________________________________________________________

   1       0.4160
   2       2.0270
   3       2.5260
   4       3.2220
   5       3.9270
   6       4.7940
   7       6.3620
   8       7.0750
   9      10.1060
  10      11.7210
  11      14.3140
```

```
JAN-1 Weights at Age - Input Data

 AGE        1982         1983         1984         1985         1986
____________________________________________________________________

  1       0.5015       0.2949       0.3608       0.3003       0.2583
  2       0.9229       0.8270       0.6745       0.7096       0.7231
  3       1.3188       1.3374       1.3088       1.2779       1.3368
  4       2.2882       1.9876       2.0842       2.1157       2.1495
  5       4.1750       3.1812       2.9884       3.4396       3.5549
  6       7.0188       5.3316       4.6675       4.4555       5.1379
  7       8.0156       6.1630       6.9729       6.7561       6.6365
  8       9.6703       9.5298       7.5003       9.5545       9.2321
  9      12.9993       9.8566      11.5530      11.1444      12.3906
 10      11.5216      12.9029      11.7977      12.8315      13.1875
 11      18.5760      18.1250      14.9620      13.8180      19.5780

 AGE        1987         1988         1989         1990         1991
____________________________________________________________________

  1       0.0952       0.1638       0.5391       0.2468       0.2152
  2       0.6163       0.4456       0.6175       0.8578       0.7012
  3       1.3170       1.2863       1.2884       1.4218       1.2917
  4       2.3713       1.9174       2.2582       1.9901       2.0253
  5       3.7262       3.9948       3.0234       3.5049       3.0354
  6       5.7106       5.5705       4.6865       5.3360       5.5742
  7       7.5708       7.9918       7.6267       6.8032       8.4715
  8       9.0350      10.2441       9.9203      10.3156      11.4941
  9      11.9624      10.5159      12.5689      12.9931      12.8544
 10      13.3502      15.4114      13.8347      14.3000      19.8187
 11      13.3330      14.0000      23.2860      20.5880      17.0000

 AGE        1992         1993         1994         1995         1996
____________________________________________________________________

  1       0.2461       0.2282       0.0403       0.1155       0.3385
  2       0.8040       0.7033       0.7585       0.4322       0.6502
  3       1.5182       1.6822       1.4662       1.5765       1.7414
  4       2.0559       2.1624       2.3225       2.1938       2.0374
  5       2.7375       3.4030       2.8330       3.8680       3.0463
  6       4.4715       4.3342       5.1510       4.3208       6.0943
  7       8.3915       7.0725       6.6198       8.2203       7.6260
  8      10.7949      11.1777      10.2328       9.0868      12.2349
  9      12.8464      12.7422      11.6631      14.0497      13.0080
 10      15.1232      14.0844      15.8214      14.3973      16.7133
 11      17.5760      17.5760      20.6370      20.3470      17.5760
```

```
JAN-1 Weights at Age - Input Data

  AGE        1997         1998         1999         2000         2001
 ─────────────────────────────────────────────────────────────────────

   1        0.2290       0.2325       0.1517       0.2018       0.2303
   2        1.0213       0.7558       0.7478       0.7354       0.8576
   3        1.8491       1.9172       1.5873       1.7501       1.9658
   4        2.5549       2.5113       2.3054       2.5062       2.7009
   5        2.6863       3.5490       3.3071       3.3717       4.0246
   6        4.0867       3.6326       4.8858       4.6832       5.2824
   7        7.8614       4.9803       5.5152       5.8918       6.4395
   8       10.9722       9.7512       7.1645       7.8332       7.0862
   9       14.3132      14.7702      12.0664      11.2963       8.5818
  10       15.2593      14.8391      15.9124      13.7943      12.6399
  11       21.8740      20.3470      17.5760      17.5760      24.4180

  AGE        2002         2003         2004         2005         2006
 ─────────────────────────────────────────────────────────────────────

   1        0.1932       0.2210       0.2139       0.1768       0.1885
   2        0.7513       0.8958       0.7831       0.8092       0.9788
   3        2.0846       1.8080       2.1246       1.7417       1.9537
   4        2.7934       2.7416       2.7869       2.5747       2.5906
   5        3.5860       3.6152       3.3395       3.7264       3.2598
   6        5.2776       4.6145       4.5854       4.0552       4.5681
   7        6.4958       6.6539       6.0362       5.7281       4.9862
   8        9.1466       7.6622       8.4069       7.3468       6.8905
   9        9.2175      11.1688      10.1562       9.9043       8.6971
  10        9.5996      11.1725      11.8421      12.5744      11.2682
  11       14.3330      13.0740      13.2600      14.3820      15.6640

  AGE        2007         2008
 ─────────────────────────────────────────────────────────────────────

   1        0.1885       0.1846
   2        0.9183       0.9021
   3        2.4119       2.0358
   4        2.7952       2.6535
   5        3.5785       3.5216
   6        4.2406       4.2879
   7        5.5519       5.4221
   8        6.2459       6.8277
   9        8.7696       9.1237
  10       10.6374      11.4933
  11       14.3140      14.7867
```

```
SSB Weight At Age - Input Data

  AGE       1982        1983        1984        1985        1986
__________________________________________________________________

  1       0.5015      0.2949      0.3608      0.3003      0.2583
  2       0.9229      0.8270      0.6745      0.7096      0.7231
  3       1.3188      1.3374      1.3088      1.2779      1.3368
  4       2.2882      1.9876      2.0842      2.1157      2.1495
  5       4.1750      3.1812      2.9884      3.4396      3.5549
  6       7.0188      5.3316      4.6675      4.4555      5.1379
  7       8.0156      6.1630      6.9729      6.7561      6.6365
  8       9.6703      9.5298      7.5003      9.5545      9.2321
  9      12.9993      9.8566     11.5530     11.1444     12.3906
 10      11.5216     12.9029     11.7977     12.8315     13.1875
 11      18.5760     18.1250     14.9620     13.8180     19.5780

  AGE       1987        1988        1989        1990        1991
__________________________________________________________________

  1       0.0952      0.1638      0.5391      0.2468      0.2152
  2       0.6163      0.4456      0.6175      0.8578      0.7012
  3       1.3170      1.2863      1.2884      1.4218      1.2917
  4       2.3713      1.9174      2.2582      1.9901      2.0253
  5       3.7262      3.9948      3.0234      3.5049      3.0354
  6       5.7106      5.5705      4.6865      5.3360      5.5742
  7       7.5708      7.9918      7.6267      6.8032      8.4715
  8       9.0350     10.2441      9.9203     10.3156     11.4941
  9      11.9624     10.5159     12.5689     12.9931     12.8544
 10      13.3502     15.4114     13.8347     14.3000     19.8187
 11      13.3330     14.0000     23.2860     20.5880     17.0000

  AGE       1992        1993        1994        1995        1996
__________________________________________________________________

  1       0.2461      0.2282      0.0403      0.1155      0.3385
  2       0.8040      0.7033      0.7585      0.4322      0.6502
  3       1.5182      1.6822      1.4662      1.5765      1.7414
  4       2.0559      2.1624      2.3225      2.1938      2.0374
  5       2.7375      3.4030      2.8330      3.8680      3.0463
  6       4.4715      4.3342      5.1510      4.3208      6.0943
  7       8.3915      7.0725      6.6198      8.2203      7.6260
  8      10.7949     11.1777     10.2328      9.0868     12.2349
  9      12.8464     12.7422     11.6631     14.0497     13.0080
 10      15.1232     14.0844     15.8214     14.3973     16.7133
 11      17.5760     17.5760     20.6370     20.3470     17.5760
```

```
SSB Weight At Age - Input Data

  AGE        1997         1998         1999         2000         2001
 ____________________________________________________________________

   1       0.2290       0.2325       0.1517       0.2018       0.2303
   2       1.0213       0.7558       0.7478       0.7354       0.8576
   3       1.8491       1.9172       1.5873       1.7501       1.9658
   4       2.5549       2.5113       2.3054       2.5062       2.7009
   5       2.6863       3.5490       3.3071       3.3717       4.0246
   6       4.0867       3.6326       4.8858       4.6832       5.2824
   7       7.8614       4.9803       5.5152       5.8918       6.4395
   8      10.9722       9.7512       7.1645       7.8332       7.0862
   9      14.3132      14.7702      12.0664      11.2963       8.5818
  10      15.2593      14.8391      15.9124      13.7943      12.6399
  11      21.8740      20.3470      17.5760      17.5760      24.4180

  AGE        2002         2003         2004         2005         2006
 ____________________________________________________________________

   1       0.1932       0.2210       0.2139       0.1768       0.1885
   2       0.7513       0.8958       0.7831       0.8092       0.9788
   3       2.0846       1.8080       2.1246       1.7417       1.9537
   4       2.7934       2.7416       2.7869       2.5747       2.5906
   5       3.5860       3.6152       3.3395       3.7264       3.2598
   6       5.2776       4.6145       4.5854       4.0552       4.5681
   7       6.4958       6.6539       6.0362       5.7281       4.9862
   8       9.1466       7.6622       8.4069       7.3468       6.8905
   9       9.2175      11.1688      10.1562       9.9043       8.6971
  10       9.5996      11.1725      11.8421      12.5744      11.2682
  11      14.3330      13.0740      13.2600      14.3820      15.6640

  AGE        2007
 ____________________________________________________________________

   1       0.1885
   2       0.9183
   3       2.4119
   4       2.7952
   5       3.5785
   6       4.2406
   7       5.5519
   8       6.2459
   9       8.7696
  10      10.6374
  11      14.3140
```

```
Natural Mortality - Input Data

 AGE         1982          1983          1984          1985          1986
-----------------------------------------------------------------------------

  1        0.2000        0.2000        0.2000        0.2000        0.2000
  2        0.2000        0.2000        0.2000        0.2000        0.2000
  3        0.2000        0.2000        0.2000        0.2000        0.2000
  4        0.2000        0.2000        0.2000        0.2000        0.2000
  5        0.2000        0.2000        0.2000        0.2000        0.2000
  6        0.2000        0.2000        0.2000        0.2000        0.2000
  7        0.2000        0.2000        0.2000        0.2000        0.2000
  8        0.2000        0.2000        0.2000        0.2000        0.2000
  9        0.2000        0.2000        0.2000        0.2000        0.2000
 10        0.2000        0.2000        0.2000        0.2000        0.2000
 11        0.2000        0.2000        0.2000        0.2000        0.2000

 AGE         1987          1988          1989          1990          1991
-----------------------------------------------------------------------------

  1        0.2000        0.2000        0.2000        0.2000        0.2000
  2        0.2000        0.2000        0.2000        0.2000        0.2000
  3        0.2000        0.2000        0.2000        0.2000        0.2000
  4        0.2000        0.2000        0.2000        0.2000        0.2000
  5        0.2000        0.2000        0.2000        0.2000        0.2000
  6        0.2000        0.2000        0.2000        0.2000        0.2000
  7        0.2000        0.2000        0.2000        0.2000        0.2000
  8        0.2000        0.2000        0.2000        0.2000        0.2000
  9        0.2000        0.2000        0.2000        0.2000        0.2000
 10        0.2000        0.2000        0.2000        0.2000        0.2000
 11        0.2000        0.2000        0.2000        0.2000        0.2000

 AGE         1992          1993          1994          1995          1996
-----------------------------------------------------------------------------

  1        0.2000        0.2000        0.2000        0.2000        0.2000
  2        0.2000        0.2000        0.2000        0.2000        0.2000
  3        0.2000        0.2000        0.2000        0.2000        0.2000
  4        0.2000        0.2000        0.2000        0.2000        0.2000
  5        0.2000        0.2000        0.2000        0.2000        0.2000
  6        0.2000        0.2000        0.2000        0.2000        0.2000
  7        0.2000        0.2000        0.2000        0.2000        0.2000
  8        0.2000        0.2000        0.2000        0.2000        0.2000
  9        0.2000        0.2000        0.2000        0.2000        0.2000
 10        0.2000        0.2000        0.2000        0.2000        0.2000
 11        0.2000        0.2000        0.2000        0.2000        0.2000
```

```
Natural Mortality - Input Data

  AGE       1997        1998        1999        2000        2001
--------------------------------------------------------------------

   1       0.2000      0.2000      0.2000      0.2000      0.2000
   2       0.2000      0.2000      0.2000      0.2000      0.2000
   3       0.2000      0.2000      0.2000      0.2000      0.2000
   4       0.2000      0.2000      0.2000      0.2000      0.2000
   5       0.2000      0.2000      0.2000      0.2000      0.2000
   6       0.2000      0.2000      0.2000      0.2000      0.2000
   7       0.2000      0.2000      0.2000      0.2000      0.2000
   8       0.2000      0.2000      0.2000      0.2000      0.2000
   9       0.2000      0.2000      0.2000      0.2000      0.2000
  10       0.2000      0.2000      0.2000      0.2000      0.2000
  11       0.2000      0.2000      0.2000      0.2000      0.2000

  AGE       2002        2003        2004        2005        2006
--------------------------------------------------------------------

   1       0.2000      0.2000      0.2000      0.2000      0.2000
   2       0.2000      0.2000      0.2000      0.2000      0.2000
   3       0.2000      0.2000      0.2000      0.2000      0.2000
   4       0.2000      0.2000      0.2000      0.2000      0.2000
   5       0.2000      0.2000      0.2000      0.2000      0.2000
   6       0.2000      0.2000      0.2000      0.2000      0.2000
   7       0.2000      0.2000      0.2000      0.2000      0.2000
   8       0.2000      0.2000      0.2000      0.2000      0.2000
   9       0.2000      0.2000      0.2000      0.2000      0.2000
  10       0.2000      0.2000      0.2000      0.2000      0.2000
  11       0.2000      0.2000      0.2000      0.2000      0.2000

  AGE       2007
--------------------------------------------------------------------

   1       0.2000
   2       0.2000
   3       0.2000
   4       0.2000
   5       0.2000
   6       0.2000
   7       0.2000
   8       0.2000
   9       0.2000
  10       0.2000
  11       0.2000

Proportion of Natural Mortality Before Spawning =       0.1667
Proportion of Fishing Mortality Before Spawning =       0.1667
```

```
Maturity - Input Data

  AGE       1982        1983        1984        1985        1986
 ------------------------------------------------------------------

   1       0.1100      0.0700      0.0100      0.0100      0.0700
   2       0.3200      0.2600      0.2100      0.3600      0.5900
   3       0.6400      0.6100      0.8500      0.9600      0.9700
   4       0.8700      0.8800      0.9900      1.0000      1.0000
   5       0.9600      0.9700      1.0000      1.0000      1.0000
   6       0.9900      0.9900      1.0000      1.0000      1.0000
   7       1.0000      1.0000      1.0000      1.0000      1.0000
   8       1.0000      1.0000      1.0000      1.0000      1.0000
   9       1.0000      1.0000      1.0000      1.0000      1.0000
  10       1.0000      1.0000      1.0000      1.0000      1.0000
  11       1.0000      1.0000      1.0000      1.0000      1.0000

  AGE       1987        1988        1989        1990        1991
 ------------------------------------------------------------------

   1       0.0300      0.0400      0.0700      0.3000      0.1000
   2       0.3900      0.4200      0.3500      0.5100      0.2600
   3       0.9300      0.9200      0.8100      0.7200      0.5300
   4       1.0000      0.9900      0.9700      0.8600      0.7900
   5       1.0000      1.0000      1.0000      0.9400      0.9200
   6       1.0000      1.0000      1.0000      0.9700      0.9700
   7       1.0000      1.0000      1.0000      0.9900      0.9900
   8       1.0000      1.0000      1.0000      1.0000      1.0000
   9       1.0000      1.0000      1.0000      1.0000      1.0000
  10       1.0000      1.0000      1.0000      1.0000      1.0000
  11       1.0000      1.0000      1.0000      1.0000      1.0000

  AGE       1992        1993        1994        1995        1996
 ------------------------------------------------------------------

   1       0.0600      0.0600      0.0100      0.0000      0.0300
   2       0.1900      0.2200      0.1900      0.1500      0.3300
   3       0.4700      0.5700      0.8200      0.9300      0.9000
   4       0.7800      0.8700      0.9900      1.0000      0.9900
   5       0.9300      0.9700      1.0000      1.0000      1.0000
   6       0.9800      0.9900      1.0000      1.0000      1.0000
   7       0.9900      1.0000      1.0000      1.0000      1.0000
   8       1.0000      1.0000      1.0000      1.0000      1.0000
   9       1.0000      1.0000      1.0000      1.0000      1.0000
  10       1.0000      1.0000      1.0000      1.0000      1.0000
  11       1.0000      1.0000      1.0000      1.0000      1.0000
```

```
Maturity - Input Data

  AGE        1997        1998        1999        2000        2001
 ____________________________________________________________________

   1        0.0100      0.0600      0.0900      0.1400      0.0900
   2        0.1600      0.3600      0.3400      0.3900      0.2800
   3        0.7900      0.8200      0.7200      0.7100      0.6100
   4        0.9900      0.9700      0.9300      0.9100      0.8600
   5        1.0000      1.0000      0.9800      0.9700      0.9600
   6        1.0000      1.0000      1.0000      0.9900      0.9900
   7        1.0000      1.0000      1.0000      1.0000      1.0000
   8        1.0000      1.0000      1.0000      1.0000      1.0000
   9        1.0000      1.0000      1.0000      1.0000      1.0000
  10        1.0000      1.0000      1.0000      1.0000      1.0000
  11        1.0000      1.0000      1.0000      1.0000      1.0000

  AGE        2002        2003        2004        2005        2006
 ____________________________________________________________________

   1        0.1900      0.1500      0.1300      0.0300      0.1200
   2        0.4100      0.3800      0.3000      0.1100      0.3200
   3        0.6800      0.6700      0.5500      0.3400      0.6300
   4        0.8600      0.8700      0.7700      0.6900      0.8600
   5        0.9500      0.9600      0.9000      0.9000      0.9600
   6        0.9800      0.9900      0.9600      0.9800      0.9900
   7        0.9900      1.0000      0.9900      0.9900      1.0000
   8        1.0000      1.0000      1.0000      1.0000      1.0000
   9        1.0000      1.0000      1.0000      1.0000      1.0000
  10        1.0000      1.0000      1.0000      1.0000      1.0000
  11        1.0000      1.0000      1.0000      1.0000      1.0000

  AGE        2007
 ____________________________________________________________________

   1        0.0800
   2        0.3400
   3        0.7600
   4        0.9500
   5        0.9900
   6        1.0000
   7        1.0000
   8        1.0000
   9        1.0000
  10        1.0000
  11        1.0000
```

```
Input Partial Recruitment

  AGE

   1       0.0000
   2       0.0021
   3       0.1618
   4       0.6821
   5       0.9004
   6       1.0000
   7       0.8264
   8       0.7333
   9       0.7720
  10       0.7530


Input F-Plus Ratio

  YEAR

  1982       1.0000
  1983       1.0000
  1984       1.0000
  1985       1.0000
  1986       1.0000
  1987       1.0000
  1988       1.0000
  1989       1.0000
  1990       1.0000
  1991       1.0000
  1992       1.0000
  1993       1.0000
  1994       1.0000
  1995       1.0000
  1996       1.0000
  1997       1.0000
  1998       1.0000
  1999       1.0000
  2000       1.0000
  2001       1.0000
  2002       1.0000
  2003       1.0000
  2004       1.0000
  2005       1.0000
  2006       1.0000
  2007       1.0000
```

```
 SURVEY - INPUT DATA

INDEX              1            2            3            4            5

SURVEY TAG      WHSpr        WHSpr        WHSpr        WHSpr        WHSpr

AGE                2            3            4            5            6
TIME            JAN-1        JAN-1        JAN-1        JAN-1        JAN-1
TYPE           NUMBERS      NUMBERS      NUMBERS      NUMBERS      NUMBERS
RETRO FLAG        1            1            1            1            1
 ________________________________________________________________________

    1982        1.0065       0.4764       0.6554       0.9877       0.0873
    1983        0.9486       0.9968       0.4647       0.4042       0.2118
    1984        1.3120       1.0226       0.8233       0.2118       0.0467
    1985        0.2308       0.6617       0.6625       0.6617       0.1031
    1986        0.2478       0.7540       0.2369       0.0912       0.0349
    1987        0.4602       0.1991       0.2307       0.0744       0.0000
    1988        0.9234       0.8229       0.2179       0.2535       0.0915
    1989        0.6048       0.7230       0.6001       0.0908       0.0627
    1990        0.2076       1.3654       0.6370       0.1020       0.0321
    1991        0.0678       0.2339       1.7167       0.2993       0.0200
    1992        0.2255       0.2424       0.2819       1.3281       0.2264
    1993        0.4965       0.7993       0.3343       0.0906       0.4842
    1994        0.3156       0.3875       0.2150       0.0942       0.0493
    1995        0.1792       1.1161       0.3717       0.1454       0.0283
    1996        0.0215       0.5927       1.3307       0.4032       0.0593
    1997        0.1316       0.3991       0.2643       0.8756       0.2424
    1998        0.2236       0.3301       0.5166       0.1415       0.4210
    1999        0.3443       0.7133       0.3445       0.3150       0.1337
    2000        0.7247       0.4385       0.4570       0.1071       0.1006
    2001        0.3234       0.7161       0.4972       0.3539       0.0635
    2002        0.0453       0.5244       1.6012       0.6142       0.3619
    2003        0.8305       0.0630       0.7077       1.0889       0.3946
    2004        0.0446       0.2213       0.1181       0.1908       0.2316
    2005        0.7265       0.1014       0.6076       0.0154       0.1498
    2006        0.2300       0.4300       0.0600       0.2000       0.0200
    2007        3.4500       2.9300       4.4800       0.5000       0.8400
    2008        1.0986       3.2112       1.3566       0.9393       0.0584
```

```
 SURVEY - INPUT DATA

INDEX             6           7           8           9          10

SURVEY TAG      WHSpr       WHSpr       WHAut       WHAut       WHAut

AGE                7           8           2           3           4
TIME            JAN-1       JAN-1       JAN-1       JAN-1       JAN-1
TYPE           NUMBERS     NUMBERS     NUMBERS     NUMBERS     NUMBERS
RETRO FLAG        1           1           1           1           1
 ________________________________________________________________________

    1982        0.1120      0.0000      0.6179      0.4188      0.5394
    1983        0.0680      0.0160      0.8426      3.3527      2.2748
    1984        0.1000      0.0000      0.3168      0.9155      0.8277
    1985        0.0910      0.0520      0.4323      0.4258      0.6307
    1986        0.0380      0.0000      0.5256      0.9567      0.6094
    1987        0.0660      0.0080      0.3920      0.4010      0.6565
    1988        0.0650      0.0000      0.5782      1.3796      0.5921
    1989        0.0140      0.0000      1.9375      2.3134      0.9896
    1990        0.0180      0.0000      0.1495      2.4065      1.5017
    1991        0.0180      0.0000      0.0447      0.1868      1.8293
    1992        0.0690      0.0000      0.1435      0.1390      0.2233
    1993        0.0550      0.0230      0.2910      0.4458      0.1400
    1994        0.1270      0.0270      0.1977      0.5678      0.3602
    1995        0.0000      0.0110      0.2071      0.8831      0.8260
    1996        0.0000      0.0000      0.0680      0.2845      1.2284
    1997        0.1200      0.0000      0.1242      0.3826      0.1883
    1998        0.0230      0.0370      0.2968      0.0855      0.1769
    1999        0.2730      0.0000      0.0966      0.3203      0.1147
    2000        0.0240      0.0220      0.4307      0.3672      0.5857
    2001        0.0980      0.0550      0.5326      0.9837      0.3936
    2002        0.1640      0.0570      0.0340      0.1410      0.7524
    2003        0.3210      0.1030      0.2691      0.0805      0.3637
    2004        0.0140      0.0140      0.4546      0.1976      0.1848
    2005        0.1297      0.0142      0.5700      0.1700      0.5400
    2006        0.1314      0.0729      0.1533      0.3806      0.0796
    2007        0.0652      0.0384      1.2514      0.5802      1.0331
    2008        0.0806      0.0000      0.1456      0.8310      0.3840
```

```
 SURVEY - INPUT DATA

INDEX            11          12          13          14          15

SURVEY TAG      WHAut       WHAut       WHAut       WHAut       MASpr

AGE                5           6           7           8           2
TIME            JAN-1       JAN-1       JAN-1       JAN-1       JAN-1
TYPE           NUMBERS     NUMBERS     NUMBERS     NUMBERS     NUMBERS
RETRO FLAG      1           1           1           1           1
 ________________________________________________________________________

    1982       0.4047      0.1205      0.0760      0.0290      7.1700
    1983       1.0892      0.2092      0.0000      0.0000     14.6100
    1984       0.1970      0.2270      0.2100      0.0000      5.1500
    1985       0.3871      0.2140      0.1630      0.0790      2.7700
    1986       0.2482      0.1820      0.0750      0.0000     11.6800
    1987       0.3417      0.0727      0.0410      0.0000      4.7100
    1988       0.2429      0.0751      0.0000      0.0000      6.3500
    1989       0.4434      0.0990      0.0650      0.0330     20.5100
    1990       0.2926      0.1605      0.0330      0.0000      5.4500
    1991       0.5978      0.2589      0.0520      0.0100      2.6900
    1992       0.6334      0.0811      0.0000      0.0230      5.1300
    1993       0.0355      0.3498      0.1040      0.0080      6.1100
    1994       0.0336      0.0000      0.0300      0.0000      4.0700
    1995       0.0854      0.0511      0.0000      0.0450      1.9200
    1996       0.3252      0.0821      0.0110      0.0000      0.5200
    1997       0.5421      0.0616      0.0000      0.0000      0.9800
    1998       0.1728      0.1402      0.0000      0.0000      0.8300
    1999       0.1923      0.0387      0.0310      0.0000      2.3900
    2000       0.2433      0.1320      0.0160      0.0060      7.0200
    2001       0.5071      0.1343      0.0100      0.0000      4.5000
    2002       0.4690      0.3368      0.1220      0.0840      0.2600
    2003       2.7972      1.0958      0.6270      0.0510     12.7000
    2004       0.5287      0.4498      0.0730      0.0770      1.5600
    2005       0.2400      0.2500      0.1680      0.0680      7.1500
    2006       0.4495      0.0221      0.0923      0.0824      3.6700
    2007       0.2475      0.2857      0.0339      0.0496      3.3600
    2008       0.5283      0.0226      0.0690      0.0000      0.0000
```

```
 SURVEY - INPUT DATA

INDEX            16          17          18          19          20

SURVEY TAG     MASpr       MASpr       MAAut       MAAut       MAAut

AGE                3           4           1           2           3
TIME           JAN-1       JAN-1       JAN-1       JAN-1       JAN-1
TYPE          NUMBERS     NUMBERS     NUMBERS     NUMBERS     NUMBERS
RETRO FLAG       1           1           1           1           1
 ------------------------------------------------------------------------

    1982        2.4100      0.8700      1.4500      6.2000      1.2500
    1983        2.8600      1.5000      4.5900      1.1400      0.3100
    1984        2.0700      0.7000      1.2700      0.2800      0.1000
    1985        2.2700      0.4500     10.3000      0.1600      0.0700
    1986        1.2300      0.6800      2.6500      0.1900      0.0200
    1987        2.9600      0.2200      1.8000      0.5500      0.3700
    1988        2.4500      1.4500    311.7200      1.4000      0.0200
    1989        8.7600      1.0600      5.5300      3.1000      0.2400
    1990       14.7500      2.3100      3.9400      0.0200      0.1000
    1991        1.5700      3.6600      7.8100      4.2200      0.3100
    1992        3.6700      0.7500      5.0400      2.0000      0.3600
    1993        2.5500      0.9000     26.4200      0.9900      0.0400
    1994        1.7500      0.4900     49.4300      1.5300      0.3600
    1995        2.7600      0.7800     40.0100      5.3600      3.4500
    1996        1.0800      1.4900      2.9300      0.8000      0.4100
    1997        0.9300      0.1700      6.9000      0.0800      0.0100
    1998        0.7000      0.7500      1.4300      0.0300      0.0000
    1999        2.3100      0.7800      3.2700      0.6400      0.3200
    2000        2.8900      2.2000      7.3300      0.5900      0.0700
    2001        4.9700      3.5200      0.0500      0.4000      0.1700
    2002        1.2300      1.4100     49.1900      0.0100      0.1300
    2003        0.2800      1.4300      0.9600      1.0900      0.1300
    2004        2.5800      0.4600    120.1700      1.6000      0.1400
    2005        0.5700      2.0700     44.6700      9.9400      0.9200
    2006        3.3800      0.5400     39.4700      0.6100      0.2400
    2007        1.8400      1.7500      2.0800      4.3500      0.4200
    2008        0.0000      0.0000      7.6100      0.1600      0.1300
```

```
 SURVEY - INPUT DATA


INDEX            21          22          23          24          25

SURVEY TAG     CM_CPE      CM_CPE      CM_CPE      CM_CPE      CM_CPE

AGE                2           3           4           5           6
TIME           MEAN        MEAN        MEAN        MEAN        MEAN
TYPE          NUMBERS     NUMBERS     NUMBERS     NUMBERS     NUMBERS
RETRO FLAG       0           0           0           0           0
 ------------------------------------------------------------------------

    1982        0.0743      0.0738      0.0450      0.0217      0.0027
    1983        0.0477      0.1099      0.0422      0.0209      0.0123
    1984        0.0331      0.0448      0.0442      0.0118      0.0055
    1985        0.0137      0.0423      0.0289      0.0179      0.0036
    1986        0.0041      0.0688      0.0226      0.0066      0.0043
    1987        0.0074      0.0186      0.0260      0.0057      0.0018
    1988        0.0146      0.0492      0.0242      0.0093      0.0015
    1989        0.0170      0.0637      0.0397      0.0106      0.0023
    1990        0.0110      0.1595      0.0782      0.0122      0.0051
    1991        0.0194      0.0404      0.1355      0.0217      0.0039
    1992        0.0149      0.0173      0.0138      0.0515      0.0052
    1993        0.0027      0.0500      0.0232      0.0041      0.0140
    1994        0.0000      0.0000      0.0000      0.0000      0.0000
    1995        0.0000      0.0000      0.0000      0.0000      0.0000
    1996        0.0000      0.0000      0.0000      0.0000      0.0000
    1997        0.0000      0.0000      0.0000      0.0000      0.0000
    1998        0.0000      0.0000      0.0000      0.0000      0.0000
    1999        0.0000      0.0000      0.0000      0.0000      0.0000
    2000        0.0000      0.0000      0.0000      0.0000      0.0000
    2001        0.0000      0.0000      0.0000      0.0000      0.0000
    2002        0.0000      0.0000      0.0000      0.0000      0.0000
    2003        0.0000      0.0000      0.0000      0.0000      0.0000
    2004        0.0000      0.0000      0.0000      0.0000      0.0000
    2005        0.0000      0.0000      0.0000      0.0000      0.0000
    2006        0.0000      0.0000      0.0000      0.0000      0.0000
    2007        0.0000      0.0000      0.0000      0.0000      0.0000
    2008        0.0000      0.0000      0.0000      0.0000      0.0000

     Additional Output Files

Population File
C:\ALLWORK\ASSESS\GARMIIIAUG2008WG\ASSMT_MTG\GOMCOD\VPA\FINALS\G
Auxilliary File
C:\ALLWORK\ASSESS\GARMIIIAUG2008WG\ASSMT_MTG\GOMCOD\VPA\FINALS\G
Covariance File
C:\ALLWORK\ASSESS\GARMIIIAUG2008WG\ASSMT_MTG\GOMCOD\VPA\FINALS\G
Residuals File
C:\ALLWORK\ASSESS\GARMIIIAUG2008WG\ASSMT_MTG\GOMCOD\VPA\FINALS\G
Log File
C:\ALLWORK\ASSESS\GARMIIIAUG2008WG\ASSMT_MTG\GOMCOD\VPA\FINALS\G
```

```
                           Estimation Results
JAN-1 Population Numbers

  AGE       1982        1983        1984        1985        1986


   1        7857.       7929.      10674.       6679.      10260.
   2       11123.       6368.       6481.       8717.       5428.
   3        5520.       7314.       4015.       4581.       6174.
   4        3128.       2329.       3348.       1856.       1771.
   5        1767.       1274.        831.       1261.        491.
   6         226.        771.        421.        255.        428.
   7         260.        116.        222.        157.         88.
   8         140.        124.         49.        111.         58.
   9          71.         55.         42.         23.         62.
  10          10.         21.         22.         21.         15.
  11          79.         35.         36.         21.        113.
====================================================================
Total      30180.      26336.      26143.      23683.      24888.

  AGE       1987        1988        1989        1990        1991


   1       12744.      24612.       4254.       4135.       6975.
   2        8388.      10347.      20148.       3480.       3386.
   3        4276.       6063.       7974.      16026.       2620.
   4        2560.       2306.       3038.       4465.       9388.
   5         609.        734.        877.        935.       1434.
   6         151.        185.        213.        276.        292.
   7         170.         41.        107.         90.         66.
   8          31.         63.         24.         50.         49.
   9          20.         13.         35.         14.         14.
  10          18.          4.         10.         26.          2.
  11           5.          2.         13.         30.          2.
====================================================================
Total      28973.      44369.      36694.      29528.      24228.

  AGE       1992        1993        1994        1995        1996


   1        6340.       9123.       3180.       3805.       3545.
   2        5711.       5191.       7469.       2603.       3099.
   3        2375.       4369.       4134.       6066.       1880.
   4         931.       1414.       1739.       2038.       3908.
   5        3243.        281.        449.        323.        590.
   6         332.        675.        104.         68.         54.
   7          96.         73.        124.         21.         30.
   8          12.         19.         34.         24.          5.
   9          13.          3.         10.          1.          3.
  10           4.          0.          1.          2.          0.
  11           0.          0.          2.          0.          0.
====================================================================
Total      19057.      21148.      17245.      14951.      13113.
```

```
JAN-1 Population Numbers

  AGE       1997        1998        1999        2000        2001

____________________________________________________________________________

   1        5245.       4458.       7847.       4016.       1187.
   2        2902.       4294.       3650.       6424.       3288.
   3        2455.       2299.       3419.       2969.       5077.
   4         969.       1562.       1446.       2213.       1947.
   5        1447.        381.        741.        670.       1063.
   6         135.        414.        168.        360.        376.
   7          11.         46.        166.         85.        205.
   8          20.          4.         14.         64.         55.
   9           3.         14.          0.          4.         46.
  10           1.          2.         11.          0.          4.
  11           0.          1.          0.          0.          2.
====================================================================
Total      13190.      13477.      17462.      16805.      13250.

  AGE       2002        2003        2004        2005        2006

____________________________________________________________________________

   1        4953.       1681.      10966.       6713.      23910.
   2         972.       4055.       1377.       8979.       5496.
   3        2559.        793.       3305.       1126.       7344.
   4        3086.       1860.        542.       2382.        801.
   5         974.       1726.       1122.        218.       1214.
   6         528.        484.        720.        548.         92.
   7         209.        248.        187.        349.        209.
   8         114.         98.        110.         86.        176.
   9          37.         61.         44.         56.         41.
  10          25.         22.         30.         19.         29.
  11           2.         16.          9.         19.         23.
====================================================================
Total      13459.      11046.      18414.      20495.      39336.

  AGE       2007        2008
______________________________________________________________________
   1        4808.          0.
   2       19576.       3937.
   3        4498.      16020.
   4        5852.       3543.
   5         401.       3970.
   6         587.        201.
   7          46.        251.
   8          83.         30.
   9         101.         47.
  10          17.         71.
  11          21.         19.
====================================================================
Total      35992.      28090.
```

```
Fishing Mortality Calculated

   AGE       1982        1983        1984        1985        1986

------------------------------------------------------------------------------

    1       0.0101      0.0016      0.0026      0.0074      0.0014
    2       0.2192      0.2612      0.1470      0.1450      0.0386
    3       0.6628      0.5814      0.5714      0.7503      0.6802
    4       0.6981      0.8305      0.7769      1.1299      0.8676
    5       0.6295      0.9064      0.9811      0.8800      0.9766
    6       0.4723      1.0461      0.7862      0.8605      0.7259
    7       0.5377      0.6505      0.4954      0.8028      0.8481
    8       0.7294      0.8727      0.5657      0.3866      0.8646
    9       1.0140      0.7010      0.4948      0.2139      1.0200
   10       0.6088      0.9342      0.8265      0.8317      0.8523
   11       0.6088      0.9342      0.8265      0.8317      0.8523

   AGE       1987        1988        1989        1990        1991

------------------------------------------------------------------------------

    1       0.0084      0.0001      0.0010      0.0000      0.0000
    2       0.1247      0.0604      0.0289      0.0840      0.1545
    3       0.4177      0.4909      0.3799      0.3348      0.8343
    4       1.0499      0.7667      0.9783      0.9361      0.8630
    5       0.9906      1.0384      0.9547      0.9634      1.2635
    6       1.1023      0.3485      0.6584      1.2250      0.9179
    7       0.7884      0.3576      0.5545      0.4021      1.5057
    8       0.6852      0.3761      0.3568      1.0760      1.1140
    9       1.4099      0.0904      0.0981      1.7050      0.9720
   10       0.9568      0.7939      0.8422      0.9642      1.2033
   11       0.9568      0.7939      0.8422      0.9642      1.2033

   AGE       1992        1993        1994        1995        1996

------------------------------------------------------------------------------

    1       0.0000      0.0000      0.0003      0.0053      0.0000
    2       0.0677      0.0276      0.0080      0.1251      0.0326
    3       0.3191      0.7214      0.5072      0.2397      0.4631
    4       0.9977      0.9473      1.4838      1.0395      0.7934
    5       1.3696      0.7941      1.6866      1.5888      1.2721
    6       1.3085      1.4954      1.4035      0.6248      1.4090
    7       1.4079      0.5791      1.4467      1.3241      0.1825
    8       1.1311      0.4254      3.4380      1.9107      0.1292
    9       8.8324      1.1807      1.2844      6.1427      0.6870
   10       1.3641      1.1501      1.6321      1.3635      1.1851
   11       1.3641      1.1501      1.6321      1.3635      1.1851
```

```
Fishing Mortality Calculated

   AGE       1997         1998         1999         2000         2001


    1       0.0000       0.0000       0.0002       0.0000       0.0000
    2       0.0331       0.0281       0.0067       0.0352       0.0507
    3       0.2522       0.2638       0.2347       0.2216       0.2979
    4       0.7331       0.5461       0.5695       0.5337       0.4927
    5       1.0524       0.6167       0.5220       0.3769       0.4994
    6       0.8742       0.7161       0.4791       0.3620       0.3864
    7       0.7168       0.9838       0.7526       0.2337       0.3888
    8       0.1523       6.4333       0.9591       0.1311       0.1957
    9       0.1066       0.0314       0.2164       0.0002       0.3866
   10       1.0156       0.6873       0.5515       0.3465       0.4486
   11       1.0156       0.6873       0.5515       0.3465       0.4486

   AGE       2002         2003         2004         2005         2006


    1       0.0000       0.0000       0.0000       0.0000       0.0000
    2       0.0034       0.0045       0.0007       0.0009       0.0003
    3       0.1189       0.1807       0.1274       0.1411       0.0271
    4       0.3808       0.3053       0.7125       0.4741       0.4914
    5       0.4985       0.6741       0.5164       0.6606       0.5260
    6       0.5550       0.7507       0.5245       0.7653       0.4948
    7       0.5582       0.6163       0.5806       0.4825       0.7225
    8       0.4224       0.5975       0.4648       0.5426       0.3577
    9       0.3310       0.4983       0.6597       0.4716       0.6789
   10       0.5163       0.6793       0.5218       0.6406       0.5272
   11       0.5163       0.6793       0.5218       0.6406       0.5272

   AGE       2007


    1       0.0000
    2       0.0004
    3       0.0388
    4       0.1880
    5       0.4892
    6       0.6492
    7       0.2288
    8       0.3714
    9       0.1484
   10       0.4888
   11       0.4888
```

```
Average Fishing Mortality For Ages   5-  7

Year      Average F   N Weighted  Biomass Wtd  Catch Wtd



1982       0.5465      0.6031      0.5896      0.6066
1983       0.8677      0.9426      0.9506      0.9488
1984       0.7543      0.8523      0.7919      0.8772
1985       0.8478      0.8698      0.8641      0.8702
1986       0.8502      0.8588      0.8383      0.8695
1987       0.9605      0.9719      0.9537      0.9778
1988       0.5815      0.8761      0.8204      0.9533
1989       0.7225      0.8662      0.8154      0.8839
1990       0.8635      0.9800      0.9711      1.0061
1991       1.2290      1.2161      1.1983      1.2252
1992       1.3620      1.3651      1.3643      1.3652
1993       0.9562      1.2385      1.2349      1.3016
1994       1.5123      1.5992      1.5540      1.6032
1995       1.1792      1.4161      1.3970      1.4752
1996       0.9545      1.2348      1.1860      1.2724
1997       0.8811      1.0350      1.0243      1.0369
1998       0.7722      0.6858      0.6925      0.6928
1999       0.5846      0.5508      0.5638      0.5605
2000       0.3242      0.3611      0.3550      0.3645
2001       0.4249      0.4598      0.4506      0.4648
2002       0.5373      0.5233      0.5298      0.5244
2003       0.6804      0.6834      0.6816      0.6848
2004       0.5405      0.5252      0.5285      0.5256
2005       0.6362      0.6564      0.6361      0.6736
2006       0.5811      0.5512      0.5613      0.5572
2007       0.4557      0.5685      0.5686      0.5845
```

```
 Back Calculated Partial Recruitment

   AGE       1982         1983         1984         1985         1986

 ------------------------------------------------------------------------------

     1      0.0100       0.0015       0.0026       0.0065       0.0014
     2      0.2162       0.2497       0.1498       0.1283       0.0378
     3      0.6537       0.5557       0.5824       0.6641       0.6669
     4      0.6884       0.7939       0.7918       1.0000       0.8506
     5      0.6208       0.8665       1.0000       0.7789       0.9575
     6      0.4658       1.0000       0.8013       0.7616       0.7116
     7      0.5303       0.6218       0.5050       0.7105       0.8314
     8      0.7194       0.8342       0.5766       0.3422       0.8477
     9      1.0000       0.6700       0.5043       0.1893       1.0000
    10      0.6004       0.8930       0.8424       0.7361       0.8356
    11      0.6004       0.8930       0.8424       0.7361       0.8356

   AGE       1987         1988         1989         1990         1991

 ------------------------------------------------------------------------------

     1      0.0059       0.0001       0.0010       0.0000       0.0000
     2      0.0884       0.0582       0.0296       0.0493       0.1026
     3      0.2962       0.4727       0.3883       0.1964       0.5541
     4      0.7446       0.7384       1.0000       0.5490       0.5731
     5      0.7026       1.0000       0.9758       0.5650       0.8392
     6      0.7818       0.3356       0.6730       0.7185       0.6096
     7      0.5592       0.3444       0.5668       0.2358       1.0000
     8      0.4860       0.3622       0.3647       0.6311       0.7399
     9      1.0000       0.0871       0.1003       1.0000       0.6455
    10      0.6786       0.7645       0.8608       0.5655       0.7992
    11      0.6786       0.7645       0.8608       0.5655       0.7992

   AGE       1992         1993         1994         1995         1996

 ------------------------------------------------------------------------------

     1      0.0000       0.0000       0.0001       0.0009       0.0000
     2      0.0077       0.0184       0.0023       0.0204       0.0232
     3      0.0361       0.4824       0.1475       0.0390       0.3287
     4      0.1130       0.6335       0.4316       0.1692       0.5631
     5      0.1551       0.5310       0.4906       0.2587       0.9028
     6      0.1481       1.0000       0.4082       0.1017       1.0000
     7      0.1594       0.3872       0.4208       0.2156       0.1295
     8      0.1281       0.2845       1.0000       0.3111       0.0917
     9      1.0000       0.7896       0.3736       1.0000       0.4875
    10      0.1544       0.7691       0.4747       0.2220       0.8411
    11      0.1544       0.7691       0.4747       0.2220       0.8411
```

```
 Back Calculated Partial Recruitment

   AGE       1997         1998         1999         2000         2001

 ------------------------------------------------------------------------

    1       0.0000       0.0000       0.0002       0.0000       0.0000
    2       0.0314       0.0044       0.0070       0.0660       0.1016
    3       0.2396       0.0410       0.2448       0.4153       0.5965
    4       0.6966       0.0849       0.5938       1.0000       0.9866
    5       1.0000       0.0959       0.5442       0.7062       1.0000
    6       0.8307       0.1113       0.4995       0.6782       0.7738
    7       0.6812       0.1529       0.7847       0.4378       0.7784
    8       0.1447       1.0000       1.0000       0.2457       0.3918
    9       0.1013       0.0049       0.2256       0.0005       0.7741
   10       0.9651       0.1068       0.5751       0.6493       0.8982
   11       0.9651       0.1068       0.5751       0.6493       0.8982

   AGE       2002         2003         2004         2005         2006

 ------------------------------------------------------------------------

    1       0.0000       0.0000       0.0000       0.0000       0.0000
    2       0.0061       0.0060       0.0010       0.0012       0.0004
    3       0.2129       0.2407       0.1788       0.1844       0.0374
    4       0.6822       0.4067       1.0000       0.6195       0.6801
    5       0.8931       0.8980       0.7248       0.8632       0.7280
    6       0.9943       1.0000       0.7361       1.0000       0.6848
    7       1.0000       0.8209       0.8148       0.6305       1.0000
    8       0.7566       0.7959       0.6523       0.7090       0.4951
    9       0.5929       0.6637       0.9258       0.6162       0.9396
   10       0.9249       0.9049       0.7324       0.8370       0.7296
   11       0.9249       0.9049       0.7324       0.8370       0.7296

   AGE       2007

 ------------------------------------------------------------------------

    1       0.0000
    2       0.0007
    3       0.0597
    4       0.2896
    5       0.7536
    6       1.0000
    7       0.3524
    8       0.5722
    9       0.2286
   10       0.7530
   11       0.7530
```

```
JAN-1 Biomass

  AGE       1982        1983        1984        1985        1986

_____________________________________________________________________________

   1        3940.       2338.       3851.       2006.       2650.
   2       10265.       5266.       4372.       6186.       3925.
   3        7279.       9782.       5255.       5854.       8253.
   4        7157.       4629.       6978.       3928.       3807.
   5        7379.       4053.       2484.       4336.       1746.
   6        1589.       4111.       1967.       1137.       2199.
   7        2081.        712.       1546.       1062.        586.
   8        1354.       1183.        370.       1057.        532.
   9         924.        545.        491.        256.        762.
  10         110.        273.        265.        272.        200.
  11        1468.        629.        533.        293.       2210.
====================================================================
Total      43548.      33522.      28112.      26386.      26871.

  AGE       1987        1988        1989        1990        1991

_____________________________________________________________________________

   1        1213.       4031.       2294.       1021.       1501.
   2        5170.       4611.      12442.       2985.       2374.
   3        5631.       7799.      10274.      22786.       3384.
   4        6071.       4421.       6861.       8887.      19014.
   5        2269.       2931.       2651.       3278.       4352.
   6         865.       1031.        997.       1475.       1629.
   7        1284.        329.        816.        613.        563.
   8         280.        647.        234.        519.        567.
   9         238.        134.        446.        175.        181.
  10         243.         61.        132.        377.         40.
  11          71.         28.        312.        614.         26.
====================================================================
Total      23334.      26023.      37458.      42729.      33630.

  AGE       1992        1993        1994        1995        1996
______________________________________________________________________
   1        1560.       2082.        128.        439.       1200.
   2        4591.       3651.       5665.       1125.       2015.
   3        3606.       7350.       6061.       9564.       3274.
   4        1914.       3057.       4039.       4471.       7962.
   5        8877.        957.       1271.       1249.       1798.
   6        1484.       2925.        536.        294.        329.
   7         802.        519.        820.        172.        227.
   8         130.        214.        345.        217.         56.
   9         170.         41.        119.         12.         38.
  10          66.          0.         13.         33.          0.
  11           0.          0.         33.          6.          0.
====================================================================
Total      23202.      20795.      19031.      17583.      16899.
```

```
JAN-1 Biomass

  AGE       1997        1998        1999        2000        2001


   1        1201.       1037.       1190.        810.        273.
   2        2964.       3246.       2730.       4724.       2820.
   3        4540.       4408.       5426.       5195.       9981.
   4        2475.       3923.       3333.       5547.       5259.
   5        3888.       1352.       2450.       2258.       4277.
   6         553.       1503.        823.       1686.       1987.
   7          85.        230.        913.        503.       1321.
   8         223.         42.        101.        500.        392.
   9          47.        211.          0.         50.        393.
  10          18.         36.        181.          0.         46.
  11           4.         18.          0.          0.         37.
====================================================================
Total      15999.      16006.      17147.      21274.      26787.

  AGE       2002        2003        2004        2005        2006


   1         957.        372.       2346.       1187.       4507.
   2         730.       3632.       1078.       7265.       5379.
   3        5334.       1434.       7022.       1962.      14348.
   4        8620.       5100.       1510.       6133.       2074.
   5        3493.       6242.       3748.        811.       3957.
   6        2787.       2235.       3303.       2223.        420.
   7        1359.       1651.       1130.       1999.       1041.
   8        1042.        751.        922.        630.       1215.
   9         343.        683.        449.        559.        355.
  10         245.        245.        360.        235.        325.
  11          23.        214.        125.        276.        368.
====================================================================
Total      24934.      22558.      21993.      23280.      33992.

  AGE       2007        2008
   1         906.          0.
   2       17977.       3551.
   3       10849.      32614.
   4       16359.       9401.
   5        1435.      13982.
   6        2491.        863.
   7         255.       1362.
   8         518.        204.
   9         886.        428.
  10         180.        819.
  11         304.        283.
====================================================================
Total      52161.      63509.
```

```
Mean Biomass

  AGE       1982        1983        1984        1985        1986


   1        4564.       3203.       4889.       2811.       3708.
   2       10094.       5418.       5586.       7336.       5418.
   3        5987.       8172.       4514.       4734.       7373.
   4        5569.       3547.       5766.       2849.       3142.
   5        5667.       2891.       1785.       3380.       1315.
   6        1084.       2656.       1556.        853.       1681.
   7        1605.        449.       1290.        780.        444.
   8         890.        791.        336.        947.        385.
   9         533.        363.        393.        240.        482.
  10          67.        162.        196.        170.        128.
  11        1007.        376.        333.        183.       1367.
====================================================================
Total      37067.      28028.      26644.      24281.      25443.

  AGE       1987        1988        1989        1990        1991


   1        2370.       7093.       2621.       1559.       2630.
   2        6819.       8781.      21592.       3278.       3370.
   3        4932.       7609.      10420.      20928.       2517.
   4        4576.       3514.       5237.       6138.      14065.
   5        1713.       2144.       1999.       2314.       3016.
   6         606.        919.        615.       1091.       1306.
   7        1026.        281.        677.        727.        309.
   8         207.        529.        199.        335.        338.
   9         130.        122.        440.         92.        116.
  10         141.         45.        103.        222.         28.
  11          42.         18.        194.        363.         14.
====================================================================
Total      22561.      31056.      44098.      37048.      27708.

  AGE       1992        1993        1994        1995        1996

   1        2390.       3440.        380.        942.       1889.
   2        7786.       5520.       9326.       3144.       4266.
   3        3613.       5199.       5358.       8820.       2946.
   4        1488.       2016.       2491.       3110.       5723.
   5        5039.        753.        675.        759.       1077.
   6         855.       1982.        325.        258.        197.
   7         451.        511.        436.        116.        258.
   8          80.        187.         94.        114.         54.
   9          20.         23.         55.          3.         28.
  10          36.          0.          7.         24.          0.
  11           0.          0.         15.          3.          0.
====================================================================
Total      21758.      19631.      19164.      17294.      16438.
```

```
Mean Biomass

  AGE       1997        1998        1999        2000        2001

   1        1978.       1685.       2375.       1514.        448.
   2        4593.       5272.       4422.       9267.       5142.
   3        4377.       3812.       5088.       5532.       9546.
   4        1919.       3133.       2587.       5368.       4487.
   5        2578.       1077.       2028.       2256.       3617.
   6         398.       1144.        706.       1571.       1792.
   7          59.        140.        768.        417.       1127.
   8         198.          7.         83.        463.        382.
   9          42.        241.          0.         52.        300.
  10          11.         24.        107.          0.         33.
  11           2.         12.          0.          0.         27.
====================================================================
Total      16154.      16548.      18164.      26440.      26901.

  AGE       2002        2003        2004        2005        2006

   1        1867.        634.       4135.       2531.       9015.
   2        1193.       7074.       1838.      12803.      11470.
   3        5386.       1589.       6595.       1964.      15933.
   4        7652.       4466.       1146.       4910.       1885.
   5        2822.       4602.       2922.        628.       3238.
   6        2182.       1653.       2695.       1585.        321.
   7         983.       1276.        895.       1578.        752.
   8         976.        592.        753.        474.       1029.
   9         294.        477.        349.        429.        262.
  10         194.        179.        280.        170.        249.
  11          17.        142.         89.        186.        261.
====================================================================
Total      23566.      22683.      21698.      27259.      44415.

  AGE       2007
   1        1813.
   2       35957.
   3       10108.
   4       15629.
   5        1138.
   6        1898.
   7         238.
   8         447.
   9         862.
  10         144.
  11         220.
====================================================================
Total      68452.
```

```
 Spawning Stock Biomass


   AGE       1982        1983        1984        1985        1986

_____________________________________________________________________________

    1         419.        158.         37.         19.        179.
    2        3063.       1268.        866.       2102.       2226.
    3        4035.       5238.       3928.       4797.       6913.
    4        5361.       3431.       5870.       3147.       3186.
    5        6169.       3270.       2040.       3621.       1435.
    6        1406.       3307.       1669.        952.       1885.
    7        1840.        618.       1377.        898.        492.
    8        1160.        989.        326.        959.        446.
    9         755.        469.        437.        239.        622.
   10          96.        226.        223.        229.        168.
   11        1283.        521.        449.        247.       1854.
 ====================================================================
 Total      25587.      19494.      17223.      17211.      19406.

   AGE       1987        1988        1989        1990        1991

_____________________________________________________________________________

    1          35.        156.        155.        296.        145.
    2        1910.       1854.       4192.       1452.        582.
    3        4725.       6394.       7555.      15007.       1509.
    4        4929.       3725.       5469.       6324.      12582.
    5        1861.       2384.       2187.       2538.       3137.
    6         696.        941.        864.       1128.       1311.
    7        1089.        300.        719.        549.        420.
    8         241.        587.        213.        420.        456.
    9         182.        128.        424.        128.        148.
   10         200.         52.        111.        310.         32.
   11          58.         24.        262.        506.         21.
 ====================================================================
 Total      15926.      16546.      22151.      28657.      20342.

   AGE       1992        1993        1994        1995        1996
_______________________________________________________________________
    1          91.        121.          1.          0.         35.
    2         834.        773.       1040.        160.        640.
    3        1554.       3593.       4418.       8266.       2639.
    4        1223.       2196.       3020.       3637.       6680.
    5        6355.        786.        928.        927.       1406.
    6        1131.       2183.        410.        256.        252.
    7         607.        456.        623.        133.        213.
    8         104.        193.        188.        153.         53.
    9          38.         32.         93.          4.         32.
   10          51.          0.          9.         26.          0.
   11           0.          0.         24.          5.          0.
 ====================================================================
 Total      11988.      10334.      10755.      13566.      11949.
```

```
 Spawning Stock Biomass

   AGE       1997         1998         1999         2000         2001


   1          12.          60.         104.         110.          24.
   2         456.        1125.         897.        1771.         757.
   3        3326.        3345.        3634.        3438.        5603.
   4        2098.        3361.        2727.        4467.        4030.
   5        3155.        1180.        2129.        1990.        3654.
   6         463.        1290.         735.        1519.        1784.
   7          73.         189.         779.         468.        1198.
   8         210.          14.          84.         473.         367.
   9          45.         203.           0.          49.         357.
  10          15.          31.         159.           0.          41.
  11           3.          15.           0.           0.          33.
 ====================================================================
 Total      9856.       10814.       11246.       14285.       17848.

   AGE       2002         2003         2004         2005         2006


   1         176.          54.         295.          34.         523.
   2         289.        1334.         313.         773.        1665.
   3        3440.         902.        3657.         630.        8704.
   4        6729.        4079.         999.        3782.        1590.
   5        2953.        5179.        2993.         632.        3366.
   6        2408.        1889.        2810.        1855.         371.
   7        1186.        1441.         982.        1767.         893.
   8         939.         658.         826.         557.        1108.
   9         314.         608.         389.         500.         307.
  10         217.         211.         319.         204.         288.
  11          21.         185.         111.         239.         326.
 ====================================================================
 Total     18673.       16539.       13693.       10974.       19139.

   AGE       2007

   1          70.
   2        5911.
   3        7924.
   4       14568.
   5        1267.
   6        2162.
   7         237.
   8         471.
   9         836.
  10         161.
  11         271.
 ====================================================================
 Total     33877.
```

```
Catch Biomass

  AGE       1982        1983        1984        1985        1986

____________________________________________________________________________

   1          46.          5.         12.         21.          5.
   2        2201.       1407.        818.       1059.        209.
   3        3918.       4697.       2551.       3503.       4951.
   4        3837.       2901.       4415.       3155.       2683.
   5        3525.       2578.       1721.       2927.       1261.
   6         507.       2727.       1206.        722.       1203.
   7         854.        289.        633.        617.        371.
   8         640.        680.        188.        363.        328.
   9         531.        251.        193.         51.        483.
  10          41.        152.        162.        141.        109.
  11         613.        352.        275.        152.       1165.
====================================================================
Total      16713.      16037.      12173.      12711.      12768.

  AGE       1987        1988        1989        1990        1991

____________________________________________________________________________

   1          20.          1.          3.          0.          0.
   2         847.        529.        623.        274.        518.
   3        2042.       3698.       3927.       6956.       2068.
   4        4715.       2656.       5034.       5649.      11948.
   5        1667.       2186.       1876.       2191.       3728.
   6         655.        318.        400.       1308.       1178.
   7         797.        100.        372.        290.        453.
   8         140.        197.         71.        354.        369.
   9         179.         11.         43.        153.        111.
  10         135.         36.         87.        214.         33.
  11          40.         14.        163.        350.         17.
====================================================================
Total      11237.       9747.      12597.      17739.      20424.

  AGE       1992        1993        1994        1995        1996

____________________________________________________________________________

   1           0.          0.          0.          5.          0.
   2         526.        152.         75.        392.        139.
   3        1145.       3700.       2691.       2102.       1352.
   4        1458.       1878.       3604.       3173.       4474.
   5        6740.        589.       1108.       1174.       1340.
   6        1094.       2890.        446.        160.        271.
   7         620.        293.        616.        150.         47.
   8          89.         79.        308.        211.          7.
   9         161.         27.         69.         15.         19.
  10          49.          0.         11.         32.          0.
  11           0.          0.         25.          4.          0.
====================================================================
Total      11881.       9607.       8952.       7419.       7648.
```

```
 Catch Biomass


   AGE       1997        1998        1999        2000        2001

_____________________________________________________________________________

    1          0.          0.          0.          0.          0.
    2        151.        148.         30.        326.        260.
    3       1097.       1000.       1188.       1220.       2825.
    4       1387.       1693.       1457.       2835.       2189.
    5       2663.        656.       1048.        843.       1789.
    6        342.        808.        335.        564.        687.
    7         42.        136.        570.         97.        435.
    8         30.         44.         78.         60.         74.
    9          4.          8.          0.          0.        115.
   10         11.         16.         59.          0.         15.
   11          2.          8.          0.          0.         12.
 ====================================================================
 Total      5731.       4517.       4765.       5946.       8401.

   AGE       2002        2003        2004        2005        2006

_____________________________________________________________________________

    1          0.          0.          0.          0.          0.
    2          4.         32.          1.         12.          4.
    3        638.        286.        837.        276.        430.
    4       2891.       1354.        806.       2305.        917.
    5       1393.       3063.       1494.        410.       1685.
    6       1198.       1224.       1399.       1196.        157.
    7        543.        777.        514.        754.        536.
    8        409.        350.        347.        255.        365.
    9         97.        235.        227.        200.        176.
   10        100.        121.        146.        109.        131.
   11          9.         97.         46.        119.        138.
 ====================================================================
 Total      7281.       7538.       5818.       5637.       4540.

   AGE       2007

_____________________________________________________________________________

    1          0.
    2         16.
    3        391.
    4       2924.
    5        551.
    6       1217.
    7         54.
    8        165.
    9        127.
   10         79.
   11        107.
 ====================================================================
 Total      5631.
```

```
Catch Numbers

  AGE       1982        1983        1984        1985        1986

______________________________________________________________________________

   1         71.4         11.3         24.7         44.3         12.8
   2       1980.9       1324.4        801.5       1064.5        186.0
   3       2420.3       2917.6       1581.5       2187.8       2756.8
   4       1422.1       1189.0       1636.5       1137.1        929.6
   5        747.1        687.2        470.1        667.5        277.0
   6         77.1        452.6        207.6        133.2        199.9
   7         97.7         50.0         78.4         78.5         45.7
   8         65.6         65.4         19.3         32.1         30.2
   9         41.0         25.2         15.0          4.0         35.6
  10          4.0         11.8         11.6         11.0          8.0
  11         33.0         19.4         18.4         11.0         59.5
====================================================================
Total      6960.2       6753.9       4864.6       5371.0       4541.1

  AGE       1987        1988        1989        1990        1991

______________________________________________________________________________

   1         96.3          2.4          3.8          0.0          0.0
   2        889.6        549.1        519.5        253.6        438.5
   3       1321.0       2128.0       2280.6       4125.6       1341.1
   4       1505.8       1117.1       1715.7       2455.9       4910.7
   5        346.4        428.8        488.0        523.3        930.6
   6         91.5         49.3         92.8        176.6        158.8
   7         83.7         11.2         41.2         27.0         46.8
   8         13.9         17.9          6.4         30.0         30.0
   9         13.6          1.0          3.0         10.0          7.9
  10         10.3          2.0          5.0         15.0          1.3
  11          3.0          1.0          7.0         17.0          1.0
====================================================================
Total      4375.1       4307.8       5163.0       7634.0       7866.7

  AGE       1992        1993        1994        1995        1996

______________________________________________________________________________

   1          0.0          0.0          0.9         18.1          0.0
   2        338.3        127.8         54.0        277.0         90.0
   3        587.1       2031.8       1488.2       1169.9        630.7
   4        531.9        783.0       1216.6       1192.0       1936.7
   5       2188.4        139.4        330.9        232.5        384.3
   6        219.1        473.8         71.0         28.6         36.9
   7         65.3         29.2         85.7         13.9          4.5
   8          7.4          6.0         29.5         18.4          0.5
   9         12.0          2.0          6.7          0.8          1.3
  10          3.0          0.0          0.6          1.6          0.0
  11          0.0          0.0          1.2          0.2          0.0
====================================================================
Total      3952.5       3593.0       3285.3       2953.0       3084.9
```

```
Catch Numbers

  AGE      1997       1998       1999       2000       2001

______________________________________________________________

   1        0.0        0.0        1.2        0.0        0.0
   2       85.4      107.5       22.1      201.1      147.2
   3      495.2      482.4      647.2      534.0     1183.5
   4      455.5      594.8      568.0      828.3      685.5
   5      852.4      158.7      272.6      190.3      378.0
   6       71.4      191.4       58.0       98.9      109.1
   7        5.0       26.2       79.2       16.1       59.8
   8        2.6        3.9        7.9        7.1        8.9
   9        0.3        0.4        0.0        0.0       13.3
  10        0.7        1.1        4.4        0.0        1.2
  11        0.1        0.4        0.0        0.0        0.5
=======================================================================
Total    1968.6     1566.8     1660.6     1875.8     2587.0

  AGE      2002       2003       2004       2005       2006

______________________________________________________________

   1        0.0        0.0        0.0        0.0        0.0
   2        3.0       16.4        0.9        7.5        1.6
   3      259.5      118.6      357.8      134.1      177.4
   4      884.3      442.9      249.9      813.8      281.3
   5      346.0      766.1      409.6       95.2      449.3
   6      203.5      231.4      266.0      265.3       32.5
   7       81.0      103.3       74.6      120.9       97.2
   8       35.5       39.9       36.9       32.5       48.0
   9        9.5       21.7       19.3       19.2       18.2
  10        9.4        9.9       11.3        8.1       10.8
  11        0.6        7.4        3.5        8.3        8.8
=======================================================================
Total    1832.3     1757.6     1429.8     1504.9     1125.1

  AGE      2007

______________________________________________________________

   1        0.0
   2        7.9
   3      154.8
   4      907.5
   5      140.4
   6      253.8
   7        8.5
   8       23.3
   9       12.6
  10        6.7
  11        7.5
=======================================================================
Total    1523.0
```

```
              Surplus Production

    Average Adjustment Factor (Delta) =   1.0000

Year        Biomass  Delta Biomass  Catch Biomass  Surplus Production

1982      43548.026     -10025.750      16713.307       6687.557
1983      33522.276      -5409.948      16037.051      10627.104
1984      28112.328      -1726.717      12173.486      10446.769
1985      26385.612        485.726      12711.449      13197.175
1986      26871.338      -3537.308      12768.471       9231.163
1987      23334.030       2688.560      11236.780      13925.340
1988      26022.590      11435.443       9746.789      21182.231
1989      37458.032       5271.009      12597.429      17868.438
1990      42729.041      -9098.808      17738.869       8640.060
1991      33630.233     -10428.550      20423.898       9995.348
1992      23201.683      -2406.842      11880.954       9474.111
1993      20794.841      -1764.240       9606.844       7842.605
1994      19030.601      -1447.956       8951.516       7503.559
1995      17582.645       -683.721       7418.520       6734.799
1996      16898.923       -899.757       7648.280       6748.523
1997      15999.167          6.556       5731.013       5737.569
1998      16005.723       1141.654       4516.532       5658.186
1999      17147.377       4126.627       4764.652       8891.279
2000      21274.004       5513.172       5945.694      11458.866
2001      26787.176      -1853.416       8401.230       6547.813
2002      24933.760      -2375.296       7280.581       4905.285
2003      22558.464       -565.860       7538.329       6972.469
2004      21992.604       1287.872       5817.528       7105.401
2005      23280.477      10711.086       5637.061      16348.146
2006      33991.562      18168.941       4540.123      22709.064
2007      52160.503      11348.568       5631.217      16979.785
2008      63509.071
```

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 Summary of Survey Indices Used in the Estimate

 INDEX    Survey Tag    Age   Time  Type  Catchability Std. Error   CV

_______________________________________________________________________________

   1        WHSpr        2   JAN-1 NUMBER  0.6391E-04  0.9883E-05  0.1546E+00
   2        WHSpr        3   JAN-1 NUMBER  0.1319E-03  0.1415E-04  0.1073E+00
   3        WHSpr        4   JAN-1 NUMBER  0.2250E-03  0.2283E-04  0.1015E+00
   4        WHSpr        5   JAN-1 NUMBER  0.2940E-03  0.3869E-04  0.1316E+00
   5        WHSpr        6   JAN-1 NUMBER  0.3828E-03  0.6419E-04  0.1677E+00
   6        WHSpr        7   JAN-1 NUMBER  0.5666E-03  0.1096E-03  0.1934E+00
   7        WHSpr        8   JAN-1 NUMBER  0.5118E-03  0.1396E-03  0.2728E+00
   8        WHAut        2   JAN-1 NUMBER  0.5338E-04  0.6870E-05  0.1287E+00
   9        WHAut        3   JAN-1 NUMBER  0.1136E-03  0.1287E-04  0.1133E+00
  10        WHAut        4   JAN-1 NUMBER  0.2238E-03  0.2260E-04  0.1010E+00
  11        WHAut        5   JAN-1 NUMBER  0.3703E-03  0.4638E-04  0.1253E+00
  12        WHAut        6   JAN-1 NUMBER  0.4782E-03  0.5653E-04  0.1182E+00
  13        WHAut        7   JAN-1 NUMBER  0.4512E-03  0.8364E-04  0.1854E+00
  14        WHAut        8   JAN-1 NUMBER  0.5668E-03  0.1292E-03  0.2279E+00
  15        MASpr        2   JAN-1 NUMBER  0.7106E-03  0.1074E-03  0.1512E+00
  16        MASpr        3   JAN-1 NUMBER  0.5446E-03  0.4749E-04  0.8720E-01
  17        MASpr        4   JAN-1 NUMBER  0.4537E-03  0.5623E-04  0.1239E+00
  19        MAAut        2   JAN-1 NUMBER  0.1230E-03  0.3679E-04  0.2992E+00
  21        CM_CPE       2   MEAN  NUMBER  0.2458E-05  0.6900E-06  0.2807E+00
  22        CM_CPE       3   MEAN  NUMBER  0.1406E-04  0.1646E-05  0.1171E+00
  23        CM_CPE       4   MEAN  NUMBER  0.2317E-04  0.1281E-05  0.5530E-01
  24        CM_CPE       5   MEAN  NUMBER  0.2291E-04  0.1239E-05  0.5410E-01
  25        CM_CPE       6   MEAN  NUMBER  0.2187E-04  0.2466E-05  0.1128E+00
```

```
Survey Index:    1 Tag:         WHSpr    AGE =  2
Time = JAN-1           Type = NUMBER
Catchability =    0.639060E-04   % Variance Contribution =     6.0022
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual


1982     0.100650E+01     0.710799E+00     0.347845E+00
1983     0.948600E+00     0.406955E+00     0.846285E+00
1984     0.131200E+01     0.414194E+00     0.115297E+01
1985     0.230800E+00     0.557076E+00    -0.881151E+00
1986     0.247800E+00     0.346899E+00    -0.336413E+00
1987     0.460200E+00     0.536073E+00    -0.152610E+00
1988     0.923400E+00     0.661229E+00     0.333963E+00
1989     0.604800E+00     0.128761E+01    -0.755643E+00
1990     0.207600E+00     0.222378E+00    -0.687655E-01
1991     0.678000E-01     0.216374E+00    -0.116045E+01
1992     0.225500E+00     0.364946E+00    -0.481430E+00
1993     0.496500E+00     0.331710E+00     0.403323E+00
1994     0.315600E+00     0.477323E+00    -0.413717E+00
1995     0.179200E+00     0.166337E+00     0.744872E-01
1996     0.215000E-01     0.198014E+00    -0.222029E+01
1997     0.131600E+00     0.185482E+00    -0.343192E+00
1998     0.223600E+00     0.274436E+00    -0.204860E+00
1999     0.344300E+00     0.233272E+00     0.389310E+00
2000     0.724700E+00     0.410507E+00     0.568365E+00
2001     0.323400E+00     0.210131E+00     0.431157E+00
2002     0.453000E-01     0.621130E-01    -0.315648E+00
2003     0.830500E+00     0.259133E+00     0.116469E+01
2004     0.446000E-01     0.879742E-01    -0.679310E+00
2005     0.726500E+00     0.573787E+00     0.235981E+00
2006     0.230000E+00     0.351219E+00    -0.423332E+00
2007     0.345000E+01     0.125103E+01     0.101441E+01
2008     0.109860E+01     0.251582E+00     0.147402E+01

Survey Index:    2 Tag:         WHSpr    AGE =  3
Time = JAN-1           Type = NUMBER
Catchability =    0.131940E-03   % Variance Contribution =     2.8875
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual


1982     0.476400E+00     0.728272E+00    -0.424417E+00
1983     0.996800E+00     0.965009E+00     0.324129E-01
1984     0.102260E+01     0.529782E+00     0.657637E+00
1985     0.661700E+00     0.604445E+00     0.905019E-01
1986     0.754000E+00     0.814568E+00    -0.772658E-01
1987     0.199100E+00     0.564175E+00    -0.104156E+01
1988     0.822900E+00     0.799946E+00     0.282904E-01
1989     0.723000E+00     0.105215E+01    -0.375184E+00
1990     0.136540E+01     0.211448E+01    -0.437363E+00
```

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1991     0.233900E+00     0.345620E+00    -0.390447E+00
1992     0.242400E+00     0.313398E+00    -0.256884E+00
1993     0.799300E+00     0.576498E+00     0.326764E+00
1994     0.387500E+00     0.545448E+00    -0.341891E+00
1995     0.111610E+01     0.800395E+00     0.332491E+00
1996     0.592700E+00     0.248098E+00     0.870866E+00
1997     0.399100E+00     0.323968E+00     0.208567E+00
1998     0.330100E+00     0.303334E+00     0.845609E-01
1999     0.713300E+00     0.451059E+00     0.458304E+00
2000     0.438500E+00     0.391672E+00     0.112936E+00
2001     0.716100E+00     0.669891E+00     0.667046E-01
2002     0.524400E+00     0.337622E+00     0.440328E+00
2003     0.630000E-01     0.104634E+00    -0.507337E+00
2004     0.221300E+00     0.436067E+00    -0.678277E+00
2005     0.101400E+00     0.148600E+00    -0.382182E+00
2006     0.430000E+00     0.969003E+00    -0.812483E+00
2007     0.293000E+01     0.593492E+00     0.159673E+01
2008     0.321120E+01     0.211373E+01     0.418189E+00

Survey Index:    3 Tag:         WHSpr    AGE =  4
Time = JAN-1           Type = NUMBER
Catchability =    0.225008E-03   % Variance Contribution =     2.5836
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual


1982     0.655400E+00     0.703819E+00    -0.712760E-01
1983     0.464700E+00     0.524085E+00    -0.120261E+00
1984     0.823300E+00     0.753380E+00     0.887512E-01
1985     0.662500E+00     0.417720E+00     0.461208E+00
1986     0.236900E+00     0.398528E+00    -0.520139E+00
1987     0.230700E+00     0.576066E+00    -0.915104E+00
1988     0.217900E+00     0.518778E+00    -0.867439E+00
1989     0.600100E+00     0.683671E+00    -0.130380E+00
1990     0.637000E+00     0.100474E+01    -0.455718E+00
1991     0.171670E+01     0.211239E+01    -0.207415E+00
1992     0.281900E+00     0.209529E+00     0.296690E+00
1993     0.334300E+00     0.318050E+00     0.498311E-01
1994     0.215000E+00     0.391268E+00    -0.598755E+00
1995     0.371700E+00     0.458588E+00    -0.210066E+00
1996     0.133070E+01     0.879362E+00     0.414264E+00
1997     0.264300E+00     0.217998E+00     0.192599E+00
1998     0.516600E+00     0.351519E+00     0.385006E+00
1999     0.344500E+00     0.325315E+00     0.573012E-01
2000     0.457000E+00     0.498022E+00    -0.859616E-01
2001     0.497200E+00     0.438150E+00     0.126431E+00
2002     0.160120E+01     0.694378E+00     0.835492E+00
2003     0.707700E+00     0.418570E+00     0.525175E+00
2004     0.118100E+00     0.121949E+00    -0.320709E-01
2005     0.607600E+00     0.536011E+00     0.125362E+00
2006     0.600000E-01     0.180179E+00    -0.109961E+01
2007     0.448000E+01     0.131685E+01     0.122438E+01
2008     0.135660E+01     0.797144E+00     0.531701E+00

Survey Index:    4 Tag:         WHSpr    AGE =  5
```

```
Time = JAN-1           Type = NUMBER
Catchability =    0.293998E-03   % Variance Contribution =     4.3467
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual


1982     0.987700E+00     0.519630E+00     0.642261E+00
1983     0.404200E+00     0.374612E+00     0.760188E-01
1984     0.211800E+00     0.244348E+00    -0.142951E+00
1985     0.661700E+00     0.370595E+00     0.579702E+00
1986     0.912000E-01     0.144370E+00    -0.459325E+00
1987     0.744000E-01     0.179037E+00    -0.878139E+00
1988     0.253500E+00     0.215680E+00     0.161567E+00
1989     0.908000E-01     0.257798E+00    -0.104352E+01
1990     0.102000E+00     0.274954E+00    -0.991631E+00
1991     0.299300E+00     0.421518E+00    -0.342417E+00
1992     0.132810E+01     0.953406E+00     0.331464E+00
1993     0.906000E-01     0.826501E-01     0.918379E-01
1994     0.942000E-01     0.131944E+00    -0.336956E+00
1995     0.145400E+00     0.949236E-01     0.426416E+00
1996     0.403200E+00     0.173484E+00     0.843345E+00
1997     0.875600E+00     0.425507E+00     0.721628E+00
1998     0.141500E+00     0.112034E+00     0.233500E+00
1999     0.315000E+00     0.217813E+00     0.368937E+00
2000     0.107100E+00     0.196910E+00    -0.608983E+00
2001     0.353900E+00     0.312421E+00     0.124663E+00
2002     0.614200E+00     0.286360E+00     0.763072E+00
2003     0.108890E+01     0.507578E+00     0.763274E+00
2004     0.190800E+00     0.329950E+00    -0.547717E+00
2005     0.154000E-01     0.639780E-01    -0.142417E+01
2006     0.200000E+00     0.356917E+00    -0.579186E+00
2007     0.500000E+00     0.117918E+00     0.144462E+01
2008     0.939300E+00     0.116730E+01    -0.217316E+00

Survey Index:    5 Tag:         WHSpr    AGE =  6
Time = JAN-1           Type = NUMBER
Catchability =    0.382779E-03   % Variance Contribution =     6.5351
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual


1982     0.873000E-01     0.866418E-01     0.756783E-02
1983     0.211800E+00     0.295150E+00    -0.331842E+00
1984     0.467000E-01     0.161312E+00    -0.123959E+01
1985     0.103100E+00     0.976474E-01     0.543368E-01
1986     0.349000E-01     0.163853E+00    -0.154648E+01
1987     N/A              0.579545E-01     N/A
1988     0.915000E-01     0.708719E-01     0.255464E+00
1989     0.627000E-01     0.813926E-01    -0.260923E+00
1990     0.321000E-01     0.105784E+00    -0.119255E+01
1991     0.200000E-01     0.111846E+00    -0.172139E+01
1992     0.226400E+00     0.127010E+00     0.578037E+00
1993     0.484200E+00     0.258344E+00     0.628205E+00
```

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1994     0.493000E-01     0.398210E-01     0.213530E+00
1995     0.283000E-01     0.260400E-01     0.832277E-01
1996     0.593000E-01     0.206587E-01     0.105447E+01
1997     0.242400E+00     0.518259E-01     0.154270E+01
1998     0.421000E+00     0.158347E+00     0.977847E+00
1999     0.133700E+00     0.644584E-01     0.729578E+00
2000     0.100600E+00     0.137766E+00    -0.314404E+00
2001     0.635000E-01     0.143989E+00    -0.818698E+00
2002     0.361900E+00     0.202110E+00     0.582556E+00
2003     0.394600E+00     0.185413E+00     0.755288E+00
2004     0.231600E+00     0.275722E+00    -0.174380E+00
2005     0.149800E+00     0.209851E+00    -0.337097E+00
2006     0.200000E-01     0.352258E-01    -0.566047E+00
2007     0.840000E+00     0.224846E+00     0.131798E+01
2008     0.584000E-01     0.770687E-01    -0.277382E+00

Survey Index:    6 Tag:         WHSpr    AGE =  7
Time = JAN-1           Type = NUMBER
Catchability =    0.566609E-03   % Variance Contribution =     8.0244
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual


1982     0.112000E+00     0.147101E+00    -0.272622E+00
1983     0.680000E-01     0.654754E-01     0.378336E-01
1984     0.100000E+00     0.125658E+00    -0.228392E+00
1985     0.910000E-01     0.890640E-01     0.215047E-01
1986     0.380000E-01     0.500514E-01    -0.275465E+00
1987     0.660000E-01     0.960915E-01    -0.375647E+00
1988     0.650000E-01     0.233256E-01     0.102484E+01
1989     0.140000E-01     0.606162E-01    -0.146550E+01
1990     0.180000E-01     0.510645E-01    -0.104272E+01
1991     0.180000E-01     0.376623E-01    -0.738287E+00
1992     0.690000E-01     0.541349E-01     0.242628E+00
1993     0.550000E-01     0.415969E-01     0.279308E+00
1994     0.127000E+00     0.701825E-01     0.593088E+00
1995     N/A              0.118593E-01     N/A
1996     N/A              0.168957E-01     N/A
1997     0.120000E+00     0.611869E-02     0.297614E+01
1998     0.230000E-01     0.262033E-01    -0.130392E+00
1999     0.273000E+00     0.937761E-01     0.106856E+01
2000     0.240000E-01     0.483830E-01    -0.701095E+00
2001     0.980000E-01     0.116258E+00    -0.170841E+00
2002     0.164000E+00     0.118570E+00     0.324362E+00
2003     0.321000E+00     0.140611E+00     0.825446E+00
2004     0.140000E-01     0.106071E+00    -0.202505E+01
2005     0.129700E+00     0.197780E+00    -0.421929E+00
2006     0.131400E+00     0.118308E+00     0.104954E+00
2007     0.652000E-01     0.260288E-01     0.918257E+00
2008     0.806000E-01     0.142377E+00    -0.568982E+00

Survey Index:    7 Tag:         WHSpr    AGE =  8
Time = JAN-1           Type = NUMBER
Catchability =    0.511812E-03   % Variance Contribution =     5.5891
Residual = LN(Observed) - LN(Predicted)
```

```
Year      Observed        Predicted         Residual

-----------------------------------------------------------------------------

1982     N/A              0.716573E-01     N/A
1983     0.160000E-01     0.635433E-01    -0.137913E+01
1984     N/A              0.252670E-01     N/A
1985     0.520000E-01     0.566227E-01    -0.851666E-01
1986     N/A              0.295134E-01     N/A
1987     0.800000E-02     0.158516E-01    -0.683828E+00
1988     N/A              0.323025E-01     N/A
1989     N/A              0.120637E-01     N/A
1990     N/A              0.257487E-01     N/A
1991     N/A              0.252609E-01     N/A
1992     N/A              0.617975E-02     N/A
1993     0.230000E-01     0.979461E-02     0.853662E+00
1994     0.270000E-01     0.172403E-01     0.448589E+00
1995     0.110000E-01     0.122153E-01    -0.104793E+00
1996     N/A              0.233333E-02     N/A
1997     N/A              0.104113E-01     N/A
1998     0.370000E-01     0.220955E-02     0.281813E+01
1999     N/A              0.724529E-02     N/A
2000     0.220000E-01     0.326741E-01    -0.395540E+00
2001     0.550000E-01     0.283257E-01     0.663565E+00
2002     0.570000E-01     0.582846E-01    -0.222870E-01
2003     0.103000E+00     0.501770E-01     0.719173E+00
2004     0.140000E-01     0.561498E-01    -0.138897E+01
2005     0.142000E-01     0.438969E-01    -0.112860E+01
2006     0.729000E-01     0.902784E-01    -0.213810E+00
2007     0.384000E-01     0.424809E-01    -0.100996E+00
2008     N/A              0.153132E-01     N/A

Survey Index:    8 Tag:         WHAut    AGE =  2
Time = JAN-1           Type = NUMBER
Catchability =    0.533836E-04   % Variance Contribution =     4.1570
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual

-----------------------------------------------------------------------------

1982     0.617900E+00     0.593763E+00     0.398469E-01
1983     0.842600E+00     0.339948E+00     0.907700E+00
1984     0.316800E+00     0.345995E+00    -0.881533E-01
1985     0.432300E+00     0.465351E+00    -0.736728E-01
1986     0.525600E+00     0.289781E+00     0.595416E+00
1987     0.392000E+00     0.447806E+00    -0.133099E+00
1988     0.578200E+00     0.552354E+00     0.457300E-01
1989     0.193750E+01     0.107560E+01     0.588523E+00
1990     0.149500E+00     0.185762E+00    -0.217172E+00
1991     0.447000E-01     0.180747E+00    -0.139713E+01
1992     0.143500E+00     0.304856E+00    -0.753505E+00
1993     0.291000E+00     0.277092E+00     0.489726E-01
1994     0.197700E+00     0.398729E+00    -0.701532E+00
1995     0.207100E+00     0.138949E+00     0.399096E+00
1996     0.680000E-01     0.165410E+00    -0.888921E+00
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1997     0.124200E+00     0.154942E+00    -0.221156E+00
1998     0.296800E+00     0.229249E+00     0.258249E+00
1999     0.966000E-01     0.194862E+00    -0.701715E+00
2000     0.430700E+00     0.342915E+00     0.227929E+00
2001     0.532600E+00     0.175532E+00     0.110995E+01
2002     0.340000E-01     0.518858E-01    -0.422685E+00
2003     0.269100E+00     0.216466E+00     0.217651E+00
2004     0.454600E+00     0.734888E-01     0.182228E+01
2005     0.570000E+00     0.479310E+00     0.173289E+00
2006     0.153300E+00     0.293389E+00    -0.649104E+00
2007     0.125140E+01     0.104504E+01     0.180205E+00
2008     0.145600E+00     0.210158E+00    -0.366997E+00

Survey Index:    9 Tag:         WHAut    AGE =  3
Time = JAN-1           Type = NUMBER
Catchability =    0.113582E-03   % Variance Contribution =     3.2202
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual


1982     0.418800E+00     0.626938E+00    -0.403454E+00
1983     0.335270E+01     0.830735E+00     0.139521E+01
1984     0.915500E+00     0.456067E+00     0.696831E+00
1985     0.425800E+00     0.520341E+00    -0.200514E+00
1986     0.956700E+00     0.701227E+00     0.310658E+00
1987     0.401000E+00     0.485674E+00    -0.191576E+00
1988     0.137960E+01     0.688639E+00     0.694831E+00
1989     0.231340E+01     0.905753E+00     0.937707E+00
1990     0.240650E+01     0.182027E+01     0.279189E+00
1991     0.186800E+00     0.297530E+00    -0.465475E+00
1992     0.139000E+00     0.269791E+00    -0.663173E+00
1993     0.445800E+00     0.496283E+00    -0.107275E+00
1994     0.567800E+00     0.469552E+00     0.189989E+00
1995     0.883100E+00     0.689026E+00     0.248160E+00
1996     0.284500E+00     0.213577E+00     0.286737E+00
1997     0.382600E+00     0.278890E+00     0.316172E+00
1998     0.855000E-01     0.261127E+00    -0.111649E+01
1999     0.320300E+00     0.388297E+00    -0.192513E+00
2000     0.367200E+00     0.337173E+00     0.853095E-01
2001     0.983700E+00     0.576681E+00     0.534032E+00
2002     0.141000E+00     0.290644E+00    -0.723340E+00
2003     0.805000E-01     0.900753E-01    -0.112388E+00
2004     0.197600E+00     0.375392E+00    -0.641725E+00
2005     0.170000E+00     0.127923E+00     0.284370E+00
2006     0.380600E+00     0.834173E+00    -0.784692E+00
2007     0.580200E+00     0.510912E+00     0.127176E+00
2008     0.831000E+00     0.181962E+01    -0.783754E+00

Survey Index:   10 Tag:         WHAut    AGE =  4
Time = JAN-1           Type = NUMBER
Catchability =    0.223833E-03   % Variance Contribution =     2.5584
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
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```
 1982     0.539400E+00     0.700144E+00    -0.260829E+00
 1983     0.227480E+01     0.521348E+00     0.147323E+01
 1984     0.827700E+00     0.749446E+00     0.993165E-01
 1985     0.630700E+00     0.415539E+00     0.417253E+00
 1986     0.609400E+00     0.396447E+00     0.429933E+00
 1987     0.656500E+00     0.573058E+00     0.135936E+00
 1988     0.592100E+00     0.516069E+00     0.137435E+00
 1989     0.989600E+00     0.680101E+00     0.375060E+00
 1990     0.150170E+01     0.999498E+00     0.407100E+00
 1991     0.182930E+01     0.210136E+01    -0.138650E+00
 1992     0.223300E+00     0.208435E+00     0.688890E-01
 1993     0.140000E+00     0.316389E+00    -0.815330E+00
 1994     0.360200E+00     0.389225E+00    -0.774982E-01
 1995     0.826000E+00     0.456194E+00     0.593677E+00
 1996     0.122840E+01     0.874770E+00     0.339506E+00
 1997     0.188300E+00     0.216860E+00    -0.141214E+00
 1998     0.176900E+00     0.349683E+00    -0.681443E+00
 1999     0.114700E+00     0.323616E+00    -0.103724E+01
 2000     0.585700E+00     0.495422E+00     0.167398E+00
 2001     0.393600E+00     0.435862E+00    -0.101991E+00
 2002     0.752400E+00     0.690752E+00     0.854870E-01
 2003     0.363700E+00     0.416385E+00    -0.135280E+00
 2004     0.184800E+00     0.121312E+00     0.420907E+00
 2005     0.540000E+00     0.533212E+00     0.126500E-01
 2006     0.796000E-01     0.179239E+00    -0.811704E+00
 2007     0.103310E+01     0.130997E+01    -0.237443E+00
 2008     0.384000E+00     0.792982E+00    -0.725158E+00

 Survey Index:   11 Tag:         WHAut    AGE =  5
 Time = JAN-1           Type = NUMBER
 Catchability =    0.370258E-03   % Variance Contribution =     3.9388
 Residual = LN(Observed) - LN(Predicted)

 Year      Observed        Predicted         Residual

 1982     0.404700E+00     0.654418E+00    -0.480600E+00
 1983     0.108920E+01     0.471783E+00     0.836679E+00
 1984     0.197000E+00     0.307730E+00    -0.446019E+00
 1985     0.387100E+00     0.466724E+00    -0.187056E+00
 1986     0.248200E+00     0.181818E+00     0.311227E+00
 1987     0.341700E+00     0.225478E+00     0.415710E+00
 1988     0.242900E+00     0.271626E+00    -0.111776E+00
 1989     0.443400E+00     0.324668E+00     0.311669E+00
 1990     0.292600E+00     0.346275E+00    -0.168426E+00
 1991     0.597800E+00     0.530856E+00     0.118765E+00
 1992     0.633400E+00     0.120071E+01    -0.639567E+00
 1993     0.355000E-01     0.104089E+00    -0.107571E+01
 1994     0.336000E-01     0.166169E+00    -0.159848E+01
 1995     0.854000E-01     0.119546E+00    -0.336355E+00
 1996     0.325200E+00     0.218485E+00     0.397724E+00
 1997     0.542100E+00     0.535880E+00     0.115407E-01
 1998     0.172800E+00     0.141094E+00     0.202706E+00
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1999     0.192300E+00     0.274311E+00    -0.355207E+00
2000     0.243300E+00     0.247987E+00    -0.190795E-01
2001     0.507100E+00     0.393460E+00     0.253728E+00
2002     0.469000E+00     0.360639E+00     0.262726E+00
2003     0.279720E+01     0.639239E+00     0.147610E+01
2004     0.528700E+00     0.415537E+00     0.240850E+00
2005     0.240000E+00     0.805733E-01     0.109147E+01
2006     0.449500E+00     0.449498E+00     0.419220E-05
2007     0.247500E+00     0.148504E+00     0.510796E+00
2008     0.528300E+00     0.147009E+01    -0.102342E+01

Survey Index:   12 Tag:         WHAut    AGE =  6
Time = JAN-1           Type = NUMBER
Catchability =    0.478237E-03   % Variance Contribution =     3.2474
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
```

```
1982     0.120500E+00     0.108249E+00     0.107218E+00
1983     0.209200E+00     0.368755E+00    -0.566843E+00
1984     0.227000E+00     0.201540E+00     0.118962E+00
1985     0.214000E+00     0.121999E+00     0.561964E+00
1986     0.182000E+00     0.204715E+00    -0.117612E+00
1987     0.727000E-01     0.724073E-01     0.403470E-02
1988     0.751000E-01     0.885462E-01    -0.164703E+00
1989     0.990000E-01     0.101691E+00    -0.268141E-01
1990     0.160500E+00     0.132165E+00     0.194241E+00
1991     0.258900E+00     0.139739E+00     0.616666E+00
1992     0.811000E-01     0.158684E+00    -0.671232E+00
1993     0.349800E+00     0.322771E+00     0.804195E-01
1994     N/A              0.497516E-01     N/A
1995     0.511000E-01     0.325339E-01     0.451501E+00
1996     0.821000E-01     0.258107E-01     0.115715E+01
1997     0.616000E-01     0.647504E-01    -0.498781E-01
1998     0.140200E+00     0.197835E+00    -0.344366E+00
1999     0.387000E-01     0.805332E-01    -0.732830E+00
2000     0.132000E+00     0.172122E+00    -0.265404E+00
2001     0.134300E+00     0.179897E+00    -0.292311E+00
2002     0.336800E+00     0.252513E+00     0.288028E+00
2003     0.109580E+01     0.231651E+00     0.155401E+01
2004     0.449800E+00     0.344482E+00     0.266762E+00
2005     0.250000E+00     0.262184E+00    -0.475867E-01
2006     0.221000E-01     0.440105E-01    -0.688851E+00
2007     0.285700E+00     0.280919E+00     0.168753E-01
2008     0.226000E-01     0.962883E-01    -0.144940E+01

Survey Index:   13 Tag:         WHAut    AGE =  7
Time = JAN-1           Type = NUMBER
Catchability =    0.451154E-03   % Variance Contribution =     5.1610
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
```

```
1982     0.760000E-01     0.117127E+00    -0.432526E+00
1983     N/A              0.521337E-01     N/A
1984     0.210000E+00     0.100053E+00     0.741407E+00
1985     0.163000E+00     0.709158E-01     0.832257E+00
1986     0.750000E-01     0.398527E-01     0.632299E+00
1987     0.410000E-01     0.765114E-01    -0.623868E+00
1988     N/A              0.185726E-01     N/A
1989     0.650000E-01     0.482647E-01     0.297687E+00
1990     0.330000E-01     0.406593E-01    -0.208720E+00
1991     0.520000E-01     0.299880E-01     0.550447E+00
1992     N/A              0.431041E-01     N/A
1993     0.104000E+00     0.331209E-01     0.114423E+01
1994     0.300000E-01     0.558817E-01    -0.622040E+00
1995     N/A              0.944275E-02     N/A
1996     0.110000E-01     0.134530E-01    -0.201304E+00
1997     N/A              0.487191E-02     N/A
1998     N/A              0.208640E-01     N/A
1999     0.310000E-01     0.746677E-01    -0.879061E+00
2000     0.160000E-01     0.385242E-01    -0.878698E+00
2001     0.100000E-01     0.925683E-01    -0.222536E+01
2002     0.122000E+00     0.944096E-01     0.256378E+00
2003     0.627000E+00     0.111959E+00     0.172281E+01
2004     0.730000E-01     0.844571E-01    -0.145784E+00
2005     0.168000E+00     0.157479E+00     0.646722E-01
2006     0.923000E-01     0.942010E-01    -0.203867E-01
2007     0.339000E-01     0.207250E-01     0.492075E+00
2008     0.690000E-01     0.113366E+00    -0.496513E+00

Survey Index:   14 Tag:         WHAut    AGE =  8
Time = JAN-1           Type = NUMBER
Catchability =    0.566767E-03   % Variance Contribution =     3.3797
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual


1982     0.290000E-01     0.793514E-01    -0.100659E+01
1983     N/A              0.703661E-01     N/A
1984     N/A              0.279800E-01     N/A
1985     0.790000E-01     0.627025E-01     0.231047E+00
1986     N/A              0.326824E-01     N/A
1987     N/A              0.175536E-01     N/A
1988     N/A              0.357710E-01     N/A
1989     0.330000E-01     0.133590E-01     0.904319E+00
1990     N/A              0.285135E-01     N/A
1991     0.100000E-01     0.279732E-01    -0.102866E+01
1992     0.230000E-01     0.684329E-02     0.121223E+01
1993     0.800000E-02     0.108463E-01    -0.304381E+00
1994     N/A              0.190914E-01     N/A
1995     0.450000E-01     0.135269E-01     0.120198E+01
1996     N/A              0.258387E-02     N/A
1997     N/A              0.115292E-01     N/A
1998     N/A              0.244679E-02     N/A
1999     N/A              0.802324E-02     N/A
2000     0.600000E-02     0.361824E-01    -0.179681E+01
2001     N/A              0.313671E-01     N/A
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2002     0.840000E-01     0.645428E-01     0.263488E+00
2003     0.510000E-01     0.555646E-01    -0.857210E-01
2004     0.770000E-01     0.621788E-01     0.213791E+00
2005     0.680000E-01     0.486102E-01     0.335674E+00
2006     0.824000E-01     0.999719E-01    -0.193304E+00
2007     0.496000E-01     0.470422E-01     0.529461E-01
2008     N/A              0.169574E-01     N/A

Survey Index:   15 Tag:         MASpr    AGE =  2
Time = JAN-1           Type = NUMBER
Catchability =    0.710558E-03   % Variance Contribution =     5.3115
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual

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1982     0.717000E+01     0.790323E+01    -0.973656E-01
1983     0.146100E+02     0.452485E+01     0.117212E+01
1984     0.515000E+01     0.460534E+01     0.111781E+00
1985     0.277000E+01     0.619402E+01    -0.804737E+00
1986     0.116800E+02     0.385710E+01     0.110796E+01
1987     0.471000E+01     0.596049E+01    -0.235465E+00
1988     0.635000E+01     0.735207E+01    -0.146526E+00
1989     0.205100E+02     0.143166E+02     0.359490E+00
1990     0.545000E+01     0.247258E+01     0.790355E+00
1991     0.269000E+01     0.240582E+01     0.111650E+00
1992     0.513000E+01     0.405776E+01     0.234474E+00
1993     0.611000E+01     0.368821E+01     0.504785E+00
1994     0.407000E+01     0.530725E+01    -0.265432E+00
1995     0.192000E+01     0.184947E+01     0.374282E-01
1996     0.520000E+00     0.220168E+01    -0.144315E+01
1997     0.980000E+00     0.206234E+01    -0.744044E+00
1998     0.830000E+00     0.305140E+01    -0.130193E+01
1999     0.239000E+01     0.259370E+01    -0.817915E-01
2000     0.702000E+01     0.456434E+01     0.430489E+00
2001     0.450000E+01     0.233641E+01     0.655462E+00
2002     0.260000E+00     0.690622E+00    -0.976910E+00
2003     0.127000E+02     0.288125E+01     0.148338E+01
2004     0.156000E+01     0.978167E+00     0.466761E+00
2005     0.715000E+01     0.637981E+01     0.113973E+00
2006     0.367000E+01     0.390514E+01    -0.621009E-01
2007     0.336000E+01     0.139099E+02    -0.142066E+01
2008     N/A              0.279729E+01     N/A

Survey Index:   16 Tag:         MASpr    AGE =  3
Time = JAN-1           Type = NUMBER
Catchability =    0.544643E-03   % Variance Contribution =     1.7670
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual

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1982     0.241000E+01     0.300628E+01    -0.221075E+00
1983     0.286000E+01     0.398352E+01    -0.331343E+00
1984     0.207000E+01     0.218692E+01    -0.549455E-01
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1985     0.227000E+01     0.249512E+01    -0.945583E-01
1986     0.123000E+01     0.336250E+01    -0.100567E+01
1987     0.296000E+01     0.232889E+01     0.239797E+00
1988     0.245000E+01     0.330214E+01    -0.298484E+00
1989     0.876000E+01     0.434324E+01     0.701575E+00
1990     0.147500E+02     0.872850E+01     0.524649E+00
1991     0.157000E+01     0.142671E+01     0.957073E-01
1992     0.367000E+01     0.129369E+01     0.104269E+01
1993     0.255000E+01     0.237976E+01     0.690935E-01
1994     0.175000E+01     0.225159E+01    -0.252019E+00
1995     0.276000E+01     0.330400E+01    -0.179902E+00
1996     0.108000E+01     0.102414E+01     0.531105E-01
1997     0.930000E+00     0.133733E+01    -0.363243E+00
1998     0.700000E+00     0.125215E+01    -0.581537E+00
1999     0.231000E+01     0.186195E+01     0.215622E+00
2000     0.289000E+01     0.161680E+01     0.580805E+00
2001     0.497000E+01     0.276528E+01     0.586277E+00
2002     0.123000E+01     0.139369E+01    -0.124940E+00
2003     0.280000E+00     0.431926E+00    -0.433466E+00
2004     0.258000E+01     0.180007E+01     0.359965E+00
2005     0.570000E+00     0.613413E+00    -0.734015E-01
2006     0.338000E+01     0.400001E+01    -0.168420E+00
2007     0.184000E+01     0.244991E+01    -0.286285E+00
2008     N/A              0.872540E+01     N/A

Survey Index:   17 Tag:         MASpr    AGE =  4
Time = JAN-1           Type = NUMBER
Catchability =    0.453706E-03   % Variance Contribution =     3.5692
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
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```
1982     0.870000E+00     0.141918E+01    -0.489343E+00
1983     0.150000E+01     0.105676E+01     0.350253E+00
1984     0.700000E+00     0.151912E+01    -0.774803E+00
1985     0.450000E+00     0.842292E+00    -0.626879E+00
1986     0.680000E+00     0.803591E+00    -0.166998E+00
1987     0.220000E+00     0.116158E+01    -0.166391E+01
1988     0.145000E+01     0.104606E+01     0.326529E+00
1989     0.106000E+01     0.137855E+01    -0.262766E+00
1990     0.231000E+01     0.202597E+01     0.131201E+00
1991     0.366000E+01     0.425942E+01    -0.151669E+00
1992     0.750000E+00     0.422495E+00     0.573897E+00
1993     0.900000E+00     0.641316E+00     0.338873E+00
1994     0.490000E+00     0.788953E+00    -0.476302E+00
1995     0.780000E+00     0.924698E+00    -0.170173E+00
1996     0.149000E+01     0.177315E+01    -0.173979E+00
1997     0.170000E+00     0.439571E+00    -0.950001E+00
1998     0.750000E+00     0.708803E+00     0.564961E-01
1999     0.780000E+00     0.655965E+00     0.173187E+00
2000     0.220000E+01     0.100421E+01     0.784254E+00
2001     0.352000E+01     0.883486E+00     0.138234E+01
2002     0.141000E+01     0.140014E+01     0.701462E-02
2003     0.143000E+01     0.844005E+00     0.527271E+00
2004     0.460000E+00     0.245898E+00     0.626310E+00
```

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2005     0.207000E+01     0.108081E+01     0.649835E+00
2006     0.540000E+00     0.363314E+00     0.396302E+00
2007     0.175000E+01     0.265530E+01    -0.416941E+00
2008     N/A              0.160736E+01     N/A

Survey Index:   19 Tag:         MAAut    AGE =  2
Time = JAN-1           Type = NUMBER
Catchability =    0.122958E-03   % Variance Contribution =    22.4734
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual


1982     0.620000E+01     0.136761E+01     0.151149E+01
1983     0.114000E+01     0.782999E+00     0.375653E+00
1984     0.280000E+00     0.796927E+00    -0.104597E+01
1985     0.160000E+00     0.107184E+01    -0.190196E+01
1986     0.190000E+00     0.667449E+00    -0.125644E+01
1987     0.550000E+00     0.103143E+01    -0.628782E+00
1988     0.140000E+01     0.127223E+01     0.956991E-01
1989     0.310000E+01     0.247741E+01     0.224188E+00
1990     0.200000E-01     0.427865E+00    -0.306308E+01
1991     0.422000E+01     0.416314E+00     0.231615E+01
1992     0.200000E+01     0.702172E+00     0.104672E+01
1993     0.990000E+00     0.638224E+00     0.439016E+00
1994     0.153000E+01     0.918390E+00     0.510401E+00
1995     0.536000E+01     0.320039E+00     0.281828E+01
1996     0.800000E+00     0.380988E+00     0.741845E+00
1997     0.800000E-01     0.356876E+00    -0.149536E+01
1998     0.300000E-01     0.528027E+00    -0.286795E+01
1999     0.640000E+00     0.448825E+00     0.354836E+00
2000     0.590000E+00     0.789833E+00    -0.291699E+00
2001     0.400000E+00     0.404302E+00    -0.106976E-01
2002     0.100000E-01     0.119508E+00    -0.248080E+01
2003     0.109000E+01     0.498583E+00     0.782162E+00
2004     0.160000E+01     0.169266E+00     0.224629E+01
2005     0.994000E+01     0.110399E+01     0.219764E+01
2006     0.610000E+00     0.675761E+00    -0.102381E+00
2007     0.435000E+01     0.240704E+01     0.591780E+00
2008     0.160000E+00     0.484055E+00    -0.110702E+01

Survey Index:   21 Tag:         CM_CPE   AGE =  2
Time = MEAN            Type = NUMBER
Catchability =    0.245830E-05   % Variance Contribution =     3.7184
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual


1982     0.743000E-01     0.223352E-01     0.120195E+01
1983     0.477000E-01     0.125412E-01     0.133591E+01
1984     0.331000E-01     0.134627E-01     0.899610E+00
1985     0.137000E-01     0.181238E-01    -0.279829E+00
1986     0.410000E-02     0.118717E-01    -0.106317E+01
1987     0.740000E-02     0.176086E-01    -0.866906E+00
```

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1988     0.146000E-01     0.223933E-01    -0.427740E+00
1989     0.170000E-01     0.442708E-01    -0.957113E+00
1990     0.110000E-01     0.744697E-02     0.390088E+00
1991     0.194000E-01     0.700807E-02     0.101821E+01
1992     0.149000E-01     0.123165E-01     0.190425E+00
1993     0.270000E-02     0.114122E-01    -0.144143E+01
1994     N/A              0.165774E-01     N/A
1995     N/A              0.546252E-02     N/A
1996     N/A              0.679601E-02     N/A
1997     N/A              0.636459E-02     N/A
1998     N/A              0.943961E-02     N/A
1999     N/A              0.810664E-02     N/A
2000     N/A              0.140715E-01     N/A
2001     N/A              0.714947E-02     N/A
2002     N/A              0.216199E-02     N/A
2003     N/A              0.901510E-02     N/A
2004     N/A              0.306613E-02     N/A
2005     N/A              0.199960E-01     N/A
2006     N/A              0.122433E-01     N/A
2007     N/A              0.436076E-01     N/A
2008     N/A              0.000000E+00     N/A

Survey Index:   22 Tag:         CM_CPE   AGE =  3
Time = MEAN            Type = NUMBER
Catchability =    0.140563E-04   % Variance Contribution =     0.6469
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual


1982     0.738000E-01     0.519778E-01     0.350541E+00
1983     0.109900E+00     0.713423E-01     0.432082E+00
1984     0.448000E-01     0.393360E-01     0.130068E+00
1985     0.423000E-01     0.415634E-01     0.175677E-01
1986     0.688000E-01     0.577049E-01     0.175861E+00
1987     0.186000E-01     0.448396E-01    -0.879930E+00
1988     0.492000E-01     0.615373E-01    -0.223750E+00
1989     0.637000E-01     0.850584E-01    -0.289154E+00
1990     0.159500E+00     0.174475E+00    -0.897392E-01
1991     0.404000E-01     0.229452E-01     0.565723E+00
1992     0.173000E-01     0.260461E-01    -0.409160E+00
1993     0.500000E-01     0.401303E-01     0.219891E+00
1994     N/A              0.416566E-01     N/A
1995     N/A              0.689939E-01     N/A
1996     N/A              0.193218E-01     N/A
1997     N/A              0.277652E-01     N/A
1998     N/A              0.258572E-01     N/A
1999     N/A              0.389707E-01     N/A
2000     N/A              0.340461E-01     N/A
2001     N/A              0.562158E-01     N/A
2002     N/A              0.307978E-01     N/A
2003     N/A              0.927102E-02     N/A
2004     N/A              0.396172E-01     N/A
2005     N/A              0.134136E-01     N/A
2006     N/A              0.923518E-01     N/A
2007     N/A              0.562457E-01     N/A
```

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2008     N/A              0.000000E+00     N/A

Survey Index:   23 Tag:         CM_CPE   AGE =  4
Time = MEAN            Type = NUMBER
Catchability =    0.231650E-04   % Variance Contribution =     0.1443
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual

____________________________________________________________________________


1982     0.450000E-01     0.478168E-01    -0.607149E-01
1983     0.422000E-01     0.336756E-01     0.225646E+00
1984     0.442000E-01     0.495054E-01    -0.113356E+00
1985     0.289000E-01     0.237841E-01     0.194823E+00
1986     0.226000E-01     0.252171E-01    -0.109574E+00
1987     0.260000E-01     0.338541E-01    -0.263964E+00
1988     0.242000E-01     0.342353E-01    -0.346903E+00
1989     0.397000E-01     0.413480E-01    -0.406733E-01
1990     0.782000E-01     0.618167E-01     0.235096E+00
1991     0.135500E+00     0.133920E+00     0.117317E-01
1992     0.138000E-01     0.125736E-01     0.930706E-01
1993     0.232000E-01     0.194789E-01     0.174818E+00
1994     N/A              0.194817E-01     N/A
1995     N/A              0.270618E-01     N/A
1996     N/A              0.573865E-01     N/A
1997     N/A              0.145917E-01     N/A
1998     N/A              0.255037E-01     N/A
1999     N/A              0.233620E-01     N/A
2000     N/A              0.363291E-01     N/A
2001     N/A              0.325446E-01     N/A
2002     N/A              0.542248E-01     N/A
2003     N/A              0.338284E-01     N/A
2004     N/A              0.823436E-02     N/A
2005     N/A              0.401443E-01     N/A
2006     N/A              0.133912E-01     N/A
2007     N/A              0.112368E+00     N/A
2008     N/A              0.000000E+00     N/A

Survey Index:   24 Tag:         CM_CPE   AGE =  5
Time = MEAN            Type = NUMBER
Catchability =    0.229116E-04   % Variance Contribution =     0.1381
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual

____________________________________________________________________________


1982     0.217000E-01     0.275207E-01    -0.237626E+00
1983     0.209000E-01     0.176589E-01     0.168507E+00
1984     0.118000E-01     0.111738E-01     0.545269E-01
1985     0.179000E-01     0.176601E-01     0.134932E-01
1986     0.660000E-02     0.661394E-02    -0.211032E-02
1987     0.570000E-02     0.815593E-02    -0.358279E+00
1988     0.930000E-02     0.963858E-02    -0.357593E-01
1989     0.106000E-01     0.119158E-01    -0.117011E+00
1990     0.122000E-01     0.126640E-01    -0.373282E-01
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1991     0.217000E-01     0.172514E-01     0.229419E+00
1992     0.515000E-01     0.374843E-01     0.317659E+00
1993     0.410000E-02     0.408155E-02     0.450955E-02
1994     N/A              0.462407E-02     N/A
1995     N/A              0.344415E-02     N/A
1996     N/A              0.707689E-02     N/A
1997     N/A              0.189098E-01     N/A
1998     N/A              0.596659E-02     N/A
1999     N/A              0.120896E-01     N/A
2000     N/A              0.116604E-01     N/A
2001     N/A              0.175142E-01     N/A
2002     N/A              0.160594E-01     N/A
2003     N/A              0.263716E-01     N/A
2004     N/A              0.183585E-01     N/A
2005     N/A              0.334331E-02     N/A
2006     N/A              0.197757E-01     N/A
2007     N/A              0.664047E-02     N/A
2008     N/A              0.000000E+00     N/A

Survey Index:   25 Tag:         CM_CPE   AGE =  6
Time = MEAN            Type = NUMBER
Catchability =    0.218712E-04   % Variance Contribution =     0.6002
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual

_____________________________________________________________________________

1982     0.270000E-02     0.360420E-02    -0.288849E+00
1983     0.123000E-01     0.964092E-02     0.243583E+00
1984     0.550000E-02     0.586004E-02    -0.634079E-01
1985     0.360000E-02     0.343923E-02     0.456871E-01
1986     0.430000E-02     0.610563E-02    -0.350596E+00
1987     0.180000E-02     0.185134E-02    -0.281215E-01
1988     0.150000E-02     0.311688E-02    -0.731367E+00
1989     0.230000E-02     0.312149E-02    -0.305403E+00
1990     0.510000E-02     0.322153E-02     0.459384E+00
1991     0.390000E-02     0.384759E-02     0.135296E-01
1992     0.520000E-02     0.374652E-02     0.327830E+00
1993     0.140000E-01     0.710875E-02     0.677731E+00
1994     N/A              0.113347E-02     N/A
1995     N/A              0.101323E-02     N/A
1996     N/A              0.586834E-03     N/A
1997     N/A              0.181507E-02     N/A
1998     N/A              0.592501E-02     N/A
1999     N/A              0.267336E-02     N/A
2000     N/A              0.602197E-02     N/A
2001     N/A              0.622466E-02     N/A
2002     N/A              0.810640E-02     N/A
2003     N/A              0.683689E-02     N/A
2004     N/A              0.112083E-01     N/A
2005     N/A              0.769048E-02     N/A
2006     N/A              0.145083E-02     N/A
2007     N/A              0.865748E-02     N/A
2008     N/A              0.000000E+00     N/A
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                   Retrospective Summary

                   Average Fishing Mortality
                    Ages =  5 -  7


             1982        1983        1984        1985        1986


2000       0.5465      0.8677      0.7543      0.8478      0.8502
2001       0.5465      0.8677      0.7543      0.8478      0.8502
2002       0.5465      0.8677      0.7543      0.8478      0.8502
2003       0.5465      0.8677      0.7543      0.8478      0.8502
2004       0.5465      0.8677      0.7543      0.8478      0.8502
2005       0.5465      0.8677      0.7543      0.8478      0.8502
2006       0.5465      0.8677      0.7543      0.8478      0.8502
2007       0.5465      0.8677      0.7543      0.8478      0.8502

             1987        1988        1989        1990        1991


2000       0.9605      0.5815      0.7225      0.8636      1.2294
2001       0.9605      0.5815      0.7225      0.8636      1.2293
2002       0.9605      0.5815      0.7225      0.8635      1.2291
2003       0.9605      0.5815      0.7225      0.8635      1.2291
2004       0.9605      0.5815      0.7225      0.8635      1.2290
2005       0.9605      0.5815      0.7225      0.8635      1.2290
2006       0.9605      0.5815      0.7225      0.8635      1.2290
2007       0.9605      0.5815      0.7225      0.8635      1.2290

             1992        1993        1994        1995        1996


2000       1.3627      0.9571      1.5425      1.2239      0.9161
2001       1.3625      0.9573      1.5339      1.2157      0.9634
2002       1.3622      0.9561      1.5204      1.1878      0.9567
2003       1.3622      0.9560      1.5177      1.1824      0.9581
2004       1.3620      0.9562      1.5125      1.1795      0.9547
2005       1.3620      0.9562      1.5129      1.1805      0.9547
2006       1.3620      0.9562      1.5126      1.1798      0.9544
2007       1.3620      0.9562      1.5123      1.1792      0.9545

             1997        1998        1999        2000        2001


2000       0.8377      0.7034      0.9794      0.6104
2001       0.9143      0.8529      0.8262      0.4132      0.5330
2002       0.8658      0.7592      0.6060      0.3896      0.4672
2003       0.8847      0.7648      0.6037      0.3519      0.4961
2004       0.8827      0.7733      0.5875      0.3281      0.4329
2005       0.8822      0.7751      0.5902      0.3273      0.4269
2006       0.8812      0.7724      0.5870      0.3253      0.4212
2007       0.8811      0.7722      0.5846      0.3242      0.4249

             2002        2003        2004        2005        2006
```

```
  2000
  2001
  2002       0.4124
  2003       0.5813      0.6681
  2004       0.5697      0.7016      0.5905
  2005       0.5559      0.7256      0.6259      0.7789
  2006       0.5399      0.6962      0.5950      0.6406      0.5204
  2007       0.5373      0.6804      0.5405      0.6362      0.5811

               2007


  2000
  2001
  2002
  2003
  2004
  2005
  2006
  2007       0.4557


                   Spawning Stock Biomass


               1982        1983        1984        1985        1986


  2000       25587.      19494.      17223.      17211.      19406.
  2001       25587.      19494.      17223.      17211.      19406.
  2002       25587.      19494.      17223.      17211.      19406.
  2003       25587.      19494.      17223.      17211.      19406.
  2004       25587.      19494.      17223.      17211.      19406.
  2005       25587.      19494.      17223.      17211.      19406.
  2006       25587.      19494.      17223.      17211.      19406.
  2007       25587.      19494.      17223.      17211.      19406.

               1987        1988        1989        1990        1991


  2000       15926.      16545.      22151.      28655.      20339.
  2001       15926.      16545.      22151.      28655.      20340.
  2002       15926.      16545.      22151.      28657.      20341.
  2003       15926.      16546.      22151.      28657.      20342.
  2004       15926.      16546.      22151.      28657.      20342.
  2005       15926.      16546.      22151.      28657.      20342.
  2006       15926.      16546.      22151.      28657.      20342.
  2007       15926.      16546.      22151.      28657.      20342.

               1992        1993        1994        1995        1996


  2000       11980.      10322.      10777.      13478.      11705.
  2001       11981.      10317.      10715.      13398.      11662.
  2002       11986.      10329.      10755.      13618.      11931.
  2003       11986.      10329.      10746.      13549.      11943.
```

```
2004       11988.      10333.      10754.      13559.      11945.
2005       11988.      10333.      10754.      13560.      11938.
2006       11988.      10334.      10754.      13563.      11945.
2007       11988.      10334.      10755.      13566.      11949.

             1997        1998        1999        2000        2001


2000        9131.       9363.       9755.      14042.
2001        9324.      10068.      10821.      15431.      21475.
2002        9657.      10652.      11773.      16946.      24018.
2003        9717.      10561.      10951.      14173.      18544.
2004        9843.      10759.      11163.      14180.      17858.
2005        9838.      10781.      11189.      14139.      17624.
2006        9848.      10813.      11253.      14254.      17787.
2007        9856.      10814.      11246.      14285.      17848.

             2002        2003        2004        2005        2006


2000
2001
2002       28693.
2003       20609.      19609.
2004       18896.      17307.      15989.
2005       18427.      16431.      14089.      11691.
2006       18623.      16760.      14633.      12359.      23403.
2007       18673.      16539.      13693.      10974.      19139.

             2007


2000
2001
2002
2003
2004
2005
2006
2007       33877.


                   Total Population Numbers


             1982        1983        1984        1985        1986


2000       30180.      26336.      26143.      23683.      24887.
2001       30180.      26336.      26143.      23683.      24888.
2002       30180.      26336.      26143.      23683.      24888.
2003       30180.      26336.      26143.      23683.      24888.
2004       30180.      26336.      26143.      23683.      24888.
2005       30180.      26336.      26143.      23683.      24888.
2006       30180.      26336.      26143.      23683.      24888.
2007       30180.      26336.      26143.      23683.      24888.
```

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                          1987        1988        1989        1990        1991


             2000        28973.      44369.      36693.      29511.      24213.
             2001        28973.      44369.      36692.      29517.      24218.
             2002        28973.      44369.      36694.      29523.      24223.
             2003        28973.      44369.      36694.      29524.      24224.
             2004        28973.      44369.      36694.      29528.      24228.
             2005        28973.      44369.      36694.      29528.      24228.
             2006        28973.      44369.      36694.      29528.      24228.
             2007        28973.      44369.      36694.      29528.      24228.

                          1992        1993        1994        1995        1996


             2000        19138.      21034.      17098.      14371.      12093.
             2001        19048.      20992.      17068.      14585.      12614.
             2002        19056.      21210.      17252.      14746.      12884.
             2003        19053.      21133.      17279.      14801.      12935.
             2004        19057.      21141.      17245.      14946.      13064.
             2005        19057.      21143.      17237.      14941.      13090.
             2006        19057.      21146.      17242.      14946.      13107.
             2007        19057.      21148.      17245.      14951.      13113.

                          1997        1998        1999        2000        2001


             2000        12119.      13858.      20971.      23393.      17455.
             2001        13018.      14774.      21508.      21509.      16376.
             2002        13744.      15306.      23309.      23087.      17810.
             2003        13035.      13170.      18732.      18600.      14407.
             2004        13154.      13306.      17668.      17029.      13255.
             2005        13184.      13334.      17312.      16718.      13046.
             2006        13237.      13419.      17396.      16748.      13203.
             2007        13190.      13477.      17462.      16805.      13250.

                          2002        2003        2004        2005        2006


             2000
             2001        11067.
             2002        26285.      19865.
             2003        17077.      17114.      12418.
             2004        15583.      14068.      32769.      25539.
             2005        14224.      12041.      21034.      20889.      15743.
             2006        14567.      12623.      21874.      23736.      45200.
             2007        13459.      11046.      18414.      20495.      39336.

                          2007        2008


             2000
             2001
             2002
             2003
             2004
             2005
```

```
   2006       35989.
   2007       35992.      28090.


                     Age  1 Population


                1982        1983        1984        1985        1986



   2000        7857.       7929.      10674.       6679.      10260.
   2001        7857.       7929.      10674.       6679.      10260.
   2002        7857.       7929.      10674.       6679.      10260.
   2003        7857.       7929.      10674.       6679.      10260.
   2004        7857.       7929.      10674.       6679.      10260.
   2005        7857.       7929.      10674.       6679.      10260.
   2006        7857.       7929.      10674.       6679.      10260.
   2007        7857.       7929.      10674.       6679.      10260.

                1987        1988        1989        1990        1991



   2000       12744.      24612.       4253.       4119.       6975.
   2001       12744.      24612.       4253.       4125.       6975.
   2002       12744.      24612.       4254.       4130.       6975.
   2003       12744.      24612.       4255.       4131.       6975.
   2004       12744.      24612.       4254.       4135.       6975.
   2005       12744.      24612.       4254.       4135.       6975.
   2006       12744.      24612.       4254.       4135.       6975.
   2007       12744.      24612.       4254.       4135.       6975.

                1992        1993        1994        1995        1996



   2000        6432.       8943.       3126.       3345.       3000.
   2001        6338.       8975.       3131.       3583.       3345.
   2002        6343.       9185.       3137.       3593.       3484.
   2003        6339.       9110.       3227.       3627.       3490.
   2004        6340.       9116.       3185.       3800.       3500.
   2005        6340.       9117.       3177.       3802.       3529.
   2006        6340.       9121.       3179.       3802.       3542.
   2007        6340.       9123.       3180.       3805.       3545.

                1997        1998        1999        2000        2001



   2000        5009.       5716.      11044.       7729.          0.
   2001        5482.       5896.      10831.       5406.        461.
   2002        5987.       5834.      12196.       5510.        603.
   2003        5236.       4278.       9369.       4770.        875.
   2004        5249.       4317.       8193.       4071.       1008.
   2005        5258.       4321.       7814.       4052.       1054.
   2006        5298.       4362.       7828.       4013.       1187.
   2007        5245.       4458.       7847.       4016.       1187.

                2002        2003        2004        2005        2006
```

```
 2000
 2001          0.
 2002      14045.          0.
 2003       7623.       4786.          0.
 2004       7073.       2963.      22845.          0.
 2005       5884.       2050.      12772.       4959.          0.
 2006       6099.       2351.      13136.       7120.      27113.
 2007       4953.       1681.      10966.       6713.      23910.

             2007        2008


 2000
 2001
 2002
 2003
 2004
 2005
 2006          0.
 2007       4808.          0.

In the Retrospective Analysis
 The Following Survey Indices Have Predicted
 Index Value Set to Zero in Terminal Year + 1

   21     CM_CPE      2
   22     CM_CPE      3
   23     CM_CPE      4
   24     CM_CPE      5
   25     CM_CPE      6
```

```
Plus Group Diagnostic Report

Calculation Method Selected = Backward

         Population  Population    F            F
Year     Backward     Forward    Forward     Backward    Ratio

1982         79.         79.    0.608762    0.608767    1.000008
1983         35.         39.    0.766578    0.934198    1.218659
1984         36.         22.    2.291808    0.826495    0.360630
1985         21.         13.    2.078124    0.831755    0.400243
1986        113.         73.    2.078124    0.852354    0.410155
1987          5.          6.    0.850480    0.956793    1.125004
1988          2.          8.    0.154090    0.793893    5.152153
1989         13.          9.    2.078124    0.842203    0.405271
1990         30.         21.    2.078124    0.964334    0.464041
1991          2.          8.    0.141677    1.203395    8.493906
1992          0.          6.    0.000172    1.364201 7931.037707
1993          0.          6.    0.000179    1.151373 6429.218887
1994          2.          5.    0.302683    1.679343    5.548194
1995          0.          3.    0.072010    1.408175   19.555209
1996          0.          3.    0.000384    1.075723 2801.841399
1997          0.          2.    0.047990    1.074636   22.392985
1998          1.          2.    0.227801    0.769676    3.378726
1999          0.          2.    0.000490    0.810592 1655.235816
2000          0.          5.    0.000221    0.640350 2892.159780
2001          0.          4.       N/A         N/A


Warning **** Infeasible Mass Balance in Plus Group
Year =  1986
Year =  1989
Year =  1990
Year =  1994
Year =  1997
```

```
Bootstrap Summary Report

 Number of Bootstrap Repetitions Requested =  1000
 Number of Bootstrap Repetitions Completed =  1000
 Bootstrap Output Variable: Stock Estimates (2008)


               NLLS           Bootstrap      Bootstrap      C.V. For
               Estimate       Mean           Std Error      NLLS Soln.

 N  2           3937.          4778.          3549.         0.7428
 N  3          16020.         17071.          6345.         0.3717
 N  4           3543.          3648.           986.         0.2703
 N  5           3970.          4078.          1050.         0.2575
 N  6            201.           214.            80.         0.3741
 N  7            251.           270.           126.         0.4652
 N  8             30.            34.            19.         0.5717
 N  9             47.            56.            45.         0.7909
 N 10             71.            86.            70.         0.8079

                                                NLLS
                                                Estimate    C.V. For
            Bias        Bias        Per Cent    Corrected   Corrected
            Estimate    Std. Error  Bias        For Bias    Estimate

 N  2         841.        115.     21.3697       3095.      1.1466
 N  3        1050.        203.      6.5570      14970.      0.4239
 N  4         105.         31.      2.9687       3438.      0.2868
 N  5         107.         33.      2.6968       3863.      0.2718
 N  6          13.          3.      6.5231        188.      0.4263
 N  7          19.          4.      7.4963        232.      0.5406
 N  8           4.          1.     13.6268         26.      0.7521
 N  9           9.          1.     20.1704         37.      1.1906
 N 10          15.          2.     21.1718         56.      1.2418

                LOWER          UPPER
             80. % CI       80. % CI
 N  2             1677.          8603.
 N  3            10069.         25149.
 N  4             2521.          4978.
 N  5             2832.          5454.
 N  6              124.           328.
 N  7              121.           439.
 N  8               12.            60.
 N  9                9.           110.
 N 10                8.           179.
```

```
Bootstrap Output Variable: Catchability Estimates

              NLLS           Bootstrap      Bootstrap      C.V. For
              Estimate       Mean           Std Error      NLLS Soln.

Q  1       0.639060E-04  0.647586E-04  0.101782E-04        0.1572
Q  2       0.131940E-03  0.133998E-03  0.145121E-04        0.1083
Q  3       0.225008E-03  0.225360E-03  0.233256E-04        0.1035
Q  4       0.293998E-03  0.295308E-03  0.383110E-04        0.1297
Q  5       0.382779E-03  0.386695E-03  0.603680E-04        0.1561
Q  6       0.566609E-03  0.571598E-03  0.110028E-03        0.1925
Q  7       0.511812E-03  0.524087E-03  0.139158E-03        0.2655
Q  8       0.533836E-04  0.535169E-04  0.726587E-05        0.1358
Q  9       0.113582E-03  0.114677E-03  0.129450E-04        0.1129
Q 10       0.223833E-03  0.223325E-03  0.225948E-04        0.1012
Q 11       0.370258E-03  0.372882E-03  0.441525E-04        0.1184
Q 12       0.478237E-03  0.480790E-03  0.575817E-04        0.1198
Q 13       0.451154E-03  0.460422E-03  0.853109E-04        0.1853
Q 14       0.566767E-03  0.586741E-03  0.137955E-03        0.2351
Q 15       0.710558E-03  0.715248E-03  0.110880E-03        0.1550
Q 16       0.544643E-03  0.546052E-03  0.476591E-04        0.0873
Q 17       0.453706E-03  0.455707E-03  0.552238E-04        0.1212
Q 19       0.122958E-03  0.128903E-03  0.390116E-04        0.3026
Q 21       0.245830E-05  0.251662E-05  0.718337E-06        0.2854
Q 22       0.140563E-04  0.141456E-04  0.162997E-05        0.1152
Q 23       0.231650E-04  0.232271E-04  0.126746E-05        0.0546
Q 24       0.229116E-04  0.229085E-04  0.120903E-05        0.0528
Q 25       0.218712E-04  0.220098E-04  0.250055E-05        0.1136
```

```
                                                 NLLS
                                                 Estimate    C.V. For
             Bias         Bias         Per Cent  Corrected   Corrected
             Estimate     Std. Error   Bias      For Bias    Estimate

Q  1         0.8525E-06  0.3230E-06      1.3340  0.6305E-04      0.1614
Q  2         0.2058E-05  0.4635E-06      1.5600  0.1299E-03      0.1117
Q  3         0.3524E-06  0.7377E-06      0.1566  0.2247E-03      0.1038
Q  4         0.1310E-05  0.1212E-05      0.4455  0.2927E-03      0.1309
Q  5         0.3917E-05  0.1913E-05      1.0232  0.3789E-03      0.1593
Q  6         0.4988E-05  0.3483E-05      0.8803  0.5616E-03      0.1959
Q  7         0.1227E-04  0.4418E-05      2.3983  0.4995E-03      0.2786
Q  8         0.1332E-06  0.2298E-06      0.2496  0.5325E-04      0.1364
Q  9         0.1096E-05  0.4108E-06      0.9645  0.1125E-03      0.1151
Q 10        -0.5082E-06  0.7147E-06     -0.2270  0.2243E-03      0.1007
Q 11         0.2624E-05  0.1399E-05      0.7086  0.3676E-03      0.1201
Q 12         0.2554E-05  0.1823E-05      0.5339  0.4757E-03      0.1211
Q 13         0.9268E-05  0.2714E-05      2.0543  0.4419E-03      0.1931
Q 14         0.1997E-04  0.4408E-05      3.5242  0.5468E-03      0.2523
Q 15         0.4690E-05  0.3509E-05      0.6600  0.7059E-03      0.1571
Q 16         0.1409E-05  0.1508E-05      0.2587  0.5432E-03      0.0877
Q 17         0.2001E-05  0.1747E-05      0.4410  0.4517E-03      0.1223
Q 19         0.5945E-05  0.1248E-05      4.8350  0.1170E-03      0.3334
Q 21         0.5832E-07  0.2279E-07      2.3723  0.2400E-05      0.2993
Q 22         0.8937E-07  0.5162E-07      0.6358  0.1397E-04      0.1167
Q 23         0.6213E-07  0.4013E-07      0.2682  0.2310E-04      0.0549
Q 24        -0.3153E-08  0.3823E-07     -0.0138  0.2291E-04      0.0528
Q 25         0.1386E-06  0.7920E-07      0.6336  0.2173E-04      0.1151


                 LOWER          UPPER
              80. % CI       80. % CI
Q  1        0.528038E-04   0.777431E-04
Q  2        0.116065E-03   0.153541E-03
Q  3        0.195847E-03   0.256823E-03
Q  4        0.251091E-03   0.347007E-03
Q  5        0.311452E-03   0.463932E-03
Q  6        0.435944E-03   0.713003E-03
Q  7        0.363137E-03   0.705006E-03
Q  8        0.448692E-04   0.627867E-04
Q  9        0.991114E-04   0.131147E-03
Q 10        0.195500E-03   0.251712E-03
Q 11        0.317280E-03   0.430807E-03
Q 12        0.407507E-03   0.551218E-03
Q 13        0.359008E-03   0.576648E-03
Q 14        0.425972E-03   0.768331E-03
Q 15        0.581905E-03   0.849728E-03
Q 16        0.486698E-03   0.606425E-03
Q 17        0.386956E-03   0.528414E-03
Q 19        0.842248E-04   0.174946E-03
Q 21        0.167670E-05   0.346849E-05
Q 22        0.121995E-04   0.162474E-04
Q 23        0.216791E-04   0.248333E-04
Q 24        0.213895E-04   0.245191E-04
Q 25        0.190392E-04   0.252692E-04
```

```
 Bootstrap Output Variable: Fishing Mortality (2007)

               NLLS           Bootstrap      Bootstrap      C.V. For
               Estimate       Mean           Std Error      NLLS Soln.

AGE  1           0.0000         0.0000       0.000000         0.7193
AGE  2           0.0004         0.0005       0.000180         0.3776
AGE  3           0.0388         0.0403       0.010717         0.2657
AGE  4           0.1880         0.1940       0.047462         0.2446
AGE  5           0.4892         0.5077       0.151260         0.2979
AGE  6           0.6492         0.7011       0.268324         0.3827
AGE  7           0.2288         0.2890       0.246963         0.8546
AGE  8           0.3714         0.5913       0.645212         1.0911
AGE  9           0.1484         0.3630       0.603834         1.6637
AGE 10           0.4888         0.5279       0.202048         0.3827
AGE 11           0.4888         0.5279       0.202048         0.3827

                                                NLLS
                                                Estimate    C.V. For
            Bias        Bias        Per Cent    Corrected   Corrected
            Estimate    Std. Error  Bias        For Bias    Estimate

AGE  1      0.000000    0.000000     25.9547      0.0000      1.2235
AGE  2      0.000031    0.000006      6.9738      0.0004      0.4343
AGE  3      0.001556    0.000342      4.0140      0.0372      0.2880
AGE  4      0.006058    0.001513      3.2227      0.1819      0.2609
AGE  5      0.018527    0.004819      3.7875      0.4706      0.3214
AGE  6      0.051977    0.008643      8.0070      0.5972      0.4493
AGE  7      0.060197    0.008039     26.3126      0.1686      1.4650
AGE  8      0.219925    0.021557     59.2126      0.1515      4.2591
AGE  9      0.214574    0.020266    144.6129     -0.0662     -9.1219
AGE 10      0.039139    0.006508      8.0070      0.4497      0.4493
AGE 11      0.039139    0.006508      8.0070      0.4497      0.4493

                LOWER          UPPER
             80. % CI       80. % CI
AGE  1        0.000000       0.000001
AGE  2        0.000284       0.000710
AGE  3        0.027715       0.053995
AGE  4        0.140155       0.254509
AGE  5        0.325552       0.702242
AGE  6        0.420262       1.058058
AGE  7        0.120909       0.499303
AGE  8        0.174605       1.208743
AGE  9        0.061730       0.855144
AGE 10        0.316457       0.796718
AGE 11        0.316457       0.796718
```

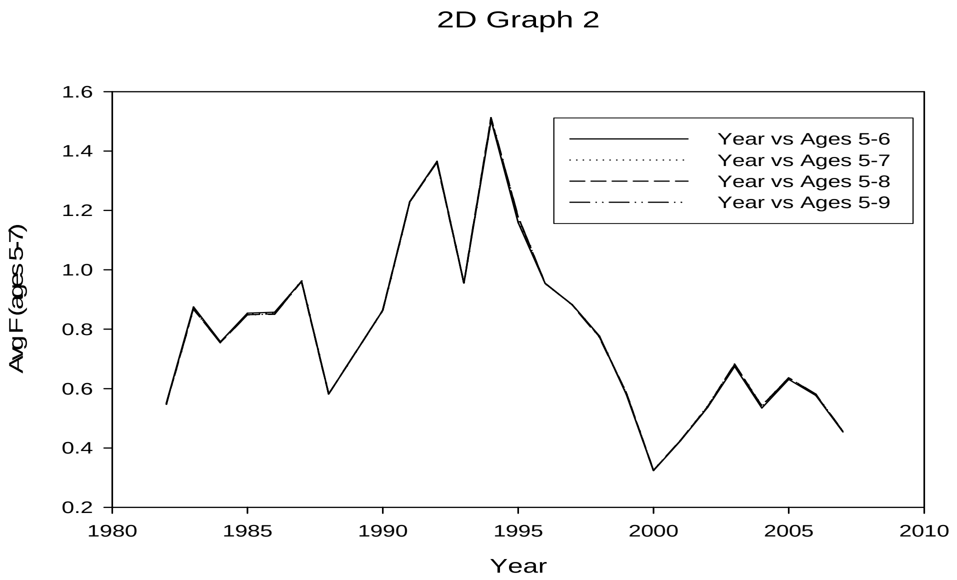
```
 Bootstrap Output Variable: Average F (2007) AGES    5 -    7

              NLLS           Bootstrap      Bootstrap      C.V. For
              Estimate       Mean           Std Error      NLLS Soln.

AVG F           0.4557         0.4993       0.136083         0.2726
N WTD           0.5685         0.5810       0.147049         0.2531
B WTD           0.5686         0.5816       0.150324         0.2584
C WTD           0.5845         0.6250       0.178702         0.2859

                                                NLLS
                                                Estimate    C.V. For
            Bias         Bias        Per Cent   Corrected   Corrected
            Estimate     Std. Error  Bias       For Bias    Estimate

AVG F       0.043567     0.004519      9.5605     0.4121      0.3302
N WTD       0.012503     0.004667      2.1994     0.5560      0.2645
B WTD       0.013043     0.004772      2.2939     0.5556      0.2706
C WTD       0.040489     0.005794      6.9270     0.5440      0.3285

               LOWER          UPPER
             80. % CI       80. % CI
AVG F        0.355693       0.669985
N WTD        0.411017       0.781374
B WTD        0.408325       0.786745
C WTD        0.428986       0.863827
```

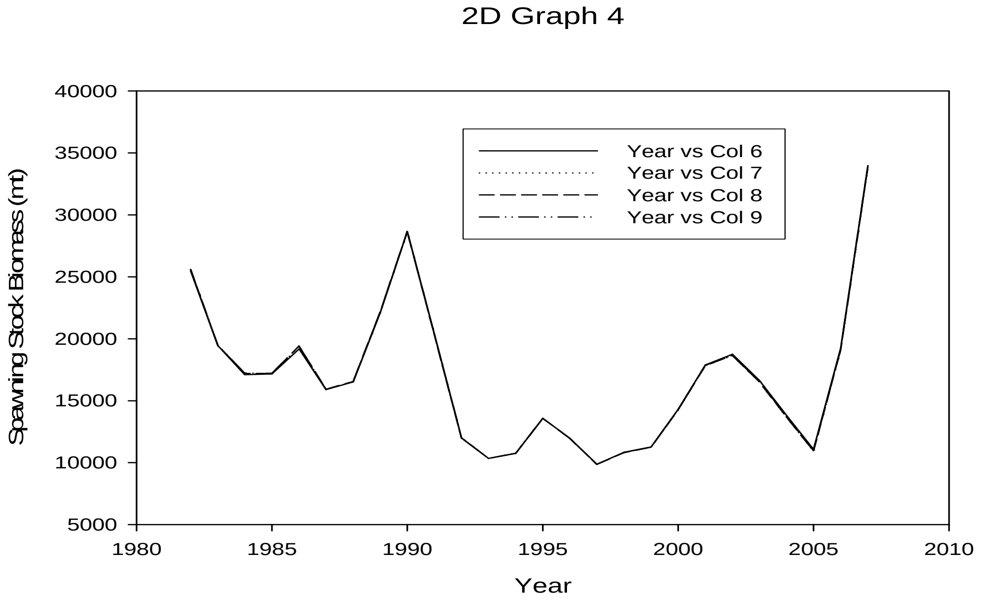
```
 Bootstrap Output Variable: Biomass

 JAN-1 Biomass (2008) Mean Biomass  & SSB (2007)


               NLLS           Bootstrap      Bootstrap      C.V. For
               Estimate       Mean           Std Error      NLLS Soln.

JAN-1            64636.         68657.         14733.         0.2146
MEAN             68452.         72310.         15634.         0.2162
SSB              33877.         35256.          5061.         0.1435

                                                NLLS
                                                Estimate    C.V. For
            Bias        Bias        Per Cent    Corrected   Corrected
            Estimate    Std. Error  Bias        For Bias    Estimate

JAN-1          4021.        483.      6.2205      60615.      0.2431
MEAN           3857.        509.      5.6350      64595.      0.2420
SSB            1379.        166.      4.0692      32499.      0.1557

                LOWER          UPPER
             80. % CI       80. % CI
JAN-1          51410.         87543.
MEAN           54179.         91739.
SSB            29133.         41747.
```

```
Plus Group Diagnostic Report

Calculation Method Selected = Backward

         Population  Population    F            F
Year     Backward     Forward    Forward     Backward    Ratio

1982         79.         79.    0.608762    0.608767    1.000008
1983         35.         39.    0.766578    0.934197    1.218659
1984         36.         22.    2.291801    0.826494    0.360631
1985         21.         13.    2.078124    0.831750    0.400241
1986        113.         73.    2.078124    0.852346    0.410152
1987          5.          6.    0.850463    0.956784    1.125015
1988          2.          8.    0.154087    0.793888    5.152224
1989         13.          9.    2.078124    0.842174    0.405257
1990         30.         21.    2.078124    0.964190    0.463971
1991          2.          8.    0.141642    1.203272    8.495139
1992          0.          6.    0.000172    1.364055 7932.243093
1993          0.          6.    0.000179    1.150044 6423.409462
1994          2.          5.    0.302595    1.631834    5.392807
1995          0.          3.    0.071812    1.363187   18.982625
1996          0.          3.    0.000379    1.184958 3124.512926
1997          0.          2.    0.047392    1.015233   21.422228
1998          1.          2.    0.221488    0.685785    3.096259
1999          0.          2.    0.000451    0.550581 1221.900183
2000          0.          7.    0.000150    0.346290 2312.462606
2001          2.          6.    0.095719    0.448343    4.683963
2002          2.          6.    0.109135    0.513022    4.700795
2003         17.         17.    0.631774    0.663032    1.049475
2004          9.         17.    0.257924    0.519155    2.012819
2005         19.         26.    0.439374    0.648994    1.477087
2006         24.         21.    0.595954    0.524603    0.880275
2007         22.         24.    0.426115    0.470989    1.105310
2008         21.         23.       N/A         N/A


Warning **** Infeasible Mass Balance in Plus Group
Year =  1986
Year =  1989
Year =  1990
Year =  1994
Year =  1997
Year =  2001
```

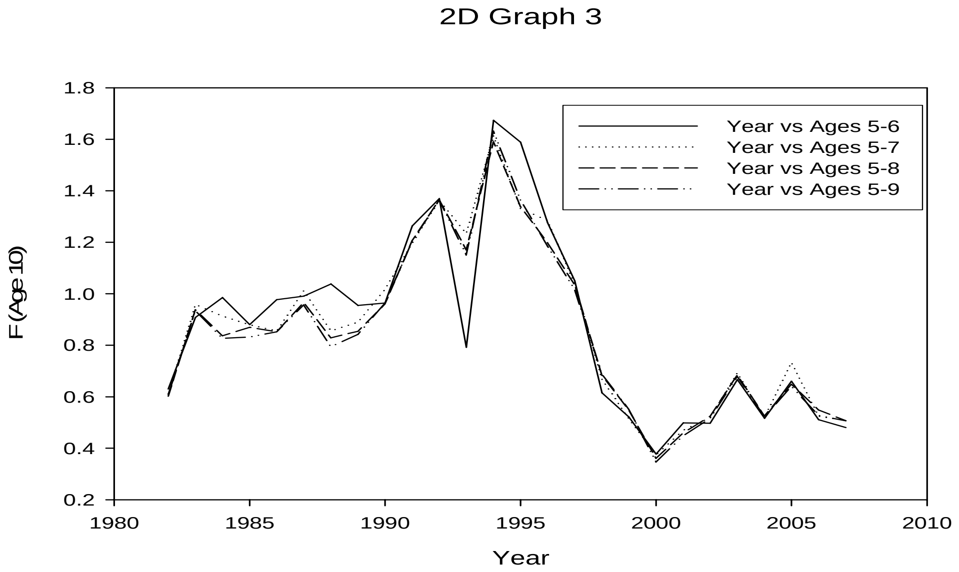
## Appendix 3. F on Oldest True Age Explorations for the Gulf of Maine stock of Atlantic cod.

In the 11 plus VPA formulation, F on the oldest true age (age 10) was estimated in a series of trial VPAs using ages 5-6, 5-7, 5-8, and 5-9 as a basis for computing F on age 10. An additional exploration was conducted using ages 8-9. The following graphics show the impact on the average F (ages 5-7), spawning stock biomass, and F on age 10.

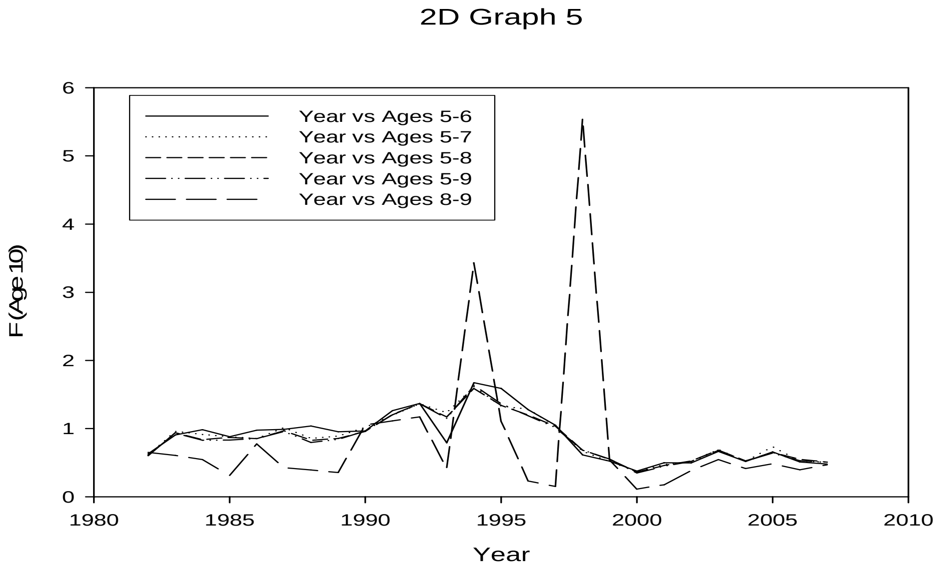




In each trial, the average F on the fully recruited ages (5-7) and the spawning stock biomass were not appreciably affected by the choice of age range.



The F on the oldest (age 10), however, was directly affected by the choice of age range. The age 5-6 range caused F to deviate from the other ranges, especially in 1993. Overall, the age range did not substantially affect the estimate of F on the oldest true age.



When ages 8-9 were included in the analysis, the estimate of F on age 10 was generally lower than the estimates obtained from the other age ranges, sometimes as much as 80-90% lower (1996 and 1997). In other cases (1994 and 1998), the estimates are as much as 2-6 times higher (1994 and 1998). The estimates of F on ages 8 and 9 are highly variable, especially during the 1990s.

# Appendix 4. Swept area survey Q analyses for the Gulf of Maine stock of Atlantic cod.

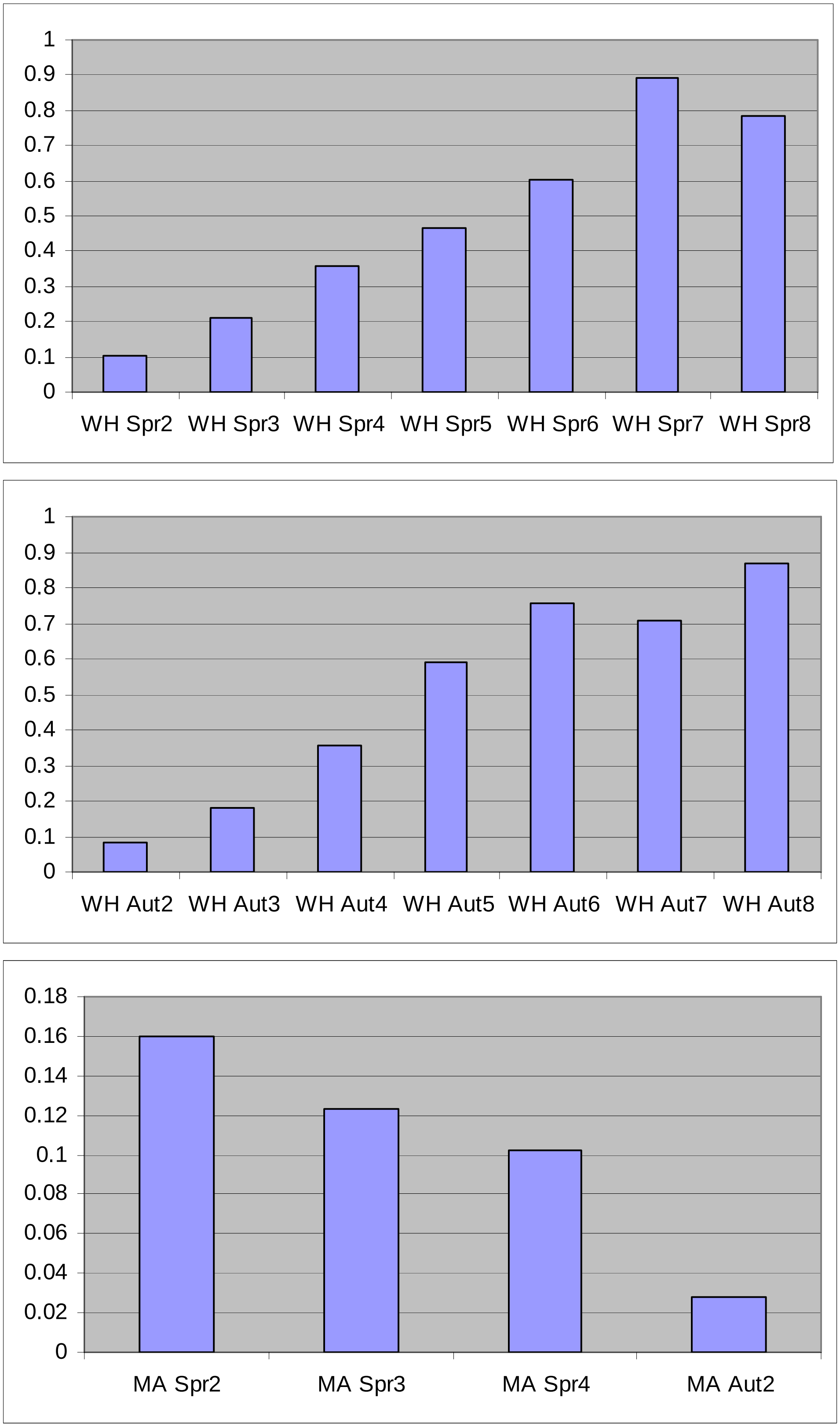
| Index | Index # | q | se | Q | CV | 2 Std |
|---|---|---|---|---|---|---|
| WH Spr2 | 1 | 0.000064 | 0.1547 | 0.10224 | 0.1547 | 0.031633 |
| WH Spr3 | 2 | 0.000132 | 0.1065 | 0.21087 | 0.1065 | 0.044915 |
| WH Spr4 | 3 | 0.000225 | 0.1026 | 0.359438 | 0.1026 | 0.073757 |
| WH Spr5 | 4 | 0.000293 | 0.1308 | 0.468068 | 0.1308 | 0.122446 |
| WH Spr6 | 5 | 0.000378 | 0.1666 | 0.603855 | 0.1666 | 0.201204 |
| WH Spr7 | 6 | 0.000557 | 0.1964 | 0.889808 | 0.1964 | 0.349516 |
| WH Spr8 | 7 | 0.000491 | 0.2765 | 0.784373 | 0.2765 | 0.433758 |
| WH Aut2 | 8 | 0.000053 | 0.1286 | 0.084668 | 0.1286 | 0.021776 |
| WH Aut3 | 9 | 0.000113 | 0.1128 | 0.180518 | 0.1128 | 0.040725 |
| WH Aut4 | 10 | 0.000224 | 0.1012 | 0.35784 | 0.1012 | 0.072427 |
| WH Aut5 | 11 | 0.000369 | 0.1239 | 0.589478 | 0.1239 | 0.146073 |
| WH Aut6 | 12 | 0.000473 | 0.1185 | 0.755618 | 0.1185 | 0.179081 |
| WH Aut7 | 13 | 0.000442 | 0.1875 | 0.706095 | 0.1875 | 0.264786 |
| WH Aut8 | 14 | 0.000545 | 0.2305 | 0.870638 | 0.2305 | 0.401364 |
| MA Spr2 | 15 | 0.00071 | 0.1511 | 0.160257 | 0.1511 | 0.04843 |
| MA Spr3 | 16 | 0.000544 | 0.0868 | 0.122789 | 0.0868 | 0.021316 |
| MA Spr4 | 17 | 0.000453 | 0.1231 | 0.102249 | 0.1231 | 0.025174 |
| MA Aut2 | 19 | 0.000123 | 0.2996 | 0.027763 | 0.2996 | 0.016636 |

| NEFSC | |
|---|---|
| Area (sq mi) A | 17892 |
| Area Swept a | 0.0112 |
| Exp Fact | 1597500 |
| Exp Fact (1000s) | 1597.5 |

| MADMF | |
|---|---|
| Area (sq mi) A | 869 |
| Area Swept a | 0.00385 |
| Exp Fact | 225714.3 |
| Exp Fact (1000s) | 225.7143 |

Survey catchabilities (qs) obtained from the VPA (calibrated with number/per tow at age) were expanded on the basis of minimum swept area population numbers using the area of the strata used in the assessment (A = 17,892 sq mi) and the footprint of a standard tow (a = 0.0112 sq mi) for the NEFSC survey and the strata used in the assessment (A = 869 sq mi) and the footprint of a standard tow (a = 0.00385 sq mi) for the MA DMF survey. The expansion factor: (A/a *1/1000) converts survey qs from a kg/tow basis to a swept area basis (Q).

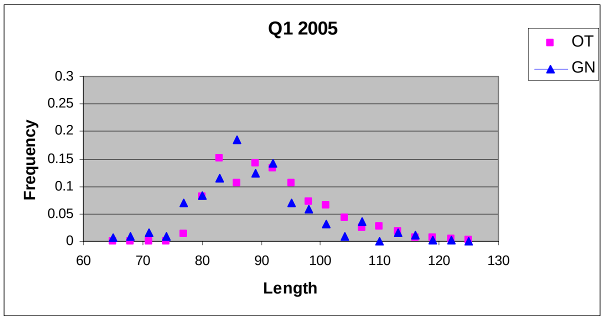
As the figures below show, the NEFSC survey Qs start at about 10% at age 2, increase through age 5 or 6 and then level off at about 70-90%. The MA DMF spring Qs show a continuously declining trend from age 2 to age 4, reflecting the movement of fish out of the survey area as they grow older

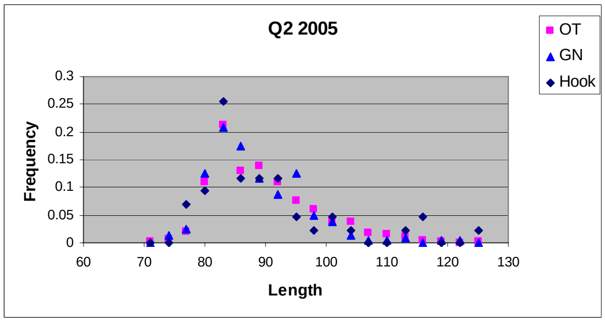


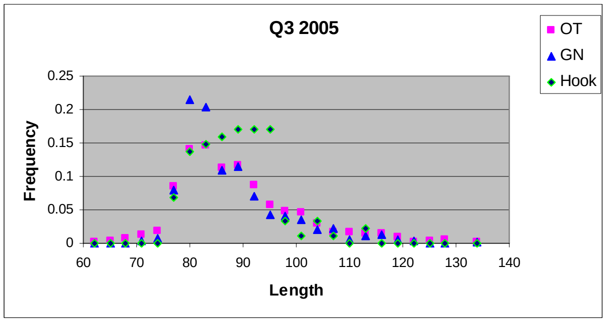
Appendix 5. Length frequency of landed large cod by major gear and quarter, 2005-2007 for the Gulf of Maine stock of Atlantic cod.

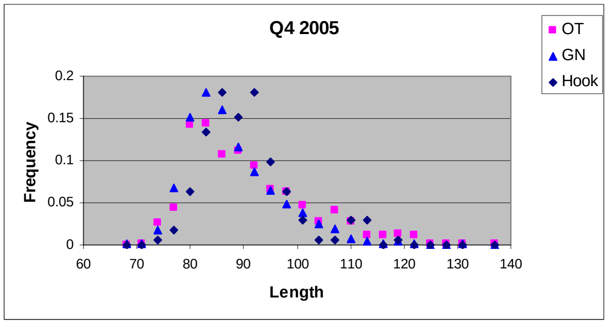
Commercial port samples collected in 2005, 2006 and 2007 were used to construct length frequency plots of landed large cod by major gear type (hooks, trawls and gillnets) and quarter. The dominant length modes coincide for all 3 gear types. Although the proportions are low for the largest fish, trawls and gillnets are capable of capturing fish as large as 135+ cm (51+ in). Hook gear tends to take somewhat smaller cod, although some catches out to 125 cm have been recorded.

## 2005

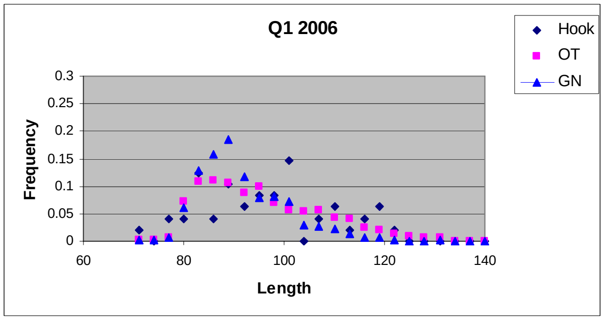


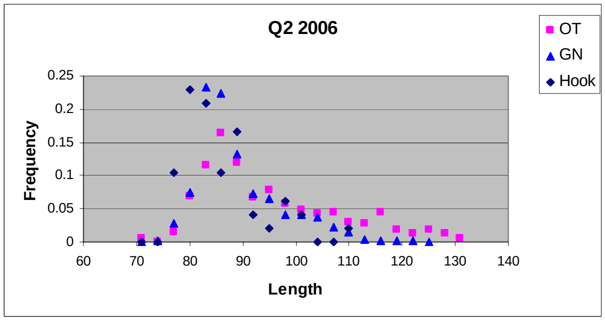


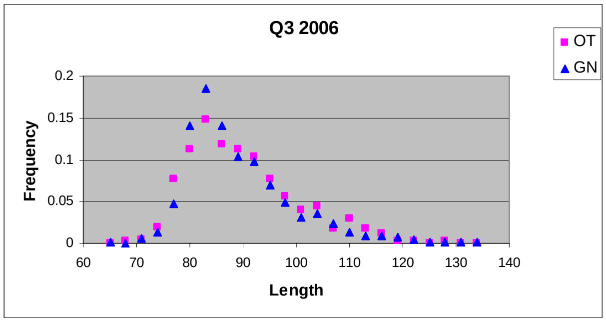


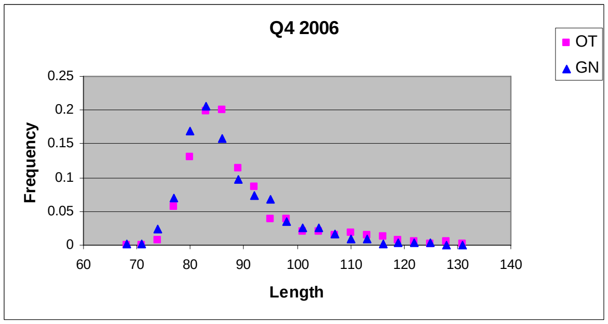


## 2006

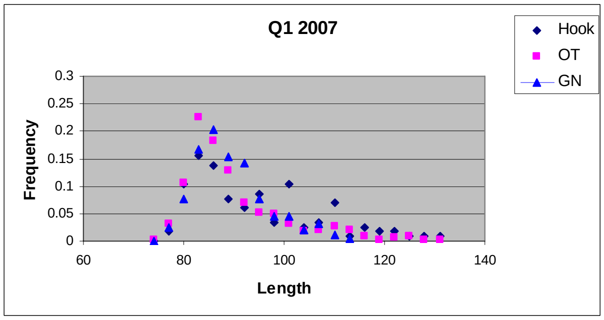


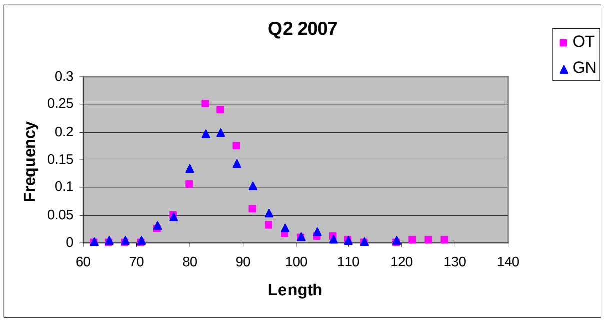


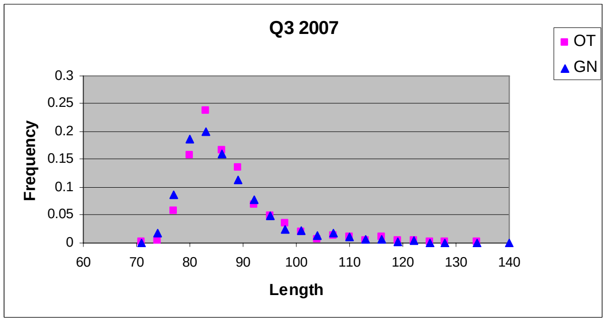


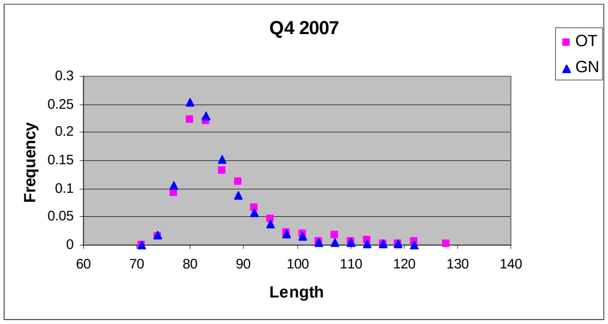


# 2007


Q1 2007
Frequency
Length
0
0.05
0.1
0.15
0.2
0.25
0.3
60
80
100
120
140
Hook
OT
GN


Q2 2007
Frequency
Length
0
0.05
0.1
0.15
0.2
0.25
0.3
60
70
80
90
100
110
120
130
140
OT
GN


Q3 2007
Frequency
Length
0
0.05
0.1
0.15
0.2
0.25
0.3
60
70
80
90
100
110
120
130
140
OT
GN


Q4 2007
Frequency
Length
0
0.05
0.1
0.15
0.2
0.25
0.3
60
70
80
90
100
110
120
130
140
OT
GN

# Appendix G.   Witch flounder

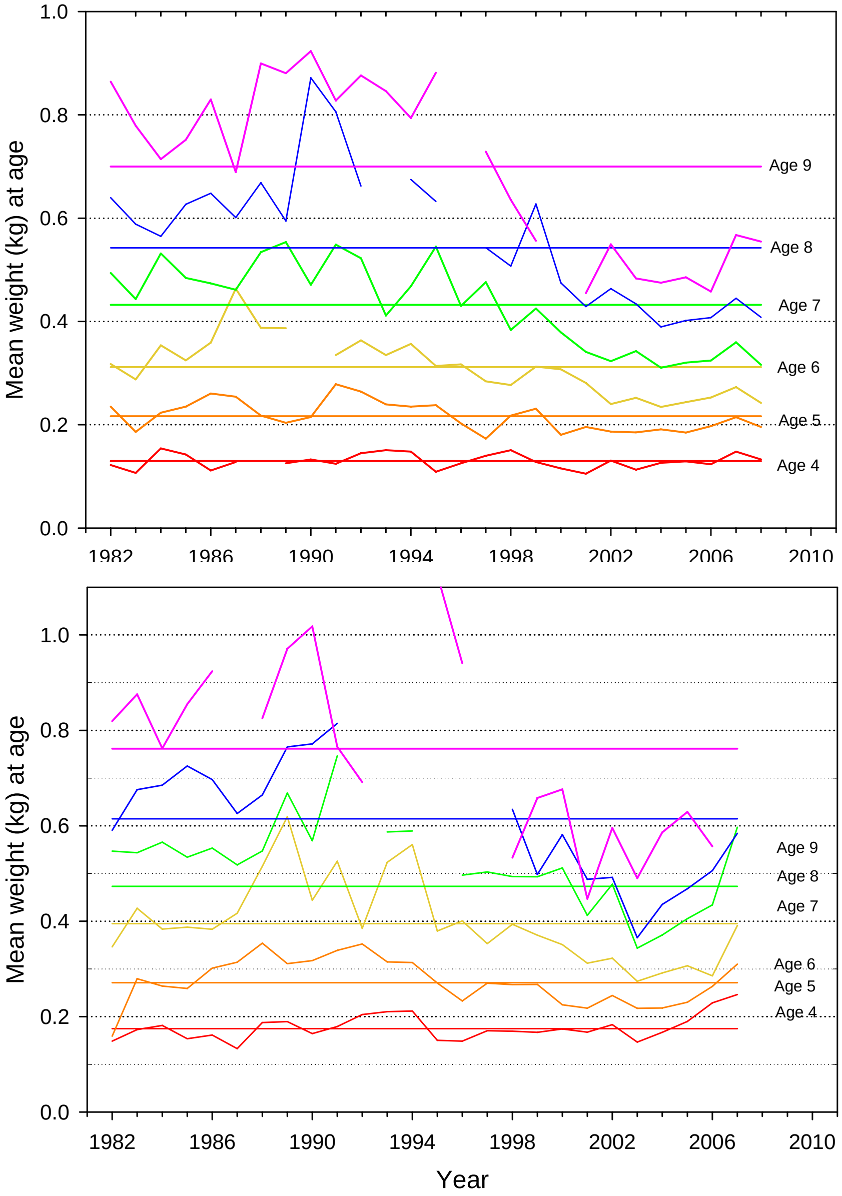
## Appendix Tables and Figures  by S.E. Wigley and L. Col

Appendix Table G1.   Stratified mean number, weight (kg), length (cm), and individual weight (kg) per tow of witch flounder in **Massachusetts Division of Marine Fisheries inshore spring and autumn survey**s in the Cape Cod Bay and Mass. Bay region (Regions 4 and 5), 1978-2007.

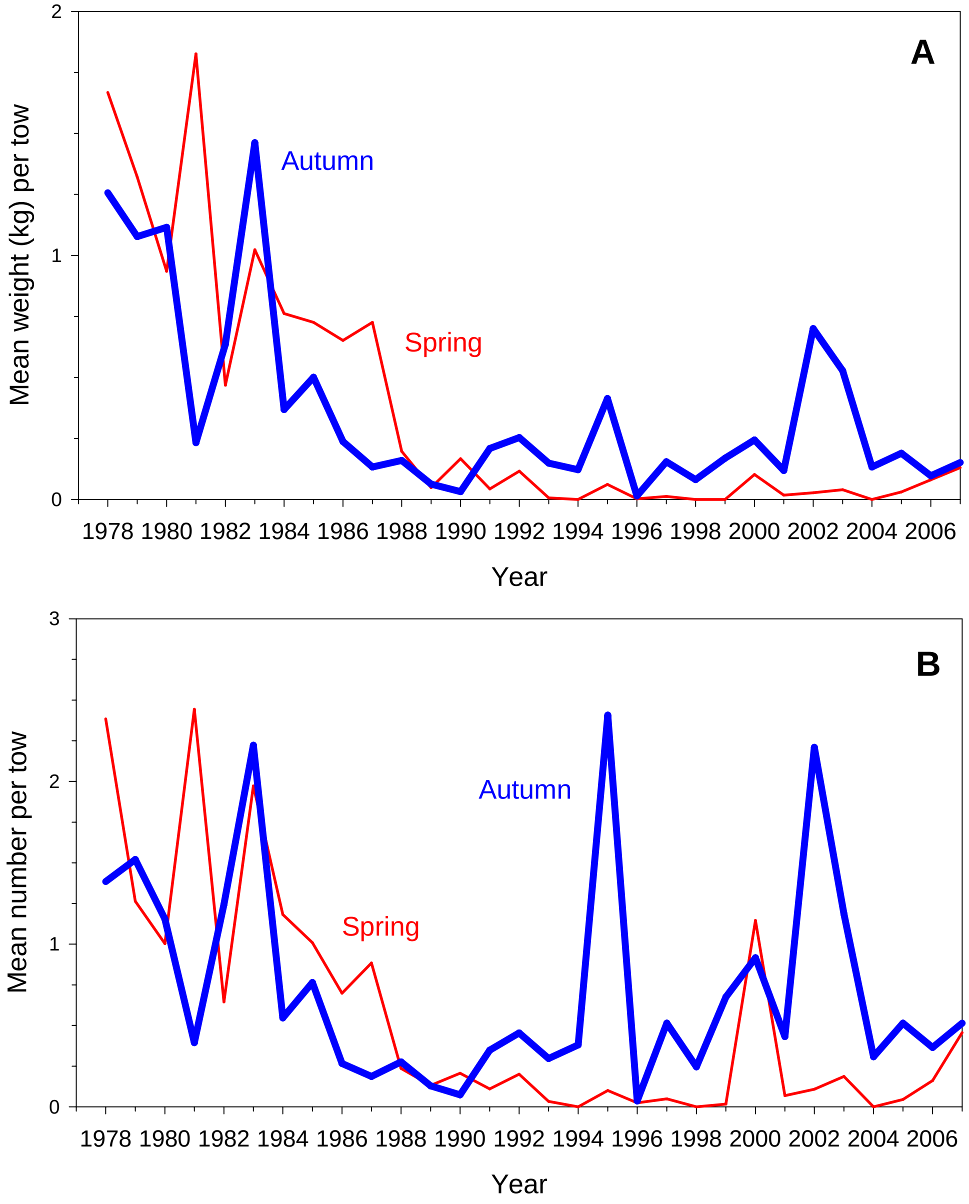
| | SPRING | | | | AUTUMN | | | |
|---|---|---|---|---|---|---|---|---|
| Year | Number per tow | Weight per tow | Length per tow | Avg. wt. per tow | Number per tow | Weight per tow | Length per tow | Avg. wt. per tow |
| 1978 | 2.38 | 1.67 | 44.6 | 0.699 | 1.38 | 1.26 | 46.4 | 0.908 |
| 1979 | 1.26 | 1.32 | 48.3 | 1.046 | 1.52 | 1.08 | 42.9 | 0.708 |
| 1980 | 1.00 | 0.93 | 44.0 | 0.932 | 1.15 | 1.12 | 46.5 | 0.966 |
| 1981 | 2.44 | 1.83 | 40.2 | 0.747 | 0.39 | 0.23 | 41.2 | 0.589 |
| 1982 | 0.65 | 0.47 | 44.2 | 0.726 | 1.24 | 0.64 | 37.7 | 0.511 |
| 1983 | 1.97 | 1.02 | 36.8 | 0.519 | 2.22 | 1.46 | 44.6 | 0.658 |
| 1984 | 1.18 | 0.76 | 40.8 | 0.645 | 0.55 | 0.37 | 43.6 | 0.674 |
| 1985 | 1.01 | 0.73 | 43.4 | 0.720 | 0.76 | 0.50 | 43.6 | 0.655 |
| 1986 | 0.70 | 0.65 | 47.6 | 0.934 | 0.27 | 0.24 | 46.4 | 0.893 |
| 1987 | 0.88 | 0.73 | 45.1 | 0.821 | 0.19 | 0.13 | 44.6 | 0.713 |
| 1988 | 0.24 | 0.20 | 45.6 | 0.837 | 0.28 | 0.16 | 39.5 | 0.579 |
| 1989 | 0.13 | 0.05 | 34.9 | 0.369 | 0.13 | 0.06 | 38.1 | 0.491 |
| 1990 | 0.21 | 0.17 | 44.2 | 0.809 | 0.07 | 0.03 | 36.8 | 0.436 |
| 1991 | 0.11 | 0.04 | 34.1 | 0.393 | 0.35 | 0.21 | 41.1 | 0.602 |
| 1992 | 0.20 | 0.12 | 40.2 | 0.583 | 0.45 | 0.25 | 40.7 | 0.557 |
| 1993 | 0.03 | 0.01 | 33.0 | 0.200 | 0.30 | 0.15 | 40.9 | 0.500 |
| 1994 | 0.00 | 0.00 | - | - | 0.38 | 0.12 | 31.0 | 0.321 |
| 1995 | 0.10 | 0.06 | 36.0 | 0.613 | 2.41 | 0.41 | 26.7 | 0.172 |
| 1996 | 0.02 | <0.01 | 21.0 | 0.100 | 0.04 | 0.01 | 40.0 | 0.400 |
| 1997 | 0.05 | 0.01 | 31.5 | 0.250 | 0.51 | 0.15 | 36.0 | 0.300 |
| 1998 | 0.00 | 0.00 | - | - | 0.25 | 0.08 | 35.2 | 0.332 |
| 1999 | 0.02 | <0.01 | 11.0 | 0.000 | 0.67 | 0.17 | 33.7 | 0.251 |
| 2000 | 1.15 | 0.10 | 23.5 | 0.089 | 0.92 | 0.24 | 31.6 | 0.266 |
| 2001 | 0.07 | 0.02 | 33.0 | 0.250 | 0.43 | 0.12 | 33.2 | 0.275 |
| 2002 | 0.11 | 0.03 | 33.4 | 0.253 | 2.21 | 0.70 | 36.5 | 0.317 |
| 2003 | 0.19 | 0.04 | 30.2 | 0.217 | 1.19 | 0.53 | 39.8 | 0.445 |
| 2004 | 0.00 | 0.00 | - | - | 0.31 | 0.13 | 40.5 | 0.432 |
| 2005 | 0.05 | 0.03 | 45.5 | 0.675 | 0.51 | 0.19 | 37.8 | 0.369 |
| 2006 | 0.16 | 0.08 | 40.9 | 0.500 | 0.37 | 0.10 | 33.0 | 0.265 |
| 2007 | 0.46 | 0.13 | 34.6 | 0.286 | 0.51 | 0.15 | 36.8 | 0.295 |

Appendix Table G2. Stratified mean number, weight (kg), length (cm), and individual weight (kg) per tow of witch flounder in the **ASMFC summer shrimp surveys** in the Gulf of Maine (strata set 1,3,6,8), 1984 - 2007.

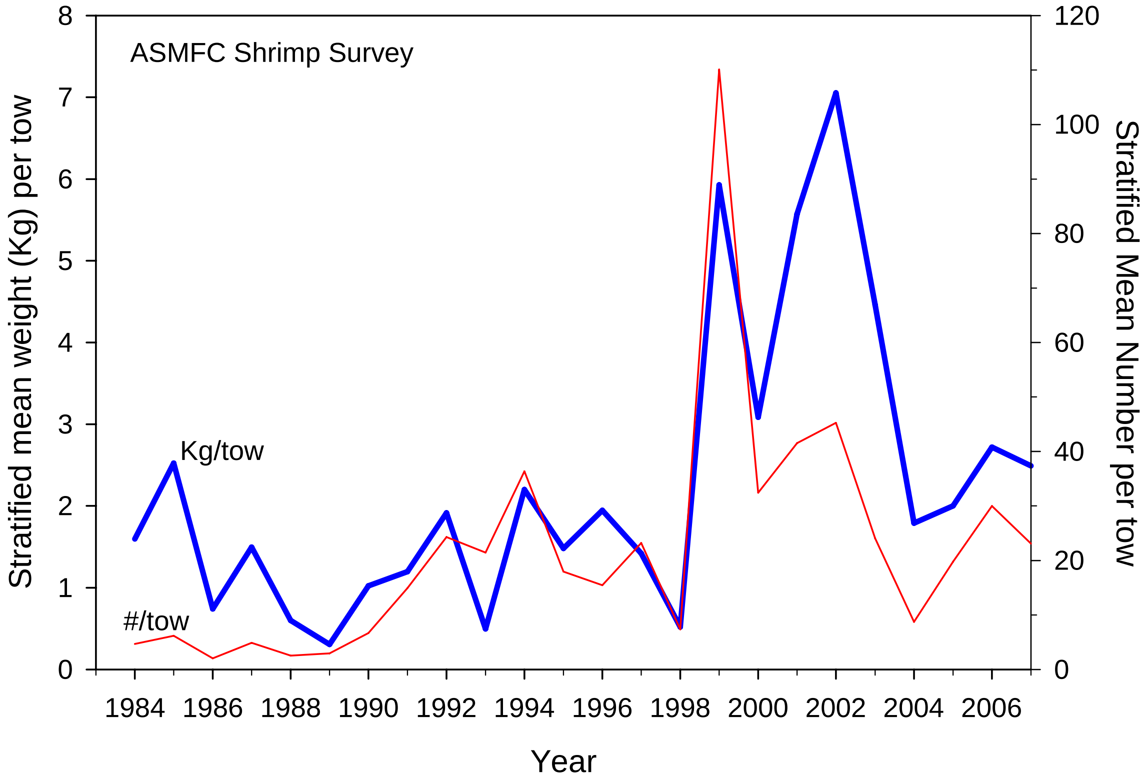
| Year | Number per tow | Weight per tow | Length per tow | Ave. wt. per tow |
|---:|---:|---:|---:|---:|
| 1984 | 4.68 | 1.60 | 33.9 | 0.341 |
| 1985 | 6.19 | 2.52 | 36.0 | 0.408 |
| 1986 | 2.05 | 0.74 | 35.9 | 0.362 |
| 1987 | 4.87 | 1.50 | 26.5 | 0.307 |
| 1988 | 2.53 | 0.60 | 25.8 | 0.238 |
| 1989 | 2.92 | 0.31 | 22.8 | 0.105 |
| 1990 | 6.66 | 1.02 | 24.5 | 0.154 |
| 1991 | 14.94 | 1.20 | 19.6 | 0.080 |
| 1992 | 24.28 | 1.91 | 20.5 | 0.079 |
| 1993 | 21.42 | 0.50 | 12.8 | 0.023 |
| 1994 | 36.36 | 2.20 | 19.1 | 0.061 |
| 1995 | 17.95 | 1.48 | 22.6 | 0.082 |
| 1996 | 15.45 | 1.95 | 25.2 | 0.126 |
| 1997 | 23.19 | 1.42 | 19.1 | 0.061 |
| 1998 | 7.35 | 0.52 | 21.9 | 0.071 |
| 1999 | 110.07 | 5.93 | 18.7 | 0.054 |
| 2000 | 32.43 | 3.09 | 24.2 | 0.095 |
| 2001 | 41.52 | 5.57 | 27.2 | 0.134 |
| 2002 | 45.25 | 7.05 | 28.8 | 0.156 |
| 2003 | 24.06 | 4.46 | 30.6 | 0.185 |
| 2004 | 8.75 | 1.79 | 31.3 | 0.205 |
| 2005 | 19.77 | 2.00 | 21.6 | 0.101 |
| 2006 | 29.98 | 2.72 | 22.6 | 0.091 |
| 2007 | 23.10 | 2.49 | 25.1 | 0.108 |



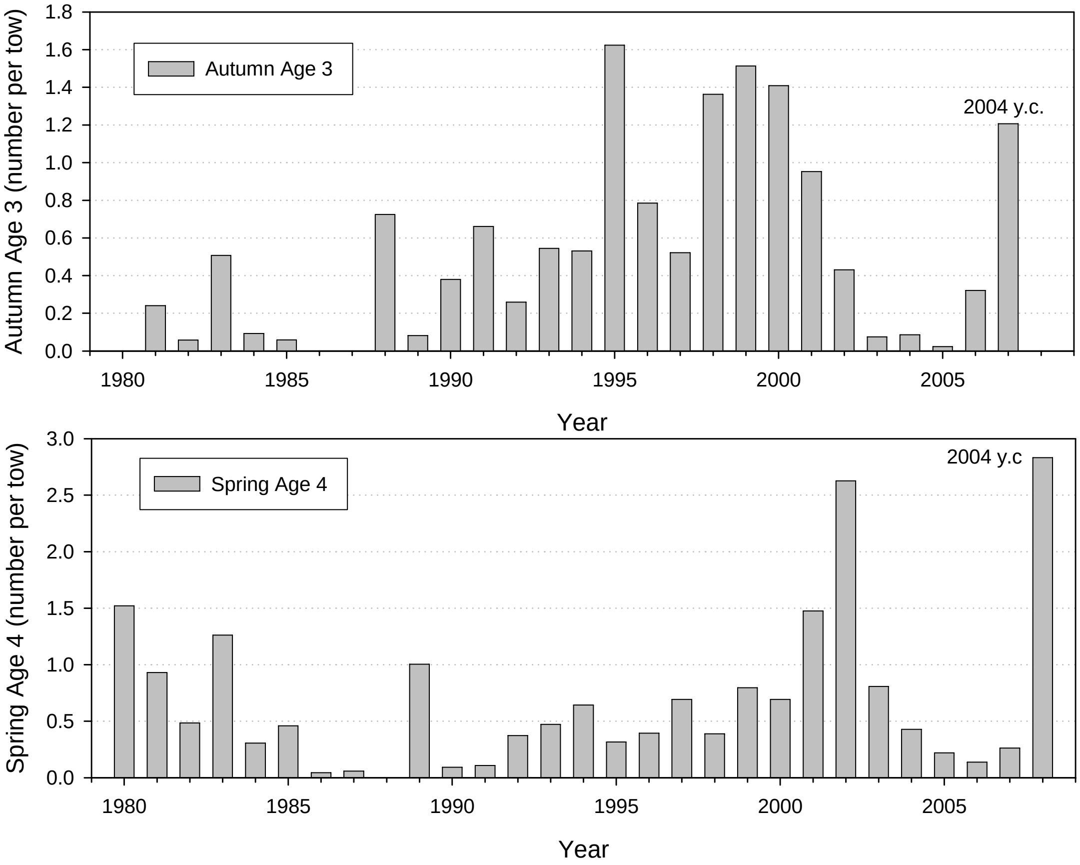
Appendix Figure G1. Mean weight at age of witch flounder (age groups 4 – 9) in the NEFSC spring (top) and autumn (bottom) survey, 1980-2007.



Appendix Figure G2  Stratified mean catch per tow, in weight (A) and number (B), of witch flounder in the Massachusetts Division of Marine Fisheries spring and autumn bottom trawl surveys in Cape Cod Bay – Mass Bay region, 1978 – 2007.



Appendix Figure G3. Stratified mean catch per tow, in weight (kg) and numbers, of witch flounder in the Atlantic States Marine Fisheries Commission summer northern shrimp survey, 1984-2007.



Appendix Figure G4. Stratified mean number per tow of age 3 witch flounder in the NEFSC autumn survey, 1980- 2007 (top), and age 4 witch flounder in the NEFSC spring survey, 1980 - 2008 (bottom).

# Appendix H. Gulf of Maine – Georges Bank American plaice

## by Loretta O'Brien, Jay Burnett , and Michele Traver

Appendix H. Table H1. Bootstrapped estimates of mean landings in numbers, with standard deviation (Stdev) and coefficient of variation (CV), and average length and weight with 5% confidence intervals (5% CI, 95% CI) at ag

| | **Gulf of Maine** | | | | | | | | | | | **Georges Bank** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| YEAR | | **Mean Catch** | **Stdev** | **CV** | **Length** | | | **Weight** | | | | **Mean Catc** | **Stdev** | **CV** | **Length** | | | **Weight** | | |
| | **Age** | **(numbers)** | | | **Average** | **5% CI** | **95% CI** | **Average** | **5% CI** | **95% CI** | **Age** | **(numbers)** | | | **Average** | **5% CI** | **95% CI** | **Average** | **5% CI** | **95% CI** |
| **2003** | 4 | 121373 | 61040.49 | 0.50 | 35.935 | 35.192 | 36.798 | 0.395 | 0.369 | 0.427 | 4 | 18324 | 20691.28 | 1.13 | 36.763 | 0 | 38 | 0.424 | 0 | 0.472 |
| | 5 | 641249 | 59791.17 | 0.09 | 37.209 | 36.855 | 37.636 | 0.446 | 0.431 | 0.464 | 5 | 95926 | 45619.39 | 0.48 | 37.112 | 36.25 | 38.867 | 0.44 | 0.405 | 0.524 |
| | 6 | 724331 | 53850.96 | 0.07 | 39.264 | 38.903 | 39.652 | 0.536 | 0.521 | 0.554 | 6 | 318260 | 74368.41 | 0.23 | 41.076 | 40.163 | 42.034 | 0.623 | 0.572 | 0.677 |
| | 7 | 380708 | 40874.67 | 0.11 | 42.01 | 41.396 | 42.71 | 0.675 | 0.644 | 0.711 | 7 | 288011 | 46336.09 | 0.16 | 43.184 | 42.58 | 43.783 | 0.735 | 0.7 | 0.77 |
| | 8 | 275690 | 27778.66 | 0.10 | 44.97 | 44.172 | 45.769 | 0.846 | 0.801 | 0.89 | 8 | 209754 | 44891.03 | 0.21 | 45.621 | 44.814 | 46.823 | 0.89 | 0.837 | 0.976 |
| | 9 | 122912 | 12307 | 0.10 | 47.639 | 46.561 | 48.505 | 1.027 | 0.962 | 1.083 | 9 | 119416 | 29827.97 | 0.25 | 46.264 | 44.52 | 48.63 | 0.956 | 0.84 | 1.122 |
| | 10 | 88951 | 12092.29 | 0.14 | 47.993 | 46.897 | 49.036 | 1.059 | 0.992 | 1.133 | 10 | 52166 | 23966.4 | 0.46 | 49.596 | 46.576 | 54.747 | 1.21 | 0.986 | 1.61 |
| | 11 | 46010 | 8141.45 | 0.18 | 49.486 | 47.62 | 51.042 | 1.176 | 1.07 | 1.294 | 11 | 19747 | 10464.62 | 0.53 | 51.556 | 47.925 | 57.123 | 1.356 | 1.063 | 1.865 |
| | 12 | 13087 | 3331.84 | 0.25 | 52.212 | 50.354 | 54.114 | 1.401 | 1.25 | 1.572 | 12 | 10070 | 7117 | 0.71 | 54.375 | 52.929 | 59 | 1.586 | 1.444 | 2.058 |
| | 13 | 5403 | 3727.05 | 0.69 | 53.254 | 49.221 | 58 | 1.513 | 1.226 | 1.95 | 13 | 1616 | 1787.39 | 1.11 | 54 | 0 | 54 | 1.531 | 0 | 1.531 |
| | 14 | 2163 | 993.67 | 0.46 | 52.853 | 51.474 | 55.727 | 1.445 | 1.313 | 1.733 | 14 | 1871 | 1860.87 | 0.99 | 55.385 | 0 | 62 | 1.672 | 0 | 2.43 |
| | 15 | 605 | 420.95 | 0.70 | 57 | 0 | 66 | 1.896 | 0 | 2.995 | 15 | 1244 | 882.28 | 0.71 | 59.372 | 0 | 62 | 2.109 | 0 | 2.43 |
| **2004** | 3 | | | | | | | | | | 3 | 8676 | 7026.83 | 0.81 | 34.4 | 32.742 | 35 | 0.34 | 0.288 | 0.359 |
| | 4 | 63995 | 16941.22 | 0.26 | 36.961 | 36.106 | 37.793 | 0.433 | 0.4 | 0.466 | 4 | 77740 | 26973.58 | 0.35 | 37.365 | 36.265 | 38.249 | 0.449 | 0.406 | 0.489 |
| | 5 | 312148 | 38419.34 | 0.12 | 37.515 | 37.13 | 37.859 | 0.456 | 0.441 | 0.471 | 5 | 157236 | 23926.21 | 0.15 | 38.688 | 37.867 | 39.451 | 0.512 | 0.474 | 0.548 |
| | 6 | 539603 | 32973.76 | 0.06 | 39.501 | 39.113 | 40.072 | 0.548 | 0.531 | 0.576 | 6 | 269574 | 39632.04 | 0.15 | 39.956 | 39.172 | 40.788 | 0.574 | 0.537 | 0.614 |
| | 7 | 273875 | 34504.72 | 0.13 | 41.719 | 41.205 | 42.34 | 0.661 | 0.634 | 0.693 | 7 | 146571 | 18649.88 | 0.13 | 43.56 | 42.408 | 44.758 | 0.766 | 0.699 | 0.84 |
| | 8 | 206459 | 27493.88 | 0.13 | 44.173 | 43.558 | 45.564 | 0.802 | 0.767 | 0.883 | 8 | 116892 | 22875.12 | 0.20 | 44.437 | 43.224 | 46.124 | 0.839 | 0.764 | 0.951 |
| | 9 | 109896 | 13118.82 | 0.12 | 46.79 | 45.914 | 47.751 | 0.971 | 0.915 | 1.033 | 9 | 57978 | 12151.3 | 0.21 | 48.857 | 47.59 | 50.728 | 1.142 | 1.043 | 1.285 |
| | 10 | 44927 | 9013.48 | 0.20 | 47.124 | 45.686 | 48.912 | 1.002 | 0.907 | 1.123 | 10 | 33243 | 13130.16 | 0.40 | 47.467 | 45.171 | 51.179 | 1.033 | 0.866 | 1.33 |
| | 11 | 26445 | 4645.92 | 0.18 | 48.78 | 46.766 | 50.84 | 1.148 | 1.009 | 1.293 | 11 | 21298 | 8875.66 | 0.42 | 49.45 | 46.929 | 54.633 | 1.204 | 0.987 | 1.649 |
| | 12 | 6113 | 1745.55 | 0.29 | 52.374 | 50.921 | 53.89 | 1.401 | 1.275 | 1.535 | 12 | 10408 | 8710.93 | 0.84 | 48.177 | 0 | 57 | 1.083 | 0 | 1.852 |
| | 13 | 4385 | 1772.16 | 0.40 | 52.575 | 50.651 | 54.711 | 1.424 | 1.261 | 1.617 | | | | | | | | | | |
| | 14 | 1683 | 957.72 | 0.57 | 54.348 | 51.706 | 56.824 | 1.582 | 1.365 | 1.828 | 14 | 577 | 995.45 | 1.72 | | | | | | |
| | 15 | 235 | 156.49 | 0.67 | 55.389 | 52 | 59.31 | 1.684 | 1.349 | 2.095 | | | | | | | | | | |
| **2005** | 3 | | | | | | | | | | 3 | 2760 | 2391.39 | 0.87 | 37 | 0 | 37 | 0.432 | 0 | 0.432 |
| | 4 | 55806 | 20451.62 | 0.37 | 36.289 | 35.602 | 36.974 | 0.408 | 0.383 | 0.434 | 4 | 130609 | 17945.66 | 0.14 | 36.411 | 35.906 | 36.809 | 0.413 | 0.393 | 0.429 |
| | 5 | 337958 | 35010.32 | 0.10 | 38.137 | 37.861 | 38.389 | 0.483 | 0.471 | 0.494 | 5 | 250463 | 31662.41 | 0.13 | 38.265 | 37.725 | 38.877 | 0.491 | 0.469 | 0.516 |
| | 6 | 349848 | 32468.56 | 0.09 | 39.754 | 39.349 | 40.228 | 0.561 | 0.542 | 0.582 | 6 | 204810 | 21103.92 | 0.10 | 40.108 | 39.444 | 40.875 | 0.582 | 0.55 | 0.618 |
| | 7 | 212722 | 22920.28 | 0.11 | 42.096 | 41.465 | 42.747 | 0.684 | 0.653 | 0.719 | 7 | 154143 | 26025.59 | 0.17 | 42.725 | 41.689 | 44.044 | 0.722 | 0.665 | 0.793 |
| | 8 | 96617 | 13459.16 | 0.14 | 44.783 | 44.085 | 45.645 | 0.835 | 0.793 | 0.887 | 8 | 63540 | 10143.65 | 0.16 | 46.092 | 45.343 | 47.016 | 0.918 | 0.867 | 0.98 |
| | 9 | 56631 | 9150.59 | 0.16 | 46.844 | 45.418 | 48.088 | 0.975 | 0.889 | 1.055 | 9 | 36807 | 8431.68 | 0.23 | 46.41 | 44.456 | 48.94 | 0.956 | 0.833 | 1.115 |
| | 10 | 31525 | 7026.8 | 0.22 | 47.158 | 45.569 | 49.044 | 1.004 | 0.899 | 1.13 | 10 | 9804 | 2914.52 | 0.30 | 51.113 | 50.144 | 52.221 | 1.303 | 1.224 | 1.391 |
| | 11 | 18296 | 4313.46 | 0.24 | 50.301 | 49.361 | 51.396 | 1.219 | 1.149 | 1.311 | 11 | 5806 | 1646.54 | 0.28 | 52.676 | 50.285 | 55.113 | 1.438 | 1.233 | 1.658 |
| | 12 | 7425 | 3516.19 | 0.47 | 47.159 | 44.475 | 52.678 | 1.021 | 0.828 | 1.426 | 12 | 6978 | 2315.46 | 0.33 | 51.058 | 48.998 | 52.862 | 1.289 | 1.126 | 1.434 |
| | 13 | 3627 | 1629.78 | 0.45 | 52.346 | 50.838 | 54.022 | 1.387 | 1.254 | 1.548 | 13 | 2649 | 1191.04 | 0.45 | 51.74 | 49.373 | 55.338 | 1.352 | 1.156 | 1.662 |
| | 14 | 1726 | 1165.54 | 0.68 | 53.764 | 51.684 | 55.97 | 1.517 | 1.328 | 1.734 | 14 | 567 | 433.41 | 0.76 | 56.831 | 0 | 59 | 1.819 | 0 | 2.058 |
| | 15 | 776 | 1029.15 | 1.33 | 53 | 0 | 53 | 1.438 | 0 | 1.438 | 15 | 399 | 410.71 | 1.03 | 53 | 0 | 53 | 1.438 | 0 | 1.438 |

Appendix H. Table H1 continued. Bootstrapped estimates of mean landings in numbers, with standard deviation (Stdev) and coefficient of variation (CV), and average length and weight with confidence intervals (5% CI, 95% CI) , at age, for American plaice, 2003-2007

| | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **2006** | 3 | | | | | | | | | | 3 | 2245 | 2277.92 | 1.01 | 34 | 0 | 34 | 0.326 | 0 | 0.326 |
| | 4 | 71243 | 16414.63 | 0.23 | 36.724 | 36.159 | 37.275 | 0.424 | 0.402 | 0.446 | 4 | 85354 | 13899.22 | 0.16 | 37.062 | 36.675 | 37.469 | 0.438 | 0.421 | 0.456 |
| | 5 | 257796 | 31417.66 | 0.12 | 37.652 | 37.319 | 38.061 | 0.463 | 0.449 | 0.481 | 5 | 230286 | 24587.07 | 0.11 | 38.567 | 38.106 | 38.956 | 0.504 | 0.484 | 0.52 |
| | 6 | 214990 | 29231.96 | 0.14 | 39.389 | 38.957 | 39.838 | 0.541 | 0.522 | 0.563 | 6 | 176564 | 24138.32 | 0.14 | 41.226 | 40.618 | 41.985 | 0.637 | 0.607 | 0.675 |
| | 7 | 169875 | 33267.54 | 0.20 | 40.963 | 40.134 | 42.414 | 0.623 | 0.581 | 0.695 | 7 | 110260 | 18343.21 | 0.17 | 43.607 | 43.025 | 44.278 | 0.766 | 0.733 | 0.807 |
| | 8 | 99224 | 11534.42 | 0.12 | 44.564 | 43.78 | 45.276 | 0.82 | 0.776 | 0.863 | 8 | 69859 | 9452.87 | 0.14 | 45.456 | 44.533 | 46.303 | 0.891 | 0.836 | 0.946 |
| | 9 | 57051 | 10638.29 | 0.19 | 45.294 | 43.935 | 46.697 | 0.873 | 0.795 | 0.96 | 9 | 32295 | 4884.53 | 0.15 | 47.742 | 46.688 | 48.916 | 1.052 | 0.974 | 1.139 |
| | 10 | 41034 | 8842.36 | 0.22 | 46.686 | 45.493 | 48.189 | 0.962 | 0.885 | 1.062 | 10 | 10804 | 2363.07 | 0.22 | 50.963 | 49.869 | 52.152 | 1.287 | 1.19 | 1.393 |
| | 11 | 15437 | 5075.82 | 0.33 | 48.746 | 46.396 | 51.251 | 1.114 | 0.953 | 1.3 | 11 | 9489 | 2366.06 | 0.25 | 51.758 | 49.492 | 53.948 | 1.37 | 1.18 | 1.559 |
| | 12 | 7427 | 3635.37 | 0.49 | 51.835 | 50.449 | 53.689 | 1.349 | 1.235 | 1.517 | 12 | 2435 | 1214.19 | 0.50 | 54.873 | 51.455 | 60.208 | 1.67 | 1.324 | 2.24 |
| | 13 | 2115 | 1232.96 | 0.58 | 52.624 | 50.943 | 55.97 | 1.42 | 1.267 | 1.755 | 13 | 1415 | 657.83 | 0.46 | 54.657 | 51.294 | 58.351 | 1.623 | 1.302 | 2.012 |
| | 14 | 1185 | 606.09 | 0.51 | 54.461 | 53.18 | 55.375 | 1.577 | 1.455 | 1.665 | 14 | 308 | 234.67 | 0.76 | 54.631 | 0 | 56 | 1.595 | 0 | 1.729 |
| | 15 | 1989 | 2080.71 | 1.05 | 53.723 | 52 | 57.571 | 1.515 | 1.349 | 1.897 | 15 | 147 | 200.46 | 1.36 | | | | | | |
| **2007** | 3 | | | | | | | | | | 3 | 18293 | 13455.03 | 0.74 | 35.637 | 0 | 36.165 | 0.382 | 0 | 0.401 |
| | 4 | 73360 | 27600.5 | 0.38 | 37.192 | 36.63 | 38.324 | 0.444 | 0.421 | 0.492 | 4 | 182533 | 27657.49 | 0.15 | 35.672 | 35.436 | 35.992 | 0.385 | 0.376 | 0.397 |
| | 5 | 372751 | 57933.98 | 0.16 | 37.876 | 37.168 | 38.341 | 0.473 | 0.445 | 0.492 | 5 | 212803 | 34719.88 | 0.16 | 37.691 | 37.236 | 38.239 | 0.466 | 0.447 | 0.489 |
| | 6 | 282839 | 43098.41 | 0.15 | 39.315 | 38.537 | 40.15 | 0.543 | 0.508 | 0.582 | 6 | 125986 | 16895.72 | 0.13 | 40.225 | 39.447 | 41.152 | 0.586 | 0.55 | 0.633 |
| | 7 | 137063 | 24917.26 | 0.18 | 41.992 | 40.667 | 43.253 | 0.679 | 0.615 | 0.745 | 7 | 55387 | 14026.68 | 0.25 | 41.37 | 40.248 | 43.731 | 0.649 | 0.591 | 0.77 |
| | 8 | 80369 | 21578.32 | 0.27 | 44.114 | 41.481 | 46.185 | 0.803 | 0.664 | 0.917 | 8 | 27632 | 7709.54 | 0.28 | 46.448 | 44.885 | 48.447 | 0.949 | 0.849 | 1.082 |
| | 9 | 53043 | 14383.79 | 0.27 | 45.787 | 42.303 | 47.785 | 0.921 | 0.724 | 1.038 | 9 | 13474 | 3491.69 | 0.26 | 51.897 | 49.407 | 54.074 | 1.368 | 1.153 | 1.565 |
| | 10 | 20473 | 3930.33 | 0.19 | 49.334 | 48.17 | 50.71 | 1.15 | 1.065 | 1.257 | 10 | 9638 | 4832.51 | 0.50 | 46.441 | 42.171 | 52.138 | 0.973 | 0.718 | 1.369 |
| | 11 | 10467 | 2530.08 | 0.24 | 50.483 | 49.382 | 51.683 | 1.241 | 1.15 | 1.337 | 11 | 3546 | 1241.23 | 0.35 | 52.964 | 52.1 | 54.586 | 1.449 | 1.364 | 1.608 |
| | 12 | 2665 | 1054.52 | 0.40 | 51.743 | 50.123 | 54.159 | 1.342 | 1.201 | 1.559 | 12 | 3182 | 1559.82 | 0.49 | 54.495 | 51.814 | 56.699 | 1.592 | 1.357 | 1.809 |
| | 13 | 1258 | 661.55 | 0.53 | 53.578 | 51.185 | 57.148 | 1.511 | 1.29 | 1.865 | 13 | 5371 | 2798.47 | 0.52 | 56.667 | 54 | 62 | 1.83 | 1.531 | 2.43 |
| | 14 | 1155 | 925.83 | 0.80 | 51.733 | 49 | 56 | 1.342 | 1.106 | 1.729 | 14 | 955 | 565.83 | 0.59 | 58.906 | 57.211 | 60 | 2.051 | 1.857 | 2.177 |
| | 15 | | | | | | | | | | 15 | 1019 | 668.75 | 0.66 | 58.198 | 53 | 61.9 | 1.998 | 1.438 | 2.417 |

## Appendix H. Table H2. VPA output and diagnostics for GB-GB American plaice.

```
VPA Version 2.7.1

Model ID: American Plaice Gulf of Maine-Georges Bank 2007 Base Run

Input File: C:\LOB\AP\ASSESS_2008\VPA\B_11P_F69_SV+_9-11\B11P_SV+_BOOT.DAT
Date of Run: 20-JUL-2008                         Time of Run: 13:47

Levenburg-Marquardt Algorithm Completed     9 Iterations
Residual Sum of Squares =     300.043

Number of Residuals     =    743
Number of Parameters    =     10
Degrees of Freedom      =    733
Mean Squared Residual   =     0.409336
Standard Deviation      =     0.639793


Number of Years =    28
Number of Ages  =    11
First Year      =  1980
Youngest Age    =     1
Oldest True Age =    10

Number of Survey Indices Available        =    30
Number of Survey Indices Used in Estimate =    27


VPA Classic Method - Auto Estimated Q's


Stock Numbers Predicted in Terminal Year Plus One (2008)
Age    Stock Predicted     Std. Error      CV

  1          42084.333   0.274534E+05   0.652342E+00
  2          19084.898   0.559295E+04   0.293056E+00
  3          34216.404   0.749229E+04   0.218968E+00
  4          23147.560   0.423645E+04   0.183019E+00
  5          15758.500   0.259021E+04   0.164369E+00
  6           7052.158   0.113337E+04   0.160712E+00
  7           6866.112   0.105831E+04   0.154136E+00
  8           1632.210   0.330953E+03   0.202763E+00
  9           1801.068   0.358493E+03   0.199044E+00
 10           2375.051   0.443839E+03   0.186875E+00

Catchability Values for Each Survey Used in Estimate
INDEX     Catchability    Std. Error      CV

  1       0.756315E-02   0.142550E-02   0.188479E+00
  2       0.117776E+00   0.131015E-01   0.111241E+00
  3       0.237083E+00   0.226727E-01   0.956320E-01
  4       0.345291E+00   0.278629E-01   0.806939E-01
  5       0.332013E+00   0.234096E-01   0.705080E-01
  6       0.270544E+00   0.198359E-01   0.733185E-01
```

```
  7       0.239287E+00   0.222962E-01   0.931778E-01
  8       0.178071E+00   0.243164E-01   0.136554E+00
  9       0.183208E+00   0.279889E-01   0.152771E+00
 11       0.106649E+00   0.124861E-01   0.117077E+00
 12       0.299685E+00   0.259527E-01   0.865999E-01
 13       0.454693E+00   0.396251E-01   0.871469E-01
 14       0.545345E+00   0.407639E-01   0.747489E-01
 15       0.521424E+00   0.446796E-01   0.856877E-01
 16       0.460618E+00   0.447785E-01   0.972141E-01
 17       0.328359E+00   0.416616E-01   0.126878E+00
 18       0.310350E+00   0.441360E-01   0.142214E+00
 20       0.421847E-01   0.102605E-01   0.243227E+00
 21       0.234209E+00   0.370230E-01   0.158077E+00
 22       0.318789E+00   0.249546E-01   0.782794E-01
 23       0.228953E+00   0.182832E-01   0.798555E-01
 24       0.128202E+00   0.126938E-01   0.990135E-01
 26       0.265599E+00   0.400073E-01   0.150631E+00
 27       0.341196E+00   0.393301E-01   0.115271E+00
 28       0.271214E+00   0.304525E-01   0.112282E+00
 29       0.140295E+00   0.194801E-01   0.138851E+00
 30       0.542392E-01   0.102775E-01   0.189484E+00


-- Non-Linear Least Squares Fit --

Default Tolerances Used

Scaled Gradient Tolerance      =    6.055454E-06
Scaled Step Tolerance          =    3.666853E-11
Relative Function Tolerance    =    3.666853E-11
Absolute Function Tolerance    =    4.930381E-32


VPA Method Options

- Catchability Values Estimated as an Analytic Function of N
- Catch Equation Used in Cohort Solution
- Plus Group Backward Calculation Method Used
- Rivard Weights Used for JAN-1 Biomass
- Rivard Weights Used for SSB Biomass
- Rivard Weights Calculation Used  5 Years for Terminal Year Plus One

- Heincke Rule Used in F-Oldest Calculation
- F-Oldest Calculation in Years Prior to Terminal Year
  Uses Stock Sizes in Ages  6 to  9
- Calculation of Population of Age 1 In Year 2008
  =  Stock Estimate

Stock Estimates

Age   1
Age   2
Age   3
Age   4
Age   5
Age   6
Age   7
```

```
Age   8
Age   9
Age  10

Full F in Terminal Year               =   0.0646

F in Oldest True Age in Terminal Year =   0.0646

Full F Calculated Using Classic Method

Age  Input Partial  Calc Partial   Fishing     Used In
     Recruitment    Recruitment    Mortality   Full F    Comments

 1      0.000          0.067       0.0075      NO      Stock Estimate in T+1
 2      0.050          0.055       0.0063      NO      Stock Estimate in T+1
 3      0.050          0.077       0.0087      NO      Stock Estimate in T+1
 4      0.250          0.298       0.0336      NO      Stock Estimate in T+1
 5      0.760          0.869       0.0981      NO      Stock Estimate in T+1
 6      1.000          0.576       0.0650      YES     Stock Estimate in T+1
 7      1.000          1.000       0.1129      YES     Stock Estimate in T+1
 8      1.000          0.486       0.0548      YES     Stock Estimate in T+1
 9      1.000          0.227       0.0256      YES     Stock Estimate in T+1
10      1.000          0.572       0.0646              Input PR * Full F


Catch At Age - Input Data


  AGE       1980         1981         1982         1983         1984
____________________________________________________________________

   1          5.2          5.1          9.6         14.5          2.5
   2         98.9        981.8        603.2        662.8        370.5
   3       1071.7       2191.8       3348.1       1478.2        990.6
   4       2671.5       5055.3       4574.0       5176.8       2422.1
   5       3938.7       5337.2       4503.1       4917.9       6031.2
   6       3933.3       3648.1       3598.6       3913.0       3244.4
   7       3632.0       2400.8       3297.0       2270.2       1935.6
   8       1185.4       1581.6       2037.6       1272.1        580.3
   9       1138.6        645.1       1256.1        701.2        273.8
  10        849.9        439.8        736.7        449.6        307.2
  11       1380.4        620.9        717.4        911.4        768.9

  AGE       1985         1986         1987         1988         1989
____________________________________________________________________

   1         64.8         59.3         38.5        313.5         15.5
   2        157.8        638.7        589.6        785.5       2275.0
   3       1217.4        738.0       1840.5       1839.5       2605.8
   4       1336.4       2284.0       1439.2       1833.4       2517.3
   5       2404.6       1700.0       2282.3       1597.4       1521.9
   6       2872.0       1476.5       1336.9       1444.4        827.2
   7       2228.2       1307.1        895.0        552.8        835.5
   8       1081.3        631.5        542.9        270.3        534.5
   9        438.1        254.9        187.2        177.1        195.6
  10        267.1        104.8         61.6         88.2        103.6
  11        181.9         99.9         59.9         55.3        118.0
```

```
  AGE       1990        1991        1992        1993        1994
 ___________________________________________________________________

   1         0.0         0.4         9.6        21.8        58.2
   2      1094.4       255.2       244.5       280.6       885.8
   3      4725.5      1030.8       861.7       421.6       406.9
   4      3606.7      5997.5      1604.6      1774.5      1710.6
   5      1971.8      4865.9      5810.5      2382.2      2840.7
   6       696.0      1260.9      2649.2      2578.6      1341.7
   7       367.2       326.5       848.7      1384.1      1158.2
   8       404.1       165.8       190.7       264.9       597.0
   9       193.0       201.6       131.2       286.6       234.7
  10        96.1        97.0       117.6       151.2       149.7
  11       161.0       104.1        93.5       124.8       290.5


Catch At Age - Input Data


  AGE       1995        1996        1997        1998        1999
 ___________________________________________________________________

   1        45.3        12.5        14.7        37.2         4.2
   2      2433.7      1149.7       636.1        85.5       216.3
   3      1572.9      1257.3       336.9       348.7       169.0
   4      2359.5      3732.1      2317.2       866.1      1136.2
   5      3294.4      2712.5      3615.0      2859.4      1674.7
   6      1854.2      1506.3      1716.5      2603.7      2352.1
   7       654.6       566.3       633.9      1071.4      1388.6
   8       588.5       242.6       182.1       317.9       488.4
   9       210.3       126.4        84.9        59.5       149.7
  10        52.6        36.8        66.3        56.8        42.3
  11        49.6        68.3       116.2       154.5        79.0

  AGE       2000        2001        2002        2003        2004
 ___________________________________________________________________

   1         2.7         0.0         1.1        11.9         6.1
   2       303.0        91.7        12.9       689.2       140.0
   3       442.2       413.8       108.7        45.5       226.2
   4       797.2       958.8       771.8       297.1       440.3
   5      1650.5      2296.8      1449.5      1238.0       923.9
   6      2223.8      2198.0      1810.7      1275.1      1195.3
   7      1755.2      1579.0      1191.3       743.8       508.0
   8       567.3       911.8       516.1       557.3       364.4
   9       138.2       293.4       283.1       278.7       195.3
  10        69.8        56.3       161.4       153.9        77.3
  11        19.8        51.8       177.2       119.0        73.8

  AGE       2005        2006        2007
 ___________________________________________________________________

   1        34.3        28.4       160.0
   2       283.5        83.4       237.7
   3       106.5       114.0       223.7
   4       434.2       477.6       596.4
```

```
   5        989.7       768.1       806.2
   6        766.8       535.7       511.0
   7        442.2       353.5       216.3
   8        177.3       191.2       112.5
   9         97.2        99.4        68.3
  10         42.3        59.9        33.4
  11         48.8        43.5        30.8


Weight At Age - Input Data


  AGE       1980        1981        1982        1983        1984
 -------------------------------------------------------------------

   1       0.0300      0.0320      0.0180      0.0130      0.0040
   2       0.0760      0.1080      0.1150      0.0330      0.0450
   3       0.1540      0.1680      0.2300      0.1850      0.1610
   4       0.2670      0.3160      0.2900      0.3780      0.3030
   5       0.4090      0.4420      0.4180      0.5300      0.5240
   6       0.6530      0.7780      0.5640      0.6700      0.6300
   7       0.8290      0.8850      0.9600      0.8230      0.8880
   8       1.0390      0.9780      1.1380      1.0420      1.1870
   9       1.1830      1.1300      1.1960      1.2380      1.1330
  10       1.3740      1.2540      1.5520      1.4460      1.3690
  11       1.8950      1.5510      1.9010      1.6800      1.9580

  AGE       1985        1986        1987        1988        1989
 -------------------------------------------------------------------

   1       0.0180      0.0160      0.0130      0.0160      0.0090
   2       0.0580      0.0420      0.0460      0.0460      0.0350
   3       0.0840      0.1380      0.1310      0.1590      0.1050
   4       0.2090      0.2290      0.2340      0.2840      0.2410
   5       0.3310      0.3840      0.4090      0.4490      0.3620
   6       0.5340      0.5870      0.6090      0.6410      0.4540
   7       0.8470      0.8420      0.8920      0.8800      0.6970
   8       1.1670      1.1740      1.1730      1.2310      0.8010
   9       1.3770      1.4910      1.4830      1.3960      1.3270
  10       1.6650      1.7470      1.7320      1.7170      1.4620
  11       2.1280      2.1940      2.2840      2.2380      1.9260

  AGE       1990        1991        1992        1993        1994
 -------------------------------------------------------------------

   1       0.0110      0.0040      0.0060      0.0030      0.0040
   2       0.0380      0.0270      0.0320      0.0310      0.0260
   3       0.1200      0.1100      0.1140      0.2280      0.1890
   4       0.2540      0.3030      0.3200      0.3680      0.3600
   5       0.4010      0.4450      0.5010      0.4890      0.4600
   6       0.5540      0.6780      0.7270      0.6340      0.6080
   7       0.7170      0.9580      0.9250      0.9440      0.7940
   8       0.8760      1.1570      1.2400      1.2340      1.0830
   9       1.0880      1.2740      1.3190      1.3940      1.2890
  10       1.3050      1.5410      1.6400      1.5770      1.4240
  11       1.6960      1.8130      2.0070      2.3130      2.4240
```

```
Weight At Age - Input Data

  AGE       1995         1996         1997         1998         1999
--------------------------------------------------------------------

    1      0.0060       0.0030       0.0060       0.0130       0.0080
    2      0.0270       0.0370       0.0210       0.0300       0.0190
    3      0.1280       0.0990       0.1460       0.1010       0.0830
    4      0.3050       0.3170       0.3470       0.2450       0.2510
    5      0.4890       0.4950       0.4200       0.3480       0.3970
    6      0.6650       0.6350       0.6010       0.4980       0.5130
    7      0.9050       0.8840       0.8070       0.7860       0.6850
    8      1.1550       1.2030       1.1270       1.0310       0.8720
    9      1.0990       1.3900       1.3360       1.3500       1.1090
   10      2.1040       1.5810       1.5700       1.4630       1.4580
   11      1.9200       2.2270       2.4250       3.2930       1.9080

  AGE       2000         2001         2002         2003         2004
--------------------------------------------------------------------

    1      0.0130       0.0110       0.0020       0.0270       0.0050
    2      0.0190       0.0190       0.0350       0.0240       0.0190
    3      0.1850       0.0750       0.1360       0.0950       0.0750
    4      0.3240       0.3170       0.2960       0.2820       0.2420
    5      0.4640       0.4300       0.4150       0.3830       0.3740
    6      0.5720       0.5220       0.5060       0.5300       0.4860
    7      0.7630       0.6960       0.6690       0.6830       0.6470
    8      1.0070       0.8350       0.8840       0.8200       0.7820
    9      1.0940       1.0450       1.0430       0.9500       0.9720
   10      1.4110       1.4540       1.2240       1.1060       1.0090
   11      1.8640       1.5290       1.4460       1.2430       1.2070

  AGE       2005         2006         2007
--------------------------------------------------------------------

    1      0.0090       0.0100       0.0080
    2      0.0170       0.0330       0.0330
    3      0.0700       0.1100       0.1720
    4      0.2910       0.2930       0.3160
    5      0.3990       0.4160       0.4300
    6      0.5070       0.5220       0.5150
    7      0.6410       0.6210       0.6440
    8      0.8480       0.8230       0.8250
    9      0.9460       0.9220       0.9810
   10      1.0730       0.9830       1.0230
   11      1.2800       1.2960       1.5110


JAN-1 Weights at Age - Input Data

  AGE       1980         1981         1982         1983         1984
--------------------------------------------------------------------

    1      0.0158       0.0169       0.0133       0.0070       0.0011
```

| | | | | | |
|---|---|---|---|---|---|
| 2 | 0.0511 | 0.0569 | 0.0607 | 0.0244 | 0.0242 |
| 3 | 0.1075 | 0.1130 | 0.1576 | 0.1459 | 0.0729 |
| 4 | 0.2075 | 0.2206 | 0.2207 | 0.2949 | 0.2368 |
| 5 | 0.2965 | 0.3435 | 0.3634 | 0.3920 | 0.4451 |
| 6 | 0.5609 | 0.5641 | 0.4993 | 0.5292 | 0.5778 |
| 7 | 0.7632 | 0.7602 | 0.8642 | 0.6813 | 0.7713 |
| 8 | 0.9963 | 0.9004 | 1.0036 | 1.0002 | 0.9884 |
| 9 | 1.1490 | 1.0835 | 1.0815 | 1.1869 | 1.0865 |
| 10 | 1.2749 | 1.2180 | 1.3243 | 1.3151 | 1.3019 |
| 11 | 1.8950 | 1.5510 | 1.9010 | 1.6800 | 1.9580 |

| AGE | 1985 | 1986 | 1987 | 1988 | 1989 |
|---|---|---|---|---|---|
| 1 | 0.0118 | 0.0094 | 0.0069 | 0.0108 | 0.0044 |
| 2 | 0.0152 | 0.0275 | 0.0271 | 0.0245 | 0.0237 |
| 3 | 0.0615 | 0.0895 | 0.0742 | 0.0855 | 0.0695 |
| 4 | 0.1834 | 0.1387 | 0.1797 | 0.1929 | 0.1958 |
| 5 | 0.3167 | 0.2833 | 0.3060 | 0.3241 | 0.3206 |
| 6 | 0.5290 | 0.4408 | 0.4836 | 0.5120 | 0.4515 |
| 7 | 0.7305 | 0.6705 | 0.7236 | 0.7321 | 0.6684 |
| 8 | 1.0180 | 0.9972 | 0.9938 | 1.0479 | 0.8396 |
| 9 | 1.2785 | 1.3191 | 1.3195 | 1.2797 | 1.2781 |
| 10 | 1.3735 | 1.5510 | 1.6070 | 1.5957 | 1.4286 |
| 11 | 2.1280 | 2.1940 | 2.2840 | 2.2380 | 1.9260 |

| AGE | 1990 | 1991 | 1992 | 1993 | 1994 |
|---|---|---|---|---|---|
| 1 | 0.0070 | 0.0014 | 0.0026 | 0.0010 | 0.0015 |
| 2 | 0.0185 | 0.0172 | 0.0113 | 0.0136 | 0.0088 |
| 3 | 0.0648 | 0.0647 | 0.0555 | 0.0854 | 0.0765 |
| 4 | 0.1633 | 0.1907 | 0.1876 | 0.2048 | 0.2865 |
| 5 | 0.3109 | 0.3362 | 0.3896 | 0.3956 | 0.4114 |
| 6 | 0.4478 | 0.5214 | 0.5688 | 0.5636 | 0.5453 |
| 7 | 0.5705 | 0.7285 | 0.7919 | 0.8284 | 0.7095 |
| 8 | 0.7814 | 0.9108 | 1.0899 | 1.0684 | 1.0111 |
| 9 | 0.9335 | 1.0564 | 1.2353 | 1.3147 | 1.2612 |
| 10 | 1.3160 | 1.2948 | 1.4455 | 1.4422 | 1.4089 |
| 11 | 1.6960 | 1.8130 | 2.0070 | 2.3130 | 2.4240 |

```
JAN-1 Weights at Age - Input Data

  AGE        1995        1996        1997        1998        1999


   1        0.0024      0.0011      0.0027      0.0108      0.0052
   2        0.0104      0.0149      0.0079      0.0134      0.0157
   3        0.0577      0.0517      0.0735      0.0461      0.0499
   4        0.2401      0.2014      0.1853      0.1891      0.1592
   5        0.4196      0.3886      0.3649      0.3475      0.3119
   6        0.5531      0.5572      0.5454      0.4573      0.4225
   7        0.7418      0.7667      0.7159      0.6873      0.5841
   8        0.9576      1.0434      0.9981      0.9121      0.8279
   9        1.0910      1.2671      1.2678      1.2335      1.0693
  10        1.6468      1.3182      1.4773      1.3981      1.4030
  11        1.9200      2.2270      2.4250      3.2930      1.9080

  AGE        2000        2001        2002        2003        2004


   1        0.0108      0.0062      0.0006      0.0322      0.0027
   2        0.0123      0.0157      0.0196      0.0069      0.0226
   3        0.0593      0.0377      0.0508      0.0577      0.0424
   4        0.1640      0.2422      0.1490      0.1958      0.1516
   5        0.3413      0.3733      0.3627      0.3367      0.3248
   6        0.4765      0.4921      0.4665      0.4690      0.4314
   7        0.6256      0.6310      0.5909      0.5879      0.5856
   8        0.8305      0.7982      0.7844      0.7407      0.7308
   9        0.9767      1.0258      0.9332      0.9164      0.8928
  10        1.2509      1.2612      1.1310      1.0740      0.9791
  11        1.8640      1.5290      1.4460      1.2430      1.2070

  AGE        2005        2006        2007        2008


   1        0.0047      0.0055      0.0035      0.0097
   2        0.0092      0.0172      0.0182      0.0148
   3        0.0365      0.0432      0.0753      0.0510
   4        0.1477      0.1432      0.1864      0.1650
   5        0.3107      0.3479      0.3550      0.3350
   6        0.4355      0.4564      0.4629      0.4510
   7        0.5581      0.5611      0.5798      0.5745
   8        0.7407      0.7263      0.7158      0.7309
   9        0.8601      0.8842      0.8985      0.8904
  10        1.0213      0.9643      0.9712      1.0020
  11        1.2800      1.2960      1.5110      1.3074
```

```
SSB Weight At Age - Input Data

 AGE        1980        1981        1982        1983        1984
-------------------------------------------------------------------

  1        0.0158      0.0169      0.0133      0.0070      0.0011
  2        0.0511      0.0569      0.0607      0.0244      0.0242
  3        0.1075      0.1130      0.1576      0.1459      0.0729
  4        0.2075      0.2206      0.2207      0.2949      0.2368
  5        0.2965      0.3435      0.3634      0.3920      0.4451
  6        0.5609      0.5641      0.4993      0.5292      0.5778
  7        0.7632      0.7602      0.8642      0.6813      0.7713
  8        0.9963      0.9004      1.0036      1.0002      0.9884
  9        1.1490      1.0835      1.0815      1.1869      1.0865
 10        1.2749      1.2180      1.3243      1.3151      1.3019
 11        1.8950      1.5510      1.9010      1.6800      1.9580

 AGE        1985        1986        1987        1988        1989
-------------------------------------------------------------------

  1        0.0118      0.0094      0.0069      0.0108      0.0044
  2        0.0152      0.0275      0.0271      0.0245      0.0237
  3        0.0615      0.0895      0.0742      0.0855      0.0695
  4        0.1834      0.1387      0.1797      0.1929      0.1958
  5        0.3167      0.2833      0.3060      0.3241      0.3206
  6        0.5290      0.4408      0.4836      0.5120      0.4515
  7        0.7305      0.6705      0.7236      0.7321      0.6684
  8        1.0180      0.9972      0.9938      1.0479      0.8396
  9        1.2785      1.3191      1.3195      1.2797      1.2781
 10        1.3735      1.5510      1.6070      1.5957      1.4286
 11        2.1280      2.1940      2.2840      2.2380      1.9260

 AGE        1990        1991        1992        1993        1994
-------------------------------------------------------------------

  1        0.0070      0.0014      0.0026      0.0010      0.0015
  2        0.0185      0.0172      0.0113      0.0136      0.0088
  3        0.0648      0.0647      0.0555      0.0854      0.0765
  4        0.1633      0.1907      0.1876      0.2048      0.2865
  5        0.3109      0.3362      0.3896      0.3956      0.4114
  6        0.4478      0.5214      0.5688      0.5636      0.5453
  7        0.5705      0.7285      0.7919      0.8284      0.7095
  8        0.7814      0.9108      1.0899      1.0684      1.0111
  9        0.9335      1.0564      1.2353      1.3147      1.2612
 10        1.3160      1.2948      1.4455      1.4422      1.4089
 11        1.6960      1.8130      2.0070      2.3130      2.4240
```

```
SSB Weight At Age - Input Data

 AGE        1995        1996        1997        1998        1999
__________________________________________________________________

  1       0.0024      0.0011      0.0027      0.0108      0.0052
  2       0.0104      0.0149      0.0079      0.0134      0.0157
  3       0.0577      0.0517      0.0735      0.0461      0.0499
  4       0.2401      0.2014      0.1853      0.1891      0.1592
  5       0.4196      0.3886      0.3649      0.3475      0.3119
  6       0.5531      0.5572      0.5454      0.4573      0.4225
  7       0.7418      0.7667      0.7159      0.6873      0.5841
  8       0.9576      1.0434      0.9981      0.9121      0.8279
  9       1.0910      1.2671      1.2678      1.2335      1.0693
 10       1.6468      1.3182      1.4773      1.3981      1.4030
 11       1.9200      2.2270      2.4250      3.2930      1.9080

 AGE        2000        2001        2002        2003        2004
__________________________________________________________________

  1       0.0108      0.0062      0.0006      0.0322      0.0027
  2       0.0123      0.0157      0.0196      0.0069      0.0226
  3       0.0593      0.0377      0.0508      0.0577      0.0424
  4       0.1640      0.2422      0.1490      0.1958      0.1516
  5       0.3413      0.3733      0.3627      0.3367      0.3248
  6       0.4765      0.4921      0.4665      0.4690      0.4314
  7       0.6256      0.6310      0.5909      0.5879      0.5856
  8       0.8305      0.7982      0.7844      0.7407      0.7308
  9       0.9767      1.0258      0.9332      0.9164      0.8928
 10       1.2509      1.2612      1.1310      1.0740      0.9791
 11       1.8640      1.5290      1.4460      1.2430      1.2070

 AGE        2005        2006        2007
__________________________________________________________________

  1       0.0047      0.0055      0.0035
  2       0.0092      0.0172      0.0182
  3       0.0365      0.0432      0.0753
  4       0.1477      0.1432      0.1864
  5       0.3107      0.3479      0.3550
  6       0.4355      0.4564      0.4629
  7       0.5581      0.5611      0.5798
  8       0.7407      0.7263      0.7158
  9       0.8601      0.8842      0.8985
 10       1.0213      0.9643      0.9712
 11       1.2800      1.2960      1.5110
```

```
Natural Mortality - Input Data

 AGE       1980        1981        1982        1983        1984
_________________________________________________________________

   1      0.2000      0.2000      0.2000      0.2000      0.2000
   2      0.2000      0.2000      0.2000      0.2000      0.2000
   3      0.2000      0.2000      0.2000      0.2000      0.2000
   4      0.2000      0.2000      0.2000      0.2000      0.2000
   5      0.2000      0.2000      0.2000      0.2000      0.2000
   6      0.2000      0.2000      0.2000      0.2000      0.2000
   7      0.2000      0.2000      0.2000      0.2000      0.2000
   8      0.2000      0.2000      0.2000      0.2000      0.2000
   9      0.2000      0.2000      0.2000      0.2000      0.2000
  10      0.2000      0.2000      0.2000      0.2000      0.2000
  11      0.2000      0.2000      0.2000      0.2000      0.2000

 AGE       1985        1986        1987        1988        1989
_________________________________________________________________

   1      0.2000      0.2000      0.2000      0.2000      0.2000
   2      0.2000      0.2000      0.2000      0.2000      0.2000
   3      0.2000      0.2000      0.2000      0.2000      0.2000
   4      0.2000      0.2000      0.2000      0.2000      0.2000
   5      0.2000      0.2000      0.2000      0.2000      0.2000
   6      0.2000      0.2000      0.2000      0.2000      0.2000
   7      0.2000      0.2000      0.2000      0.2000      0.2000
   8      0.2000      0.2000      0.2000      0.2000      0.2000
   9      0.2000      0.2000      0.2000      0.2000      0.2000
  10      0.2000      0.2000      0.2000      0.2000      0.2000
  11      0.2000      0.2000      0.2000      0.2000      0.2000

 AGE       1990        1991        1992        1993        1994
_________________________________________________________________

   1      0.2000      0.2000      0.2000      0.2000      0.2000
   2      0.2000      0.2000      0.2000      0.2000      0.2000
   3      0.2000      0.2000      0.2000      0.2000      0.2000
   4      0.2000      0.2000      0.2000      0.2000      0.2000
   5      0.2000      0.2000      0.2000      0.2000      0.2000
   6      0.2000      0.2000      0.2000      0.2000      0.2000
   7      0.2000      0.2000      0.2000      0.2000      0.2000
   8      0.2000      0.2000      0.2000      0.2000      0.2000
   9      0.2000      0.2000      0.2000      0.2000      0.2000
  10      0.2000      0.2000      0.2000      0.2000      0.2000
  11      0.2000      0.2000      0.2000      0.2000      0.2000
```

```
Natural Mortality - Input Data

   AGE         1995         1996         1997         1998         1999
--------------------------------------------------------------------------

    1        0.2000       0.2000       0.2000       0.2000       0.2000
    2        0.2000       0.2000       0.2000       0.2000       0.2000
    3        0.2000       0.2000       0.2000       0.2000       0.2000
    4        0.2000       0.2000       0.2000       0.2000       0.2000
    5        0.2000       0.2000       0.2000       0.2000       0.2000
    6        0.2000       0.2000       0.2000       0.2000       0.2000
    7        0.2000       0.2000       0.2000       0.2000       0.2000
    8        0.2000       0.2000       0.2000       0.2000       0.2000
    9        0.2000       0.2000       0.2000       0.2000       0.2000
   10        0.2000       0.2000       0.2000       0.2000       0.2000
   11        0.2000       0.2000       0.2000       0.2000       0.2000

   AGE         2000         2001         2002         2003         2004
--------------------------------------------------------------------------

    1        0.2000       0.2000       0.2000       0.2000       0.2000
    2        0.2000       0.2000       0.2000       0.2000       0.2000
    3        0.2000       0.2000       0.2000       0.2000       0.2000
    4        0.2000       0.2000       0.2000       0.2000       0.2000
    5        0.2000       0.2000       0.2000       0.2000       0.2000
    6        0.2000       0.2000       0.2000       0.2000       0.2000
    7        0.2000       0.2000       0.2000       0.2000       0.2000
    8        0.2000       0.2000       0.2000       0.2000       0.2000
    9        0.2000       0.2000       0.2000       0.2000       0.2000
   10        0.2000       0.2000       0.2000       0.2000       0.2000
   11        0.2000       0.2000       0.2000       0.2000       0.2000

   AGE         2005         2006         2007
--------------------------------------------------------------------------

    1        0.2000       0.2000       0.2000
    2        0.2000       0.2000       0.2000
    3        0.2000       0.2000       0.2000
    4        0.2000       0.2000       0.2000
    5        0.2000       0.2000       0.2000
    6        0.2000       0.2000       0.2000
    7        0.2000       0.2000       0.2000
    8        0.2000       0.2000       0.2000
    9        0.2000       0.2000       0.2000
   10        0.2000       0.2000       0.2000
   11        0.2000       0.2000       0.2000

Proportion of Natural Mortality Before Spawning =       0.2500
Proportion of Fishing Mortality Before Spawning =       0.2500
```

```
Maturity - Input Data

 AGE      1980        1981        1982        1983        1984

   1     0.0100      0.0100      0.0100      0.0100      0.0200
   2     0.0400      0.0500      0.0500      0.0500      0.0700
   3     0.1500      0.1800      0.1700      0.1700      0.2100
   4     0.4500      0.4600      0.4300      0.4400      0.5000
   5     0.8000      0.7700      0.7400      0.7600      0.7900
   6     0.9500      0.9300      0.9100      0.9300      0.9300
   7     0.9900      0.9800      0.9700      0.9800      0.9800
   8     1.0000      1.0000      0.9900      1.0000      0.9900
   9     1.0000      1.0000      1.0000      1.0000      1.0000
  10     1.0000      1.0000      1.0000      1.0000      1.0000
  11     1.0000      1.0000      1.0000      1.0000      1.0000

 AGE      1985        1986        1987        1988        1989

   1     0.0300      0.0200      0.0100      0.0100      0.0100
   2     0.1000      0.0700      0.0500      0.0500      0.0400
   3     0.2600      0.2400      0.2400      0.2500      0.2200
   4     0.5500      0.5600      0.6500      0.6900      0.6600
   5     0.8000      0.8400      0.9200      0.9400      0.9300
   6     0.9300      0.9600      0.9900      0.9900      0.9900
   7     0.9800      0.9900      1.0000      1.0000      1.0000
   8     0.9900      1.0000      1.0000      1.0000      1.0000
   9     1.0000      1.0000      1.0000      1.0000      1.0000
  10     1.0000      1.0000      1.0000      1.0000      1.0000
  11     1.0000      1.0000      1.0000      1.0000      1.0000

 AGE      1990        1991        1992        1993        1994

   1     0.0000      0.0000      0.0000      0.0000      0.0000
   2     0.0200      0.0200      0.0200      0.0200      0.0200
   3     0.1500      0.1500      0.1500      0.1300      0.1300
   4     0.6200      0.6000      0.6000      0.5700      0.5700
   5     0.9400      0.9300      0.9200      0.9200      0.9200
   6     0.9900      0.9900      0.9900      0.9900      0.9900
   7     1.0000      1.0000      1.0000      1.0000      1.0000
   8     1.0000      1.0000      1.0000      1.0000      1.0000
   9     1.0000      1.0000      1.0000      1.0000      1.0000
  10     1.0000      1.0000      1.0000      1.0000      1.0000
  11     1.0000      1.0000      1.0000      1.0000      1.0000
```

```
Maturity - Input Data

  AGE       1995        1996        1997        1998        1999
____________________________________________________________________

   1       0.0000      0.0000      0.0000      0.0000      0.0000
   2       0.0200      0.0200      0.0200      0.0200      0.0200
   3       0.1300      0.1400      0.1200      0.1400      0.1500
   4       0.5600      0.5600      0.5600      0.5800      0.5500
   5       0.9200      0.9100      0.9200      0.9200      0.9000
   6       0.9900      0.9900      0.9900      0.9900      0.9800
   7       1.0000      1.0000      1.0000      1.0000      1.0000
   8       1.0000      1.0000      1.0000      1.0000      1.0000
   9       1.0000      1.0000      1.0000      1.0000      1.0000
  10       1.0000      1.0000      1.0000      1.0000      1.0000
  11       1.0000      1.0000      1.0000      1.0000      1.0000

  AGE       2000        2001        2002        2003        2004
____________________________________________________________________

   1       0.0000      0.0000      0.0000      0.0000      0.0000
   2       0.0200      0.0200      0.0200      0.0300      0.0200
   3       0.1600      0.1600      0.1500      0.1500      0.1300
   4       0.5900      0.6200      0.5900      0.5400      0.5400
   5       0.9200      0.9400      0.9200      0.8800      0.9000
   6       0.9900      0.9900      0.9900      0.9800      0.9900
   7       1.0000      1.0000      1.0000      1.0000      1.0000
   8       1.0000      1.0000      1.0000      1.0000      1.0000
   9       1.0000      1.0000      1.0000      1.0000      1.0000
  10       1.0000      1.0000      1.0000      1.0000      1.0000
  11       1.0000      1.0000      1.0000      1.0000      1.0000

  AGE       2005        2006        2007
____________________________________________________________________

   1       0.0100      0.0100      0.0100
   2       0.0300      0.0300      0.0400
   3       0.1800      0.1800      0.2000
   4       0.5700      0.5700      0.5900
   5       0.8900      0.8900      0.9000
   6       0.9800      0.9800      0.9800
   7       1.0000      1.0000      1.0000
   8       1.0000      1.0000      1.0000
   9       1.0000      1.0000      1.0000
  10       1.0000      1.0000      1.0000
  11       1.0000      1.0000      1.0000
```

```
Input Partial Recruitment

  AGE

   1       0.0000
   2       0.0500
   3       0.0500
   4       0.2500
   5       0.7600
   6       1.0000
   7       1.0000
   8       1.0000
   9       1.0000
  10       1.0000


Input F-Plus Ratio

  YEAR

  1980       1.0000
  1981       1.0000
  1982       1.0000
  1983       1.0000
  1984       1.0000
  1985       1.0000
  1986       1.0000
  1987       1.0000
  1988       1.0000
  1989       1.0000
  1990       1.0000
  1991       1.0000
  1992       1.0000
  1993       1.0000
  1994       1.0000
  1995       1.0000
  1996       1.0000
  1997       1.0000
  1998       1.0000
  1999       1.0000
  2000       1.0000
  2001       1.0000
  2002       1.0000
  2003       1.0000
  2004       1.0000
  2005       1.0000
  2006       1.0000
  2007       1.0000
```

```
 SURVEY - INPUT DATA

INDEX              1           2           3           4           5

SURVEY TAG      spr_us      spr_us      spr_us      spr_us      spr_us

AGE                 1           2           3           4           5
TIME            JAN-1       JAN-1       JAN-1       JAN-1       JAN-1
TYPE           NUMBERS     NUMBERS     NUMBERS     NUMBERS     NUMBERS
RETRO FLAG        1           1           1           1           1
 ________________________________________________________________________

    1980     1333.6100  10935.5800  13484.2500   9038.8900   8683.2600
    1981      385.2600  10165.0500  12476.6400  10253.9600   7734.9200
    1982       88.9100   3111.7500   5304.7900   9394.5200   6312.4100
    1983      592.7100  10905.9400   9868.6900  13276.8000   7823.8300
    1984       29.6400   1037.2500   1659.6000   2667.2100   3823.0100
    1985       88.9100    948.3400   2904.3000   2548.6700   2163.4100
    1986       29.6400   1363.2400   1007.6100   2993.2100   1748.5100
    1987      266.7200   1807.7800   2933.9400   2044.8600   1511.4200
    1988      592.7100   2933.9400   2489.4000   2252.3100    918.7100
    1989      148.1800   4712.0800   3763.7400   2548.6700   1452.1500
    1990        0.0000   1689.2400   7853.4600   3022.8400   1600.3300
    1991       88.9100   2104.1400   4830.6200   6905.1200   2726.4900
    1992      177.8100   1007.6100   3408.1100   2607.9400   3171.0200
    1993      977.9800   2489.4000   3437.7400   4682.4400   1807.7800
    1994       88.9100   4237.9100   3378.4700   3319.2000   2222.6800
    1995       88.9100   5838.2400   9513.0600   6816.2100   3289.5600
    1996       59.2700   1392.8800   5749.3300   9779.7900   3882.2800
    1997       29.6400   2519.0400   4919.5300   7468.2000   6075.3200
    1998      177.8100    563.0800   3022.8400   3319.2000   3615.5600
    1999      237.0900   1215.0600   1541.0600   3348.8400   2341.2200
    2000       88.9100   5660.4200   7349.6600   6579.1300   4741.7100
    2001        0.0000   2098.2100  10876.3100   9987.2400   4297.1800
    2002      297.8400   1024.5100   2911.1200   6964.3900   4931.6800
    2003      132.7700   2247.2800    798.9800   2088.7300   3676.0100
    2004     1074.2900   2567.6400   6001.8200   5303.0100   3930.2900
    2005      578.7900   2303.2900   3087.4500   3647.8600   2707.8200
    2006     2258.2400   4799.8000   5080.7500   5042.5200   2480.5100
    2007      726.0800  11092.0600   8227.7600   4780.5400   3017.2100
    2008      318.2900   1728.9500   6066.1300   8426.0300   4146.9300
```

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 SURVEY - INPUT DATA

INDEX              6           7           8           9          10

SURVEY TAG     spr_us      spr_us      spr_us      spr_us      us0aut

AGE                6           7           8      9 -  11          1
TIME           JAN-1       JAN-1       JAN-1       JAN-1       JAN-1
TYPE         NUMBERS     NUMBERS     NUMBERS     NUMBERS     NUMBERS
RETRO FLAG         1           1           1           1           1
 ________________________________________________________________________

    1980   4771.3500   3378.4700    770.5300   1944.1029      0.0000
    1981   5008.4400   4178.6400   2281.9500   3082.1143      0.0000
    1982   3941.5500   2726.4900   1481.7900   2044.8643      8.8900
    1983   3497.0100   1718.8700    948.3400   1541.0571      0.0000
    1984   1718.8700    651.9900    296.3600    266.7214    177.8100
    1985   2548.6700   1363.2400   1244.7000    859.4357     59.2700
    1986    859.4400    622.3500    296.3600    237.0857     59.2700
    1987    740.8900    503.8100    207.4500    296.3571    296.3600
    1988    681.6200    355.6300     29.6400    325.9929     29.6400
    1989    859.4400    474.1700     88.9100    266.7214      0.0000
    1990    503.8100    177.8100    118.5400    148.1786    148.1800
    1991    444.5400    207.4500    118.5400    148.1786     29.6400
    1992   1274.3400    325.9900    118.5400    118.5429     29.6400
    1993   1333.6100    503.8100    237.0900    237.0857     59.2700
    1994    681.6200    296.3600     88.9100    148.1786     29.6400
    1995   1303.9700    651.9900     88.9100    355.6286    118.5400
    1996   1570.6900    592.7100    148.1800     59.2714     29.6400
    1997   1155.7900    266.7200     29.6400     88.9071     29.6400
    1998   2015.2300    474.1700    177.8100     88.9071     29.6400
    1999   1896.6900   1215.0600    503.8100    118.5429     29.6400
    2000   2548.6700   1778.1400    444.5400    296.3571     59.2700
    2001   2222.6800   1096.5200    503.8100    474.1714     88.9100
    2002   1515.5700    988.6500    579.9700    645.4659     59.2700
    2003   1892.2400    653.4700    303.7700    554.7806    144.0300
    2004   3370.1700   1020.0600    290.4300    611.0884     98.9800
    2005   1470.2300    702.9600    342.8900     48.8989     28.7500
    2006    958.4200    881.9600    317.9900    170.7017      0.0000
    2007    966.4200    406.9000    207.7500    120.0246     77.6500
    2008   1886.3100    642.2100    253.0900    362.1484     56.3100
```

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 SURVEY - INPUT DATA

INDEX            11          12          13          14          15

SURVEY TAG     us1aut      us2aut      us3aut      us4aut      us5aut

AGE                2           3           4           5           6
TIME            JAN-1       JAN-1       JAN-1       JAN-1       JAN-1
TYPE          NUMBERS     NUMBERS     NUMBERS     NUMBERS     NUMBERS
RETRO FLAG       1           1           1           1           1
 ________________________________________________________________________

    1980       0.0000      0.0000      0.0000      0.0000      0.0000
    1981    4682.4400   6608.7600   8060.9100   8416.5400   4534.2600
    1982    1303.9700   7823.8300   6401.3100   7349.6600   6401.3100
    1983     592.7100   2696.8500   4889.8900   3763.7400   1689.2400
    1984    1481.7900   2993.2100   5986.4100   8653.6300   4030.4600
    1985     651.9900   6638.4000   4623.1700   3585.9200   3171.0200
    1986    2696.8500   2459.7600   7823.8300   3111.7500   2341.2200
    1987    1511.4200   4326.8100   2578.3100   4237.9100   1392.8800
    1988    1570.6900   3763.7400   2933.9400   1274.3400   2044.8600
    1989    8416.5400   8801.8100   7082.9400   2311.5900   1392.8800
    1990    1422.5100  13187.8900   8475.8100   2904.3000    563.0800
    1991    5067.7100   6697.6700  22197.1500   8564.7200   1748.5100
    1992    1392.8800   7320.0200   5986.4100   4712.0800   2163.4100
    1993    1926.3200   3645.1900   5482.6100   3793.3700   2311.5900
    1994    5038.0700   6934.7600  10283.5900   6756.9400   3111.7500
    1995   11350.4800  22315.6900   8327.6400   5067.7100   3852.6400
    1996    1481.7900  11261.5700  11320.8400   7408.9300   2667.2100
    1997    1600.3300   2400.4900   5927.1400   8120.1900   2756.1200
    1998    1066.8900   3141.3900   4593.5400   5512.2400   3082.1100
    1999    5126.9800   1778.1400   5571.5100   5956.7800   5275.1600
    2000    5927.1400   6519.8600   6075.3200   6312.4100   4741.7100
    2001    1392.8800   8594.3600  11587.5600   6756.9400   4000.8200
    2002    1185.4300   3615.5600   9809.4200   7823.8300   4326.8100
    2003    2955.8700   2270.6900   3864.2000   9955.8200   5120.1600
    2004    2077.7600   6697.3800   3726.6900   5206.4000   5147.7200
    2005    2081.6100   2845.9200   3533.7600   2917.0400   2172.8900
    2006    2041.0100   4876.8500   2141.1800   3464.1200   2209.9400
    2007    6052.8000   7517.9900   7742.3300   7619.6400   4186.9300
    2008    3187.0200  10214.2500   8386.3100   6491.4100   2508.9600
```

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 SURVEY - INPUT DATA

INDEX            16          17          18          19          20

SURVEY TAG     us6aut      us7aut      us8paut     us8aut      spr_ma

AGE                7           8       9 -  11         9           1
TIME           JAN-1       JAN-1       JAN-1       JAN-1       JAN-1
TYPE          NUMBERS     NUMBERS     NUMBERS     NUMBERS     NUMBERS
RETRO FLAG       1           1           1           1           1

    1980        0.0000      0.0000      0.0000      0.0000      0.0000
    1981     3022.8400   2756.1200   4119.3643   1689.2400      0.0000
    1982     4267.5400   1748.5100   3259.9286   1570.6900   1622.2300
    1983     1422.5100    889.0700   1452.1500    503.8100    436.0600
    1984     2015.2300   1007.6100   1333.6071    503.8100    485.7600
    1985     1511.4200    355.6300    503.8071    296.3600   4871.2000
    1986     1215.0600    563.0800    325.9929    148.1800   6113.8500
    1987     1244.7000    474.1700    563.0786    325.9900   7763.1900
    1988      740.8900    296.3600    325.9929    118.5400  18407.0700
    1989      296.3600    207.4500    148.1786      0.0000   1823.3100
    1990      296.3600     59.2700    266.7214     59.2700   1746.4900
    1991      740.8900    355.6300    414.9000    207.4500    474.4700
    1992      859.4400    118.5400    237.0857    177.8100   1852.2800
    1993      889.0700    207.4500    355.6286    148.1800   2619.9000
    1994     2370.8600    325.9900    355.6286    118.5400   2621.0000
    1995     1185.4300    740.8900    563.0786    385.2600    122.1900
    1996      651.9900    118.5400    148.1786     88.9100    516.7600
    1997     1155.7900    207.4500    325.9929    118.5400    349.8200
    1998      948.3400    118.5400    118.5429     29.6400    639.4000
    1999     3200.6600    355.6300    237.0857    148.1800    305.0100
    2000     2400.4900    592.7100     88.9071     88.9100    779.2800
    2001     2222.6800    977.9800    592.7143    414.9000     15.8200
    2002     1570.6900   1215.0600   1185.4286    592.7100   1414.3600
    2003     1573.0600   1170.3100   1655.4510    853.8000   1163.5700
    2004     2621.2800   1033.9900    923.7452    395.3400   3727.9600
    2005     1472.9000    566.9300    430.6069    271.7600   1504.7400
    2006     1259.5200    432.9800    678.6579    298.7300   1070.9400
    2007     1677.0900   1305.7500    734.6694    487.8000    571.6200
    2008     1239.3700    442.1600    120.0246     65.7900      0.0000
```

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 SURVEY - INPUT DATA

INDEX            21          22          23          24          25

SURVEY TAG     spr_ma      spr_ma      spr_ma      spr_ma      ma0aut

AGE                2           3           4           5           1
TIME           JAN-1       JAN-1       JAN-1       JAN-1       JAN-1
TYPE          NUMBERS     NUMBERS     NUMBERS     NUMBERS     NUMBERS
RETRO FLAG       1           1           1           1           1
 ------------------------------------------------------------------------

    1980        0.0000      0.0000      0.0000      0.0000      0.0000
    1981        0.0000      0.0000      0.0000      0.0000      0.0000
    1982    11127.3900   7534.9900   3872.5600   1129.6800      0.0000
    1983     4238.5700   5065.5000   4848.6000   2309.0700     38.4100
    1984     6199.7100   4816.9700   2388.1500   1048.3500    291.4600
    1985     3877.0800   5472.1900   2146.4000    851.7800     24.8500
    1986    24914.0500   6079.9600   3260.2700    641.6600      0.0000
    1987     3899.6700   3567.5400    881.1500    397.6500     51.9700
    1988    14362.8000   4032.9700   1970.1700    347.9400     54.2200
    1989    28752.7200  10160.3800   2708.9800    684.5900      0.0000
    1990     5732.0200  12812.8800   3723.4400    774.9600      6.7800
    1991     4514.2200   7855.8200   4288.2800    732.0400     18.0700
    1992     2498.2700   7677.1300   3387.2900   1676.9500      9.0400
    1993     4288.4400   3633.7000   2069.4000    779.1000      0.0000
    1994    11876.5300   4998.7200   1611.3600    876.3600      0.0000
    1995     7828.7800  11216.3800   2332.7500    712.9400      0.0000
    1996      935.9700   3371.2500   7092.5200   1429.3200      0.0000
    1997     1799.0700   3151.8400   3894.1300   2758.4900     20.7900
    1998      978.3100   2586.9800   1701.3000   2017.6200      0.0000
    1999     2632.1600   2632.1600   3413.9100   1710.3400     36.1500
    2000    12768.4400   7875.5900   4513.7200   3002.8800      0.0000
    2001     1073.2000   5356.9600   3847.7000   1070.9400      6.7800
    2002      937.6400   2433.3400   4200.1700   1339.8100      0.0000
    2003    10140.0400   2797.1000   4127.8700   4026.1900     38.4100
    2004     2675.0900   7661.5200   2952.9900   1281.0600      0.0000
    2005     4753.7100   5180.7300   1861.7200   1084.5000      0.0000
    2006    12252.5500   7907.7900   3210.5600   1116.1300      0.0000
    2007    11021.2000   9688.1700   3563.0200   1683.2300      0.0000
    2008        0.0000      0.0000      0.0000      0.0000     15.8200
```

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 SURVEY - INPUT DATA


INDEX            26          27          28          29          30

SURVEY TAG     ma1aut      ma2aut      ma3aut      ma4aut      ma5aut

AGE                2           3           4           5           6
TIME           JAN-1       JAN-1       JAN-1       JAN-1       JAN-1
TYPE          NUMBERS     NUMBERS     NUMBERS     NUMBERS     NUMBERS
RETRO FLAG       1           1           1           1           1
 ________________________________________________________________________

    1980        0.0000      0.0000      0.0000      0.0000      0.0000
    1981        0.0000      0.0000      0.0000      0.0000      0.0000
    1982        0.0000      0.0000      0.0000      0.0000      0.0000
    1983     2991.4000   3492.9800   2309.0700   1154.5400    257.5700
    1984    11787.1200   4288.2800   2263.8900   1875.2800    314.0500
    1985      709.4400   2991.4000    964.7500    413.4600    173.9700
    1986    13775.3700   2135.1000   3210.5600    352.4600     31.6300
    1987     9324.4100   9055.5500   2727.0600   1197.4700     88.1200
    1988    10474.4300   3298.6800    677.8100    117.4900     51.9700
    1989    19346.9700   9326.6700   3158.6000    302.7600    101.6700
    1990    13004.9200  27620.7800   7010.8200    526.4300     29.3700
    1991     7227.7200   3208.3000   4545.8500    887.9300     47.4500
    1992     5438.3000  20415.6500   9048.7700   2600.5300    264.3500
    1993    10467.3800   2935.9800   6731.6300   2495.1300    311.2300
    1994    17217.8500   8314.0200   3973.6900   1547.9600    386.2600
    1995     8294.1200  17919.8900   2431.8500    656.6200    351.7600
    1996     2675.3900   9990.4700   5632.1500    952.1700    204.5200
    1997     3672.1500   4348.6300   6225.6400   3155.1900    313.4000
    1998     3075.2900   6345.1200   4045.9200   2325.4500    329.7300
    1999     7808.3800   1382.7300   3117.9300   1604.1500    849.5200
    2000     6604.1300   7358.7600   4656.5600   2390.4100    643.9200
    2001     1414.3600   5799.8000   4387.6900   1357.8800    675.5500
    2002      680.0700   3323.5300   6961.1100   2049.2500    603.2500
    2003     8881.5800   2117.0300   2661.5400   3361.9400    840.4800
    2004     5417.9600   7473.9900   3217.3400   1712.6000    903.7500
    2005    13560.7300   4315.3900   2250.3300   1425.6600    619.0700
    2006     9358.3000  12318.0800   3330.3100   2632.1600    953.4500
    2007     3278.3400  10198.7900   4699.4900   2458.1900    933.1200
    2008     1796.2000   5542.2300   4347.0200   2444.6400    630.3600

     Additional Output Files

Population File C:\LOB\AP\ASSESS_2008\VPA\B_11P_F69_SV+_9-
11\B11P_SV+_BOOT.PP2
Auxilliary File C:\LOB\AP\ASSESS_2008\VPA\B_11P_F69_SV+_9-
11\B11P_SV+_BOOT.AUX
Covariance File C:\LOB\AP\ASSESS_2008\VPA\B_11P_F69_SV+_9-11\B11P_SV+_BOOT.CV
Residuals File  C:\LOB\AP\ASSESS_2008\VPA\B_11P_F69_SV+_9-
11\B11P_SV+_BOOT.RSD
Log File        C:\LOB\AP\ASSESS_2008\VPA\B_11P_F69_SV+_9-
11\B11P_SV+_BOOT.LOG

     Bootstrap Files
```

```
Bootstrap Stock Numbers     C:\LOB\AP\ASSESS_2008\VPA\B_11P_F69_SV+_9-
11\B11P_SV+_BOOT.BSN
Bootstrap Fishing Mortality C:\LOB\AP\ASSESS_2008\VPA\B_11P_F69_SV+_9-
11\B11P_SV+_BOOT.BSF
Bootstrap Biomass           C:\LOB\AP\ASSESS_2008\VPA\B_11P_F69_SV+_9-
11\B11P_SV+_BOOT.BSB
Bootstrap Catchability      C:\LOB\AP\ASSESS_2008\VPA\B_11P_F69_SV+_9-
11\B11P_SV+_BOOT.BSQ


                           Estimation Results

 JAN-1 Population Numbers


   AGE       1980        1981        1982        1983        1984
 ______________________________________________________________________
    1       50300.      26027.      20849.      24666.      15520.
    2       39477.      41178.      21304.      17061.      20182.
    3       32635.      32231.      32827.      16898.      13370.
    4       24065.      25752.      24412.      23858.      12502.
    5       19254.      17295.      16536.      15870.      14878.
    6       13955.      12221.       9371.       9494.       8582.
    7        9947.       7894.       6732.       4451.       4273.
    8        4678.       4891.       4309.       2570.       1621.
    9        3006.       2765.       2586.       1709.        970.
   10        2776.       1441.       1684.        996.        772.
   11        4509.       2035.       1640.       2019.       1932.
 ===================================================================
 Total     204602.     173729.     142248.     119593.      94601.

   AGE       1985        1986        1987        1988        1989
 ______________________________________________________________________

    1       19012.      23602.      41613.      53494.      20981.
    2       12704.      15507.      19270.      34035.      43514.
    3       16189.      10259.      12120.      15245.      27156.
    4       10053.      12156.       7733.       8265.      10824.
    5        8056.       7027.       7897.       5037.       5118.
    6        6785.       4438.       4225.       4417.       2691.
    7        4121.       2987.       2310.       2260.       2321.
    8        1770.       1390.       1278.       1090.       1354.
    9         807.        489.        574.        561.        649.
   10         548.        271.        173.        302.        300.
   11         373.        258.        169.        189.        342.
 ===================================================================
 Total      80418.      78384.      97362.     124895.     115250.

   AGE       1990        1991        1992        1993        1994
 ______________________________________________________________________

    1       21648.      22668.      25137.      39653.      38756.
    2       17164.      17722.      18557.      20571.      32445.
    3       33573.      13065.      14279.      14973.      16589.
    4       19884.      23231.       9767.      10913.      11878.
```

```
    5       6599.      13034.      13632.       6552.       7337.
    6       2825.       3633.       6314.       5966.       3230.
    7       1461.       1687.       1844.       2800.       2580.
    8       1152.        866.       1088.        752.       1058.
    9        630.        581.        560.        719.        379.
   10        356.        342.        295.        340.        332.
   11        597.        368.        235.        281.        644.
 ====================================================================
 Total     105888.      97197.      91707.     103521.     115228.

JAN-1 Population Numbers


  AGE       1995        1996        1997        1998        1999
 _______________________________________________________________________


    1      26619.      24201.      21348.      16743.      26464.
    2      31678.      21753.      19803.      17465.      13674.
    3      25764.      23741.      16772.      15639.      14222.
    4      13215.      19675.      18303.      13428.      12489.
    5       8184.       8695.      12750.      12897.      10212.
    6       3464.       3753.       4686.       7193.       7988.
    7       1445.       1185.       1725.       2299.       3557.
    8       1077.        598.        465.        844.        926.
    9        335.        358.        273.        218.        407.
   10        102.         88.        180.        147.        125.
   11         96.        163.        315.        400.        233.
 ====================================================================
 Total     111979.     104210.      96620.      87273.      90296.

  AGE       2000        2001        2002        2003        2004
 _______________________________________________________________________
    1      16173.      12409.      28387.      22483.      36846.
    2      21663.      13239.      10159.      23239.      18396.
    3      11000.      17462.      10756.       8306.      18404.
    4      11491.       8607.      13923.       8708.       6759.
    5       9201.       8689.       6182.      10703.       6862.
    6       6853.       6047.       5051.       3759.       7647.
    7       4429.       3617.       2982.       2513.       1934.
    8       1669.       2056.       1550.       1376.       1390.
    9        323.        858.        868.        806.        628.
   10        199.        141.        440.        457.        410.
   11         56.        129.        483.        353.        392.
 ====================================================================
 Total      83058.      73255.      80782.      82703.      99669.

  AGE       2005        2006        2007        2008
 _______________________________________________________________________
    1      42696.      51397.      23487.      42084.
    2      30161.      34926.      42054.      19085.
    3      14935.      24438.      28519.      34216.
    4      14864.      12132.      19905.      23148.
    5       5137.      11777.       9502.      15758.
    6       4785.       3315.       8949.       7052.
    7       5185.       3228.       2232.       6866.
    8       1128.       3846.       2324.       1632.
    9        811.        763.       2976.       1801.
```

```
  10        339.        576.        536.       2375.
  11        391.        418.        543.        828.
 ===================================================================
 Total     120431.     146816.     141027.     154846.


Fishing Mortality Calculated


  AGE      1980        1981        1982        1983        1984
 -------------------------------------------------------------------
   1      0.0001      0.0002      0.0005      0.0006      0.0002
   2      0.0028      0.0266      0.0317      0.0438      0.0205
   3      0.0369      0.0779      0.1191      0.1013      0.0852
   4      0.1304      0.2430      0.2306      0.2722      0.2394
   5      0.2546      0.4127      0.3548      0.4148      0.5851
   6      0.3697      0.3963      0.5445      0.5983      0.5335
   7      0.5100      0.4054      0.7628      0.8104      0.6816
   8      0.3258      0.4373      0.7247      0.7748      0.4973
   9      0.5349      0.2959      0.7537      0.5946      0.3705
  10      0.4087      0.4071      0.6493      0.6781      0.5707
  11      0.4087      0.4071      0.6493      0.6781      0.5707

  AGE      1985        1986        1987        1988        1989
 -------------------------------------------------------------------
   1      0.0038      0.0028      0.0010      0.0065      0.0008
   2      0.0138      0.0465      0.0343      0.0258      0.0594
   3      0.0865      0.0826      0.1828      0.1425      0.1117
   4      0.1582      0.2313      0.2288      0.2792      0.2948
   5      0.3962      0.3087      0.3810      0.4269      0.3944
   6      0.6204      0.4531      0.4257      0.4434      0.4108
   7      0.8867      0.6494      0.5510      0.3126      0.5007
   8      1.0857      0.6844      0.6237      0.3177      0.5650
   9      0.8925      0.8369      0.4418      0.4248      0.4006
  10      0.7573      0.5506      0.4920      0.3857      0.4745
  11      0.7573      0.5506      0.4920      0.3857      0.4745

  AGE      1990        1991        1992        1993        1994
 -------------------------------------------------------------------

   1      0.0001      0.0001      0.0004      0.0006      0.0017
   2      0.0729      0.0160      0.0146      0.0152      0.0306
   3      0.1683      0.0909      0.0688      0.0315      0.0274
   4      0.2224      0.3331      0.1993      0.1970      0.1725
   5      0.3968      0.5248      0.6263      0.5072      0.5504
   6      0.3153      0.4779      0.6130      0.6384      0.6046
   7      0.3228      0.2391      0.6969      0.7732      0.6732
   8      0.4845      0.2362      0.2141      0.4868      0.9492
   9      0.4092      0.4778      0.2974      0.5723      1.1144
  10      0.3509      0.3719      0.5723      0.6629      0.6770
  11      0.3509      0.3719      0.5723      0.6629      0.6770


Fishing Mortality Calculated


  AGE      1995        1996        1997        1998        1999
```

```
-----------------------------------------------------------------------

   1       0.0019      0.0006      0.0008      0.0025      0.0002
   2       0.0884      0.0600      0.0361      0.0054      0.0176
   3       0.0697      0.0601      0.0224      0.0249      0.0132
   4       0.2185      0.2338      0.1501      0.0737      0.1056
   5       0.5797      0.4182      0.3724      0.2790      0.1989
   6       0.8726      0.5774      0.5121      0.5042      0.3898
   7       0.6819      0.7357      0.5143      0.7097      0.5565
   8       0.9011      0.5856      0.5589      0.5306      0.8535
   9       1.1376      0.4881      0.4173      0.3564      0.5153
  10       0.8280      0.6102      0.5157      0.5487      0.4638
  11       0.8280      0.6102      0.5157      0.5487      0.4638

  AGE       2000        2001        2002        2003        2004
-----------------------------------------------------------------------

   1       0.0002      0.0001      0.0001      0.0006      0.0002
   2       0.0155      0.0077      0.0014      0.0333      0.0084
   3       0.0453      0.0265      0.0112      0.0061      0.0137
   4       0.0795      0.1308      0.0630      0.0383      0.0745
   5       0.2197      0.3425      0.2976      0.1362      0.1604
   6       0.4392      0.5070      0.4980      0.4643      0.1886
   7       0.5677      0.6474      0.5737      0.3922      0.3398
   8       0.4653      0.6619      0.4536      0.5846      0.3391
   9       0.6301      0.4688      0.4419      0.4755      0.4169
  10       0.4848      0.5748      0.5135      0.4601      0.2320
  11       0.4848      0.5748      0.5135      0.4601      0.2320

  AGE       2005        2006        2007
-----------------------------------------------------------------------

   1       0.0009      0.0006      0.0075
   2       0.0104      0.0026      0.0063
   3       0.0079      0.0052      0.0087
   4       0.0327      0.0444      0.0336
   5       0.2379      0.0746      0.0981
   6       0.1939      0.1957      0.0650
   7       0.0987      0.1285      0.1129
   8       0.1899      0.0564      0.0548
   9       0.1415      0.1546      0.0256
  10       0.1479      0.1216      0.0646
  11       0.1479      0.1216      0.0646

Average Fishing Mortality For Ages   4-  9

Year      Average F   N Weighted  Biomass Wtd  Catch Wtd


-----------------------------------------------------------------------

1980       0.3542      0.2857      0.3574      0.3426
1981       0.3651      0.3445      0.3700      0.3607
1982       0.5619      0.4192      0.5377      0.4957
1983       0.5775      0.4378      0.5078      0.4949
1984       0.4846      0.4753      0.5203      0.5211
1985       0.6733      0.4839      0.6563      0.6261
1986       0.5273      0.3613      0.4841      0.4202
```

```
 1987       0.4420      0.3706      0.4353      0.4014
 1988       0.3674      0.3563      0.3699      0.3690
 1989       0.4277      0.3704      0.4148      0.3857
 1990       0.3585      0.2832      0.3242      0.3035
 1991       0.3815      0.3997      0.4089      0.4187
 1992       0.4412      0.4831      0.5238      0.5567
 1993       0.5292      0.4413      0.5407      0.5267
 1994       0.6774      0.4234      0.5271      0.5427
 1995       0.7319      0.4687      0.5852      0.5869
 1996       0.5065      0.3444      0.4206      0.3936
 1997       0.4208      0.2920      0.3629      0.3551
 1998       0.4090      0.2813      0.3652      0.4018
 1999       0.4366      0.2654      0.3545      0.3667
 2000       0.4002      0.2779      0.3675      0.3856
 2001       0.4597      0.3773      0.4477      0.4600
 2002       0.3880      0.2628      0.3720      0.4026
 2003       0.3485      0.2049      0.2815      0.3467
 2004       0.2532      0.1759      0.2180      0.2162
 2005       0.1491      0.1090      0.1357      0.1683
 2006       0.1090      0.0803      0.0929      0.1051
 2007       0.0650      0.0575      0.0611      0.0713

Average Fishing Mortality For Ages   5-  9

 Year      Average F   N Weighted  Biomass Wtd  Catch Wtd

 _______________________________________________________________________

 1980       0.3990      0.3593      0.3962      0.3836
 1981       0.3896      0.4025      0.3975      0.4044
 1982       0.6281      0.5357      0.6078      0.5783
 1983       0.6386      0.5537      0.5955      0.5831
 1984       0.5336      0.5726      0.5677      0.5776
 1985       0.7763      0.6359      0.7329      0.6954
 1986       0.5865      0.4580      0.5375      0.5006
 1987       0.4847      0.4379      0.4705      0.4487
 1988       0.3851      0.4040      0.3894      0.4098
 1989       0.4543      0.4377      0.4546      0.4442
 1990       0.3857      0.3787      0.3829      0.3841
 1991       0.3912      0.4779      0.4466      0.4941
 1992       0.4896      0.6013      0.5723      0.6163
 1993       0.5956      0.6001      0.6173      0.6116
 1994       0.7784      0.6277      0.6750      0.6453
 1995       0.8346      0.6966      0.7340      0.7185
 1996       0.5610      0.4935      0.5198      0.5092
 1997       0.4750      0.4225      0.4409      0.4313
 1998       0.4760      0.4001      0.4365      0.4429
 1999       0.5028      0.3518      0.4048      0.4157
 2000       0.4644      0.3793      0.4174      0.4241
 2001       0.5255      0.4771      0.5076      0.5034
 2002       0.4530      0.4300      0.4485      0.4525
 2003       0.4106      0.2806      0.3297      0.3691
 2004       0.2890      0.2131      0.2359      0.2357
 2005       0.1724      0.1754      0.1636      0.1921
 2006       0.1219      0.0993      0.1007      0.1200
 2007       0.0713      0.0758      0.0689      0.0844
```

```
Average Fishing Mortality For Ages   6-  9

Year      Average F   N Weighted  Biomass Wtd  Catch Wtd

_______________________________________________________________________


1980       0.4351      0.4231      0.4305      0.4350
1981       0.3838      0.3961      0.3931      0.3990
1982       0.6965      0.6657      0.6941      0.6770
1983       0.6945      0.6746      0.6844      0.6845
1984       0.5207      0.5605      0.5572      0.5701
1985       0.8713      0.7791      0.8240      0.8040
1986       0.6559      0.5708      0.6136      0.5894
1987       0.5106      0.4915      0.5081      0.5009
1988       0.3746      0.3902      0.3788      0.3986
1989       0.4693      0.4694      0.4755      0.4758
1990       0.3829      0.3590      0.3749      0.3690
1991       0.3577      0.3874      0.3709      0.4175
1992       0.4554      0.5665      0.5310      0.6009
1993       0.6177      0.6595      0.6557      0.6667
1994       0.8354      0.7060      0.7481      0.7261
1995       0.8983      0.8479      0.8548      0.8568
1996       0.5967      0.6046      0.6040      0.6103
1997       0.5006      0.5120      0.5103      0.5128
1998       0.5252      0.5481      0.5559      0.5585
1999       0.5788      0.4731      0.5034      0.4986
2000       0.5256      0.4900      0.4976      0.4961
2001       0.5713      0.5700      0.5765      0.5776
2002       0.4918      0.5084      0.5035      0.5115
2003       0.4791      0.4635      0.4692      0.4701
2004       0.3211      0.2442      0.2639      0.2665
2005       0.1560      0.1485      0.1454      0.1616
2006       0.1338      0.1254      0.1164      0.1495
2007       0.0646      0.0629      0.0588      0.0722
```

```
Back Calculated Partial Recruitment

  AGE        1980        1981        1982        1983        1984
-----------------------------------------------------------------
   1       0.0002      0.0005      0.0007      0.0008      0.0003
   2       0.0052      0.0609      0.0416      0.0540      0.0300
   3       0.0689      0.1781      0.1562      0.1250      0.1249
   4       0.2437      0.5556      0.3023      0.3359      0.3513
   5       0.4759      0.9438      0.4651      0.5119      0.8585
   6       0.6911      0.9062      0.7138      0.7383      0.7828
   7       0.9533      0.9270      1.0000      1.0000      1.0000
   8       0.6091      1.0000      0.9500      0.9561      0.7297
   9       1.0000      0.6767      0.9881      0.7338      0.5437
  10       0.7640      0.9309      0.8512      0.8367      0.8374
  11       0.7640      0.9309      0.8512      0.8367      0.8374

  AGE        1985        1986        1987        1988        1989
-----------------------------------------------------------------

   1       0.0035      0.0033      0.0016      0.0146      0.0014
   2       0.0127      0.0555      0.0550      0.0581      0.1050
   3       0.0797      0.0987      0.2931      0.3214      0.1977
   4       0.1457      0.2764      0.3669      0.6297      0.5218
   5       0.3650      0.3688      0.6110      0.9628      0.6981
   6       0.5714      0.5413      0.6825      1.0000      0.7271
   7       0.8167      0.7759      0.8836      0.7051      0.8861
   8       1.0000      0.8177      1.0000      0.7165      1.0000
   9       0.8221      1.0000      0.7084      0.9579      0.7091
  10       0.6975      0.6579      0.7889      0.8698      0.8398
  11       0.6975      0.6579      0.7889      0.8698      0.8398

  AGE        1990        1991        1992        1993        1994
-----------------------------------------------------------------
   1       0.0002      0.0002      0.0006      0.0008      0.0015
   2       0.1504      0.0305      0.0210      0.0196      0.0274
   3       0.3473      0.1733      0.0988      0.0408      0.0246
   4       0.4590      0.6346      0.2859      0.2548      0.1548
   5       0.8190      1.0000      0.8987      0.6559      0.4939
   6       0.6508      0.9105      0.8796      0.8257      0.5426
   7       0.6662      0.4556      1.0000      1.0000      0.6041
   8       1.0000      0.4501      0.3073      0.6296      0.8518
   9       0.8446      0.9104      0.4268      0.7401      1.0000
  10       0.7243      0.7086      0.8211      0.8573      0.6075
  11       0.7243      0.7086      0.8211      0.8573      0.6075
```

```
Back Calculated Partial Recruitment

  AGE       1995        1996        1997        1998        1999
-----------------------------------------------------------------------

   1       0.0017      0.0008      0.0014      0.0035      0.0002
   2       0.0777      0.0816      0.0645      0.0076      0.0206
   3       0.0612      0.0818      0.0401      0.0351      0.0155
   4       0.1921      0.3178      0.2685      0.1039      0.1237
   5       0.5096      0.5685      0.6663      0.3932      0.2330
   6       0.7671      0.7848      0.9163      0.7105      0.4567
   7       0.5994      1.0000      0.9202      1.0000      0.6520
   8       0.7922      0.7959      1.0000      0.7476      1.0000
   9       1.0000      0.6634      0.7467      0.5021      0.6038
  10       0.7279      0.8293      0.9228      0.7731      0.5434
  11       0.7279      0.8293      0.9228      0.7731      0.5434

  AGE       2000        2001        2002        2003        2004
-----------------------------------------------------------------------

   1       0.0003      0.0002      0.0002      0.0010      0.0004
   2       0.0247      0.0116      0.0024      0.0569      0.0202
   3       0.0719      0.0400      0.0195      0.0104      0.0327
   4       0.1262      0.1977      0.1099      0.0656      0.1787
   5       0.3486      0.5174      0.5187      0.2330      0.3846
   6       0.6969      0.7659      0.8680      0.7941      0.4525
   7       0.9009      0.9781      1.0000      0.6708      0.8151
   8       0.7385      1.0000      0.7905      1.0000      0.8134
   9       1.0000      0.7084      0.7701      0.8133      1.0000
  10       0.7693      0.8685      0.8950      0.7870      0.5565
  11       0.7693      0.8685      0.8950      0.7870      0.5565

  AGE       2005        2006        2007
-----------------------------------------------------------------------
   1       0.0037      0.0031      0.0668
   2       0.0438      0.0135      0.0554
   3       0.0332      0.0264      0.0770
   4       0.1376      0.2268      0.2977
   5       1.0000      0.3812      0.8694
   6       0.8148      1.0000      0.5759
   7       0.4147      0.6567      1.0000
   8       0.7981      0.2880      0.4859
   9       0.5948      0.7903      0.2271
  10       0.6215      0.6213      0.5722
  11       0.6215      0.6213      0.5722
```

```
JAN-1 Biomass

  AGE       1980        1981        1982        1983        1984
_______________________________________________________________________
   1         795.        440.        277.        173.         17.
   2        2017.       2343.       1293.        416.        488.
   3        3508.       3642.       5174.       2465.        975.
   4        4993.       5681.       5388.       7036.       2960.
   5        5709.       5941.       6009.       6221.       6622.
   6        7827.       6894.       4679.       5024.       4958.
   7        7591.       6001.       5817.       3032.       3296.
   8        4661.       4403.       4325.       2571.       1602.
   9        3453.       2996.       2796.       2029.       1054.
  10        3540.       1755.       2230.       1310.       1005.
  11        8545.       3156.       3117.       3393.       3784.
====================================================================
Total      52640.      43252.      41105.      33670.      26761.

  AGE       1985        1986        1987        1988        1989
_______________________________________________________________________

   1         224.        222.        287.        578.         92.
   2         193.        426.        522.        834.       1031.
   3         996.        918.        899.       1303.       1887.
   4        1844.       1686.       1390.       1594.       2119.
   5        2551.       1991.       2417.       1632.       1641.
   6        3589.       1956.       2043.       2262.       1215.
   7        3010.       2003.       1671.       1655.       1551.
   8        1802.       1386.       1270.       1142.       1136.
   9        1032.        645.        758.        717.        830.
  10         753.        420.        279.        482.        429.
  11         794.        566.        385.        424.        658.
====================================================================
Total      16788.      12220.      11921.      12623.      12591.

  AGE       1990        1991        1992        1993        1994
_______________________________________________________________________
   1         152.         32.         65.         40.         58.
   2         318.        305.        210.        280.        286.
   3        2176.        845.        792.       1279.       1269.
   4        3247.       4430.       1832.       2235.       3403.
   5        2052.       4382.       5311.       2592.       3019.
   6        1265.       1894.       3591.       3362.       1761.
   7         833.       1229.       1461.       2320.       1830.
   8         900.        789.       1185.        804.       1070.
   9         588.        614.        692.        945.        477.
  10         469.        443.        426.        491.        468.
  11        1012.        666.        471.        650.       1562.
====================================================================
Total      13010.      15630.      16037.      14997.      15203.
```

```
JAN-1 Biomass

  AGE       1995         1996         1997         1998         1999
______________________________________________________________________

   1         64.          27.          58.         181.         138.
   2        329.         324.         156.         234.         215.
   3       1487.        1227.        1233.         721.         710.
   4       3173.        3962.        3391.        2539.        1988.
   5       3434.        3379.        4653.        4482.        3185.
   6       1916.        2091.        2556.        3290.        3375.
   7       1072.         909.        1235.        1580.        2078.
   8       1032.         624.         464.         770.         766.
   9        366.         454.         346.         269.         435.
  10        167.         116.         266.         206.         175.
  11        184.         364.         765.        1317.         445.
=====================================================================
Total      13224.       13477.       15122.       15588.       13509.

  AGE       2000         2001         2002         2003         2004
______________________________________________________________________

   1        175.          77.          17.         724.          99.
   2        266.         208.         199.         160.         416.
   3        652.         658.         546.         479.         780.
   4       1885.        2085.        2075.        1705.        1025.
   5       3140.        3244.        2242.        3604.        2229.
   6       3266.        2976.        2356.        1763.        3299.
   7       2771.        2282.        1762.        1478.        1133.
   8       1386.        1641.        1216.        1019.        1016.
   9        315.         880.         810.         739.         560.
  10        249.         178.         497.         491.         402.
  11        105.         198.         698.         439.         473.
=====================================================================
Total      14210.       14426.       12419.       12600.       11432.

  AGE       2005         2006         2007         2008
______________________________________________________________________
   1        201.         283.          82.         408.
   2        277.         601.         765.         282.
   3        545.        1056.        2148.        1745.
   4       2195.        1737.        3710.        3819.
   5       1596.        4097.        3373.        5279.
   6       2084.        1513.        4143.        3181.
   7       2893.        1811.        1294.        3945.
   8        835.        2793.        1663.        1193.
   9        697.         675.        2674.        1604.
  10        346.         556.         520.        2380.
  11        500.         542.         820.        1082.
=====================================================================
Total      12171.       15664.       21193.       24918.
```

```
Mean Biomass


  AGE       1980        1981        1982        1983        1984
_______________________________________________________________________


   1        1368.        755.        340.        291.         56.
   2        2716.       3979.       2187.        500.        815.
   3        4475.       4728.       6464.       2699.       1873.
   4        5472.       6574.       5752.       7188.       3065.
   5        6328.       5716.       5305.       6283.       5401.
   6        6947.       7161.       3727.       4382.       3831.
   7        5904.       5241.       4149.       2306.       2522.
   8        3780.       3537.       3200.       1711.       1385.
   9        2518.       2463.       1993.       1460.        837.
  10        2857.       1355.       1761.        959.        737.
  11        6401.       2366.       2100.       2258.       2638.
====================================================================
Total      48765.      43874.      36978.      30035.      23161.

  AGE       1985        1986        1987        1988        1989
_______________________________________________________________________


   1         310.        342.        490.        773.        171.
   2         663.        577.        790.       1401.       1342.
   3        1182.       1233.       1319.       2052.       2450.
   4        1766.       2261.       1472.       1865.       2058.
   5        2009.       2115.       2450.       1680.       1397.
   6        2472.       1913.       1913.       2088.        914.
   7        2129.       1695.       1449.       1556.       1163.
   8        1162.       1083.       1021.       1047.        758.
   9         676.        454.        628.        582.        648.
  10         587.        332.        217.        393.        319.
  11         511.        398.        278.        321.        479.
====================================================================
Total      13467.      12404.      12026.      13759.      11698.

  AGE       1990        1991        1992        1993        1994
_______________________________________________________________________
   1         216.         82.        137.        108.        140.
   2         571.        430.        534.        574.        753.
   3        3370.       1247.       1427.       3047.       2804.
   4        4120.       5456.       2577.       3315.       3570.
   5        1993.       4126.       4648.       2297.       2374.
   6        1223.       1789.       3142.       2561.       1349.
   7         816.       1308.       1126.       1690.       1366.
   8         731.        812.       1104.        671.        681.
   9         513.        538.        582.        698.        271.
  10         357.        402.        337.        360.        315.
  11         778.        508.        328.        435.       1040.
====================================================================
Total      14687.      16698.      15942.      15756.      14665.
```

```
Mean Biomass


  AGE       1995        1996        1997        1998        1999


   1        145.         66.        116.        197.        192.
   2        743.        709.        370.        474.        233.
   3       2891.       2069.       2196.       1415.       1063.
   4       3293.       5060.       5359.       2878.       2701.
   5       2779.       3210.       4077.       3566.       3343.
   6       1413.       1657.       2015.       2571.       3096.
   7        869.        680.        995.       1187.       1709.
   8        754.        498.        367.        618.        499.
   9        203.        360.        272.        225.        322.
  10        134.         95.        202.        151.        133.
  11        115.        249.        546.        927.        325.
====================================================================
Total     13339.      14655.      16515.      14209.      13617.

  AGE       2000        2001        2002        2003        2004

   1        191.        124.         51.        550.        167.
   2        370.        227.        322.        497.        316.
   3       1805.       1172.       1319.        713.       1243.
   4       3248.       2323.       3624.       2185.       1430.
   5       3487.       2884.       2021.       3481.       2155.
   6       2896.       2263.       1840.       1456.       3079.
   7       2359.       1698.       1389.       1295.        967.
   8       1228.       1150.       1006.        782.        840.
   9        240.        654.        668.        557.        455.
  10        203.        142.        385.        370.        336.
  11         76.        138.        499.        321.        384.
====================================================================
Total     16103.      12775.      13124.      12208.      11373.

  AGE       2005        2006        2007

   1        348.        466.        170.
   2        462.       1043.       1254.
   3        944.       2430.       4427.
   4       3859.       3154.       5609.
   5       1660.       4284.       3533.
   6       2005.       1429.       4049.
   7       2873.       1708.       1234.
   8        792.       2792.       1692.
   9        650.        593.       2614.
  10        307.        484.        481.
  11        422.        464.        721.
====================================================================
Total     14322.      18848.      25784.
```

```
Spawning Stock Biomass


  AGE       1980        1981        1982        1983        1984
_______________________________________________________________________

   1            8.          4.          3.          2.          0.
   2           77.        111.         61.         20.         32.
   3          496.        612.        812.        389.        191.
   4         2069.       2339.       2080.       2751.       1326.
   5         4076.       3925.       3871.       4054.       4299.
   6         6449.       5523.       3535.       3827.       3839.
   7         6293.       5055.       4436.       2308.       2591.
   8         4086.       3755.       3398.       2015.       1332.
   9         2874.       2646.       2203.       1663.        913.
  10         3040.       1508.       1803.       1052.        829.
  11         7339.       2711.       2521.       2724.       3121.
====================================================================
Total       36807.      28190.      24722.      20805.      18474.

  AGE       1985        1986        1987        1988        1989
_______________________________________________________________________
   1            6.          4.          3.          5.          1.
   2           18.         28.         25.         39.         39.
   3          241.        205.        196.        299.        384.
   4          927.        848.        811.        976.       1236.
   5         1758.       1472.       1923.       1312.       1315.
   6         2719.       1595.       1730.       1906.       1032.
   7         2248.       1604.       1385.       1456.       1302.
   8         1293.       1111.       1033.       1003.        939.
   9          785.        498.        645.        614.        714.
  10          593.        348.        234.        416.        362.
  11          625.        469.        324.        366.        556.
====================================================================
Total       11215.       8183.       8310.       8393.       7881.

  AGE       1990        1991        1992        1993        1994
_______________________________________________________________________

   1            0.          0.          0.          0.          0.
   2            6.          6.          4.          5.          5.
   3          298.        118.        111.        157.        156.
   4         1811.       2326.        995.       1154.       1767.
   5         1661.       3400.       3974.       1998.       2302.
   6         1101.       1583.       2901.       2699.       1426.
   7          731.       1101.       1167.       1819.       1471.
   8          759.        707.       1069.        677.        803.
   9          505.        518.        611.        779.        344.
  10          408.        384.        352.        396.        376.
  11          882.        578.        388.        524.       1255.
====================================================================
Total        8162.      10722.      11572.      10208.       9905.
```

```
Spawning Stock Biomass

  AGE       1995        1996        1997        1998        1999
________________________________________________________________________

   1          0.          0.          0.          0.          0.
   2          6.          6.          3.          4.          4.
   3        181.        161.        140.         95.        101.
   4       1600.       1991.       1740.       1375.       1013.
   5       2600.       2635.       3710.       3658.       2595.
   6       1451.       1705.       2118.       2731.       2854.
   7        860.        719.       1033.       1259.       1720.
   8        783.        513.        384.        642.        589.
   9        262.        382.        296.        234.        364.
  10        129.         95.        222.        171.        148.
  11        142.        297.        640.       1092.        377.
====================================================================
Total       8014.       8503.      10285.      11261.       9764.

  AGE       2000        2001        2002        2003        2004
________________________________________________________________________

   1          0.          0.          0.          0.          0.
   2          5.          4.          4.          5.          8.
   3         98.        100.         78.         68.         96.
   4       1037.       1190.       1146.        867.        517.
   5       2601.       2662.       1822.       2916.       1833.
   6       2756.       2469.       1959.       1463.       2964.
   7       2287.       1846.       1452.       1274.        990.
   8       1174.       1323.       1032.        837.        888.
   9        256.        745.        690.        624.        480.
  10        210.        146.        416.        416.        361.
  11         89.        163.        584.        372.        424.
====================================================================
Total      10512.      10648.       9183.       8843.       8560.

  AGE       2005        2006        2007
________________________________________________________________________
   1          2.          3.          1.
   2          8.         17.         29.
   3         93.        181.        408.
   4       1181.        932.       2065.
   5       1273.       3405.       2818.
   6       1851.       1343.       3800.
   7       2685.       1668.       1197.
   8        758.       2620.       1561.
   9        640.        618.       2527.
  10        317.        513.        487.
  11        458.        500.        768.
====================================================================
Total       9266.      11799.      15659.
```

```
Catch Biomass

  AGE       1980        1981        1982        1983        1984
_____________________________________________________________________

   1          0.          0.          0.          0.          0.
   2          8.        106.         69.         22.         17.
   3        165.        368.        770.        273.        159.
   4        713.       1597.       1326.       1957.        734.
   5       1611.       2359.       1882.       2606.       3160.
   6       2568.       2838.       2030.       2622.       2044.
   7       3011.       2125.       3165.       1868.       1719.
   8       1232.       1547.       2319.       1326.        689.
   9       1347.        729.       1502.        868.        310.
  10       1168.        552.       1143.        650.        421.
  11       2616.        963.       1364.       1531.       1506.
==================================================================
Total     14439.      13184.      15571.      13724.      10758.

  AGE       1985        1986        1987        1988        1989
_____________________________________________________________________
   1          1.          1.          1.          5.          0.
   2          9.         27.         27.         36.         80.
   3        102.        102.        241.        292.        274.
   4        279.        523.        337.        521.        607.
   5        796.        653.        933.        717.        551.
   6       1534.        867.        814.        926.        376.
   7       1887.       1101.        798.        486.        582.
   8       1262.        741.        637.        333.        428.
   9        603.        380.        278.        247.        260.
  10        445.        183.        107.        151.        151.
  11        387.        219.        137.        124.        227.
==================================================================
Total      7306.       4796.       4309.       3839.       3535.

  AGE       1990        1991        1992        1993        1994
_____________________________________________________________________

   1          0.          0.          0.          0.          0.
   2         42.          7.          8.          9.         23.
   3        567.        113.         98.         96.         77.
   4        916.       1817.        513.        653.        616.
   5        791.       2165.       2911.       1165.       1307.
   6        386.        855.       1926.       1635.        816.
   7        263.        313.        785.       1307.        920.
   8        354.        192.        236.        327.        647.
   9        210.        257.        173.        400.        303.
  10        125.        149.        193.        238.        213.
  11        273.        189.        188.        289.        704.
==================================================================
Total      3927.       6057.       7032.       6118.       5624.
```

```
Catch Biomass


  AGE       1995        1996        1997        1998        1999
_______________________________________________________________________
   1           0.          0.          0.          0.          0.
   2          66.         43.         13.          3.          4.
   3         201.        124.         49.         35.         14.
   4         720.       1183.        804.        212.        285.
   5        1611.       1343.       1518.        995.        665.
   6        1233.        957.       1032.       1297.       1207.
   7         592.        501.        512.        842.        951.
   8         680.        292.        205.        328.        426.
   9         231.        176.        113.         80.        166.
  10         111.         58.        104.         83.         62.
  11          95.        152.        282.        509.        151.
====================================================================
Total       5540.       4828.       4633.       4384.       3930.

  AGE       2000        2001        2002        2003        2004
_______________________________________________________________________

   1           0.          0.          0.          0.          0.
   2           6.          2.          0.         17.          3.
   3          82.         31.         15.          4.         17.
   4         258.        304.        228.         84.        107.
   5         766.        988.        602.        474.        346.
   6        1272.       1147.        916.        676.        581.
   7        1339.       1099.        797.        508.        329.
   8         571.        761.        456.        457.        285.
   9         151.        307.        295.        265.        190.
  10          98.         82.        198.        170.         78.
  11          37.         79.        256.        148.         89.
====================================================================
Total       4581.       4800.       3764.       2803.       2023.

  AGE       2005        2006        2007
_______________________________________________________________________

   1           0.          0.          1.
   2           5.          3.          8.
   3           7.         13.         38.
   4         126.        140.        188.
   5         395.        320.        347.
   6         389.        280.        263.
   7         283.        220.        139.
   8         150.        157.         93.
   9          92.         92.         67.
  10          45.         59.         34.
  11          62.         56.         47.
====================================================================
Total       1556.       1338.       1226.
```

```
Catch Numbers

  AGE      1980        1981        1982        1983        1984
_____________________________________________________________________
   1         5.2         5.1         9.6        14.5         2.5
   2        98.9       981.8       603.2       662.8       370.5
   3      1071.7      2191.8      3348.1      1478.2       990.6
   4      2671.5      5055.3      4574.0      5176.8      2422.1
   5      3938.7      5337.2      4503.1      4917.9      6031.2
   6      3933.3      3648.1      3598.6      3913.0      3244.4
   7      3632.0      2400.8      3297.0      2270.2      1935.6
   8      1185.4      1581.6      2037.6      1272.1       580.3
   9      1138.6       645.1      1256.1       701.2       273.8
  10       849.9       439.8       736.7       449.6       307.2
  11      1380.4       620.9       717.4       911.4       768.9
==================================================================
Total    19905.6     22907.5     24681.4     21767.7     16927.1

  AGE      1985        1986        1987        1988        1989
_____________________________________________________________________

   1        64.8        59.3        38.5       313.5        15.5
   2       157.8       638.7       589.6       785.5      2275.0
   3      1217.4       738.0      1840.5      1839.5      2605.8
   4      1336.4      2284.0      1439.2      1833.4      2517.3
   5      2404.6      1700.0      2282.3      1597.4      1521.9
   6      2872.0      1476.5      1336.9      1444.4       827.2
   7      2228.2      1307.1       895.0       552.8       835.5
   8      1081.3       631.5       542.9       270.3       534.5
   9       438.1       254.9       187.2       177.1       195.6
  10       267.1       104.8        61.6        88.2       103.6
  11       181.9        99.9        59.9        55.3       118.0
==================================================================
Total    12249.6      9294.7      9273.6      8957.4     11549.9

  AGE      1990        1991        1992        1993        1994
_____________________________________________________________________

   1         0.0         0.4         9.6        21.8        58.2
   2      1094.4       255.2       244.5       280.6       885.8
   3      4725.5      1030.8       861.7       421.6       406.9
   4      3606.7      5997.5      1604.6      1774.5      1710.6
   5      1971.8      4865.9      5810.5      2382.2      2840.7
   6       696.0      1260.9      2649.2      2578.6      1341.7
   7       367.2       326.5       848.7      1384.1      1158.2
   8       404.1       165.8       190.7       264.9       597.0
   9       193.0       201.6       131.2       286.6       234.7
  10        96.1        97.0       117.6       151.2       149.7
  11       161.0       104.1        93.5       124.8       290.5
==================================================================
Total    13315.8     14305.7     12561.8      9670.9      9674.0
```

```
Catch Numbers

  AGE       1995        1996        1997        1998        1999
______________________________________________________________________

   1        45.3        12.5        14.7        37.2         4.2
   2      2433.7      1149.7       636.1        85.5       216.3
   3      1572.9      1257.3       336.9       348.7       169.0
   4      2359.5      3732.1      2317.2       866.1      1136.2
   5      3294.4      2712.5      3615.0      2859.4      1674.7
   6      1854.2      1506.3      1716.5      2603.7      2352.1
   7       654.6       566.3       633.9      1071.4      1388.6
   8       588.5       242.6       182.1       317.9       488.4
   9       210.3       126.4        84.9        59.5       149.7
  10        52.6        36.8        66.3        56.8        42.3
  11        49.6        68.3       116.2       154.5        79.0
===================================================================
Total    13115.6     11410.8      9719.8      8460.7      7700.5

  AGE       2000        2001        2002        2003        2004
______________________________________________________________________
   1         2.7         0.0         1.1        11.9         6.1
   2       303.0        91.7        12.9       689.2       140.0
   3       442.2       413.8       108.7        45.5       226.2
   4       797.2       958.8       771.8       297.1       440.3
   5      1650.5      2296.8      1449.5      1238.0       923.9
   6      2223.8      2198.0      1810.7      1275.1      1195.3
   7      1755.2      1579.0      1191.3       743.8       508.0
   8       567.3       911.8       516.1       557.3       364.4
   9       138.2       293.4       283.1       278.7       195.3
  10        69.8        56.3       161.4       153.9        77.3
  11        19.8        51.8       177.2       119.0        73.8
===================================================================
Total     7969.7      8851.4      6483.8      5409.5      4150.6

  AGE       2005        2006        2007
______________________________________________________________________

   1        34.3        28.4       160.0
   2       283.5        83.4       237.7
   3       106.5       114.0       223.7
   4       434.2       477.6       596.4
   5       989.7       768.1       806.2
   6       766.8       535.7       511.0
   7       442.2       353.5       216.3
   8       177.3       191.2       112.5
   9        97.2        99.4        68.3
  10        42.3        59.9        33.4
  11        48.8        43.5        30.8
===================================================================
Total     3422.8      2754.7      2996.3


              Surplus Production
```

```
    Average Adjustment Factor (Delta) =   1.0000

Year        Biomass  Delta Biomass  Catch Biomass  Surplus Production

1980      52640.218      -9388.332      14438.521       5050.189
1981      43251.887      -2146.978      13184.160      11037.182
1982      41104.909      -7434.662      15571.310       8136.649
1983      33670.247      -6908.762      13723.817       6815.055
1984      26761.485      -9973.316      10758.293        784.978
1985      16788.169      -4568.418       7305.689       2737.271
1986      12219.751       -299.043       4796.441       4497.398
1987      11920.708        702.752       4309.415       5012.167
1988      12623.460        -32.184       3839.044       3806.860
1989      12591.276        419.175       3535.290       3954.464
1990      13010.451       2619.375       3926.749       6546.124
1991      15629.826        406.972       6057.404       6464.377
1992      16036.798      -1039.888       7031.703       5991.815
1993      14996.910        206.181       6117.735       6323.916
1994      15203.091      -1979.560       5624.494       3644.934
1995      13223.531        253.672       5540.118       5793.789
1996      13477.203       1644.821       4827.751       6472.572
1997      15122.024        465.966       4632.705       5098.671
1998      15587.990      -2078.878       4384.243       2305.364
1999      13509.112        701.117       3930.338       4631.456
2000      14210.229        215.765       4580.812       4796.577
2001      14425.995      -2006.746       4799.699       2792.953
2002      12419.249        181.206       3763.717       3944.923
2003      12600.455      -1168.929       2802.821       1633.892
2004      11431.526        739.219       2023.203       2762.422
2005      12170.745       3493.289       1556.197       5049.486
2006      15664.034       5528.882       1338.464       6867.345
2007      21192.915       3724.808       1225.713       4950.521
2008      24917.724
```

```
Summary of Survey Indices Used in the Estimate

INDEX    Survey Tag    Age   Time  Type  Catchability Std. Error   CV
_______________________________________________________________________

   1        spr_us      1   JAN-1 NUMBER  0.7563E-02  0.1425E-02  0.1885E+00
   2        spr_us      2   JAN-1 NUMBER  0.1178E+00  0.1310E-01  0.1112E+00
   3        spr_us      3   JAN-1 NUMBER  0.2371E+00  0.2267E-01  0.9563E-01
   4        spr_us      4   JAN-1 NUMBER  0.3453E+00  0.2786E-01  0.8069E-01
   5        spr_us      5   JAN-1 NUMBER  0.3320E+00  0.2341E-01  0.7051E-01
   6        spr_us      6   JAN-1 NUMBER  0.2705E+00  0.1984E-01  0.7332E-01
   7        spr_us      7   JAN-1 NUMBER  0.2393E+00  0.2230E-01  0.9318E-01
   8        spr_us      8   JAN-1 NUMBER  0.1781E+00  0.2432E-01  0.1366E+00
   9        spr_us    9 - 11 JAN-1 NUMBER  0.1832E+00  0.2799E-01
0.1528E+00
  11        us1aut      2   JAN-1 NUMBER  0.1066E+00  0.1249E-01  0.1171E+00
  12        us2aut      3   JAN-1 NUMBER  0.2997E+00  0.2595E-01  0.8660E-01
  13        us3aut      4   JAN-1 NUMBER  0.4547E+00  0.3963E-01  0.8715E-01
  14        us4aut      5   JAN-1 NUMBER  0.5453E+00  0.4076E-01  0.7475E-01
  15        us5aut      6   JAN-1 NUMBER  0.5214E+00  0.4468E-01  0.8569E-01
  16        us6aut      7   JAN-1 NUMBER  0.4606E+00  0.4478E-01  0.9721E-01
  17        us7aut      8   JAN-1 NUMBER  0.3284E+00  0.4166E-01  0.1269E+00
  18        us8paut   9 - 11 JAN-1 NUMBER  0.3104E+00  0.4414E-01
0.1422E+00
  20        spr_ma      1   JAN-1 NUMBER  0.4218E-01  0.1026E-01  0.2432E+00
  21        spr_ma      2   JAN-1 NUMBER  0.2342E+00  0.3702E-01  0.1581E+00
  22        spr_ma      3   JAN-1 NUMBER  0.3188E+00  0.2495E-01  0.7828E-01
  23        spr_ma      4   JAN-1 NUMBER  0.2290E+00  0.1828E-01  0.7986E-01
  24        spr_ma      5   JAN-1 NUMBER  0.1282E+00  0.1269E-01  0.9901E-01
  26        ma1aut      2   JAN-1 NUMBER  0.2656E+00  0.4001E-01  0.1506E+00
  27        ma2aut      3   JAN-1 NUMBER  0.3412E+00  0.3933E-01  0.1153E+00
  28        ma3aut      4   JAN-1 NUMBER  0.2712E+00  0.3045E-01  0.1123E+00
  29        ma4aut      5   JAN-1 NUMBER  0.1403E+00  0.1948E-01  0.1389E+00
  30        ma5aut      6   JAN-1 NUMBER  0.5424E-01  0.1028E-01  0.1895E+00


Survey Index:    1 Tag:         spr_us   AGE =  1
Time = JAN-1           Type = NUMBER
Catchability =    0.756315E-02   % Variance Contribution =     8.3115
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_______________________________________________________________________
1980     0.133361E+04     0.380428E+03     0.125435E+01
1981     0.385260E+03     0.196844E+03     0.671508E+00
1982     0.889100E+02     0.157682E+03    -0.572957E+00
1983     0.592710E+03     0.186551E+03     0.115600E+01
1984     0.296400E+02     0.117378E+03    -0.137628E+01
1985     0.889100E+02     0.143789E+03    -0.480721E+00
1986     0.296400E+02     0.178505E+03    -0.179549E+01
1987     0.266720E+03     0.314726E+03    -0.165505E+00
1988     0.592710E+03     0.404585E+03     0.381845E+00
1989     0.148180E+03     0.158681E+03    -0.684651E-01
1990     N/A              0.163726E+03     N/A
1991     0.889100E+02     0.171442E+03    -0.656623E+00
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1992     0.177810E+03     0.190111E+03    -0.668933E-01
1993     0.977980E+03     0.299900E+03     0.118204E+01
1994     0.889100E+02     0.293118E+03    -0.119295E+01
1995     0.889100E+02     0.201323E+03    -0.817288E+00
1996     0.592700E+02     0.183035E+03    -0.112757E+01
1997     0.296400E+02     0.161459E+03    -0.169513E+01
1998     0.177810E+03     0.126626E+03     0.339476E+00
1999     0.237090E+03     0.200148E+03     0.169384E+00
2000     0.889100E+02     0.122320E+03    -0.319012E+00
2001     N/A              0.938545E+02     N/A
2002     0.297840E+03     0.214693E+03     0.327348E+00
2003     0.132770E+03     0.170040E+03    -0.247413E+00
2004     0.107429E+04     0.278671E+03     0.134938E+01
2005     0.578790E+03     0.322916E+03     0.583547E+00
2006     0.225824E+04     0.388719E+03     0.175948E+01
2007     0.726080E+03     0.177635E+03     0.140793E+01
2008     0.318290E+03     0.318290E+03    -0.109231E-07

Survey Index:    2 Tag:         spr_us   AGE =  2
Time = JAN-1           Type = NUMBER
Catchability =    0.117776E+00   % Variance Contribution =     3.3489
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_______________________________________________________________________

1980     0.109356E+05     0.464939E+04     0.855286E+00
1981     0.101650E+05     0.484972E+04     0.740035E+00
1982     0.311175E+04     0.250912E+04     0.215253E+00
1983     0.109059E+05     0.200935E+04     0.169150E+01
1984     0.103725E+04     0.237689E+04    -0.829220E+00
1985     0.948340E+03     0.149625E+04    -0.456004E+00
1986     0.136324E+04     0.182634E+04    -0.292452E+00
1987     0.180778E+04     0.226955E+04    -0.227481E+00
1988     0.293394E+04     0.400852E+04    -0.312075E+00
1989     0.471208E+04     0.512491E+04    -0.839833E-01
1990     0.168924E+04     0.202145E+04    -0.179537E+00
1991     0.210414E+04     0.208722E+04     0.807461E-02
1992     0.100761E+04     0.218559E+04    -0.774304E+00
1993     0.248940E+04     0.242280E+04     0.271159E-01
1994     0.423791E+04     0.382127E+04     0.103489E+00
1995     0.583824E+04     0.373093E+04     0.447772E+00
1996     0.139288E+04     0.256196E+04    -0.609398E+00
1997     0.251904E+04     0.233227E+04     0.770346E-01
1998     0.563080E+03     0.205696E+04    -0.129556E+01
1999     0.121506E+04     0.161047E+04    -0.281730E+00
2000     0.566042E+04     0.255134E+04     0.796879E+00
2001     0.209821E+04     0.155923E+04     0.296893E+00
2002     0.102451E+04     0.119648E+04    -0.155170E+00
2003     0.224728E+04     0.273696E+04    -0.197127E+00
2004     0.256764E+04     0.216666E+04     0.169802E+00
2005     0.230329E+04     0.355227E+04    -0.433248E+00
2006     0.479980E+04     0.411338E+04     0.154330E+00
2007     0.110921E+05     0.495296E+04     0.806243E+00
2008     0.172895E+04     0.224774E+04    -0.262409E+00

Survey Index:    3 Tag:         spr_us   AGE =  3
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Time = JAN-1           Type = NUMBER
Catchability =    0.237083E+00   % Variance Contribution =     2.4750
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_______________________________________________________________________

1980     0.134842E+05     0.773728E+04     0.555472E+00
1981     0.124766E+05     0.764154E+04     0.490259E+00
1982     0.530479E+04     0.778270E+04    -0.383294E+00
1983     0.986869E+04     0.400620E+04     0.901524E+00
1984     0.165960E+04     0.316979E+04    -0.647089E+00
1985     0.290430E+04     0.383806E+04    -0.278776E+00
1986     0.100761E+04     0.243220E+04    -0.881215E+00
1987     0.293394E+04     0.287334E+04     0.208708E-01
1988     0.248940E+04     0.361427E+04    -0.372849E+00
1989     0.376374E+04     0.643833E+04    -0.536856E+00
1990     0.785346E+04     0.795968E+04    -0.134352E-01
1991     0.483062E+04     0.309748E+04     0.444385E+00
1992     0.340811E+04     0.338533E+04     0.670620E-02
1993     0.343774E+04     0.354975E+04    -0.320623E-01
1994     0.337847E+04     0.393298E+04    -0.151973E+00
1995     0.951306E+04     0.610827E+04     0.443023E+00
1996     0.574933E+04     0.562855E+04     0.212323E-01
1997     0.491953E+04     0.397641E+04     0.212832E+00
1998     0.302284E+04     0.370770E+04    -0.204215E+00
1999     0.154106E+04     0.337180E+04    -0.782976E+00
2000     0.734966E+04     0.260792E+04     0.103610E+01
2001     0.108763E+05     0.414002E+04     0.965886E+00
2002     0.291112E+04     0.255015E+04     0.132386E+00
2003     0.798980E+03     0.196917E+04    -0.902032E+00
2004     0.600182E+04     0.436330E+04     0.318835E+00
2005     0.308745E+04     0.354092E+04    -0.137040E+00
2006     0.508075E+04     0.579383E+04    -0.131335E+00
2007     0.822776E+04     0.676145E+04     0.196277E+00
2008     0.606613E+04     0.811214E+04    -0.290641E+00

Survey Index:    4 Tag:         spr_us   AGE =  4
Time = JAN-1           Type = NUMBER
Catchability =    0.345291E+00   % Variance Contribution =     1.7622
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_______________________________________________________________________
1980     0.903889E+04     0.830944E+04     0.841436E-01
1981     0.102540E+05     0.889194E+04     0.142519E+00
1982     0.939452E+04     0.842908E+04     0.108439E+00
1983     0.132768E+05     0.823792E+04     0.477270E+00
1984     0.266721E+04     0.431673E+04    -0.481466E+00
1985     0.254867E+04     0.347115E+04    -0.308913E+00
1986     0.299321E+04     0.419737E+04    -0.338111E+00
1987     0.204486E+04     0.267030E+04    -0.266863E+00
1988     0.225231E+04     0.285387E+04    -0.236718E+00
1989     0.254867E+04     0.373729E+04    -0.382788E+00
1990     0.302284E+04     0.686585E+04    -0.820364E+00
1991     0.690512E+04     0.802138E+04    -0.149847E+00
1992     0.260794E+04     0.337243E+04    -0.257074E+00
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1993     0.468244E+04     0.376823E+04     0.217213E+00
1994     0.331920E+04     0.410132E+04    -0.211585E+00
1995     0.681621E+04     0.456286E+04     0.401355E+00
1996     0.977979E+04     0.679351E+04     0.364350E+00
1997     0.746820E+04     0.631975E+04     0.166974E+00
1998     0.331920E+04     0.463647E+04    -0.334229E+00
1999     0.334884E+04     0.431238E+04    -0.252875E+00
2000     0.657913E+04     0.396786E+04     0.505675E+00
2001     0.998724E+04     0.297188E+04     0.121211E+01
2002     0.696439E+04     0.480759E+04     0.370614E+00
2003     0.208873E+04     0.300692E+04    -0.364360E+00
2004     0.530301E+04     0.233387E+04     0.820748E+00
2005     0.364786E+04     0.513229E+04    -0.341412E+00
2006     0.504252E+04     0.418901E+04     0.185442E+00
2007     0.478054E+04     0.687306E+04    -0.363056E+00
2008     0.842603E+04     0.799264E+04     0.528041E-01

Survey Index:    5 Tag:         spr_us   AGE =  5
Time = JAN-1           Type = NUMBER
Catchability =    0.332013E+00   % Variance Contribution =     1.3454
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_______________________________________________________________________

1980     0.868326E+04     0.639246E+04     0.306278E+00
1981     0.773492E+04     0.574210E+04     0.297921E+00
1982     0.631241E+04     0.549009E+04     0.139573E+00
1983     0.782383E+04     0.526919E+04     0.395297E+00
1984     0.382301E+04     0.493968E+04    -0.256261E+00
1985     0.216341E+04     0.267479E+04    -0.212186E+00
1986     0.174851E+04     0.233289E+04    -0.288345E+00
1987     0.151142E+04     0.262198E+04    -0.550881E+00
1988     0.918710E+03     0.167219E+04    -0.598917E+00
1989     0.145215E+04     0.169937E+04    -0.157214E+00
1990     0.160033E+04     0.219087E+04    -0.314090E+00
1991     0.272649E+04     0.432740E+04    -0.461953E+00
1992     0.317102E+04     0.452597E+04    -0.355778E+00
1993     0.180778E+04     0.217528E+04    -0.185059E+00
1994     0.222268E+04     0.243607E+04    -0.916715E-01
1995     0.328956E+04     0.271718E+04     0.191158E+00
1996     0.388228E+04     0.288701E+04     0.296202E+00
1997     0.607532E+04     0.423319E+04     0.361278E+00
1998     0.361556E+04     0.428197E+04    -0.169167E+00
1999     0.234122E+04     0.339061E+04    -0.370337E+00
2000     0.474171E+04     0.305474E+04     0.439704E+00
2001     0.429718E+04     0.288491E+04     0.398464E+00
2002     0.493168E+04     0.205267E+04     0.876537E+00
2003     0.367601E+04     0.355353E+04     0.338868E-01
2004     0.393029E+04     0.227814E+04     0.545353E+00
2005     0.270782E+04     0.170544E+04     0.462320E+00
2006     0.248051E+04     0.391023E+04    -0.455133E+00
2007     0.301721E+04     0.315465E+04    -0.445452E-01
2008     0.414693E+04     0.523203E+04    -0.232431E+00

Survey Index:    6 Tag:         spr_us   AGE =  6
Time = JAN-1           Type = NUMBER
```

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Catchability =    0.270544E+00   % Variance Contribution =     1.4548
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_______________________________________________________________________


1980     0.477135E+04     0.377550E+04     0.234096E+00
1981     0.500844E+04     0.330621E+04     0.415321E+00
1982     0.394155E+04     0.253537E+04     0.441234E+00
1983     0.349701E+04     0.256866E+04     0.308525E+00
1984     0.171887E+04     0.232169E+04    -0.300628E+00
1985     0.254867E+04     0.183571E+04     0.328141E+00
1986     0.859440E+03     0.120067E+04    -0.334358E+00
1987     0.740890E+03     0.114305E+04    -0.433603E+00
1988     0.681620E+03     0.119500E+04    -0.561426E+00
1989     0.859440E+03     0.727961E+03     0.166033E+00
1990     0.503810E+03     0.764223E+03    -0.416661E+00
1991     0.444540E+03     0.982912E+03    -0.793479E+00
1992     0.127434E+04     0.170812E+04    -0.292967E+00
1993     0.133361E+04     0.161406E+04    -0.190866E+00
1994     0.681620E+03     0.873917E+03    -0.248514E+00
1995     0.130397E+04     0.937269E+03     0.330198E+00
1996     0.157069E+04     0.101532E+04     0.436312E+00
1997     0.115579E+04     0.126774E+04    -0.924492E-01
1998     0.201523E+04     0.194614E+04     0.348838E-01
1999     0.189669E+04     0.216114E+04    -0.130526E+00
2000     0.254867E+04     0.185412E+04     0.318164E+00
2001     0.222268E+04     0.163607E+04     0.306415E+00
2002     0.151557E+04     0.136653E+04     0.103514E+00
2003     0.189224E+04     0.101694E+04     0.620961E+00
2004     0.337017E+04     0.206887E+04     0.487962E+00
2005     0.147023E+04     0.129467E+04     0.127161E+00
2006     0.958420E+03     0.896867E+03     0.663790E-01
2007     0.966420E+03     0.242123E+04    -0.918432E+00
2008     0.188631E+04     0.190792E+04    -0.113911E-01

Survey Index:    7 Tag:         spr_us   AGE =  7
Time = JAN-1           Type = NUMBER
Catchability =    0.239287E+00   % Variance Contribution =     2.3496
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_______________________________________________________________________


1980     0.337847E+04     0.238017E+04     0.350251E+00
1981     0.417864E+04     0.188898E+04     0.793947E+00
1982     0.272649E+04     0.161077E+04     0.526305E+00
1983     0.171887E+04     0.106507E+04     0.478622E+00
1984     0.651990E+03     0.102256E+04    -0.450039E+00
1985     0.136324E+04     0.986091E+03     0.323871E+00
1986     0.622350E+03     0.714833E+03    -0.138546E+00
1987     0.503810E+03     0.552688E+03    -0.925947E-01
1988     0.355630E+03     0.540781E+03    -0.419123E+00
1989     0.474170E+03     0.555414E+03    -0.158149E+00
1990     0.177810E+03     0.349555E+03    -0.675946E+00
1991     0.207450E+03     0.403746E+03    -0.665895E+00
1992     0.325990E+03     0.441362E+03    -0.303000E+00
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1993     0.503810E+03     0.670045E+03    -0.285145E+00
1994     0.296360E+03     0.617267E+03    -0.733727E+00
1995     0.651990E+03     0.345702E+03     0.634451E+00
1996     0.592710E+03     0.283605E+03     0.737121E+00
1997     0.266720E+03     0.412728E+03    -0.436589E+00
1998     0.474170E+03     0.550117E+03    -0.148565E+00
1999     0.121506E+04     0.851151E+03     0.355959E+00
2000     0.177814E+04     0.105982E+04     0.517466E+00
2001     0.109652E+04     0.865436E+03     0.236663E+00
2002     0.988650E+03     0.713604E+03     0.326013E+00
2003     0.653470E+03     0.601381E+03     0.830681E-01
2004     0.102006E+04     0.462899E+03     0.790107E+00
2005     0.702960E+03     0.124059E+04    -0.568040E+00
2006     0.881960E+03     0.772309E+03     0.132762E+00
2007     0.406900E+03     0.534038E+03    -0.271900E+00
2008     0.642210E+03     0.164297E+04    -0.939347E+00

Survey Index:    8 Tag:         spr_us   AGE =  8
Time = JAN-1           Type = NUMBER
Catchability =    0.178071E+00   % Variance Contribution =     5.0464
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
______________________________________________________________________

1980     0.770530E+03     0.832982E+03    -0.779340E-01
1981     0.228195E+04     0.870858E+03     0.963306E+00
1982     0.148179E+04     0.767316E+03     0.658107E+00
1983     0.948340E+03     0.457665E+03     0.728575E+00
1984     0.296360E+03     0.288573E+03     0.266284E-01
1985     0.124470E+04     0.315146E+03     0.137361E+01
1986     0.296360E+03     0.247546E+03     0.179978E+00
1987     0.207450E+03     0.227514E+03    -0.923218E-01
1988     0.296400E+02     0.194078E+03    -0.187914E+01
1989     0.889100E+02     0.241024E+03    -0.997272E+00
1990     0.118540E+03     0.205114E+03    -0.548315E+00
1991     0.118540E+03     0.154225E+03    -0.263162E+00
1992     0.118540E+03     0.193682E+03    -0.490965E+00
1993     0.237090E+03     0.133950E+03     0.570971E+00
1994     0.889100E+02     0.188411E+03    -0.751002E+00
1995     0.889100E+02     0.191837E+03    -0.769023E+00
1996     0.148180E+03     0.106508E+03     0.330211E+00
1997     0.296400E+02     0.827966E+02    -0.102726E+01
1998     0.177810E+03     0.150362E+03     0.167669E+00
1999     0.503810E+03     0.164833E+03     0.111727E+01
2000     0.444540E+03     0.297265E+03     0.402415E+00
2001     0.503810E+03     0.366025E+03     0.319497E+00
2002     0.579970E+03     0.275994E+03     0.742597E+00
2003     0.303770E+03     0.244961E+03     0.215172E+00
2004     0.290430E+03     0.247538E+03     0.159799E+00
2005     0.342890E+03     0.200778E+03     0.535209E+00
2006     0.317990E+03     0.684847E+03    -0.767176E+00
2007     0.207750E+03     0.413809E+03    -0.689069E+00
2008     0.253090E+03     0.290649E+03    -0.138373E+00

Survey Index:    9 Tag:         spr_us   AGE =  9 - 11
Time = JAN-1           Type = NUMBER
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Catchability =    0.183208E+00   % Variance Contribution =     6.3162
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_______________________________________________________________________
1980     0.194410E+04     0.188545E+04     0.306341E-01
1981     0.308211E+04     0.114337E+04     0.991640E+00
1982     0.204486E+04     0.108259E+04     0.635979E+00
1983     0.154106E+04     0.865628E+03     0.576769E+00
1984     0.266721E+03     0.673151E+03    -0.925764E+00
1985     0.859436E+03     0.316619E+03     0.998578E+00
1986     0.237086E+03     0.186478E+03     0.240106E+00
1987     0.296357E+03     0.167865E+03     0.568405E+00
1988     0.325993E+03     0.192786E+03     0.525296E+00
1989     0.266721E+03     0.236615E+03     0.119771E+00
1990     0.148179E+03     0.289978E+03    -0.671386E+00
1991     0.148179E+03     0.236523E+03    -0.467629E+00
1992     0.118543E+03     0.199584E+03    -0.520960E+00
1993     0.237086E+03     0.245565E+03    -0.351397E-01
1994     0.148179E+03     0.248250E+03    -0.516019E+00
1995     0.355629E+03     0.976208E+02     0.129280E+01
1996     0.592714E+02     0.111673E+03    -0.633448E+00
1997     0.889071E+02     0.140730E+03    -0.459251E+00
1998     0.889071E+02     0.140119E+03    -0.454898E+00
1999     0.118543E+03     0.140073E+03    -0.166889E+00
2000     0.296357E+03     0.105911E+03     0.102896E+01
2001     0.474171E+03     0.206744E+03     0.830086E+00
2002     0.645466E+03     0.328047E+03     0.676817E+00
2003     0.554781E+03     0.296155E+03     0.627691E+00
2004     0.611088E+03     0.261937E+03     0.847139E+00
2005     0.488989E+02     0.282185E+03    -0.175281E+01
2006     0.170702E+03     0.322110E+03    -0.634976E+00
2007     0.120025E+03     0.742816E+03    -0.182275E+01
2008     0.362148E+03     0.916722E+03    -0.928750E+00

Survey Index:   11 Tag:         us1aut   AGE =  2
Time = JAN-1           Type = NUMBER
Catchability =    0.106649E+00   % Variance Contribution =     3.4536
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_______________________________________________________________________

1980     N/A              0.421014E+04     N/A
1981     0.468244E+04     0.439154E+04     0.641395E-01
1982     0.130397E+04     0.227207E+04    -0.555279E+00
1983     0.592710E+03     0.181952E+04    -0.112162E+01
1984     0.148179E+04     0.215233E+04    -0.373302E+00
1985     0.651990E+03     0.135489E+04    -0.731447E+00
1986     0.269685E+04     0.165380E+04     0.489008E+00
1987     0.151142E+04     0.205513E+04    -0.307291E+00
1988     0.157069E+04     0.362981E+04    -0.837666E+00
1989     0.841654E+04     0.464073E+04     0.595326E+00
1990     0.142251E+04     0.183048E+04    -0.252153E+00
1991     0.506771E+04     0.189003E+04     0.986297E+00
1992     0.139288E+04     0.197911E+04    -0.351272E+00
1993     0.192632E+04     0.219391E+04    -0.130074E+00
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1994     0.503807E+04     0.346025E+04     0.375682E+00
1995     0.113505E+05     0.337845E+04     0.121184E+01
1996     0.148179E+04     0.231992E+04    -0.448280E+00
1997     0.160033E+04     0.211193E+04    -0.277393E+00
1998     0.106689E+04     0.186263E+04    -0.557243E+00
1999     0.512698E+04     0.145832E+04     0.125723E+01
2000     0.592714E+04     0.231030E+04     0.942163E+00
2001     0.139288E+04     0.141192E+04    -0.135774E-01
2002     0.118543E+04     0.108344E+04     0.899618E-01
2003     0.295587E+04     0.247838E+04     0.176186E+00
2004     0.207776E+04     0.196196E+04     0.573449E-01
2005     0.208161E+04     0.321667E+04    -0.435204E+00
2006     0.204101E+04     0.372476E+04    -0.601559E+00
2007     0.605280E+04     0.448503E+04     0.299775E+00
2008     0.318702E+04     0.203538E+04     0.448403E+00

Survey Index:   12 Tag:         us2aut   AGE =  3
Time = JAN-1           Type = NUMBER
Catchability =    0.299685E+00   % Variance Contribution =     1.8896
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_______________________________________________________________________

1980     N/A              0.978030E+04     N/A
1981     0.660876E+04     0.965928E+04    -0.379523E+00
1982     0.782383E+04     0.983772E+04    -0.229050E+00
1983     0.269685E+04     0.506403E+04    -0.630078E+00
1984     0.299321E+04     0.400677E+04    -0.291639E+00
1985     0.663840E+04     0.485150E+04     0.313583E+00
1986     0.245976E+04     0.307442E+04    -0.223053E+00
1987     0.432681E+04     0.363204E+04     0.175035E+00
1988     0.376374E+04     0.456862E+04    -0.193797E+00
1989     0.880181E+04     0.813837E+04     0.783679E-01
1990     0.131879E+05     0.100614E+05     0.270590E+00
1991     0.669767E+04     0.391537E+04     0.536850E+00
1992     0.732002E+04     0.427922E+04     0.536841E+00
1993     0.364519E+04     0.448705E+04    -0.207788E+00
1994     0.693476E+04     0.497147E+04     0.332830E+00
1995     0.223157E+05     0.772115E+04     0.106133E+01
1996     0.112616E+05     0.711476E+04     0.459225E+00
1997     0.240049E+04     0.502638E+04    -0.739028E+00
1998     0.314139E+04     0.468671E+04    -0.400066E+00
1999     0.177814E+04     0.426212E+04    -0.874199E+00
2000     0.651986E+04     0.329654E+04     0.681980E+00
2001     0.859436E+04     0.523319E+04     0.496085E+00
2002     0.361556E+04     0.322351E+04     0.114775E+00
2003     0.227069E+04     0.248913E+04    -0.918491E-01
2004     0.669738E+04     0.551542E+04     0.194169E+00
2005     0.284592E+04     0.447589E+04    -0.452819E+00
2006     0.487685E+04     0.732369E+04    -0.406615E+00
2007     0.751799E+04     0.854680E+04    -0.128258E+00
2008     0.102142E+05     0.102541E+05    -0.389800E-02

Survey Index:   13 Tag:         us3aut   AGE =  4
Time = JAN-1           Type = NUMBER
Catchability =    0.454693E+00   % Variance Contribution =     1.9136
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Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
______________________________________________________________________

1980     N/A              0.109422E+05     N/A
1981     0.806091E+04     0.117093E+05    -0.373354E+00
1982     0.640131E+04     0.110998E+05    -0.550420E+00
1983     0.488989E+04     0.108480E+05    -0.796814E+00
1984     0.598641E+04     0.568445E+04     0.517571E-01
1985     0.462317E+04     0.457095E+04     0.113605E-01
1986     0.782383E+04     0.552726E+04     0.347481E+00
1987     0.257831E+04     0.351636E+04    -0.310293E+00
1988     0.293394E+04     0.375809E+04    -0.247564E+00
1989     0.708294E+04     0.492141E+04     0.364094E+00
1990     0.847581E+04     0.904124E+04    -0.645796E-01
1991     0.221972E+05     0.105629E+05     0.742618E+00
1992     0.598641E+04     0.444096E+04     0.298622E+00
1993     0.548261E+04     0.496216E+04     0.997398E-01
1994     0.102836E+05     0.540078E+04     0.644006E+00
1995     0.832764E+04     0.600856E+04     0.326396E+00
1996     0.113208E+05     0.894597E+04     0.235442E+00
1997     0.592714E+04     0.832211E+04    -0.339374E+00
1998     0.459354E+04     0.610549E+04    -0.284538E+00
1999     0.557151E+04     0.567871E+04    -0.190585E-01
2000     0.607532E+04     0.522504E+04     0.150772E+00
2001     0.115876E+05     0.391350E+04     0.108550E+01
2002     0.980942E+04     0.633083E+04     0.437912E+00
2003     0.386420E+04     0.395964E+04    -0.243974E-01
2004     0.372669E+04     0.307333E+04     0.192758E+00
2005     0.353376E+04     0.675841E+04    -0.648426E+00
2006     0.214118E+04     0.551626E+04    -0.946342E+00
2007     0.774233E+04     0.905073E+04    -0.156143E+00
2008     0.838631E+04     0.105250E+05    -0.227157E+00

Survey Index:   14 Tag:         us4aut   AGE =  5
Time = JAN-1           Type = NUMBER
Catchability =    0.545345E+00   % Variance Contribution =     1.4078
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
______________________________________________________________________

1980     N/A              0.104999E+05     N/A
1981     0.841654E+04     0.943162E+04    -0.113869E+00
1982     0.734966E+04     0.901769E+04    -0.204535E+00
1983     0.376374E+04     0.865486E+04    -0.832708E+00
1984     0.865363E+04     0.811362E+04     0.644354E-01
1985     0.358592E+04     0.439345E+04    -0.203101E+00
1986     0.311175E+04     0.383187E+04    -0.208168E+00
1987     0.423791E+04     0.430671E+04    -0.161045E-01
1988     0.127434E+04     0.274663E+04    -0.767948E+00
1989     0.231159E+04     0.279129E+04    -0.188568E+00
1990     0.290430E+04     0.359860E+04    -0.214352E+00
1991     0.856472E+04     0.710794E+04     0.186440E+00
1992     0.471208E+04     0.743409E+04    -0.455946E+00
1993     0.379337E+04     0.357299E+04     0.598518E-01
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1994     0.675694E+04     0.400134E+04     0.523941E+00
1995     0.506771E+04     0.446308E+04     0.127049E+00
1996     0.740893E+04     0.474203E+04     0.446222E+00
1997     0.812019E+04     0.695319E+04     0.155153E+00
1998     0.551224E+04     0.703331E+04    -0.243687E+00
1999     0.595678E+04     0.556921E+04     0.672766E-01
2000     0.631241E+04     0.501753E+04     0.229579E+00
2001     0.675694E+04     0.473858E+04     0.354832E+00
2002     0.782383E+04     0.337160E+04     0.841788E+00
2003     0.995582E+04     0.583681E+04     0.533972E+00
2004     0.520640E+04     0.374194E+04     0.330284E+00
2005     0.291704E+04     0.280126E+04     0.405016E-01
2006     0.346412E+04     0.642271E+04    -0.617382E+00
2007     0.761964E+04     0.518164E+04     0.385607E+00
2008     0.649141E+04     0.859382E+04    -0.280564E+00

Survey Index:   15 Tag:         us5aut   AGE =  6
Time = JAN-1           Type = NUMBER
Catchability =    0.521424E+00   % Variance Contribution =     1.8500
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_______________________________________________________________________

1980     N/A              0.727658E+04     N/A
1981     0.453426E+04     0.637211E+04    -0.340269E+00
1982     0.640131E+04     0.488646E+04     0.270035E+00
1983     0.168924E+04     0.495061E+04    -0.107523E+01
1984     0.403046E+04     0.447463E+04    -0.104543E+00
1985     0.317102E+04     0.353799E+04    -0.109505E+00
1986     0.234122E+04     0.231408E+04     0.116608E-01
1987     0.139288E+04     0.220302E+04    -0.458455E+00
1988     0.204486E+04     0.230314E+04    -0.118942E+00
1989     0.139288E+04     0.140301E+04    -0.724719E-02
1990     0.563080E+03     0.147290E+04    -0.961566E+00
1991     0.174851E+04     0.189438E+04    -0.801280E-01
1992     0.216341E+04     0.329209E+04    -0.419838E+00
1993     0.231159E+04     0.311081E+04    -0.296948E+00
1994     0.311175E+04     0.168431E+04     0.613827E+00
1995     0.385264E+04     0.180641E+04     0.757416E+00
1996     0.266721E+04     0.195684E+04     0.309702E+00
1997     0.275612E+04     0.244333E+04     0.120463E+00
1998     0.308211E+04     0.375083E+04    -0.196363E+00
1999     0.527516E+04     0.416520E+04     0.236245E+00
2000     0.474171E+04     0.357346E+04     0.282862E+00
2001     0.400082E+04     0.315323E+04     0.238072E+00
2002     0.432681E+04     0.263374E+04     0.496425E+00
2003     0.512016E+04     0.195997E+04     0.960257E+00
2004     0.514772E+04     0.398736E+04     0.255425E+00
2005     0.217289E+04     0.249524E+04    -0.138328E+00
2006     0.220994E+04     0.172854E+04     0.245686E+00
2007     0.418693E+04     0.466647E+04    -0.108436E+00
2008     0.250896E+04     0.367716E+04    -0.382273E+00

Survey Index:   16 Tag:         us6aut   AGE =  7
Time = JAN-1           Type = NUMBER
Catchability =    0.460618E+00   % Variance Contribution =     2.3812
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Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_______________________________________________________________________


1980     N/A              0.458173E+04     N/A
1981     0.302284E+04     0.363621E+04    -0.184746E+00
1982     0.426754E+04     0.310066E+04     0.319423E+00
1983     0.142251E+04     0.205022E+04    -0.365526E+00
1984     0.201523E+04     0.196839E+04     0.235164E-01
1985     0.151142E+04     0.189818E+04    -0.227848E+00
1986     0.121506E+04     0.137602E+04    -0.124404E+00
1987     0.124470E+04     0.106390E+04     0.156952E+00
1988     0.740890E+03     0.104098E+04    -0.340066E+00
1989     0.296360E+03     0.106915E+04    -0.128304E+01
1990     0.296360E+03     0.672879E+03    -0.819991E+00
1991     0.740890E+03     0.777193E+03    -0.478368E-01
1992     0.859440E+03     0.849604E+03     0.115108E-01
1993     0.889070E+03     0.128981E+04    -0.372072E+00
1994     0.237086E+04     0.118821E+04     0.690802E+00
1995     0.118543E+04     0.665462E+03     0.577379E+00
1996     0.651990E+03     0.545928E+03     0.177541E+00
1997     0.115579E+04     0.794484E+03     0.374847E+00
1998     0.948340E+03     0.105895E+04    -0.110322E+00
1999     0.320066E+04     0.163843E+04     0.669619E+00
2000     0.240049E+04     0.204011E+04     0.162667E+00
2001     0.222268E+04     0.166593E+04     0.288331E+00
2002     0.157069E+04     0.137366E+04     0.134038E+00
2003     0.157306E+04     0.115763E+04     0.306646E+00
2004     0.262128E+04     0.891061E+03     0.107900E+01
2005     0.147290E+04     0.238808E+04    -0.483255E+00
2006     0.125952E+04     0.148666E+04    -0.165803E+00
2007     0.167709E+04     0.102800E+04     0.489444E+00
2008     0.123937E+04     0.316265E+04    -0.936808E+00

Survey Index:   17 Tag:         us7aut   AGE =  8
Time = JAN-1           Type = NUMBER
Catchability =    0.328359E+00   % Variance Contribution =     4.0561
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_______________________________________________________________________
1980     N/A              0.153600E+04     N/A
1981     0.275612E+04     0.160584E+04     0.540175E+00
1982     0.174851E+04     0.141491E+04     0.211696E+00
1983     0.889070E+03     0.843924E+03     0.521131E-01
1984     0.100761E+04     0.532121E+03     0.638465E+00
1985     0.355630E+03     0.581122E+03    -0.491070E+00
1986     0.563080E+03     0.456470E+03     0.209900E+00
1987     0.474170E+03     0.419531E+03     0.122429E+00
1988     0.296360E+03     0.357876E+03    -0.188612E+00
1989     0.207450E+03     0.444443E+03    -0.761931E+00
1990     0.592700E+02     0.378226E+03    -0.185339E+01
1991     0.355630E+03     0.284387E+03     0.223553E+00
1992     0.118540E+03     0.357144E+03    -0.110289E+01
1993     0.207450E+03     0.247001E+03    -0.174503E+00
1994     0.325990E+03     0.347426E+03    -0.636850E-01
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1995     0.740890E+03     0.353744E+03     0.739280E+00
1996     0.118540E+03     0.196398E+03    -0.504891E+00
1997     0.207450E+03     0.152675E+03     0.306578E+00
1998     0.118540E+03     0.277264E+03    -0.849721E+00
1999     0.355630E+03     0.303949E+03     0.157032E+00
2000     0.592710E+03     0.548150E+03     0.781554E-01
2001     0.977980E+03     0.674942E+03     0.370862E+00
2002     0.121506E+04     0.508927E+03     0.870245E+00
2003     0.117031E+04     0.451703E+03     0.952000E+00
2004     0.103399E+04     0.456454E+03     0.817693E+00
2005     0.566930E+03     0.370230E+03     0.426110E+00
2006     0.432980E+03     0.126284E+04    -0.107043E+01
2007     0.130575E+04     0.763054E+03     0.537204E+00
2008     0.442160E+03     0.535951E+03    -0.192371E+00

Survey Index:   18 Tag:         us8paut  AGE =  9 - 11
Time = JAN-1           Type = NUMBER
Catchability =    0.310350E+00   % Variance Contribution =     5.0959
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
________________________________________________________________________

1980     N/A              0.319391E+04     N/A
1981     0.411936E+04     0.193683E+04     0.754644E+00
1982     0.325993E+04     0.183387E+04     0.575274E+00
1983     0.145215E+04     0.146635E+04    -0.973354E-02
1984     0.133361E+04     0.114030E+04     0.156595E+00
1985     0.503807E+03     0.536345E+03    -0.625832E-01
1986     0.325993E+03     0.315890E+03     0.314807E-01
1987     0.563079E+03     0.284359E+03     0.683180E+00
1988     0.325993E+03     0.326575E+03    -0.178326E-02
1989     0.148179E+03     0.400820E+03    -0.995095E+00
1990     0.266721E+03     0.491215E+03    -0.610678E+00
1991     0.414900E+03     0.400665E+03     0.349110E-01
1992     0.237086E+03     0.338091E+03    -0.354892E+00
1993     0.355629E+03     0.415981E+03    -0.156754E+00
1994     0.355629E+03     0.420530E+03    -0.167629E+00
1995     0.563079E+03     0.165367E+03     0.122525E+01
1996     0.148179E+03     0.189172E+03    -0.244236E+00
1997     0.325993E+03     0.238393E+03     0.312953E+00
1998     0.118543E+03     0.237358E+03    -0.694295E+00
1999     0.237086E+03     0.237280E+03    -0.821011E-03
2000     0.889071E+02     0.179411E+03    -0.702089E+00
2001     0.592714E+03     0.350220E+03     0.526151E+00
2002     0.118543E+04     0.555703E+03     0.757625E+00
2003     0.165545E+04     0.501679E+03     0.119387E+01
2004     0.923745E+03     0.443715E+03     0.733254E+00
2005     0.430607E+03     0.478015E+03    -0.104446E+00
2006     0.678658E+03     0.545647E+03     0.218145E+00
2007     0.734669E+03     0.125831E+04    -0.538107E+00
2008     0.120025E+03     0.155291E+04    -0.256019E+01

Survey Index:   20 Tag:         spr_ma   AGE =  1
Time = JAN-1           Type = NUMBER
Catchability =    0.421847E-01   % Variance Contribution =    12.8161
Residual = LN(Observed) - LN(Predicted)
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Year      Observed        Predicted         Residual
________________________________________________________________________

1980     N/A              0.212190E+04     N/A
1981     N/A              0.109793E+04     N/A
1982     0.162223E+04     0.879498E+03     0.612205E+00
1983     0.436060E+03     0.104052E+04    -0.869694E+00
1984     0.485760E+03     0.654696E+03    -0.298457E+00
1985     0.487120E+04     0.802006E+03     0.180398E+01
1986     0.611385E+04     0.995642E+03     0.181492E+01
1987     0.776319E+04     0.175544E+04     0.148667E+01
1988     0.184071E+05     0.225664E+04     0.209886E+01
1989     0.182331E+04     0.885067E+03     0.722746E+00
1990     0.174649E+04     0.913208E+03     0.648399E+00
1991     0.474470E+03     0.956248E+03    -0.700819E+00
1992     0.185228E+04     0.106038E+04     0.557793E+00
1993     0.261990E+04     0.167274E+04     0.448671E+00
1994     0.262100E+04     0.163492E+04     0.471964E+00
1995     0.122190E+03     0.112291E+04    -0.221811E+01
1996     0.516760E+03     0.102091E+04    -0.680867E+00
1997     0.349820E+03     0.900566E+03    -0.945604E+00
1998     0.639400E+03     0.706279E+03    -0.994797E-01
1999     0.305010E+03     0.111636E+04    -0.129748E+01
2000     0.779280E+03     0.682258E+03     0.132963E+00
2001     0.158200E+02     0.523489E+03    -0.349924E+01
2002     0.141436E+04     0.119749E+04     0.166453E+00
2003     0.116357E+04     0.948424E+03     0.204447E+00
2004     0.372796E+04     0.155433E+04     0.874816E+00
2005     0.150474E+04     0.180112E+04    -0.179787E+00
2006     0.107094E+04     0.216815E+04    -0.705336E+00
2007     0.571620E+03     0.990786E+03    -0.550024E+00
2008     N/A              0.177532E+04     N/A

Survey Index:   21 Tag:         spr_ma   AGE =  2
Time = JAN-1           Type = NUMBER
Catchability =    0.234209E+00   % Variance Contribution =     5.4133
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
________________________________________________________________________
1980     N/A              0.924579E+04     N/A
1981     N/A              0.964415E+04     N/A
1982     0.111274E+05     0.498964E+04     0.802045E+00
1983     0.423857E+04     0.399580E+04     0.589824E-01
1984     0.619971E+04     0.472669E+04     0.271277E+00
1985     0.387708E+04     0.297544E+04     0.264689E+00
1986     0.249140E+05     0.363187E+04     0.192568E+01
1987     0.389967E+04     0.451323E+04    -0.146121E+00
1988     0.143628E+05     0.797134E+04     0.588789E+00
1989     0.287527E+05     0.101914E+05     0.103719E+01
1990     0.573202E+04     0.401986E+04     0.354820E+00
1991     0.451422E+04     0.415065E+04     0.839682E-01
1992     0.249827E+04     0.434627E+04    -0.553719E+00
1993     0.428844E+04     0.481799E+04    -0.116435E+00
1994     0.118765E+05     0.759898E+04     0.446551E+00
1995     0.782878E+04     0.741933E+04     0.537176E-01
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1996     0.935970E+03     0.509471E+04    -0.169438E+01
1997     0.179907E+04     0.463796E+04    -0.947005E+00
1998     0.978310E+03     0.409048E+04    -0.143059E+01
1999     0.263216E+04     0.320258E+04    -0.196151E+00
2000     0.127684E+05     0.507360E+04     0.922925E+00
2001     0.107320E+04     0.310069E+04    -0.106098E+01
2002     0.937640E+03     0.237932E+04    -0.931205E+00
2003     0.101400E+05     0.544272E+04     0.622213E+00
2004     0.267509E+04     0.430862E+04    -0.476635E+00
2005     0.475371E+04     0.706405E+04    -0.396093E+00
2006     0.122525E+05     0.817987E+04     0.404058E+00
2007     0.110212E+05     0.984947E+04     0.112403E+00
2008     N/A              0.446985E+04     N/A

Survey Index:   22 Tag:         spr_ma   AGE =  3
Time = JAN-1           Type = NUMBER
Catchability =    0.318789E+00   % Variance Contribution =     1.3275
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_______________________________________________________________________

1980     N/A              0.104038E+05     N/A
1981     N/A              0.102750E+05     N/A
1982     0.753499E+04     0.104648E+05    -0.328464E+00
1983     0.506550E+04     0.538684E+04    -0.615069E-01
1984     0.481697E+04     0.426219E+04     0.122362E+00
1985     0.547219E+04     0.516077E+04     0.585937E-01
1986     0.607996E+04     0.327040E+04     0.620085E+00
1987     0.356754E+04     0.386357E+04    -0.797162E-01
1988     0.403297E+04     0.485985E+04    -0.186504E+00
1989     0.101604E+05     0.865716E+04     0.160109E+00
1990     0.128129E+05     0.107028E+05     0.179944E+00
1991     0.785582E+04     0.416496E+04     0.634548E+00
1992     0.767713E+04     0.455201E+04     0.522677E+00
1993     0.363370E+04     0.477309E+04    -0.272742E+00
1994     0.499872E+04     0.528839E+04    -0.563316E-01
1995     0.112164E+05     0.821334E+04     0.311615E+00
1996     0.337125E+04     0.756830E+04    -0.808685E+00
1997     0.315184E+04     0.534680E+04    -0.528511E+00
1998     0.258698E+04     0.498548E+04    -0.656038E+00
1999     0.263216E+04     0.453382E+04    -0.543759E+00
2000     0.787559E+04     0.350668E+04     0.809098E+00
2001     0.535696E+04     0.556679E+04    -0.384219E-01
2002     0.243334E+04     0.342900E+04    -0.343004E+00
2003     0.279710E+04     0.264780E+04     0.548531E-01
2004     0.766152E+04     0.586701E+04     0.266866E+00
2005     0.518073E+04     0.476122E+04     0.844431E-01
2006     0.790779E+04     0.779055E+04     0.149371E-01
2007     0.968817E+04     0.909163E+04     0.635516E-01
2008     N/A              0.109078E+05     N/A

Survey Index:   23 Tag:         spr_ma   AGE =  4
Time = JAN-1           Type = NUMBER
Catchability =    0.228953E+00   % Variance Contribution =     1.3815
Residual = LN(Observed) - LN(Predicted)
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Year      Observed        Predicted         Residual
_______________________________________________________________________
1980     N/A               0.550978E+04     N/A
1981     N/A               0.589601E+04     N/A
1982     0.387256E+04     0.558910E+04    -0.366903E+00
1983     0.484860E+04     0.546235E+04    -0.119189E+00
1984     0.238815E+04     0.286231E+04    -0.181111E+00
1985     0.214640E+04     0.230163E+04    -0.698238E-01
1986     0.326027E+04     0.278316E+04     0.158222E+00
1987     0.881150E+03     0.177061E+04    -0.697850E+00
1988     0.197017E+04     0.189232E+04     0.403144E-01
1989     0.270898E+04     0.247810E+04     0.890815E-01
1990     0.372344E+04     0.455257E+04    -0.201044E+00
1991     0.428828E+04     0.531877E+04    -0.215356E+00
1992     0.338729E+04     0.223617E+04     0.415265E+00
1993     0.206940E+04     0.249862E+04    -0.188478E+00
1994     0.161136E+04     0.271948E+04    -0.523361E+00
1995     0.233275E+04     0.302551E+04    -0.260032E+00
1996     0.709252E+04     0.450460E+04     0.453942E+00
1997     0.389413E+04     0.419046E+04    -0.733410E-01
1998     0.170130E+04     0.307432E+04    -0.591691E+00
1999     0.341391E+04     0.285942E+04     0.177238E+00
2000     0.451372E+04     0.263099E+04     0.539763E+00
2001     0.384770E+04     0.197058E+04     0.669149E+00
2002     0.420017E+04     0.318779E+04     0.275798E+00
2003     0.412787E+04     0.199381E+04     0.727714E+00
2004     0.295299E+04     0.154753E+04     0.646160E+00
2005     0.186172E+04     0.340309E+04    -0.603183E+00
2006     0.321056E+04     0.277762E+04     0.144851E+00
2007     0.356302E+04     0.455735E+04    -0.246133E+00
2008     N/A               0.529971E+04     N/A

Survey Index:   24 Tag:         spr_ma   AGE =  5
Time = JAN-1           Type = NUMBER
Catchability =    0.128202E+00   % Variance Contribution =     2.1238
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_______________________________________________________________________
1980     N/A               0.246836E+04     N/A
1981     N/A               0.221723E+04     N/A
1982     0.112968E+04     0.211992E+04    -0.629446E+00
1983     0.230907E+04     0.203463E+04     0.126532E+00
1984     0.104835E+04     0.190739E+04    -0.598518E+00
1985     0.851780E+03     0.103284E+04    -0.192735E+00
1986     0.641660E+03     0.900816E+03    -0.339242E+00
1987     0.397650E+03     0.101244E+04    -0.934550E+00
1988     0.347940E+03     0.645692E+03    -0.618293E+00
1989     0.684590E+03     0.656190E+03     0.423694E-01
1990     0.774960E+03     0.845976E+03    -0.876800E-01
1991     0.732040E+03     0.167097E+04    -0.825324E+00
1992     0.167695E+04     0.174764E+04    -0.412908E-01
1993     0.779100E+03     0.839957E+03    -0.752107E-01
1994     0.876360E+03     0.940655E+03    -0.707994E-01
1995     0.712940E+03     0.104920E+04    -0.386390E+00
1996     0.142932E+04     0.111478E+04     0.248542E+00
1997     0.275849E+04     0.163459E+04     0.523291E+00
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1998     0.201762E+04     0.165343E+04     0.199069E+00
1999     0.171034E+04     0.130924E+04     0.267247E+00
2000     0.300288E+04     0.117955E+04     0.934442E+00
2001     0.107094E+04     0.111397E+04    -0.393936E-01
2002     0.133981E+04     0.792612E+03     0.524950E+00
2003     0.402619E+04     0.137215E+04     0.107644E+01
2004     0.128106E+04     0.879674E+03     0.375892E+00
2005     0.108450E+04     0.658533E+03     0.498859E+00
2006     0.111613E+04     0.150988E+04    -0.302165E+00
2007     0.168323E+04     0.121813E+04     0.323401E+00
2008     N/A              0.202028E+04     N/A

Survey Index:   26 Tag:         ma1aut   AGE =  2
Time = JAN-1           Type = NUMBER
Catchability =    0.265599E+00   % Variance Contribution =     4.9154
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_______________________________________________________________________
1980     N/A              0.104850E+05     N/A
1981     N/A              0.109367E+05     N/A
1982     N/A              0.565838E+04     N/A
1983     0.299140E+04     0.453134E+04    -0.415275E+00
1984     0.117871E+05     0.536019E+04     0.788009E+00
1985     0.709440E+03     0.337423E+04    -0.155945E+01
1986     0.137754E+05     0.411863E+04     0.120736E+01
1987     0.932441E+04     0.511811E+04     0.599850E+00
1988     0.104744E+05     0.903970E+04     0.147311E+00
1989     0.193470E+05     0.115573E+05     0.515218E+00
1990     0.130049E+05     0.455863E+04     0.104831E+01
1991     0.722772E+04     0.470694E+04     0.428886E+00
1992     0.543830E+04     0.492878E+04     0.983756E-01
1993     0.104674E+05     0.546373E+04     0.650133E+00
1994     0.172178E+05     0.861743E+04     0.692160E+00
1995     0.829412E+04     0.841371E+04    -0.143156E-01
1996     0.267539E+04     0.577753E+04    -0.769882E+00
1997     0.367215E+04     0.525957E+04    -0.359271E+00
1998     0.307529E+04     0.463871E+04    -0.411037E+00
1999     0.780838E+04     0.363180E+04     0.765469E+00
2000     0.660413E+04     0.575359E+04     0.137871E+00
2001     0.141436E+04     0.351625E+04    -0.910719E+00
2002     0.680070E+03     0.269821E+04    -0.137815E+01
2003     0.888158E+04     0.617218E+04     0.363927E+00
2004     0.541796E+04     0.488608E+04     0.103328E+00
2005     0.135607E+05     0.801081E+04     0.526387E+00
2006     0.935830E+04     0.927617E+04     0.881444E-02
2007     0.327834E+04     0.111696E+05    -0.122585E+01
2008     0.179620E+04     0.506892E+04    -0.103746E+01

Survey Index:   27 Tag:         ma2aut   AGE =  3
Time = JAN-1           Type = NUMBER
Catchability =    0.341196E+00   % Variance Contribution =     2.8785
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_______________________________________________________________________
1980     N/A              0.111350E+05     N/A
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1981     N/A              0.109972E+05     N/A
1982     N/A              0.112004E+05     N/A
1983     0.349298E+04     0.576547E+04    -0.501132E+00
1984     0.428828E+04     0.456177E+04    -0.618247E-01
1985     0.299140E+04     0.552350E+04    -0.613271E+00
1986     0.213510E+04     0.350027E+04    -0.494327E+00
1987     0.905555E+04     0.413513E+04     0.783858E+00
1988     0.329868E+04     0.520144E+04    -0.455412E+00
1989     0.932667E+04     0.926565E+04     0.656400E-02
1990     0.276208E+05     0.114551E+05     0.880135E+00
1991     0.320830E+04     0.445771E+04    -0.328893E+00
1992     0.204157E+05     0.487196E+04     0.143281E+01
1993     0.293598E+04     0.510858E+04    -0.553880E+00
1994     0.831402E+04     0.566010E+04     0.384502E+00
1995     0.179199E+05     0.879064E+04     0.712224E+00
1996     0.999047E+04     0.810025E+04     0.209736E+00
1997     0.434863E+04     0.572261E+04    -0.274564E+00
1998     0.634512E+04     0.533589E+04     0.173230E+00
1999     0.138273E+04     0.485249E+04    -0.125543E+01
2000     0.735876E+04     0.375316E+04     0.673294E+00
2001     0.579980E+04     0.595807E+04    -0.269225E-01
2002     0.332353E+04     0.367002E+04    -0.991685E-01
2003     0.211703E+04     0.283391E+04    -0.291643E+00
2004     0.747399E+04     0.627939E+04     0.174157E+00
2005     0.431539E+04     0.509587E+04    -0.166243E+00
2006     0.123181E+05     0.833813E+04     0.390229E+00
2007     0.101988E+05     0.973066E+04     0.469878E-01
2008     0.554223E+04     0.116745E+05    -0.745009E+00

Survey Index:   28 Tag:         ma3aut   AGE =  4
Time = JAN-1           Type = NUMBER
Catchability =    0.271214E+00   % Variance Contribution =     2.7312
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_______________________________________________________________________

1980     N/A              0.652678E+04     N/A
1981     N/A              0.698431E+04     N/A
1982     N/A              0.662075E+04     N/A
1983     0.230907E+04     0.647060E+04    -0.103042E+01
1984     0.226389E+04     0.339064E+04    -0.403936E+00
1985     0.964750E+03     0.272646E+04    -0.103889E+01
1986     0.321056E+04     0.329689E+04    -0.265328E-01
1987     0.272706E+04     0.209743E+04     0.262511E+00
1988     0.677810E+03     0.224161E+04    -0.119608E+01
1989     0.315860E+04     0.293551E+04     0.732484E-01
1990     0.701082E+04     0.539289E+04     0.262373E+00
1991     0.454585E+04     0.630051E+04    -0.326416E+00
1992     0.904877E+04     0.264893E+04     0.122847E+01
1993     0.673163E+04     0.295982E+04     0.821690E+00
1994     0.397369E+04     0.322144E+04     0.209866E+00
1995     0.243185E+04     0.358397E+04    -0.387818E+00
1996     0.563215E+04     0.533607E+04     0.540023E-01
1997     0.622564E+04     0.496395E+04     0.226475E+00
1998     0.404592E+04     0.364178E+04     0.105235E+00
1999     0.311793E+04     0.338722E+04    -0.828407E-01
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2000     0.465656E+04     0.311662E+04     0.401528E+00
2001     0.438769E+04     0.233431E+04     0.631086E+00
2002     0.696111E+04     0.377619E+04     0.611622E+00
2003     0.266154E+04     0.236183E+04     0.119467E+00
2004     0.321734E+04     0.183317E+04     0.562507E+00
2005     0.225033E+04     0.403124E+04    -0.582997E+00
2006     0.333031E+04     0.329032E+04     0.120808E-01
2007     0.469949E+04     0.539855E+04    -0.138677E+00
2008     0.434702E+04     0.627794E+04    -0.367552E+00

Survey Index:   29 Tag:         ma4aut   AGE =  5
Time = JAN-1           Type = NUMBER
Catchability =    0.140295E+00   % Variance Contribution =     4.1766
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_______________________________________________________________________
1980     N/A              0.270119E+04     N/A
1981     N/A              0.242638E+04     N/A
1982     N/A              0.231989E+04     N/A
1983     0.115454E+04     0.222655E+04    -0.656750E+00
1984     0.187528E+04     0.208731E+04    -0.107116E+00
1985     0.413460E+03     0.113026E+04    -0.100564E+01
1986     0.352460E+03     0.985786E+03    -0.102850E+01
1987     0.119747E+04     0.110794E+04     0.777058E-01
1988     0.117490E+03     0.706598E+03    -0.179411E+01
1989     0.302760E+03     0.718086E+03    -0.863649E+00
1990     0.526430E+03     0.925774E+03    -0.564512E+00
1991     0.887930E+03     0.182858E+04    -0.722405E+00
1992     0.260053E+04     0.191249E+04     0.307309E+00
1993     0.249513E+04     0.919186E+03     0.998607E+00
1994     0.154796E+04     0.102938E+04     0.407978E+00
1995     0.656620E+03     0.114817E+04    -0.558820E+00
1996     0.952170E+03     0.121993E+04    -0.247807E+00
1997     0.315519E+04     0.178878E+04     0.567518E+00
1998     0.232545E+04     0.180939E+04     0.250925E+00
1999     0.160415E+04     0.143273E+04     0.113010E+00
2000     0.239041E+04     0.129081E+04     0.616196E+00
2001     0.135788E+04     0.121905E+04     0.107856E+00
2002     0.204925E+04     0.867376E+03     0.859757E+00
2003     0.336194E+04     0.150158E+04     0.806003E+00
2004     0.171260E+04     0.962650E+03     0.576078E+00
2005     0.142566E+04     0.720650E+03     0.682237E+00
2006     0.263216E+04     0.165231E+04     0.465633E+00
2007     0.245819E+04     0.133303E+04     0.611973E+00
2008     0.244464E+04     0.221084E+04     0.100524E+00

Survey Index:   30 Tag:         ma5aut   AGE =  6
Time = JAN-1           Type = NUMBER
Catchability =    0.542392E-01   % Variance Contribution =     7.7781
Residual = LN(Observed) - LN(Predicted)

Year      Observed        Predicted         Residual
_______________________________________________________________________
1980     N/A              0.756920E+03     N/A
1981     N/A              0.662836E+03     N/A
1982     N/A              0.508296E+03     N/A
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1983     0.257570E+03     0.514970E+03    -0.692816E+00
1984     0.314050E+03     0.465457E+03    -0.393467E+00
1985     0.173970E+03     0.368026E+03    -0.749272E+00
1986     0.316300E+02     0.240714E+03    -0.202950E+01
1987     0.881200E+02     0.229161E+03    -0.955725E+00
1988     0.519700E+02     0.239575E+03    -0.152820E+01
1989     0.101670E+03     0.145943E+03    -0.361485E+00
1990     0.293700E+02     0.153213E+03    -0.165186E+01
1991     0.474500E+02     0.197056E+03    -0.142381E+01
1992     0.264350E+03     0.342448E+03    -0.258846E+00
1993     0.311230E+03     0.323591E+03    -0.389476E-01
1994     0.386260E+03     0.175205E+03     0.790556E+00
1995     0.351760E+03     0.187906E+03     0.627010E+00
1996     0.204520E+03     0.203553E+03     0.473886E-02
1997     0.313400E+03     0.254158E+03     0.209523E+00
1998     0.329730E+03     0.390167E+03    -0.168299E+00
1999     0.849520E+03     0.433270E+03     0.673311E+00
2000     0.643920E+03     0.371717E+03     0.549443E+00
2001     0.675550E+03     0.328003E+03     0.722504E+00
2002     0.603250E+03     0.273965E+03     0.789330E+00
2003     0.840480E+03     0.203879E+03     0.141645E+01
2004     0.903750E+03     0.414770E+03     0.778828E+00
2005     0.619070E+03     0.259558E+03     0.869237E+00
2006     0.953450E+03     0.179806E+03     0.166821E+01
2007     0.933120E+03     0.485413E+03     0.653534E+00
2008     0.630360E+03     0.382503E+03     0.499553E+00
```

## Appendix H. Table H3. Bootstrap summary report for BASE VPA.

```
Number of Bootstrap Repetitions Requested =  1000
Number of Bootstrap Repetitions Completed =  1000
Bootstrap Output Variable: Stock Estimates (2008)


              NLLS           Bootstrap      Bootstrap      C.V. For
              Estimate       Mean           Std Error      NLLS Soln.

N  1          42084.         65284.         71615.         1.0970
N  2          19085.         20537.          8568.         0.4172
N  3          34216.         35707.          9150.         0.2562
N  4          23148.         23598.          4586.         0.1943
N  5          15758.         15998.          2621.         0.1638
N  6           7052.          7115.          1162.         0.1634
N  7           6866.          6927.           998.         0.1440
N  8           1632.          1649.           316.         0.1920
N  9           1801.          1831.           351.         0.1916
N 10           2375.          2401.           446.         0.1858

                                               NLLS
                                               Estimate    C.V. For
           Bias        Bias        Per Cent    Corrected   Corrected
           Estimate    Std. Error  Bias        For Bias    Estimate

N  1       23200.       2381.     55.1265      18885.      3.7922
```

```
N  2        1452.         275.      7.6088       17633.       0.4859
N  3        1491.         293.      4.3571       32726.       0.2796
N  4         451.         146.      1.9463       22697.       0.2020
N  5         239.          83.      1.5193       15519.       0.1689
N  6          63.          37.      0.8873        6990.       0.1663
N  7          61.          32.      0.8814        6806.       0.1466
N  8          16.          10.      1.0063        1616.       0.1959
N  9          30.          11.      1.6734        1771.       0.1981
N 10          26.          14.      1.0773        2349.       0.1899

               LOWER          UPPER
            80. % CI       80. % CI
N  1           10757.        144356.
N  2           11236.         31673.
N  3           24756.         47556.
N  4           18153.         30140.
N  5           12816.         19328.
N  6            5679.          8659.
N  7            5690.          8264.
N  8            1257.          2058.
N  9            1392.          2310.
N 10            1848.          2985.


Bootstrap Output Variable: Catchability Estimates


              NLLS          Bootstrap      Bootstrap      C.V. For
              Estimate      Mean           Std Error      NLLS Soln.

Q  1       0.756315E-02   0.770774E-02   0.144252E-02         0.1872
Q  2       0.117776E+00   0.118771E+00   0.127091E-01         0.1070
Q  3       0.237083E+00   0.239087E+00   0.227411E-01         0.0951
Q  4       0.345291E+00   0.346650E+00   0.280943E-01         0.0810
Q  5       0.332013E+00   0.331733E+00   0.233815E-01         0.0705
Q  6       0.270544E+00   0.270522E+00   0.199042E-01         0.0736
Q  7       0.239287E+00   0.241399E+00   0.213392E-01         0.0884
Q  8       0.178071E+00   0.178580E+00   0.247282E-01         0.1385
Q  9       0.183208E+00   0.185229E+00   0.276103E-01         0.1491
Q 11       0.106649E+00   0.107148E+00   0.123519E-01         0.1153
Q 12       0.299685E+00   0.299161E+00   0.263101E-01         0.0879
Q 13       0.454693E+00   0.457009E+00   0.395940E-01         0.0866
Q 14       0.545345E+00   0.549657E+00   0.421753E-01         0.0767
Q 15       0.521424E+00   0.520937E+00   0.449762E-01         0.0863
Q 16       0.460618E+00   0.462973E+00   0.460468E-01         0.0995
Q 17       0.328359E+00   0.331775E+00   0.424902E-01         0.1281
Q 18       0.310350E+00   0.313354E+00   0.455381E-01         0.1453
Q 20       0.421847E-01   0.436443E-01   0.107612E-01         0.2466
Q 21       0.234209E+00   0.237316E+00   0.384314E-01         0.1619
Q 22       0.318789E+00   0.320039E+00   0.252073E-01         0.0788
Q 23       0.228953E+00   0.228867E+00   0.178809E-01         0.0781
Q 24       0.128202E+00   0.129252E+00   0.124536E-01         0.0964
Q 26       0.265599E+00   0.269927E+00   0.388474E-01         0.1439
Q 27       0.341196E+00   0.342865E+00   0.398068E-01         0.1161
Q 28       0.271214E+00   0.272847E+00   0.304749E-01         0.1117
Q 29       0.140295E+00   0.141027E+00   0.192814E-01         0.1367
Q 30       0.542392E-01   0.551007E-01   0.103137E-01         0.1872
```

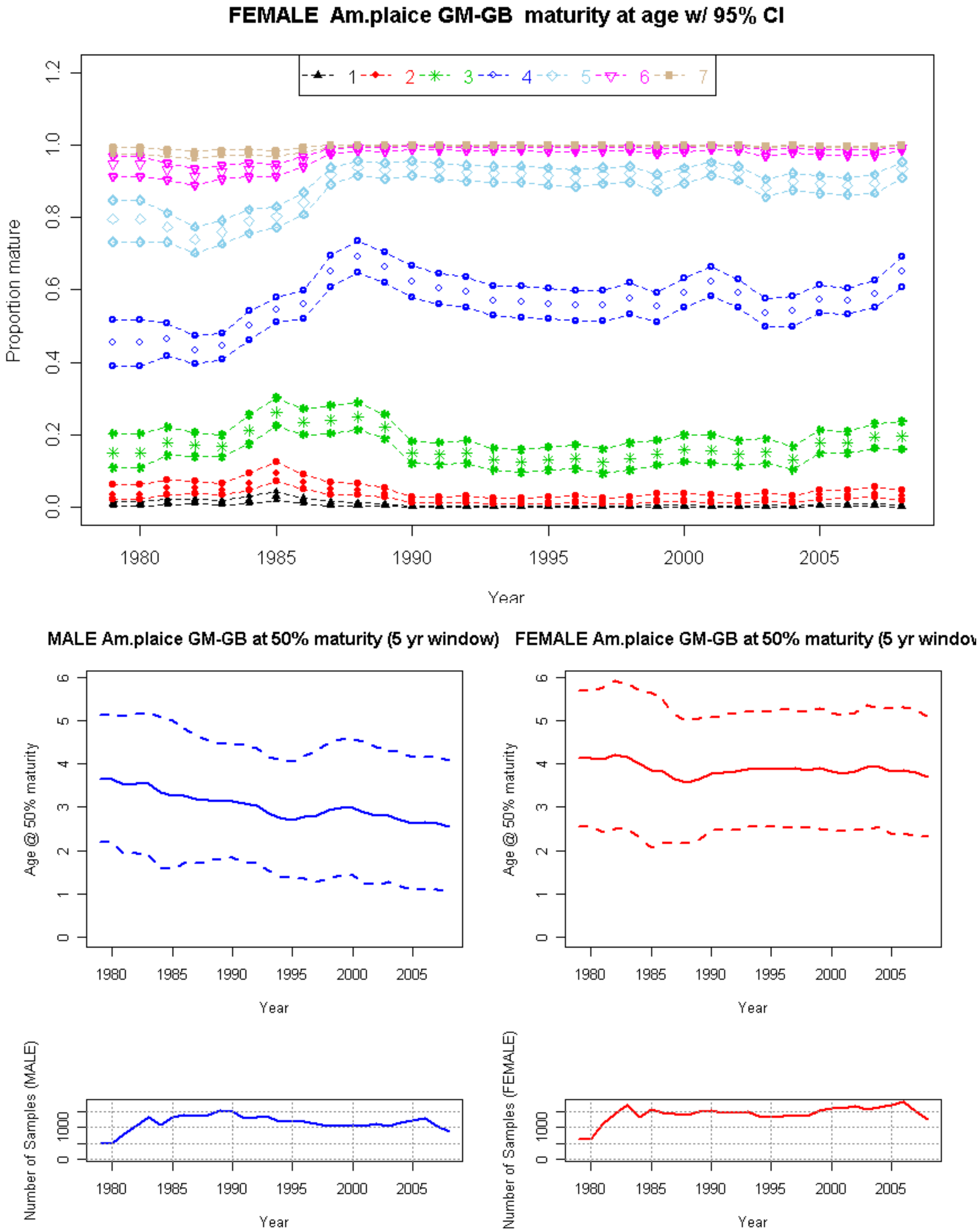
```
                                                NLLS
                                                Estimate    C.V. For
           Bias         Bias         Per Cent   Corrected   Corrected
           Estimate     Std. Error   Bias       For Bias    Estimate

Q  1      0.1446E-03  0.4585E-04      1.9119  0.7419E-02      0.1944
Q  2      0.9957E-03  0.4031E-03      0.8454  0.1168E+00      0.1088
Q  3      0.2003E-02  0.7219E-03      0.8450  0.2351E+00      0.0967
Q  4      0.1359E-02  0.8895E-03      0.3937  0.3439E+00      0.0817
Q  5     -0.2807E-03  0.7394E-03     -0.0845  0.3323E+00      0.0704
Q  6     -0.2239E-04  0.6294E-03     -0.0083  0.2706E+00      0.0736
Q  7      0.2112E-02  0.6781E-03      0.8826  0.2372E+00      0.0900
Q  8      0.5089E-03  0.7821E-03      0.2858  0.1776E+00      0.1393
Q  9      0.2021E-02  0.8755E-03      1.1031  0.1812E+00      0.1524
Q 11      0.4990E-03  0.3909E-03      0.4679  0.1061E+00      0.1164
Q 12     -0.5239E-03  0.8322E-03     -0.1748  0.3002E+00      0.0876
Q 13      0.2316E-02  0.1254E-02      0.5094  0.4524E+00      0.0875
Q 14      0.4312E-02  0.1341E-02      0.7907  0.5410E+00      0.0780
Q 15     -0.4867E-03  0.1422E-02     -0.0933  0.5219E+00      0.0862
Q 16      0.2356E-02  0.1458E-02      0.5114  0.4583E+00      0.1005
Q 17      0.3416E-02  0.1348E-02      1.0402  0.3249E+00      0.1308
Q 18      0.3004E-02  0.1443E-02      0.9680  0.3073E+00      0.1482
Q 20      0.1460E-02  0.3434E-03      3.4600  0.4073E-01      0.2642
Q 21      0.3107E-02  0.1219E-02      1.3268  0.2311E+00      0.1663
Q 22      0.1250E-02  0.7981E-03      0.3921  0.3175E+00      0.0794
Q 23     -0.8653E-04  0.5654E-03     -0.0378  0.2290E+00      0.0781
Q 24      0.1049E-02  0.3952E-03      0.8186  0.1272E+00      0.0979
Q 26      0.4328E-02  0.1236E-02      1.6297  0.2613E+00      0.1487
Q 27      0.1669E-02  0.1260E-02      0.4893  0.3395E+00      0.1172
Q 28      0.1633E-02  0.9651E-03      0.6022  0.2696E+00      0.1130
Q 29      0.7314E-03  0.6102E-03      0.5213  0.1396E+00      0.1382
Q 30      0.8614E-03  0.3273E-03      1.5882  0.5338E-01      0.1932
```

```
               LOWER          UPPER
            80. % CI       80. % CI
Q  1     0.592635E-02   0.973937E-02
Q  2     0.102788E+00   0.135353E+00
Q  3     0.210345E+00   0.269494E+00
Q  4     0.312310E+00   0.385463E+00
Q  5     0.302428E+00   0.362163E+00
Q  6     0.246814E+00   0.297561E+00
Q  7     0.213922E+00   0.269274E+00
Q  8     0.148702E+00   0.212379E+00
Q  9     0.152209E+00   0.219613E+00
Q 11     0.918104E-01   0.122527E+00
Q 12     0.266269E+00   0.332966E+00
Q 13     0.406826E+00   0.510527E+00
Q 14     0.496418E+00   0.604570E+00
Q 15     0.464128E+00   0.577613E+00
Q 16     0.404882E+00   0.523305E+00
Q 17     0.279897E+00   0.384030E+00
Q 18     0.258180E+00   0.376934E+00
Q 20     0.309468E-01   0.586785E-01
Q 21     0.190101E+00   0.288070E+00
Q 22     0.288129E+00   0.353768E+00
Q 23     0.206341E+00   0.251690E+00
Q 24     0.113929E+00   0.146198E+00
Q 26     0.222215E+00   0.322941E+00
Q 27     0.293258E+00   0.396187E+00
Q 28     0.234032E+00   0.311780E+00
Q 29     0.118008E+00   0.166817E+00
Q 30     0.427027E-01   0.689150E-01
```

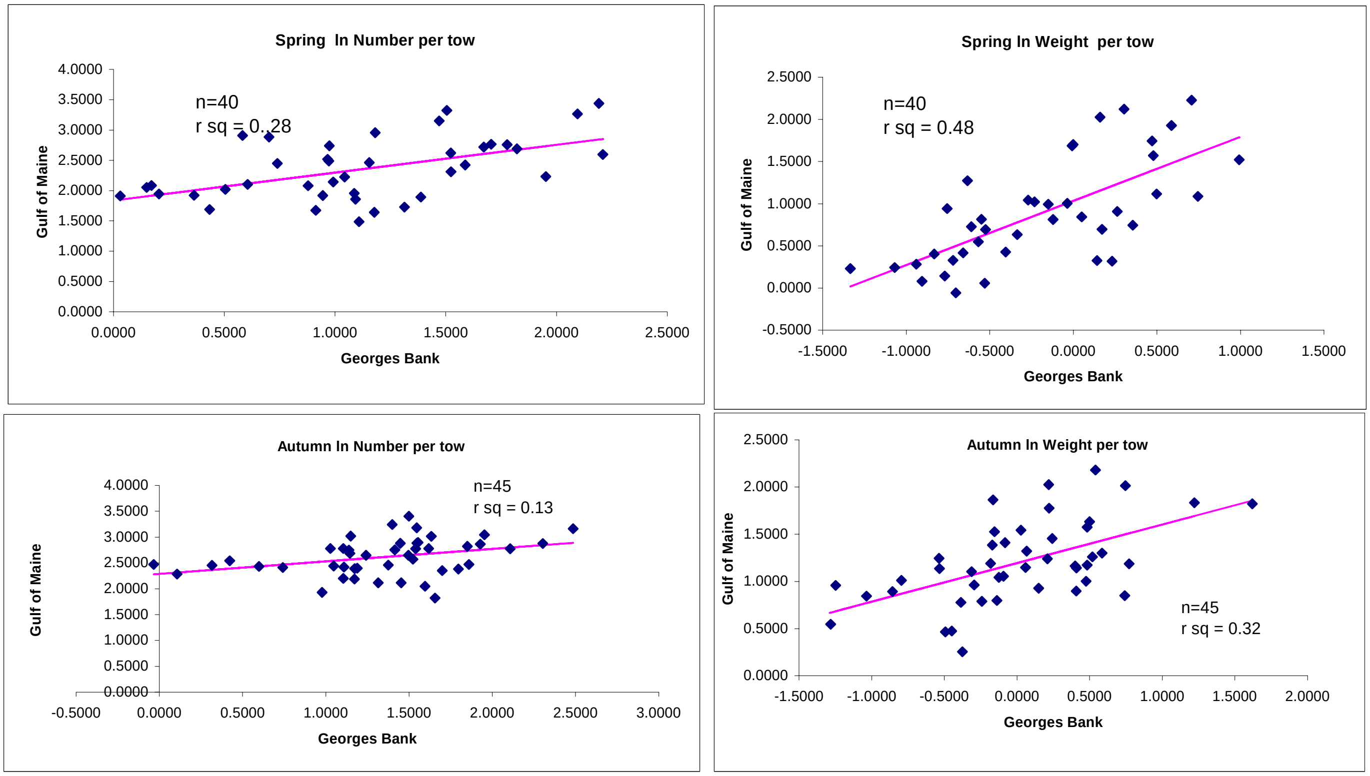
```
 Bootstrap Output Variable: Fishing Mortality (2007)

               NLLS           Bootstrap      Bootstrap      C.V. For
               Estimate       Mean           Std Error      NLLS Soln.

AGE  1           0.0075         0.0083       0.003652         0.4410
AGE  2           0.0063         0.0064       0.001608         0.2520
AGE  3           0.0087         0.0088       0.001683         0.1903
AGE  4           0.0336         0.0340       0.005419         0.1596
AGE  5           0.0981         0.0996       0.015321         0.1538
AGE  6           0.0650         0.0657       0.009321         0.1418
AGE  7           0.1129         0.1203       0.155959         1.2962
AGE  8           0.0548         0.0559       0.010728         0.1919
AGE  9           0.0256         0.0262       0.004954         0.1888
AGE 10           0.0646         0.0670       0.039266         0.5857
AGE 11           0.0646         0.0670       0.039266         0.5857

                                                NLLS
                                                Estimate    C.V. For
            Bias        Bias        Per Cent    Corrected   Corrected
            Estimate    Std. Error  Bias        For Bias    Estimate

AGE  1      0.000736    0.000118      9.7528      0.0068      0.5364
AGE  2      0.000127    0.000051      2.0251      0.0061      0.2625
AGE  3      0.000150    0.000053      1.7285      0.0085      0.1970
AGE  4      0.000354    0.000172      1.0543      0.0332      0.1630
AGE  5      0.001507    0.000487      1.5357      0.0966      0.1586
AGE  6      0.000724    0.000296      1.1142      0.0643      0.1450
AGE  7      0.007448    0.004937      6.5992      0.1054      1.4794
AGE  8      0.001052    0.000341      1.9177      0.0538      0.1994
AGE  9      0.000607    0.000158      2.3687      0.0250      0.1979
AGE 10      0.002458    0.001244      3.8056      0.0621      0.6320
AGE 11      0.002458    0.001244      3.8056      0.0621      0.6320

                LOWER          UPPER
             80. % CI       80. % CI
AGE  1        0.004546       0.012777
AGE  2        0.004500       0.008627
AGE  3        0.006669       0.011067
AGE  4        0.027473       0.041134
AGE  5        0.080179       0.120161
AGE  6        0.054207       0.077782
AGE  7        0.090534       0.144093
AGE  8        0.042854       0.070363
AGE  9        0.020429       0.032789
AGE 10        0.057349       0.074650
AGE 11        0.057349       0.074650
```

```
 Bootstrap Output Variable: Average F (2007) AGES    6 -    9

               NLLS           Bootstrap      Bootstrap      C.V. For
               Estimate       Mean           Std Error      NLLS Soln.

AVG F            0.0646         0.0670       0.039266         0.5857
N WTD            0.0629         0.0629       0.006226         0.0989
B WTD            0.0588         0.0588       0.005666         0.0964
C WTD            0.0722         0.0745       0.037699         0.5058

                                                NLLS
                                                Estimate    C.V. For
            Bias        Bias        Per Cent    Corrected   Corrected
            Estimate    Std. Error  Bias        For Bias    Estimate

AVG F       0.002458    0.001244      3.8056      0.0621      0.6320
N WTD       0.000008    0.000197      0.0125      0.0629      0.0989
B WTD      -0.000040    0.000179     -0.0677      0.0589      0.0962
C WTD       0.002358    0.001194      3.2662      0.0698      0.5399

                LOWER          UPPER
             80. % CI       80. % CI
AVG F        0.057349       0.074650
N WTD        0.055657       0.070912
B WTD        0.051933       0.066022
C WTD        0.063608       0.083727


 Bootstrap Output Variable: Biomass

 JAN-1 Biomass (2008) Mean Biomass  & SSB (2007)


               NLLS           Bootstrap      Bootstrap      C.V. For
               Estimate       Mean           Std Error      NLLS Soln.

JAN-1            24918.         25522.          1924.         0.0754
MEAN             25784.         26150.          1859.         0.0711
SSB              15659.         15815.          1128.         0.0713

                                                NLLS
                                                Estimate    C.V. For
            Bias        Bias        Per Cent    Corrected   Corrected
            Estimate    Std. Error  Bias        For Bias    Estimate

JAN-1           604.         64.      2.4253      24313.      0.0792
MEAN            366.         60.      1.4200      25418.      0.0731
SSB             156.         36.      0.9938      15503.      0.0728

                LOWER          UPPER
             80. % CI       80. % CI
JAN-1          23116.         27952.
MEAN           23776.         28602.
SSB            14382.         17229.
```

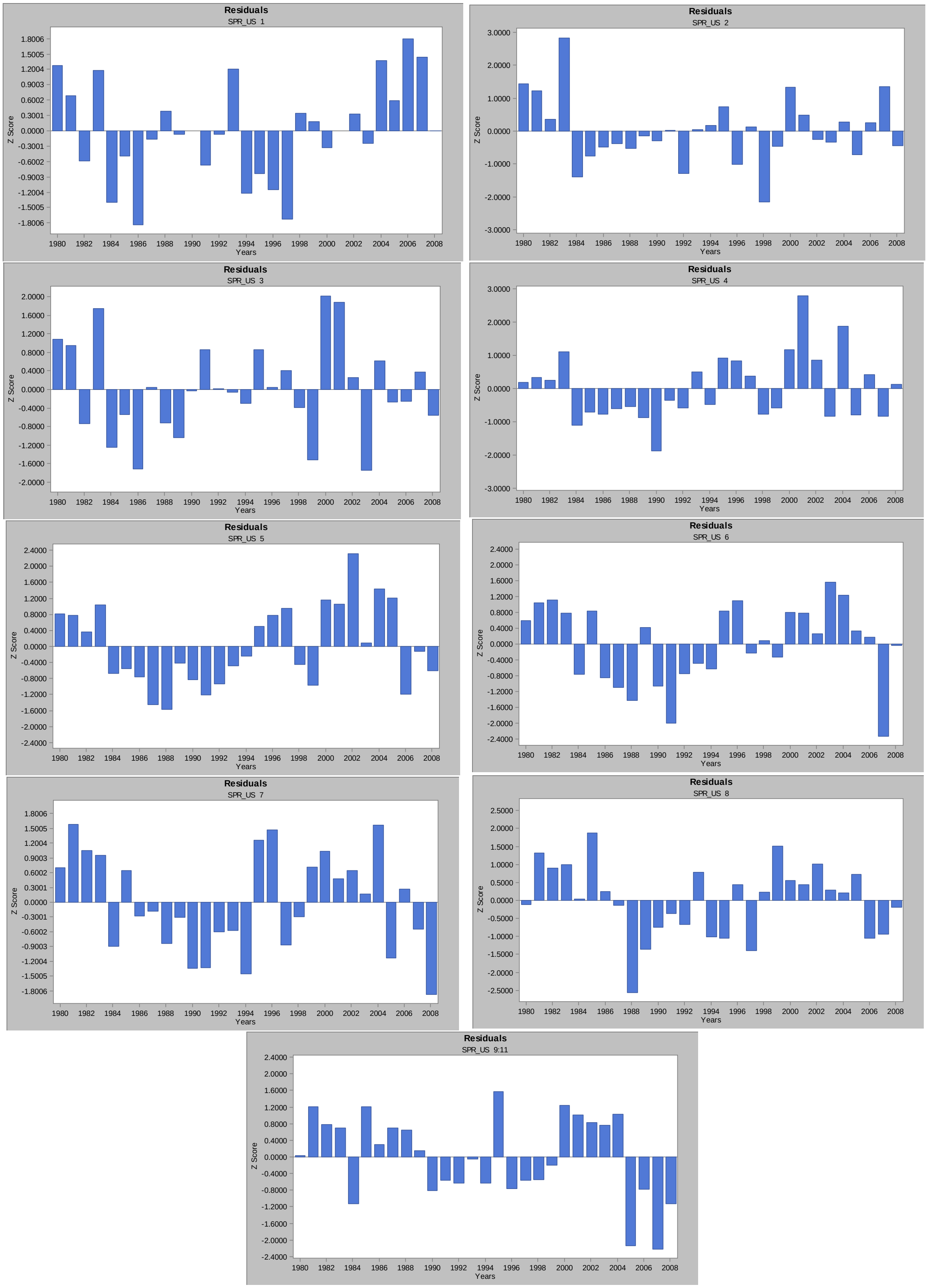
```
Plus Group Diagnostic Report

Calculation Method Selected = Backward

         Population  Population    F            F
Year     Backward     Forward    Forward     Backward    Ratio

1980       4509.       4509.    0.408676    0.408673    0.999992
1981       2035.       3964.    0.189078    0.407096    2.153053
1982       1640.       3472.    0.257504    0.649320    2.521596
1983       2019.       2917.    0.419029    0.678075    1.618207
1984       1933.       1985.    0.550844    0.570704    1.036052
1985        373.       1294.    0.168017    0.757274    4.507116
1986        258.       1106.    0.104786    0.550632    5.254830
1987        169.        943.    0.072554    0.492033    6.781583
1988        189.        805.    0.078711    0.385659    4.899662
1989        342.        777.    0.182671    0.474510    2.597627
1990        597.        683.    0.299398    0.350873    1.171930
1991        368.        620.    0.204128    0.371846    1.821630
1992        235.        607.    0.185578    0.572218    3.083446
1993        281.        549.    0.287051    0.662789    2.308960
1994        645.        481.    1.063442    0.676688    0.636318
1995         96.        274.    0.221655    0.827379    3.732734
1996        164.        216.    0.424547    0.608911    1.434258
1997        316.        155.    1.637405    0.514499    0.314216
1998        402.        189.    2.078124    0.545921    0.262699
1999        234.         96.    2.078124    0.461173    0.221918
2000         57.         65.    0.404322    0.476097    1.177520
2001        132.        138.    0.527333    0.559539    1.061073
2002        497.        216.    2.078124    0.494489    0.237950
2003        363.        227.    0.843471    0.445250    0.527878
2004        452.        326.    0.285708    0.197950    0.692839
2005        444.        519.    0.109412    0.128863    1.177783
2006        452.        658.    0.075662    0.111961    1.479752
2007        531.        955.    0.036202    0.066081    1.825331
2008        834.       1181.       N/A         N/A


Warning **** Infeasible Mass Balance in Plus Group
Year =  1994
Year =  1997
Year =  2002
```



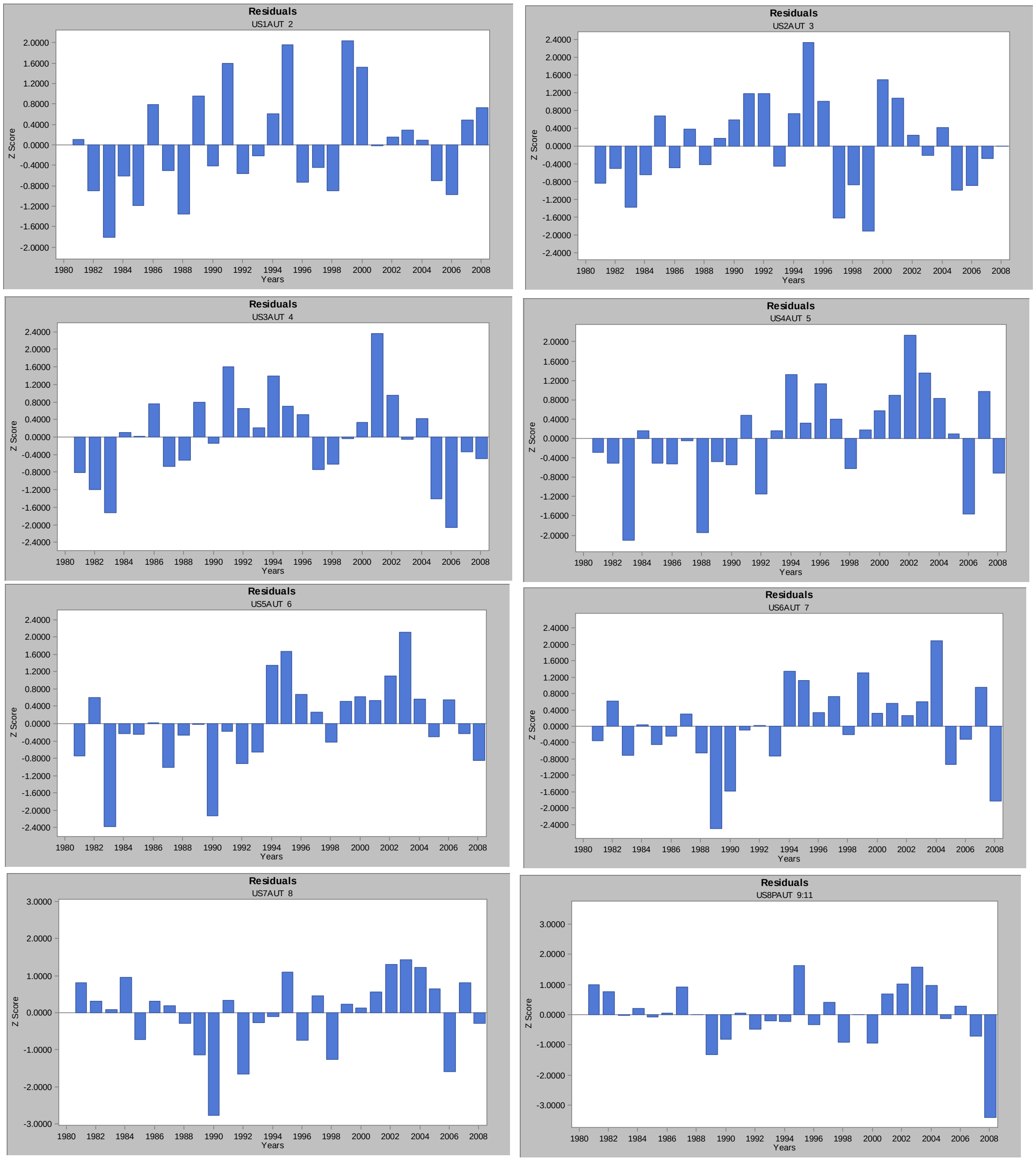
Appendix H. Figure H1. Proportion mature at age with 95% confidence intervals for female Gulf of Maine-Georges Bank American plaice using a 5-year moving window for ages 1-7 (upper panel), median age at maturity (A50) for males (middle left panel) and females (middle right panel) with 95% confidence intervals, and number of samples in the combined 5-year moving average for males (lower left panel) and females (lower right panel).



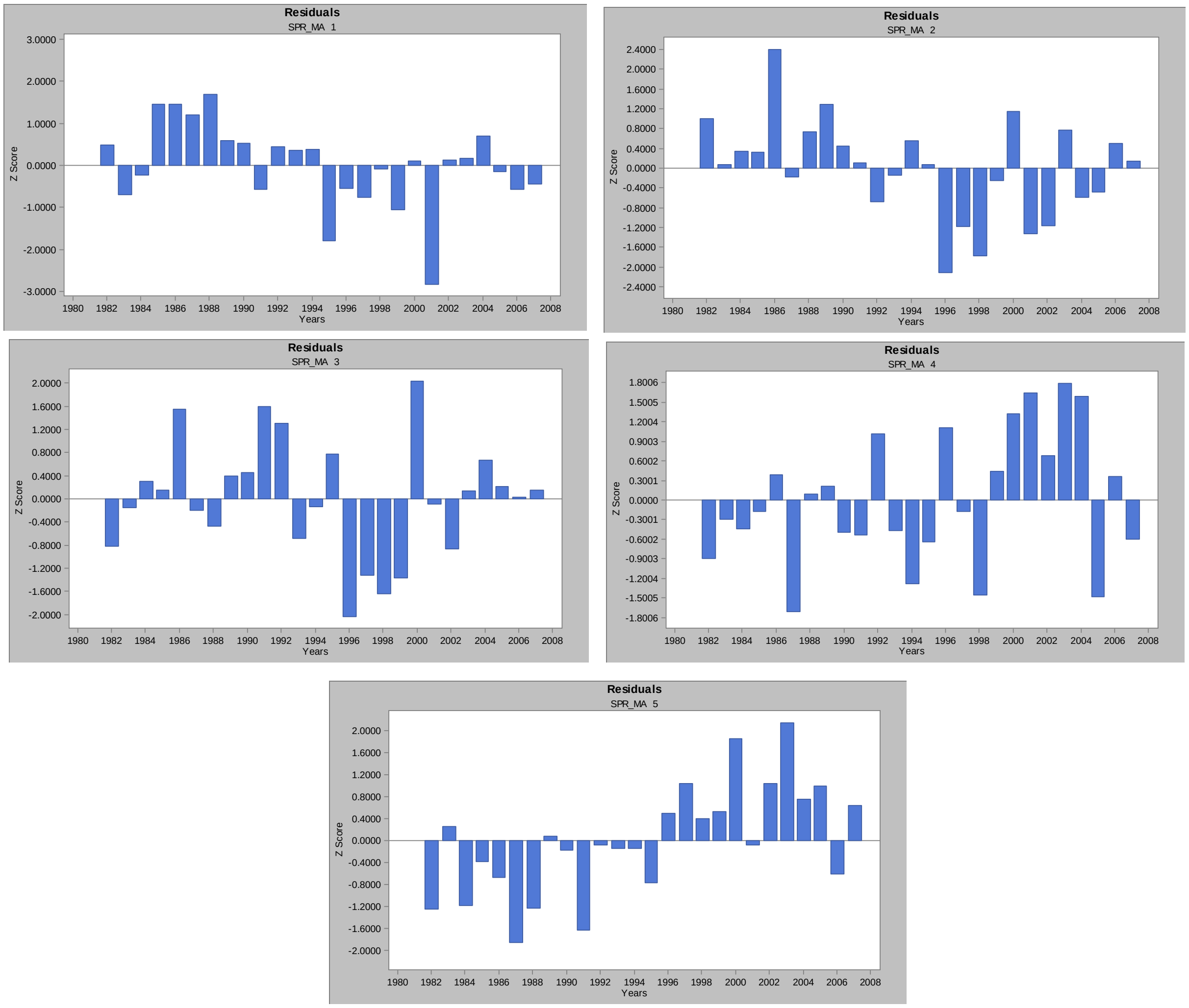
Appendix H. Figure H2. Regression of Georges Bank and Gulf of Maine spring and autumn NEFSC research survey ln(mean number per tow) and ln(mean weight per tow) for American plaice.



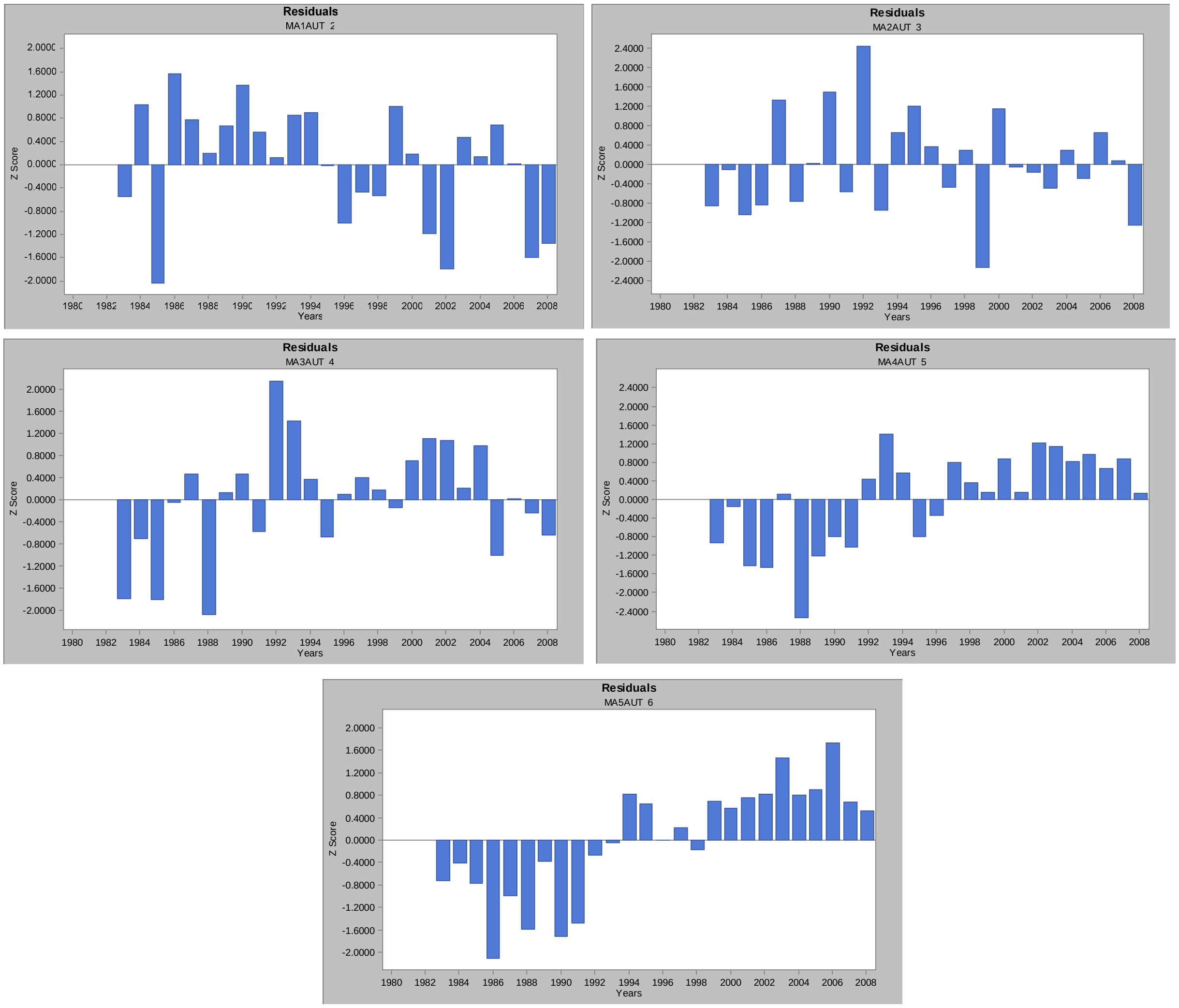
Appendix H. Figure H3a. Base VPA residuals for ages 1-9+ for NEFSC spring surveys, 1980-2008.



Appendix H. Figure H3b. Base VPA residuals for ages 2-9+ for NEFSC autumn surveys, 1981-2008.



Appendix H. Figure H3c. Base VPA residuals for ages 1-5 for MA Division of Marine Fisheries spring surveys, 1982-2007.



Appendix H. Figure H3d. Base VPA residuals for ages 2-6 for MA Division of Marine Fisheries autumn surveys, 1983-2008.

## Appendix I. Gulf of Maine winter flounder
### by Paul Nitschke

## SCALE Model Results

The use of a simple forward projecting model that tunes to length data for larger fish and indices of recruitment at age (SCALE) was investigated as an alternative model for Gulf of Maine winter flounder. For the biological reference point meeting recruitment indices at age in SCALE were estimated by length slicing due to questions of smearing across ages in the age-length keys. The assumed negligible error in the catch for the VPA was questioned with the poor sampling of the commercial landings data. For the final GARM III meeting length slicing indices were not used with the exception of the Seabrook index (Figures I19 through I22). Some SCALE runs modeled the population with the sexes separated. Females grow larger and appear to have a lower natural mortality rate than males (Figures I25 through I27). A natural mortality of 0.2 was assumed for females and 0.3 for males. Female based reference points were developed for the sex specific model. Similar results and status determinations are seen between the sex specific model and the single sex model. Both models had similar problems in the diagnostics.

The retrospective pattern in the SCALE model was very similar to the retrospective pattern seen in the VPA. The scale model can not fit the age 1 and 2 recruitment indices along with the trends in the catch, 30+ cm abundance indices, and 30+ cm survey length frequencies. Lower weights on the recruitment indices and a low penalty on recruitment variation were used to allow the model to produce a lack of fit to the recruitment indices so that a larger initial population in 1982 can be estimated by the model. The model needs to estimate a declining trend in recruitment to fit the trend in the catch and the adult abundance in the surveys. Splitting the surveys had the same effect as in the VPA (Figure I31). This allowed the model to estimate further declines in the recruitment indices to produce a closer fit to the catch. Comparisons between the split SCALE and VPA runs can be seen in Table I4 and Figure I32. The splitting of the survey results in about a tripling of the survey Qs (Table I3).

## SCALE Model Biological Reference Points

For SCALE the length based selectivity was converted to an age based vector (Figure I56). Mean weights of the population and the catch was estimated by sex or for the sexes combined (Figure I35). Long term AGEPRO projections were run to determine the biological reference points. Separate runs were done for each sex in the sex specific model to estimate biological reference points.

$F_{40\%}$ was also estimated within the SCALE model so that the model will be consistent with the reference points. $F_{40\%}$ was estimated with the sexes combined using a female maturity vector. $F_{40\%}$ was also estimated for a female only $SSB_{msy}$ reference point and a two sex MSY yield. The scale model estimated $F_{40\%}$ at 0.38 in the combined sex model (run 5) and 0.35 for females in the sex specific model (run 6) (Table I4). Little differences in the estimated selectivity exists between the age based VPA model and the SCALE model. Lower mean weights of the older fish from the estimated growth curve in the SCALE model likely contributed to the higher $F_{40\%}$ reference points from the SCALE model.

Table I1. Gulf of Maine winter flounder large and small mesh trawl and gillnet kept ratios (kept/sum all species kept), CVs, and estimated landings in metric tons.

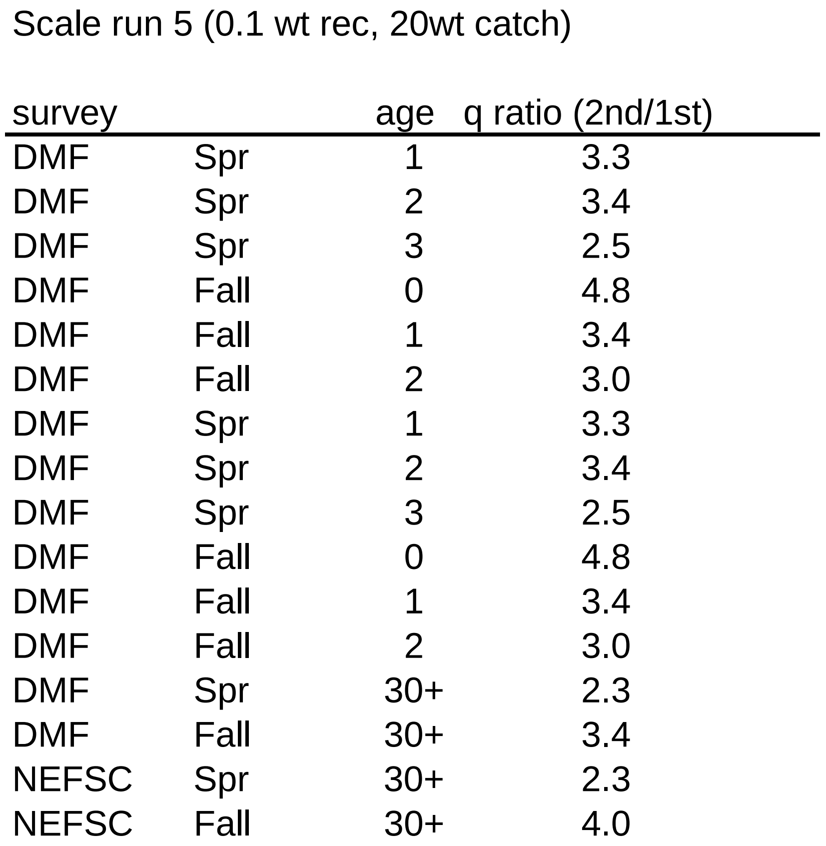
| | Kept Ratio | | | CV | | | Metric Tons | | |
|---|---|---|---|---|---|---|---|---|---|
| | trawl | | | trawl | | | trawl | | |
| year | lg mesh | sm mesh | gillnet | lg mesh | sm mesh | gillnet | lg mesh | sm mesh | gillnet |
| 1989 | 0.006 | 0.015 | 0.007 | 0.38 | 0.45 | 0.58 | 131 | 27 | 107 |
| 1990 | 0.001 | 0.000 | 0.015 | 0.47 | 0.77 | 0.44 | 42 | 1 | 244 |
| 1991 | 0.019 | 0.001 | 0.003 | 0.44 | 0.54 | 0.22 | 572 | 2 | 43 |
| 1992 | 0.008 | 0.001 | 0.013 | 0.49 | 0.58 | 0.13 | 227 | 4 | 163 |
| 1993 | 0.004 | 0.027 | 0.014 | 0.76 | 0.53 | 0.14 | 93 | 68 | 236 |
| 1994 | 0.001 | | 0.006 | 0.83 | | 0.88 | 14 | 0 | 84 |
| 1995 | 0.032 | 0.000 | 0.005 | 1.03 | | 0.28 | 575 | 0 | 83 |
| 1996 | 0.017 | 0.000 | 0.007 | 2.32 | | 0.41 | 305 | 0 | 99 |
| 1997 | 0.001 | 0.040 | 0.021 | 2.01 | 0.33 | 0.51 | 12 | 76 | 262 |
| 1998 | 0.005 | | 0.010 | 0.80 | | 0.37 | 65 | 0 | 136 |
| 1999 | 0.110 | 0.000 | 0.007 | 0.66 | | 0.45 | 1241 | 0 | 57 |
| 2000 | 0.012 | | 0.023 | 0.40 | | 0.39 | 179 | 0 | 183 |
| 2001 | 0.025 | 0.000 | 0.011 | 0.25 | | 0.72 | 410 | 0 | 85 |
| 2002 | 0.028 | 0.005 | 0.045 | 0.29 | 0.51 | 0.40 | 446 | 7 | 295 |
| 2003 | 0.021 | 0.013 | 0.033 | 0.19 | 0.54 | 0.18 | 369 | 7 | 220 |
| 2004 | 0.031 | 0.034 | 0.025 | 0.21 | 0.72 | 0.13 | 841 | 13 | 176 |
| 2005 | 0.021 | 0.018 | 0.012 | 0.16 | 0.38 | 0.15 | 404 | 6 | 78 |
| 2006 | 0.017 | 0.003 | 0.002 | 0.27 | 0.39 | 0.41 | 189 | 1 | 12 |
| 2007 | 0.012 | 0.005 | 0.013 | 0.20 | 0.34 | 0.37 | 121 | 4 | 98 |

Table I2. Split SCALE area swept estimated Qs.

Scale run 5 (0.1 wt rec, 20wt catch)

| survey | season | age | split | q |
|---|---|---|---|---|
| DMF | Spr | 1 | 1 | 0.44 |
| DMF | Spr | 2 | 1 | 0.92 |
| DMF | Spr | 3 | 1 | 0.85 |
| DMF | Fall | 0 | 1 | 0.01 |
| DMF | Fall | 1 | 1 | 0.89 |
| DMF | Fall | 2 | 1 | 1.03 |
| SEA | Spr | 1 | 1 | 0.000001 |
| SEA | Spr | 2 | 1 | 0.000002 |
| NEFSC | spr | 1 | 1 | 0.01 |
| NEFSC | spr | 2 | 1 | 0.10 |
| NEFSC | spr | 3 | 1 | 0.20 |
| NEFSC | Fa | 1 | 1 | 0.05 |
| NEFSC | Fa | 2 | 1 | 0.22 |
| DMF | Spr | 1 | 2 | 1.46 |
| DMF | Spr | 2 | 2 | 3.16 |
| DMF | Spr | 3 | 2 | 2.09 |
| DMF | Fall | 0 | 2 | 0.05 |
| DMF | Fall | 1 | 2 | 3.05 |
| DMF | Fall | 2 | 2 | 3.07 |
| NEFSC | spr | 1 | 2 | 0.03 |
| NEFSC | spr | 2 | 2 | 0.21 |
| NEFSC | spr | 3 | 2 | 0.52 |
| NEFSC | Fall | 0 | 2 | 0.13 |
| NEFSC | Fall | 1 | 2 | 0.55 |
| DMF | Spr | 30+ | 1 | 0.62 |
| DMF | Fall | 30+ | 1 | 0.38 |
| NEFSC | Spr | 30+ | 1 | 0.20 |
| NEFSC | Fall | 30+ | 1 | 0.20 |
| DMF | Spr | 30+ | 2 | 1.44 |
| DMF | Fall | 30+ | 2 | 1.27 |
| NEFSC | Spr | 30+ | 2 | 0.46 |
| NEFSC | Fall | 30+ | 2 | 0.80 |

Table I3. Split SCALE area swept Q ratios (2nd/1st).



Scale run 5 (0.1 wt rec, 20wt catch)

| survey | | age | q ratio (2nd/1st) |
|---|---|---|---|
| DMF | Spr | 1 | 3.3 |
| DMF | Spr | 2 | 3.4 |
| DMF | Spr | 3 | 2.5 |
| DMF | Fall | 0 | 4.8 |
| DMF | Fall | 1 | 3.4 |
| DMF | Fall | 2 | 3.0 |
| DMF | Spr | 1 | 3.3 |
| DMF | Spr | 2 | 3.4 |
| DMF | Spr | 3 | 2.5 |
| DMF | Fall | 0 | 4.8 |
| DMF | Fall | 1 | 3.4 |
| DMF | Fall | 2 | 3.0 |
| DMF | Spr | 30+ | 2.3 |
| DMF | Fall | 30+ | 3.4 |
| NEFSC | Spr | 30+ | 2.3 |
| NEFSC | Fall | 30+ | 4.0 |

Table I4. Non-parametric empirical biological reference points from the VPA and SCALE models for Gulf of Maine winter flounder.

| | 1<br>VPA<br>Base<br>all indices | 2<br>VPA<br>Split<br>all indices | 3<br>SCALE<br>Split<br>1.0 wt rec | 4<br>SCALE<br>Split<br>0.1 wt rec | 5<br>SCALE<br>Split<br>0.1 wt rec<br>20 wt catch | 6<br>SCALE<br>Split<br>separate sex |
|---|---|---|---|---|---|---|
| F40% | 0.30 | 0.28 | 0.38 | 0.39 | 0.38 | 0.35 |
| YPR | 0.237 | 0.235 | 0.214 | 0.215 | 0.214 | 0.162 |
| SSBR | 0.972 | 0.972 | 0.846 | 0.851 | 0.843 | 0.481 |
| Mean Recruit million | 4.585 | 4.072 | 4.286 | 4.251 | 4.289 | 2.582 |
| MSY | 1,050 | 917 | 902 | 873 | 873 | lower |
| SSBMSY | 4,305 | 3,792 | 3,162 | 3,069 | 3,040 | 2,146 |
| | | | | | | |
| SSB07 | 2,765 | 1,100 | 1,723 | 1,030 | 1,067 | 725 |
| F07 | 0.11 | 0.42 | 0.27 | 0.53 | 0.47 | 0.48 |
| | | | | | | |
| SSB07/SSBMSY | 64% | 29% | 54% | 34% | 35% | 34% |
| F07/FMSY | 39% | 147% | 71% | 135% | 125% | 136% |

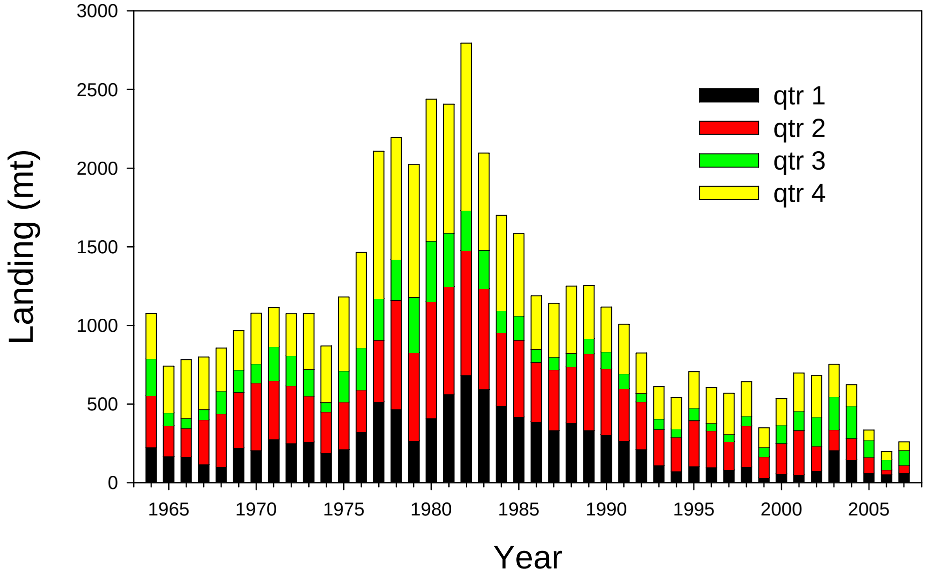


Figure I1. Gulf of Maine winter flounder commercial landings by quarter from 1964-2007.

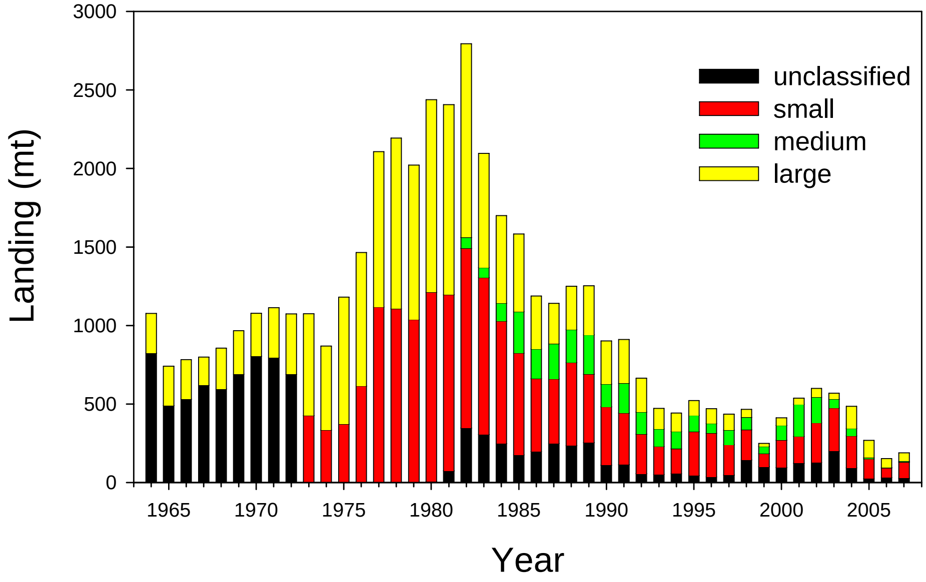


Figure I2. Gulf of Maine winter flounder commercial landings by market category from 1964-2007.

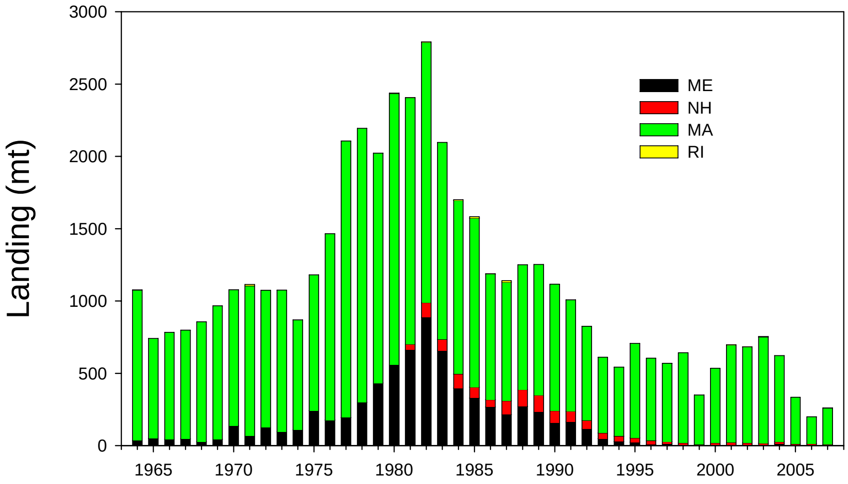


Figure I3.  Commercial landings by state from 1964-2007.

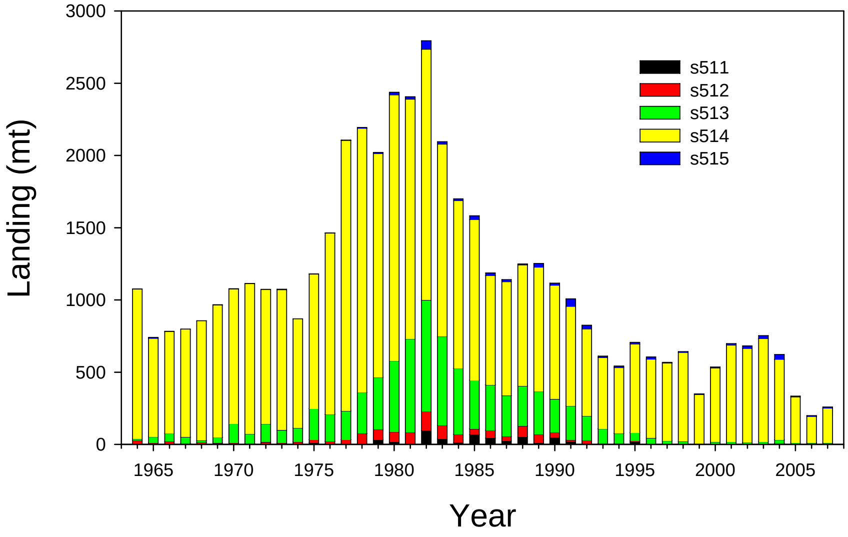


Figure I4.  Commercial landings by statistical area from 1964-200

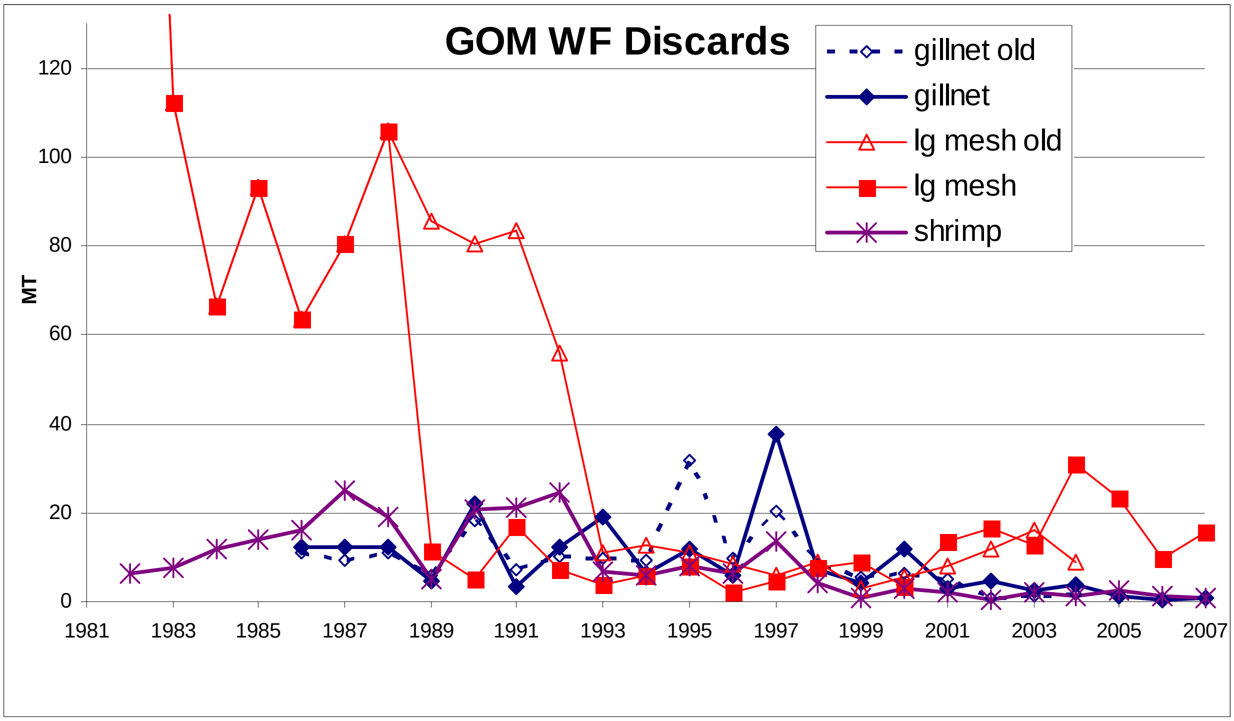


Figure I5. Estimated discards using the GARM II method and updated GARM III method.

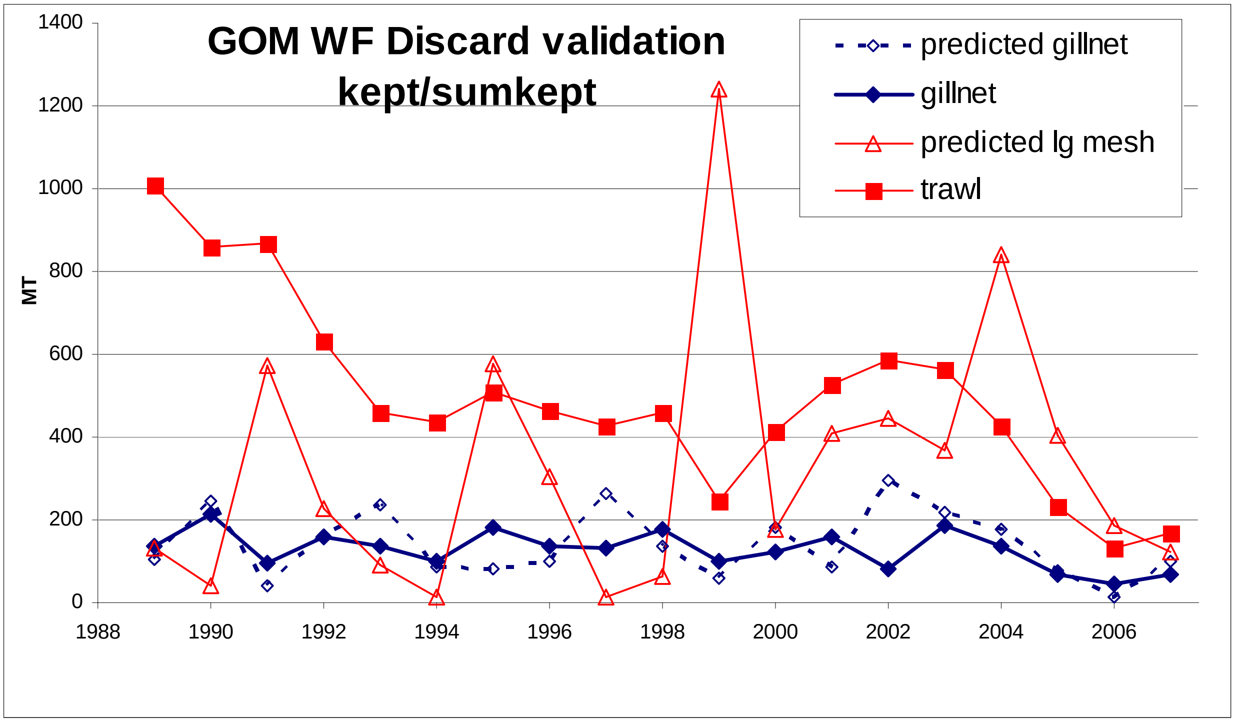


Figure I6. Estimated landings using the kept to sum all species ratios and the actual landings by fleet.

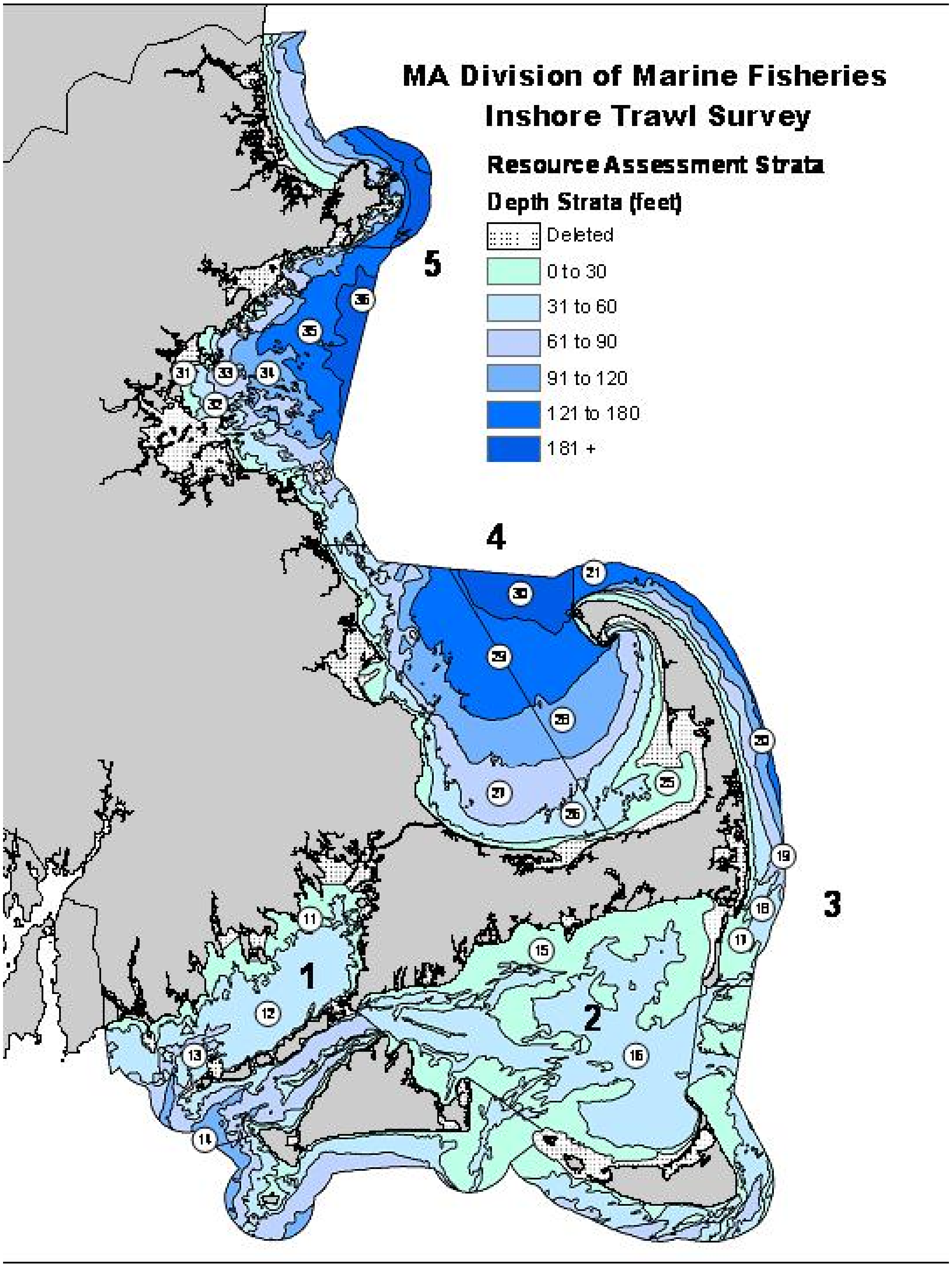


Figure I7. Survey strata for the MDMF bottom trawl survey.

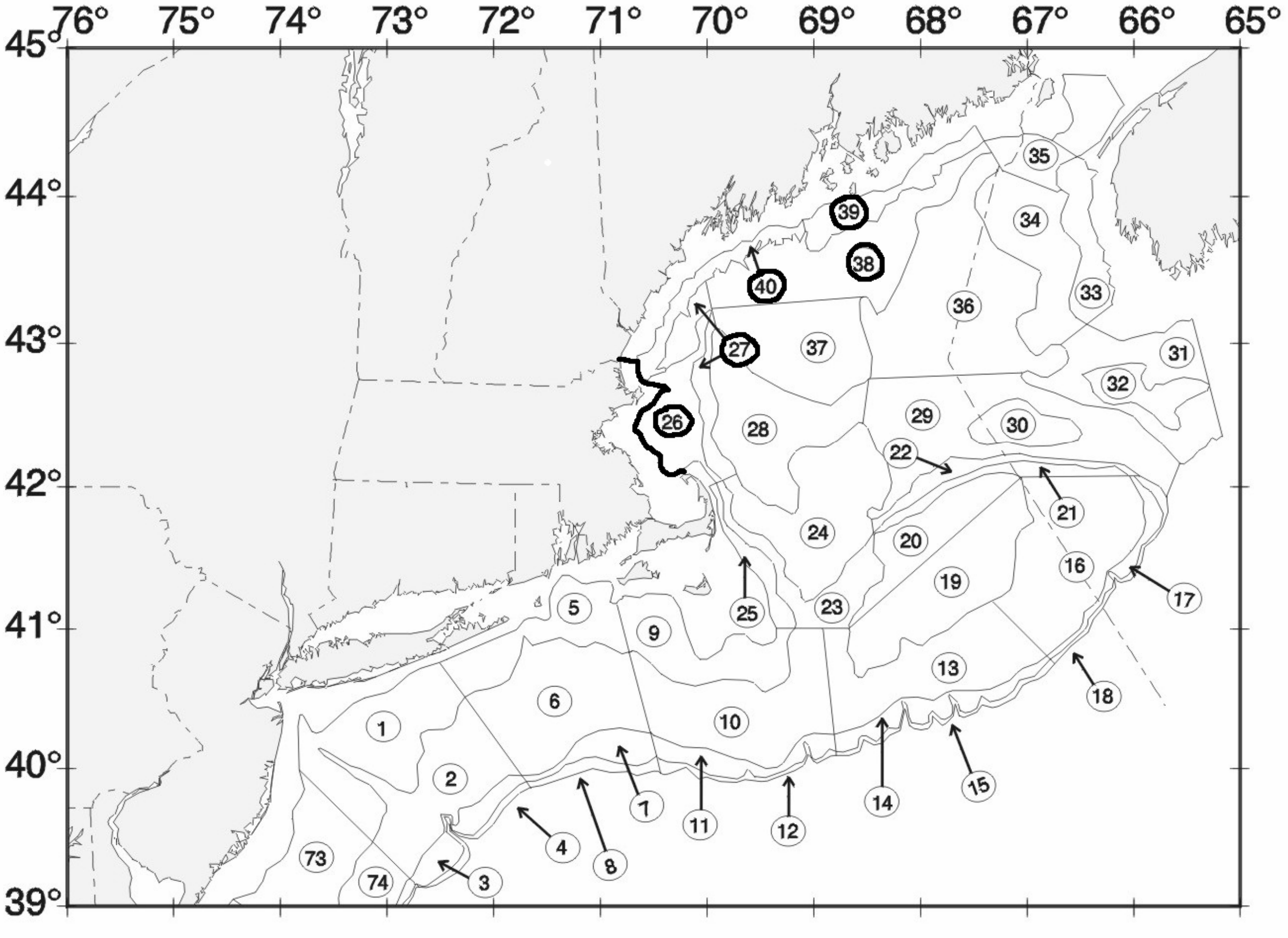


Figure I8. Offshore survey strata for the NEFSC bottom trawl survey for Gulf of Maine winter flounder.

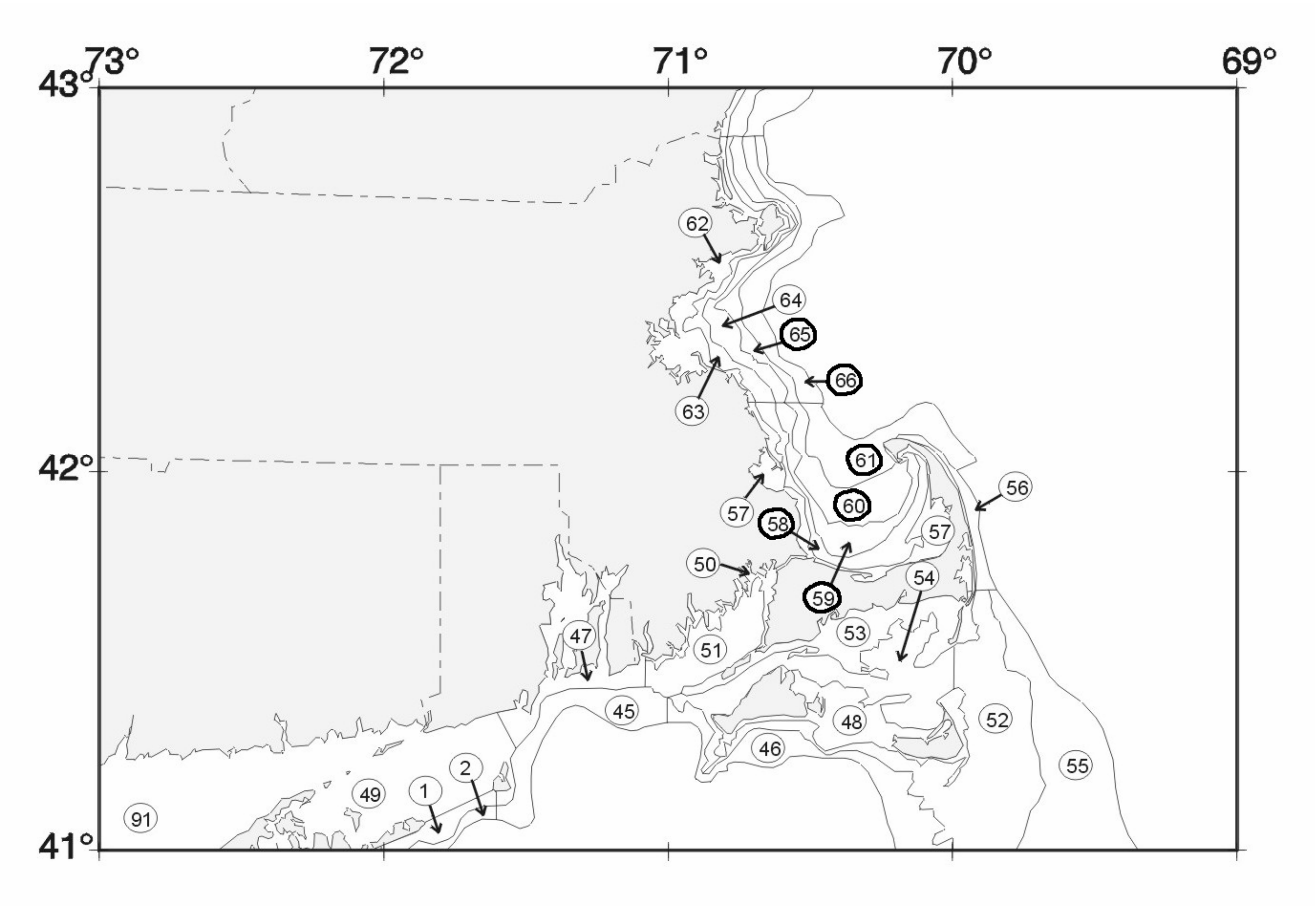


Figure I9.  Inshore survey strata for the NEFSC bottom trawl survey for Gulf of Maine winter flounder.

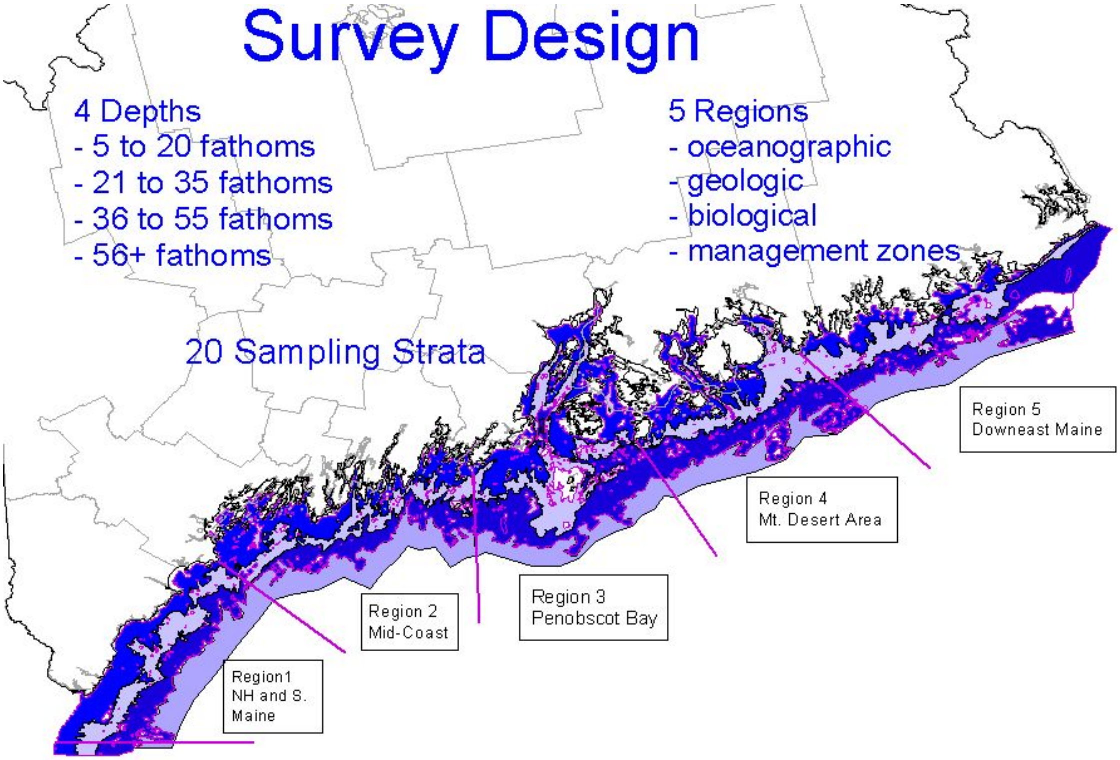


Figure I10. Survey strata for the NH/ME bottom trawl survey.

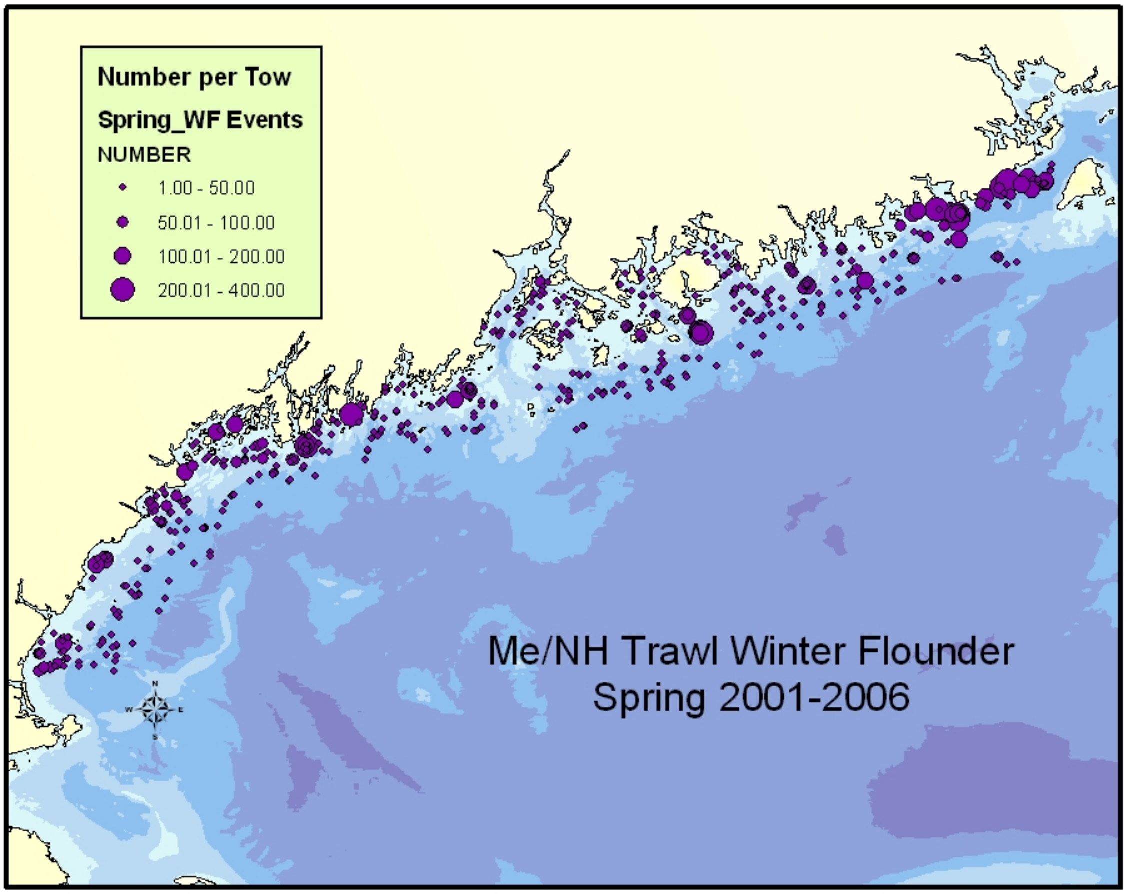


Figure I11. Spring ME/NH bottom trawl survey winter flounder distribution.

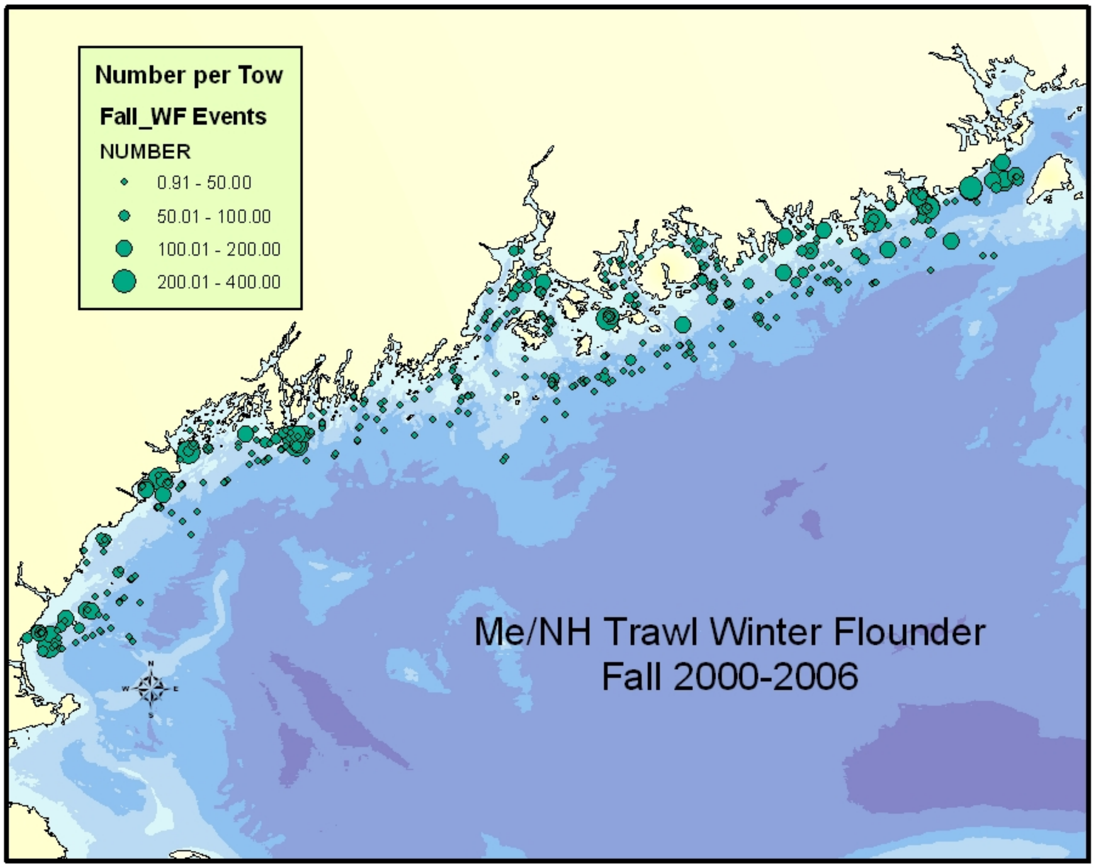


Figure I12. Fall ME/NH bottom trawl survey winter flounder distribution.

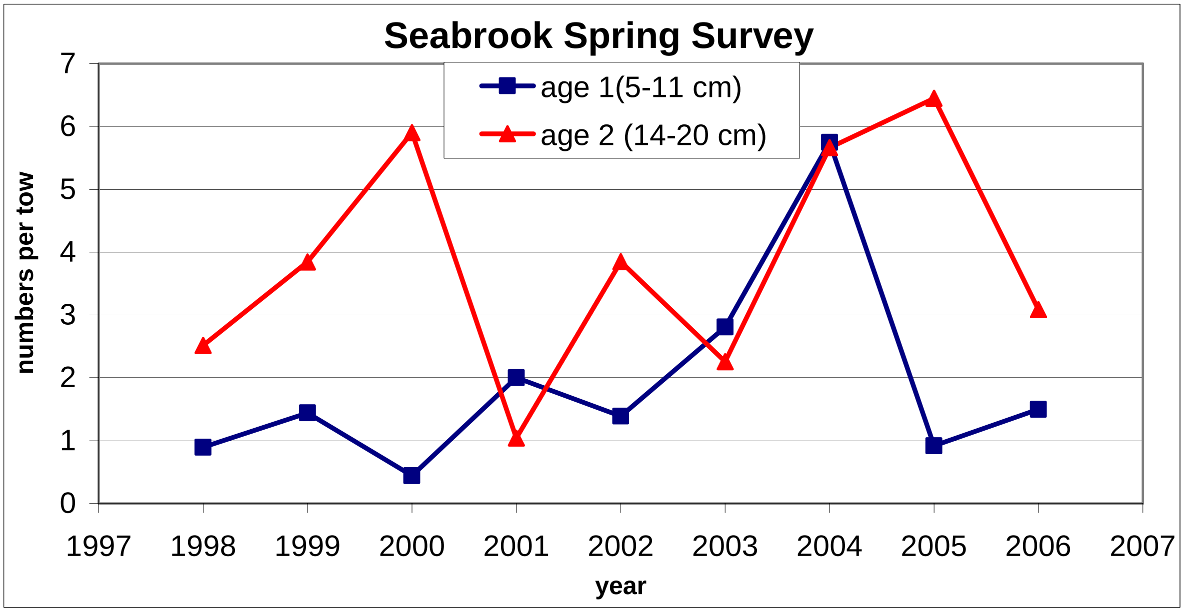


Figure I13. Estimated Seabrook age 1 and 2 index using length slicing.

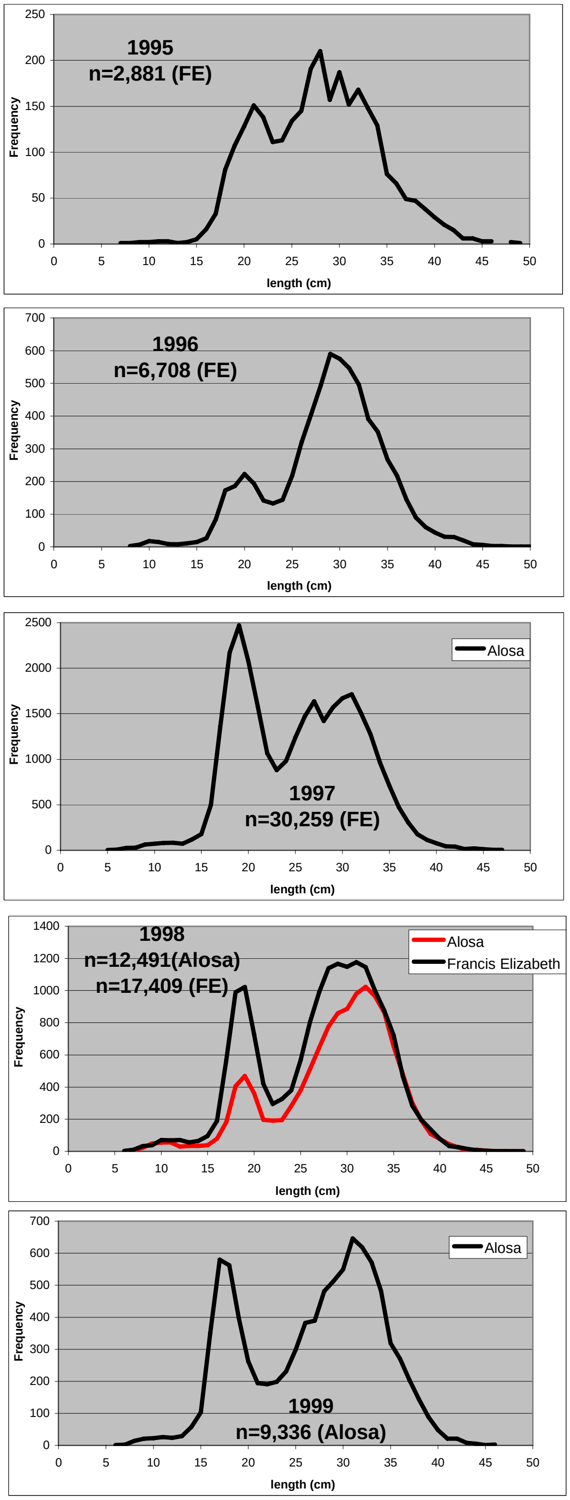


Figure I14. Length frequency distributions from the Pilgrim Nuclear power plant winter flounder area swept study in Western Cape Cod Bay. 1998 and 1999 had an additional vessel (FV Alosa) was contracted for the survey.

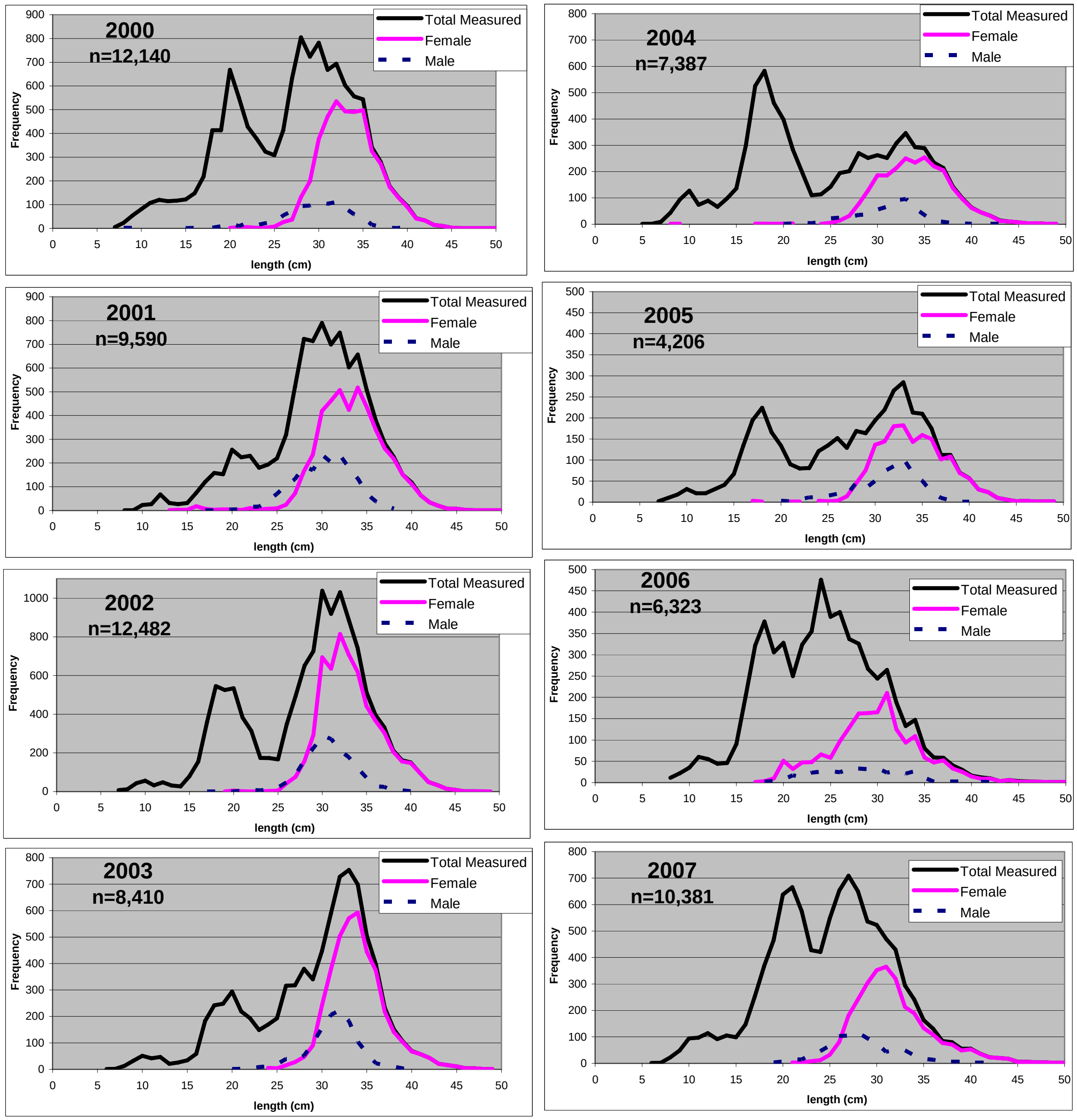


Figure I4. Cont.

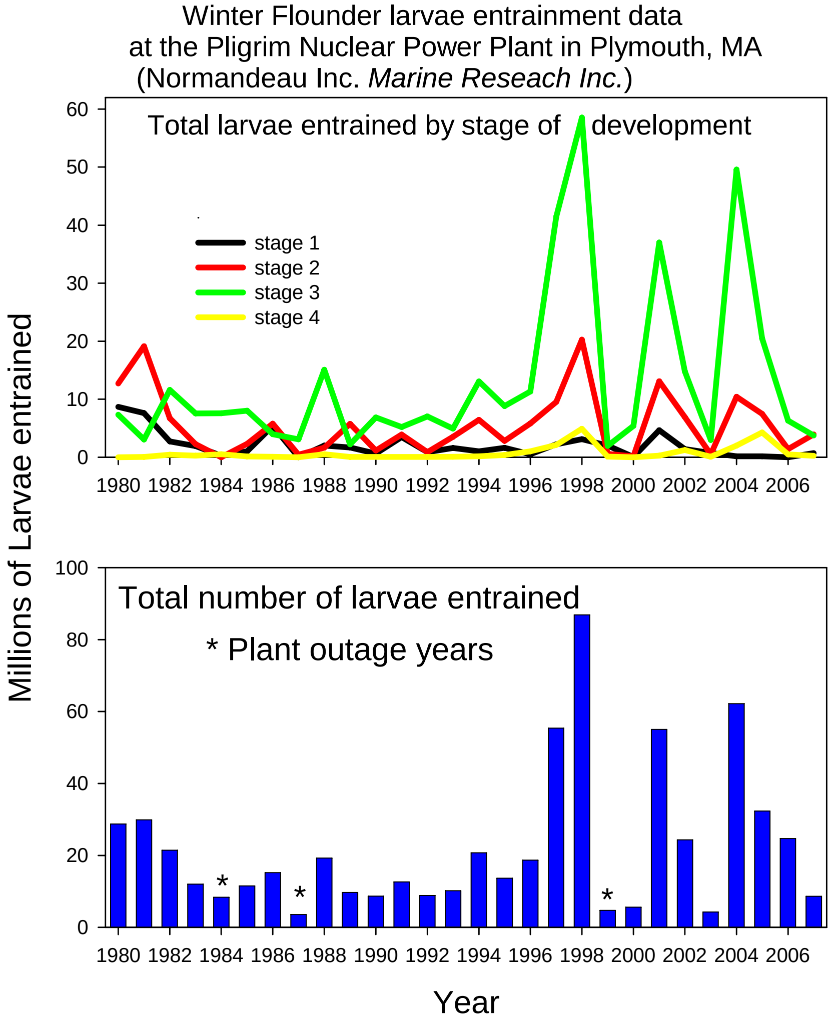


Figure I15. Entrainment of winter flounder larvae at the Pilgrim Nuclear power plant in Plymouth MA from Normandeau Inc.

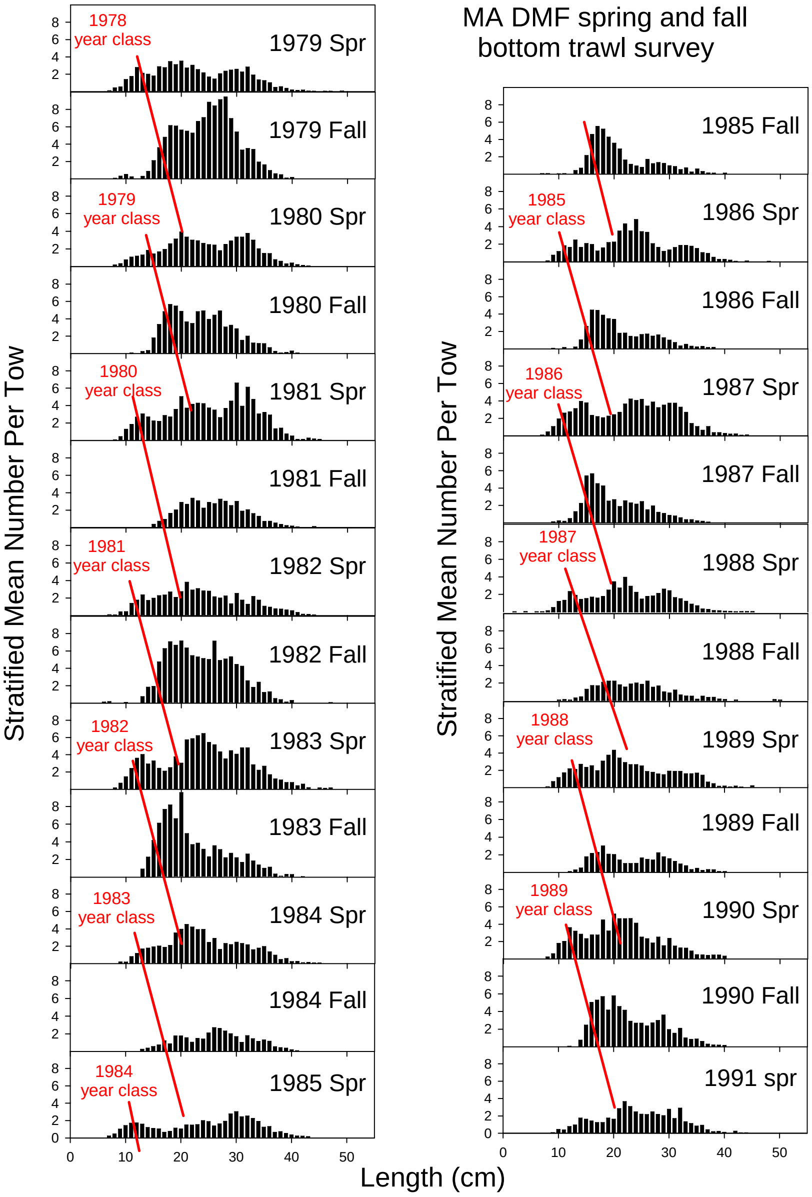


Figure I16. Spring and fall MDMF bottom trawl survey Gulf of Maine winter flounder catch per tow at length.

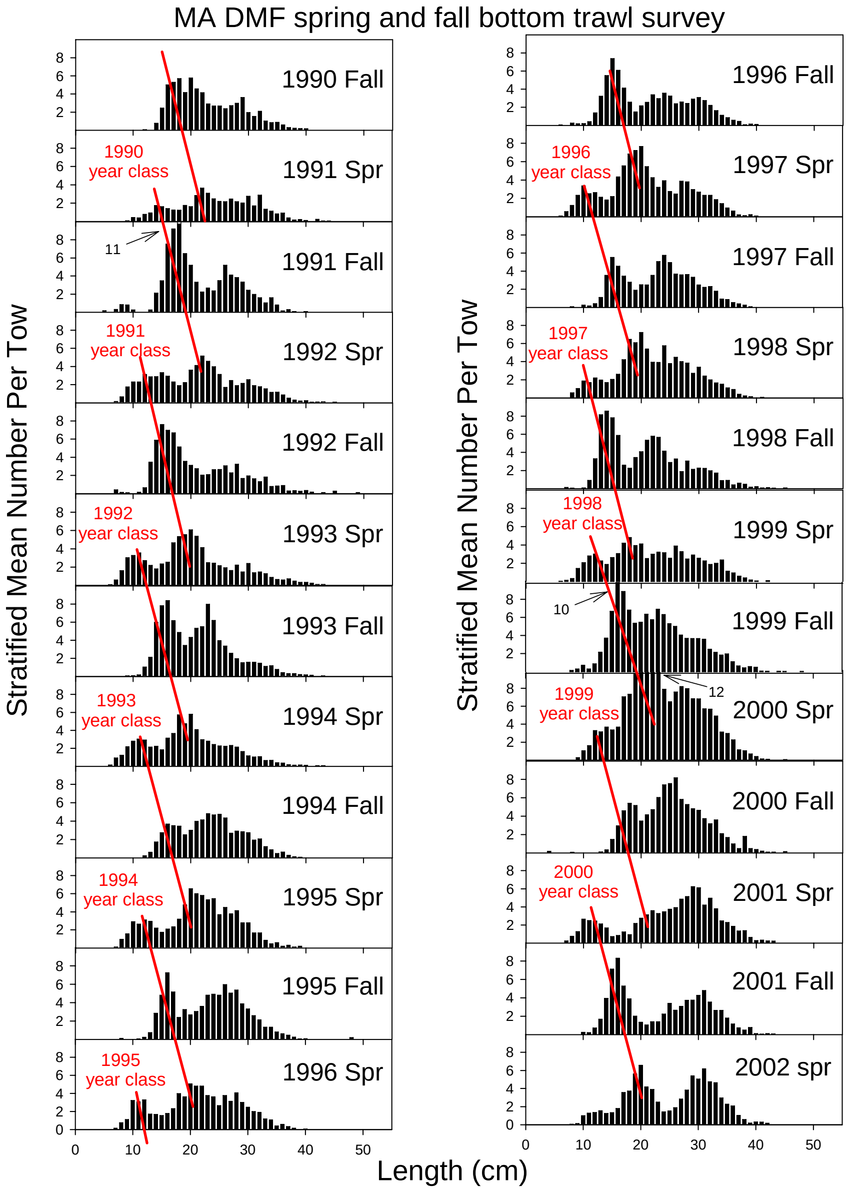


Figure I16. Cont.

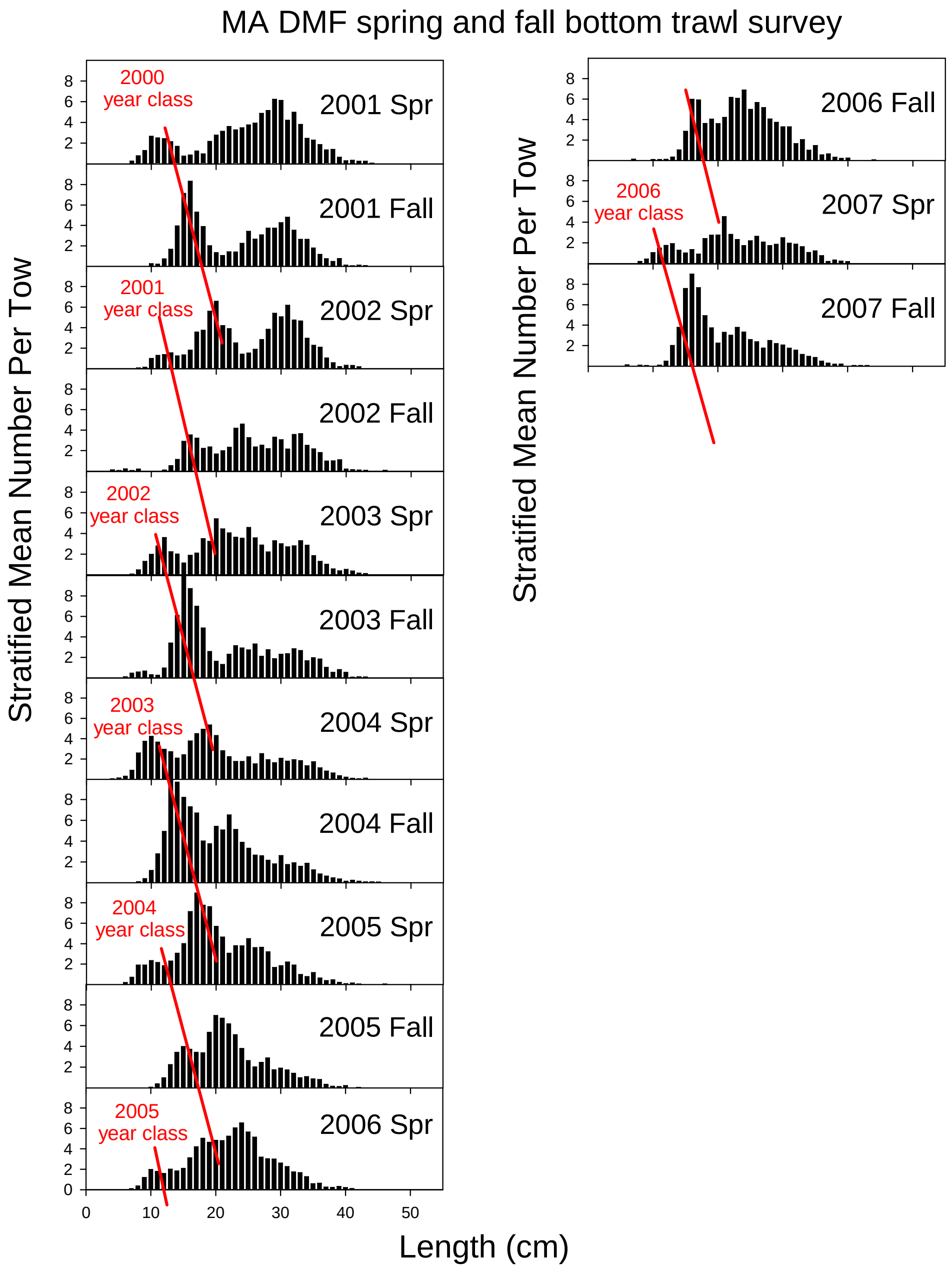


Figure I16. Cont.

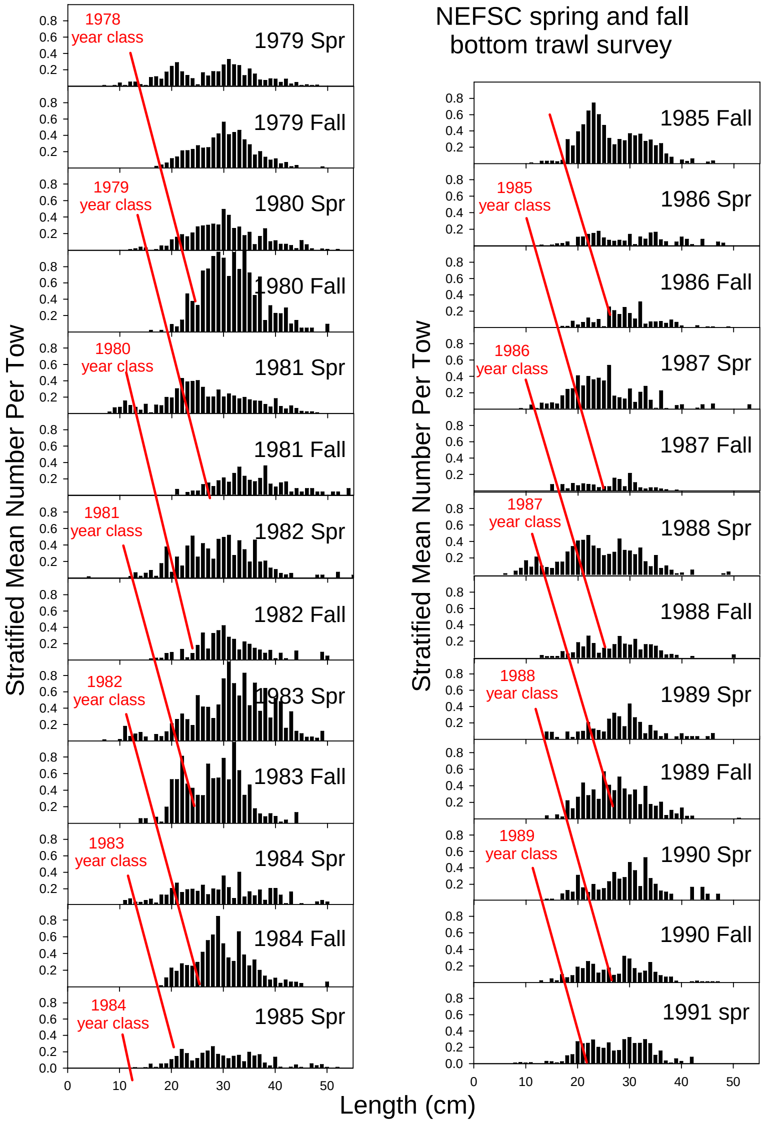


Figure I17. Spring and fall NEFSC bottom trawl survey Gulf of Maine winter flounder catch per tow at length.

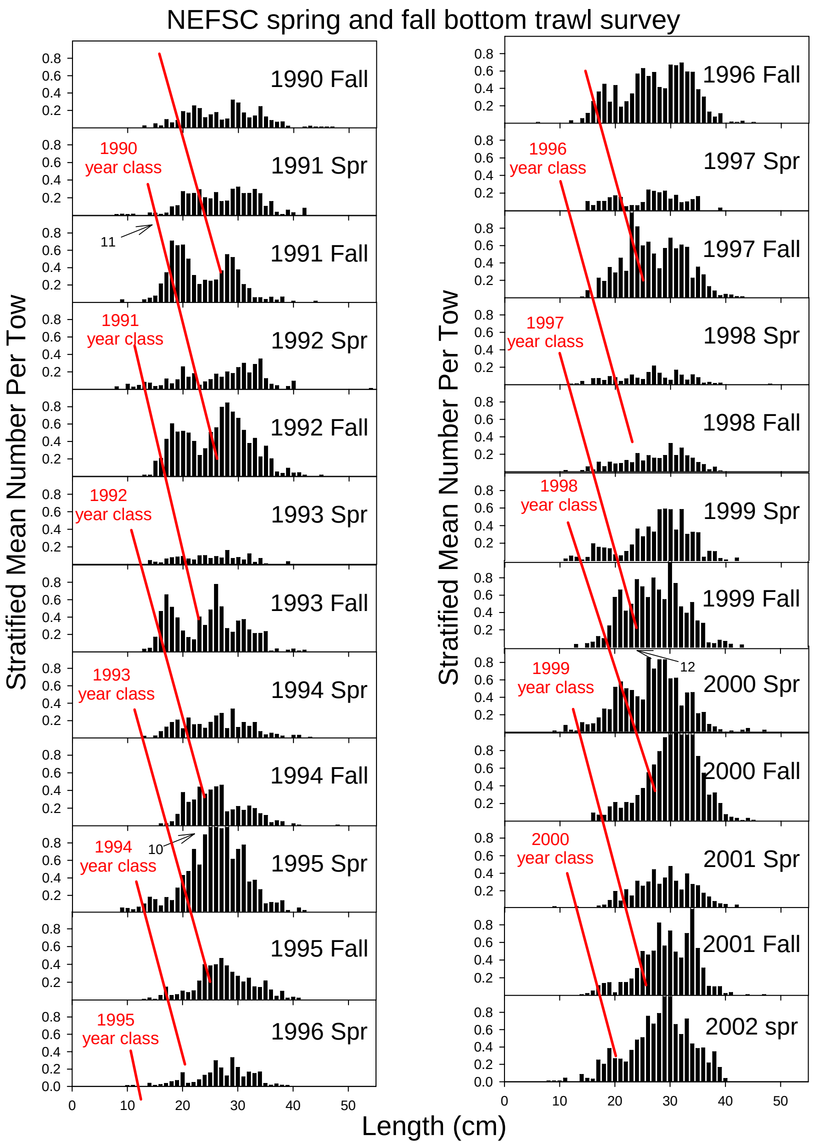


Figure I17. Cont.

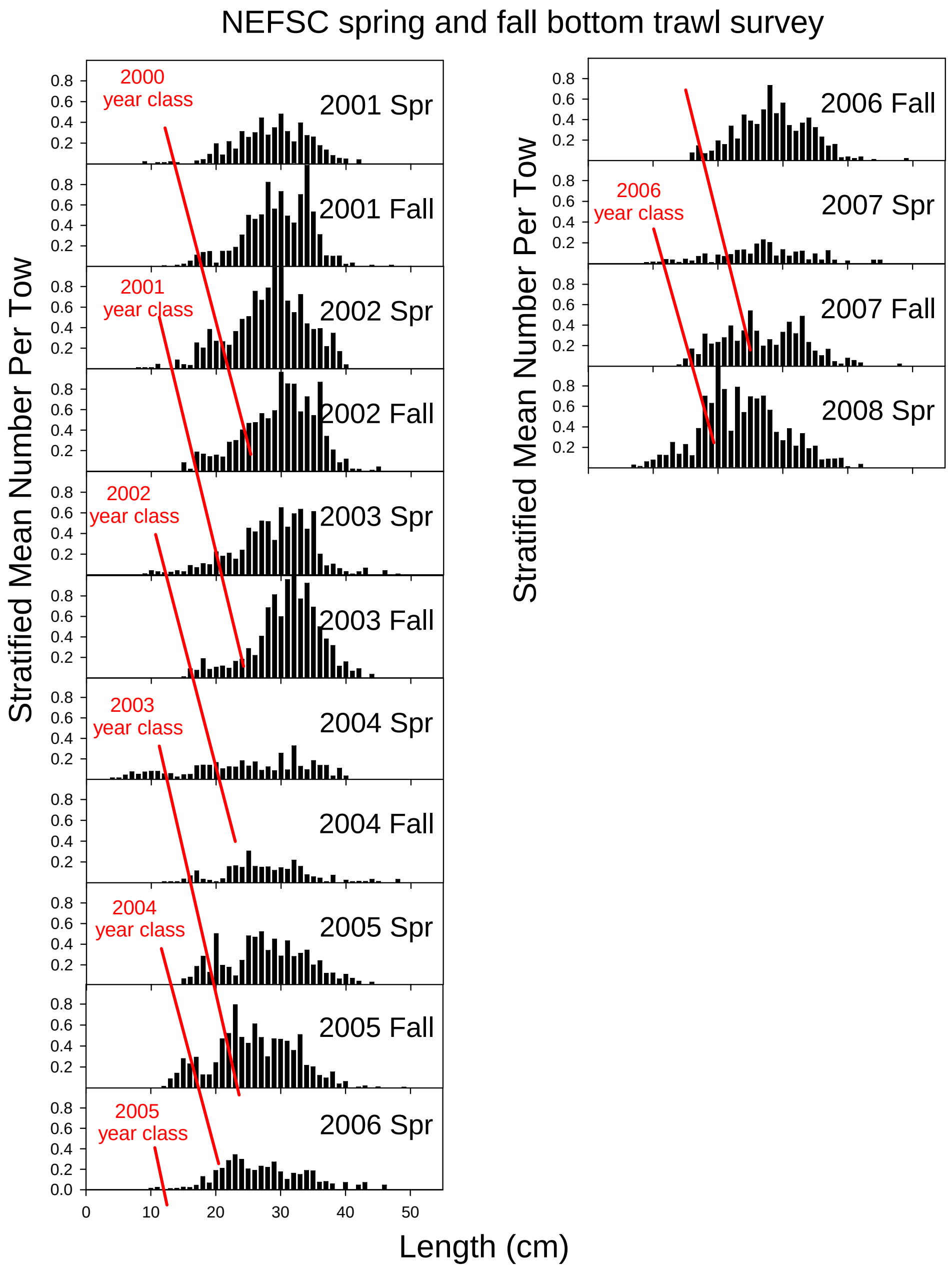


Figure I17. Cont.

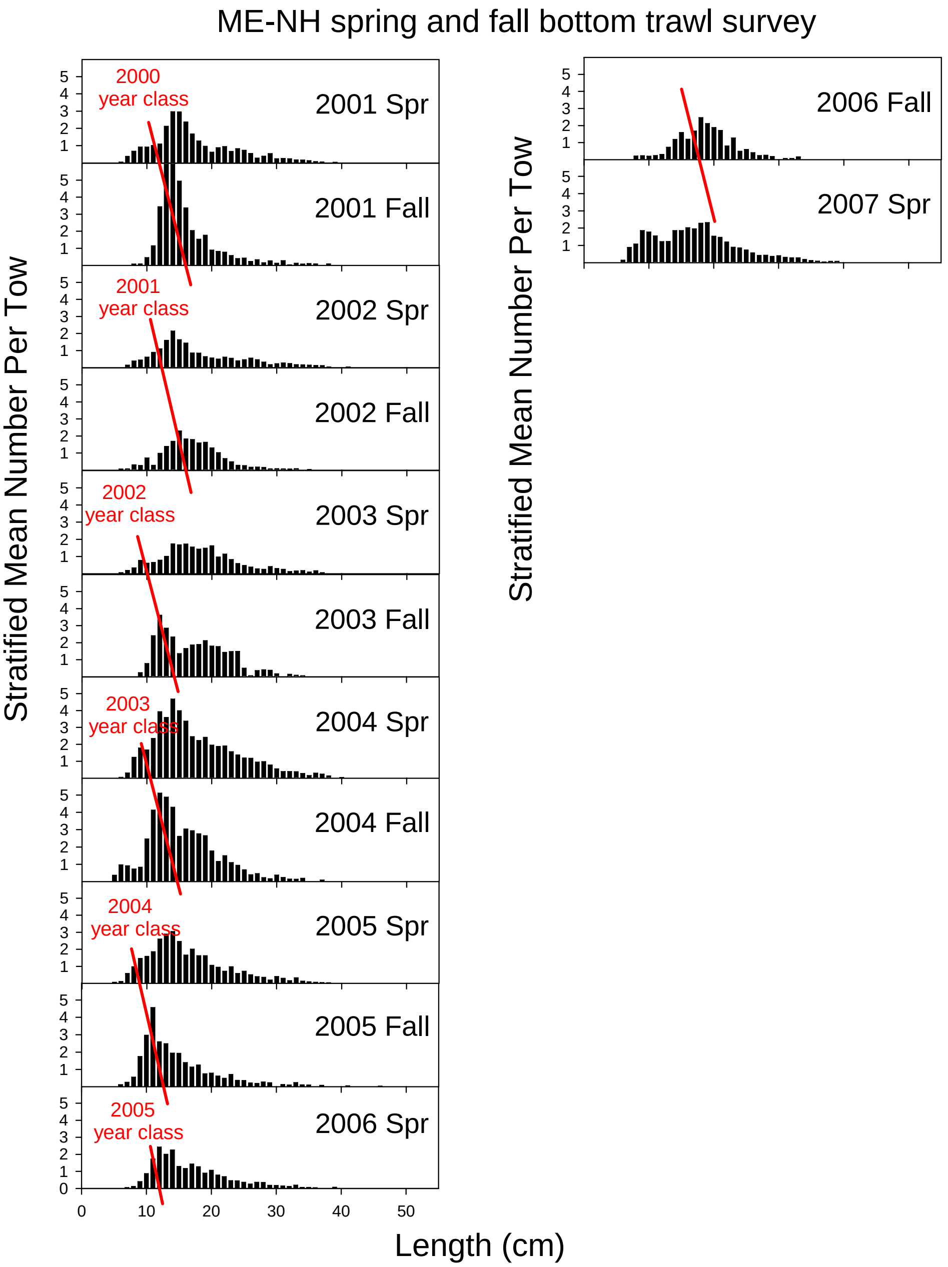


Figure I18. Spring and fall ME/NH bottom trawl survey Gulf of Maine winter flounder catch per tow at length.

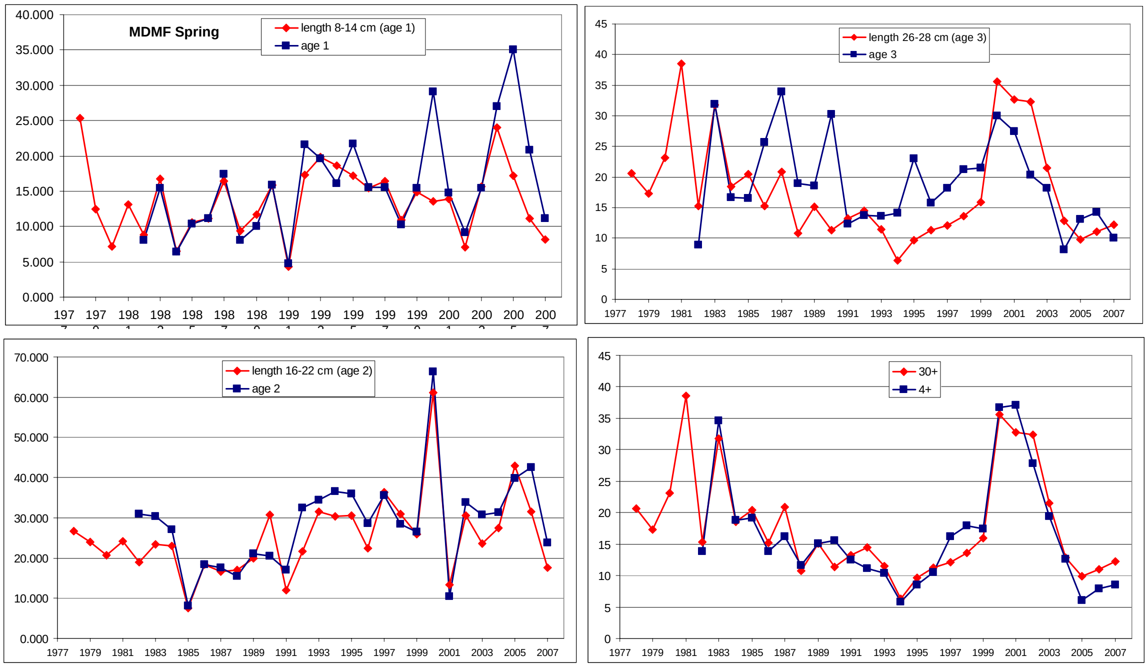


Figure I19. MDMF spring comparison of indices at age with the estimated index at age from slicing of length modes from the catch per tow at length distributions.

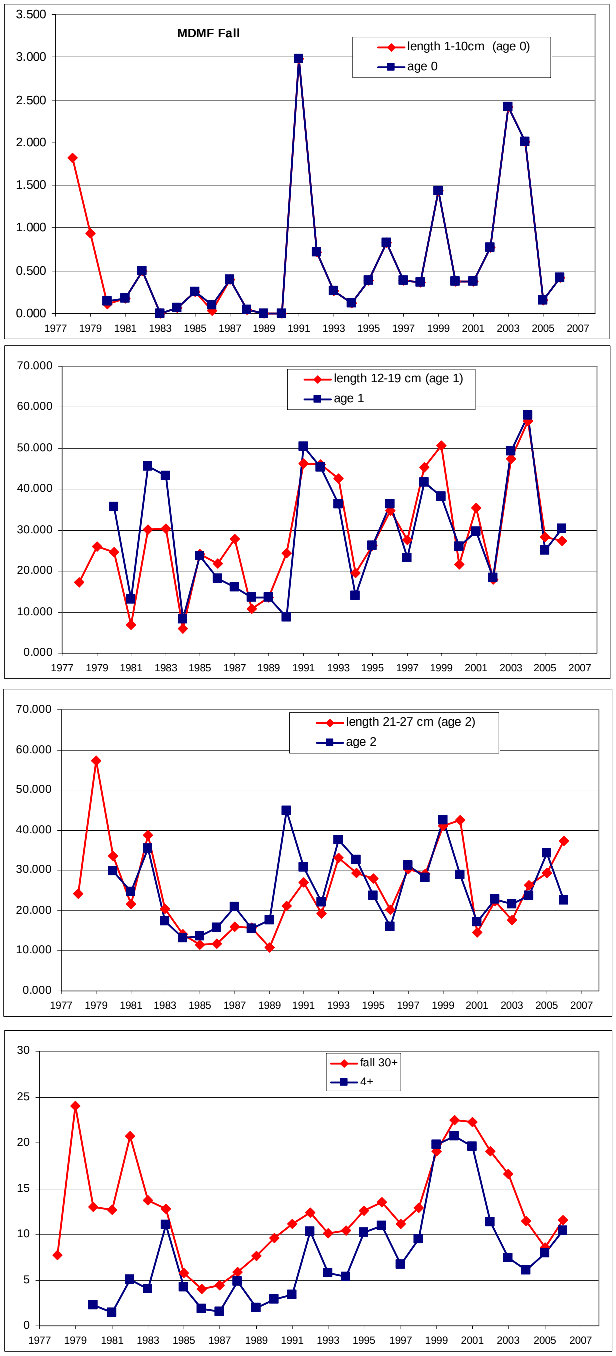


Figure I20. MDMF fall comparison of indices at age with the estimated index at age from slicing of length modes from the catch per tow at length distribution.

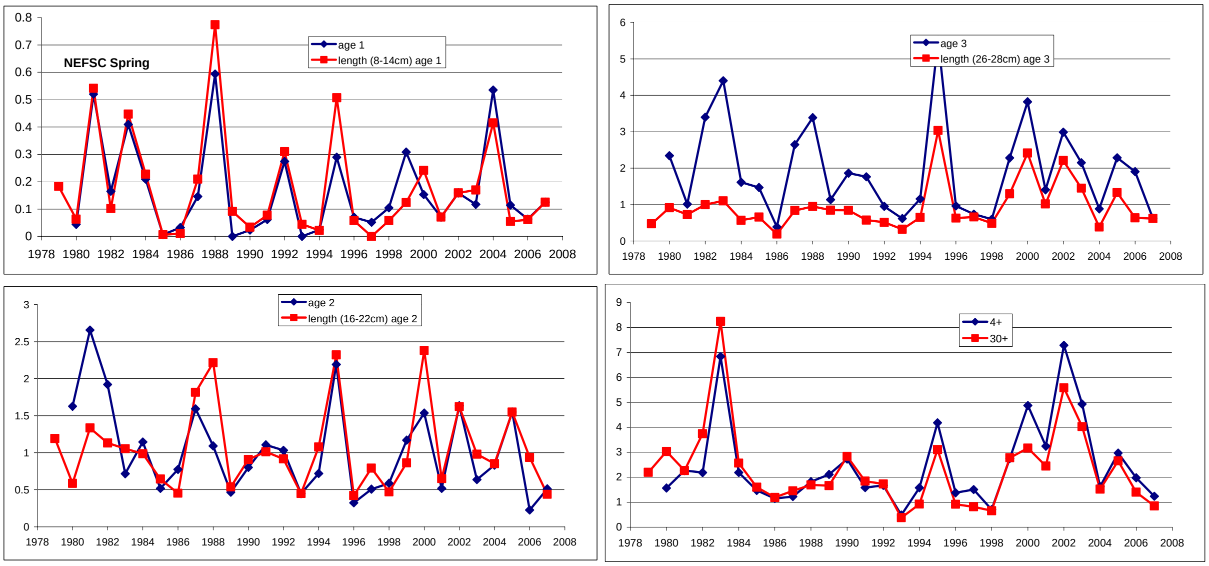


Figure I21. NEFSC spring comparison of indices at age with the estimated index at age from slicing of length modes from the catch per tow at length distribution.

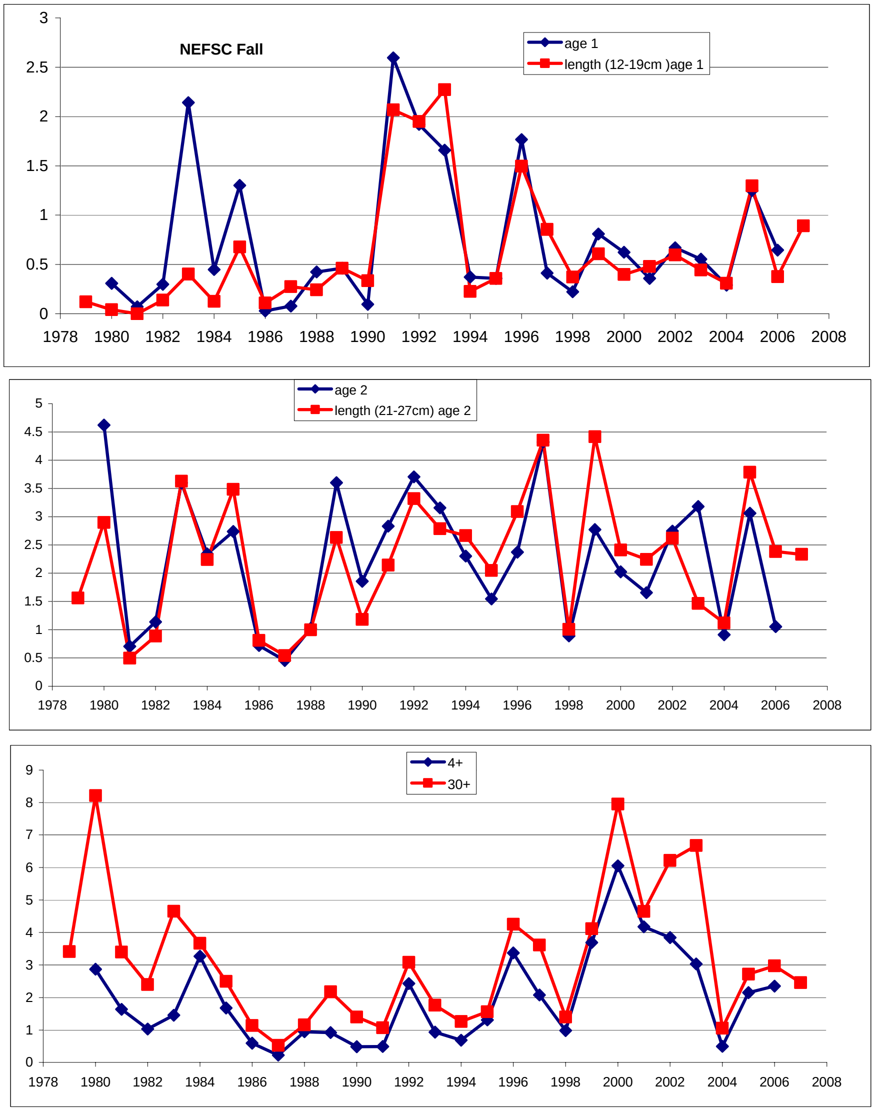


Figure I22. NEFSC fall Spring comparison of indices at age with the estimated index at age from slicing of length modes from the catch per tow at length distribution.

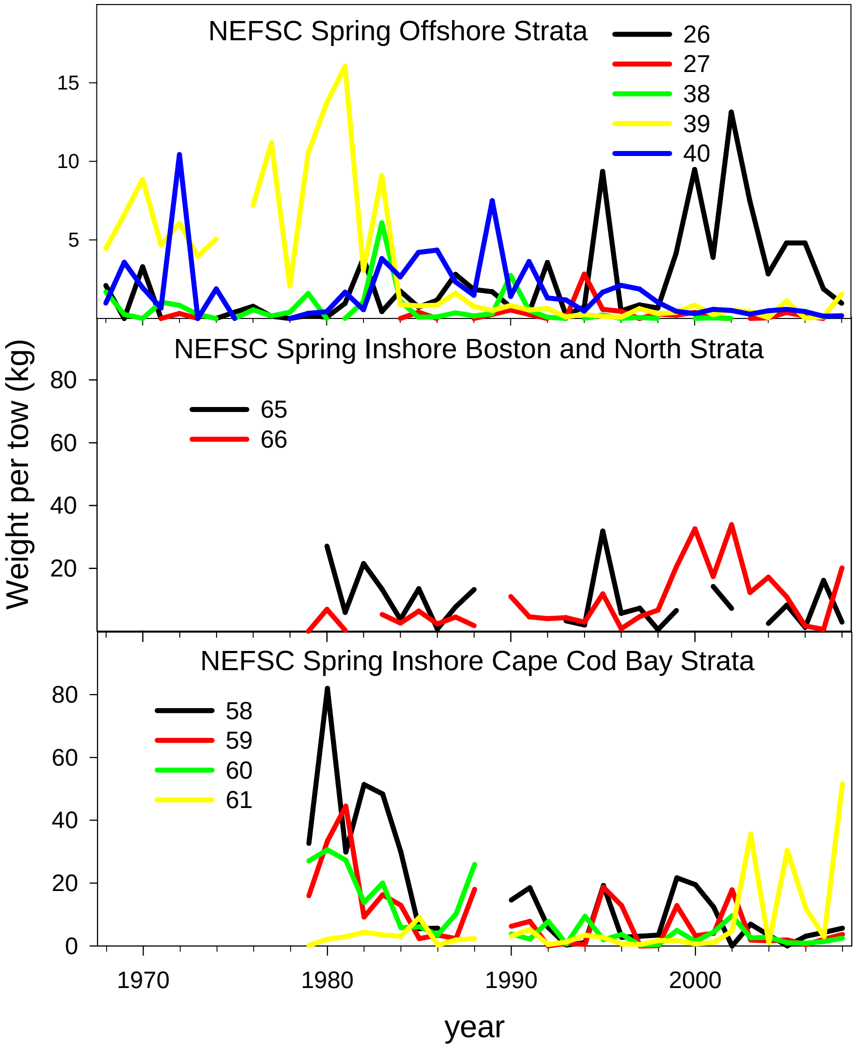


Figure I23. NEFSC spring weight per tow by strata.

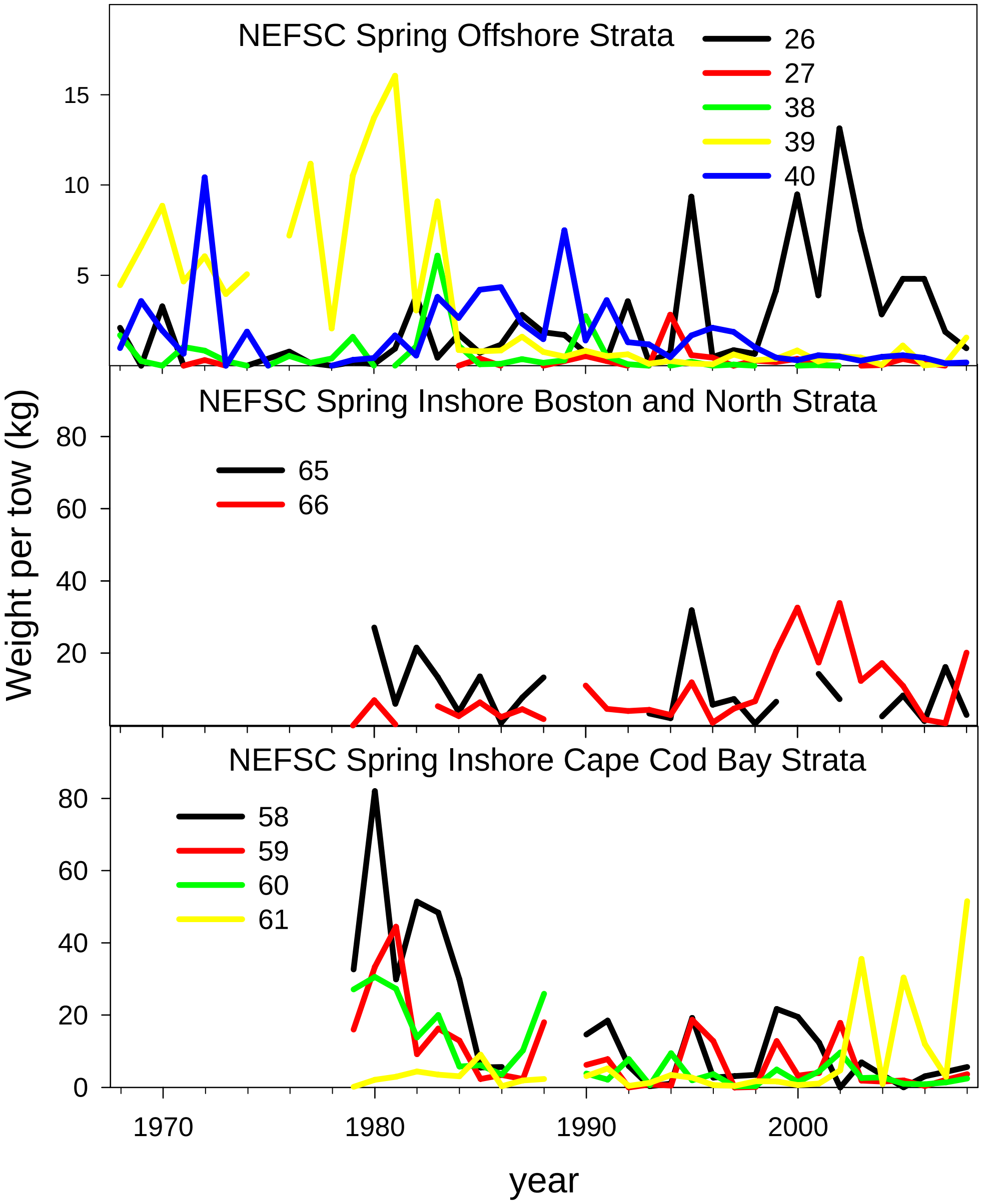


Figure I24. NEFSC fall weight per tow by strata.

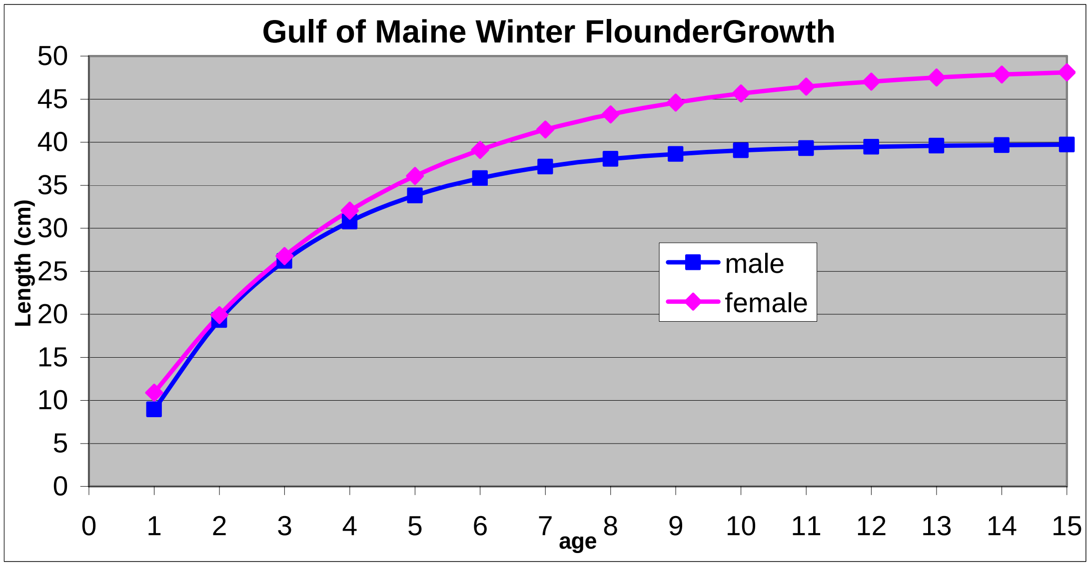
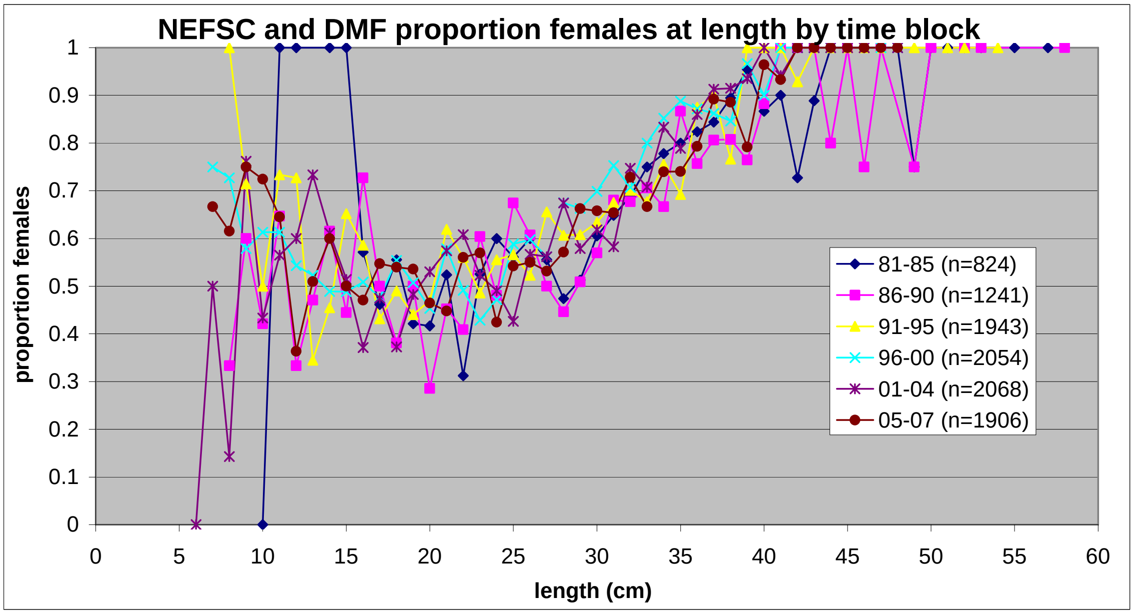


Figure I25. Von Bertalanffy growth curves by sex from Witherell and Burnett (1993).



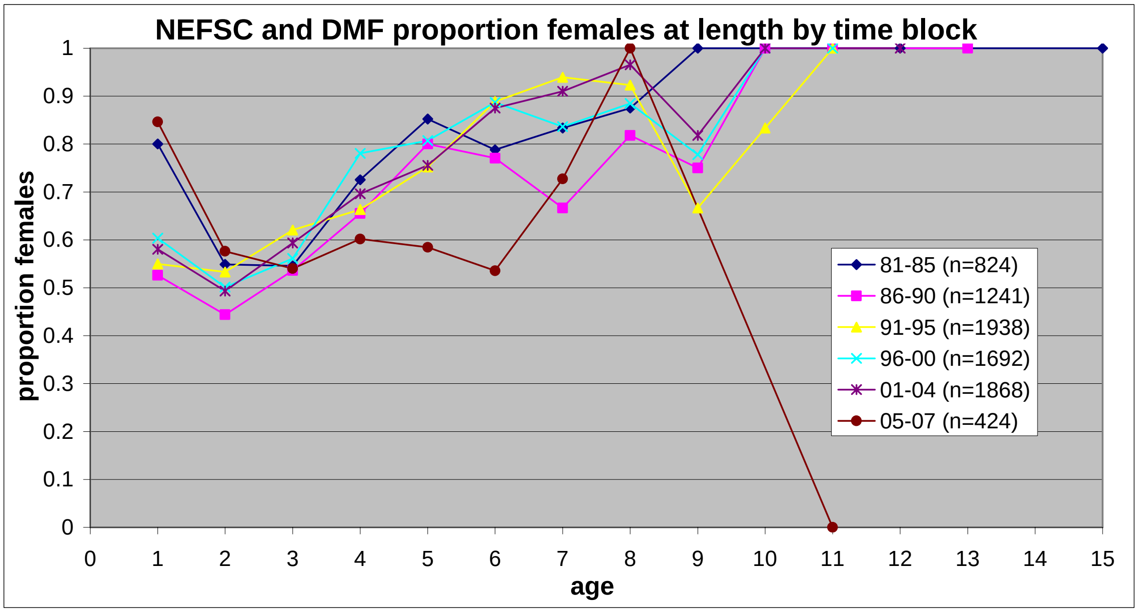


Figure I26. Proportion female by time block in the NEFSC and MDMF survey sample data.

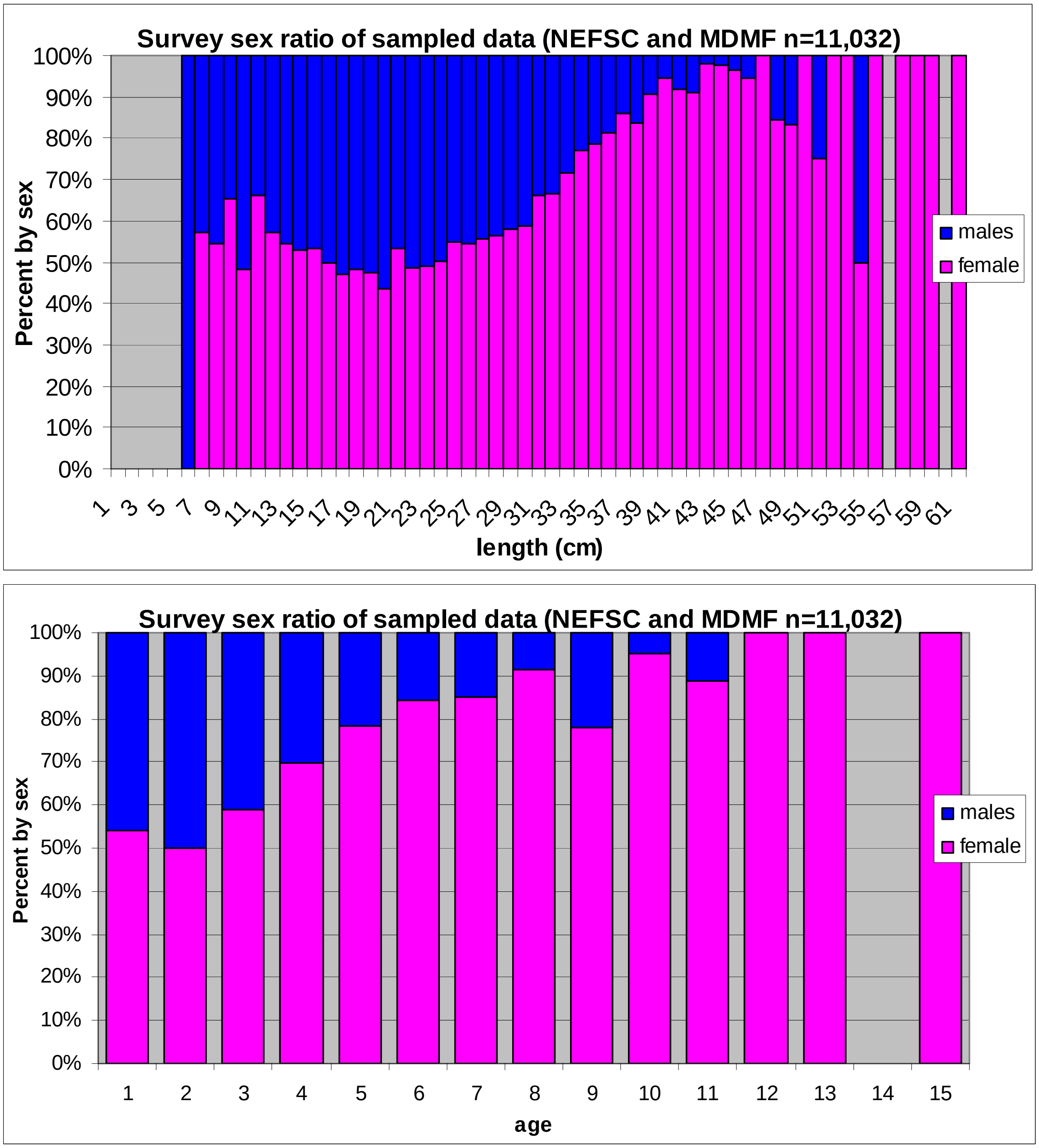
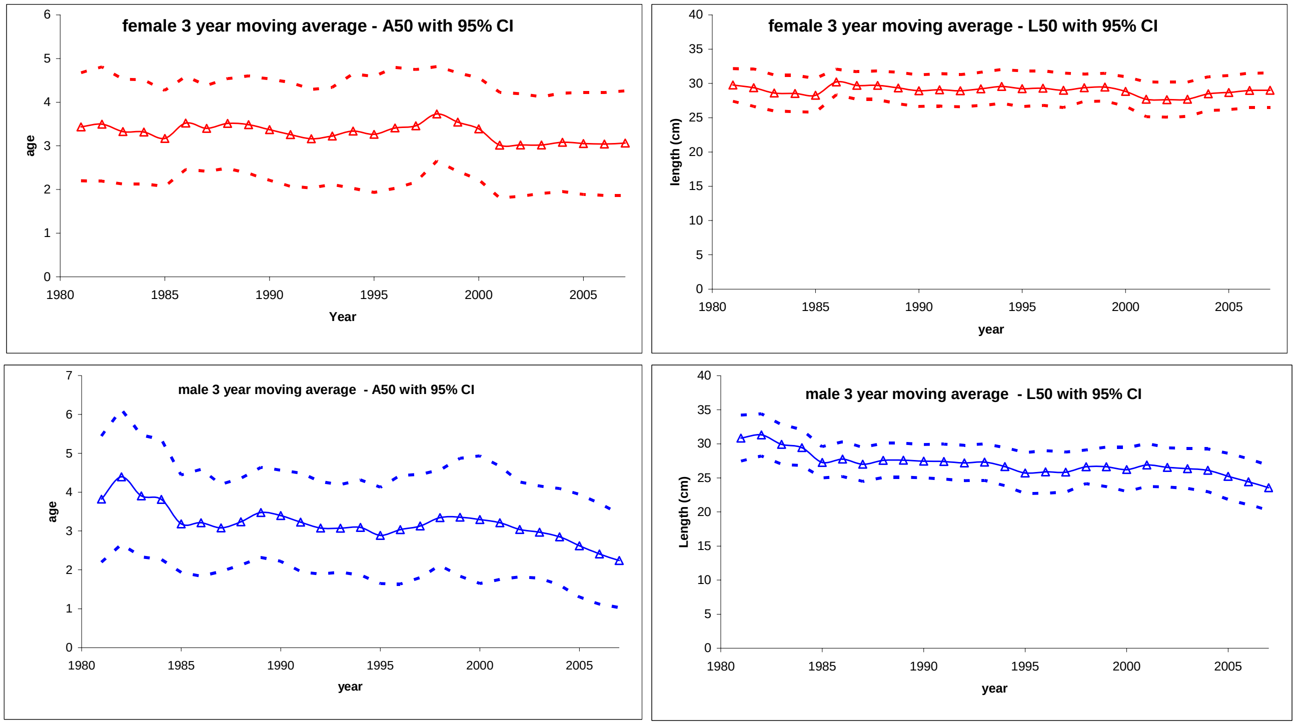


Figure I27. Sex ratio at length and age in the NEFSC and MDMF survey sample data with all year combined (1982-2007).



female 3 year moving average - A50 with 95% CI

female 3 year moving average - L50 with 95% CI

male 3 year moving average - A50 with 95% CI

male 3 year moving average - L50 with 95% CI

Figure I28. Gulf of Maine winter flounder female and male three year moving average of the A50 and L50 from the spring MDMF survey.

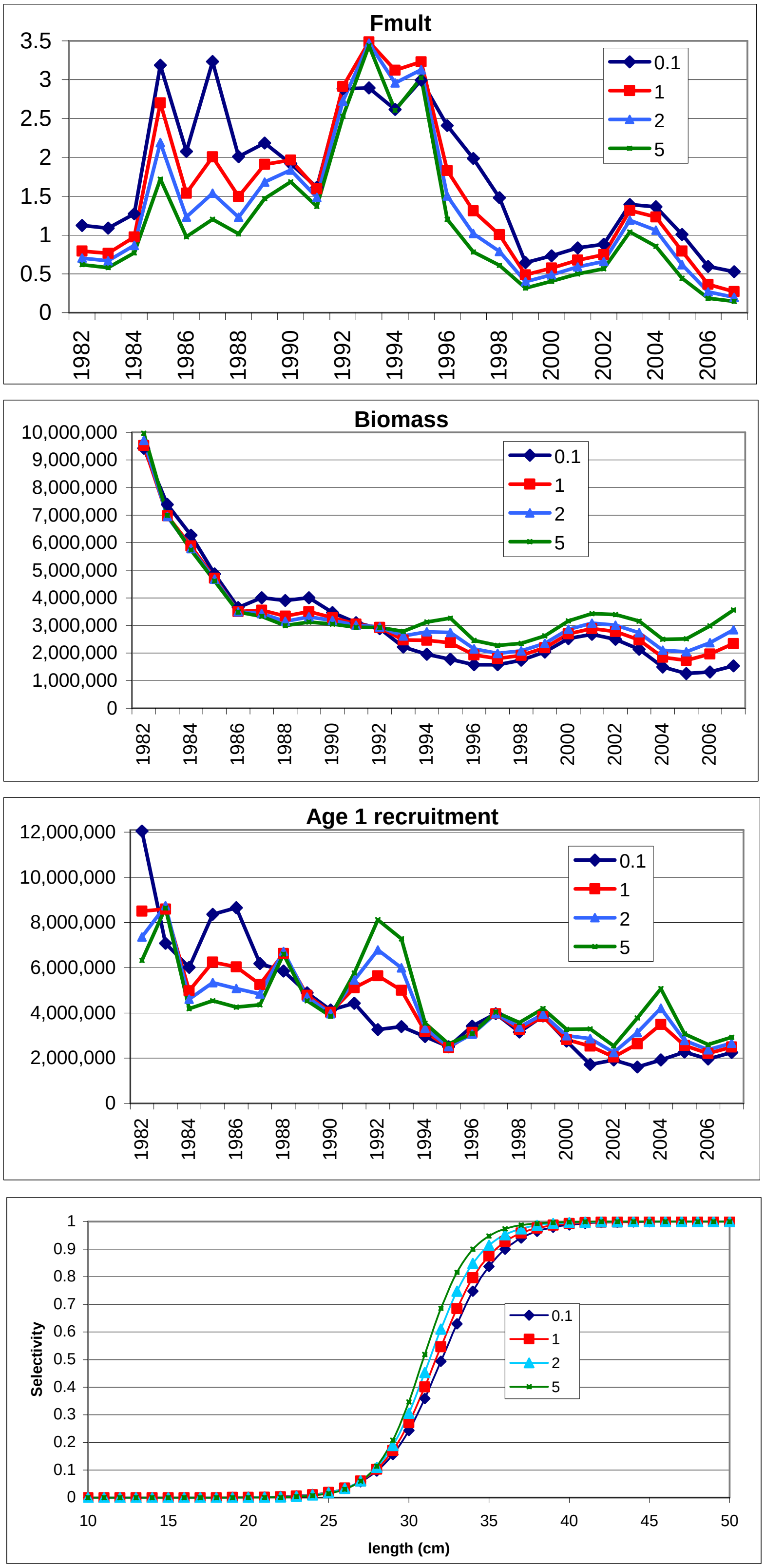


Figure I29. SCALE sensitivity to input weight on the recruitment indices.

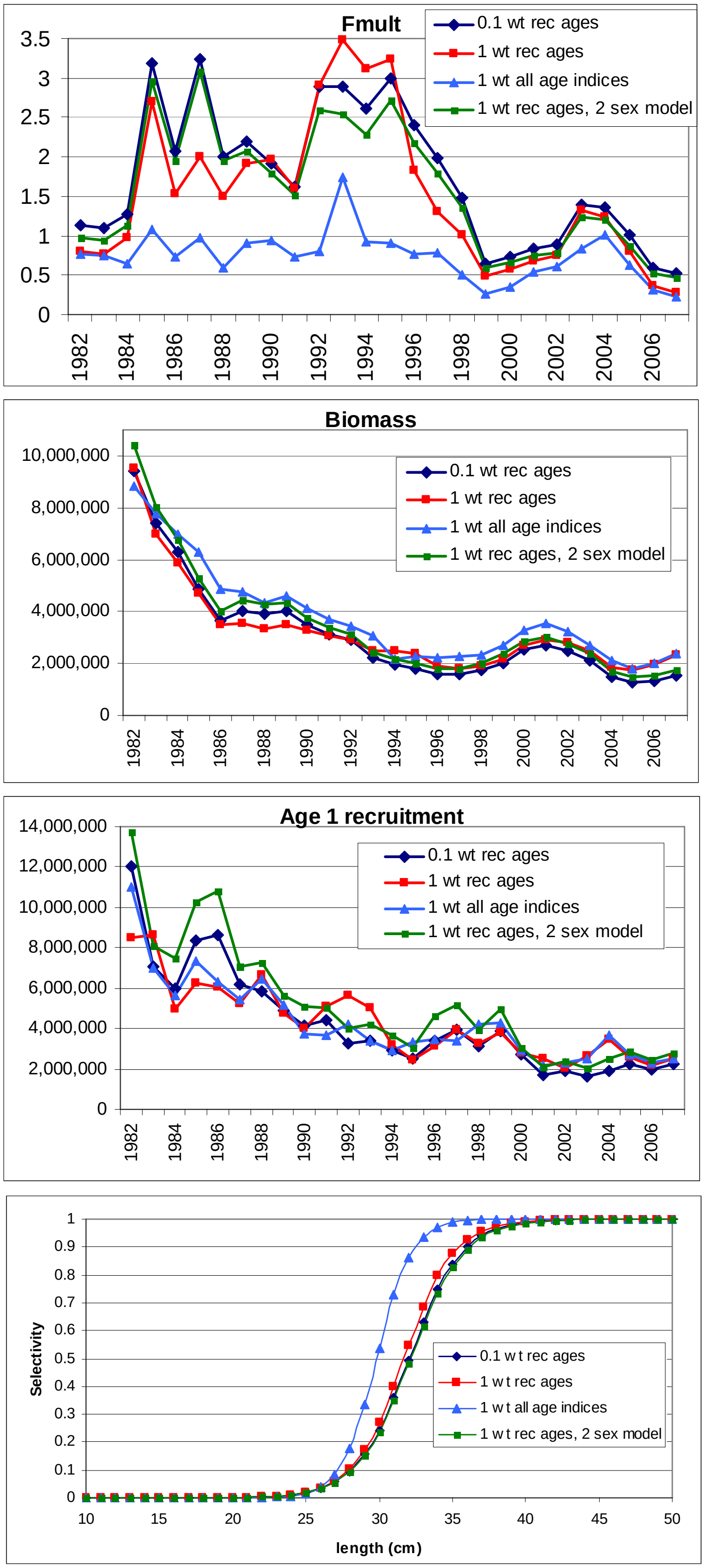


Figure I30. SCALE sensitivity to different model configurations.

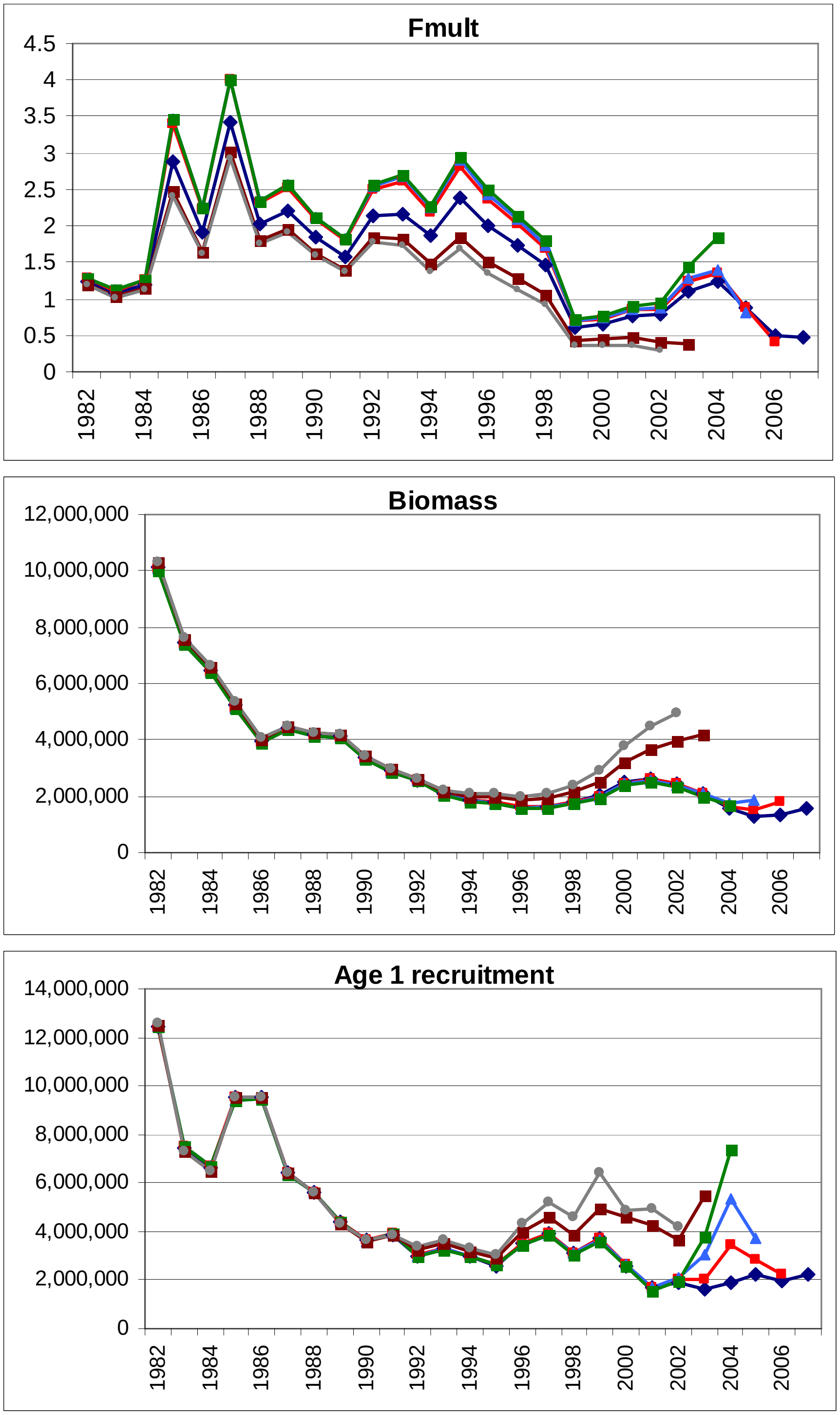


Figure I31. Gulf of Maine winter flounder split SCALE run 5 retrospective.

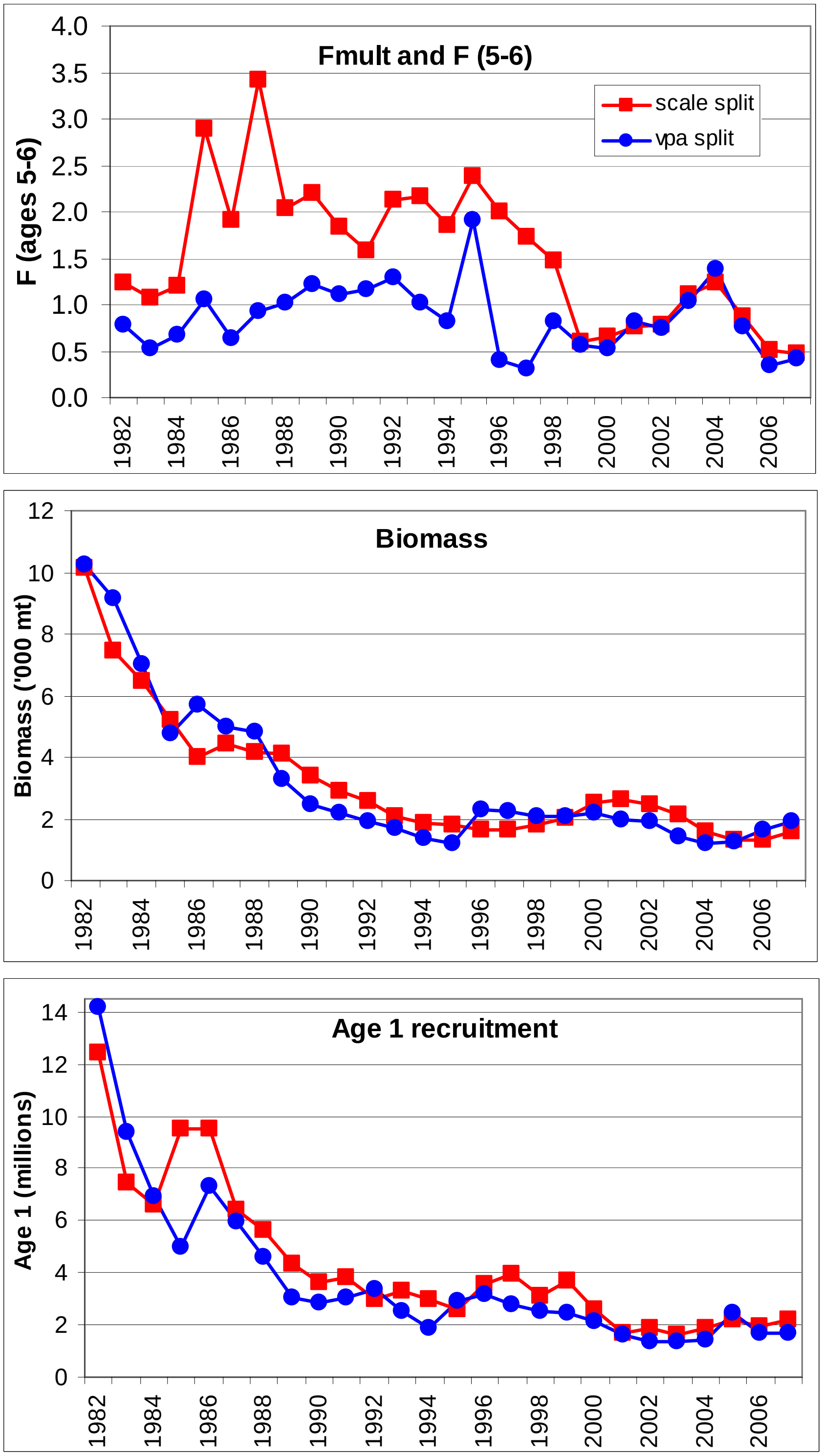


Figure I32. Comparison between the Split VPA run 2b and the split SCALE run 5.

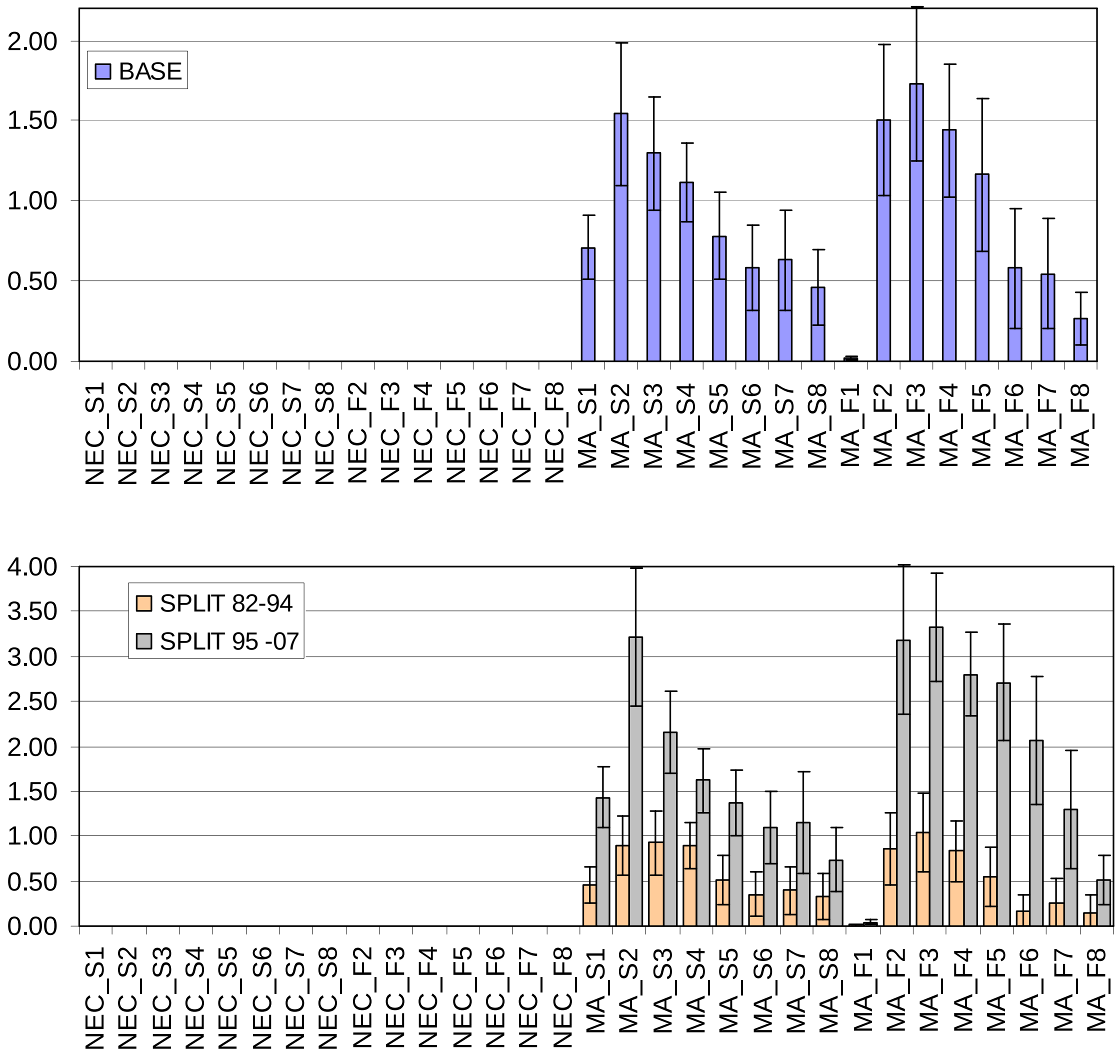


Figure I33. Gulf of Maine winter flounder Base and split VPA area swept Q estimates with standard deviations for run 5 and 6 which excludes the NEFSC surveys.

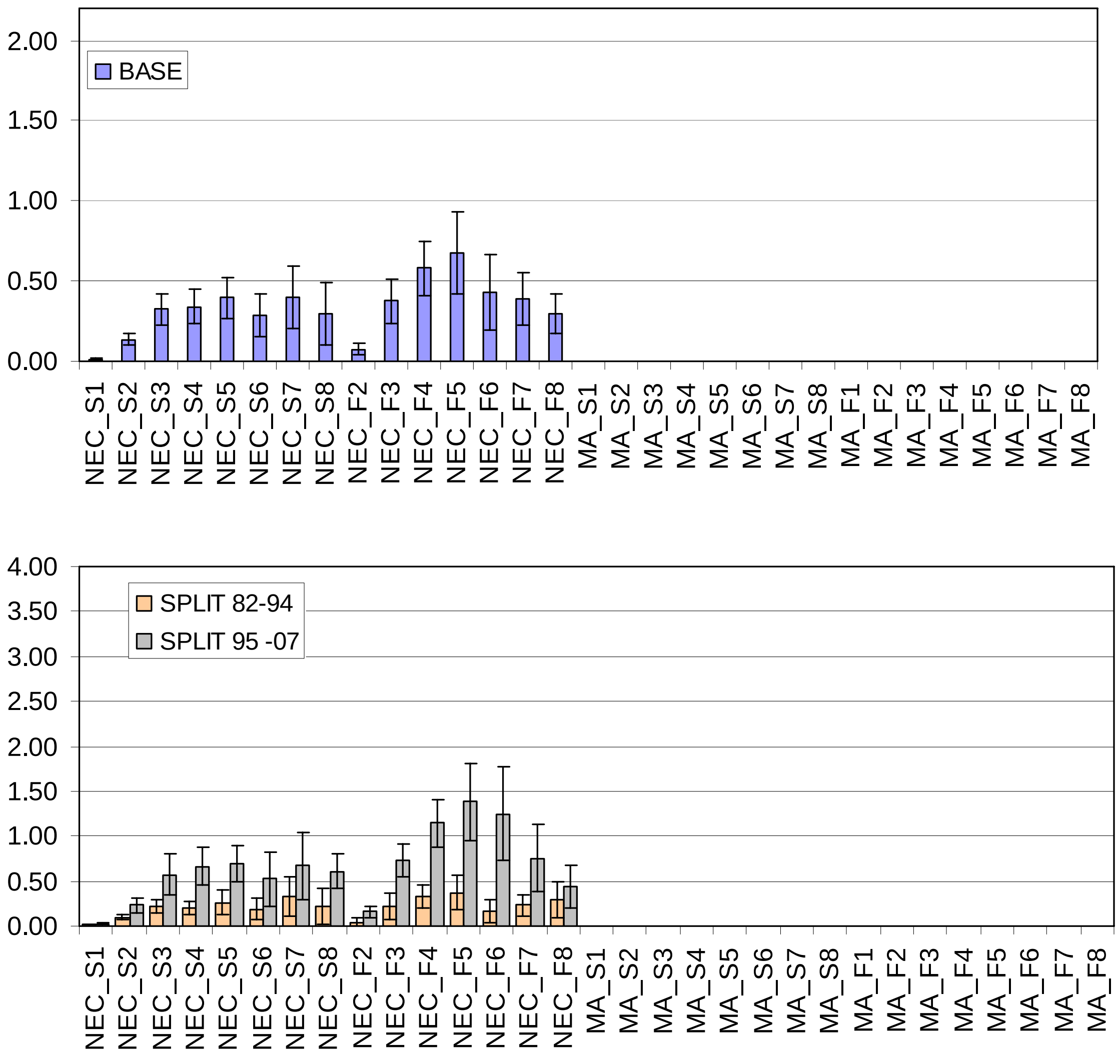


Figure I34. Gulf of Maine winter flounder Base and split VPA area swept Q estimates with standard deviations for run 7 and 8 which excludes the MDMF surveys.

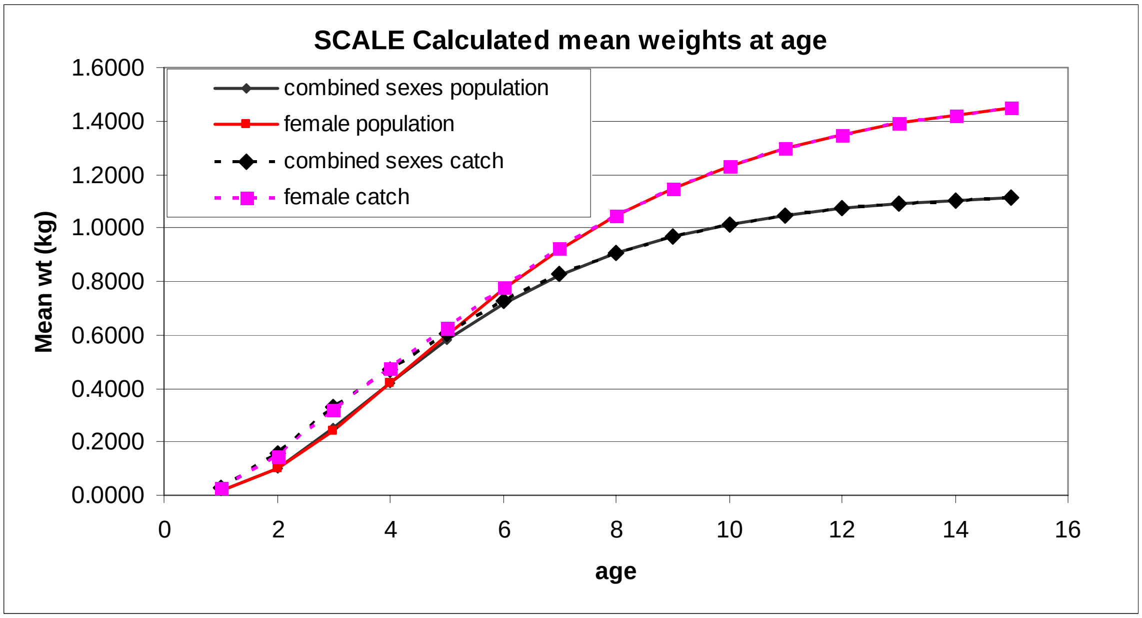


Figure I35. SCALE population and catch mean weight at age for females and for combined sexes.

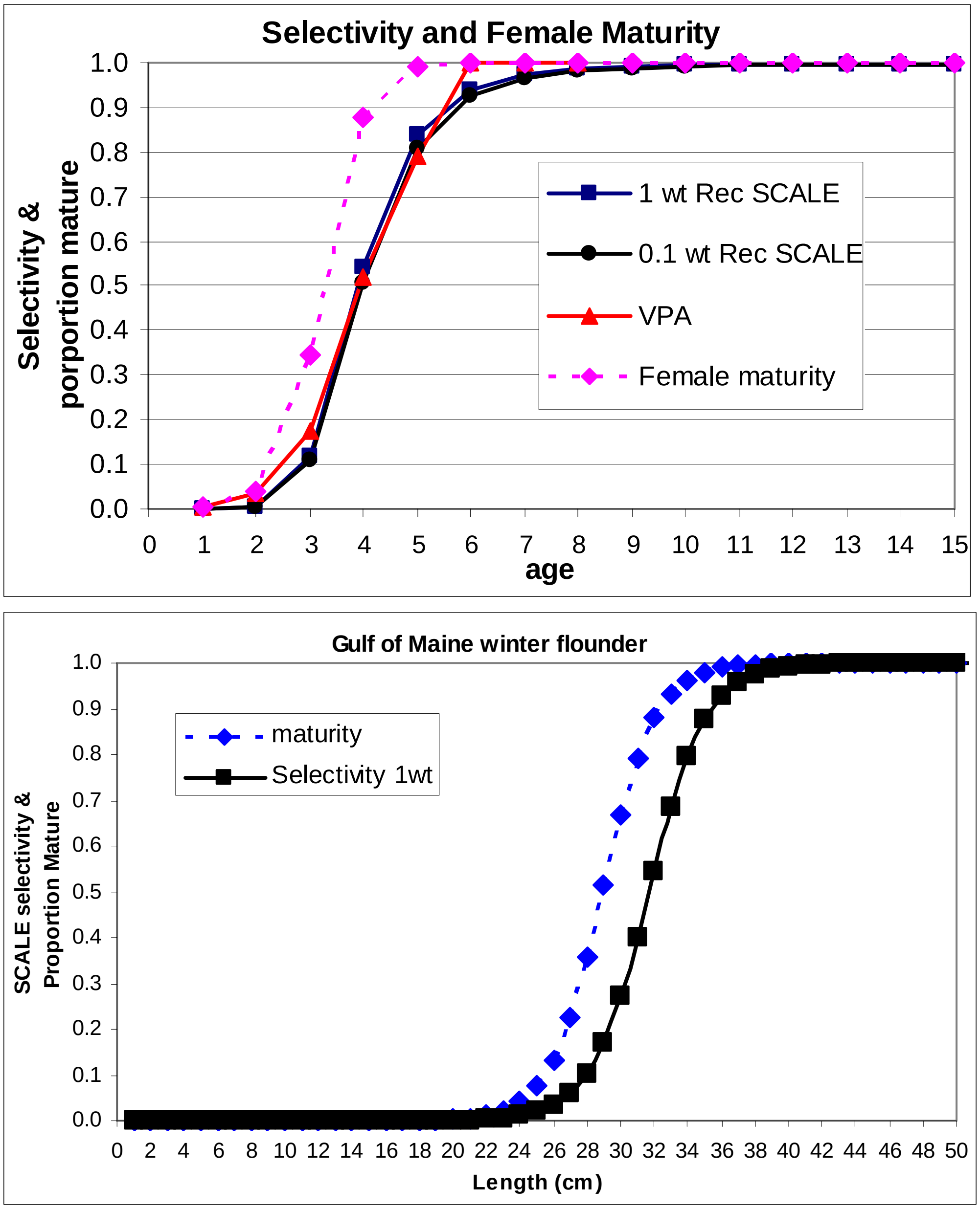


Figure I36. Comparison between estimated selectivity from the SCALE and VPA model. Maturity schedule is also shown.

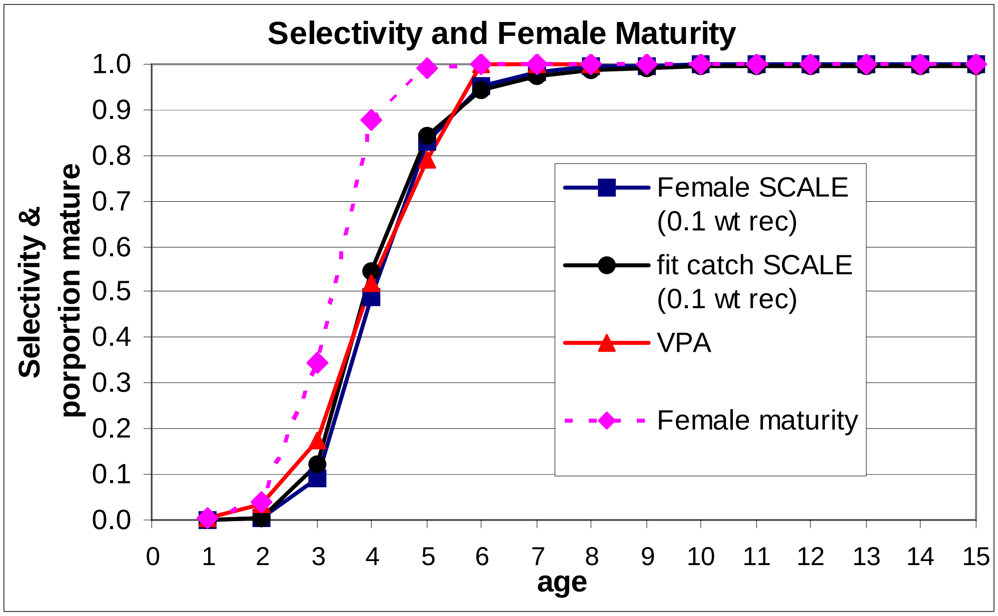


Figure I37. Comparison between estimated selectivity from the split SCALE sex specific run, sexes combined run and the split VPA model run. Maturity schedule is also shown.

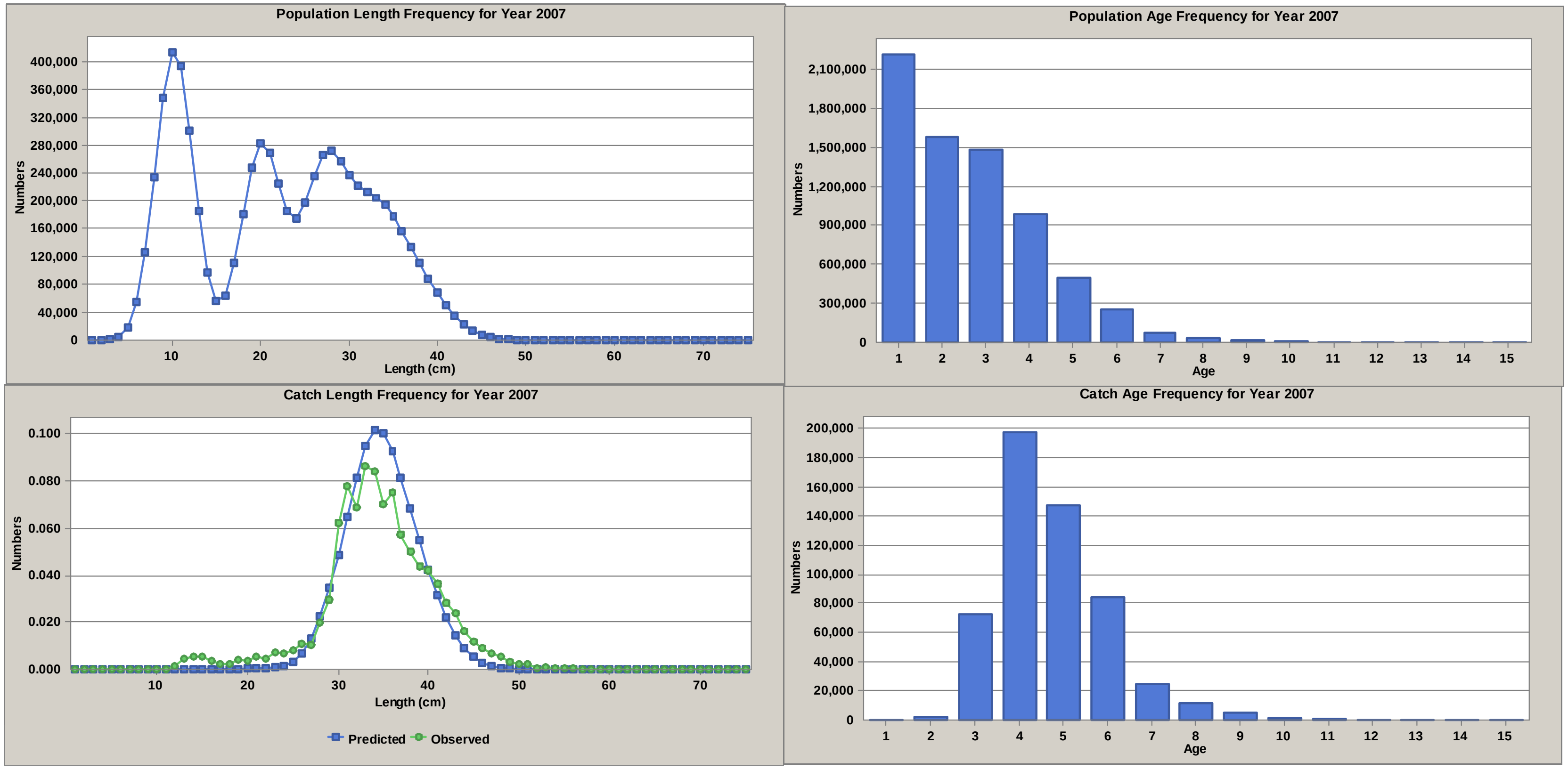


Figure I38. Split SCALE model (1982-1994, 1995-2006) population length and age frequency, predicted and observed catch length frequency and the predict age frequency in 2007 for run 5 (0.1 wt on recruitment indices and 20 wt on fitting the catch).

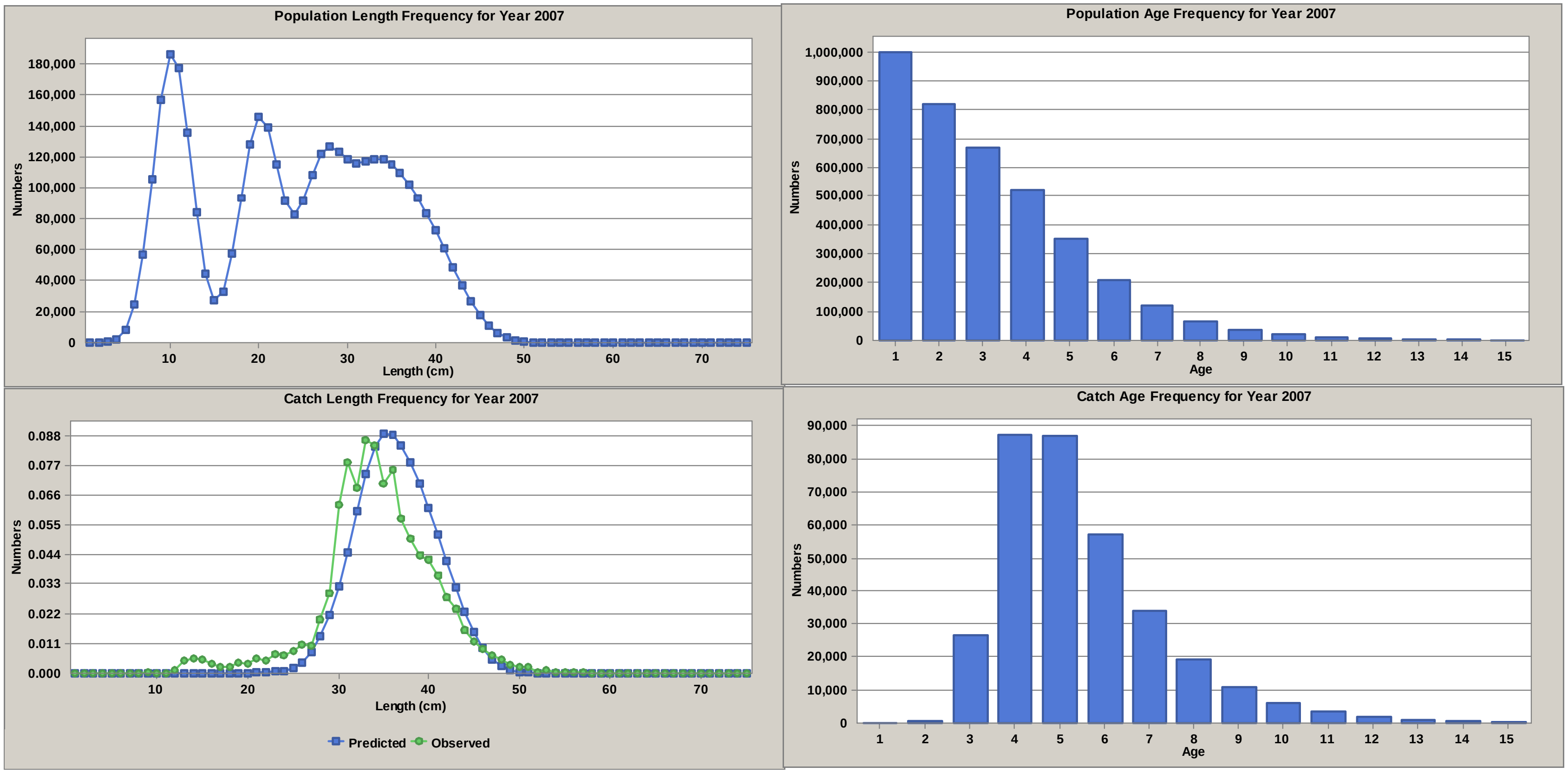


Figure I39. Split SCALE model (1982-1994, 1995-2006) predicted $F_{40} = 0.38$ population length and age frequency, predicted run 5 length frequency and observed catch length frequency at $F_{40}$ and the predict age frequency at $F_{40}$.

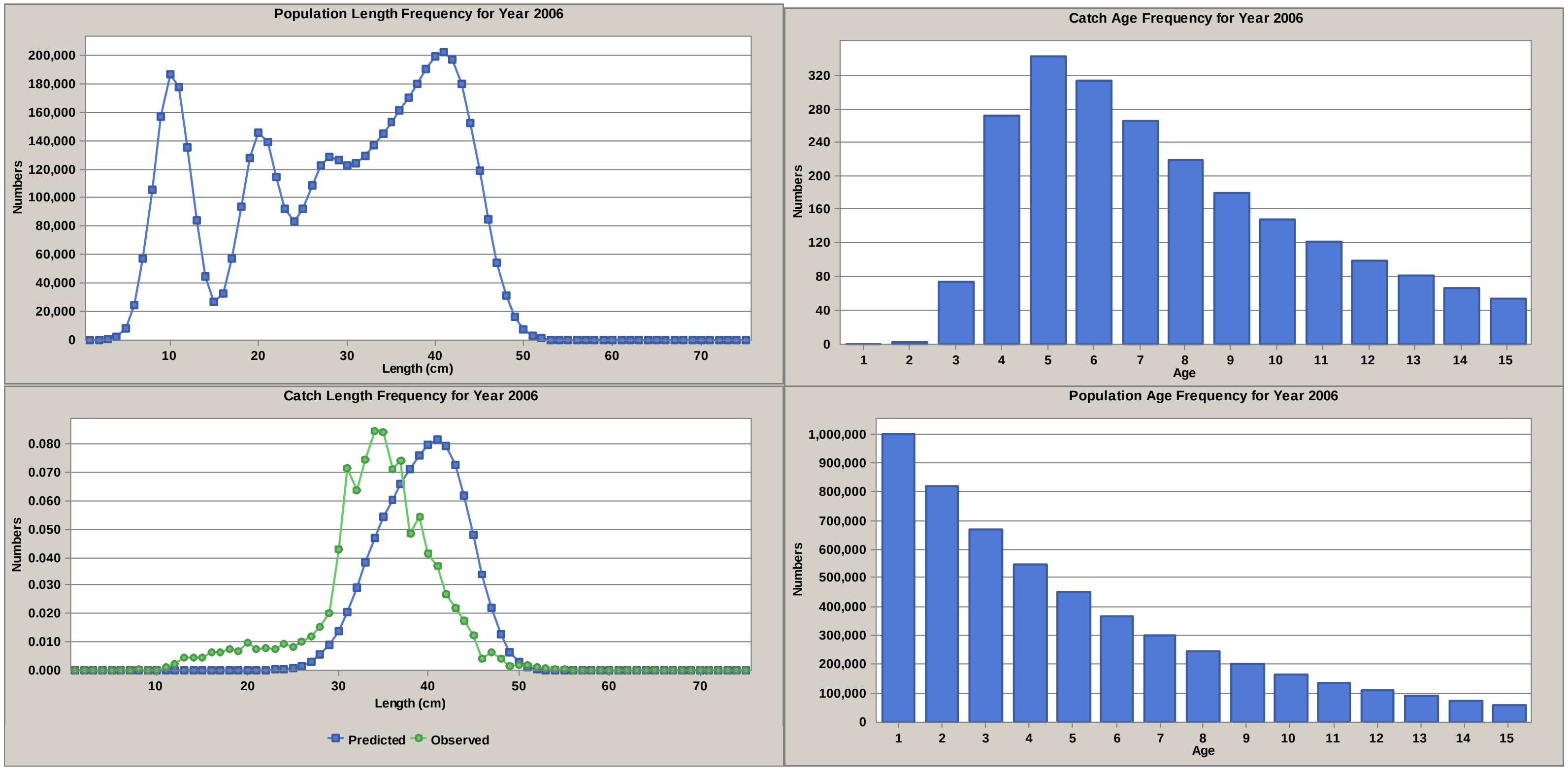


Figure I40. Split SCALE model (1982-1994, 1995-2006) predicted F=0 population length and age frequency, predicted run 5 length frequency and observed catch length frequency at F=0 and the predict age frequency at F=0

# Appendix J. Southern New England/Mid-Atlantic winter flounder

By: Mark Terceiro

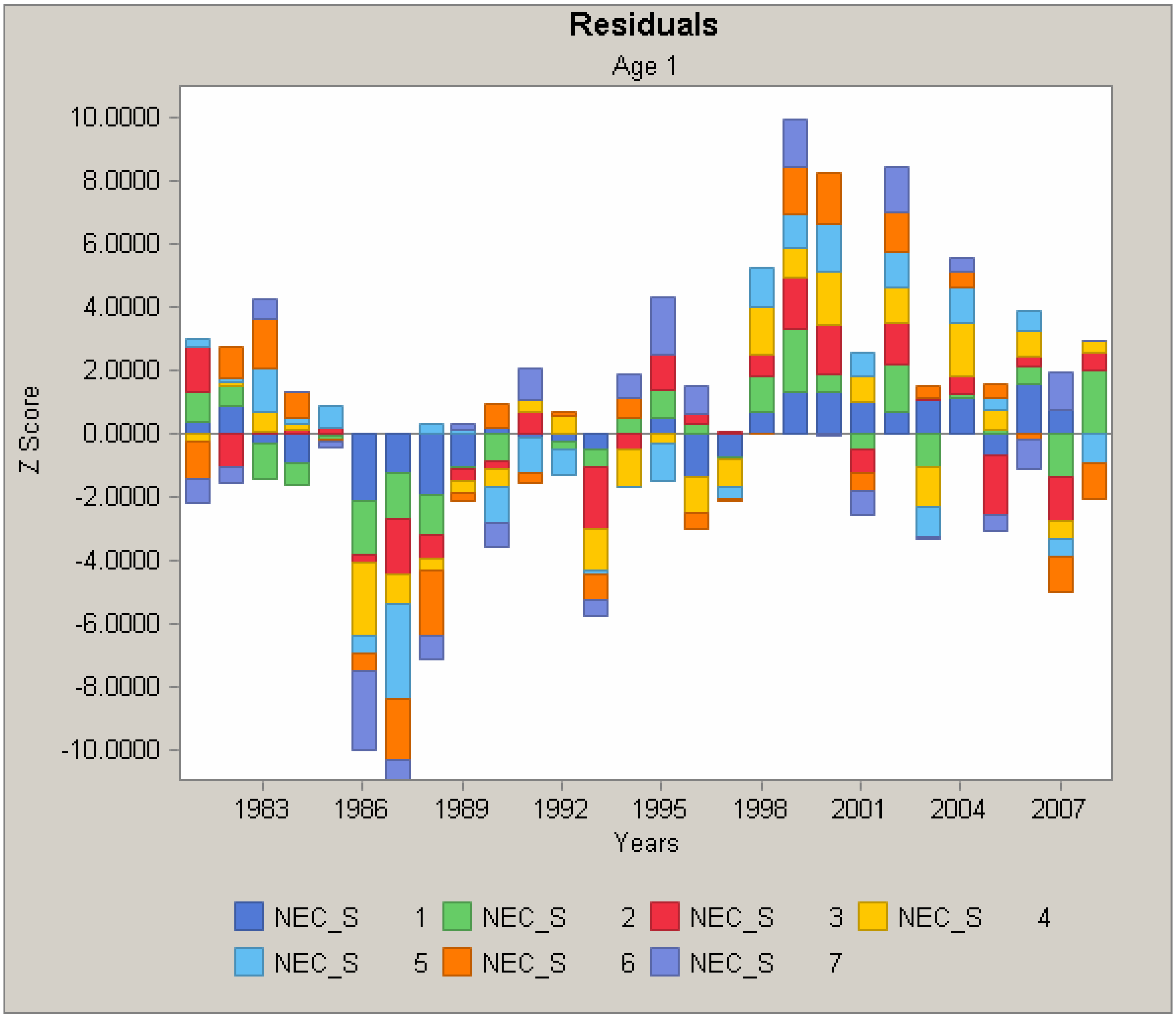


Figure 1. GARM3 ADAPT VPA BASE run survey index combined residuals:
NEFSC Spring Survey ages 1-7.

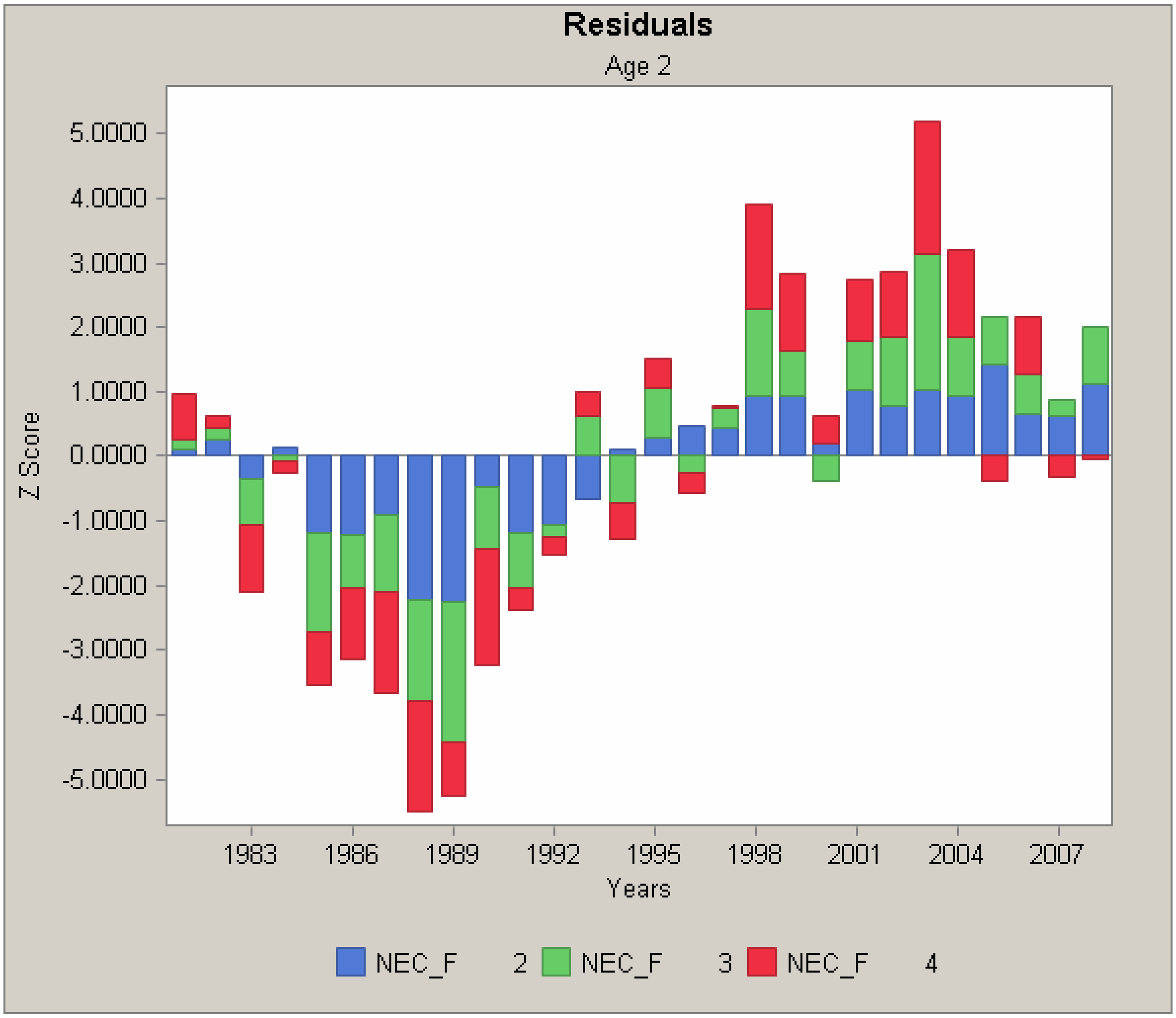


Figure 2. GARM3 ADAPT VPA BASE run survey index combined residuals:
NEFSC Fall Survey ages 1-3 (tuned to ages 2-4 in year+1).

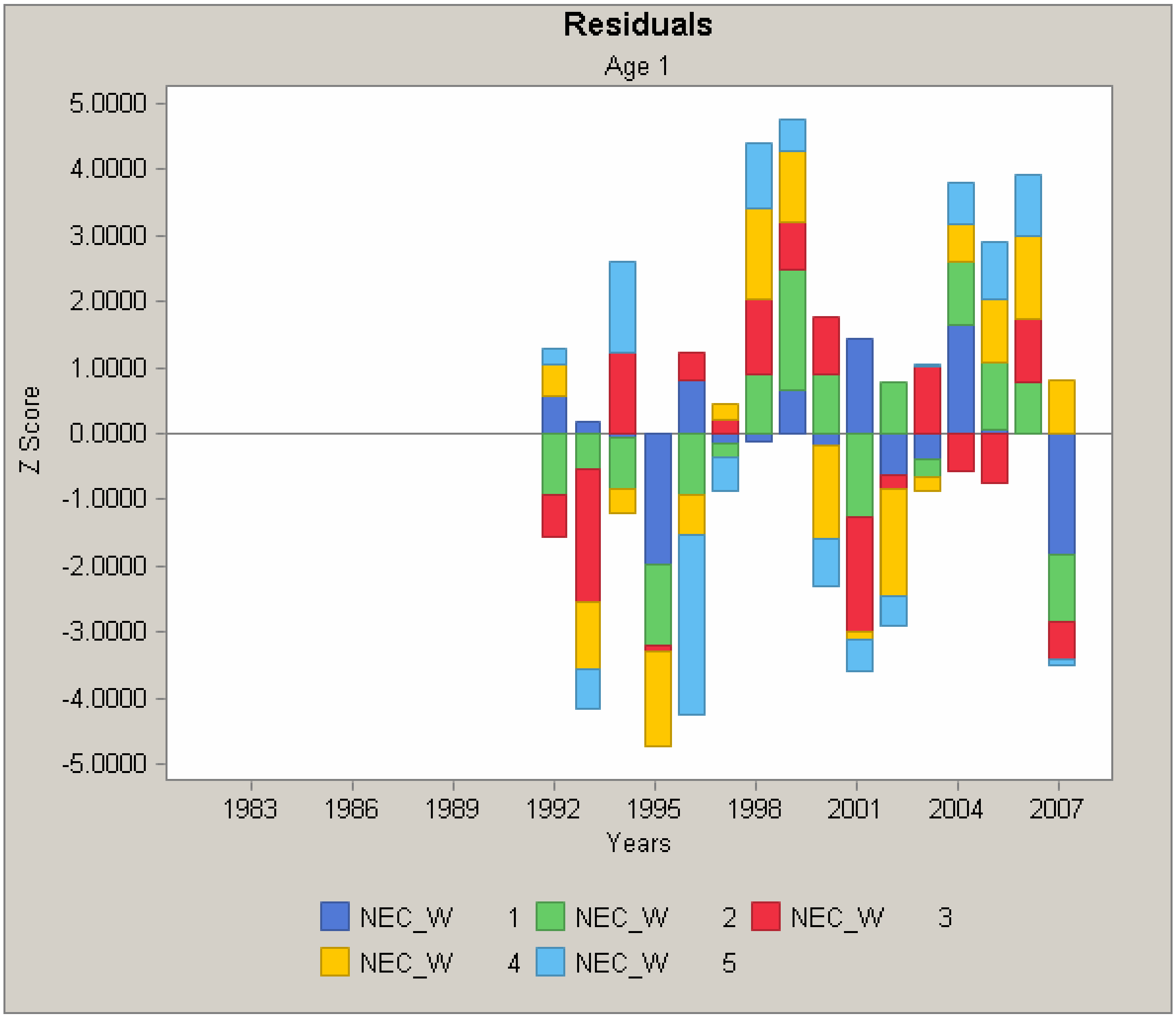


Figure 3. GARM3 ADAPT VPA BASE run survey index combined residuals:
NEFSC Winter Survey ages 1-5.

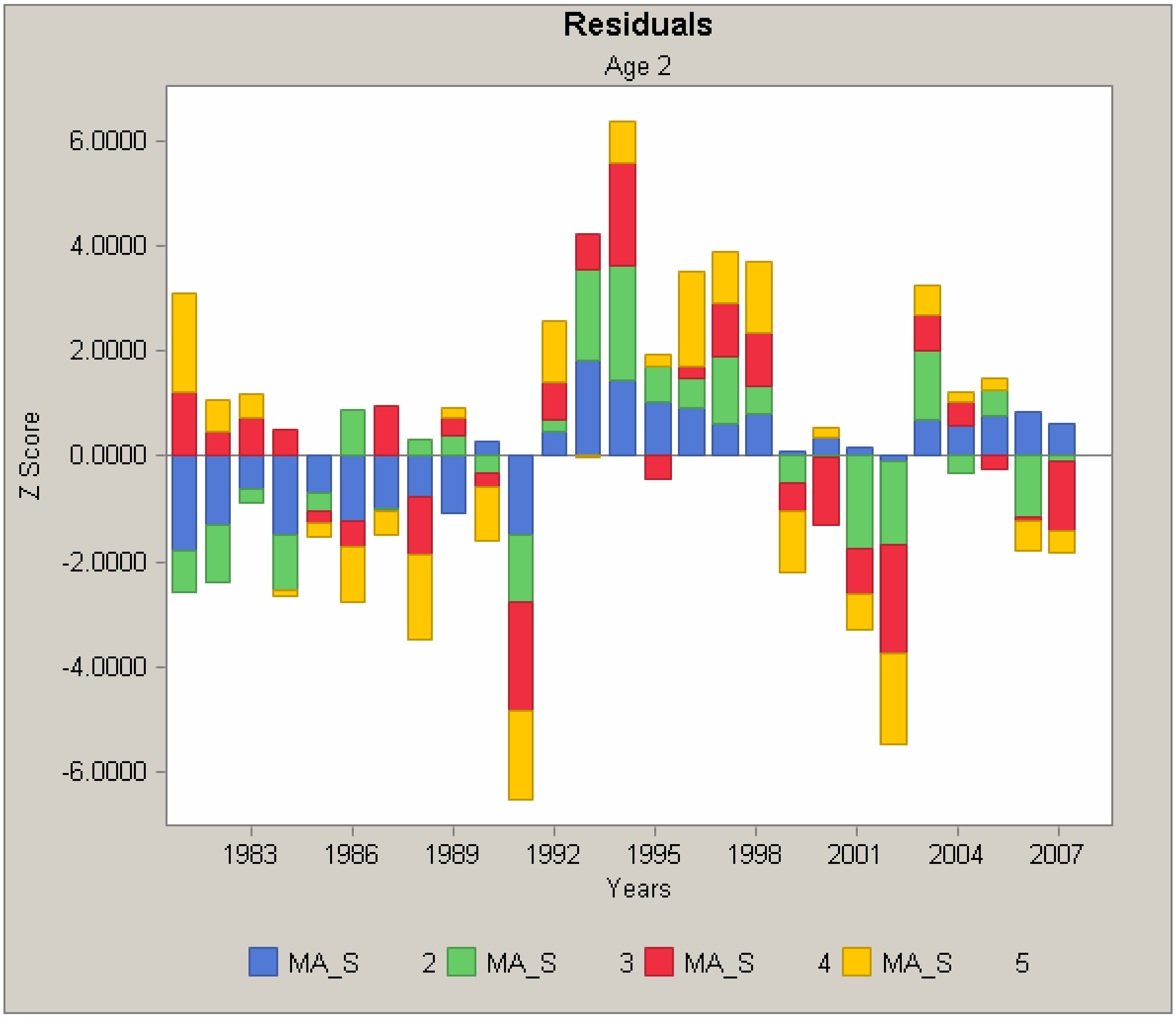


Figure 4. GARM3 ADAPT VPA BASE run survey index combined residuals:
MADMF Spring Survey ages 2-5.

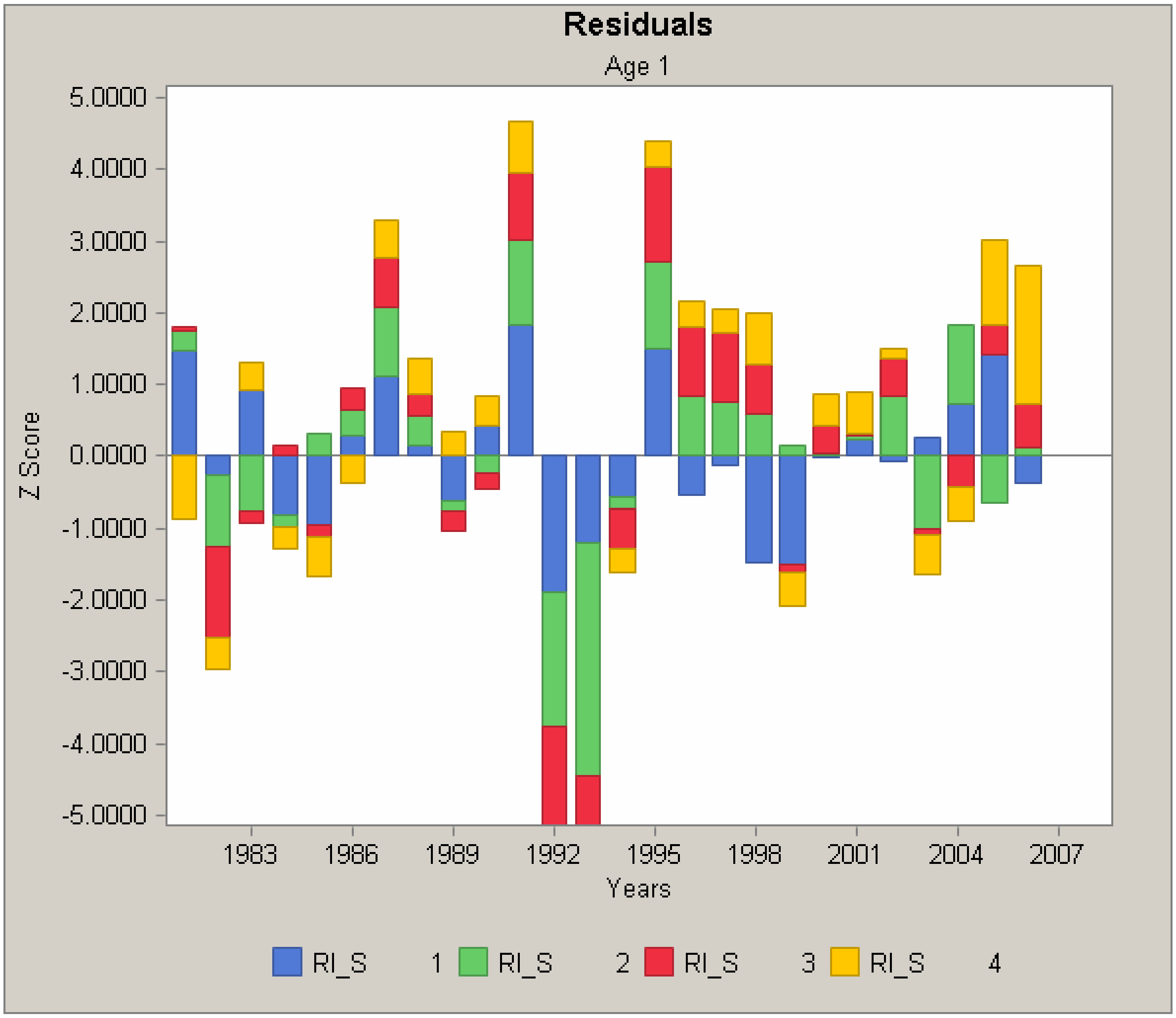


Figure 5. GARM3 ADAPT VPA BASE run survey index combined residuals:
RIDFW Spring Survey ages 1-4.

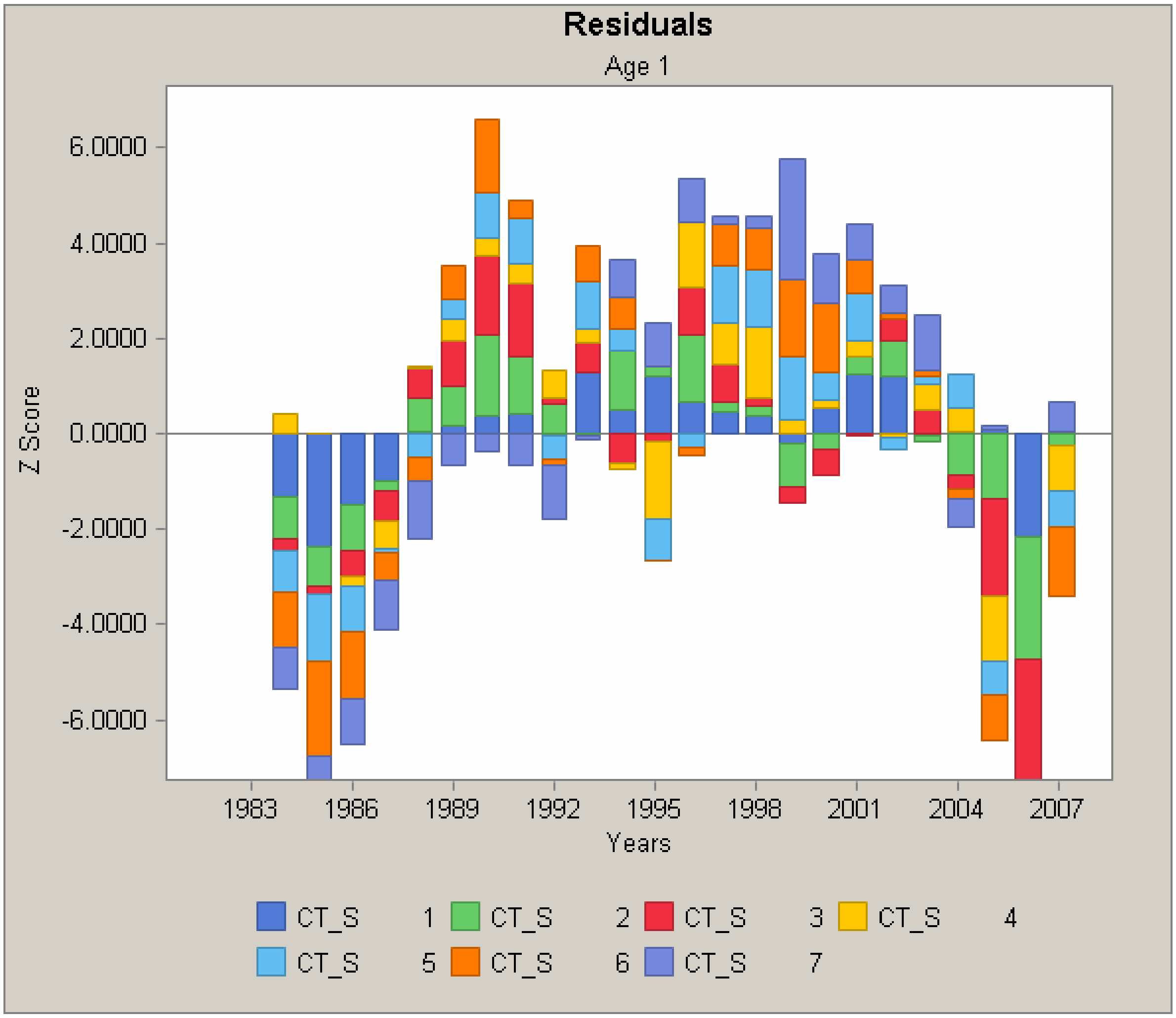


Figure 6. GARM3 ADAPT VPA BASE run survey index combined residuals:
CTDEP Spring Survey ages 1-7.

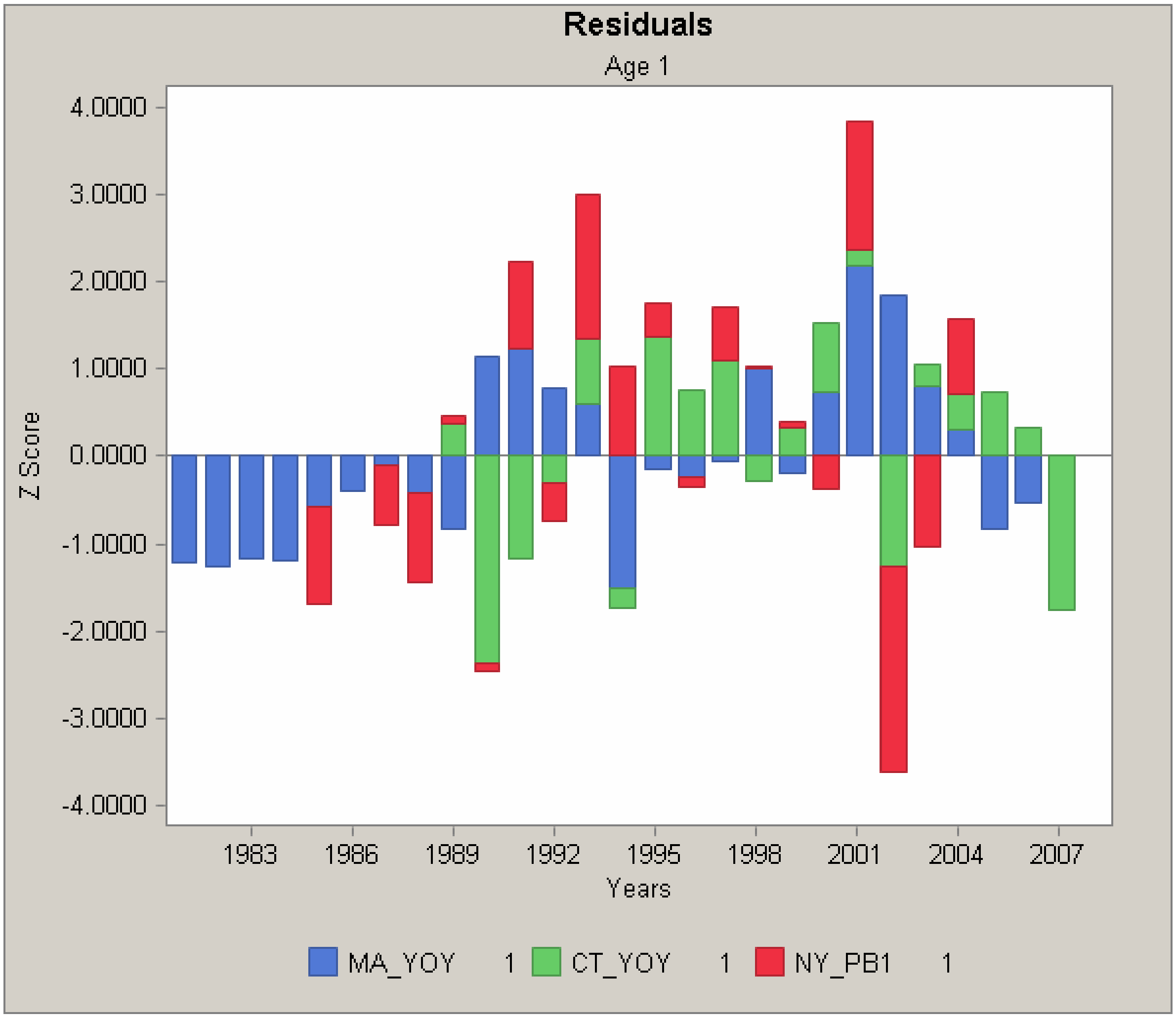


Figure 7. GARM3 ADAPT VPA BASE run survey index combined residuals: MADMF, CTDEP, and NYDEC age 1 indices (recruitment indices).

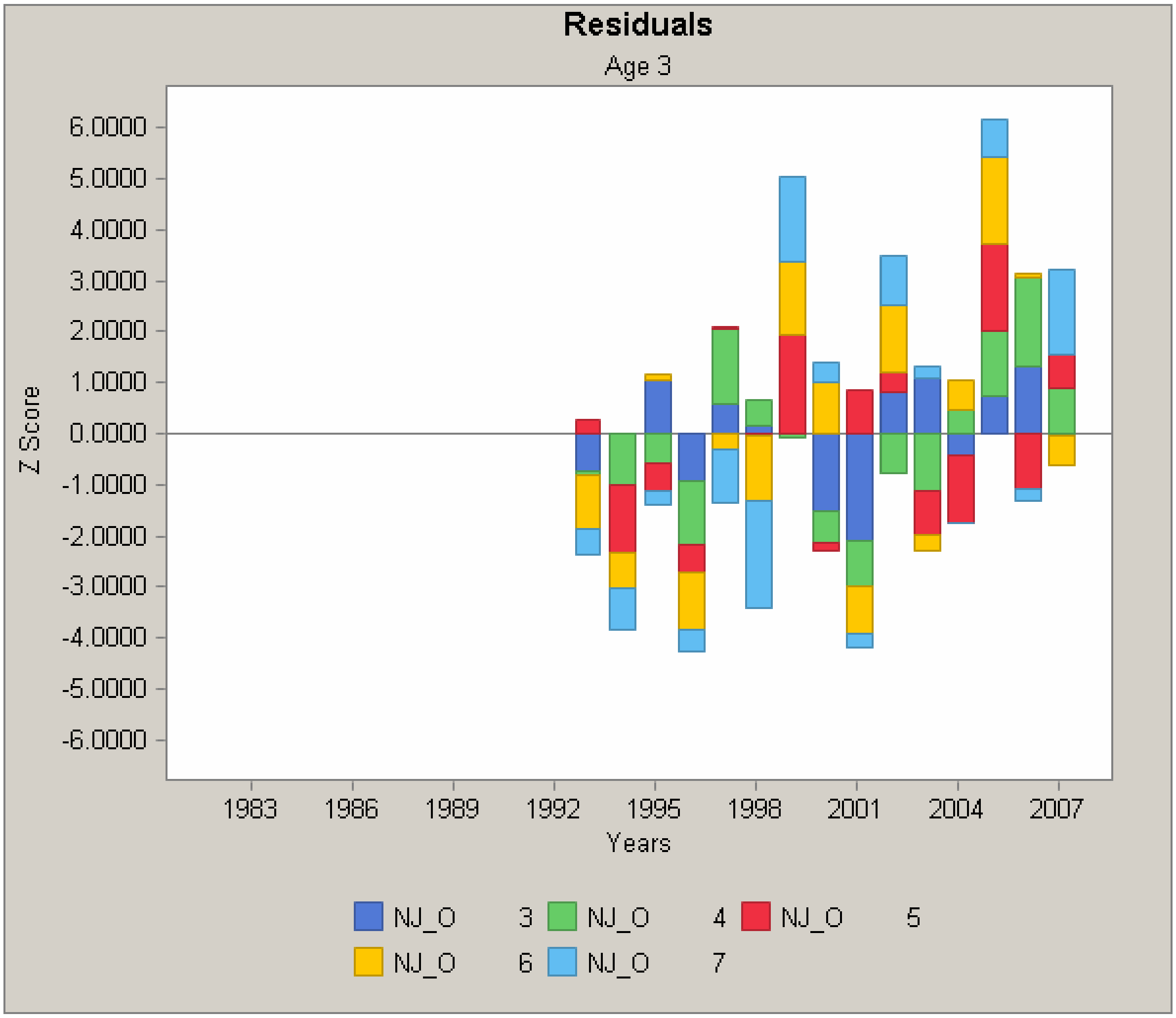


Figure 8. GARM3 ADAPT VPA BASE run survey index combined residuals: NJDFW Ocean survey ages 3-7.

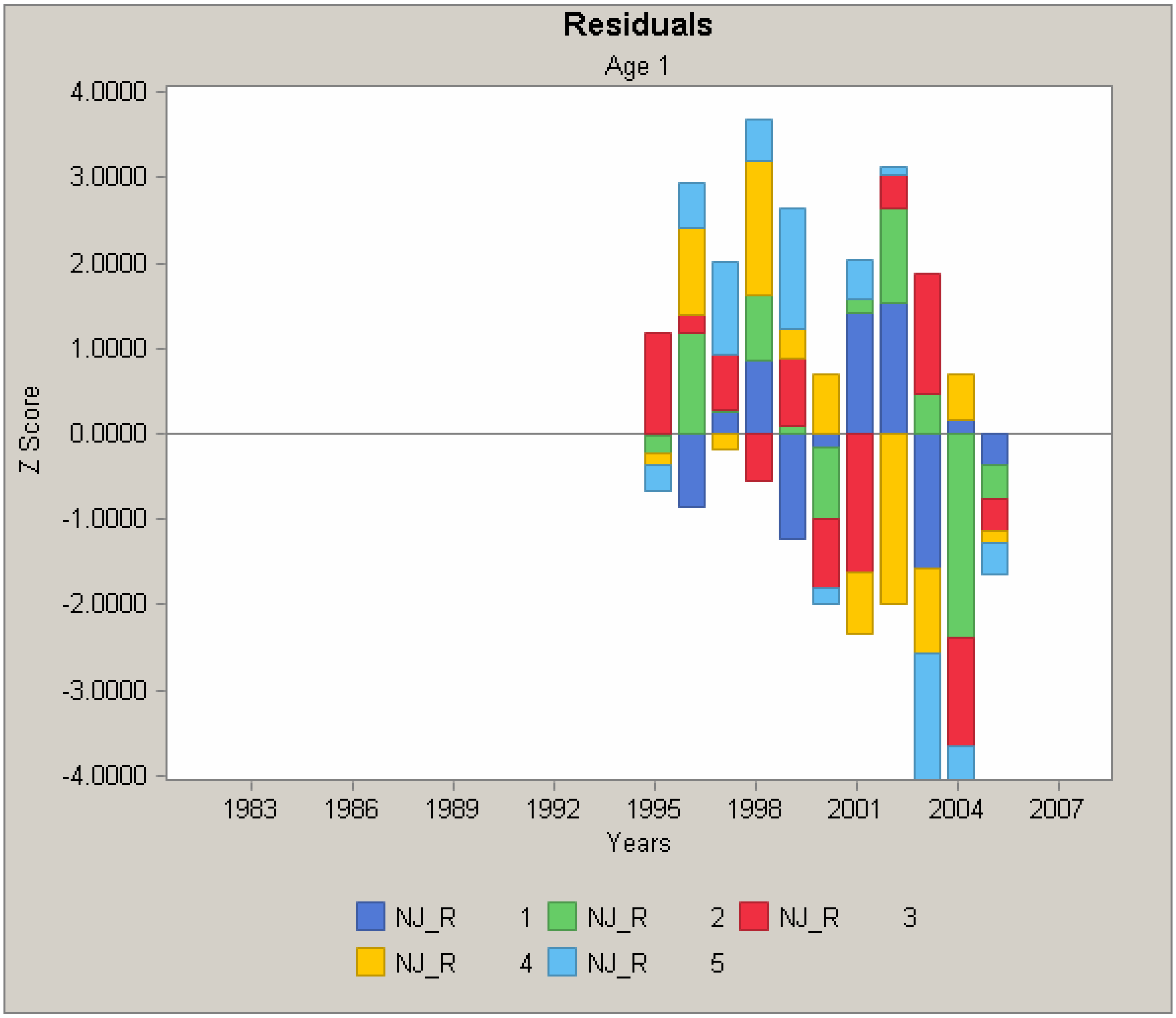


Figure 9. GARM3 ADAPT VPA BASE run survey index combined residuals:
NJDFW Rivers survey ages 3-7.

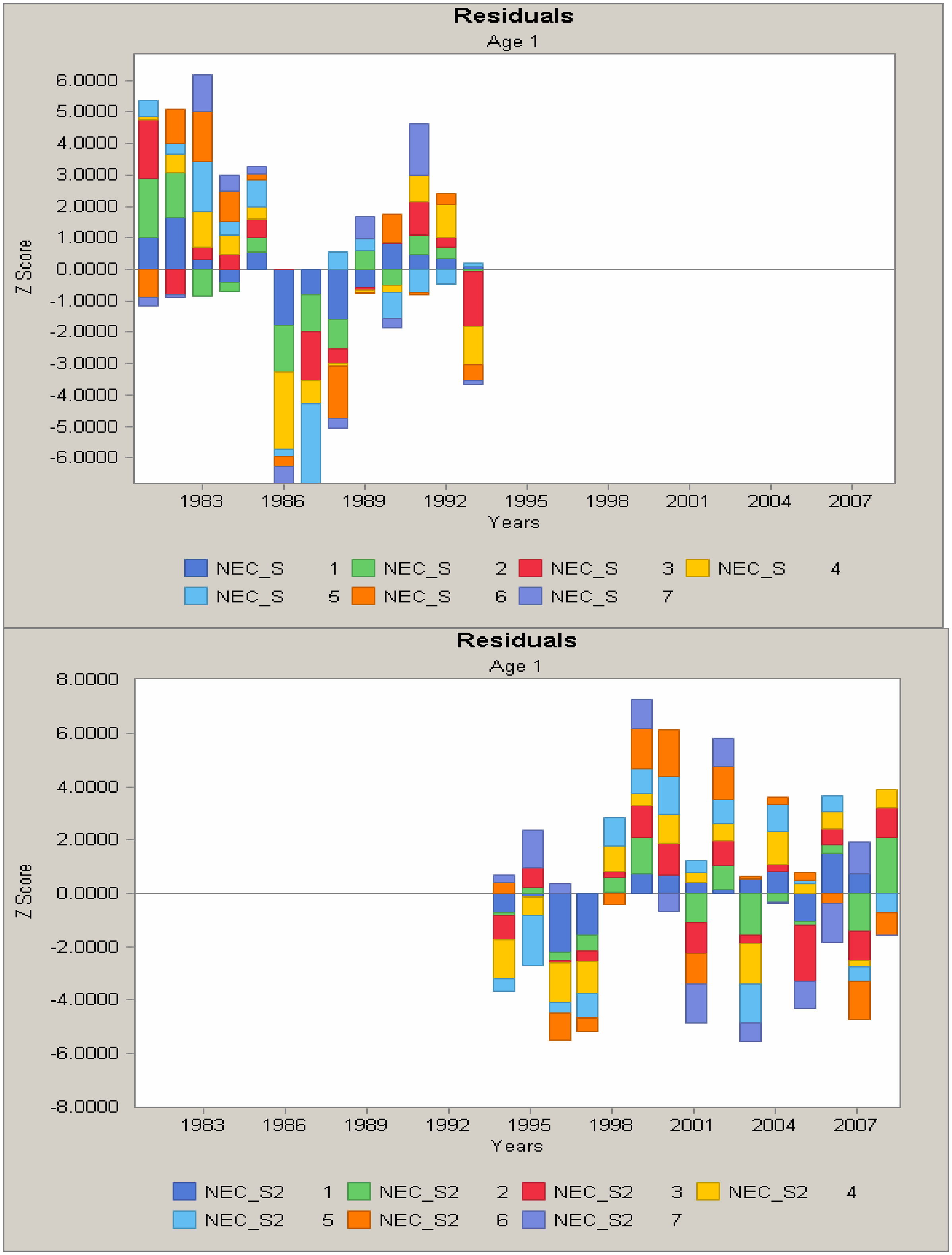


Figure 10. GARM3 ADAPT VPA SPLIT run survey index combined residuals: NEFSC Spring Survey ages 1-7.

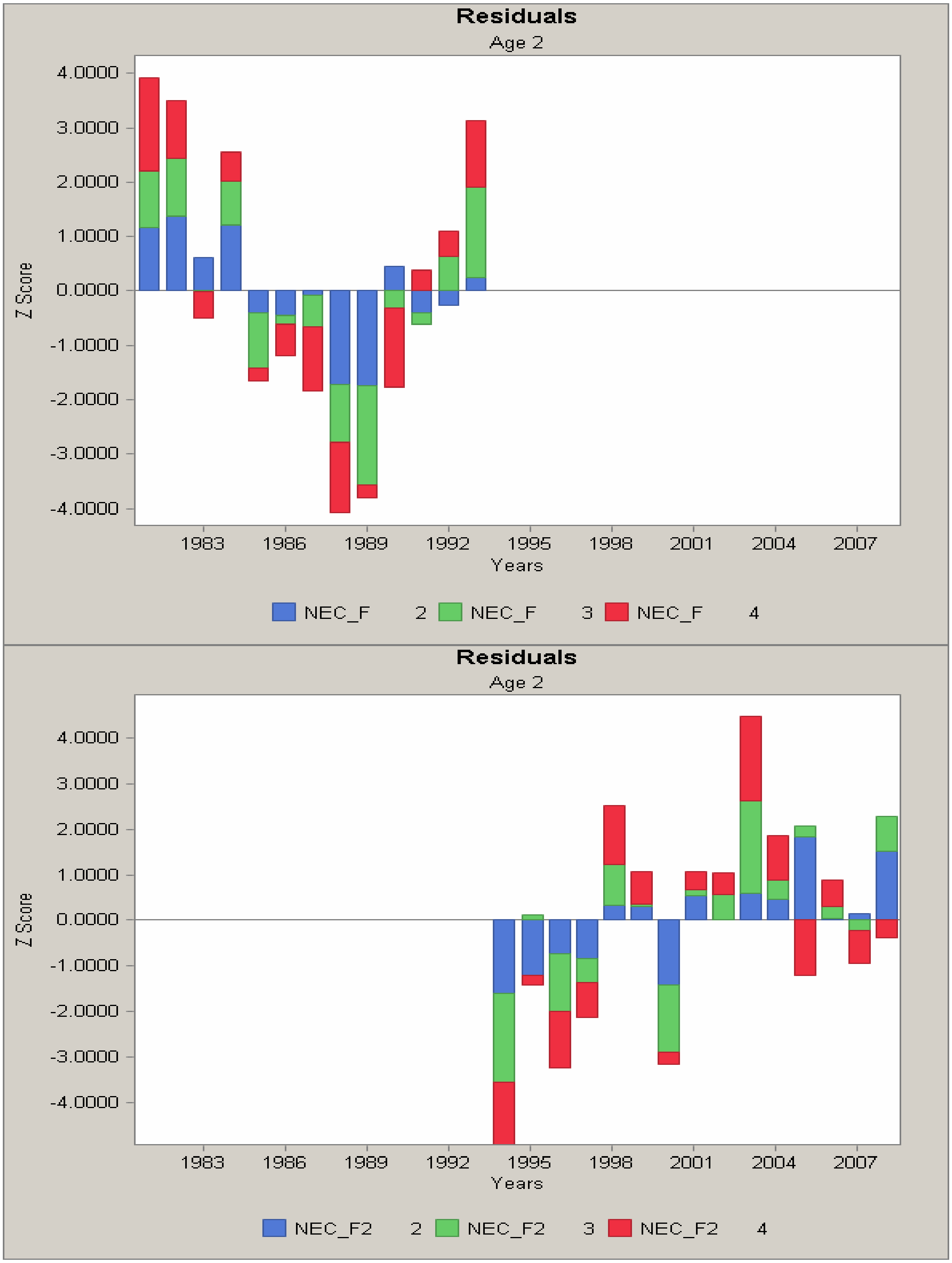


Figure 11. GARM3 ADAPT VPA SPLIT run survey index combined residuals:
NEFSC Fall Survey ages 2-4.

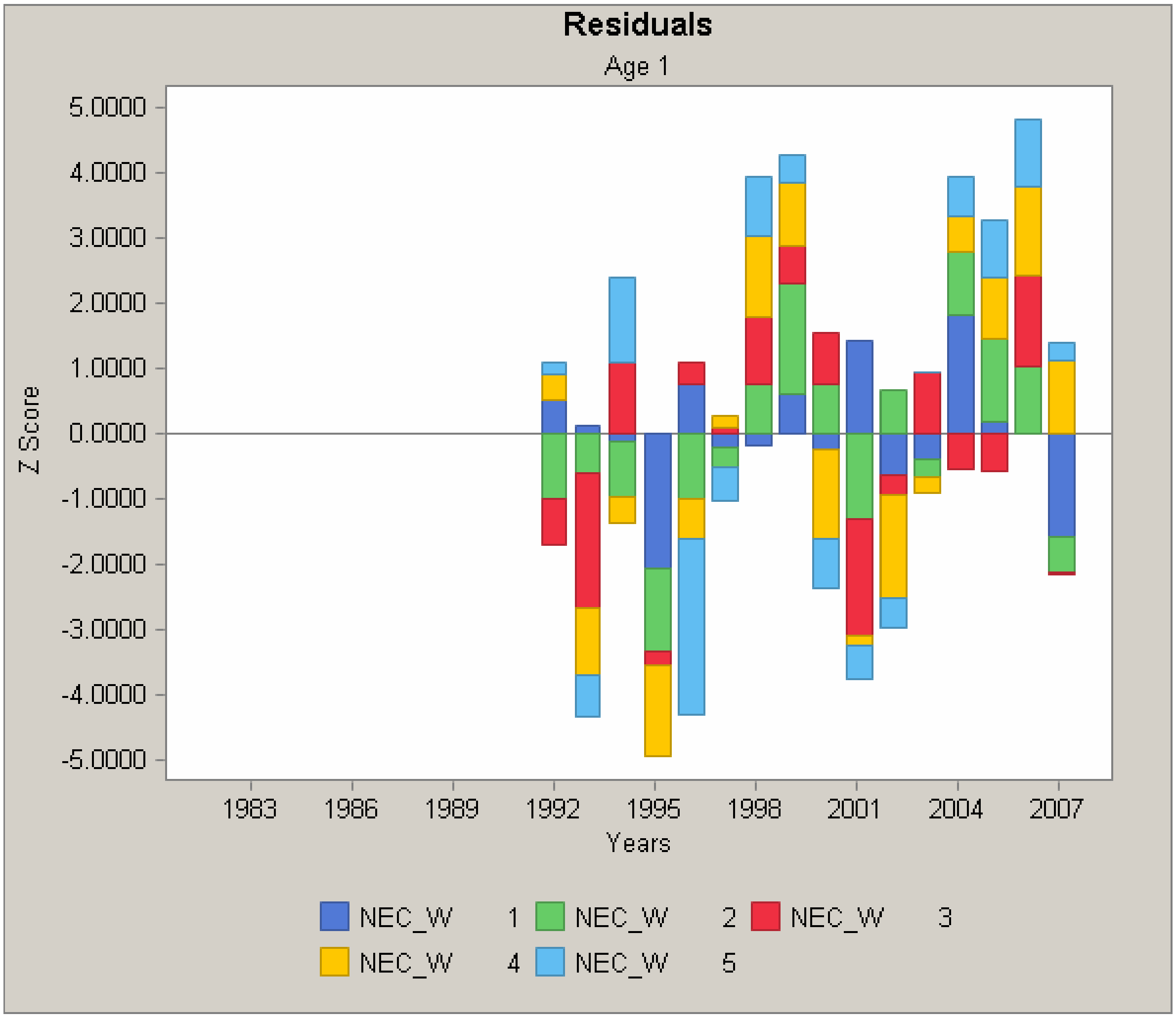


Figure 12. GARM3 ADAPT VPA SPLIT run survey index combined residuals:
NEFSC Winter Survey ages 1- 5.

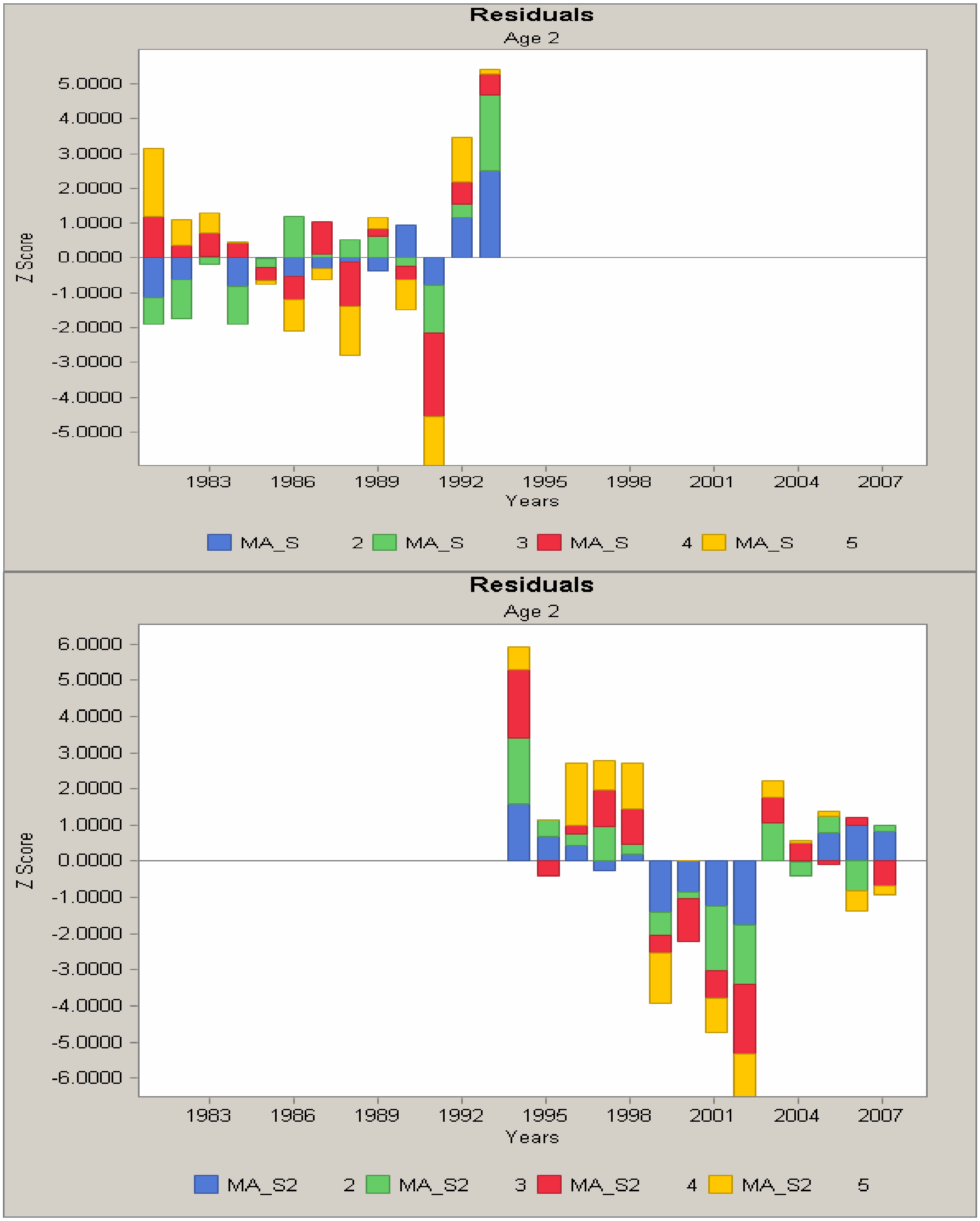


Figure 13. GARM3 ADAPT VPA SPLIT run survey index combined residuals:
MADMF Spring Survey ages 2-5 .

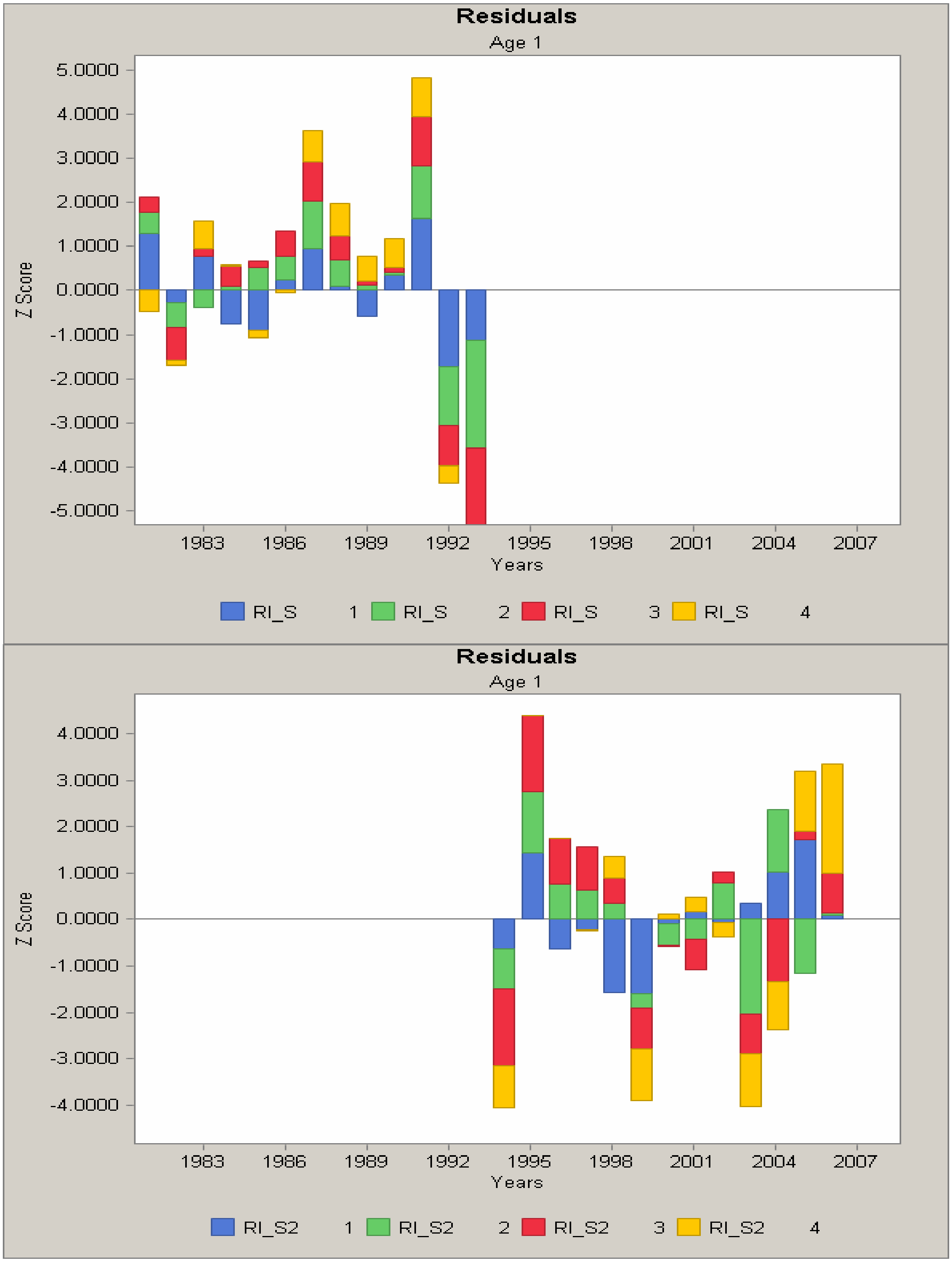


Figure 14. GARM3 ADAPT VPA SPLIT run survey index combined residuals:
RIDFW Spring Survey ages 1-4 .

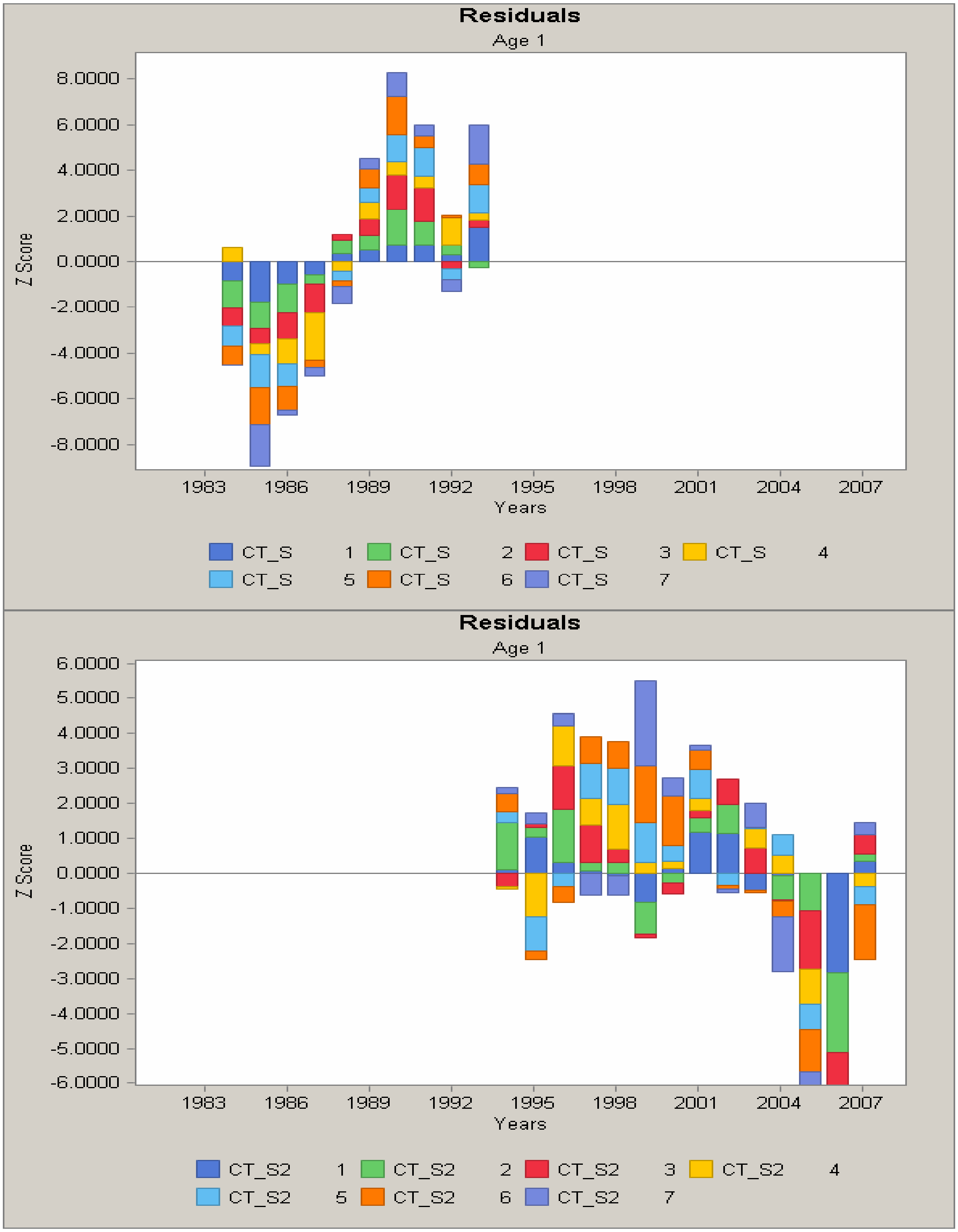


Figure 15. GARM3 ADAPT VPA SPLIT run survey index combined residuals:
CTDEP Spring Survey ages 1-4.

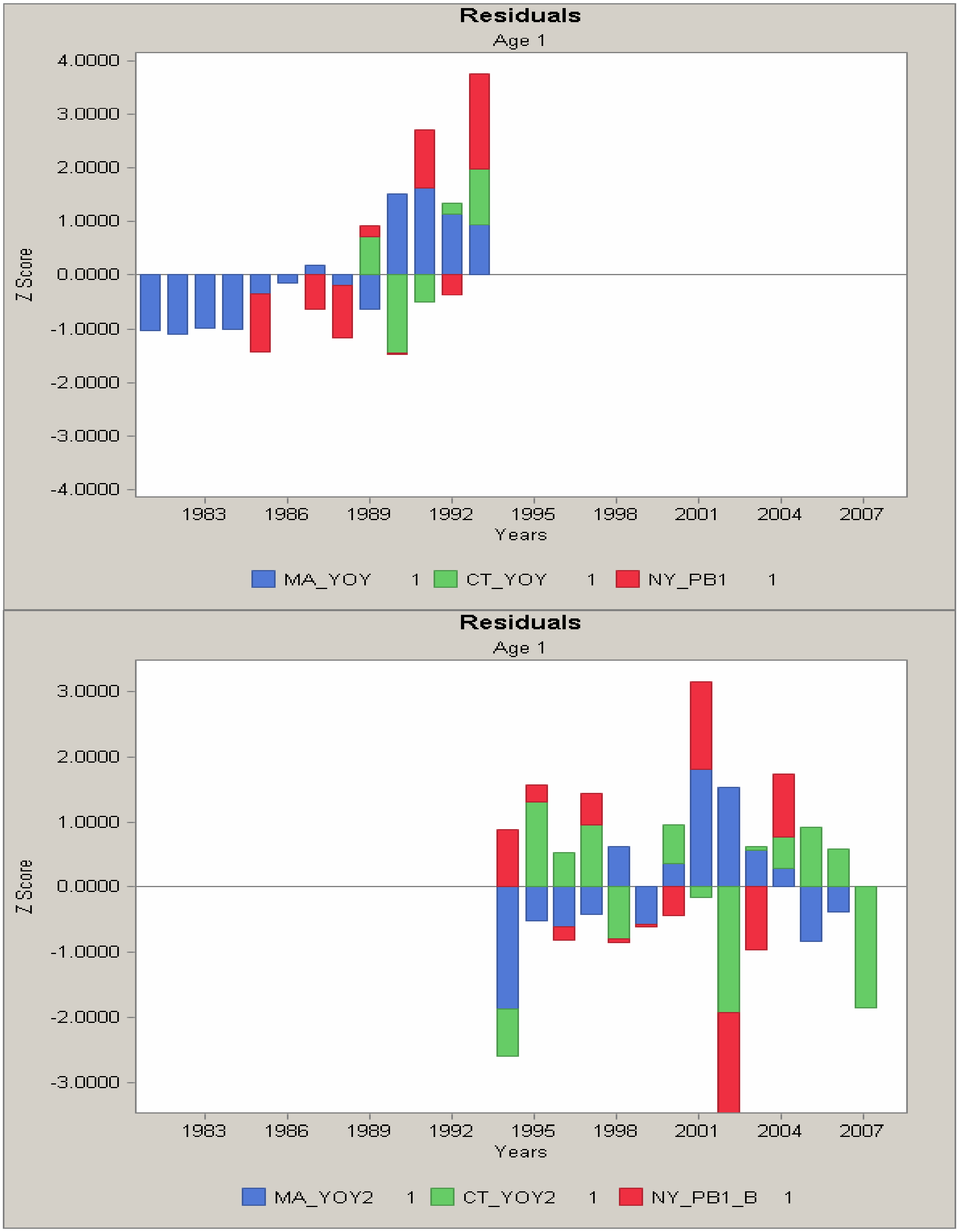


Figure 16. GARM3 ADAPT VPA PLIT run survey index combined residuals:
MADMF, CTDEP, and NYDEC age 1 indices (recruitment indices).

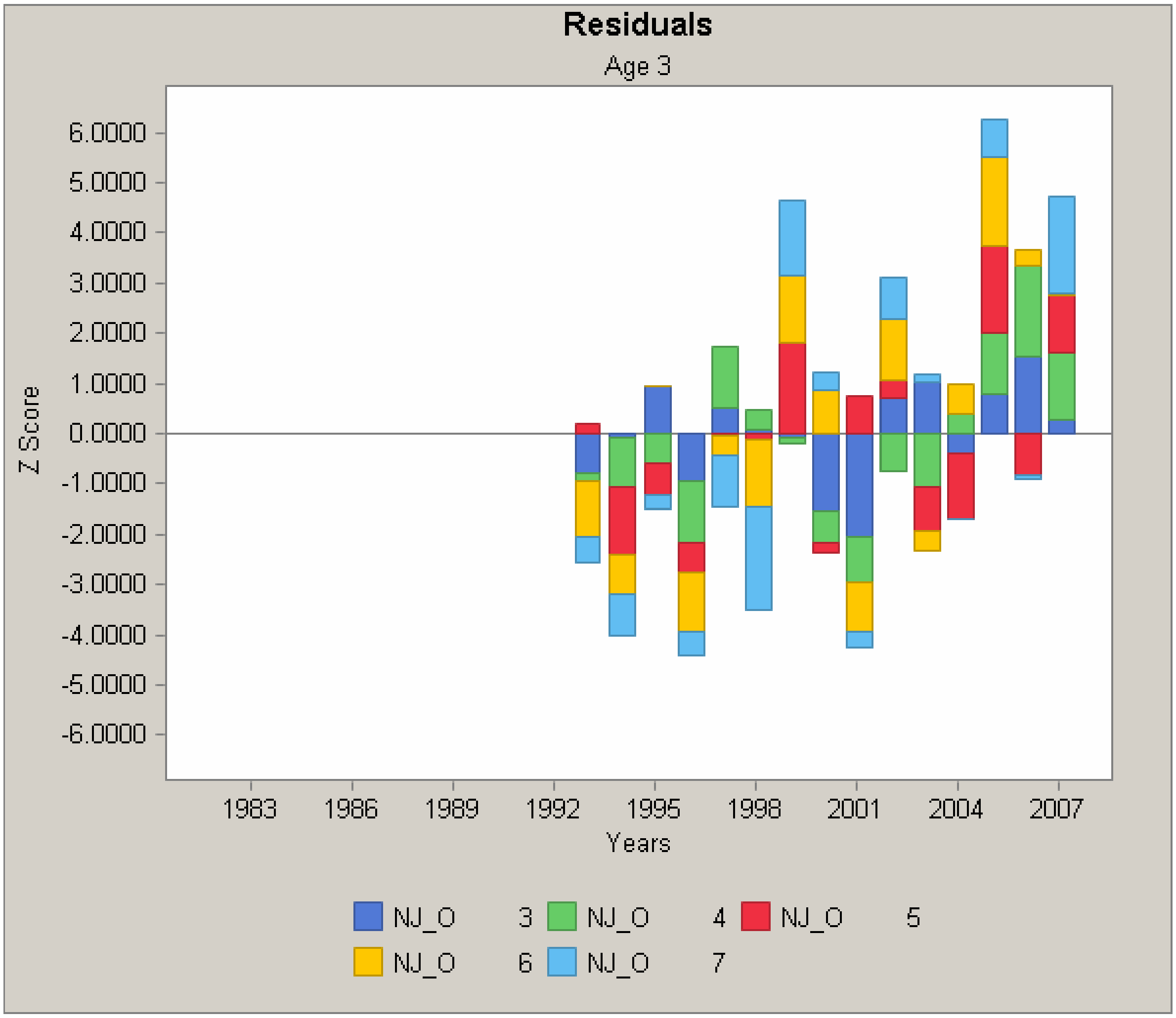


Figure 17. GARM3 ADAPT VPA SPLIT run survey index combined residuals: NJDFW Ocean survey ages 3-7.

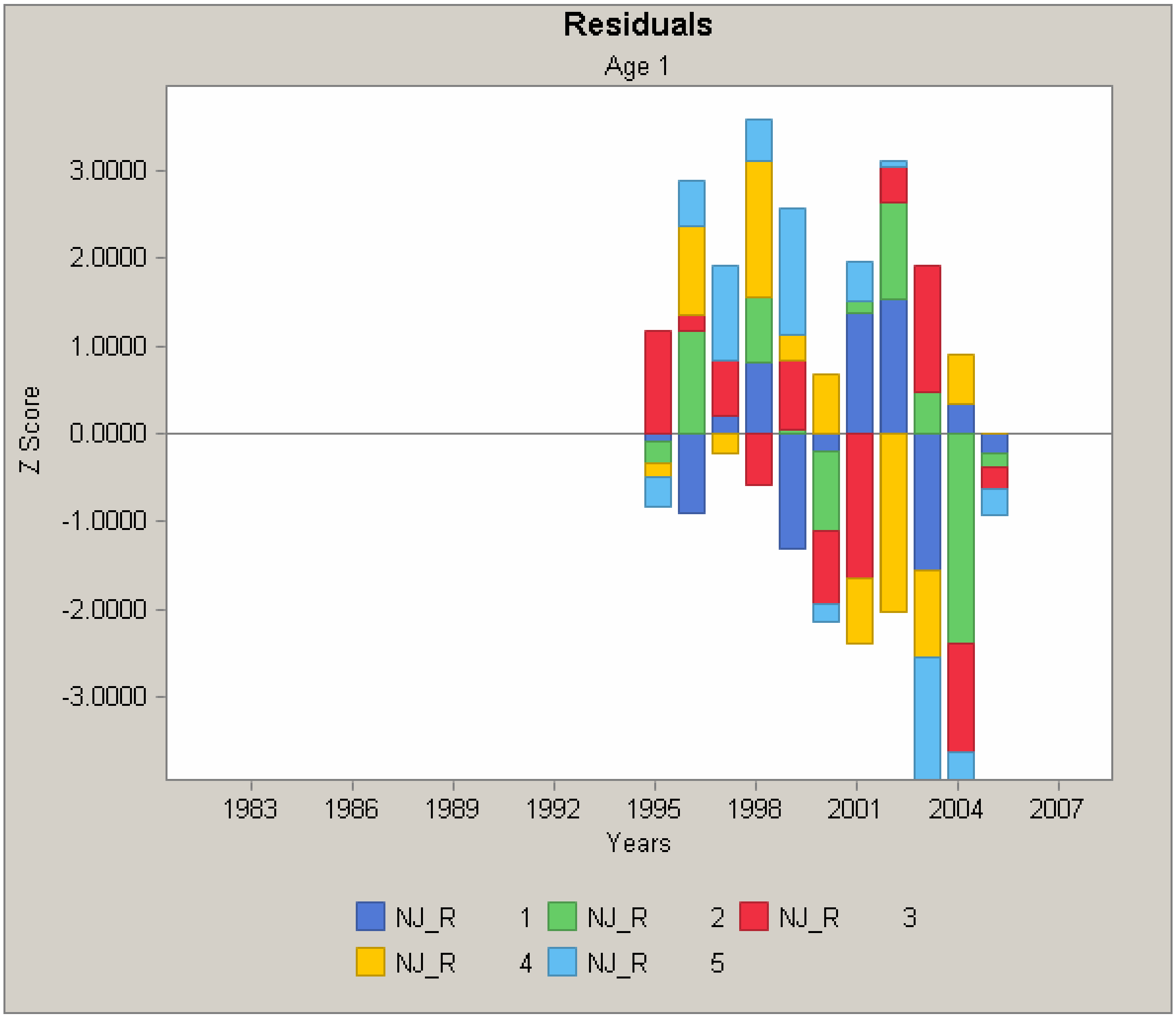


Figure 18. GARM3 ADAPT VPA SPLIT run survey index combined residuals:
NJDFW Rivers survey ages 1-5.

## **Appendix K. Georges Bank winter flounder** by Lisa Hendrickson

Table K1. Number of observed trips, by fleet and quarter, included in the discard estimates of GB winter flounder, 1989-2007.

| | Large mesh otter trawl | | | | | Small mesh groundfish otter trawl | | | | | Scallop dredge/otter trawl | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | Q1 | Q2 | Q3 | Q4 | Total | Q1 | Q2 | Q3 | Q4 | Total | Q1 | Q2 | Q3 | Q4 | Total |
| 1989 | 2 | 8 | 3 | 4 | 17 | | 3 | 10 | 2 | 15 | | | | | 0 |
| 1990 | 4 | 3 | 4 | 2 | 13 | | 2 | 6 | | 8 | | | | | 0 |
| 1991 | 8 | 1 | 1 | 3 | 13 | 1 | | 7 | | 8 | | | | 1 | 1 |
| 1992 | 9 | 4 | | 3 | 16 | | | 5 | 1 | 6 | 1 | 2 | 1 | 2 | 6 |
| 1993 | 4 | 10 | | 3 | 17 | | | 1 | | 1 | 2 | 2 | 2 | 2 | 8 |
| 1994 | 10 | 6 | 3 | 3 | 22 | | 1 | | 1 | 2 | | 1 | 1 | 3 | 5 |
| 1995 | 18 | 9 | 5 | 5 | 37 | 2 | | 1 | | 3 | 1 | | 2 | | 3 |
| 1996 | 3 | 9 | | 1 | 13 | 1 | 1 | | | 2 | 1 | 1 | 1 | 1 | 4 |
| 1997 | 3 | | 3 | | 6 | | 1 | | | 1 | 1 | 2 | 2 | 1 | 6 |
| 1998 | 3 | | 2 | | 5 | 1 | | | | 1 | | 2 | 1 | 1 | 4 |
| 1999 | | 2 | 2 | 3 | 7 | 1 | | | | 1 | | 4 | 12 | 3 | 19 |
| 2000 | 4 | 2 | 5 | 6 | 17 | 3 | | | 2 | 5 | | 25 | 64 | 90 | 179 |
| 2001 | 8 | 5 | 6 | 7 | 26 | 2 | 3 | 1 | 1 | 7 | 16 | | | | 16 |
| 2002 | 5 | 6 | 15 | 22 | 48 | | 1 | 2 | 4 | 7 | | | 4 | | 4 |
| 2003 | 28 | 33 | 22 | 24 | 107 | 3 | 4 | 5 | 3 | 15 | | | 1 | 1 | 2 |
| 2004 | 32 | 36 | 43 | 43 | 154 | | 5 | 8 | 4 | 17 | 2 | | 3 | 25 | 30 |
| 2005 | 157 | 212 | 82 | 118 | 569 | 19 | 23 | 14 | 23 | 79 | 5 | 3 | 34 | 20 | 62 |
| 2006 | 95 | 87 | 91 | 30 | 303 | 8 | 3 | 4 | 3 | 18 | 6 | 8 | 40 | 14 | 68 |
| 2007 | 51 | 95 | 63 | 93 | 302 | 4 | 5 | 2 | 1 | 12 | 5 | 12 | 31 | 11 | 59 |

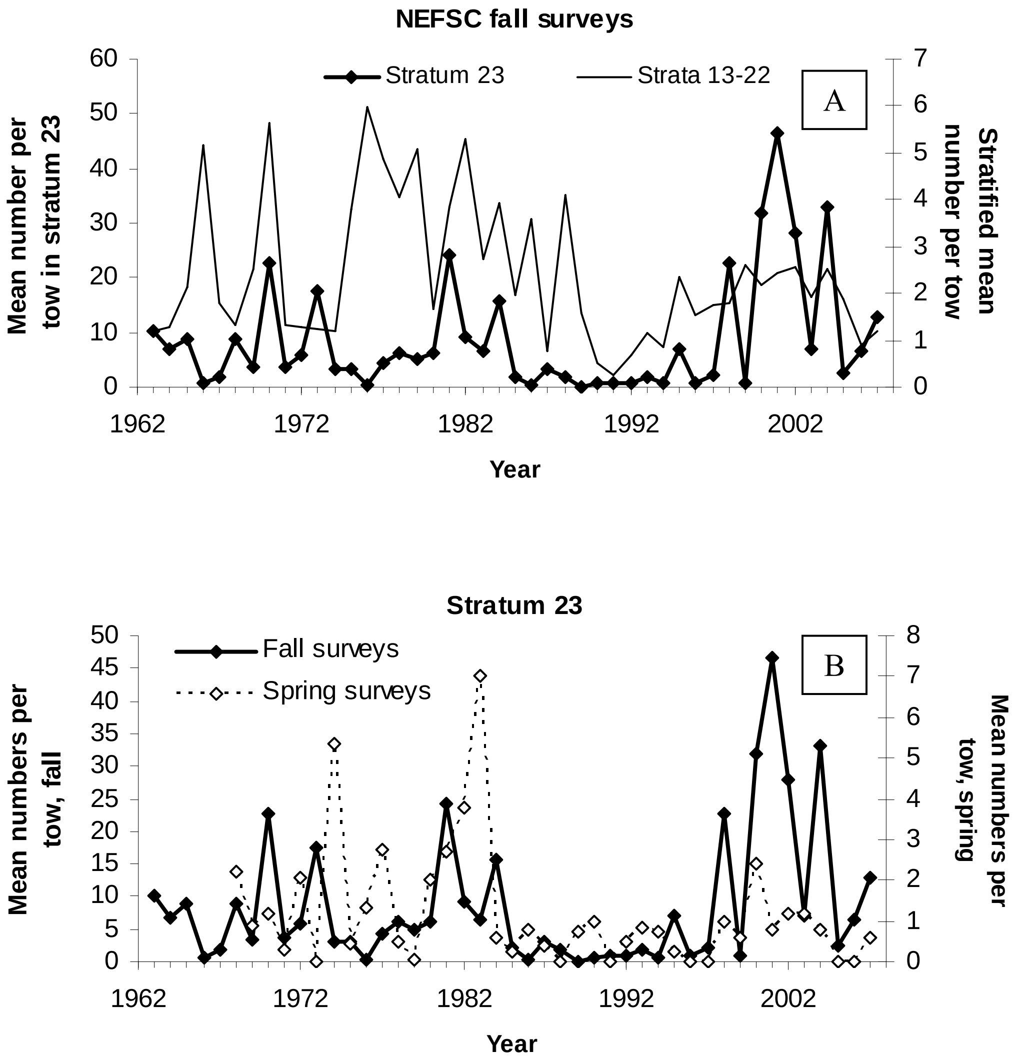


Figure K1. Trends in (A) relative abundance indices for winter flounder caught during NEFSC fall surveys in Georges Bank strata 13-22 versus stratum 23 and (B) relative abundance of winter flounder caught in stratum 23, during NEFSC fall and spring surveys, 1963-2007.

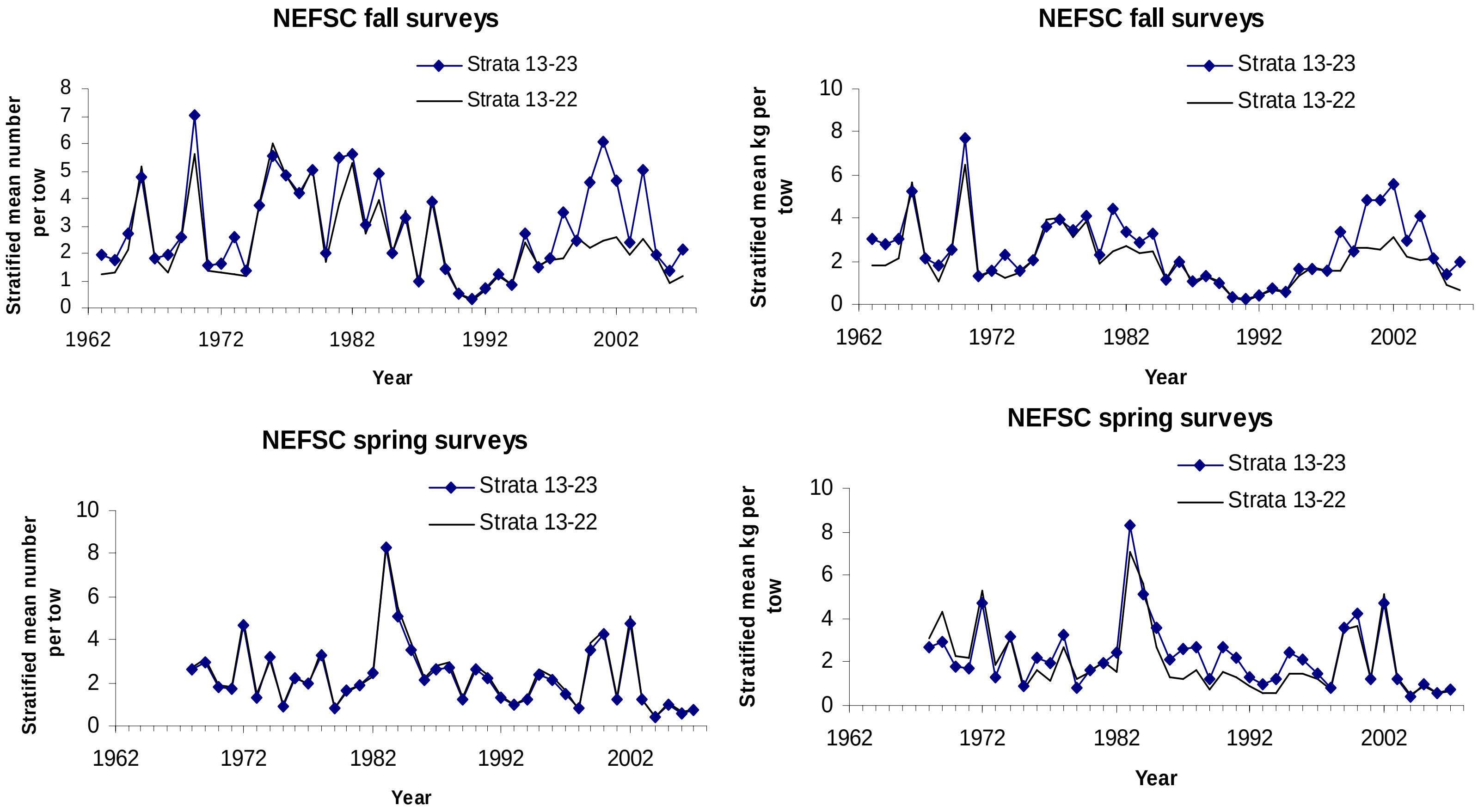


Figure K2. Relative biomass (stratified mean kg per tow) and abundance (stratified mean numbers per tow) indices for Georges Bank winter flounder caught during NEFSC spring (1968-2007) and autumn (1963-2007) bottom trawl surveys. Survey indices were computed using data from strata 13-23 versus strata 13-22 and standardization coefficients for gear changes (weight = 1.86 and numbers = 2.02) and trawl door changes (weight = 1.39 and numbers = 1.46) were applied to all sets of survey indices.

Figure K3. Trends in male and female ages at 50% maturity ($A_{50}$), and 95% confidence intervals, along with sample sizes for Georges Bank winter flounder based on catches from NEFSC spring bottom trawl surveys conducted during 1978-2008.

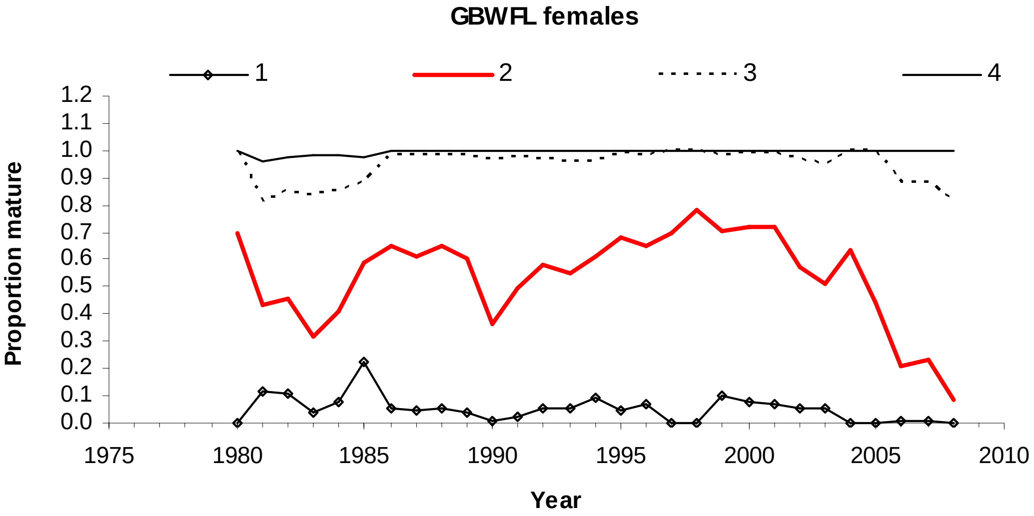


Figure K4. Trends in female proportion mature at age for ages 1-4 winter flounder caught on Georges Bank during NEFSC spring bottom trawl surveys conducted during 1980-2008.

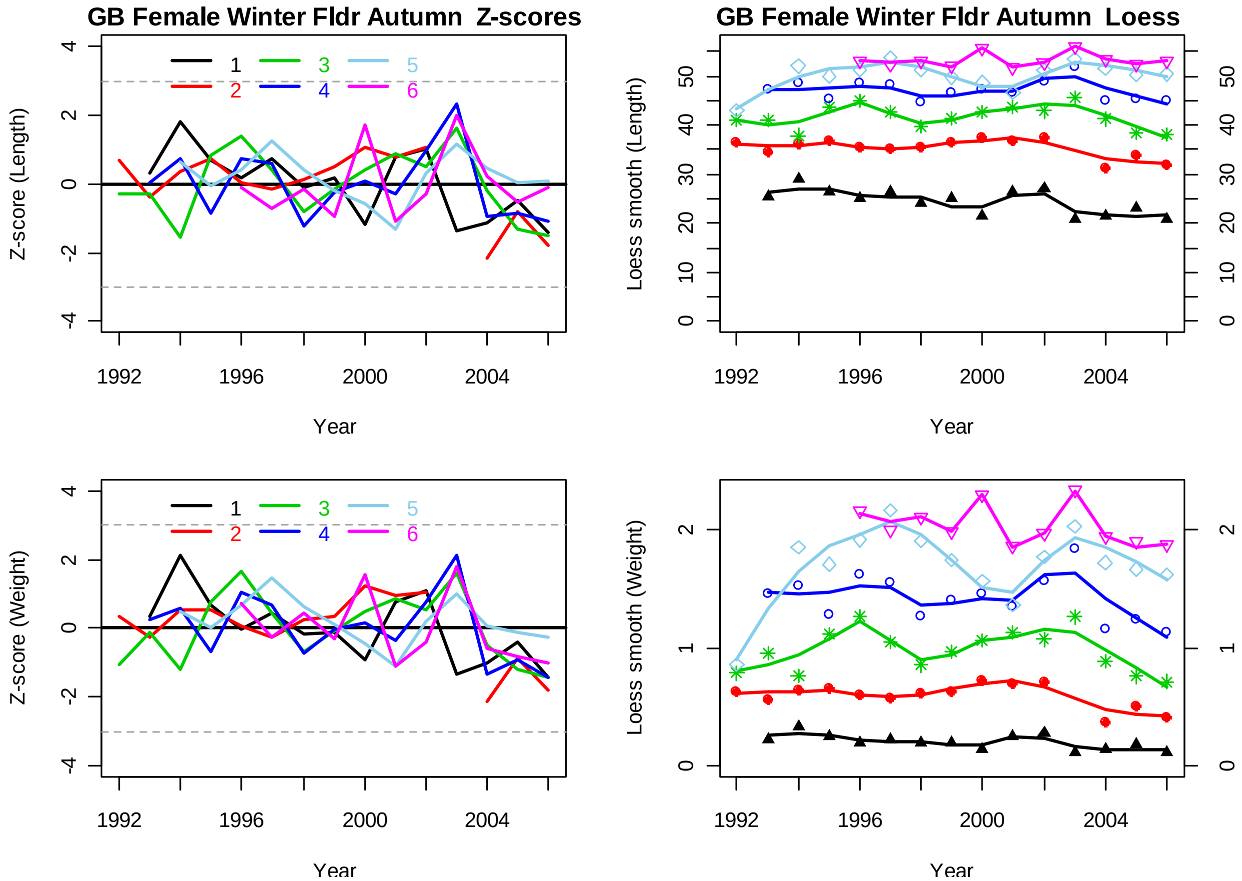


Figure K5. Trends in female mean length and mean weight for ages 1-6 winter flounder caught on Georges Bank during NEFSC fall bottom trawl surveys conducted during 1992-2006.

## Appendix L. Georges Bank/Gulf of Maine white hake

by Katharine Sosebee, Doug Butterworth and Rebecca Rademeyer

This section does not have an appendix. The complete assessment is available in the Report of the 3rd Groundfish Assessment Review Meeting (GARM III), Center Reference Document 08-15.

# Appendix M Pollock

by R Mayo, L Col, M Traver  Catch per tow at age for Pollock in NEFSC spring and autumn bottom trawl surveys.

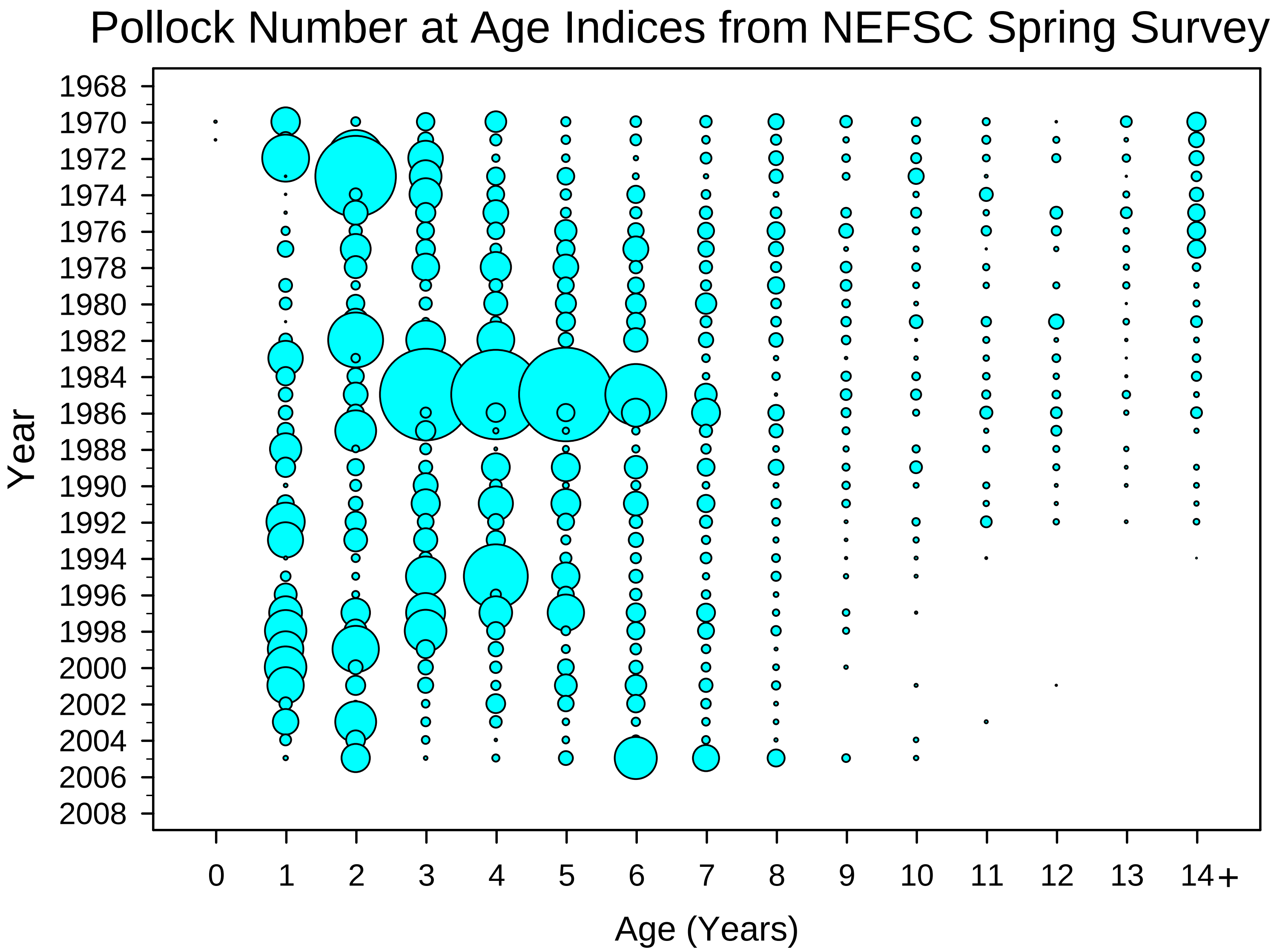
| Spring | Linear | | | Pollock | | | | Age | | ~lcol/survey/Pollock/polindices_agetr.xls | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
| 1970 | 0.0086 | 0.419 | 0.051 | 0.17 | 0.2345 | 0.0554 | 0.0732 | 0.0818 | 0.1324 | 0.0821 | 0.0499 | 0.0364 | 0.0063 | 0.0755 | 0.183 |
| 1971 | 0.0057 | 0.1366 | 0.1125 | 0.1291 | 0.0773 | 0.049 | 0.0727 | 0.0403 | 0.0666 | 0.0243 | 0.0412 | 0.0464 | 0.0277 | 0.0151 | 0.1287 |
| 1972 | 0 | 1.0853 | 1.5422 | 0.6085 | 0.0397 | 0.0418 | 0.0187 | 0.0722 | 0.1158 | 0.0431 | 0.0638 | 0.0352 | 0.0473 | 0.0385 | 0.1194 |
| 1973 | 0 | 0.0057 | 3.0894 | 0.5151 | 0.1722 | 0.1534 | 0.0274 | 0.0173 | 0.1053 | 0.0345 | 0.1306 | 0.0101 | 0 | 0.0055 | 0.0622 |
| 1974 | 0 | 0.006 | 0.0874 | 0.5265 | 0.1576 | 0.0686 | 0.1618 | 0.0528 | 0.0218 | 0 | 0.0245 | 0.1008 | 0 | 0.0299 | 0.1061 |
| 1975 | 0 | 0.0086 | 0.3018 | 0.2062 | 0.3276 | 0.0653 | 0.08 | 0.0918 | 0.0742 | 0.0606 | 0.0652 | 0.025 | 0.0855 | 0.0737 | 0.1555 |
| 1976 | 0 | 0.0466 | 0.0956 | 0.1571 | 0.1551 | 0.25 | 0.1355 | 0.1452 | 0.1677 | 0.1159 | 0.0355 | 0.0594 | 0.0535 | 0.0245 | 0.1699 |
| 1977 | 0 | 0.1419 | 0.4603 | 0.1975 | 0.0723 | 0.173 | 0.3276 | 0.1349 | 0.1201 | 0.0145 | 0.0214 | 0.0043 | 0.0194 | 0.0297 | |
| 1978 | 0 | 0 | 0.2605 | 0.3756 | 0.4696 | 0.3292 | 0.0923 | 0.0916 | 0.0668 | 0.0722 | 0.0423 | 0.0321 | 0 | 0.024 | 0.0414 |
| 1979 | 0 | 0.1025 | 0.0494 | 0.071 | 0.0971 | 0.1455 | 0.1447 | 0.0671 | 0.1508 | 0.0748 | 0.0268 | 0.0257 | 0.0288 | 0.0314 | 0.0202 |
| 1980 | 0 | 0.0861 | 0.171 | 0.0879 | 0.2841 | 0.2226 | 0.2145 | 0.2288 | 0.0616 | 0.044 | 0.0155 | 0 | 0 | 0.0044 | 0.0303 |
| 1981 | 0 | 0.0051 | 0.3445 | 0.0385 | 0.0664 | 0.1849 | 0.1772 | 0.0784 | 0.0615 | 0.0603 | 0.0975 | 0.06 | 0.1199 | 0.026 | 0.075 |
| 1982 | 0 | 0.0994 | 1.4502 | 0.7482 | 0.6801 | 0.1214 | 0.2943 | 0.1227 | 0.1082 | 0.0494 | 0.008 | 0.0277 | 0.0145 | 0.0082 | 0.0224 |
| 1983 | 0 | 0.6007 | 0.0497 | 0.0224 | 0.0205 | 0.0036 | 0 | 0.0416 | 0.0189 | 0.009 | 0.0139 | 0.025 | 0.0436 | 0.0055 | 0.0423 |
| 1984 | 0 | 0.1832 | 0.152 | 0.1206 | 0.1092 | 0.1498 | 0.0759 | 0.0332 | 0.0383 | 0.0585 | 0.0409 | 0.0336 | 0.0247 | 0.0075 | 0.0565 |
| 1985 | 0 | 0.1113 | 0.2993 | 3.9476 | 3.7598 | 4.1374 | 1.7813 | 0.2464 | 0.0086 | 0.0747 | 0.0675 | 0.0479 | 0.0443 | 0.0393 | 0.0214 |
| 1986 | 0 | 0.1141 | 0.1494 | 0.0656 | 0.1902 | 0.1682 | 0.4018 | 0.4063 | 0.1379 | 0.0553 | 0.0302 | 0.09 | 0.0713 | 0.0196 | 0.073 |
| 1987 | 0 | 0.1469 | 0.8294 | 0.2079 | 0.0235 | 0.0325 | 0.0383 | 0.0956 | 0.1037 | 0.0375 | 0 | 0.0189 | 0.0639 | 0 | 0.0178 |
| 1988 | 0 | 0.4955 | 0.0356 | 0.0734 | 0.0117 | 0.0291 | 0.0374 | 0.0592 | 0.0263 | 0.0228 | 0.0376 | 0.0318 | 0.0286 | 0.018 | 0 |
| 1989 | 0 | 0.2045 | 0.152 | 0.1025 | 0.3948 | 0.3992 | 0.2716 | 0.1581 | 0.1302 | 0.0368 | 0.0862 | 0 | 0.0281 | 0.0112 | 0.0223 |
| 1990 | 0 | 0.0142 | 0.0763 | 0.3089 | 0.0837 | 0.0298 | 0.0568 | 0.0358 | 0.0222 | 0.0398 | 0.0213 | 0.0274 | 0.0116 | 0.0104 | 0.0221 |
| 1991 | 0 | 0.1547 | 0.1075 | 0.4132 | 0.5857 | 0.4284 | 0.2992 | 0.1614 | 0.0541 | 0.0411 | 0 | 0.0253 | 0.0129 | 0 | 0.0196 |
| 1992 | 0 | 0.7278 | 0.2214 | 0.1416 | 0.1389 | 0.1529 | 0.0917 | 0.0898 | 0.0385 | 0.0119 | 0.0385 | 0.0719 | 0.0242 | 0.0121 | 0.0262 |
| 1993 | 0 | 0.6247 | 0.2723 | 0.2922 | 0.1835 | 0.0556 | 0.1169 | 0.0468 | 0.0232 | 0.0098 | 0.0232 | 0 | 0 | 0 | 0 |
| 1994 | 0 | 0.0125 | 0.0447 | 0.0912 | 0.1226 | 0.0765 | 0.0665 | 0.0738 | 0.0447 | 0.0077 | 0.0113 | 0.0068 | 0 | 0 | 0.0032 |
| 1995 | 0 | 0.0627 | 0.0349 | 0.7764 | 1.9524 | 0.3867 | 0.1025 | 0.0311 | 0.054 | 0.0195 | 0.0113 | 0 | 0 | 0 | 0 |
| 1996 | 0 | 0.2516 | 0.0352 | 0.0052 | 0.0648 | 0.1416 | 0.0823 | 0.0492 | 0.0199 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1997 | 0 | 0.5384 | 0.4224 | 0.7541 | 0.5494 | 0.6651 | 0.1879 | 0.1783 | 0.0323 | 0.0336 | 0.0075 | 0 | 0 | 0 | 0 |
| 1998 | 0 | 0.8484 | 0.2697 | 0.866 | 0.1725 | 0.053 | 0.1625 | 0.1477 | 0.0584 | 0.0305 | 0 | 0 | 0 | 0 | 0 |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1999 | 0 | 0.6332 | 1.0499 | 0.1803 | 0.123 | 0.0449 | 0.0736 | 0.0488 | 0.0116 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2000 | 0 | 0.8535 | 0.1098 | 0.1216 | 0.0805 | 0.1425 | 0.1024 | 0.0511 | 0.0262 | 0.0142 | 0 | 0 | 0 | 0 | 0 |
| 2001 | 0 | 0.6668 | 0.2016 | 0.1326 | 0.0562 | 0.2597 | 0.2333 | 0.1048 | 0.0466 | 0 | 0.0118 | 0 | 0.005 | 0 | 0 |
| 2002 | 0 | 0.0934 | 0.0265 | 0.0427 | 0.1979 | 0.1349 | 0.1697 | 0.0613 | 0.0152 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2003 | 0 | 0.3387 | 0.8167 | 0.0527 | 0.0826 | 0.0341 | 0.0474 | 0.0408 | 0.0208 | 0 | 0 | 0.0121 | 0 | 0 | 0 |
| 2004 | 0 | 0.0772 | 0.1962 | 0.0426 | 0.0085 | 0.0358 | 0.0578 | 0.0424 | 0.0128 | 0 | 0.0209 | 0 | 0 | 0 | 0 |
| 2005 | 0 | 0.0174 | 0.4148 | 0.0142 | 0.0371 | 0.1133 | 0.8795 | 0.3521 | 0.1578 | 0.0428 | 0.0173 | 0 | 0 | 0 | 0 |

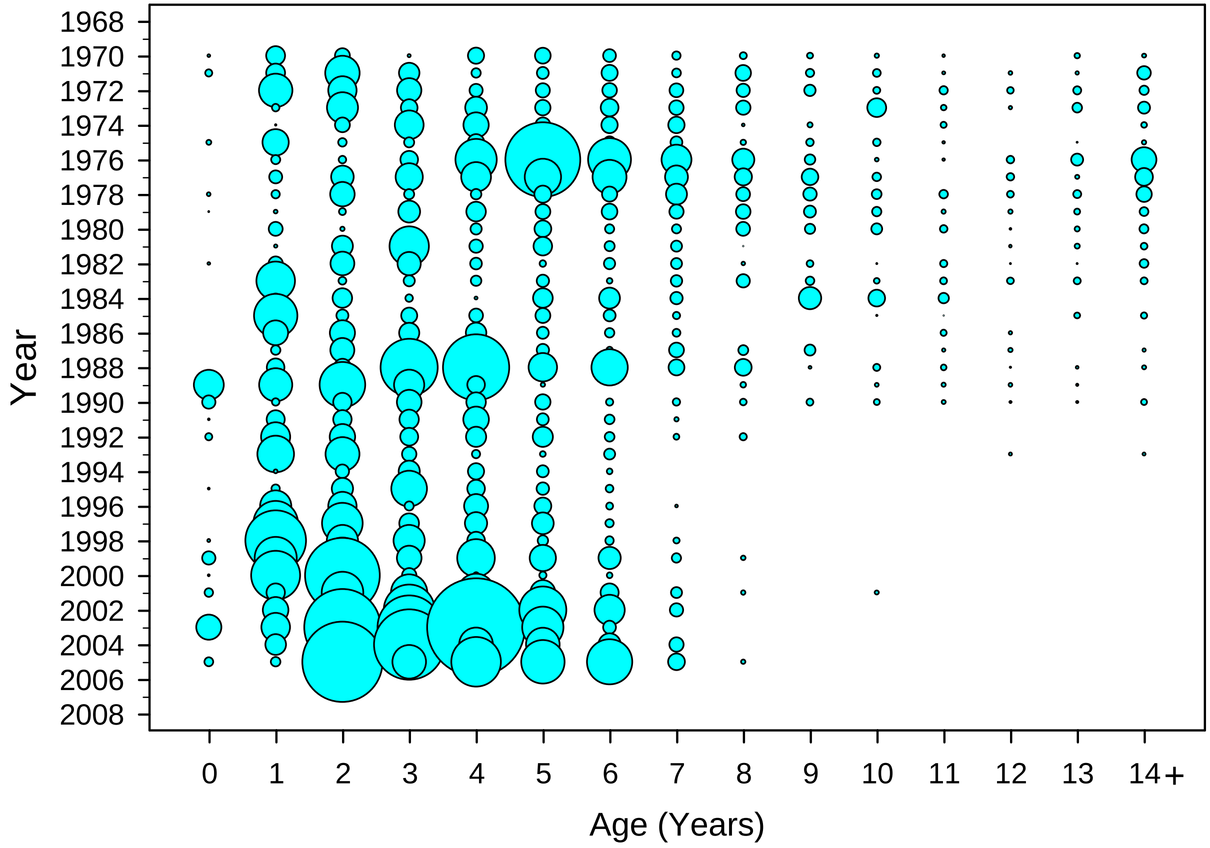
Autumn Linear Pollock Age ~lcol/survey/Pollock/polindices_agetr.xls

| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1970 | 0.006 | 0.131 | 0.0883 | 0.0071 | 0.0991 | 0.0934 | 0.0678 | 0.032 | 0.0232 | 0.0179 | 0.0113 | 0.006 | 0 | 0.0158 | 0.0099 |
| 1971 | 0.0247 | 0.1308 | 0.4066 | 0.1537 | 0.0389 | 0.0597 | 0.0986 | 0.0346 | 0.0947 | 0.0305 | 0.0288 | 0.0074 | 0.0088 | 0.0081 | 0.0744 |
| 1972 | 0 | 0.3839 | 0.2812 | 0.2119 | 0.0683 | 0.0773 | 0.0834 | 0.0757 | 0.0697 | 0.053 | 0.0229 | 0.0312 | 0.0208 | 0.0299 | 0.0392 |
| 1973 | 0 | 0.0276 | 0.3318 | 0.1073 | 0.1711 | 0.0916 | 0.12 | 0.0829 | 0.0792 | 0 | 0.1316 | 0.0168 | 0.0078 | 0.0401 | 0.0592 |
| 1974 | 0 | 0.0029 | 0.0857 | 0.2918 | 0.226 | 0.0864 | 0.1017 | 0.1011 | 0.0058 | 0.0144 | 0 | 0.0203 | 0 | 0 | 0.0171 |
| 1975 | 0.0135 | 0.2487 | 0.0321 | 0.0437 | 0.1051 | 0.0732 | 0.0576 | 0.0571 | 0.0155 | 0.0272 | 0.0254 | 0.0051 | 0 | 0.0025 | 0.0115 |
| 1976 | 0 | 0.0377 | 0.0267 | 0.1149 | 0.5738 | 1.8192 | 0.616 | 0.3119 | 0.174 | 0.0452 | 0.0096 | 0.0051 | 0.026 | 0.0568 | 0.2211 |
| 1977 | 0 | 0.0668 | 0.1853 | 0.2615 | 0.3053 | 0.4529 | 0.4017 | 0.1882 | 0.1132 | 0.1056 | 0.0328 | 0 | 0.0267 | 0.0105 | 0.1213 |
| 1978 | 0.0096 | 0.0316 | 0.2118 | 0.0432 | 0.0457 | 0.1104 | 0.0897 | 0.1592 | 0.0768 | 0.0685 | 0.0416 | 0.0323 | 0.0219 | 0.0293 | 0.0921 |
| 1979 | 0.0025 | 0.0095 | 0.0228 | 0.1713 | 0.1442 | 0.0861 | 0.0949 | 0.0771 | 0.0828 | 0.0599 | 0.0389 | 0.0121 | 0.0119 | 0.0174 | 0.0336 |
| 1980 | 0 | 0.0766 | 0.012 | 0.009 | 0.0515 | 0.1063 | 0.0368 | 0.0371 | 0.0768 | 0.0439 | 0.0503 | 0.0257 | 0.0038 | 0.0147 | 0.0362 |
| 1981 | 0 | 0.0081 | 0.1607 | 0.5275 | 0.0722 | 0.1283 | 0.0426 | 0.0495 | 0.0013 | 0.0006 | 0 | 0 | 0.0057 | 0.0143 | 0.0226 |
| 1982 | 0.0057 | 0.0783 | 0.2017 | 0.1965 | 0.0562 | 0.0206 | 0.0527 | 0.0499 | 0.0085 | 0.0216 | 0.0025 | 0.025 | 0.0023 | 0.0023 | 0.0347 |
| 1983 | 0 | 0.5078 | 0.0281 | 0.0527 | 0.0456 | 0.0604 | 0.0164 | 0.0533 | 0.0722 | 0.0323 | 0.0164 | 0.0229 | 0.022 | 0.0228 | 0.0228 |
| 1984 | 0 | 0.0363 | 0.1424 | 0.0276 | 0.0066 | 0.1443 | 0.1588 | 0.0612 | 0 | 0.1766 | 0.1081 | 0.0469 | 0 | 0 | 0 |
| 1985 | 0 | 0.6378 | 0.0573 | 0.0957 | 0.0753 | 0.0874 | 0.0589 | 0.0242 | 0 | 0 | 0.0028 | 0.0013 | 0 | 0.0192 | 0.0197 |
| 1986 | 0 | 0.221 | 0.2236 | 0.1494 | 0.1524 | 0.0579 | 0.0379 | 0.0285 | 0 | 0 | 0 | 0.0193 | 0.0082 | 0 | 0 |
| 1987 | 0 | 0.039 | 0.21 | 0.0602 | 0 | 0.0605 | 0.0214 | 0.0869 | 0.0422 | 0.0494 | 0 | 0.0082 | 0.0113 | 0 | 0.0082 |
| 1988 | 0 | 0.1193 | 0.1131 | 1.084 | 1.4345 | 0.2868 | 0.4487 | 0.0976 | 0.1058 | 0.0057 | 0.0234 | 0.0162 | 0.0033 | 0.006 | 0.01 |
| 1989 | 0.3121 | 0.3775 | 0.6935 | 0.321 | 0.1148 | 0.0113 | 0 | 0 | 0.0164 | 0 | 0.0098 | 0.0118 | 0.0098 | 0.005 | 0 |
| 1990 | 0.07 | 0.0254 | 0.1271 | 0.2151 | 0.1396 | 0.0915 | 0.0239 | 0.0262 | 0.0226 | 0.0227 | 0.0192 | 0.0101 | 0.005 | 0.005 | 0.0192 |
| 1991 | 0.0036 | 0.1228 | 0.1255 | 0.1365 | 0.2313 | 0.0574 | 0.0397 | 0.0113 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1992 | 0.024 | 0.2958 | 0.2318 | 0.1198 | 0.1486 | 0.1496 | 0.0395 | 0.0175 | 0.0243 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1993 | 0 | 0.4554 | 0.3943 | 0.0811 | 0.0313 | 0.0166 | 0.0505 | 0 | 0 | 0 | 0 | 0 | 0.0071 | 0 | 0.0071 |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1994 | 0 | 0.0094 | 0.0727 | 0.1643 | 0.1003 | 0.0589 | 0.0163 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1995 | 0.0041 | 0.0305 | 0.1655 | 0.4329 | 0.1141 | 0.0643 | 0.0288 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1996 | 0 | 0.3433 | 0.2826 | 0.0371 | 0.2063 | 0.1104 | 0.0237 | 0.0057 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1997 | 0 | 0.6759 | 0.5626 | 0.1475 | 0.1775 | 0.1723 | 0.0306 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1998 | 0.0076 | 1.2064 | 0.3386 | 0.3354 | 0.1161 | 0.0468 | 0.0326 | 0.0199 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1999 | 0.07 | 0.6034 | 0.5628 | 0.2154 | 0.4835 | 0.2453 | 0.1825 | 0.0382 | 0.0126 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2000 | 0.0041 | 0.8003 | 1.8248 | 0.0811 | 0.0187 | 0.0247 | 0.0162 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2001 | 0.0325 | 0.1249 | 0.5812 | 0.4545 | 0.4854 | 0.219 | 0.1244 | 0.0497 | 0.0118 | 0 | 0.0099 | 0 | 0 | 0 | 0 |
| 2002 | 0 | 0.236 | 0.1753 | 0.8632 | 0.6586 | 0.7452 | 0.3193 | 0.0711 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2003 | 0.2231 | 0.2901 | 1.9049 | 1.3269 | 3.0857 | 0.5745 | 0.0675 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2004 | 0 | 0.1545 | 0.4166 | 1.6252 | 0.3926 | 0.3879 | 0.1828 | 0.0797 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2005 | 0.0349 | 0.04 | 2.095 | 0.3912 | 0.8209 | 0.6295 | 0.6874 | 0.1076 | 0.0113 | 0 | 0 | 0 | 0 | 0 | 0 |


Pollock Number at Age Indices from NEFSC Spring Survey
Year
1968
1970
1972
1974
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14+
Age (Years)

## Pollock Number at Age Indices from NEFSC Autumn Survey



# Appendix N. Gulf of Maine-Georges Bank Acadian redfish

Timothy J. Miller, Ralph K. Mayo, Michelle L. Traver and Laurel A. Col

The input (*.dat) and output (*.rep) files for the base ASAP model used for assessment of Gulf of Main-Georges Bank Acadian Redfish.

```
# ASAP VERSION 2.0
# c:\work\redfish\garm3\asap_2_0\garm3_final_model_1913_2007\discards_revised_mat_waa\red_1913_2007.dat
#
# ASAP GUI - 15 JAN 2008
#
# Number of Years
95
# First Year
1913
# Number of Ages
26
# Number of Fleets
1
# Number of Selectivity Blocks (sum over all fleets)
1
# Number of Available Indices
2
# Fleet Names
#$trawl
# Index Names
#$fall
#$spring
#
# Natural Mortality Rate Matrix
0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05
0.05  0.05  0.05  0.05  0.05
0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05
0.05  0.05  0.05  0.05  0.05
0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05
0.05  0.05  0.05  0.05  0.05
0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05
0.05  0.05  0.05  0.05  0.05
0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05
0.05  0.05  0.05  0.05  0.05
0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05
0.05  0.05  0.05  0.05  0.05
0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05
0.05  0.05  0.05  0.05  0.05
0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05
0.05  0.05  0.05  0.05  0.05
0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05
0.05  0.05  0.05  0.05  0.05
0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05
0.05  0.05  0.05  0.05  0.05
0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05
0.05  0.05  0.05  0.05  0.05
0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05
0.05  0.05  0.05  0.05  0.05
0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05
0.05  0.05  0.05  0.05  0.05
0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05
0.05  0.05  0.05  0.05  0.05
0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05
0.05  0.05  0.05  0.05  0.05
0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05
0.05  0.05  0.05  0.05  0.05
0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05
0.05  0.05  0.05  0.05  0.05
0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05
0.05  0.05  0.05  0.05  0.05
0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05
0.05  0.05  0.05  0.05  0.05
0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05
0.05  0.05  0.05  0.05  0.05
0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05
0.05  0.05  0.05  0.05  0.05
0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05
0.05  0.05  0.05  0.05  0.05
0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05
0.05  0.05  0.05  0.05  0.05
0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05
0.05  0.05  0.05  0.05  0.05
0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05
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0.05  0.05  0.05  0.05  0.05
0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05
0.05  0.05  0.05  0.05  0.05
```

```
0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05
0.05  0.05  0.05  0.05  0.05
0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05
0.05  0.05  0.05  0.05  0.05
0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05
0.05  0.05  0.05  0.05  0.05
0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05
0.05  0.05  0.05  0.05  0.05
0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05
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0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05
0.05  0.05  0.05  0.05  0.05
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0.05  0.05  0.05  0.05  0.05
0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05
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0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05
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0.05  0.05  0.05  0.05  0.05
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0.05  0.05  0.05  0.05  0.05
0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05
0.05  0.05  0.05  0.05  0.05
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0.05  0.05  0.05  0.05  0.05
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0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05
0.05  0.05  0.05  0.05  0.05
0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05
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0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05
0.05  0.05  0.05  0.05  0.05
0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05
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0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05  0.05
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0.05  0.05  0.05  0.05  0.05
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0.05  0.05  0.05  0.05  0.05
# Fecundity Option
0
# Fraction of year that elapses prior to SSB calculation (0=Jan-1)
0.4
# Maturity Matrix
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0.931361245406288  0.956459992793854  0.978473233070305  0.997733413080289  1.01455002472961  1.02920721967162  1.04196306638365
1.05304992501907
0.00425554399541484  0.0212341297618548  0.0541193750235485  0.101789293594059  0.161112048725549  0.228364263969509
0.300002061570202  0.373017075294653  0.445049553930037  0.514371222740375  0.579806856021414  0.640634384842789
0.696484994217087  0.747253574120542  0.793023491469678  0.834006170338387  0.870494241576283  0.902826311459321
0.931361245406288  0.956459992793854  0.978473233070305  0.997733413080289  1.01455002472961  1.02920721967162  1.04196306638365
1.05304992501907
0.00425554399541484  0.0212341297618548  0.0541193750235485  0.101789293594059  0.161112048725549  0.228364263969509
0.300002061570202  0.373017075294653  0.445049553930037  0.514371222740375  0.579806856021414  0.640634384842789
0.696484994217087  0.747253574120542  0.793023491469678  0.834006170338387  0.870494241576283  0.902826311459321
0.931361245406288  0.956459992793854  0.978473233070305  0.997733413080289  1.01455002472961  1.02920721967162  1.04196306638365
1.05304992501907
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0.00425554399541484  0.0212341297618548  0.0541193750235485  0.101789293594059  0.161112048725549  0.228364263969509
0.300002061570202  0.373017075294653  0.445049553930037  0.514371222740375  0.579806856021414  0.640634384842789
0.696484994217087  0.747253574120542  0.793023491469678  0.834006170338387  0.870494241576283  0.902826311459321
0.931361245406288  0.956459992793854  0.978473233070305  0.997733413080289  1.01455002472961  1.02920721967162  1.04196306638365
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0.300002061570202  0.373017075294653  0.445049553930037  0.514371222740375  0.579806856021414  0.640634384842789
0.696484994217087  0.747253574120542  0.793023491469678  0.834006170338387  0.870494241576283  0.902826311459321
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0.696484994217087  0.747253574120542  0.793023491469678  0.834006170338387  0.870494241576283  0.902826311459321
0.931361245406288  0.956459992793854  0.978473233070305  0.997733413080289  1.01455002472961  1.02920721967162  1.04196306638365
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0.300002061570202  0.373017075294653  0.445049553930037  0.514371222740375  0.579806856021414  0.640634384842789
0.696484994217087  0.747253574120542  0.793023491469678  0.834006170338387  0.870494241576283  0.902826311459321
0.931361245406288  0.956459992793854  0.978473233070305  0.997733413080289  1.01455002472961  1.02920721967162  1.04196306638365
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0.00425554399541484  0.0212341297618548  0.0541193750235485  0.101789293594059  0.161112048725549  0.228364263969509
0.300002061570202  0.373017075294653  0.445049553930037  0.514371222740375  0.579806856021414  0.640634384842789
0.696484994217087  0.747253574120542  0.793023491469678  0.834006170338387  0.870494241576283  0.902826311459321
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0.00425554399541484  0.0212341297618548  0.0541193750235485  0.101789293594059  0.161112048725549  0.228364263969509
0.300002061570202  0.373017075294653  0.445049553930037  0.514371222740375  0.579806856021414  0.640634384842789
0.696484994217087  0.747253574120542  0.793023491469678  0.834006170338387  0.870494241576283  0.902826311459321
0.931361245406288  0.956459992793854  0.978473233070305  0.997733413080289  1.01455002472961  1.02920721967162  1.04196306638365
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0.00425554399541484  0.0212341297618548  0.0541193750235485  0.101789293594059  0.161112048725549  0.228364263969509
0.300002061570202  0.373017075294653  0.445049553930037  0.514371222740375  0.579806856021414  0.640634384842789
0.696484994217087  0.747253574120542  0.793023491469678  0.834006170338387  0.870494241576283  0.902826311459321
0.931361245406288  0.956459992793854  0.978473233070305  0.997733413080289  1.01455002472961  1.02920721967162  1.04196306638365
1.05304992501907
# Selectivity Blocks (fleet outer loop, year inner loop)
# Sel block for fleet 1
1
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1
# Selectivity Options for each block 1=by age, 2=logisitic, 3=double logistic
1
# Selectivity initial guess, phase, lambda, and CV
# (have to enter values for nages + 6 parameters for each block)
# Sel Block 1
1             4             1             0.5
1             4             1             0.5
1             4             1             0.5
1             4             1             0.5
1             4             1             0.5
1             4             1             0.5
1             4             1             0.5
1             4             1             0.5
1             4             1             0.5
1             -1            1             1
1             -1            1             1
1             -1            1             1
1             -1            1             1
1             -1            1             1
1             -1            1             1
1             -1            1             1
1             -1            1             1
1             -1            1             1
1             -1            1             1
1             -1            1             1
1             -1            1             1
1             -1            1             1
1             -1            1             1
1             -1            1             1
1             -1            1             1
1             -1            1             1
3             -1            0             1
1             -1            0             1
3             -1            0             1
1             -1            0             1
8             -1            0             1
1             -1            0             1
# Selectivity Start Age by fleet
```

```
1
# Selectivity End Age by fleet
26
# Age range for average F
1  26
# Average F report option (1=unweighted, 2=Nweighted, 3=Bweighted)
1
# Use likelihood constants? (1=yes)
1
# Release Mortality by fleet
0
# Fleet 1 Catch at Age - Last Column is Total Weight
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
7.24
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
29.8
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
40.23
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
53.17
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
82.48
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
72.98
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
24.8
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
30.67
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
12.54
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
8.6
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
6.92
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
39.74
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
24.77
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
29.76
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
30.06
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
57.07
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
33.85
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
53.8
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
107.62
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
59.94
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
119.89
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
519.0
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
7549.0
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
23162.0
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
14823.0
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
20640.0
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
25406.0
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0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
26762.0
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
50796.0
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
55892.0
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
48348.0
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
50439.0
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
37912.0
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
42423.0
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
40160.0
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
43631.0
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
30743.0
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
34307.0
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
30077.0
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
21377.0
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
16791.0
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
12988.0
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
13914.0
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
14388.0
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
18490.0
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
16047.0
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
15521.0
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
11375.0
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
14101.0
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
14134.0
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
10046.0
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
8313.0
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
8057.0
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
8569.0
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
10864.0
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
6777.0
0.000     0.000     0.000     0.0006     0.0111     0.0115     0.0265     0.1594     0.066     0.1765     0.0699     0.1045
0.0864     0.0584     0.0741     0.0354     0.0197     0.0138     0.0159     0.0112     0.0119     0.0091     0.0123     0.001
0.0026     0.0223     12455.0
0.000     0.000     0.000     0.000     0.0027     0.0741     0.074     0.0194     0.1772     0.0589     0.1526     0.050
0.0859     0.0488     0.0421     0.0638     0.0325     0.030     0.0072     0.0121     0.0067     0.0097     0.0105     0.0089
0.0012     0.0319     16741.0
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0.000     0.000     0.000     0.000     0.000     0.0014     0.0376     0.0859     0.0298     0.1533     0.0536     0.1261
0.0599     0.0827     0.0713     0.0561     0.0428     0.0536     0.0261     0.0225     0.0109     0.0203     0.0108     0.0055
0.0027     0.0473     20034.0
0.000     0.000     0.000     0.000     0.000     0.000     0.0196     0.0692     0.1554     0.036     0.1592     0.0584
0.0606     0.0419     0.0742     0.0514     0.0253     0.0268     0.0471     0.0154     0.0212     0.0246     0.0151     0.0113
0.0269     0.0604     19095.0
0.000     0.000     0.000     0.000     0.000     0.000     0.005     0.0523     0.1685     0.1781     0.0467     0.1558
0.0441     0.0658     0.0504     0.043     0.0382     0.0293     0.0183     0.0198     0.0087     0.0125     0.009     0.0063
0.0061     0.042     17360.0
0.000     0.000     0.0122     0.0042     0.000     0.0007     0.0003     0.0069     0.0748     0.1874     0.1168     0.0966
0.0678     0.0442     0.0517     0.0371     0.0577     0.0361     0.0254     0.0262     0.0234     0.029     0.0108     0.0113
0.0099     0.0696     10471.0
0.000     0.000     0.0002     0.0294     0.003     0.0005     0.000     0.0013     0.0052     0.0822     0.1844     0.0911
0.0817     0.061     0.0427     0.0569     0.0575     0.0522     0.040     0.0472     0.0257     0.0375     0.0208     0.0124
0.0126     0.0542     10572.0
0.000     0.000     0.000     0.0065     0.2986     0.0146     0.000     0.000     0.0007     0.0016     0.0156     0.0902
0.1125     0.0567     0.0575     0.0463     0.0411     0.0389     0.0475     0.0203     0.0256     0.0227     0.0108     0.0224
0.0031     0.067     10696.0
0.000     0.000     0.000     0.000     0.0061     0.4335     0.0081     0.000     0.000     0.000     0.0021     0.0551
0.0327     0.1039     0.0472     0.0711     0.0379     0.0308     0.0275     0.0119     0.0183     0.014     0.003     0.0148
0.0262     0.0558     13223.0
0.000     0.000     0.000     0.000     0.000     0.0064     0.5767     0.005     0.000     0.0008     0.0008     0.0043
0.0396     0.0348     0.0692     0.041     0.0307     0.0203     0.0211     0.0301     0.021     0.0172     0.0117     0.0045
0.0124     0.0521     14083.0
0.000     0.000     0.000     0.000     0.0006     0.0051     0.0211     0.5911     0.0038     0.0029     0.0012     0.0042
0.0135     0.0306     0.0491     0.0324     0.0394     0.0245     0.021     0.0251     0.0199     0.0148     0.0133     0.0134
0.0106     0.0624     14755.0
0.000     0.000     0.000     0.000     0.000     0.0049     0.0065     0.0412     0.6266     0.0077     0.0016     0.0017
0.008     0.0182     0.0308     0.0453     0.0319     0.0246     0.0209     0.0168     0.0175     0.0137     0.0129     0.0109
0.0098     0.0485     10183.0
0.000     0.000     0.0012     0.000     0.0039     0.002     0.0029     0.0024     0.0114     0.6313     0.0043     0.0011
0.000     0.0022     0.0162     0.0186     0.065     0.0258     0.0272     0.0202     0.0162     0.0194     0.0156     0.0166
0.0178     0.0785     7915.0
0.000     0.000     0.0002     0.019     0.0086     0.0042     0.0064     0.0021     0.000     0.0011     0.5091     0.0039
0.0022     0.0015     0.009     0.013     0.0408     0.0317     0.0588     0.0227     0.0351     0.0339     0.0211     0.0094
0.0073     0.159     6903.0
0.000     0.000     0.000     0.001     0.1464     0.0138     0.004     0.0037     0.0075     0.0043     0.0122     0.4302
0.005     0.0092     0.0056     0.0036     0.0074     0.0277     0.0234     0.0478     0.0147     0.0194     0.0272     0.0169
0.0114     0.1576     5328.0
0.000     0.000     0.0033     0.0008     0.0037     0.4813     0.000     0.0014     0.0029     0.000     0.0025     0.0011
0.2575     0.000     0.0032     0.0035     0.0025     0.0066     0.0151     0.012     0.0234     0.0155     0.0104     0.0113
0.0117     0.1303     4793.0
0.000     0.000     0.0026     0.0143     0.0032     0.003     0.3734     0.000     0.0027     0.0011     0.0013     0.0039
0.0012     0.3131     0.000     0.0024     0.0011     0.0099     0.0113     0.0254     0.0225     0.0183     0.0193     0.0139
0.0105     0.1456     4282.0
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
2929.0
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
1894.0
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
1177.0
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
669.427
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
638.655
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
2039.117
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
977.965
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
1045.675
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
545.862
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
630.859
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
688.715
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
431.629
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
586.094
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
382.944
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
487.886
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
727.67
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0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
493.573
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
564.253
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
522.55
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
664.651
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
647.908
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
1160.395
# Fleet 1 Discards at Age - Last Column is Total Weight
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
```

```
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
```

```
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
# Fleet 1 Release Proportion at Age
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
```

```
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
```

```
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
# Index Units
1  1
# Index Month
10.5  4.5
# Index Selectivity Choice
-1  -1
# Index Selectivity Option for each Index 1=by age, 2=logisitic, 3=double logistic
1  1
# Index Start Age
1  1
# Index End Age
26  26
# Use Index? 1=yes
1  1
# Index Selectivity initial guess, phase, lambda, and CV
# (have to enter values for nages + 6 parameters for each block)
# Index-1
1              4              1              0.5
1              4              1              0.5
1              4              1              0.5
1              4              1              0.5
1              4              1              0.5
1              4              1              0.5
1              4              1              0.5
1              4              1              0.5
1              4              1              0.5
1              -1             1              1
1              -1             1              1
1              -1             1              1
1              -1             1              1
1              -1             1              1
1              -1             1              1
1              -1             1              1
1              -1             1              1
1              -1             1              1
1              -1             1              1
1              -1             1              1
1              -1             1              1
1              -1             1              1
1              -1             1              1
1              -1             1              1
1              -1             1              1
1              -1             1              1
3              -1             0              1
1              -1             0              1
3              -1             0              1
1              -1             0              1
8              -1             0              1
1              -1             0              1
# Index-2
1              4              1              0.5
1              4              1              0.5
1              4              1              0.5
1              4              1              0.5
1              4              1              0.5
1              4              1              0.5
1              4              1              0.5
1              4              1              0.5
1              4              1              0.5
1              -1             1              1
1              -1             1              1
1              -1             1              1
1              -1             1              1
1              -1             1              1
1              -1             1              1
1              -1             1              1
1              -1             1              1
1              -1             1              1
1              -1             1              1
1              -1             1              1
1              -1             1              1
1              -1             1              1
1              -1             1              1
```

```
1              -1             1              1
1              -1             1              1
1              -1             1              1
3              -1             0              1
1              -1             0              1
3              -1             0              1
1              -1             0              1
8              -1             0              1
1              -1             0              1
# Index Data - Year, Index Value, CV, proportions at age and input effective sample size (only used if estimating parameters)
# Index-1
1913     0         0         0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0
1914     0         0         0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0
1915     0         0         0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0
1916     0         0         0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0
1917     0         0         0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0
1918     0         0         0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0
1919     0         0         0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0
1920     0         0         0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0
1921     0         0         0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0
1922     0         0         0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0
1923     0         0         0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0
1924     0         0         0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0
1925     0         0         0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0
1926     0         0         0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0
1927     0         0         0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0
1928     0         0         0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0
1929     0         0         0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0
1930     0         0         0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0
1931     0         0         0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0
1932     0         0         0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0
1933     0         0         0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0
1934     0         0         0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0
1935     0         0         0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0
1936     0         0         0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0
1937     0         0         0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0
1938     0         0         0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0
1939     0         0         0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0
1940     0         0         0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0
```

```
1941    0        0        0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
0.0000    0.0000    0.0000    0.0000    0.0000    0
1942    0        0        0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
0.0000    0.0000    0.0000    0.0000    0.0000    0
1943    0        0        0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
0.0000    0.0000    0.0000    0.0000    0.0000    0
1944    0        0        0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
0.0000    0.0000    0.0000    0.0000    0.0000    0
1945    0        0        0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
0.0000    0.0000    0.0000    0.0000    0.0000    0
1946    0        0        0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
0.0000    0.0000    0.0000    0.0000    0.0000    0
1947    0        0        0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
0.0000    0.0000    0.0000    0.0000    0.0000    0
1948    0        0        0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
0.0000    0.0000    0.0000    0.0000    0.0000    0
1949    0        0        0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
0.0000    0.0000    0.0000    0.0000    0.0000    0
1950    0        0        0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
0.0000    0.0000    0.0000    0.0000    0.0000    0
1951    0        0        0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
0.0000    0.0000    0.0000    0.0000    0.0000    0
1952    0        0        0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
0.0000    0.0000    0.0000    0.0000    0.0000    0
1953    0        0        0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
0.0000    0.0000    0.0000    0.0000    0.0000    0
1954    0        0        0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
0.0000    0.0000    0.0000    0.0000    0.0000    0
1955    0        0        0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
0.0000    0.0000    0.0000    0.0000    0.0000    0
1956    0        0        0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
0.0000    0.0000    0.0000    0.0000    0.0000    0
1957    0        0        0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
0.0000    0.0000    0.0000    0.0000    0.0000    0
1958    0        0        0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
0.0000    0.0000    0.0000    0.0000    0.0000    0
1959    0        0        0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
0.0000    0.0000    0.0000    0.0000    0.0000    0
1960    0        0        0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
0.0000    0.0000    0.0000    0.0000    0.0000    0
1961    0        0        0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
0.0000    0.0000    0.0000    0.0000    0.0000    0
1962    0        0        0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
0.0000    0.0000    0.0000    0.0000    0.0000    0
1963    44045.968184395    0.3      0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0
1964    97988.3915178571    0.748936998476806    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0
1965    24120.4152636054    0.368413238393123    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0
1966    53479.2409226191    0.447613084775748    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0
1967    44522.2091092687    0.36721842574417    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0
1968    73869.3711770125    0.433262611035651    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0
1969    43404.5480654762    0.259498952648771    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0
1970    60207.0261550454    0.187014112143186    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0
1971    42779.2105017007    0.224338610377811    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0
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1972      44988.7839427438     0.186808667406035     0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0
1973      31117.446960034     0.179111628330722     0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0
1974      44137.5879464286     0.302663031640376     0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0
1975      72978.806459042     0.285549050194399     0.0000    0.0001    0.0085    0.2724    0.0023    0.0025    0.0000
0.0000    0.0000    0.0135    0.0173    0.0996    0.0382    0.0829    0.0436    0.0461    0.0298    0.0176    0.0216
0.0120    0.0529    0.0195    0.0231    0.0271    0.0181    0.1514    100
1976      27933.7897321429     0.38676100913081     0.0000    0.0000    0.0020    0.0168    0.3159    0.0048    0.0000
0.0000    0.0000    0.0000    0.0311    0.0049    0.0880    0.0449    0.0415    0.0576    0.0358    0.0341    0.0285
0.0206    0.0029    0.0586    0.0000    0.0106    0.0155    0.1859    100
1977      31515.4773629149     0.154789125889299     0.0000    0.0020    0.0007    0.0006    0.0319    0.5005    0.0014
0.0000    0.0000    0.0000    0.0000    0.0201    0.0259    0.0774    0.0366    0.0301    0.0146    0.0147    0.0127
0.0151    0.0166    0.0083    0.0314    0.0087    0.1509    0.0000    100
1978      37883.3319733169     0.157740389262214     0.0003    0.0001    0.0041    0.0020    0.0069    0.0732    0.5333
0.0032    0.0000    0.0015    0.0023    0.0126    0.0616    0.0434    0.0318    0.0269    0.0207    0.0100    0.0237
0.0160    0.0113    0.0114    0.0227    0.0088    0.0131    0.0589    100
1979      29189.315702255     0.211500272707986     0.0033    0.0000    0.0022    0.0069    0.0022    0.0095    0.0387
0.5368    0.0012    0.0013    0.0012    0.0062    0.0123    0.0222    0.0453    0.0614    0.0238    0.0323    0.0223
0.0155    0.0290    0.0187    0.0128    0.0050    0.0039    0.0860    100
1980      23073.9150191327     0.308889115123398     0.0014    0.0403    0.0019    0.0049    0.0208    0.0145    0.0078
0.0222    0.4781    0.0026    0.0000    0.0000    0.0026    0.0020    0.0142    0.0691    0.0365    0.0258    0.0382
0.0184    0.0115    0.0303    0.0137    0.0153    0.0213    0.1066    100
1981      22352.3353528912     0.31898624119992     0.0000    0.0062    0.0431    0.0123    0.0015    0.0124    0.0042
0.0074    0.0416    0.2958    0.0084    0.0183    0.0231    0.0239    0.0187    0.0468    0.0282    0.1701    0.0123
0.0339    0.0252    0.0198    0.0166    0.0153    0.0208    0.0940    100
1982      6349.98487811791     0.271856209535326     0.0000    0.0033    0.0064    0.4456    0.0451    0.0000    0.0000
0.0020    0.0133    0.0183    0.2467    0.0105    0.0089    0.0039    0.0066    0.0166    0.0378    0.0188    0.0331
0.0038    0.0077    0.0096    0.0077    0.0096    0.0052    0.0394    100
1983      7535.29475623583     0.231020715463835     0.0015    0.0250    0.0308    0.0343    0.4121    0.0163    0.0052
0.0076    0.0120    0.0238    0.0250    0.2443    0.0058    0.0055    0.0073    0.0121    0.0141    0.0120    0.0177
0.0031    0.0056    0.0142    0.0121    0.0095    0.0072    0.0360    100
1984      7188.51019345238     0.377813593850363     0.0052    0.0509    0.0330    0.0274    0.0035    0.3223    0.0043
0.0070    0.0027    0.0035    0.0039    0.0000    0.4073    0.0000    0.0039    0.0000    0.0099    0.0041    0.0023
0.0000    0.0897    0.0000    0.0017    0.0023    0.0017    0.0137    100
1985      10396.7651254252     0.309738389127771     0.0000    0.0140    0.1024    0.1178    0.0277    0.0242    0.2419
0.0139    0.0000    0.0303    0.0000    0.0541    0.0033    0.2339    0.0015    0.0109    0.0000    0.0111    0.0022
0.0049    0.0043    0.0830    0.0000    0.0106    0.0000    0.0080    100
1986      14629.1905718537     0.336070857570531     0.0000    0.0000    0.0108    0.2161    0.3510    0.0197    0.0000
0.1921    0.0034    0.0004    0.0057    0.0025    0.0057    0.0047    0.1472    0.0000    0.0008    0.0000    0.0010
0.0027    0.0000    0.0000    0.0268    0.0000    0.0007    0.0087    100
1987      9968.57141794218     0.323399316864771     0.0000    0.0119    0.0461    0.0502    0.2591    0.1388    0.0057
0.0061    0.1637    0.0000    0.0027    0.0066    0.0037    0.0037    0.0023    0.2074    0.0036    0.0037    0.0000
0.0021    0.0016    0.0055    0.0030    0.0634    0.0000    0.0092    100
1988      11559.7036139456     0.569417368265127     0.0299    0.0904    0.0334    0.0595    0.0198    0.1900    0.1144
0.0063    0.0000    0.1856    0.0000    0.0000    0.0051    0.0102    0.0041    0.0092    0.1856    0.0000    0.0000
0.0012    0.0000    0.0000    0.0000    0.0000    0.0392    0.0160    100
1989      12447.9070684524     0.300597549345325     0.0031    0.0450    0.1682    0.1314    0.0440    0.0274    0.2423
0.0503    0.0000    0.0063    0.1317    0.0000    0.0000    0.0018    0.0092    0.0027    0.0028    0.0630    0.0000
0.0018    0.0076    0.0110    0.0064    0.0000    0.0015    0.0423    100
1990      22206.2899447279     0.331332133463519     0.0063    0.0070    0.0253    0.1055    0.3132    0.1092    0.0454
0.0759    0.0695    0.0223    0.0014    0.0819    0.0000    0.0000    0.0090    0.0048    0.0070    0.0015    0.0587
0.0000    0.0073    0.0010    0.0035    0.0000    0.0034    0.0409    100
1991      15275.9560161565     0.446909525624668     0.0106    0.0059    0.0184    0.0558    0.2403    0.1495    0.0614
0.0379    0.0965    0.0432    0.0240    0.0000    0.1097    0.0051    0.0059    0.0000    0.0121    0.0101    0.0037
0.0666    0.0000    0.0051    0.0000    0.0089    0.0000    0.0294    100
1992      14786.4635629252     0.291798723284711     0.0089    0.0100    0.0256    0.0881    0.1258    0.1779    0.1768
0.0519    0.0335    0.0557    0.0392    0.0143    0.0168    0.0861    0.0000    0.0112    0.0027    0.0081    0.0099
0.0000    0.0317    0.0000    0.0041    0.0025    0.0000    0.0190    100
1993      20458.0521896259     0.325839928890841     0.0101    0.0294    0.0531    0.1174    0.1520    0.1935    0.1263
0.1162    0.0252    0.0255    0.0345    0.0156    0.0177    0.0000    0.0407    0.0018    0.0000    0.0019    0.0030
0.0014    0.0000    0.0175    0.0000    0.0000    0.0000    0.0173    100
1994      10850.3763818027     0.433564933414897     0.0184    0.0466    0.0949    0.1340    0.1052    0.1212    0.1074
0.1308    0.0725    0.0306    0.0198    0.0374    0.0106    0.0016    0.0000    0.0427    0.0000    0.0000    0.0009
0.0008    0.0015    0.0000    0.0176    0.0000    0.0000    0.0056    100
1995      8499.75251204649     0.239522466024601     0.0061    0.0299    0.1631    0.5279    0.0875    0.0570    0.0280
0.0221    0.0298    0.0073    0.0074    0.0026    0.0027    0.0086    0.0000    0.0000    0.0120    0.0000    0.0000
0.0000    0.0000    0.0000    0.0000    0.0028    0.0000    0.0051    100
1996      55962.3741390306     0.332323577778657     0.0003    0.0006    0.0114    0.3269    0.4075    0.0770    0.0695
0.0504    0.0048    0.0110    0.0189    0.0027    0.0028    0.0029    0.0038    0.0000    0.0000    0.0052    0.0000
0.0003    0.0007    0.0000    0.0000    0.0000    0.0015    0.0017    100
1997      34605.1963329082     0.392660463626439     0.0051    0.0015    0.0216    0.0725    0.2734    0.2226    0.0642
0.0540    0.0576    0.0373    0.0276    0.0760    0.0047    0.0177    0.0111    0.0091    0.0050    0.0021    0.0185
0.0009    0.0000    0.0025    0.0001    0.0024    0.0000    0.0126    100
1998      57948.1060171228     0.446158535880193     0.0022    0.0007    0.0079    0.0274    0.1177    0.3412    0.2411
0.0717    0.0602    0.0458    0.0337    0.0074    0.0215    0.0000    0.0029    0.0069    0.0015    0.0000    0.0000
0.0078    0.0000    0.0004    0.0006    0.0000    0.0000    0.0014    100
1999      41769.3885770975     0.235075767171274     0.0219    0.0100    0.0062    0.0217    0.0970    0.1553    0.2282
0.1878    0.0822    0.0521    0.0618    0.0145    0.0034    0.0420    0.0000    0.0014    0.0004    0.0021    0.0003
0.0000    0.0015    0.0000    0.0000    0.0004    0.0008    0.0091    100
2000      47793.5371811224     0.287312588423261     0.0029    0.0157    0.0375    0.0557    0.0773    0.1372    0.1710
0.2676    0.1115    0.0160    0.0097    0.0469    0.0059    0.0064    0.0302    0.0008    0.0008    0.0026    0.0009
0.0000    0.0000    0.0009    0.0000    0.0000    0.0000    0.0023    100
2001      51463.0304101828     0.24749107362391     0.0161    0.0084    0.0140    0.0255    0.0288    0.0539    0.0905
0.0997    0.2999    0.1934    0.0119    0.0329    0.0436    0.0054    0.0010    0.0528    0.0000    0.0022    0.0000
0.0054    0.0000    0.0000    0.0107    0.0000    0.0000    0.0039    100
2002      76505.0088679847     0.333909931262869     0.0014    0.0105    0.0736    0.0758    0.0928    0.0793    0.0974
0.1269    0.1034    0.1788    0.1101    0.0109    0.0089    0.0077    0.0019    0.0000    0.0167    0.0000    0.0006
0.0000    0.0000    0.0000    0.0000    0.0029    0.0000    0.0004    100
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2003     119647.24591943     0.488089741434981     0.0012     0.0040     0.0188     0.0943     0.1047     0.0937     0.0568
0.0948     0.1086     0.0919     0.1490     0.1104     0.0128     0.0068     0.0059     0.0054     0.0008     0.0293     0.0000
0.0008     0.0041     0.0000     0.0000     0.0000     0.0038     0.0022     100
2004     66915.5742163053     0.3     0.0299     0.0025     0.0100     0.0632     0.1557     0.0915     0.0578     0.0662
0.0786     0.1096     0.0875     0.1012     0.0762     0.0117     0.0068     0.0094     0.0041     0.0011     0.0280     0.0000
0.0004     0.0000     0.0001     0.0000     0.0000     0.0085     100
2005     85779.0035297619     0.232000840135772     0.0074     0.0059     0.0142     0.0998     0.0718     0.2202     0.0748
0.0730     0.0717     0.0628     0.0941     0.0607     0.0892     0.0167     0.0089     0.0039     0.0071     0.0034     0.0000
0.0134     0.0005     0.0000     0.0000     0.0003     0.0000     0.0004     100
2006     91753.168153699     0.304010455983417     0.0004     0.0156     0.0352     0.0325     0.1579     0.0568     0.2283
0.0622     0.0561     0.0405     0.0394     0.0746     0.0340     0.1037     0.0069     0.0080     0.0149     0.0072     0.0059
0.0041     0.0136     0.0000     0.0005     0.0000     0.0000     0.0016     100
2007     92058.1899674745     0.247392264779095     0.0259     0.0031     0.0165     0.0356     0.0247     0.1688     0.0538
0.2116     0.0541     0.0397     0.0500     0.0751     0.0704     0.0324     0.0956     0.0022     0.0177     0.0088     0.0016
0.0024     0.0008     0.0092     0.0000     0.0000     0.0000     0.0002     100
# Index-2
1913     0          0          0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0
1914     0          0          0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0
1915     0          0          0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0
1916     0          0          0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0
1917     0          0          0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0
1918     0          0          0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0
1919     0          0          0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0
1920     0          0          0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0
1921     0          0          0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0
1922     0          0          0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0
1923     0          0          0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0
1924     0          0          0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0
1925     0          0          0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0
1926     0          0          0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0
1927     0          0          0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0
1928     0          0          0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0
1929     0          0          0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0
1930     0          0          0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0
1931     0          0          0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0
1932     0          0          0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0
1933     0          0          0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0
1934     0          0          0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0
1935     0          0          0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0
1936     0          0          0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0
1937     0          0          0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0
1938     0          0          0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0
```

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1939     0         0         0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0
1940     0         0         0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0
1941     0         0         0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0
1942     0         0         0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0
1943     0         0         0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0
1944     0         0         0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0
1945     0         0         0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0
1946     0         0         0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0
1947     0         0         0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0
1948     0         0         0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0
1949     0         0         0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0
1950     0         0         0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0
1951     0         0         0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0
1952     0         0         0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0
1953     0         0         0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0
1954     0         0         0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0
1955     0         0         0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0
1956     0         0         0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0
1957     0         0         0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0
1958     0         0         0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0
1959     0         0         0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0
1960     0         0         0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0
1961     0         0         0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0
1962     0         0         0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0
1963     0         0         0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0
1964     0         0         0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0
1965     0         0         0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0
1966     0         0         0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0
1967     0         0         0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0
1968     31214.9445365646     0.337071486029026     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0
1969     35969.3491071429     0.286263611454295     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0
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1970     34585.875170068     0.529461733192582     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0
1971     130736.520401077     0.30056913938835     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0
1972     81045.2801303855     0.497994898944637     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0
1973     46216.4049213435     0.320399151062617     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0
1974     34412.0797619048     0.657302506841752     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0
1975     32173.4068521465     0.354769617585745     0.0000     0.0000     0.0151     0.2174     0.0080     0.0161     0.0080
0.0000     0.0000     0.0342     0.0140     0.0899     0.0445     0.1262     0.0413     0.0682     0.0453     0.0242     0.0215
0.0267     0.0469     0.0149     0.0207     0.0032     0.0107     0.1031     100
1976     47852.9242346939     0.5392477353679     0.0000     0.0000     0.0010     0.0329     0.0229     0.0034     0.0105
0.0021     0.0150     0.0033     0.0622     0.0218     0.1676     0.1320     0.0464     0.0759     0.0594     0.0162     0.0253
0.0285     0.0218     0.0780     0.0004     0.0183     0.0176     0.1375     100
1977     21170.0137542517     0.263396060642724     0.0000     0.0000     0.0008     0.0027     0.0548     0.0717     0.0147
0.0019     0.0000     0.0023     0.0037     0.0368     0.0309     0.1327     0.0604     0.0622     0.0463     0.0513     0.0162
0.0278     0.0281     0.0189     0.0520     0.0223     0.0289     0.2324     100
1978     22226.801264881     0.202108420591571     0.0000     0.0000     0.0089     0.0026     0.0005     0.0267     0.4146
0.0031     0.0016     0.0000     0.0029     0.0110     0.0740     0.0373     0.0412     0.0253     0.0396     0.0268     0.0328
0.0170     0.0299     0.0278     0.0203     0.0150     0.0200     0.1208     100
1979     58848.4979981576     0.328930019499467     0.0000     0.0004     0.0001     0.0002     0.0015     0.0055     0.0093
0.5378     0.0000     0.0000     0.0051     0.0136     0.0244     0.0503     0.0375     0.0327     0.0402     0.0343     0.0202
0.0182     0.0187     0.0354     0.0121     0.0068     0.0167     0.0790     100
1980     37165.7758078231     0.341173532962543     0.0000     0.0034     0.0026     0.0000     0.0036     0.0000     0.0000
0.0050     0.4086     0.0000     0.0057     0.0024     0.0000     0.0091     0.0200     0.0731     0.0650     0.0528     0.0389
0.0424     0.0259     0.0397     0.0386     0.0108     0.0163     0.1363     100
1981     33443.9398915816     0.686168693643769     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0
1982     17186.0247130102     0.367288143701539     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0
1983     11086.4626062925     0.40715760615919     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0
1984     4895.68000637755     0.325530514083166     0.0000     0.0066     0.0344     0.0129     0.0000     0.2546     0.0029
0.0000     0.0033     0.0123     0.0100     0.0000     0.4611     0.0000     0.0000     0.0000     0.0055     0.0000     0.0029
0.0000     0.1862     0.0000     0.0000     0.0000     0.0000     0.0074     100
1985     12068.0948554422     0.400029945608712     0.0000     0.0040     0.0178     0.0608     0.0133     0.0000     0.2764
0.0000     0.0000     0.0124     0.0000     0.0165     0.0055     0.3921     0.0039     0.0039     0.0000     0.0000     0.0017
0.0000     0.0026     0.1531     0.0000     0.0000     0.0077     0.0283     100
1986     5876.65507015306     0.319656830024576     0.0000     0.0000     0.0000     0.0111     0.0747     0.0177     0.0091
0.2037     0.0054     0.0050     0.0123     0.0016     0.0179     0.0105     0.4224     0.0036     0.0036     0.0111     0.0089
0.0020     0.0034     0.0081     0.1187     0.0131     0.0056     0.0306     100
1987     23614.9644026361     0.8447789368599     0.0000     0.0000     0.0000     0.0048     0.0549     0.1204     0.0057
0.0041     0.2703     0.0000     0.0000     0.0000     0.0035     0.0000     0.0055     0.3953     0.0000     0.0059     0.0000
0.0320     0.0000     0.0172     0.0000     0.0695     0.0000     0.0110     100
1988     5967.38578160431     0.474278762005575     0.0070     0.0243     0.0273     0.0413     0.0416     0.2168     0.1646
0.0215     0.0054     0.2054     0.0000     0.0039     0.0110     0.0029     0.0132     0.0039     0.1589     0.0000     0.0000
0.0029     0.0099     0.0029     0.0015     0.0000     0.0303     0.0035     100
1989     5448.57435161565     0.357017097280783     0.0000     0.0431     0.1388     0.0859     0.0805     0.0645     0.1898
0.0807     0.0061     0.0048     0.1558     0.0000     0.0151     0.0030     0.0124     0.0101     0.0026     0.0780     0.0000
0.0000     0.0000     0.0041     0.0000     0.0024     0.0000     0.0225     100
1990     12449.0616284014     0.426028236117632     0.0000     0.0000     0.0000     0.0141     0.0815     0.0375     0.0197
0.1127     0.0850     0.0419     0.0105     0.2091     0.0149     0.0151     0.0052     0.0262     0.0195     0.0000     0.1692
0.0000     0.0035     0.0035     0.0166     0.0000     0.0031     0.1111     100
1991     7786.53940263606     0.379808207927155     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0
1992     19494.9759885204     0.407235611439399     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0
1993     31966.7723214286     0.499139170565946     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0
1994     7161.55848214286     0.633318413710598     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0
1995     3501.43797831633     0.401858130269111     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0
1996     21716.3541028912     0.637950530208278     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0
1997     62182.3301126701     0.705002334994897     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0
1998     14319.2365704236     0.332962748888804     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0
1999     34744.646960034     0.292910218576118     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0
2000     102319.642772109     0.581966752983467     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0
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2001     69361.8980600553     0.538636517557833     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0
2002     111816.589645302     0.631168862430275     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0
2003     60899.523953125     0.425057707393348     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0
2004     101702.498581739     0.426975267155812     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0
2005     84513.6894034864     0.52556976471304     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0
2006     18873.6882891865     0.340864500133323     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0
2007     64115.3795633503     0.35375956066862     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000
0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0
# Phase Control Data
# Phase for F mult in 1st Year
2
# Phase for F mult Deviations
4
# Phase for Recruitment Deviations
3
# Phase for N in 1st Year
4
# Phase for Catchability in 1st Year
1
# Phase for Catchability Deviations
-5
# Phase for Stock Recruitment Relationship
1
# Phase for Steepness
5
# Recruitment CV by Year
0.1
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#Lambda for Each Index
1  1
# Lambda for Total Catch in Weight by Fleet
1
# Lambda for Total Discards at Age by Fleet
0
# Catch Total CV by Year and Fleet
0.010
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0.030
0.029
0.552
0.040
0.126
0.505
0.142
0.198
0.182
0.440
0.040
0.167
0.169
0.095
0.069
0.042
0.023
0.055
0.108
# Discard Total CV by Year and Fleet
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# Input Effective Sample Size for Catch at Age by Year & Fleet
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# Input Effective Sample Size for Discards at Age by Year & Fleet
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0
# Lambda for F mult in first year by fleet
0
# CV for F mult in first year by fleet
1
# Lambda for F mult Deviations by Fleet
0
# CV for F mult deviations by Fleet
1
# Lambda for N in 1st Year Deviations
1
# CV for N in 1st Year Deviations
0.01
# Lambda for Recruitment Deviations
1
# Lambda for Catchability in first year by index
0  0
# CV for Catchability in first year by index
1  1
# Lambda for Catchability Deviations by Index
0  0
# CV for Catchability Deviations by Index
1  1
# Lambda for Deviation from Initial Steepness
0
# CV for Deviation from Initial Steepness
0.2
# Lambda for Deviation from Initial unexploited Stock Size
1
# CV for Deviation from Initial unexploited Stock Size
0.6
# NAA for Year 1
2.6e+07  2.5e+07  2.4e+07  2.3e+07  2.2e+07  2.1e+07  2e+07  1.9e+07  1.8e+07  1.7e+07  1.6e+07  1.5e+07  1.4e+07  1.3e+07
1.2e+07  1.1e+07  1e+07  9e+06  8e+06  7e+06  6e+06  5e+06  4e+06  3e+06  2e+06  1e+06
# F mult in 1st year by Fleet
0.001
# Catchability in 1st year by index
1e-09  1e-09
# Initial unexploited Stock Size
2e+05
# Initial Steepness
0.65
# Maximum F
0.8
# Ignore Guesses
0
# Projection Control Data
```

```
# Do Projections? (1=yes, 0=no), still need to enter values even if not doing projections
1
# Fleet Directed Flag
1
# Final Year of Projections
2008
# Year Projected Recruits, What Projected, Target, non- directed F mult
2008     -1     3     -99     0
# MCMC info
# doMCMC (1=yes)
1
# MCMCnyear option (0=use final year values of NAA, 1=use final year + 1 values of NAA)
1
# MCMCnboot
100
# MCMCnthin
200
# MCMCseed
1415963
# R in agepro.bsn file (enter 0 to use NAA, 1 to use stock-recruit relationship, 2 to used geometric mean of previous years)
1
# Starting year for calculation of R
1990
# Starting year for calculation of R
2007
# Test Value
-23456
#####
# ---- FINIS ----
```

```
#c:\work\redfish\garm3\asap_2_0\garm3_final_model_1913_2007\discards_revised_mat_waa\red_1913_2007.rep

Age Structured Assessment Program (ASAP) Version 2.0
Start time for run: Thu Jul 10 09:21:29 2008

obj_fun        = 5847.54

Component                Lambda          obj_fun
__Catch_Fleet_1               1          433.777
Catch_Fleet_Total             1          433.777
Discard_Fleet_Total           0          0
__Index_Fit_1                 1          513.52
__Index_Fit_2                 1          471.303
Index_Fit_Total               2          984.823
Catch_Age_Comps       see_below          893.235
Discard_Age_Comps     see_below          0
Survey_Age_Comps      see_below          2034.91
__Sel_Param_1                 1          28.1528
__Sel_Param_2                 1          28.3867
__Sel_Param_3                 1          26.755
__Sel_Param_4                 1          19.9076
__Sel_Param_5                 1          4.88645
__Sel_Param_6                 1          1.05695
__Sel_Param_7                 1          0.646849
__Sel_Param_8                 1          0.235195
__Sel_Param_9                 1          0.168969
Sel_Params_Total              9          110.197
__Index_Sel_Param_1           1          0.168969
__Index_Sel_Param_2           1          0.281511
__Index_Sel_Param_3           1          0.223825
__Index_Sel_Param_4           1          0.168969
__Index_Sel_Param_5           1          0.168969
__Index_Sel_Param_6           1          0.168969
__Index_Sel_Param_7           1          0.168969
__Index_Sel_Param_8           1          0.192309
__Index_Sel_Param_9           1          0.235404
__Index_Sel_Param_27          1          0.441013
__Index_Sel_Param_28          1          0.650305
__Index_Sel_Param_29          1          0.356215
__Index_Sel_Param_30          1          0.412965
__Index_Sel_Param_31          1          1.11904
__Index_Sel_Param_32          1          0.463146
__Index_Sel_Param_33          1          0.205532
__Index_Sel_Param_34          1          0.333029
__Index_Sel_Param_35          1          0.399088
Index_Sel_Params_Total        18          6.15823
q_year1_Total                 0          0
q_devs_Total                  0          0
__Fmult_year1_fleet_1         0          0
Fmult_year1_fleet_Total       0          0
Fmult_devs_fleet_Total        0          0
N_year_1                      1          265.035
Recruit_devs                  1          1104.2
SRR_steepness                 0          -0
SRR_unexpl_stock              1          14.7494
Fmult_Max_penalty          1000          0.451968
F_penalty                     0          0

 Input and Estimated effective sample sizes for fleet 1
1913  0  5.16987
1914  0  5.17033
1915  0  5.1708
1916  0  5.17132
1917  0  5.1721
1918  0  5.17473
1919  0  5.17967
1920  0  5.18516
1921  0  5.19172
1922  0  5.19889
1923  0  5.20598
1924  0  5.21298
1925  0  5.21991
1926  0  5.22675
1927  0  5.2335
1928  0  5.24018
1929  0  5.24677
1930  0  5.25327
1931  0  5.2597
1932  0  5.26605
1933  0  5.27227
1934  0  5.27857
1935  0  5.28787
1936  0  5.30976
1937  0  5.34636
1938  0  5.39161
1939  0  5.44671
1940  0  5.52318
1941  0  5.63576
1942  0  5.81102
1943  0  6.0475
1944  0  6.34934
1945  0  6.72165
1946  0  7.15714
1947  0  7.68057
1948  0  8.29468
```

```
1949  0  8.97539
1950  0  9.67956
1951  0  10.425
1952  0  11.1183
1953  0  11.7171
1954  0  12.2133
1955  0  12.6508
1956  0  13.0698
1957  0  13.6111
1958  0  14.0295
1959  0  14.4208
1960  0  14.5098
1961  0  14.61
1962  0  14.7363
1963  0  14.7342
1964  0  15.0675
1965  0  14.97
1966  0  15.1908
1967  0  14.9297
1968  0  15.1156
1969  200  39.1796
1970  200  60.0522
1971  200  58.5578
1972  200  99.4896
1973  200  74.8004
1974  200  91.3737
1975  200  67.9365
1976  200  205.273
1977  200  135.924
1978  200  214.267
1979  200  469.428
1980  200  488.111
1981  200  186.531
1982  200  37.4877
1983  200  55.3494
1984  200  30.3489
1985  200  45.8613
1986  0  3.0473
1987  0  4.10773
1988  0  4.86413
1989  0  5.81336
1990  0  6.54031
1991  0  6.50771
1992  0  6.74486
1993  0  7.625
1994  0  8.51066
1995  0  9.87511
1996  0  7.61265
1997  0  4.77622
1998  0  4.21546
1999  0  4.77621
2000  0  5.23416
2001  0  5.87283
2002  0  7.37043
2003  0  8.78809
2004  0  9.80004
2005  0  8.45614
2006  0  8.87488
2007  0  7.96235
 Total  3400  2973.83

 Input and Estimated effective Discard sample sizes for fleet 1
1913  0  1e+15
1914  0  1e+15
1915  0  1e+15
1916  0  1e+15
1917  0  1e+15
1918  0  1e+15
1919  0  1e+15
1920  0  1e+15
1921  0  1e+15
1922  0  1e+15
1923  0  1e+15
1924  0  1e+15
1925  0  1e+15
1926  0  1e+15
1927  0  1e+15
1928  0  1e+15
1929  0  1e+15
1930  0  1e+15
1931  0  1e+15
1932  0  1e+15
1933  0  1e+15
1934  0  1e+15
1935  0  1e+15
1936  0  1e+15
1937  0  1e+15
1938  0  1e+15
1939  0  1e+15
1940  0  1e+15
1941  0  1e+15
1942  0  1e+15
1943  0  1e+15
1944  0  1e+15
1945  0  1e+15
```

```
1946  0  1e+15
1947  0  1e+15
1948  0  1e+15
1949  0  1e+15
1950  0  1e+15
1951  0  1e+15
1952  0  1e+15
1953  0  1e+15
1954  0  1e+15
1955  0  1e+15
1956  0  1e+15
1957  0  1e+15
1958  0  1e+15
1959  0  1e+15
1960  0  1e+15
1961  0  1e+15
1962  0  1e+15
1963  0  1e+15
1964  0  1e+15
1965  0  1e+15
1966  0  1e+15
1967  0  1e+15
1968  0  1e+15
1969  0  1e+15
1970  0  1e+15
1971  0  1e+15
1972  0  1e+15
1973  0  1e+15
1974  0  1e+15
1975  0  1e+15
1976  0  1e+15
1977  0  1e+15
1978  0  1e+15
1979  0  1e+15
1980  0  1e+15
1981  0  1e+15
1982  0  1e+15
1983  0  1e+15
1984  0  1e+15
1985  0  1e+15
1986  0  1e+15
1987  0  1e+15
1988  0  1e+15
1989  0  1e+15
1990  0  1e+15
1991  0  1e+15
1992  0  1e+15
1993  0  1e+15
1994  0  1e+15
1995  0  1e+15
1996  0  1e+15
1997  0  1e+15
1998  0  1e+15
1999  0  1e+15
2000  0  1e+15
2001  0  1e+15
2002  0  1e+15
2003  0  1e+15
2004  0  1e+15
2005  0  1e+15
2006  0  1e+15
2007  0  1e+15
 Total  0  9.5e+16

Observed and predicted total fleet catch by year and standardized residual
 fleet 1 total catches
1913  7.24  7.24  -1.1839e-05
1914  29.8  29.8  4.14824e-06
1915  40.23  40.23  5.92513e-06
1916  53.17  53.17  8.26824e-06
1917  82.48  82.48  1.35392e-05
1918  72.98  72.98  1.26364e-05
1919  24.8  24.8  4.52402e-06
1920  30.67  30.67  5.90157e-06
1921  12.54  12.54  2.54283e-06
1922  8.6  8.6  1.8331e-06
1923  6.92  6.92  1.55075e-06
1924  39.74  39.74  9.37301e-06
1925  24.77  24.77  6.13474e-06
1926  29.76  29.76  7.72995e-06
1927  30.06  30.06  8.19543e-06
1928  57.07  57.07  1.63163e-05
1929  33.85  33.85  1.01334e-05
1930  53.8  53.8  1.68515e-05
1931  107.62  107.62  3.52387e-05
1932  59.94  59.94  2.04888e-05
1933  119.89  119.89  4.27482e-05
1934  519  518.999  0.000192816
1935  7549  7548.78  0.00291776
1936  23162  23159.8  0.0093026
1937  14823  14822.1  0.00618519
1938  20640  20638.2  0.00893661
1939  25406  25403.1  0.0114044
1940  26762  26758.7  0.0124459
1941  50796  50783.6  0.0244457
```

```
1942  55892  55876.4  0.0278543
1943  48348  48335.9  0.0249823
1944  50439  50425.4  0.0270644
1945  37912  37903.9  0.0213414
1946  42423  42412.5  0.0247457
1947  40160  40150.6  0.0235276
1948  43631  43619.7  0.0259189
1949  30743  30737.3  0.018589
1950  34307  34300  0.0203559
1951  30077  30071.4  0.0186122
1952  21377  21374.9  0.00993788
1953  16791  16790.3  0.00416061
1954  12988  12988.2  -0.00135078
1955  13914  13914.5  -0.00335346
1956  14388  14388.7  -0.005191
1957  18490  18491.8  -0.0096077
1958  16047  16047.3  -0.00212329
1959  15521  15521  8.37354e-05
1960  11375  11374.1  0.00760518
1961  14101  14099.6  0.0100519
1962  14134  14131.2  0.0197551
1963  10046  10044.8  0.0118109
1964  8313  8312.04  0.0115344
1965  8057  8055.48  0.0189059
1966  8569  8566.3  0.0314785
1967  10864  10858.3  0.0525444
1968  6777  6774.14  0.0422041
1969  12455  12443.1  0.0956155
1970  16741  16718  0.137425
1971  20034  20000.8  0.165962
1972  19095  19064.1  0.162041
1973  17360  17335  0.144051
1974  10471  10461.5  0.0908746
1975  10572  10561.9  0.0952384
1976  10696  10685.4  0.098931
1977  13223  13206.4  0.125608
1978  14083  14061.9  0.149969
1979  14755  14740.9  0.0959291
1980  10183  10184.1  -0.0107329
1981  7915  7918.53  -0.044607
1982  6903  6906.57  -0.0517195
1983  5328  5326.69  0.0245985
1984  4793  4790.3  0.0563814
1985  4282  4282.15  -0.00348379
1986  2929  2931.14  -0.0728875
1987  1894  1895.29  -0.0681718
1988  1177  1177.48  -0.0407916
1989  669.427  670.178  -0.0374051
1990  638.655  639.339  -0.0368992
1991  2039.12  7903.43  -2.62692
1992  977.965  985.496  -0.191864
1993  1045.67  1141.74  -0.700271
1994  545.862  8123.59  -5.66537
1995  630.859  680.507  -0.536163
1996  688.715  741.812  -0.378725
1997  431.629  444.577  -0.163729
1998  586.094  731.752  -0.52762
1999  382.944  383.294  -0.0228475
2000  487.886  495.95  -0.098839
2001  727.67  741.883  -0.115268
2002  493.573  495.301  -0.0368743
2003  564.253  565.146  -0.0229354
2004  522.55  522.782  -0.0105585
2005  664.651  664.73  -0.00513963
2006  647.908  648.123  -0.0060345
2007  1160.39  1161.13  -0.00591422
Observed and predicted total fleet Discards by year and standardized residual
 fleet 1 total Discards
1913  0  0  0
1914  0  0  0
1915  0  0  0
1916  0  0  0
1917  0  0  0
1918  0  0  0
1919  0  0  0
1920  0  0  0
1921  0  0  0
1922  0  0  0
1923  0  0  0
1924  0  0  0
1925  0  0  0
1926  0  0  0
1927  0  0  0
1928  0  0  0
1929  0  0  0
1930  0  0  0
1931  0  0  0
1932  0  0  0
1933  0  0  0
1934  0  0  0
1935  0  0  0
1936  0  0  0
1937  0  0  0
1938  0  0  0
1939  0  0  0
```

```
1940  0  0  0
1941  0  0  0
1942  0  0  0
1943  0  0  0
1944  0  0  0
1945  0  0  0
1946  0  0  0
1947  0  0  0
1948  0  0  0
1949  0  0  0
1950  0  0  0
1951  0  0  0
1952  0  0  0
1953  0  0  0
1954  0  0  0
1955  0  0  0
1956  0  0  0
1957  0  0  0
1958  0  0  0
1959  0  0  0
1960  0  0  0
1961  0  0  0
1962  0  0  0
1963  0  0  0
1964  0  0  0
1965  0  0  0
1966  0  0  0
1967  0  0  0
1968  0  0  0
1969  0  0  0
1970  0  0  0
1971  0  0  0
1972  0  0  0
1973  0  0  0
1974  0  0  0
1975  0  0  0
1976  0  0  0
1977  0  0  0
1978  0  0  0
1979  0  0  0
1980  0  0  0
1981  0  0  0
1982  0  0  0
1983  0  0  0
1984  0  0  0
1985  0  0  0
1986  0  0  0
1987  0  0  0
1988  0  0  0
1989  0  0  0
1990  0  0  0
1991  0  0  0
1992  0  0  0
1993  0  0  0
1994  0  0  0
1995  0  0  0
1996  0  0  0
1997  0  0  0
1998  0  0  0
1999  0  0  0
2000  0  0  0
2001  0  0  0
2002  0  0  0
2003  0  0  0
2004  0  0  0
2005  0  0  0
2006  0  0  0
2007  0  0  0

Index data
index number 1
units = 1
month = 10.5
starting and ending ages for selectivity = 1  26
selectivity choice = -1
 year, obs index, pred index, standardized residual
1963  44046  69771.8  -1.56696
1964  97988.4  71148.1  0.479684
1965  24120.4  72847.8  -3.09824
1966  53479.2  74453.4  -0.774278
1967  44522.2  74995.4  -1.46608
1968  73869.4  76642.1  -0.0888415
1969  43404.5  75589  -2.17307
1970  60207  70816.9  -0.875408
1971  42779.2  63113.6  -1.75497
1972  44988.8  54529.7  -1.03846
1973  31117.4  47237.3  -2.34899
1974  44137.6  43684.1  0.0348819
1975  72978.8  41759.9  1.99389
1976  27933.8  39192.1  -0.906995
1977  31515.5  35180.3  -0.714916
1978  37883.3  29851.9  1.5198
1979  29189.3  22429.7  1.25922
1980  23073.9  17166.8  0.979617
1981  22352.3  14931.8  1.29601
```

```
1982  6349.98  12059.1  -2.4019
1983  7535.29  9874.63  -1.18571
1984  7188.51  8098.38  -0.326267
1985  10396.8  6638.59  1.48211
1986  14629.2  5750.24  2.85453
1987  9968.57  5619.57  1.81737
1988  11559.7  6410.91  1.11244
1989  12447.9  7488.63  1.72775
1990  22206.3  8784.34  2.87351
1991  15276  7003.77  1.82748
1992  14786.5  7791.21  2.24138
1993  20458.1  9402.61  2.44727
1994  10850.4  8502.97  0.587384
1995  8499.75  11549.6  -1.29818
1996  55962.4  16540.9  3.76582
1997  34605.2  22484  1.13872
1998  57948.1  29231.9  1.60605
1999  41769.4  36252.2  0.610829
2000  47793.5  43629.9  0.323636
2001  51463  53724.1  -0.176349
2002  76505  67283.5  0.395051
2003  119647  82830.1  0.795561
2004  66915.6  100522  -1.38624
2005  85779  120127  -1.47084
2006  91753.2  140006  -1.42132
2007  92058.2  159541  -2.25613
index number 2
units = 1
month = 4.5
starting and ending ages for selectivity = 1  26
selectivity choice = -1
 year, obs index, pred index, standardized residual
1968  31214.9  68719.3  -2.40556
1969  35969.3  69575.2  -2.35079
1970  34585.9  67271.9  -1.33833
1971  130737  62005.4  2.53648
1972  81045.3  54303.7  0.850713
1973  46216.4  47658.1  -0.0982659
1974  34412.1  42837  -0.365445
1975  32173.4  39917  -0.626359
1976  47852.9  34977.3  0.620384
1977  21170  32725  -1.68173
1978  22226.8  29953.8  -1.49113
1979  58848.5  22926.9  2.94102
1980  37165.8  17223.5  2.31782
1981  33443.9  15848.1  1.20233
1982  17186  12648.8  0.861693
1983  11086.5  9665.73  0.350157
1984  4895.68  8035.46  -1.56131
1985  12068.1  6806.6  1.48638
1986  5876.66  5286.55  0.339266
1987  23615  4748.11  2.18573
1988  5967.39  5559.1  0.157343
1989  5448.57  6264.59  -0.402926
1990  12449.1  6940.98  1.43049
1991  7786.54  7052.14  0.269869
1992  19495  6281.7  2.89115
1993  31966.8  7592.94  3.04775
1994  7161.56  8325.64  -0.259348
1995  3501.44  8913.52  -2.41499
1996  21716.4  11869.2  1.03385
1997  62182.3  15752.4  2.16164
1998  14319.2  21987.5  -1.32265
1999  34744.6  28242.2  0.722226
2000  102320  34457.5  2.0152
2001  69361.9  44016.4  0.901045
2002  111817  56334.9  1.1839
2003  60899.5  68382.8  -0.284381
2004  101702  81526.4  0.540344
2005  84513.7  98469.6  -0.309463
2006  18873.7  115875  -5.47366
2007  64115.4  133541  -2.13675

Input and Estimated effective sample sizes for index 1
1963  0  0
1964  0  0
1965  0  0
1966  0  0
1967  0  0
1968  0  0
1969  0  0
1970  0  0
1971  0  0
1972  0  0
1973  0  0
1974  0  0
1975  100  43.5838
1976  100  47.0108
1977  100  13.4821
1978  100  29.4016
1979  100  57.7553
1980  100  159.191
1981  100  13.9383
1982  100  4.56135
1983  100  8.86103
```

```
1984  100  44.3771
1985  100  31.2661
1986  100  9.58476
1987  100  37.9065
1988  100  59.1712
1989  100  30.0483
1990  100  22.0125
1991  100  73.4789
1992  100  230.766
1993  100  41.3722
1994  100  87.9942
1995  100  8.9579
1996  100  19.6147
1997  100  201.546
1998  100  78.8371
1999  100  102.072
2000  100  74.7965
2001  100  55.325
2002  100  100.454
2003  100  113.391
2004  100  94.5182
2005  100  66.5313
2006  100  70.6867
2007  100  77.8214
 Total  3300  2110.31
Input and Estimated effective sample sizes for index 2
1968  0  0
1969  0  0
1970  0  0
1971  0  0
1972  0  0
1973  0  0
1974  0  0
1975  100  46.9123
1976  100  27.9764
1977  100  17.754
1978  100  115.106
1979  100  29.6122
1980  100  301.632
1981  0  0
1982  0  0
1983  0  0
1984  100  19.2948
1985  100  32.0107
1986  100  19.2766
1987  100  21.321
1988  100  54.2548
1989  100  42.6256
1990  100  42.4326
1991  0  0
1992  0  0
1993  0  0
1994  0  0
1995  0  0
1996  0  0
1997  0  0
1998  0  0
1999  0  0
2000  0  0
2001  0  0
2002  0  0
2003  0  0
2004  0  0
2005  0  0
2006  0  0
2007  0  0
 Total  1300  770.209

Survey proportions at age by index
 Index number 1
Year 1963 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 1963 Pred =  0.00100169 0.00591899 0.0105383 0.0290306 0.0348517 0.0532695 0.0584872 0.0545608 0.0607724 0.0642922 0.0666037
0.0528254 0.0525571 0.0492283 0.0460401 0.0436086 0.0381172 0.032472 0.0282994 0.0240422 0.020124 0.0170085 0.0143664 0.0121604
0.0103312 0.119492
Year 1964 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 1964 Pred =  0.00178367 0.00371786 0.0150203 0.0215415 0.0422266 0.0444397 0.0622315 0.0575541 0.0524784 0.0719304 0.0624773
0.0634428 0.049511 0.0486121 0.0450391 0.0417423 0.0392397 0.0340813 0.0288789 0.0250543 0.0212037 0.0176904 0.0149101 0.0125642
0.0106134 0.112015
Year 1965 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 1965 Pred =  0.00112134 0.00659466 0.00939822 0.0305871 0.0312357 0.0537637 0.0519106 0.0612961 0.0554799 0.0622859
0.0700938 0.0596772 0.0596271 0.0459217 0.0445987 0.040948 0.0376645 0.0351822 0.0303941 0.0256383 0.0221577 0.0186912 0.0155509
0.0130759 0.0109962 0.106109
Year 1966 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 1966 Pred =  0.00060865 0.00415322 0.0166998 0.0191714 0.0444114 0.0398032 0.0628576 0.0511559 0.0591069 0.0658795 0.0607242
0.066984 0.0561145 0.0553305 0.0421503 0.0405668 0.0369653 0.0337859 0.0313908 0.0269963 0.0226849 0.0195414 0.0164385 0.0136443
0.0114495 0.101385
Year 1967 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 1967 Pred =  0.000151891 0.00228635 0.0106662 0.0345383 0.0281466 0.0569686 0.04677 0.0620595 0.0493009 0.0701402 0.0641854
0.057992 0.0629437 0.0520369 0.0507531 0.0383145 0.0365971 0.0331369 0.0301252 0.0278632 0.0238707 0.0199932 0.0171749 0.0144135
0.0119393 0.0976317
Year 1968 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 1968 Pred =  0.000109348 0.000562768 0.00579203 0.021772 0.0503029 0.036096 0.0670313 0.0465007 0.0604507 0.0590954
0.0690276 0.0619174 0.0550451 0.05896 0.0482146 0.0466009 0.0349148 0.0331386 0.0298452 0.0270102 0.0248864 0.021251 0.0177496
0.0152115 0.01274 0.0957741
Year 1969 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
```

```
Year 1969 Pred =  5.2426e-05 0.000419464 0.00147589 0.012231 0.0325943 0.0656919 0.0431952 0.0673151 0.0455636 0.0729755
0.0585716 0.067062 0.0591889 0.051928 0.0550177 0.0445849 0.0427679 0.0318401 0.030059 0.0269495 0.0242961 0.0223128 0.0190005
0.0158324 0.0135409 0.0955334
Year 1970 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 1970 Pred =  6.81598e-05 0.000211464 0.0011566 0.0032747 0.0191266 0.0439751 0.080741 0.0442193 0.0667738 0.0556008
0.0731135 0.0575212 0.0648025 0.056443 0.0489816 0.0514279 0.0413617 0.0394248 0.0291945 0.027437 0.0245045 0.0220199 0.0201663
0.017132 0.0142465 0.0970754
Year 1971 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 1971 Pred =  8.12806e-05 0.000288665 0.000612149 0.00269242 0.00533952 0.0266031 0.0554066 0.084074 0.0443079 0.0822022
0.0561972 0.0724355 0.0560733 0.0623412 0.0537101 0.0461895 0.0481308 0.0384648 0.0364679 0.026883 0.0251679 0.0224047 0.0200771
0.0183435 0.015552 0.0999537
Year 1972 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 1972 Pred =  0.00594218 0.000354884 0.000861461 0.00146871 0.00451518 0.00760206 0.034186 0.0586607 0.0853536 0.0551892
0.0840645 0.0563332 0.0714457 0.0545802 0.0600227 0.0512462 0.0437384 0.0452881 0.0359998 0.0339768 0.0249507 0.0232828 0.0206691
0.0184779 0.0168483 0.104942
Year 1973 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 1973 Pred =  0.000255068 0.0258675 0.00105591 0.0020603 0.00245098 0.00637643 0.00967333 0.035761 0.0587223 0.104785
0.0556272 0.0830551 0.0547637 0.0685424 0.0517941 0.0564451 0.0478283 0.0405628 0.0417758 0.033058 0.0310808 0.0227497 0.02117
0.018749 0.0167275 0.109063
Year 1974 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 1974 Pred =  0.000128805 0.00104152 0.0722046 0.00237142 0.00325798 0.00332739 0.00783199 0.00986858 0.0351698 0.0707979
0.103722 0.0539736 0.0792931 0.051596 0.063877 0.0478334 0.0517356 0.0435603 0.0367459 0.0376739 0.0296979 0.0278307 0.0203143
0.0188589 0.0166684 0.110619
Year 1975 Obs  =  0 9.999e-05 0.00849915 0.272373 0.00229977 0.00249975 0 0 0 0.0134987 0.0172983 0.09959 0.0381962 0.0828917
0.0435956 0.0460954 0.029797 0.0175982 0.0215978 0.0119988 0.0528947 0.0194981 0.0230977 0.0270973 0.0180982 0.151385
Year 1975 Pred =  8.34017e-05 0.000508739 0.00281191 0.156798 0.00361524 0.00425193 0.00393754 0.0076792 0.00932782 0.0408364
0.0674925 0.0969232 0.0496263 0.0719482 0.0463087 0.0568141 0.0422237 0.0453792 0.0380043 0.0319144 0.032595 0.0256106 0.0239338
0.0174285 0.0161471 0.1078
Year 1976 Obs  =  0 0 0.002 0.0168 0.3159 0.0048 0 0 0 0 0.0311 0.0049 0.088 0.0449 0.0415 0.0576 0.0358 0.0341 0.0285 0.0206
0.0029 0.0586 0 0.0106 0.0155 0.1859
Year 1976 Pred =  8.65153e-05 0.000335324 0.00139809 0.00621351 0.242472 0.0047581 0.00505897 0.00386626 0.00724256 0.0107992
0.0388165 0.0628847 0.0888571 0.0448984 0.0643874 0.0410685 0.0500052 0.0369281 0.039476 0.0329113 0.0275316 0.0280272 0.0219604
0.020474 0.0148789 0.104665
Year 1977 Obs  =  0 0.0019996 0.00069986 0.00059988 0.0318936 0.5004 0.00139972 0 0 0 0 0.020096 0.0258948 0.0773845 0.0365927
0.030094 0.0145971 0.0146971 0.0126975 0.015097 0.0165967 0.00829834 0.0313937 0.00869826 0.15087 0
Year 1977 Pred =  6.04625e-05 0.000363155 0.00096195 0.00322198 0.0099362 0.325248 0.0057366 0.00498262 0.00362777 0.00833633
0.0102055 0.0359565 0.0573165 0.0799248 0.0399468 0.0567698 0.0359367 0.0434797 0.0319377 0.0339872 0.0282267 0.0235359 0.0238931
0.0186769 0.0173775 0.100354
Year 1978 Obs  =  0.00030006 0.00010002 0.00410082 0.0020004 0.00690138 0.0732146 0.533407 0.00320064 0 0.0015003 0.00230046
0.0126025 0.0616123 0.0434087 0.0318064 0.0269054 0.0207041 0.010002 0.0237047 0.0160032 0.0113023 0.0114023 0.0227045 0.00880176
0.0131026 0.0589118
Year 1978 Pred =  8.97719e-05 0.000268038 0.0011001 0.00233881 0.00538991 0.0137262 0.400629 0.00571086 0.00468011 0.00417198
0.00787109 0.00944523 0.032744 0.0515097 0.0710482 0.0351899 0.0496326 0.0312198 0.0375711 0.027473 0.029124 0.024109 0.0200467
0.0203027 0.0158382 0.0987704
Year 1979 Obs  =  0.0033 0 0.0022 0.0069 0.0022 0.0095 0.0387 0.5368 0.0012 0.0013 0.0012 0.0062 0.0123 0.0222 0.0453 0.0614
0.0238 0.0323 0.0223 0.0155 0.029 0.0187 0.0128 0.005 0.0039 0.086
Year 1979 Pred =  0.00303573 0.000448659 0.000915244 0.00301195 0.00436581 0.00817113 0.0184017 0.429137 0.00571324 0.00572175
0.00418767 0.00774436 0.00914403 0.0312833 0.0486778 0.0665365 0.0327069 0.0458384 0.0286793 0.0343579 0.0250272 0.0264448
0.0218304 0.018109 0.0183032 0.102207
Year 1980 Obs  =  0.0014 0.0403 0.0019 0.0049 0.0208 0.0145 0.0078 0.0222 0.4781 0.0026 0 0 0.0026 0.002 0.0142 0.0691 0.0365
0.0258 0.0382 0.0184 0.0115 0.0303 0.0137 0.0153 0.0213 0.1066
Year 1980 Pred =  0.000149799 0.0149103 0.00150583 0.00246533 0.00558087 0.00665291 0.0110227 0.0200203 0.438314 0.00711683
0.00585181 0.00419811 0.0076391 0.0089012 0.0301221 0.0464482 0.0630103 0.0307774 0.042904 0.0267221 0.0318907 0.0231543 0.024398
0.020093 0.0166341 0.109516
Year 1981 Obs  =  0 0.00620062 0.0431043 0.0123012 0.00150015 0.0124012 0.00420042 0.00740074 0.0416042 0.29583 0.00840084
0.0183018 0.0231023 0.0239024 0.0187019 0.0468047 0.0282028 0.170117 0.0123012 0.0339034 0.0252025 0.019802 0.0166017 0.0153015
0.0208021 0.0940094
Year 1981 Pred =  0.000324118 0.000647679 0.0440526 0.00357085 0.00402368 0.00751255 0.00796027 0.0106539 0.0182215 0.487546
0.00649941 0.00523839 0.00369774 0.00664016 0.00765327 0.0256654 0.0392777 0.0529456 0.0257233 0.0356966 0.0221479 0.0263457
0.0190753 0.0200523 0.0164807 0.102348
Year 1982 Obs  =  0 0.00330033 0.00640064 0.445645 0.0451045 0 0 0.0020002 0.0133013 0.0183018 0.246725 0.0105011 0.00890089
0.00390039 0.00660066 0.0166017 0.0378038 0.0188019 0.0331033 0.00380038 0.00770077 0.00960096 0.00770077 0.00960096 0.00520052
0.0394039
Year 1982 Pred =  0.00199911 0.0015078 0.00205867 0.112309 0.00622566 0.00572618 0.0094718 0.00804764 0.0100874 0.0210861
0.463219 0.00605291 0.00480024 0.00334392 0.00593964 0.00678413 0.0225792 0.0343359 0.0460371 0.0222658 0.0307803 0.0190354
0.0225804 0.0163104 0.017111 0.100305
Year 1983 Obs  =  0.00149985 0.0249975 0.0307969 0.0342966 0.412059 0.0162984 0.00519948 0.00759924 0.0119988 0.0237976 0.0249975
0.244276 0.00579942 0.00549945 0.00729927 0.0120988 0.0140986 0.0119988 0.0176982 0.00309969 0.00559944 0.0141986 0.0120988
0.00949905 0.00719928 0.0359964
Year 1983 Pred =  0.00321639 0.00916928 0.00472529 0.00517442 0.192952 0.0087116 0.00707807 0.00937636 0.0074445 0.0113882
0.0195449 0.420865 0.00541122 0.00423496 0.00291812 0.00513657 0.00582264 0.0192565 0.0291267 0.0388764 0.0187305 0.0258088
0.0159166 0.0188361 0.0135782 0.0967011
Year 1984 Obs  =  0.00519844 0.0508847 0.0329901 0.0273918 0.00349895 0.322203 0.00429871 0.0069979 0.00269919 0.00349895
0.00389883 0 0.407178 0 0.00389883 0 0.00989703 0.00409877 0.00229931 0 0.0896731 0 0.00169949 0.00229931 0.00169949 0.0136959
Year 1984 Pred =  0.00110824 0.0147172 0.0286642 0.0118406 0.00881553 0.265401 0.0105536 0.00682449 0.00840844 0.00814702
0.0102324 0.0172137 0.364719 0.0046277 0.00358246 0.00244625 0.0042735 0.00481363 0.0158345 0.0238426 0.0317016 0.015224 0.020919
0.0128705 0.0152004 0.088019
Year 1985 Obs  =  0 0.014 0.1024 0.1178 0.0277 0.0242 0.2419 0.0139 0 0.0303 0 0.0541 0.0033 0.2339 0.0015 0.0109 0 0.0111 0.0022
0.0049 0.0043 0.083 0 0.0106 0 0.008
Year 1985 Pred =  0.00213384 0.00506471 0.0459434 0.0716529 0.019933 0.011783 0.31017 0.00970305 0.00577937 0.00867925 0.00690434
0.00850003 0.0140699 0.294192 0.00369233 0.00283257 0.00191962 0.00333226 0.00373339 0.0122256 0.018338 0.0243032 0.0116387
0.0159546 0.00979628 0.0777246
Year 1986 Obs  =  0 0 0.0108 0.2161 0.351 0.0197 0 0.1921 0.0034 0.0004 0.0057 0.0025 0.0057 0.0047 0.1472 0 0.0008 0 0.001
0.0027 0 0 0.0268 0 0.0007 0.0087
Year 1986 Pred =  0.00804011 0.00924286 0.0149889 0.109013 0.115862 0.0260379 0.0134906 0.28295 0.00821532 0.00595152 0.00733814
0.00572198 0.00693138 0.0113226 0.234178 0.0029126 0.00221756 0.00149331 0.0025784 0.00287574 0.00938101 0.0140254 0.0185362
0.00885589 0.0121153 0.0657243
Year 1987 Obs  =  0 0.0118988 0.0460954 0.050195 0.259074 0.138786 0.00569943 0.00609939 0.163684 0 0.00269973 0.00659934
0.00369963 0.00369963 0.00229977 0.207379 0.00359964 0.00369963 0 0.00209979 0.00159984 0.00549945 0.0029997 0.0633937 0
0.00919908
Year 1987 Pred =  0.00748202 0.0309667 0.0243296 0.0316927 0.159861 0.141617 0.028298 0.0119374 0.236731 0.00838296 0.00498606
0.0060261 0.0046235 0.00552712 0.00893073 0.183043 0.00225944 0.00170937 0.00114495 0.00196799 0.00218653 0.00710948 0.0105998
0.0139757 0.00666354 0.0579485
Year 1988 Obs  =  0.029903 0.090409 0.0334033 0.059506 0.019802 0.190019 0.114411 0.00630063 0 0.185619 0 0 0.00510051 0.010201
0.00410041 0.00920092 0.185619 0 0 0.00120012 0 0 0 0 0.0392039 0.0160016
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Year 1988 Pred =  0.00418344 0.0247584 0.070048 0.0442769 0.0405849 0.175366 0.140196 0.023238 0.00943079 0.228991 0.00665757
0.00388147 0.00461583 0.00349494 0.00413265 0.00661732 0.134605 0.00165102 0.0012424 0.000828415 0.00141846 0.00157084 0.00509342
0.00757599 0.00996861 0.0455724
Year 1989 Obs  =  0.00310062 0.045009 0.168234 0.131426 0.0440088 0.0274055 0.242348 0.0503101 0 0.00630126 0.131726 0 0
0.00180036 0.00920184 0.00270054 0.00280056 0.0630126 0 0.00180036 0.00760152 0.0110022 0.00640128 0 0.0015003 0.0423085
Year 1989 Pred =  0.00416507 0.0135501 0.0548281 0.124948 0.0561825 0.045042 0.177685 0.119506 0.0193121 0.00962688 0.191916
0.00546929 0.00313752 0.00368209 0.00275769 0.00323147 0.00513531 0.103798 0.00126635 0.000948635 0.000630112 0.0010754
0.00118762 0.00384173 0.00570265 0.0413743
Year 1990 Obs  =  0.0063 0.007 0.0253 0.1055 0.3132 0.1092 0.0454 0.0759 0.0695 0.0223 0.0014 0.0819 0 0 0.009 0.0048 0.007
0.0015 0.0587 0 0.0073 0.001 0.0035 0 0.0034 0.0409
Year 1990 Pred =  0.00322051 0.0134449 0.0299065 0.097501 0.15848 0.0627391 0.0461855 0.153924 0.10146 0.0201872 0.00826206
0.161449 0.00452718 0.00256294 0.00297514 0.00220813 0.00256799 0.0040551 0.0815263 0.000990143 0.000738885 0.000489192
0.000832577 0.000917285 0.00296123 0.0358892
Year 1991 Obs  =  0.0105989 0.00589941 0.0183982 0.0557944 0.240276 0.149485 0.0613939 0.0378962 0.0964904 0.0431957 0.0239976 0
0.109689 0.00509949 0.00589941 0 0.0120988 0.010099 0.00369963 0.0665933 0 0.00509949 0 0.00889911 0 0.0293971
Year 1991 Pred =  0.00467856 0.0150371 0.042842 0.0758989 0.158319 0.189854 0.0652023 0.0357644 0.106425 0.0864184 0.0141171
0.00566342 0.108893 0.00301334 0.00168741 0.00194113 0.00142983 0.00165232 0.00259525 0.0519409 0.00062841 0.000467419
0.000308604 0.000523983 0.000576126 0.0241219
Year 1992 Obs  =  0.00890178 0.010002 0.0256051 0.0881176 0.125825 0.177936 0.176835 0.0519104 0.0335067 0.0557111 0.0392078
0.0143029 0.0168034 0.0861172 0 0.0112022 0.00270054 0.00810162 0.00990198 0 0.0317063 0 0.00410082 0.0025005 0 0.0190038
Year 1992 Pred =  0.0174115 0.0158346 0.034795 0.0797688 0.0997101 0.175802 0.184168 0.05217 0.0269673 0.0964447 0.0642978
0.0102957 0.00406409 0.0771151 0.00211081 0.00117135 0.00133732 0.000978828 0.0011251 0.00175918 0.0350732 0.000422953
0.000313724 0.00020664 0.000350147 0.0163062
Year 1993 Obs  =  0.010099 0.0293971 0.0530947 0.117388 0.151985 0.193481 0.126287 0.116188 0.0251975 0.0254975 0.0344966
0.0155984 0.0176982 0 0.0406959 0.00179982 0 0.00189981 0.0029997 0.00139986 0 0.0174983 0 0 0 0.0172983
Year 1993 Pred =  0.0208432 0.0545592 0.0339217 0.0600126 0.0974447 0.105897 0.170418 0.149521 0.0411969 0.0261867 0.0768916
0.0502478 0.00791683 0.00308399 0.0578831 0.0015701 0.000864722 0.000980995 0.000714191 0.000817211 0.00127288 0.025295
0.00030419 0.000225098 0.000147965 0.0117834
Year 1994 Obs  =  0.0183982 0.0465953 0.0948905 0.133987 0.105189 0.121188 0.107389 0.130787 0.0724928 0.0305969 0.019798
0.0373963 0.0105989 0.00159984 0 0.0426957 0 0 0.00089991 0.00079992 0.00149985 0 0.0175982 0 0 0.00559944
Year 1994 Pred =  0.0116784 0.0857629 0.153203 0.0758517 0.0857395 0.102326 0.0961259 0.114994 0.0898047 0.0304341 0.0158831
0.0457144 0.0293945 0.0045704 0.00176108 0.0327553 0.000881799 0.000482572 0.000544537 0.000394648 0.000449845 0.000698391
0.0138401 0.000166043 0.000122622 0.00642088
Year 1995 Obs  =  0.00610061 0.029903 0.163116 0.527953 0.0875088 0.0570057 0.0280028 0.0221022 0.029803 0.00730073 0.00740074
0.00260026 0.00270027 0.00860086 0 0 0.0120012 0 0 0 0 0 0 0.00280028 0 0.00510051
Year 1995 Pred =  0.00966505 0.0323987 0.162684 0.233985 0.0822107 0.079268 0.0828561 0.0646219 0.0731908 0.0686767 0.0191085
0.00977512 0.0276831 0.0175664 0.00270167 0.00103163 0.0190431 0.000509411 0.000277291 0.000311485 0.000224881 0.000255499
0.000395565 0.00782043 9.36335e-05 0.0036455
Year 1996 Obs  =  0.00030003 0.00060006 0.0114011 0.326933 0.407541 0.0770077 0.069507 0.050405 0.00480048 0.0110011 0.0189019
0.00270027 0.00280028 0.00290029 0.00380038 0 0 0.00520052 0 0.00030003 0.00070007 0 0 0 0.00150015 0.00170017
Year 1996 Pred =  0.00544386 0.0255552 0.058572 0.236975 0.243162 0.0752561 0.0666464 0.0588728 0.0450145 0.062777 0.0483627
0.0131901 0.00663924 0.0185552 0.0116465 0.00177505 0.000672688 0.0123388 0.000328305 0.000177902 0.000199074 0.000143256
0.000162309 0.000250693 0.00494623 0.00233658
Year 1997 Obs  =  0.00509949 0.00149985 0.0215978 0.0724928 0.273373 0.222578 0.0641936 0.0539946 0.0575942 0.0372963 0.0275972
0.0759924 0.00469953 0.0176982 0.0110989 0.00909909 0.0049995 0.00209979 0.0184982 0.00089991 0 0.00249975 9.999e-05 0.00239976 0
0.0125987
Year 1997 Pred =  0.00394318 0.0151793 0.0487249 0.090033 0.261238 0.238264 0.0679813 0.0512006 0.0445693 0.0419828 0.0480704
0.0363001 0.00974138 0.00483888 0.0133768 0.00832048 0.00125857 0.000473938 0.0086468 0.000229032 0.000123632 0.000137895
9.89559e-05 0.000111852 0.00017241 0.00498307
Year 1998 Obs  =  0.0022 0.0007 0.0079 0.0274 0.1177 0.3412 0.2411 0.0717 0.0602 0.0458 0.0337 0.0074 0.0215 0 0.0029 0.0069
0.0015 0 0 0.0078 0 0.0004 0.0006 0 0 0.0014
Year 1998 Pred =  0.00428699 0.0114973 0.0302639 0.0783176 0.103767 0.267849 0.225679 0.0547809 0.0407104 0.0437094 0.0338039
0.0379396 0.0281902 0.00746562 0.00366819 0.0100491 0.00620345 0.000932405 0.00034924 0.00634297 0.000167366 9.00505e-05
0.000100161 7.17067e-05 8.08873e-05 0.00368394
Year 1999 Obs  =  0.0218978 0.009999 0.00619938 0.0216978 0.0969903 0.155284 0.228177 0.187781 0.0821918 0.0520948 0.0617938
0.0144986 0.00339966 0.0419958 0 0.00139986 0.00039996 0.00209979 0.00029997 0 0.00149985 0 0 0.00039996 0.00079992 0.00909909
Year 1999 Pred =  0.00496756 0.0131086 0.0240402 0.0510275 0.0948964 0.112251 0.267951 0.192559 0.0462046 0.0423486 0.0373306
0.0282995 0.031252 0.0229159 0.00600299 0.00292293 0.00794705 0.00487479 0.00072879 0.000271742 0.00491653 0.000129305 6.93791e-
05 7.69857e-05 5.50038e-05 0.00285317
Year 2000 Obs  =  0.00290058 0.0157031 0.0375075 0.0557111 0.0773155 0.137227 0.171034 0.267654 0.111522 0.0160032 0.00970194
0.0469094 0.00590118 0.00640128 0.030206 0.00080016 0.00080016 0.00260052 0.00090018 0 0 0.00090018 0 0 0 0.00230046
Year 2000 Pred =  0.0108908 0.0156537 0.0282468 0.0417733 0.0637292 0.105885 0.115942 0.236152 0.167884 0.0497082 0.0374058
0.032321 0.0241086 0.0262741 0.0190568 0.00494702 0.00239061 0.00645859 0.0039406 0.000586468 0.000217837 0.00392842 0.000103031
5.51507e-05 6.10735e-05 0.0022793
Year 2001 Obs  =  0.0161 0.0084 0.014 0.0255 0.0288 0.0539 0.0905 0.0997 0.2999 0.1934 0.0119 0.0329 0.0436 0.0054 0.001 0.0528 0
0.0022 0 0.0054 0 0 0.0107 0 0 0.0039
Year 2001 Pred =  0.00366303 0.0335419 0.0329673 0.0479701 0.0509777 0.0694588 0.106821 0.0997797 0.201016 0.176341 0.0428675
0.0316198 0.0268832 0.0197889 0.0213324 0.015333 0.00395034 0.00189688 0.00509736 0.00309603 0.000459008 0.000169938 0.00305612
7.99634e-05 4.27164e-05 0.00179101
Year 2002 Obs  =  0.0014 0.0105 0.0736 0.0758 0.0928 0.0793 0.0974 0.1269 0.1034 0.1788 0.1101 0.0109 0.0089 0.0077 0.0019 0
0.0167 0 0.0006 0 0 0 0 0.0029 0 0.0004
Year 2002 Pred =  0.00685174 0.0110931 0.0694613 0.055056 0.0576036 0.0547268 0.0690379 0.0906376 0.0837811 0.208266 0.150002
0.0357432 0.0259417 0.0217658 0.0158481 0.0169301 0.012077 0.00309179 0.0014767 0.00395031 0.00239015 0.000353202 0.000130403
0.00233958 6.10912e-05 0.00138414
Year 2003 Obs  =  0.00119988 0.0039996 0.0187981 0.0942906 0.10469 0.0936906 0.0567943 0.0947905 0.108589 0.0918908 0.148985
0.110389 0.0127987 0.00679932 0.00589941 0.00539946 0.00079992 0.0292971 0 0.00079992 0.00409959 0 0 0 0.00379962 0.00219978
Year 2003 Pred =  0.00165161 0.02111 0.0233713 0.118016 0.067264 0.0629313 0.0553715 0.0596378 0.0774983 0.0884051 0.180429
0.127381 0.0298659 0.0213912 0.0177531 0.0128098 0.0135812 0.00962675 0.00245135 0.00116553 0.00310595 0.00187315 0.000276035
0.000101671 0.0018204 0.00111126
Year 2004 Obs  =  0.0299 0.0025 0.01 0.0632 0.1557 0.0915 0.0578 0.0662 0.0786 0.1096 0.0875 0.1012 0.0762 0.0117 0.0068 0.0094
0.0041 0.0011 0.028 0 0.0004 0 0.0001 0 0 0.0085
Year 2004 Pred =  0.00319716 0.00516194 0.0451168 0.040282 0.146294 0.0745823 0.0646302 0.0485617 0.0517786 0.083037 0.0777703
0.155583 0.108078 0.025007 0.0177167 0.0145709 0.0104344 0.0109927 0.00775039 0.00196464 0.000930537 0.00247167 0.00148648
0.000218536 8.033e-05 0.00230305
Year 2005 Obs  =  0.00739852 0.00589882 0.0141972 0.09978 0.0717856 0.220156 0.074785 0.0729854 0.0716857 0.0627874 0.0940812
0.0606879 0.0891822 0.0166967 0.00889822 0.00389922 0.00709858 0.00339932 0 0.0133973 0.0004999 0 0 0.00029994 0 0.00039992
Year 2005 Pred =  0.00210083 0.0101477 0.0112036 0.0789696 0.0507086 0.164728 0.0777895 0.057565 0.0428205 0.0563477 0.0741916
0.0681109 0.134073 0.0919112 0.0210357 0.0147687 0.0120548 0.00857796 0.00898869 0.00630882 0.0015931 0.0007521 0.00199217
0.00119527 0.000175367 0.00188984
Year 2006 Obs  =  0.00040004 0.0156016 0.0352035 0.0325033 0.157916 0.0568057 0.228323 0.0622062 0.0561056 0.0405041 0.0394039
0.0746075 0.0340034 0.10371 0.00690069 0.0080008 0.0149015 0.00720072 0.00590059 0.00410041 0.0136014 0 0.00050005 0 0 0.00160016
Year 2006 Pred =  0.00103005 0.0068371 0.0225836 0.0201079 0.101945 0.0585651 0.176234 0.0710785 0.0520776 0.0478091 0.0516525
0.0666638 0.0602181 0.116978 0.0793223 0.0179907 0.0125357 0.0101673 0.00719625 0.00750678 0.00524855 0.00132104 0.000621932
0.00164348 0.000984066 0.00168099
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Year 2007 Obs  =  0.0258948 0.00309938 0.0164967 0.0355929 0.0246951 0.168766 0.0537892 0.211558 0.0540892 0.0396921 0.04999
0.075085 0.0703859 0.0323935 0.0955809 0.00219956 0.0176965 0.00879824 0.00159968 0.00239952 0.00079984 0.00919816 0 0 0
0.00019996
Year 2007 Pred =  0.00314387 0.00342853 0.0155619 0.0414528 0.0265416 0.120344 0.0640368 0.164538 0.0656926 0.0594027 0.0447736
0.0474158 0.0602139 0.053677 0.10314 0.069308 0.0156009 0.0108017 0.00871416 0.00613988 0.0063803 0.00444641 0.00111604
0.000524176 0.00138235 0.00222287
 Index number 2
Year 1968 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 1968 Pred =  8.05531e-05 0.000462345 0.00529505 0.0163477 0.027537 0.0266 0.0626294 0.0419613 0.0559145 0.0633977 0.0740529
0.066425 0.0590525 0.0632524 0.0517247 0.0499936 0.0374566 0.0355511 0.032018 0.0289765 0.0266982 0.0227981 0.0190418 0.0163189
0.0136675 0.102747
Year 1969 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 1969 Pred =  3.76463e-05 0.000335916 0.0013153 0.00895658 0.0174739 0.0477311 0.0398808 0.060314 0.0419966 0.0780135
0.0626151 0.0716917 0.0632751 0.0555129 0.0588159 0.0476629 0.0457204 0.0340382 0.0321342 0.02881 0.0259734 0.0238532 0.0203122
0.0169254 0.0144757 0.102129
Year 1970 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 1970 Pred =  4.74517e-05 0.000164178 0.000999363 0.0023259 0.00998128 0.0312856 0.0731308 0.0390306 0.060819 0.0587367
0.0772372 0.0607654 0.0684574 0.0596265 0.0517442 0.0543285 0.0436945 0.0416484 0.0308411 0.0289845 0.0258866 0.0232618 0.0213037
0.0180983 0.01505 0.102551
Year 1971 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 1971 Pred =  5.47476e-05 0.000216832 0.000511772 0.00185104 0.00270745 0.0185046 0.0491652 0.0730234 0.0398428 0.0857329
0.058611 0.0755468 0.0584818 0.0650188 0.056017 0.0481734 0.0501981 0.040117 0.0380343 0.0280376 0.0262489 0.023367 0.0209395
0.0191314 0.0162199 0.104247
Year 1972 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 1972 Pred =  0.00394929 0.000263033 0.000710653 0.000996481 0.00226217 0.00523529 0.0300531 0.0505487 0.0762277 0.0571664
0.0870762 0.0583514 0.0740053 0.0565356 0.0621731 0.0530821 0.0453054 0.0469106 0.0372896 0.035194 0.0258446 0.0241169 0.0214095
0.0191399 0.0174519 0.108701
Year 1973 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 1973 Pred =  0.000167358 0.0189275 0.000859946 0.00138018 0.00121372 0.00434769 0.00842423 0.0305641 0.0520628 0.10775
0.0572015 0.0854056 0.0563135 0.0704821 0.0532599 0.0580425 0.0491819 0.0417108 0.0429581 0.0339935 0.0319603 0.0233935 0.0217691
0.0192796 0.0172008 0.112149
Year 1974 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 1974 Pred =  8.68726e-05 0.00078338 0.0604412 0.00163182 0.00164775 0.00229554 0.0068802 0.00845175 0.0310907 0.0725901
0.106348 0.05534 0.0813004 0.0529022 0.0654941 0.0490443 0.0530454 0.044663 0.0376762 0.0386276 0.0304497 0.0285353 0.0208285
0.0193364 0.0170904 0.113419
Year 1975 Obs  =  0 0 0.0150985 0.217378 0.0079992 0.0160984 0.0079992 0 0 0.0341966 0.0139986 0.089891 0.0444956 0.126187
0.0412959 0.0681932 0.0452955 0.0241976 0.0214979 0.0266973 0.0468953 0.0148985 0.0206979 0.00319968 0.0106989 0.10309
Year 1975 Pred =  5.77247e-05 0.000392677 0.00241557 0.110751 0.00188063 0.0030271 0.00357341 0.00681013 0.0085536 0.0434323
0.0717828 0.103084 0.0527809 0.0765218 0.0492524 0.0604256 0.0449077 0.0482638 0.0404202 0.0339431 0.034667 0.0272386 0.0254552
0.0185363 0.0171736 0.114652
Year 1976 Obs  =  0 0 0.001 0.0329 0.0229 0.0034 0.0105 0.0021 0.015 0.0033 0.0622 0.0218 0.1676 0.132 0.0464 0.0759 0.0594
0.0162 0.0253 0.0285 0.0218 0.078 0.0004 0.0183 0.0176 0.1375
Year 1976 Pred =  6.41541e-05 0.000277299 0.0012868 0.00470317 0.13543 0.00364861 0.00495016 0.00370511 0.00718879 0.0124323
0.0446865 0.0723943 0.102294 0.0516881 0.0741243 0.047279 0.0575672 0.0425125 0.0454457 0.0378882 0.031695 0.0322656 0.0252814
0.0235702 0.017129 0.120492
Year 1977 Obs  =  0 0 0.00080016 0.00270054 0.054811 0.0717143 0.0147029 0.00190038 0 0.00230046 0.00370074 0.0368074 0.0309062
0.132727 0.0604121 0.0622124 0.0463093 0.0513103 0.0162032 0.0278056 0.0281056 0.0189038 0.0520104 0.0223045 0.0289058 0.232446

Year 1977 Pred =  4.30519e-05 0.000288367 0.000850233 0.00234332 0.00536085 0.243015 0.0054848 0.0046945 0.00355644 0.00947866
0.0116039 0.0408836 0.0651706 0.0908769 0.0454207 0.0645489 0.0408611 0.0494378 0.0363142 0.0386445 0.0320946 0.026761 0.0271671
0.0212361 0.0197587 0.114105
Year 1978 Obs  =  0 0 0.00890267 0.00260078 0.00050015 0.026708 0.414724 0.00310093 0.00160048 0 0.00290087 0.0110033 0.0740222
0.0373112 0.0412124 0.0253076 0.0396119 0.026808 0.0328098 0.0170051 0.029909 0.0278083 0.0203061 0.0150045 0.020006 0.120836
Year 1978 Pred =  5.93073e-05 0.000197472 0.000902219 0.0015792 0.00271387 0.00965272 0.361519 0.00510896 0.00437605 0.00452444
0.00853607 0.0102432 0.0355103 0.0558614 0.0770505 0.0381629 0.0538257 0.0338573 0.0407452 0.029794 0.0315845 0.0261458 0.0217403
0.022018 0.0171763 0.107115
Year 1979 Obs  =  0 0.0004 0.0001 0.0002 0.0015 0.0055 0.0093 0.5378 0 0 0.0051 0.0136 0.0244 0.0503 0.0375 0.0327 0.0402 0.0343
0.0202 0.0182 0.0187 0.0354 0.0121 0.0068 0.0167 0.079
Year 1979 Pred =  0.0019705 0.000324762 0.000737564 0.00199956 0.00217347 0.00573378 0.016619 0.386731 0.0054075 0.00628115
0.00459709 0.0085015 0.010038 0.0343417 0.0534369 0.0730415 0.0359045 0.0503198 0.0314831 0.037717 0.027474 0.0290302 0.0239647
0.0198795 0.0200927 0.112199
Year 1980 Obs  =  0 0.00339932 0.00259948 0 0.00359928 0 0 0.004999 0.408518 0 0.00569886 0.00239952 0 0.00909818 0.019996
0.0730854 0.064987 0.0527894 0.0388922 0.0423915 0.0258948 0.0396921 0.0385923 0.0107978 0.0162967 0.136273
Year 1980 Pred =  9.89721e-05 0.0109858 0.00123507 0.00166474 0.00280976 0.0046769 0.00994237 0.0178992 0.409529 0.00771226
0.00634141 0.00454935 0.00827822 0.00964592 0.0326422 0.0503343 0.068282 0.0333524 0.0464936 0.0289578 0.0345588 0.0250915
0.0264392 0.0217741 0.0180258 0.118679
Year 1981 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 1981 Pred =  0.000202425 0.000451089 0.0341541 0.00227925 0.00191453 0.00498973 0.00678313 0.00899669 0.0160778 0.498948
0.0066514 0.00536089 0.00378421 0.00679544 0.00783225 0.0262656 0.0401962 0.0541838 0.0263248 0.0365314 0.0226659 0.0269618
0.0195214 0.0205212 0.0168661 0.104741
Year 1982 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 1982 Pred =  0.00126417 0.00106329 0.00161619 0.0726199 0.00301303 0.00389407 0.00828167 0.00700588 0.00920785 0.0223241
0.490414 0.00640828 0.00508206 0.00354024 0.00628836 0.00718243 0.0239048 0.0363517 0.0487399 0.023573 0.0325874 0.020153
0.0239061 0.017268 0.0181156 0.106194
Year 1983 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 1983 Pred =  0.00217958 0.00692909 0.00397531 0.00358548 0.100091 0.00635188 0.00663607 0.0087546 0.00728948 0.0129334
0.0221968 0.477969 0.00614544 0.00480957 0.00331407 0.00583352 0.00661268 0.0218693 0.0330787 0.0441513 0.021272 0.0293106
0.0180763 0.0213919 0.0154206 0.109822
Year 1984 Obs  =  0 0.00659934 0.0343966 0.0128987 0 0.254575 0.00289971 0 0.00329967 0.0122988 0.009999 0 0.461054 0 0 0
0.00549945 0 0.00289971 0 0.186181 0 0 0 0 0.00739926
Year 1984 Pred =  0.000741264 0.0109774 0.0238033 0.00810164 0.00453073 0.192781 0.00987493 0.00638414 0.00827312 0.00929712
0.0116769 0.0196437 0.416205 0.00528099 0.00408818 0.00279158 0.00487678 0.00549316 0.0180698 0.0272084 0.0361769 0.0173732
0.0238721 0.0146874 0.0173462 0.100444
Year 1985 Obs  =  0 0.004 0.0178 0.0608 0.0133 0 0.2764 0 0 0.0124 0 0.0165 0.0055 0.3921 0.0039 0.0039 0 0 0.0017 0 0.0026
0.1531 0 0 0.0077 0.0283
Year 1985 Pred =  0.00138251 0.00365923 0.0369597 0.047524 0.00998956 0.00842698 0.28665 0.00902694 0.00568403 0.00990042
0.00787578 0.00969598 0.0160496 0.335585 0.00421184 0.00323111 0.00218971 0.00380111 0.00425868 0.0139457 0.0209182 0.0277227
0.0132763 0.0181995 0.0111746 0.0886604
Year 1986 Obs  =  0 0 0 0.0110989 0.0746925 0.0176982 0.00909909 0.20368 0.00539946 0.0049995 0.0122988 0.00159984 0.0178982
0.010499 0.422358 0.00359964 0.00359964 0.0110989 0.00889911 0.0019998 0.00339966 0.00809919 0.118688 0.0130987 0.00559944
0.0305969
Year 1986 Pred =  0.00580239 0.00743852 0.0134296 0.080462 0.0641245 0.0203098 0.0135425 0.283406 0.00864163 0.00726098
0.00895269 0.00698094 0.00845643 0.0138138 0.285702 0.00355344 0.00270547 0.00182187 0.0031457 0.00350846 0.011445 0.0171113
0.0226146 0.0108044 0.0147809 0.080185
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Year 1987 Obs  =  0 0 0 0.00479952 0.0548945 0.120388 0.00569943 0.00409959 0.270273 0 0 0 0.00349965 0 0.00549945 0.39526 0
0.00589941 0 0.0319968 0 0.0171983 0 0.0694931 0 0.0109989
Year 1987 Pred =  0.00586515 0.0270709 0.0236741 0.0253755 0.0949394 0.116448 0.0297737 0.0123751 0.255322 0.0104864 0.00623715
0.00753815 0.00578362 0.00691397 0.0111716 0.228972 0.00282637 0.00213828 0.00143224 0.00246179 0.00273516 0.00889338 0.0132595
0.0174824 0.00833554 0.0724888
Year 1988 Obs  =  0.007 0.0243 0.0273 0.0413 0.0416 0.2168 0.1646 0.0215 0.0054 0.2054 0 0.0039 0.011 0.0029 0.0132 0.0039 0.1589
0 0 0.0029 0.0099 0.0029 0.0015 0 0.0303 0.0035
Year 1988 Pred =  0.0031909 0.02106 0.0663127 0.0344577 0.0232211 0.136934 0.139418 0.0225369 0.00944328 0.265943 0.00773191
0.00450783 0.00536069 0.00405892 0.00479954 0.00768517 0.156327 0.00191744 0.00144289 0.000962097 0.00164735 0.00182433
0.00591535 0.00879854 0.0115773 0.0529264
Year 1989 Obs  =  0 0.0430914 0.138772 0.0858828 0.0804839 0.0644871 0.189762 0.0806839 0.00609878 0.00479904 0.155769 0 0.015097
0.0029994 0.0123975 0.010098 0.00259948 0.0779844 0 0 0 0.00409918 0 0.00239952 0 0.0224955
Year 1989 Pred =  0.00328956 0.0119349 0.0537399 0.100606 0.0330392 0.0357602 0.179027 0.11653 0.019332 0.0111771 0.22282
0.00634998 0.00364274 0.004275 0.00320175 0.00375182 0.00596223 0.120512 0.00147026 0.00110139 0.000731577 0.00124857 0.00137886
0.00446034 0.00662093 0.0480366
Year 1990 Obs  =  0 0 0 0.0141014 0.0815082 0.0375038 0.019702 0.112711 0.0850085 0.0419042 0.0105011 0.209121 0.0149015
0.0151015 0.00520052 0.0262026 0.019502 0 0.169217 0 0.00350035 0.00350035 0.0166017 0 0.00310031 0.111111
Year 1990 Pred =  0.00269226 0.0125347 0.0310259 0.083081 0.0984816 0.0525074 0.0490153 0.157821 0.106658 0.0246134 0.0100736
0.196848 0.00551981 0.00312488 0.00362747 0.00269228 0.00313104 0.00494421 0.0994016 0.00120724 0.000900892 0.000596452
0.00101513 0.00111841 0.0036105 0.0437582
Year 1991 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 1991 Pred =  0.00310302 0.0111207 0.0352984 0.0517404 0.0843013 0.152293 0.0687901 0.0394718 0.127782 0.120344 0.0196592
0.00788675 0.151642 0.00419631 0.00234985 0.00270318 0.00199115 0.00230099 0.00361408 0.0723319 0.000875111 0.000650917
0.000429756 0.000729688 0.000802301 0.0335916
Year 1992 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 1992 Pred =  0.0142761 0.0144791 0.0354072 0.0667066 0.06111 0.146286 0.194842 0.0536303 0.0285445 0.118402 0.0789364
0.0126397 0.00498936 0.0946718 0.00259138 0.00143803 0.00164178 0.00120168 0.00138125 0.00215969 0.0430583 0.000519246 0.00038515
0.000253685 0.000429864 0.0200186
Year 1993 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 1993 Pred =  0.0170611 0.0498045 0.0344599 0.0500971 0.059579 0.0878177 0.17962 0.15302 0.0433881 0.0319878 0.0939251
0.061379 0.00967061 0.00376718 0.0707056 0.00191791 0.00105628 0.00119831 0.000872402 0.000998244 0.00155485 0.0308985
0.000371576 0.000274963 0.000180743 0.0143937
Year 1994 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 1994 Pred =  0.00796616 0.0652318 0.129823 0.0531856 0.0469943 0.0845954 0.104563 0.130968 0.111342 0.0437641 0.0228398
0.0657371 0.0422691 0.00657222 0.00253242 0.047102 0.00126802 0.000693936 0.000783042 0.000567502 0.000646876 0.00100428
0.0199021 0.00023877 0.00017633 0.0092332
Year 1995 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 1995 Pred =  0.008274 0.0309315 0.172835 0.204206 0.0523911 0.0681777 0.0904297 0.0682414 0.079332 0.0863371 0.0240224
0.0122888 0.0348019 0.0220836 0.00339642 0.00129691 0.0239401 0.000640408 0.000348598 0.000391584 0.00028271 0.000321201
0.000497286 0.00983147 0.000117712 0.00458295
Year 1996 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 1996 Pred =  0.00501112 0.0262344 0.0669092 0.222343 0.166356 0.0693223 0.0778423 0.0664213 0.0520627 0.0842115 0.0648756
0.0176938 0.00890613 0.0248907 0.015623 0.00238112 0.000902369 0.0165517 0.000440401 0.000238644 0.000267045 0.000192169
0.000217728 0.000336289 0.00663507 0.00313438
Year 1997 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 1997 Pred =  0.00371571 0.015952 0.056976 0.0864404 0.182286 0.222666 0.0804152 0.0582822 0.0518627 0.0566613 0.0648772
0.0489917 0.0131473 0.00653069 0.0180538 0.0112296 0.0016986 0.000639641 0.01167 0.000309108 0.000166858 0.000186107 0.000133554
0.000150958 0.000232689 0.00672529
Year 1998 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 1998 Pred =  0.00376282 0.0112545 0.0329636 0.0700409 0.0674588 0.233286 0.248821 0.058135 0.0441718 0.0550061 0.0425406
0.0477451 0.0354759 0.00939511 0.00461623 0.0126462 0.00780674 0.00117339 0.000439502 0.00798232 0.000210622 0.000113324
0.000126047 9.02393e-05 0.000101793 0.00463605
Year 1999 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 1999 Pred =  0.00420883 0.0123863 0.0252753 0.0440433 0.059457 0.0940076 0.28386 0.196027 0.0480334 0.0510613 0.045011
0.0341218 0.0376818 0.0276306 0.00723804 0.00352429 0.00958207 0.00587772 0.00087873 0.00032765 0.00592805 0.000155908 8.36531e-
05 9.28246e-05 6.63203e-05 0.00344018
Year 2000 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 2000 Pred =  0.00910204 0.0145904 0.0292945 0.0355658 0.0393847 0.0874599 0.121137 0.237087 0.172111 0.0591051 0.0444769
0.038431 0.0286661 0.0312409 0.0226592 0.00588221 0.00284253 0.00767952 0.00468553 0.000697333 0.000259017 0.00467104 0.000122508
6.55764e-05 7.26188e-05 0.00271017
Year 2001 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 2001 Pred =  0.0029511 0.0301369 0.0329584 0.0393709 0.0303739 0.0553259 0.107635 0.0966242 0.198798 0.202269 0.0491706
0.036269 0.0308359 0.0226986 0.024469 0.0175874 0.00453117 0.00217579 0.00584685 0.00355125 0.000526498 0.000194925 0.00350547
9.17208e-05 4.89972e-05 0.00205435
Year 2002 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 2002 Pred =  0.00540123 0.00975246 0.0679471 0.0442116 0.0335675 0.0426051 0.0679751 0.085726 0.0808973 0.233239 0.167989
0.0400292 0.0290524 0.0243757 0.0177485 0.0189603 0.0135252 0.00346253 0.00165377 0.004424 0.00267676 0.000395555 0.00014604
0.00262012 6.84167e-05 0.00155012
Year 2003 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 2003 Pred =  0.0013204 0.0188216 0.0231857 0.0961125 0.0397512 0.0496834 0.0552875 0.0571996 0.0758822 0.100397 0.204904
0.14466 0.0339172 0.0242929 0.0201612 0.0145474 0.0154235 0.0109326 0.00278387 0.00132363 0.00352727 0.00212724 0.000313478
0.000115463 0.00206734 0.001262
Year 2004 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 2004 Pred =  0.00260182 0.00468485 0.0455604 0.0333931 0.0879938 0.0599184 0.0656644 0.0473875 0.0515767 0.0959336 0.0898489
0.179747 0.124863 0.0288909 0.0204683 0.0168339 0.012055 0.0127001 0.00895411 0.00226978 0.00107506 0.00285555 0.00171735
0.000252477 9.28062e-05 0.00266074
Year 2005 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 2005 Pred =  0.00169153 0.00911223 0.011194 0.0647714 0.0301781 0.130944 0.0782012 0.0555819 0.0422053 0.064415 0.0848136
0.0778624 0.153268 0.10507 0.0240474 0.0168832 0.0137807 0.00980607 0.0102756 0.00721206 0.00182118 0.000859778 0.00227739
0.0013664 0.000200475 0.00216041
Year 2006 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 2006 Pred =  0.000821415 0.00608056 0.0223476 0.0163342 0.0600834 0.0460981 0.175425 0.0679493 0.0508171 0.0541085 0.0584583
0.0754475 0.0681525 0.132391 0.0897739 0.0203612 0.0141874 0.011507 0.00814444 0.00849589 0.0059401 0.0014951 0.000703879
0.00186002 0.00111373 0.00190248
Year 2007 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 2007 Pred =  0.00247901 0.00301503 0.015227 0.033297 0.0154703 0.0937039 0.0630599 0.155636 0.0634348 0.0665293 0.0501452
0.0531044 0.0674379 0.0601168 0.115514 0.0776231 0.0174726 0.0120976 0.00975962 0.0068765 0.00714576 0.00497986 0.00124994
0.000587063 0.00154819 0.00248955

Index Selectivity at Age
 1 0.799225 0.85516 1 1 1 1 0.902973 0.841819 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
 0.705789 0.62909 0.748954 0.718932 0.521442 0.696048 0.880082 0.76293 0.72581 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

Deviations section: only applicable if associated lambda > 0
Nyear1 observed, expected, standardized residual
```

```
2  48745.5  48742.9  0.00528627
3  46368  46365.7  0.00500119
4  44106.4  44104.4  0.00470653
5  41955.2  41953.3  0.00440029
6  39908.8  39907.2  0.0040855
7  37962.1  37960.6  0.00377043
8  36110.3  36109  0.00346552
9  34348.7  34347.6  0.00317951
10  32673.1  32672.1  0.00291741
11  31079.1  31078.3  0.00268068
12  29563  29562.3  0.00246846
13  28120.8  28120.2  0.00227875
14  26749  26748.4  0.00210911
15  25444.1  25443.6  0.00195713
16  24202.9  24202.4  0.00182059
17  23022.2  23021.8  0.00169749
18  21899.1  21898.8  0.00158614
19  20830.8  20830.5  0.00148504
20  19814.7  19814.4  0.00139292
21  18848.1  18847.8  0.0013087
22  17928.6  17928.4  0.00123142
23  17054  17053.8  0.0011603
24  16222.1  16221.9  0.00109463
25  15430.7  15430.6  0.00103383
26  300951  300891  0.0200398

Fleet Obs, Initial, and Stadardized Residual for Fmult
N/A

Standardized Residuals for Fmult_devs by fleet and year
N/A

Index Obs, Initial, and Standardized Residual for q_year1
N/A

Standardized Residuals for catchability deviations by index and year
N/A

Obs, Initial, and Stadardized Residual for SRR steepness
N/A

Obs, Initial, and Stadardized Residual for SRR unexpl S
642383  200000  2.10431

End of Deviations Section

Selectivity by age and year for each fleet
 fleet 1 selectivity at age
 0.0291893 0.0287622 0.0319188 0.0514053 0.23434 0.532849 0.63014 0.842048 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
 0.0291893 0.0287622 0.0319188 0.0514053 0.23434 0.532849 0.63014 0.842048 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
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 0.0291893 0.0287622 0.0319188 0.0514053 0.23434 0.532849 0.63014 0.842048 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

Fmult by year for each fleet
1913   1.13186e-05
1914   4.65886e-05
1915   6.28974e-05
1916   8.31335e-05
1917   0.000128972
1918   0.000114125
1919   3.87792e-05
1920   4.79501e-05
1921   1.95997e-05
1922   1.34361e-05
1923   1.08063e-05
1924   6.20287e-05
1925   3.86434e-05
1926   4.64035e-05
1927   4.68456e-05
1928   8.88897e-05
1929   5.26942e-05
1930   8.37034e-05
1931   0.000167353
1932   9.31618e-05
1933   0.000186247
1934   0.000806143
1935   0.0117904
1936   0.0370214
1937   0.0243946
1938   0.0349132
1939   0.0445806
1940   0.0490079
1941   0.0995626
1942   0.121287
1943   0.11685
1944   0.136228
1945   0.11382
1946   0.141126
1947   0.149861
1948   0.185337
1949   0.14757
1950   0.184425
1951   0.182792
1952   0.142785
1953   0.118622
1954   0.0943276
1955   0.102695
1956   0.108495
1957   0.145145
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1958   0.132158
1959   0.132998
1960   0.0994072
1961   0.125001
1962   0.128569
1963   0.0923007
1964   0.0753124
1965   0.071137
1966   0.0739233
1967   0.0923968
1968   0.0565511
1969   0.101947
1970   0.141265
1971   0.182919
1972   0.196333
1973   0.207792
1974   0.145073
1975   0.167227
1976   0.188335
1977   0.246385
1978   0.303262
1979   0.364648
1980   0.301533
1981   0.299575
1982   0.343829
1983   0.345944
1984   0.382745
1985   0.447507
1986   0.363824
1987   0.244977
1988   0.14831
1989   0.0759009
1990   0.0596688
1991   0.810317
1992   0.113762
1993   0.106902
1994   0.818588
1995   0.0737693
1996   0.0579532
1997   0.0222713
1998   0.0244263
1999   0.00905789
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Directed F by age and year for each fleet
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Average F for ages 1 to 26
Freport unweighted in .std and MCMC files
year    unweighted   Nweighted    Bweighted
1913  8.87233e-06  8.57849e-06  1.09242e-05
1914  3.65195e-05  3.5282e-05  4.49648e-05
1915  4.93035e-05  4.75958e-05  6.07036e-05
1916  6.51659e-05  6.28614e-05  8.02288e-05
1917  0.000101098  9.74526e-05  0.000124452
1918  8.94591e-05  8.61871e-05  0.00011011
1919  3.03979e-05  2.92782e-05  3.7411e-05
1920  3.75867e-05  3.6196e-05  4.62534e-05
1921  1.53636e-05  1.47951e-05  1.89051e-05
1922  1.05321e-05  1.01435e-05  1.296e-05
1923  8.47078e-06  8.15906e-06  1.04235e-05
1924  4.86225e-05  4.68379e-05  5.98315e-05
1925  3.02914e-05  2.91821e-05  3.72747e-05
1926  3.63744e-05  3.50454e-05  4.47604e-05
1927  3.67209e-05  3.53824e-05  4.51871e-05
1928  6.96781e-05  6.71441e-05  8.57436e-05
1929  4.13055e-05  3.98066e-05  5.08296e-05
1930  6.56127e-05  6.32376e-05  8.07424e-05
1931  0.000131183  0.000126446  0.000161435
1932  7.30268e-05  7.03951e-05  8.98681e-05
1933  0.000145994  0.000140746  0.000179665
1934  0.000631912  0.000609245  0.00077766
1935  0.00924212  0.0089102  0.0113737
1936  0.02902  0.0279142  0.0357024
1937  0.0191222  0.0182567  0.0235011
1938  0.0273674  0.0260061  0.0336076
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1939  0.0349455  0.0329864  0.0428661
1940  0.0384159  0.0359578  0.0470569
1941  0.0780443  0.0723934  0.0954481
1942  0.0950736  0.0864205  0.115894
1943  0.091595  0.0811806  0.111161
1944  0.106785  0.0924552  0.128992
1945  0.08922  0.0751955  0.10716
1946  0.110625  0.0915793  0.132225
1947  0.117472  0.0948678  0.139573
1948  0.14528  0.114217  0.171505
1949  0.115676  0.0879968  0.135388
1950  0.144565  0.107966  0.168084
1951  0.143285  0.104152  0.165132
1952  0.111925  0.079871  0.127926
1953  0.0929843  0.0651638  0.105791
1954  0.0739407  0.0516471  0.0839571
1955  0.0804999  0.0560018  0.0914636
1956  0.0850458  0.059382  0.0965576
1957  0.113775  0.079194  0.12889
1958  0.103594  0.0708276  0.116835
1959  0.104253  0.0713283  0.117081
1960  0.0779225  0.052473  0.087313
1961  0.0979845  0.0671098  0.109856
1962  0.100781  0.0673683  0.112946
1963  0.0723519  0.0489497  0.0809657
1964  0.0590352  0.0385052  0.0660223
1965  0.0557622  0.0370885  0.0625012
1966  0.0579463  0.0406762  0.0649767
1967  0.0724272  0.0557842  0.0815773
1968  0.0443288  0.03742  0.0502376
1969  0.0799132  0.0758973  0.09255
1970  0.110734  0.114469  0.130983
1971  0.143385  0.157934  0.17345
1972  0.1539  0.105693  0.189441
1973  0.162882  0.105684  0.198863
1974  0.113719  0.0682444  0.132917
1975  0.131084  0.0756941  0.143132
1976  0.14763  0.0982708  0.154107
1977  0.193134  0.166087  0.207808
1978  0.237718  0.219527  0.256467
1979  0.285837  0.24586  0.332691
1980  0.236363  0.209563  0.29284
1981  0.234829  0.189315  0.283541
1982  0.269518  0.17499  0.309309
1983  0.271176  0.146269  0.293337
1984  0.300022  0.169248  0.316951
1985  0.350788  0.173785  0.346254
1986  0.285191  0.111097  0.273081
1987  0.19203  0.0674766  0.180797
1988  0.116256  0.0398134  0.103416
1989  0.0594966  0.0200318  0.0505836
1990  0.0467726  0.0180281  0.0406013
1991  0.635184  0.282745  0.576265
1992  0.0891748  0.0234869  0.0718463
1993  0.0837972  0.017728  0.0675594
1994  0.641668  0.14019  0.500605
1995  0.0578256  0.00945504  0.0328209
1996  0.0454278  0.00964791  0.0255391
1997  0.0174578  0.00541777  0.0112839
1998  0.0191471  0.0074619  0.0143252
1999  0.00710022  0.00301252  0.00596864
2000  0.00666187  0.00247185  0.00624213
2001  0.00783888  0.00308157  0.00760385
2002  0.00433936  0.00154431  0.00414417
2003  0.00415699  0.00164653  0.00387799
2004  0.00319856  0.0013763  0.00297459
2005  0.0033312  0.00163813  0.00318082
2006  0.00270267  0.00153714  0.00265
2007  0.00397234  0.00231012  0.00412204

Population Numbers at the Start of the Year
 51250.4 48745.5 46368 44106.4 41955.2 39908.8 37962.1 36110.3 34348.7 32673.1 31079.1 29563 28120.8 26749 25444.1 24202.9
23022.2 21899.1 20830.8 19814.7 18848.1 17928.6 17054 16222.1 15430.7 300951
 52112.5 48750.9 46368.1 44106.6 41955.3 39908.9 37962.2 36110.4 34348.8 32673.1 31079.2 29563.1 28120.9 26749.1 25444.2 24202.9
23022.2 21899.2 20830.9 19814.7 18848.1 17928.6 17054 16222.1 15430.8 300948
 52128 49570.9 46373.2 44106.6 41955.4 39908.7 37961.6 36109.7 34347.9 32672.1 31078.2 29562.1 28119.9 26748.2 25443.3 24202.1
23021.5 21898.4 20830.1 19814 18847.4 17928 17053.4 16221.5 15430.2 300935
 52143.7 49585.6 47153.2 44111.5 41955.4 39908.6 37961.1 36108.7 34346.8 32670.7 31076.7 29560.6 28118.6 26746.8 25442 24200.9
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 37073 43638.8 36681.7 67538.1 44153.1 9773.6 6618.08 5257.91 3640.61 3698.05 2527.41 623.861 288.839 752.397 444.998 64.4898
23.4151 414.111 10.6809 5.63588 6.16473 4.35058 4.84751 7.38055 143.837 67.2329
 36471.5 35205.3 41441.4 34828.3 64053.2 41433.2 9014.23 6069.56 4763.27 3268.07 3319.63 2268.78 560.021 259.282 675.404 399.461
57.8905 21.0191 371.735 9.58793 5.05916 5.53389 3.90538 4.35146 6.6253 189.471
 51554.2 34670.2 33466.9 39392.2 33091.8 60612.1 38947.5 8455.11 5666.28 4431.16 3040.21 3088.18 2110.6 520.976 241.204 628.313
371.61 53.8543 19.5536 345.817 8.91945 4.70643 5.14806 3.6331 4.04807 182.424
 74059 49004.9 32956.2 31809.8 37424 31298.2 56910.4 36482.2 7879.01 5259.87 4113.34 2822.16 2866.68 1959.22 483.609 223.904
583.248 344.957 49.9916 18.1511 321.013 8.27971 4.36886 4.77882 3.37251 173.098
 195407 70428.4 46602.8 31339.8 30244.4 35523.3 29628.4 53826.8 34439.2 7427.17 4958.23 3877.45 2660.31 2702.29 1846.86 455.875
211.064 549.8 325.174 47.1247 17.1102 302.604 7.80488 4.11832 4.50476 166.35
 80932 185830 66977.2 44317.9 29798.3 28712.1 33638.2 28032.9 50836.5 32482.4 7005.15 4676.5 3657.13 2509.15 2548.74 1741.92
429.972 199.071 518.56 306.698 44.4471 16.138 285.41 7.36141 3.88431 161.147
 189572 76962.4 176717 63690.4 42134.8 28278.7 27166.6 31796.6 26442.1 47876 30590.7 6597.2 4404.16 3444.16 2363.03 2400.31
1640.48 404.933 187.478 488.362 288.837 41.8587 15.1982 268.789 6.93271 155.421
 56254.6 180298 73197.3 168068 60566.9 40027.9 26820.3 25751.7 30105.2 25013.7 45289.7 28938.2 6240.81 4166.24 3258.1 2235.37
2270.64 1551.86 383.057 177.35 461.979 273.233 39.5974 14.3771 254.268 153.583
 132153 53502.7 171478 69615.6 159828 57541.5 37968.3 25427.2 24386.7 28485.5 23667.9 42853 27381.3 5905.04 3942.09 3082.81
2115.11 2148.48 1468.37 362.448 167.808 437.124 258.533 37.467 13.6036 385.908
 103773 125692 50887.4 163094 66206.5 151888 54616.3 36023.8 24104.1 23102.8 26985.9 22421.9 40597 25939.8 5594.18 3734.56
2920.51 2003.76 2035.37 1391.07 343.367 158.974 414.112 244.923 35.4946 378.48
 59299.5 98699.3 119548 48399 155106 62914.9 144153 51813.7 34144.5 22831.3 21882.9 25560.9 21237.9 38453.3 24570.1 5298.78
3537.36 2766.3 1897.95 1927.9 1317.61 325.236 150.58 392.245 231.99 392.114
 206252 56401.7 93876.4 113705 46030.4 147422 59736.7 136825 49143.8 32367.5 21643.1 20744 24230.6 20132.6 36452 23291.3 5023.01
3353.26 2622.33 1799.17 1827.56 1249.04 308.309 142.743 371.831 591.623

q by index
 index 1 q over time
1963  0.594601
1964  0.594601
1965  0.594601
1966  0.594601
1967  0.594601
1968  0.594601
1969  0.594601
1970  0.594601
1971  0.594601
1972  0.594601
1973  0.594601
1974  0.594601
1975  0.594601
1976  0.594601
1977  0.594601
1978  0.594601
1979  0.594601
1980  0.594601
1981  0.594601
1982  0.594601
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1983  0.594601
1984  0.594601
1985  0.594601
1986  0.594601
1987  0.594601
1988  0.594601
1989  0.594601
1990  0.594601
1991  0.594601
1992  0.594601
1993  0.594601
1994  0.594601
1995  0.594601
1996  0.594601
1997  0.594601
1998  0.594601
1999  0.594601
2000  0.594601
2001  0.594601
2002  0.594601
2003  0.594601
2004  0.594601
2005  0.594601
2006  0.594601
2007  0.594601
 index 2 q over time
1968  0.542274
1969  0.542274
1970  0.542274
1971  0.542274
1972  0.542274
1973  0.542274
1974  0.542274
1975  0.542274
1976  0.542274
1977  0.542274
1978  0.542274
1979  0.542274
1980  0.542274
1981  0.542274
1982  0.542274
1983  0.542274
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1992  0.542274
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1994  0.542274
1995  0.542274
1996  0.542274
1997  0.542274
1998  0.542274
1999  0.542274
2000  0.542274
2001  0.542274
2002  0.542274
2003  0.542274
2004  0.542274
2005  0.542274
2006  0.542274
2007  0.542274

Proportions of catch at age by fleet
 fleet 1
Year 1 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 1 Pred =  0.00187876 0.00176079 0.00185873 0.00284748 0.0123476 0.0267068 0.0300425 0.0381871 0.0431379 0.0410335 0.0390317
0.0371276 0.0353164 0.0335936 0.0319548 0.030396 0.0289132 0.0275027 0.0261611 0.0248849 0.0236709 0.0225162 0.0214178 0.020373
0.0193792 0.377959
Year 2 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 2 Pred =  0.00191034 0.00176096 0.00185871 0.00284745 0.0123474 0.0267063 0.0300419 0.0381862 0.0431368 0.0410324 0.0390307
0.0371266 0.0353154 0.0335926 0.0319539 0.0303951 0.0289123 0.0275019 0.0261603 0.0248842 0.0236703 0.0225156 0.0214172 0.0203724
0.0193786 0.377944
Year 3 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 3 Pred =  0.00191093 0.0017906 0.00185894 0.00284749 0.0123476 0.0267064 0.0300416 0.0381857 0.0431358 0.0410312 0.0390295
0.0371255 0.0353144 0.0335917 0.0319529 0.0303942 0.0289115 0.0275011 0.0261595 0.0248834 0.0236695 0.0225149 0.0214166 0.0203718
0.019378 0.377929
Year 4 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 4 Pred =  0.00191155 0.00179118 0.00189025 0.00284787 0.0123479 0.0267068 0.0300418 0.0381853 0.043135 0.0410301 0.0390282
0.0371243 0.0353132 0.0335905 0.0319518 0.0303931 0.0289105 0.0275001 0.0261586 0.0248825 0.0236687 0.0225141 0.0214158 0.0203711
0.0193773 0.377912
Year 5 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 5 Pred =  0.00191221 0.00179178 0.00189088 0.00289587 0.0123496 0.0267074 0.030042 0.0381849 0.0431337 0.0410284 0.0390263
0.0371222 0.0353112 0.0335886 0.03195 0.0303914 0.0289088 0.0274986 0.0261571 0.0248811 0.0236673 0.0225128 0.0214146 0.0203699
0.0193762 0.377887
Year 6 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 6 Pred =  0.00191257 0.00179212 0.00189123 0.00289639 0.0125558 0.026707 0.0300378 0.0381791 0.0431262 0.0410203 0.0390182
0.0371141 0.0353034 0.0335811 0.0319429 0.0303846 0.0289023 0.0274924 0.0261512 0.0248755 0.023662 0.0225077 0.0214097 0.0203653
0.0193719 0.377799
Year 7 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
```

```
Year 7 Pred =  0.00191239 0.00179194 0.00189103 0.00289608 0.0125545 0.0271457 0.0300295 0.038164 0.043109 0.0410031 0.0390008
0.0370973 0.0352869 0.0335653 0.0319279 0.0303703 0.0288887 0.0274794 0.0261389 0.0248638 0.0236508 0.0224971 0.0213996 0.0203557
0.0193627 0.377617
Year 8 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 8 Pred =  0.00191204 0.0017916 0.00189066 0.0028955 0.012552 0.0271404 0.0305202 0.0381504 0.0430889 0.040984 0.0389819
0.0370784 0.0352686 0.0335475 0.0319108 0.030354 0.0288732 0.0274647 0.0261249 0.0248504 0.0236381 0.022485 0.0213881 0.0203448
0.0193523 0.377412
Year 9 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 9 Pred =  0.0019114 0.00179099 0.00189 0.00289448 0.0125475 0.0271308 0.0305097 0.0387681 0.0430671 0.0409588 0.038958
0.0370549 0.0352454 0.0335251 0.0318891 0.0303333 0.0288535 0.0274459 0.026107 0.0248334 0.023622 0.0224696 0.0213735 0.0203308
0.019339 0.37715
Year 10 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 10 Pred =  0.00191056 0.0017902 0.00188915 0.00289315 0.0125417 0.0271183 0.0304958 0.0387508 0.0437603 0.0409343 0.0389304
0.0370287 0.0352198 0.0335 0.0318649 0.0303099 0.0288311 0.0274246 0.0260867 0.0248141 0.0236036 0.0224521 0.0213569 0.020315
0.019324 0.376854
Year 11 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 11 Pred =  0.00190975 0.00178944 0.00188835 0.0028919 0.0125362 0.0271063 0.0304824 0.038734 0.0437417 0.0415941 0.038908
0.0370033 0.0351957 0.0334764 0.0318417 0.0302875 0.0288095 0.0274039 0.026067 0.0247954 0.0235858 0.0224352 0.0213407 0.0202997
0.0193094 0.376567
Year 12 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 12 Pred =  0.001909 0.00178876 0.00188763 0.0028908 0.0125312 0.0270952 0.0304698 0.038718 0.0437237 0.0415773 0.039536
0.0369828 0.0351723 0.0334542 0.0318199 0.0302661 0.0287888 0.027384 0.0260479 0.0247772 0.0235685 0.0224187 0.0213251 0.0202847
0.0192952 0.376287
Year 13 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 13 Pred =  0.00190827 0.00178811 0.00188697 0.0028898 0.0125269 0.0270853 0.0304581 0.038703 0.0437065 0.0415609 0.0395207
0.0375803 0.0351535 0.0334325 0.0317994 0.0302459 0.028769 0.0273648 0.0260294 0.0247595 0.0235516 0.0224027 0.0213098 0.0202702
0.0192814 0.376015
Year 14 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 14 Pred =  0.00190752 0.00178745 0.00188631 0.00288882 0.0125227 0.0270763 0.0304475 0.0386887 0.0436903 0.0415454 0.0395059
0.0375666 0.0357221 0.0334152 0.0317794 0.030227 0.0287504 0.0273465 0.0260117 0.0247424 0.0235352 0.0223871 0.0212949 0.0202561
0.0192679 0.375751
Year 15 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 15 Pred =  0.00190674 0.00178678 0.00188566 0.00288787 0.0125187 0.0270677 0.0304379 0.0386759 0.043675 0.0415307 0.0394918
0.0375531 0.0357096 0.0339563 0.0317635 0.0302085 0.0287329 0.0273292 0.0259947 0.0247259 0.0235193 0.0223718 0.0212805 0.0202423
0.0192548 0.375493
Year 16 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 16 Pred =  0.00190595 0.00178612 0.00188501 0.00288697 0.012515 0.0270598 0.030429 0.0386645 0.0436612 0.0415167 0.0394784
0.0375402 0.0356973 0.033945 0.0322784 0.0301939 0.0287158 0.027313 0.0259787 0.0247102 0.0235041 0.0223571 0.0212663 0.0202289
0.019242 0.375241
Year 17 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 17 Pred =  0.00190515 0.00178541 0.00188435 0.00288603 0.0125113 0.0270524 0.0304206 0.0386539 0.043649 0.0415043 0.0394657
0.0375281 0.0356857 0.0339338 0.032268 0.0306837 0.0287022 0.0272971 0.0259637 0.0246953 0.0234894 0.0223429 0.0212526 0.0202157
0.0192295 0.374994
Year 18 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 18 Pred =  0.0019043 0.00178468 0.00188363 0.00288505 0.0125074 0.0270447 0.0304126 0.0386437 0.0436377 0.0414933 0.0394545
0.0375166 0.0356746 0.0339232 0.0322579 0.0306744 0.0291683 0.0272847 0.025949 0.0246814 0.0234757 0.0223293 0.0212395 0.020203
0.0192173 0.374754
Year 19 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 19 Pred =  0.00190352 0.001784 0.00188298 0.00288414 0.0125039 0.0270374 0.0304051 0.0386345 0.0436267 0.041483 0.0394445
0.0375063 0.0356641 0.0339131 0.0322482 0.0306651 0.0291598 0.0277281 0.0259375 0.0246677 0.0234627 0.0223165 0.0212268 0.0201907
0.0192054 0.374518
Year 20 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 20 Pred =  0.00190278 0.0017833 0.0018823 0.00288321 0.0125002 0.0270305 0.0303974 0.0386257 0.0436172 0.0414731 0.0394352
0.0374974 0.0356548 0.0339036 0.032239 0.0306563 0.0291513 0.0277203 0.0263593 0.0246571 0.02345 0.0223045 0.0212149 0.0201789
0.019194 0.374288
Year 21 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 21 Pred =  0.00190199 0.00178265 0.0018816 0.00288222 0.0124964 0.0270228 0.0303901 0.0386163 0.0436077 0.0414646 0.0394264
0.037489 0.0356468 0.0338953 0.0322304 0.030648 0.0291434 0.0277127 0.0263523 0.0250585 0.0234402 0.0222927 0.0212037 0.0201679
0.0191831 0.374063
Year 22 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 22 Pred =  0.00190179 0.00178252 0.00188156 0.00288212 0.0124956 0.0270193 0.0303855 0.0386095 0.0435973 0.0414555 0.0394182
0.0374806 0.0356388 0.0338875 0.0322224 0.0306397 0.0291354 0.027705 0.026345 0.0250517 0.0238217 0.0222834 0.0211925 0.0201572
0.0191725 0.373838
Year 23 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 23 Pred =  0.00191166 0.00179182 0.0018914 0.00289703 0.0125475 0.0270852 0.0304386 0.0386305 0.0435796 0.041434 0.0393985
0.0374623 0.0356208 0.0338705 0.0322061 0.0306236 0.0291194 0.0276898 0.0263303 0.0250378 0.0238087 0.0226397 0.0211777 0.0201409
0.0191571 0.37351
Year 24 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 24 Pred =  0.00195255 0.00183071 0.00193243 0.00295914 0.0127851 0.0274399 0.0306964 0.0388074 0.0435896 0.041368 0.0393314
0.0373992 0.0355612 0.0338132 0.0321516 0.0305717 0.0290695 0.0276417 0.0262846 0.0249942 0.0237672 0.0226005 0.0214908 0.020103
0.0191189 0.37274
Year 25 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 25 Pred =  0.00200132 0.00187904 0.00198411 0.00303849 0.0131365 0.0281118 0.0311678 0.0392263 0.0438142 0.0413174 0.0392116
0.0372811 0.0354496 0.0337075 0.0320506 0.0304756 0.0289781 0.0275542 0.0262008 0.0249144 0.0236913 0.0225282 0.0214223 0.0203705
0.0190551 0.371432
Year 26 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 26 Pred =  0.00204361 0.00192198 0.00203222 0.00311295 0.0134482 0.0287865 0.0318675 0.0397306 0.0442021 0.0414926 0.0391281
0.0371339 0.0353057 0.0335712 0.0319214 0.0303523 0.0288608 0.0274426 0.0260941 0.0248125 0.0235943 0.0224359 0.0213345 0.0202872
0.0192912 0.369796
Year 27 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 27 Pred =  0.00210471 0.00197823 0.0020952 0.00321346 0.0138723 0.0296008 0.0327104 0.0406577 0.044725 0.0417822 0.0392211
0.036986 0.035101 0.0333729 0.0317334 0.0301739 0.0286906 0.0272808 0.0259402 0.0246656 0.0234541 0.0223026 0.0212077 0.0201665
0.0191766 0.367787
Year 28 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 28 Pred =  0.00217521 0.00204708 0.00216678 0.00332862 0.0143804 0.0306153 0.0336685 0.0417347 0.045707 0.0421867 0.0394109
0.0369951 0.0348869 0.0331088 0.0314788 0.0299323 0.0284613 0.0270623 0.0257325 0.024468 0.0232657 0.022123 0.0210368 0.020004
0.019022 0.365001
Year 29 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 29 Pred =  0.00229703 0.00216435 0.00229363 0.00351956 0.0151598 0.0320476 0.0350557 0.0430106 0.0467724 0.042964 0.0396549
0.0370457 0.0347749 0.0327932 0.0311219 0.0295897 0.028136 0.0267533 0.0254382 0.0241882 0.0229996 0.0218695 0.0207953 0.0197743
0.0188035 0.360977
Year 30 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 30 Pred =  0.00249209 0.00235364 0.0024972 0.00383536 0.0164611 0.0344232 0.0370655 0.0450203 0.0481132 0.0437039 0.0401453
0.0370533 0.0346153 0.0324935 0.0306418 0.0290801 0.0276484 0.0262901 0.0249981 0.0237693 0.0226013 0.0214907 0.0204347 0.019431
0.018477 0.354864
```

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Year 31 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 31 Pred =  0.00269425 0.00256073 0.00272331 0.00418767 0.0179927 0.0374406 0.0397559 0.0475026 0.050154 0.0446917 0.0405959
0.0372904 0.0344183 0.0321537 0.0301827 0.0284627 0.0270121 0.0256822 0.0244205 0.0232204 0.022079 0.020994 0.0199624 0.0189815
0.0180492 0.346792
Year 32 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 32 Pred =  0.00290418 0.00277013 0.00296463 0.00456864 0.0196197 0.0407721 0.0430699 0.0506607 0.0525673 0.0462943 0.0412523
0.0374718 0.0344207 0.0317696 0.0296792 0.02786 0.0262723 0.0249333 0.0237058 0.0225412 0.0214334 0.0203798 0.0193784 0.0184262
0.0175207 0.336764
Year 33 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 33 Pred =  0.00309552 0.00296276 0.00318225 0.00493593 0.0212819 0.0442689 0.0466128 0.0546164 0.055764 0.0481866 0.0424364
0.0378146 0.0343491 0.0315522 0.0291221 0.0272059 0.0255383 0.0240829 0.0228555 0.0217303 0.0206627 0.0196473 0.0186815 0.0177635
0.0168906 0.32476
Year 34 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 34 Pred =  0.00324064 0.00314325 0.00338752 0.00527211 0.0228282 0.0475851 0.0502604 0.0586031 0.0596282 0.0507944 0.0438922
0.0386545 0.0344446 0.0312879 0.0287403 0.0265267 0.0247813 0.0232623 0.0219367 0.0208186 0.0197937 0.0188213 0.0178963 0.0170166
0.0161804 0.311203
Year 35 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 35 Pred =  0.0035462 0.00332026 0.00362624 0.005662 0.0245734 0.051246 0.0539927 0.0630084 0.0635647 0.0538392 0.045863
0.039631 0.0349017 0.0311005 0.0282503 0.0259501 0.0239514 0.0223754 0.0210039 0.0198069 0.0187975 0.017872 0.016994 0.0161589
0.0153646 0.2956
Year 36 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 36 Pred =  0.003919 0.00367489 0.00387406 0.00612782 0.0265943 0.0552598 0.0580734 0.0673315 0.0677393 0.0568453 0.0481479
0.0410148 0.0354416 0.0312123 0.0278129 0.025264 0.0232069 0.0214195 0.0200101 0.0187836 0.0177132 0.0168104 0.0159828 0.0151976
0.0144507 0.278092
Year 37 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 37 Pred =  0.00404743 0.00402456 0.00424941 0.00648993 0.0286203 0.059597 0.0621751 0.0720481 0.071933 0.0600202 0.0503676
0.0426613 0.0363411 0.0314029 0.0276555 0.0246435 0.0223851 0.0205624 0.0189787 0.0177299 0.0166431 0.0156947 0.0148948 0.0141615
0.0134658 0.259207
Year 38 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 38 Pred =  0.00425575 0.00412148 0.00461431 0.00705633 0.0299574 0.0632721 0.0664215 0.0762703 0.0762185 0.0633119 0.0528268
0.0443311 0.0375484 0.0319856 0.0276393 0.024341 0.02169 0.0197022 0.018098 0.0167041 0.015605 0.0146485 0.0138137 0.0131097
0.0124642 0.239993
Year 39 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 39 Pred =  0.0045314 0.00436372 0.00475831 0.00771523 0.03279 0.0664593 0.0703692 0.0811699 0.0800598 0.0663589 0.0551219
0.0459931 0.0385964 0.0326911 0.0278479 0.0240639 0.0211923 0.0188842 0.0171536 0.0157568 0.0145433 0.0135863 0.0127535 0.0120268
0.0114138 0.219799
Year 40 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 40 Pred =  0.00446549 0.00452424 0.00490586 0.00775037 0.0350517 0.0715442 0.0728498 0.0851059 0.0845893 0.0692109 0.0573667
0.0476523 0.0397606 0.0333662 0.0282612 0.0240743 0.020803 0.0183205 0.0163252 0.0148291 0.0136216 0.0125725 0.0117453 0.0110253
0.010397 0.199881
Year 41 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 41 Pred =  0.00539697 0.00431354 0.00492117 0.00773353 0.0341659 0.0747471 0.0772078 0.0871296 0.088259 0.0730141 0.0597401
0.0495166 0.0411315 0.0343198 0.0288004 0.0243939 0.0207799 0.0179563 0.0158135 0.0140913 0.0127999 0.0117576 0.0108521 0.010138
0.00951659 0.181504
Year 42 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 42 Pred =  0.00499029 0.00510641 0.00459591 0.0076009 0.0334841 0.0719751 0.0800735 0.0920054 0.0904349 0.0763993 0.0632029
0.0517126 0.0428628 0.0356045 0.0297081 0.0249304 0.021116 0.0179877 0.0155434 0.0136886 0.0121978 0.0110799 0.0101777 0.00939384
0.00877574 0.165352
Year 43 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 43 Pred =  0.00546036 0.0046909 0.00540518 0.0070519 0.0326768 0.0701112 0.0768908 0.0951906 0.095459 0.0784093 0.0662401
0.0547985 0.0448361 0.0371631 0.03087 0.0257576 0.0216152 0.0183081 0.0155957 0.0134765 0.0118684 0.0105758 0.00960654 0.00882434
0.00814469 0.150973
Year 44 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 44 Pred =  0.00471536 0.00518326 0.00501416 0.00837458 0.0305939 0.0689349 0.0753456 0.0918583 0.099117 0.0830043 0.0681791
0.0575976 0.0476488 0.0389862 0.0323144 0.0268424 0.022397 0.0187951 0.0159194 0.0135609 0.0117182 0.0103199 0.00919592
0.00835316 0.00767301 0.138358
Year 45 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 45 Pred =  0.00509852 0.00455132 0.0056333 0.00789607 0.0368038 0.0649957 0.074409 0.0900475 0.0953605 0.0858858 0.071924
0.0590778 0.0499089 0.0412881 0.0337819 0.0280007 0.0232591 0.0194072 0.0162861 0.0137943 0.0117507 0.010154 0.00894227
0.00796835 0.00723809 0.126537
Year 46 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 46 Pred =  0.00558912 0.00493999 0.00496556 0.00890584 0.0348651 0.0784396 0.070032 0.0887232 0.09298 0.0819395 0.0737982
0.0618014 0.0507632 0.0428847 0.0354772 0.0290274 0.0240599 0.0199856 0.0166758 0.013994 0.0118529 0.0100969 0.00872488
0.00768373 0.00684688 0.114947
Year 47 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 47 Pred =  0.0048278 0.00538236 0.00535676 0.00780246 0.0390868 0.07394 0.0842634 0.0833003 0.0915143 0.0798944 0.0704076
0.0634121 0.0531037 0.0436189 0.0368492 0.0304843 0.0249422 0.0206738 0.0171729 0.0143289 0.0120245 0.0101847 0.00867588
0.00749697 0.00660235 0.104653
Year 48 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 48 Pred =  0.00600421 0.00456092 0.00572593 0.00826044 0.0337082 0.0819898 0.0786787 0.099617 0.0856059 0.0783413 0.068394
0.0602728 0.0542842 0.0454597 0.0373402 0.031545 0.0260962 0.0213519 0.0176979 0.014701 0.0122664 0.0102936 0.00871871 0.00742704
0.00641782 0.0952411
Year 49 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 49 Pred =  0.00459184 0.00567746 0.00485624 0.00883562 0.03564 0.0705714 0.0874184 0.0931137 0.102663 0.0736941 0.0674403
0.0588771 0.051886 0.0467307 0.0391341 0.0321444 0.0271556 0.022465 0.0183809 0.0152353 0.0126554 0.0105595 0.00886131 0.00750552
0.00639358 0.0875133
Year 50 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 50 Pred =  0.00678931 0.00436856 0.00608212 0.00753896 0.0383304 0.0748078 0.0751308 0.103131 0.0953652 0.0876442 0.0629131
0.0575742 0.0502638 0.0442954 0.0398943 0.033409 0.0274419 0.0231829 0.0191785 0.0156918 0.0130065 0.010804 0.00901472 0.00756496
0.00640751 0.0801689
Year 51 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 51 Pred =  0.00438312 0.00639948 0.00463694 0.00935855 0.0325212 0.0803997 0.0796791 0.088991 0.106299 0.081909 0.0752774
0.0540359 0.0494504 0.0431714 0.0380452 0.0342651 0.0286949 0.0235698 0.0199117 0.0164724 0.0134777 0.0111712 0.0092795
0.00774273 0.00649752 0.0743603
Year 52 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 52 Pred =  0.00783641 0.00403593 0.00663571 0.00697158 0.0395212 0.0671714 0.084862 0.0938604 0.0917032 0.0915519 0.0705456
0.064834 0.0465394 0.04259 0.0371822 0.0327671 0.0295115 0.024714 0.0202999 0.0171493 0.0141871 0.0116079 0.00962141 0.00799214
0.00666856 0.0696402
Year 53 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 53 Pred =  0.00493147 0.00716602 0.00415612 0.00990872 0.0292564 0.0812952 0.0708057 0.0999611 0.0969267 0.0792589 0.0791281
0.0609724 0.056036 0.0402239 0.0368105 0.0321365 0.0283206 0.0255067 0.0213603 0.0175452 0.0148221 0.0122619 0.0100327 0.00831577
0.00690759 0.0659535
Year 54 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
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Year 54 Pred =  0.00269112 0.00453728 0.00742471 0.00624405 0.0418276 0.0605343 0.086241 0.0839297 0.103903 0.0843508 0.0689754
0.0688615 0.0530615 0.0487655 0.035005 0.0320344 0.0279669 0.0246461 0.0221973 0.0185889 0.0152687 0.012899 0.010671 0.00873098
0.00723683 0.0634077
Year 55 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 55 Pred =  0.000671295 0.00249672 0.00474027 0.0112456 0.0265278 0.0868456 0.064356 0.102238 0.0871004 0.0902574 0.0732732
0.059917 0.0598181 0.046093 0.0423612 0.0304079 0.0278274 0.0242941 0.0214094 0.0192822 0.0161476 0.0132635 0.011205 0.00926958
0.00758437 0.0613669
Year 56 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 56 Pred =  0.000487381 0.000619777 0.0025959 0.00714752 0.0477084 0.0551951 0.0924208 0.0765826 0.10658 0.075889 0.0786396
0.0638416 0.0522046 0.0521184 0.04016 0.0369086 0.0264938 0.0242455 0.021167 0.0186536 0.0168002 0.0140691 0.0115563 0.00976273
0.00807642 0.060076
Year 57 Obs  =  0 0 0 0.00059994 0.0110989 0.0114989 0.0264974 0.159384 0.0659934 0.176482 0.069893 0.10449 0.0863914 0.0583942
0.0740926 0.0353965 0.019698 0.0137986 0.0158984 0.0111989 0.0118988 0.00909909 0.0122988 0.0009999 0.00259974 0.0222978
Year 57 Pred =  0.000226822 0.000448413 0.000642106 0.00389878 0.0300903 0.0981765 0.058286 0.108817 0.0790249 0.0921879
0.0656413 0.0680205 0.0552208 0.0451551 0.0450806 0.034737 0.0319246 0.0229162 0.0209715 0.0183087 0.0161347 0.0145316 0.0121693
0.00999577 0.00844442 0.0589494
Year 58 Obs  =  0 0 0 0 0.00269946 0.0740852 0.0739852 0.0193961 0.177165 0.0588882 0.152569 0.04999 0.0858828 0.0487902
0.0420916 0.0637872 0.0324935 0.029994 0.00719856 0.0120976 0.00669866 0.00969806 0.0104979 0.00889822 0.00119976 0.0318936
Year 58 Pred =  0.000290843 0.000222951 0.000496296 0.00102978 0.0174567 0.065206 0.108223 0.0711895 0.115564 0.0700884 0.0817629
0.0582183 0.0603284 0.0489762 0.0400488 0.0399827 0.0308088 0.0283144 0.0203248 0.0186 0.0162383 0.0143101 0.0128883 0.0107931
0.0088654 0.0597727
Year 59 Obs  =  0 0 0 0 0 0.00139972 0.0375925 0.0858828 0.029794 0.153269 0.0535893 0.126075 0.059888 0.0826835 0.0712857
0.0560888 0.0427914 0.0535893 0.0260948 0.0224955 0.0108978 0.0202959 0.0107978 0.0054989 0.00269946 0.0472905
Year 59 Pred =  0.000345534 0.000303206 0.0002617 0.000843738 0.00486754 0.0395504 0.0745542 0.136258 0.0773588 0.104535
0.0633996 0.07396 0.0526623 0.054571 0.0443022 0.0362268 0.036167 0.0278686 0.0256123 0.0183851 0.0168249 0.0146886 0.0129444
0.0116583 0.00976311 0.0620877
Year 60 Obs  =  0 0 0 0 0 0 0.0196 0.0692 0.1554 0.036 0.1592 0.0584 0.0606 0.0419 0.0742 0.0514 0.0253 0.0268 0.0471 0.0154
0.0212 0.0246 0.0151 0.0113 0.0269 0.0604
Year 60 Pred =  0.0250138 0.000369113 0.000364684 0.000455794 0.00407916 0.0112143 0.0456626 0.094459 0.148165 0.0697794
0.0942929 0.0571879 0.0667135 0.0475026 0.0492243 0.0399615 0.0326774 0.0326234 0.0251381 0.0231029 0.0165838 0.0151764 0.0132494
0.0116762 0.0105161 0.064811
Year 61 Obs  =  0 0 0 0 0 0 0.0050005 0.0523052 0.168517 0.178118 0.0467047 0.155816 0.0441044 0.0658066 0.050405 0.0430043
0.0382038 0.0293029 0.0183018 0.019802 0.00870087 0.0125013 0.0090009 0.00630063 0.00610061 0.0420042
Year 61 Pred =  0.00113257 0.0283794 0.000471505 0.000674486 0.00233733 0.00993947 0.0136579 0.060917 0.107899 0.140237 0.0660456
0.0892475 0.0541279 0.0631438 0.0449608 0.0465904 0.0378233 0.0309289 0.0308778 0.023793 0.0218667 0.0156964 0.0143644 0.0125405
0.0110514 0.0712965
Year 62 Obs  =  0 0 0.0121988 0.00419958 0 0.00069993 0.00029997 0.00689931 0.0747925 0.187381 0.116788 0.0965903 0.0677932
0.0441956 0.0516948 0.0370963 0.0576942 0.0360964 0.0253975 0.0261974 0.0233977 0.0289971 0.0107989 0.0112989 0.00989901 0.069593
Year 62 Pred =  0.000639547 0.00127776 0.0360523 0.000867761 0.00346084 0.00574441 0.0122238 0.0185046 0.0709069 0.103966
0.135125 0.0636382 0.0859943 0.0521548 0.0608421 0.0433219 0.0448921 0.0364446 0.0298015 0.0297523 0.0229257 0.0210696 0.0151242
0.0138408 0.0120834 0.0793461
Year 63 Obs  =  0 0 0.00020006 0.0294088 0.0030009 0.00050015 0 0.00130039 0.00520156 0.0822247 0.184455 0.0911273 0.0817245
0.0610183 0.0427128 0.0569171 0.0575173 0.0522157 0.040012 0.0472142 0.0257077 0.0375113 0.0208062 0.0124037 0.0126038 0.0542163
Year 63 Pred =  0.000462731 0.000697413 0.00156889 0.0641225 0.0042971 0.00823022 0.00689501 0.0161792 0.0211544 0.0674559
0.0989055 0.128548 0.0605409 0.0818089 0.0496164 0.0578809 0.0412134 0.0427072 0.0346708 0.028351 0.0283042 0.0218099 0.0200441
0.0143881 0.0131671 0.0869796
Year 64 Obs  =  0 0 0 0.0064987 0.29854 0.0145971 0 0 0.00069986 0.00159968 0.0155969 0.090182 0.112478 0.0566887 0.0574885
0.0462907 0.0410918 0.0388922 0.0474905 0.0202959 0.0255949 0.0226955 0.0107978 0.0223955 0.00309938 0.0669866
Year 64 Pred =  0.000437403 0.000418884 0.000710835 0.0023158 0.262966 0.00841974 0.00810385 0.00746223 0.0150632 0.0163594
0.0521658 0.0764869 0.0994106 0.0468182 0.0632655 0.03837 0.0447612 0.0318717 0.0330269 0.0268121 0.0219248 0.0218886 0.0168663
0.0155008 0.0111268 0.0774468
Year 65 Obs  =  0 0 0 0 0.0061 0.4335 0.0081 0 0 0 0.0021 0.0551 0.0327 0.1039 0.0472 0.0711 0.0379 0.0308 0.0275 0.0119 0.0183
0.014 0.003 0.0148 0.0262 0.0558
Year 65 Pred =  0.00024936 0.000370059 0.000398987 0.000979957 0.00882195 0.473715 0.00757701 0.00796109 0.00626488 0.0104857
0.0113881 0.0363134 0.0532437 0.0692013 0.0325909 0.0440401 0.02671 0.031159 0.0221864 0.0229905 0.0186643 0.0152622 0.015237
0.0117409 0.0107903 0.0616575
Year 66 Obs  =  0 0 0 0 0 0.00640192 0.576873 0.0050015 0 0.00080024 0.00080024 0.00430129 0.0396119 0.0348104 0.0692208
0.0410123 0.0307092 0.0203061 0.0211063 0.030109 0.0210063 0.0172052 0.0117035 0.00450135 0.0124037 0.0521156
Year 66 Pred =  0.000368293 0.000271696 0.00045391 0.00070787 0.00477713 0.0200634 0.532001 0.00921016 0.00818274 0.00531295
0.00889246 0.00965767 0.0307957 0.0451535 0.0586863 0.0276388 0.0373483 0.0226515 0.0264245 0.0188152 0.0194972 0.0158283
0.0129431 0.0129218 0.00995691 0.0614395
Year 67 Obs  =  0 0 0 0 0.0006 0.0051 0.0211 0.5911 0.0038 0.0029 0.0012 0.0042 0.0135 0.0306 0.0491 0.0324 0.0394 0.0245 0.021
0.0251 0.0199 0.0148 0.0133 0.0134 0.0106 0.0624
Year 67 Pred =  0.0107308 0.000391845 0.000325395 0.000785773 0.00334675 0.0103904 0.0212999 0.605916 0.00877478 0.00640079
0.00415595 0.00695595 0.00755452 0.0240893 0.0353204 0.0459062 0.0216199 0.029215 0.0177187 0.02067 0.0147178 0.0152513 0.0123814
0.0101245 0.0101078 0.0558485
Year 68 Obs  =  0 0 0 0 0 0.0049 0.0065 0.0412 0.6266 0.0077 0.0016 0.0017 0.008 0.0182 0.0308 0.0453 0.0319 0.0246 0.0209 0.0168
0.0175 0.0137 0.0129 0.0109 0.0098 0.0485
Year 68 Pred =  0.000511011 0.0125673 0.000516632 0.000620438 0.00411254 0.00808385 0.0121671 0.0268356 0.636889 0.00753208
0.0054943 0.00356738 0.00597084 0.00648464 0.0206778 0.0303183 0.0394049 0.0185581 0.0250775 0.0152093 0.0177427 0.0126335
0.0130914 0.0106279 0.00869065 0.0566154
Year 69 Obs  =  0 0 0.00120024 0 0.00390078 0.0020004 0.00290058 0.00240048 0.0114023 0.631426 0.00430086 0.00110022 0 0.00220044
0.0162032 0.0186037 0.065013 0.0258052 0.0272054 0.020204 0.0162032 0.0194039 0.0156031 0.0166033 0.0178036 0.0785157
Year 69 Pred =  0.00132259 0.000653003 0.0180791 0.00107495 0.00354632 0.0109159 0.0105067 0.0170738 0.0316515 0.616847
0.00729506 0.0053214 0.00345512 0.00578295 0.00628058 0.0200271 0.0293642 0.0381649 0.0179741 0.0242884 0.0147307 0.0171844
0.0122359 0.0126794 0.0102935 0.063251
Year 70 Obs  =  0 0 0.00019998 0.0189981 0.00859914 0.00419958 0.00639936 0.00209979 0 0.00109989 0.509049 0.00389961 0.00219978
0.00149985 0.0089991 0.0129987 0.0407959 0.0316968 0.0587941 0.0226977 0.0350965 0.0338966 0.0210979 0.00939906 0.00729927
0.158984
Year 70 Pred =  0.0090406 0.00168476 0.000936371 0.0374799 0.00609783 0.00928514 0.0139712 0.0144583 0.0196908 0.0299801 0.584273
0.00690982 0.00504039 0.00327266 0.00547756 0.00594891 0.0189695 0.0278135 0.0361495 0.0170249 0.0230058 0.0139528 0.0162769
0.0115898 0.0120098 0.0696607
Year 71 Obs  =  0 0 0 0.001 0.1464 0.0138 0.004 0.0037 0.0075 0.0043 0.0122 0.4302 0.005 0.0092 0.0056 0.0036 0.0074 0.0277
0.0234 0.0478 0.0147 0.0194 0.0272 0.0169 0.0114 0.1576
Year 71 Pred =  0.0142601 0.0100444 0.0021071 0.00169296 0.185306 0.0138535 0.0102396 0.016524 0.0142562 0.0158846 0.024185
0.471334 0.00557417 0.00406609 0.00264006 0.00441876 0.004799 0.0153027 0.0224373 0.0291619 0.013734 0.0185588 0.0112558
0.0131306 0.00934949 0.0658838
Year 72 Obs  =  0 0 0.0033 0.0008 0.0037 0.4813 0 0.0014 0.0029 0 0.0025 0.0011 0.2575 0 0.0032 0.0035 0.0025 0.0066 0.0151 0.012
0.0234 0.0155 0.0104 0.0113 0.0117 0.1303
Year 72 Pred =  0.0044024 0.0144448 0.0114527 0.00347187 0.00760299 0.380348 0.0137753 0.0108802 0.0145968 0.0103013 0.0114779
0.0174756 0.340577 0.00402779 0.00293808 0.00190766 0.00319291 0.00346766 0.0110575 0.0162127 0.0210718 0.00992394 0.0134102
0.00813319 0.00948792 0.0543621
Year 73 Obs  =  0 0 0.0026 0.0143 0.0032 0.003 0.3734 0 0.0027 0.0011 0.0013 0.0039 0.0012 0.3131 0 0.0024 0.0011 0.0099 0.0113
0.0254 0.0225 0.0183 0.0193 0.0139 0.0105 0.1456
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Year 73 Pred =  0.00894126 0.00524345 0.019364 0.0221713 0.0182075 0.0179963 0.432381 0.0166 0.0108056 0.0118196 0.00834135
0.00929411 0.0141507 0.275779 0.00326146 0.00237908 0.00154471 0.00258542 0.0028079 0.00895366 0.0131281 0.0170627 0.0080358
0.0108588 0.00658576 0.0517019
Year 74 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 74 Pred =  0.0314864 0.00894329 0.00590387 0.0315078 0.0983944 0.0366771 0.0172971 0.442513 0.0139752 0.00737415 0.0080661
0.00569242 0.00634262 0.00965692 0.188201 0.00222573 0.00162357 0.00105416 0.00176438 0.00191621 0.00611028 0.00895905 0.0116442
0.00548391 0.00741041 0.0397775
Year 75 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 75 Pred =  0.0270162 0.0276273 0.008835 0.00843925 0.124255 0.180546 0.0327153 0.016693 0.357772 0.0092278 0.00486914
0.00532603 0.0037587 0.00418802 0.00637645 0.124269 0.00146965 0.00107204 0.00069606 0.00116502 0.00126527 0.00403461 0.00591565
0.00768861 0.00362101 0.0311581
Year 76 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 76 Pred =  0.0163578 0.0239198 0.0275435 0.0127594 0.0339576 0.238537 0.172418 0.0343421 0.0149879 0.26507 0.0068368
0.0036075 0.00394601 0.00278479 0.00310287 0.00472425 0.0920695 0.00108885 0.000794263 0.000515705 0.000863152 0.000937428
0.00298921 0.00438285 0.00569643 0.0257675
Year 77 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 77 Pred =  0.01744 0.0140189 0.0230852 0.0385399 0.0501167 0.0648921 0.230952 0.185772 0.0321686 0.0116799 0.206565
0.00532782 0.00281127 0.00307507 0.00217014 0.00241802 0.00368154 0.0717484 0.000848523 0.000618958 0.000401881 0.000672642
0.000730524 0.00232944 0.00341549 0.0245194
Year 78 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 78 Pred =  0.0128167 0.0132208 0.0119679 0.0285805 0.134231 0.0856995 0.0568899 0.226517 0.159867 0.0231681 0.00841194
0.14877 0.00383714 0.0020247 0.00221469 0.00156296 0.00174148 0.00265148 0.0516739 0.000611114 0.000445779 0.000289439
0.000484443 0.00052613 0.00167769 0.020119
Year 79 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 79 Pred =  0.0153049 0.0121532 0.0141011 0.0183792 0.115532 0.240235 0.0762577 0.0528241 0.175683 0.103906 0.0150582
0.00546737 0.0966938 0.00249397 0.00131596 0.00143945 0.00101585 0.00113188 0.00172334 0.0335856 0.000397196 0.000289736
0.000188122 0.000314866 0.00034196 0.0141668
Year 80 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 80 Pred =  0.0635434 0.0142786 0.0127694 0.0214502 0.0777025 0.222021 0.210073 0.0713456 0.0395914 0.103132 0.0609962
0.00883966 0.00320953 0.0567625 0.00146404 0.000772515 0.000845004 0.000596338 0.000664452 0.00101166 0.0197159 0.000233167
0.000170085 0.000110434 0.000184837 0.00851714
Year 81 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 81 Pred =  0.0732433 0.0473714 0.0119866 0.0155378 0.0730871 0.128639 0.186939 0.196553 0.0581182 0.0269079 0.0700924
0.0414555 0.0060078 0.00218133 0.0385781 0.000995022 0.000525033 0.000574299 0.000405295 0.000451589 0.000687564 0.0133997
0.00015847 0.000115596 7.50553e-05 0.00591422
Year 82 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 82 Pred =  0.0394459 0.071569 0.052066 0.0189662 0.0646371 0.133878 0.116278 0.175789 0.153517 0.0378937 0.0175443 0.045701
0.0270295 0.00391715 0.00142225 0.0251534 0.000648765 0.000342327 0.000374449 0.000264257 0.000294441 0.000448299 0.00873677
0.000103324 7.53701e-05 0.00390507
Year 83 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 83 Pred =  0.044491 0.0368504 0.0753037 0.0793422 0.0806113 0.125509 0.118351 0.110379 0.133946 0.0915444 0.0225966
0.0104619 0.0272523 0.0161181 0.00233586 0.00084811 0.0149993 0.000386869 0.000204135 0.00022329 0.000157581 0.00017558
0.000267328 0.00520987 6.16139e-05 0.0023736
Year 84 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 84 Pred =  0.0250484 0.0290536 0.0270996 0.0803118 0.238095 0.11882 0.0948841 0.100126 0.0819634 0.0832566 0.0569013
0.0140454 0.00650281 0.0169392 0.0100185 0.0014519 0.00052716 0.00932314 0.000240466 0.000126884 0.00013879 9.79474e-05
0.000109135 0.000166163 0.0032383 0.00151366
Year 85 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 85 Pred =  0.0154631 0.014708 0.0192127 0.0259988 0.217532 0.318904 0.0819611 0.0735737 0.0684508 0.046964 0.0477049
0.0326037 0.00804782 0.00372603 0.00970593 0.00574048 0.000831919 0.000302056 0.00534203 0.000137784 7.2703e-05 7.95251e-05
5.61226e-05 6.25329e-05 9.52092e-05 0.00272281
Year 86 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 86 Pred =  0.015461 0.0102455 0.0109748 0.0207995 0.0794764 0.329813 0.250329 0.0724335 0.0575378 0.0449959 0.0308716
0.0313587 0.0214319 0.00529021 0.00244929 0.00638016 0.00377349 0.000546859 0.000198555 0.00351157 9.05719e-05 4.77911e-05
5.22756e-05 3.6892e-05 4.11058e-05 0.00185242
Year 87 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 87 Pred =  0.0172892 0.0112729 0.00841303 0.0130767 0.0700761 0.133081 0.286043 0.244797 0.0627413 0.0418848 0.0327549
0.0224731 0.0228277 0.0156014 0.00385102 0.00178297 0.00464446 0.00274692 0.000398088 0.000144539 0.00255626 6.5932e-05 3.47897e-
05 3.80541e-05 2.68556e-05 0.00137839
Year 88 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 88 Pred =  0.0355711 0.012633 0.0092766 0.0100461 0.0441621 0.117796 0.11614 0.281698 0.213901 0.0461299 0.0307954 0.0240827
0.0165231 0.0167838 0.0114708 0.00283143 0.00131091 0.00341479 0.00201965 0.00029269 0.000106271 0.00187946 4.84759e-05 2.55788e-
05 2.79789e-05 0.0010332
Year 89 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 89 Pred =  0.0127063 0.0287487 0.0114986 0.0122523 0.037521 0.0820847 0.113672 0.126454 0.272122 0.173875 0.0374978
0.0250328 0.0195762 0.0134312 0.0136431 0.00932433 0.0023016 0.00106561 0.0027758 0.00164172 0.000237921 8.63849e-05 0.00152777
3.94048e-05 2.07923e-05 0.000862603
Year 90 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 90 Pred =  0.0260204 0.0104092 0.0265239 0.0153947 0.0464044 0.0707586 0.0803661 0.125622 0.12401 0.224532 0.143466
0.0309399 0.0206549 0.0161526 0.0110823 0.0112571 0.00769362 0.00189908 0.000879245 0.00229035 0.0013546 0.000196311 7.12772e-05
0.00126058 3.25134e-05 0.0007289
Year 91 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 91 Pred =  0.00677841 0.0214072 0.00964463 0.0356627 0.0585591 0.0879304 0.0696565 0.0893228 0.12396 0.102995 0.186482
0.119154 0.0256968 0.0171547 0.0134154 0.00920426 0.00934949 0.00638985 0.00157726 0.000730248 0.00190222 0.00112505 0.000163044
5.91986e-05 0.00104696 0.000632384
Year 92 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 92 Pred =  0.0130956 0.00522427 0.0185815 0.0121485 0.1271 0.103985 0.0811254 0.0725684 0.0826278 0.0965157 0.0801924
0.145196 0.0927742 0.0200077 0.0133567 0.0104453 0.00716649 0.00727956 0.00497518 0.00122806 0.000568575 0.00148108 0.000875972
0.000126947 4.60923e-05 0.00130755
Year 93 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 93 Pred =  0.00842114 0.0100507 0.00451565 0.0233072 0.0431146 0.224766 0.0955596 0.0841876 0.0668756 0.0640977 0.0748711
0.0622085 0.112634 0.0719687 0.0155208 0.0103614 0.00810282 0.00555933 0.00564705 0.00385944 0.000952656 0.000441066 0.00114893
0.000679526 9.84779e-05 0.00105007
Year 94 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 94 Pred =  0.00410565 0.00673356 0.00905095 0.00590114 0.0861846 0.0794495 0.21524 0.103344 0.0808552 0.0540652 0.0518194
0.0605291 0.0502921 0.0910587 0.0581826 0.0125477 0.00837658 0.00655068 0.00449441 0.00456532 0.00312014 0.000770169 0.000356577
0.000928848 0.000549359 0.000928539
Year 95 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 95 Pred =  0.0119693 0.00322526 0.00595731 0.0116202 0.0214347 0.155979 0.074726 0.228595 0.0974674 0.0641947 0.0429249
0.0411418 0.0480568 0.0399292 0.0722957 0.0461939 0.00996218 0.00665055 0.00520089 0.00356832 0.00362462 0.00247723 0.000611473
0.000283103 0.000737456 0.00117337

Proportions of Discards at age by fleet
 fleet 1
Year 1 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
```

```
Year 1 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 2 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 2 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 3 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 3 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 4 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 4 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 5 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 5 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 6 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 6 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 7 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 7 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 8 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 8 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 9 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 9 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 10 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 10 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 11 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 11 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 12 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 12 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 13 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 13 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 14 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 14 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 15 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 15 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 16 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 16 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 17 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 17 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 18 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 18 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 19 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 19 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 20 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 20 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 21 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 21 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 22 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 22 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 23 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 23 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 24 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 24 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 25 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 25 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 26 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 26 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 27 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 27 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 28 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 28 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 29 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 29 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 30 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 30 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 31 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 31 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 32 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 32 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
```

```
Year 33 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 33 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 34 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 34 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 35 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 35 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 36 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 36 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 37 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 37 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 38 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 38 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 39 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 39 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 40 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 40 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 41 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 41 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 42 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 42 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 43 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 43 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 44 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 44 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 45 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 45 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 46 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 46 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 47 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 47 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 48 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 48 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 49 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 49 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 50 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 50 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 51 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 51 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 52 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 52 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 53 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 53 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 54 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 54 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 55 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 55 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 56 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 56 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 57 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 57 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 58 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 58 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 59 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 59 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 60 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 60 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 61 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 61 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 62 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 62 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 63 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 63 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 64 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
```

```
Year 64 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 65 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 65 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 66 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 66 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 67 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 67 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 68 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 68 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 69 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 69 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 70 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 70 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 71 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 71 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 72 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 72 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 73 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 73 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 74 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 74 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 75 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 75 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 76 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 76 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 77 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 77 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 78 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 78 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 79 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 79 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 80 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 80 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 81 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 81 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 82 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 82 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 83 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 83 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 84 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 84 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 85 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 85 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 86 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 86 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 87 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 87 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 88 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 88 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 89 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 89 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 90 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 90 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 91 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 91 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 92 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 92 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 93 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 93 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 94 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 94 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 95 Obs  =  0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Year 95 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
```

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F Reference Points Using Final Year Selectivity and Freport options
 refpt           F       slope to plot on SRR
  F0.1     0.0460683     0.213765
  Fmax     0.0938409     0.389873
  F30%SPR  0.0611839     0.265907
  F40%SPR  0.04171     0.199422
  Fmsy     0.0408952     0.196777    SSBmsy    203582     MSY   10490.6
  Fcurrent 0.00397234     0.0896961

Stock-Recruitment Relationship Parameters
 alpha     = 58868.2
 beta      = 95580.4
 unexpl    = 642383
 steepness = 0.658728
Spawning Stock, Obs Recruits(year+1), Pred Recruits(year+1), standardized residual
init  xxxx  51250.4  51242  0.00164143
1913  642256  52112.5  51242.3  0.168808
1914  642246  52128  51242.2  0.171807
1915  642221  52143.7  51242  0.174886
1916  642194  52159.7  51241.7  0.178007
1917  642167  52175.7  51241.4  0.181147
1918  642156  52192  51241.3  0.184289
1919  642209  52208.8  51241.8  0.187407
1920  642334  52226.1  51243.1  0.190488
1921  642510  52243.6  51244.9  0.193477
1922  642743  52260.8  51247.3  0.196319
1923  643017  52277.5  51250.2  0.198969
1924  643313  52293.2  51253.2  0.201379
1925  643621  52307.4  51256.4  0.203475
1926  643957  52320  51259.9  0.205221
1927  644307  52330.4  51263.5  0.206508
1928  644657  52339.4  51267.1  0.207525
1929  645008  52346.3  51270.7  0.208148
1930  645371  52351.7  51274.4  0.208457
1931  645703  52357.2  51277.8  0.208846
1932  646024  52360.2  51281.1  0.208769
1933  646348  52361.4  51284.4  0.208354
1934  646477  52360.5  51285.7  0.207921
1935  643595  52326.9  51256.1  0.207277
1936  630416  52182.4  51118  0.20661
1937  611730  51969.8  50913.2  0.205925
1938  595845  51774.2  50730.4  0.20417
1939  575019  51499.7  50477.7  0.200936
1940  551349  51158.3  50170.7  0.195408
1941  517571  50626  49691.6  0.186764
1942  468693  49751.4  48896.7  0.173711
1943  421056  48724.2  47977.3  0.154867
1944  377730  47528  46980.3  0.116183
1945  339493  45777.9  45935.6  -0.034456
1946  307277  45641.2  44901.4  0.163833
1947  274346  45424.5  43658  0.397639
1948  241919  42589.2  42196.6  0.0928445
1949  213686  41044.3  40674.7  0.0906922
1950  191539  39736.7  39271.3  0.118117
1951  169645  36567.6  37653.6  -0.293407
1952  153992  42706.9  36323  1.62312
1953  145259  38985  35505.5  0.937216
1954  140868  42419.1  35071.7  1.90677
1955  138484  36063.3  34829.3  0.349023
1956  135554  37748.1  34524.6  0.894849
1957  130763  39862.9  34009.3  1.59209
1958  124627  33386.2  33316.6  0.020913
1959  119992  41037.2  32767.2  2.25613
1960  117277  31020.4  32434.3  -0.446818
1961  115820  45024.2  32252.2  3.34446
1962  112806  28797  31867.1  -1.01554
1963  111311  52268.9  31672.1  5.02216
1964  112799  33641.7  31866.2  0.229116
1965  115510  18664  32213.1  -1.48607
1966  118339  4693.57  32565.5  -3.95952
1967  120076  3450.28  32777.4  -3.74391
1968  121974  1633.2  33005.1  -4.27403
1969  123597  1991.1  33196.5  -4.00053
1970  119361  2118.14  32690.6  -3.89075
1971  109776  133832  31468.8  2.05814
1972  96844.1  4977.78  29627.4  -2.53604
1973  83568.6  2321.25  27460.6  -3.5127
1974  73439.2  1437.55  25578.3  -4.09301
1975  67286.8  1400.21  24320.7  -4.05875
1976  61981  879.565  23157.4  -4.65012
1977  56638.7  1109.6  21904.1  -4.24069
1978  49717  28232.9  20143.2  0.480025
1979  41128.7  1064.72  17710.4  -3.99724
1980  32701.4  2003.7  15006.6  -2.86273
1981  26352.5  9991.06  12722.7  -0.343644
1982  20941.9  13163.5  10580  0.310626
1983  16583.5  3722.92  8703.68  -1.20742
1984  13386.5  5884.9  7231.92  -0.293049
1985  10736.9  19169.4  5945.06  1.66455
1986  8954.26  17385.6  5042.55  1.75978
1987  8350.72  11065  4729.98  1.20832
1988  8728.63  12846.8  4926.12  1.36284
1989  9957.03  11647.8  5553.97  1.05297
1990  11874.6  13727.3  6505.4  1.06172
```

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1991  11208.9  55923.2  6178.94  3.13193
1992  9921.22  80778.6  5535.88  3.81101
1993  12066  41608.1  6598.51  2.61813
1994  12015.4  45975.1  6573.89  2.76534
1995  12366.3  37073  6743.88  2.42306
1996  17675.1  36471.5  9187.2  1.96023
1997  25225.4  51554.2  12292.2  2.03835
1998  35062  74059  15799.1  2.19651
1999  46798.9  195407  19349.5  3.28773
2000  60380.8  80932  22791  1.80174
2001  75578.1  189572  25994.3  2.82491
2002  92938.5  56254.6  29021.6  0.940998
2003  113478  132153  31954  2.01844
2004  137858  103773  34764.9  1.55484
2005  166468  59299.5  37396.4  0.655475
2006  199012  206252  39768.4  2.34028
2007  234609       xxxx   41827.5

Root Mean Square Error computed from Standardized Residuals
Component                 #resids         RMSE
_Catch_Fleet_1               95           0.652927
Catch_Fleet_Total            95           0.652927
_Discard_Fleet_1             0            0
Discard_Fleet_Total          0            0
_Index_1                     45           1.6492
_Index_2                     40           1.78355
Index_Total                  85           1.71373
Nyear1                       25           0.0049155
Fmult_Year1                  0           0
_Fmult_devs_Fleet_1          0           0
Fmult_devs_Total             0           0
Recruit_devs                 95           1.95332
Fleet_Sel_params             26           2.89131
Index_Sel_params             52           0.346232
q_year1                      0           0
q_devs                       0           0
SRR_steepness                0           0
SRR_unexpl_S                 1           -2.10431

Projection into Future
Projected NAA
 41827.5 196164 53643.2 89283.6 108131 43733.5 139854 56642.1 129598 46510.7 30633.3 20483.4 19632.6 22932.4 19053.9 34499
22043.4 4753.88 3173.6 2481.83 1702.78 1729.64 1182.11 291.79 135.095 911.833
Projected Directed FAA
 0.00152283 0.00150055 0.00166523 0.00268185 0.0122257 0.0277991 0.0328749 0.0439303 0.0521707 0.0521708 0.0521708 0.0521708
0.0521708 0.0521708 0.0521708 0.0521708 0.0521708 0.0521708 0.0521708 0.0521708 0.0521708 0.0521708 0.0521708 0.0521708 0.0521708
0.0521708
Projected Discard FAA
 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Projected Nondirected FAA
 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Projected Catch at Age
 62.0829 286.902 87.0598 233.247 1281.69 1169.66 4412.32 2375.02 6427.29 2306.66 1519.23 1015.86 973.66 1137.31 944.962 1710.95
1093.22 235.764 157.392 123.084 84.4476 85.78 58.6259 14.4711 6.69991 45.2215
Projected Discards at Age (in numbers)
 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Projected Yield at Age
 0.264197 6.0921 4.71162 23.7421 206.495 267.109 1323.71 885.921 2860.46 1186.48 880.859 650.793 678.14 849.859 749.377 1426.94
951.643 212.854 146.588 117.725 82.6297 85.5856 59.4789 14.8937 6.98105 47.6205
Year, Total Yield (in weight), Total Discards (in weight), SSB, proj_what, SS/SSmsy
2008  13727  0  267529  3  1.31411

that's all
```

## Appendix O. Ocean pout

## Appendix Tables and Figures

by S.E. Wigley, L. Col, and C.M. Legault

Appendix Table O1. Number of commercial lengths (individual fish measured) and number of samples for Ocean pout collected during 1969 to 2007, by calendar quarter.

| Year | Q1 | Q2 | Q3 | Q4 | Total | # of Samples |
|---|---|---|---|---|---|---|
| 1969 | | | | | 0 | |
| 1970 | | | | | 0 | |
| 1971 | | | | | 0 | |
| 1972 | | | | | 0 | |
| 1973 | | | | | 0 | |
| 1974 | | | | | 0 | |
| 1975 | | | | | 0 | |
| 1976 | | | | | 0 | |
| 1977 | | | | | 0 | |
| 1978 | | | | | 0 | |
| 1979 | | | | | 0 | |
| 1980 | | | | | 0 | |
| 1981 | | | | | 0 | |
| 1982 | | | | | 0 | |
| 1983 | | | | | 0 | |
| 1984 | | 592 | | | 592 | 5 |
| 1985 | 670 | 335 | | | 1005 | 9 |
| 1986 | 780 | 458 | | | 1238 | 11 |
| 1987 | 1477 | 717 | | | 2194 | 19 |
| 1988 | 1093 | 805 | | 106 | 2004 | 17 |
| 1989 | 1283 | 864 | | | 2147 | 17 |
| 1990 | 1006 | 112 | | | 1118 | 12 |
| 1991 | 1044 | 259 | | 93 | 1396 | 14 |
| 1992 | 402 | 181 | | | 583 | 6 |
| 1993 | 93 | | | | 93 | 1 |
| 1994 | | | | | 0 | 1 |
| 1995 | | 76 | | | 76 | 1 |
| 1996 | | | | 17 | 17 | 1 |
| 1997 | | | | | 0 | 0 |
| 1998 | | | | | 0 | 0 |
| 1999 | | | | | 0 | 0 |
| 2000 | | | | | 0 | 0 |
| 2001 | | | | | 0 | 0 |
| 2002 | 109 | | | | 109 | 1 |
| 2003 | 136 | 76 | | | 212 | 4 |
| 2004 | 37 | | | | 37 | 1 |
| 2005 | | | | | 0 | 0 |
| 2006 | 133 | 54 | | | 187 | 4 |
| 2007 | 167 | 11 | | | 178 | 3 |

*Five commercial age samples have been obtained: 28 fish in 1985; 29 fish in 1989; 53 fish in 1991(from 2 samples); and 21 fish in 1992.*

Appendix Table O2. Number of observed trips and combined discard ratio of Ocean pout discards to kept of all species for selected fleets, 1989 – 2007 using NEFOP data.

| | Large-mesh Otter Trawl | | Small-mesh Otter Trawl | | Gillnet | | Scallop Dredge | |
|---|---|---|---|---|---|---|---|---|
| YEAR | OB trips | d/k ratio | OB trips | d/k ratio | OB trips | d/k ratio | OB trips | d/k ratio |
| 1989 | 34 | 0.07836 | 91 | 0.06529 | 67 | 0.00001 | | |
| 1990 | 43 | 0.11079 | 55 | 0.01436 | 84 | 0.00014 | | |
| 1991 | 56 | 0.04205 | 127 | 0.04462 | 448 | 0.00028 | | |
| 1992 | 58 | 0.01583 | 74 | 0.00543 | 599 | 0.00023 | 13 | 0.00177 |
| 1993 | 27 | 0.01606 | 23 | 0.00374 | 420 | 0.00024 | 20 | 0.00457 |
| 1994 | 28 | 0.00792 | 17 | 0.01852 | 195 | 0.00030 | 18 | 0.00200 |
| 1995 | 74 | 0.00890 | 77 | 0.00456 | 182 | 0.00004 | 22 | 0.00026 |
| 1996 | 44 | 0.00840 | 59 | 0.00356 | 136 | 0.00005 | 35 | 0.00087 |
| 1997 | 26 | 0.00922 | 60 | 0.00074 | 152 | 0.00016 | 26 | 0.00075 |
| 1998 | 17 | 0.01144 | 34 | 0.00075 | 209 | 0.00001 | 23 | 0.00138 |
| 1999 | 33 | 0.01458 | 53 | 0.00123 | 122 | 0.00023 | 28 | 0.00056 |
| 2000 | 93 | 0.00572 | 43 | 0.00058 | 137 | 0.00059 | 250 | 0.00012 |
| 2001 | 150 | 0.00827 | 59 | 0.00101 | 92 | 0.00009 | 64 | 0.00009 |
| 2002 | 197 | 0.00945 | 101 | 0.00111 | 125 | 0.00020 | 84 | 0.00004 |
| 2003 | 352 | 0.00656 | 106 | 0.00150 | 418 | 0.00017 | 91 | 0.00008 |
| 2004 | 563 | 0.00375 | 312 | 0.00163 | 971 | 0.00014 | 213 | 0.00001 |
| 2005 | 1363 | 0.00299 | 358 | 0.00293 | 787 | 0.00008 | 268 | 0.00002 |
| 2006 | 639 | 0.00269 | 185 | 0.00175 | 221 | 0.00003 | 199 | 0.00002 |
| 2007 | 724 | 0.00358 | 218 | 0.00126 | 259 | 0.00005 | 288 | 0.00003 |
| mean 2004-2006 | | 0.00314 | | 0.00210 | | 0.00009 | | 0.00002 |

Appendix Table O3. Ocean pout discards (mt) and coefficient of variation from the large-mesh otter trawl, small-mesh otter trawl, gillnet, and scallop dredge fleets, 1989 – 2007. Discards were derived using a combined ratio estimator of Ocean pout discard to kept of all species.

| | Large-mesh Otter Trawl | | Small-mesh Otter Trawl | | Gillnet | | Scallop Dredge | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|
| YEAR | mt | CV | mt | CV | mt | CV | mt | CV | mt | CV |
| 1989 | 4912.2 | 0.33 | 2488.3 | 0.50 | 0.1 | 1.50 | | | *7400.6* | 0.28 |
| 1990 | 8887.3 | 0.30 | 525.4 | 0.42 | 1.8 | 1.26 | | | *9414.5* | 0.29 |
| 1991 | 3189.1 | 0.41 | 1713.2 | 0.37 | 3.5 | 0.58 | | | *4905.9* | 0.30 |
| 1992 | 1147.6 | 0.36 | 192.3 | 0.42 | 3.1 | 0.27 | 177.1 | 0.570 | 1520.0 | 0.29 |
| 1993 | 941.5 | 0.28 | 146.6 | 0.62 | 3.9 | 0.39 | 254.0 | 0.340 | 1345.9 | 0.21 |
| 1994 | 445.0 | 0.40 | 784.8 | 4.51 | 4.9 | 0.85 | 46.1 | 0.525 | 1280.9 | 2.77 |
| 1995 | 417.9 | 0.34 | 146.2 | 0.48 | 0.8 | 0.65 | 8.6 | 0.451 | 573.5 | 0.28 |
| 1996 | 448.7 | 0.39 | 137.6 | 1.21 | 1.1 | 0.84 | 41.2 | 0.722 | 628.6 | 0.39 |
| 1997 | 456.3 | 0.53 | 29.3 | 0.49 | 3.2 | 0.59 | 32.6 | 0.290 | 521.5 | 0.46 |
| 1998 | 595.7 | 0.63 | 30.2 | 0.57 | 0.3 | 0.80 | 46.7 | 0.748 | 672.9 | 0.56 |
| 1999 | 701.5 | 0.30 | 45.6 | 0.69 | 4.4 | 0.57 | 34.6 | 0.679 | 786.1 | 0.27 |
| 2000 | 310.3 | 0.64 | 19.5 | 0.51 | 8.4 | 0.75 | 9.6 | 0.265 | 347.8 | 0.57 |
| 2001 | 490.0 | 0.36 | 30.4 | 0.43 | 1.3 | 0.56 | 9.8 | 0.413 | 531.6 | 0.34 |
| 2002 | 539.4 | 0.33 | 28.0 | 0.34 | 3.4 | 0.54 | 5.0 | 0.561 | 575.7 | 0.31 |
| 2003 | 379.7 | 0.17 | 34.6 | 0.40 | 3.1 | 0.34 | 9.3 | 0.276 | 426.8 | 0.15 |
| 2004 | 248.1 | 0.12 | 38.8 | 0.29 | 2.7 | 0.34 | 1.2 | 0.544 | 290.7 | 0.11 |
| 2005 | 140.5 | 0.09 | 56.2 | 0.21 | 1.0 | 0.62 | 3.1 | 0.196 | 200.8 | 0.09 |
| 2006 | 113.3 | 0.12 | 65.0 | 0.54 | 0.5 | 0.77 | 3.8 | 0.210 | 182.5 | 0.21 |
| 2007 | 143.4 | 0.11 | 26.3 | 0.44 | 0.8 | 0.78 | 4.3 | 0.276 | 175.0 | 0.11 |

*Note: 1989 – 1991 total discard do not include scallop discards.*

Appendix Table O4. Ocean pout discards (mt) from the large-mesh otter trawl, small-mesh otter trawl, gillnet from 1968 - 1988 and scallop dredge fleets from 1968 – 1991 based on the survey scale method.

| YEAR | Large-mesh Otter Trawl | Small-mesh Otter Trawl | Gillnet | Scallop Dredge | Total |
|---|---|---|---|---|---|
| 1968 | | 3470.4 | 1.0 | 5.5 | 3476.9 |
| 1969 | | 3125.1 | 0.9 | 3.5 | 3129.5 |
| 1970 | | 2761.6 | 0.9 | 3.2 | 2765.8 |
| 1971 | | 2018.4 | 0.6 | 2.5 | 2021.5 |
| 1972 | | 1495.9 | 0.8 | 1.4 | 1498.2 |
| 1973 | | 1292.2 | 0.6 | 1.4 | 1294.2 |
| 1974 | | 1131.6 | 0.7 | 1.6 | 1133.9 |
| 1975 | | 714.8 | 0.3 | 1.5 | 716.6 |
| 1976 | | 520.0 | 0.2 | 2.0 | 522.2 |
| 1977 | | 922.9 | 0.4 | 4.7 | 928.1 |
| 1978 | | 1369.5 | 1.3 | 6.9 | 1377.6 |
| 1979 | | 1499.2 | 1.9 | 8.1 | 1509.3 |
| 1980 | | 2002.6 | 5.1 | 8.3 | 2015.9 |
| 1981 | | 2724.3 | 5.5 | 13.5 | 2743.2 |
| 1982 | 2110.5 | 2308.1 | 6.3 | 14.6 | 4439.5 |
| 1983 | 3308.0 | 1161.2 | 6.0 | 13.4 | 4488.7 |
| 1984 | 2988.9 | 687.0 | 7.0 | 9.3 | 3692.2 |
| 1985 | 2506.7 | 636.8 | 7.4 | 10.1 | 3161.0 |
| 1986 | 2420.9 | 851.0 | 10.4 | 14.1 | 3296.4 |
| 1987 | 2002.6 | 597.1 | 7.5 | 16.5 | 2623.6 |
| 1988 | 1681.5 | 541.4 | 6.7 | 14.0 | 2243.6 |
| 1989 | | | | 14.3 | |
| 1990 | | | | 19.5 | |
| 1991 | | | | 19.7 | |

*Note: Regulatory otter trawl mesh size prior to 1982 was less than 5.5 inches;*
*1989 – 1991 scallop dredge discards were estimated using this method due to no observer coverage of this fleet.*

Appendix Table O5. Stratified mean catch per tow in weight and numbers, mean length and individual average fish weight of Ocean pout in **NEFSC winter surveys** (strata 1-3, 5-7, 9-11, 13-14, 73-75), 1992-2007. *No vessel conversion factors applied.*

| Year | Mean weight per tow (kg) | Mean number per tow | Individual average weight (kg) | Mean length (cm) |
|---|---|---|---|---|
| 1992 | 34.64 | 47.29 | 0.733 | 51.9 |
| 1993 | 27.86 | 48.57 | 0.574 | 47.1 |
| 1994 | 9.18 | 15.28 | 0.601 | 47.1 |
| 1995 | 7.32 | 16.92 | 0.433 | 43.3 |
| 1996 | 9.68 | 17.13 | 0.565 | 47.2 |
| 1997 | 11.70 | 21.36 | 0.548 | 47.5 |
| 1998 | 4.77 | 12.63 | 0.378 | 40.4 |
| 1999 | 15.44 | 24.85 | 0.621 | 48.3 |
| 2000 | 8.46 | 18.14 | 0.466 | 44.6 |
| 2001 | 13.45 | 28.01 | 0.480 | 46.1 |
| 2002 | 7.94 | 12.05 | 0.659 | 51.1 |
| 2003 | 18.54 | 20.25 | 0.916 | 56.0 |
| 2004 | 9.58 | 12.89 | 0.744 | 49.6 |
| 2005 | 2.84 | 5.61 | 0.506 | 41.3 |
| 2006 | 3.09 | 7.44 | 0.415 | 40.3 |
| 2007 | 1.72 | 2.43 | 0.709 | 48.9 |

Appendix Table O6. Stratified mean catch per tow in weight and numbers, individual average fish weight and mean length of Ocean pout in **Mass. inshore spring surveys** (strata 25-36), 1978-2007.

| Year | Mean weight per tow (kg) | Mean number per tow | Individual average weight (kg) | Mean length (cm) |
|---|---|---|---|---|
| 1978 | 42.00 | 107.39 | 0.391 | 38.8 |
| 1979 | 47.11 | 94.79 | 0.497 | 39.6 |
| 1980 | 34.42 | 60.13 | 0.572 | 42.9 |
| 1981 | 74.98 | 125.46 | 0.598 | 43.5 |
| 1982 | 61.39 | 90.50 | 0.678 | 47.2 |
| 1983 | 98.69 | 123.35 | 0.800 | 50.2 |
| 1984 | 85.25 | 147.25 | 0.579 | 45.0 |
| 1985 | 96.36 | 130.93 | 0.736 | 47.2 |
| 1986 | 28.46 | 62.62 | 0.454 | 39.4 |
| 1987 | 31.61 | 66.44 | 0.476 | 41.3 |
| 1988 | 26.18 | 56.71 | 0.462 | 39.7 |
| 1989 | 36.40 | 54.19 | 0.672 | 46.8 |
| 1990 | 25.04 | 38.19 | 0.656 | 47.0 |
| 1991 | 21.20 | 29.08 | 0.729 | 49.6 |
| 1992 | 42.43 | 59.02 | 0.719 | 48.5 |
| 1993 | 32.87 | 46.82 | 0.702 | 51.0 |
| 1994 | 22.34 | 36.73 | 0.608 | 46.9 |
| 1995 | 25.75 | 44.22 | 0.582 | 46.5 |
| 1996 | 14.03 | 26.06 | 0.538 | 45.6 |
| 1997 | 13.05 | 28.04 | 0.465 | 41.9 |
| 1998 | 5.56 | 8.45 | 0.658 | 49.7 |
| 1999 | 5.42 | 8.61 | 0.630 | 46.5 |
| 2000 | 16.35 | 22.22 | 0.736 | 49.8 |
| 2001 | 13.27 | 19.55 | 0.679 | 49.9 |
| 2002 | 6.27 | 10.47 | 0.599 | 48.1 |
| 2003 | 4.95 | 8.42 | 0.588 | 47.8 |
| 2004 | 7.66 | 9.27 | 0.827 | 53.0 |
| 2005 | 7.48 | 9.51 | 0.787 | 53.4 |
| 2006 | 6.22 | 9.03 | 0.689 | 49.6 |
| 2007 | 5.58 | 8.44 | 0.661 | 48.6 |

Appendix Table O7. Stratified mean catch per tow in weight and numbers, individual average fish weight and mean length of Ocean pout in **NEFSC spring surveys with conversion factors applied**, in the Gulf of Maine - Mid-Atlantic region (strata 1-26, 73-76), 1968-2007; 2008 preliminary.

*with vessel conversion factors*

| Year | Mean weight per tow (kg) | Mean number per tow | Individual average weight (kg) | Mean length (cm) |
|---:|---:|---:|---:|---:|
| 1968 | 5.446 | 6.768 | 0.805 | 51.1 |
| 1969 | 6.154 | 8.629 | 0.713 | 49.3 |
| 1970 | 5.143 | 6.133 | 0.839 | 51.9 |
| 1971 | 2.195 | 3.135 | 0.700 | 50.2 |
| 1972 | 4.463 | 5.104 | 0.874 | 51.6 |
| 1973 | 2.753 | 3.618 | 0.761 | 49.3 |
| 1974 | 1.479 | 2.310 | 0.640 | 47.0 |
| 1975 | 1.293 | 1.358 | 0.952 | 53.4 |
| 1976 | 1.170 | 1.912 | 0.612 | 46.9 |
| 1977 | 3.461 | 6.201 | 0.558 | 44.7 |
| 1978 | 3.371 | 11.831 | 0.285 | 31.6 |
| 1979 | 1.096 | 3.695 | 0.297 | 34.9 |
| 1980 | 4.333 | 8.955 | 0.484 | 42.7 |
| 1981 | 5.247 | 9.891 | 0.530 | 42.7 |
| 1982 | 3.273 | 6.083 | 0.538 | 44.0 |
| 1983 | 4.236 | 5.076 | 0.835 | 50.5 |
| 1984 | 5.540 | 7.275 | 0.762 | 50.0 |
| 1985 | 6.494 | 9.011 | 0.721 | 48.7 |
| 1986 | 6.345 | 6.995 | 0.907 | 53.0 |
| 1987 | 2.686 | 3.065 | 0.876 | 51.7 |
| 1988 | 3.244 | 5.405 | 0.600 | 45.0 |
| 1989 | 1.926 | 3.726 | 0.517 | 44.0 |
| 1990 | 3.501 | 4.459 | 0.785 | 50.3 |
| 1991 | 2.610 | 3.917 | 0.666 | 49.7 |
| 1992 | 2.257 | 2.639 | 0.855 | 52.9 |
| 1993 | 3.084 | 3.546 | 0.870 | 53.4 |
| 1994 | 1.593 | 1.848 | 0.862 | 54.3 |
| 1995 | 1.916 | 2.525 | 0.759 | 50.5 |
| 1996 | 2.058 | 3.127 | 0.658 | 47.6 |
| 1997 | 1.632 | 2.069 | 0.789 | 52.4 |
| 1998 | 1.733 | 2.957 | 0.586 | 46.1 |
| 1999 | 2.561 | 3.340 | 0.767 | 50.2 |
| 2000 | 2.016 | 3.113 | 0.648 | 48.2 |
| 2001 | 2.798 | 3.748 | 0.746 | 51.6 |
| 2002 | 2.025 | 2.809 | 0.721 | 51.3 |
| 2003 | 1.903 | 2.043 | 0.931 | 55.4 |
| 2004 | 0.546 | 0.673 | 0.812 | 50.8 |
| 2005 | 0.526 | 0.854 | 0.616 | 45.9 |
| 2006 | 0.526 | 0.789 | 0.667 | 47.4 |
| 2007 | 0.477 | 1.076 | 0.443 | 42.9 |
| *2008* | *0.424* | *0.839* | *0.505* | *43.9* |
| mean 1968-2007 | 2.878 | | | |
| median 1968-2007 | 2.586 | | | |
| median 1980 -1991 | 3.869 | | | |

Appendix Table O8. Relative F and randomization test results of eight formulations of AIM for Ocean pout: with and without vessel conversion factor applied to the survey biomass index and landings, catch, catch calculated using half of the estimated discard, and catch calculated using twice the estimated discard.

*without vessel conversion factor*

| | Landings | Catch | Catch (0.5xDiscards) | Catch (2xDiscards) |
|---|---|---|---|---|
| Relative F | 564460.60 | 0.02 | 0.01 | 0.03 |
| 5%percentile | 0.00 | 0.00 | 0.00 | 0.00 |
| 95% percentile | 745206700000.00 | 4085.19 | 43718.27 | 61560.40 |
| | | | | |
| Randomization Test | | | | |
| Critical Value | 0.042 | -0.081 | -0.086 | -0.066 |
| Significant Level | 0.732 | 0.570 | 0.552 | 0.608 |

*with vessel conversion factor*

| | Landings | Catch | Catch (0.5xDiscards) | Catch (2xDiscards) |
|---|---|---|---|---|
| Relative F | 0.00 | 0.11 | 0.05 | 0.18 |
| 5%percentile | 0.00 | 0.00 | 0.00 | 0.00 |
| 95% percentile | 1043285000000.00 | 1316.51 | 2201.72 | 36624.88 |
| | | | | |
| Randomization Test | | | | |
| Critical Value | -0.011 | -0.153 | -0.154 | -0.139 |
| Significant Level | 0.626 | 0.391 | 0.372 | 0.438 |

Appendix Table O9a. Ocean pout input vectors used in LOSS model exploration.

Input vectors

| Age | M | Mean weight at age | Maturity at age | Fishing Selectivity | Index Selectivity |
|---:|---:|---:|---:|---:|---:|
| 1 | 0.2 | 0.001 | 0.1 | 0.01 | 0.5 |
| 2 | 0.2 | 0.008 | 0.5 | 0.1 | 1 |
| 3 | 0.2 | 0.022 | 1 | 0.5 | 1 |
| 4 | 0.2 | 0.045 | 1 | 1 | 1 |
| 5 | 0.2 | 0.075 | 1 | 1 | 1 |
| 6 | 0.2 | 0.112 | 1 | 1 | 1 |
| 7 | 0.2 | 0.153 | 1 | 1 | 1 |
| 8 | 0.2 | 0.199 | 1 | 1 | 1 |
| 9 | 0.2 | 0.247 | 1 | 1 | 1 |
| 10 | 0.2 | 0.297 | 1 | 1 | 1 |
| 11 | 0.2 | 0.347 | 1 | 1 | 1 |
| 12 | 0.2 | 0.397 | 1 | 1 | 1 |
| 13 | 0.2 | 0.446 | 1 | 1 | 1 |
| 14 | 0.2 | 0.494 | 1 | 1 | 1 |
| 15 | 0.2 | 0.54 | 1 | 1 | 1 |
| 16 | 0.2 | 0.584 | 1 | 1 | 1 |
| 17 | 0.2 | 0.626 | 1 | 1 | 1 |
| 18 | 0.2 | 0.665 | 1 | 1 | 1 |
| 19 | 0.2 | 0.702 | 1 | 1 | 1 |
| 20 | 0.2 | 0.737 | 1 | 1 | 1 |
| 21 | 0.2 | 0.769 | 1 | 1 | 1 |
| 22 | 0.2 | 0.799 | 1 | 1 | 1 |
| 23 | 0.2 | 0.827 | 1 | 1 | 1 |
| 24 | 0.2 | 0.852 | 1 | 1 | 1 |
| 25 | 0.2 | 0.876 | 1 | 1 | 1 |
| 26 | 0.2 | 0.898 | 1 | 1 | 1 |
| 27 | 0.2 | 0.918 | 1 | 1 | 1 |
| 28 | 0.2 | 0.936 | 1 | 1 | 1 |
| 29 | 0.2 | 0.953 | 1 | 1 | 1 |
| 30 | 0.2 | 0.969 | 1 | 1 | 1 |

# Appendix Table O9b. Summary of LOSS model exploration run results for Ocean pout, with varying steepness, depletion (S1/S0) values and two initial stock sizes (200,000 and 500,000).

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| obj_fun | 18.9304 | 18.9808 | 19.0364 | 19.0956 | 19.1582 | 19.1166 | 19.1019 | 19.103 | 18.9265 | 18.9272 | 18.9279 | 18.9292 | 18.9304 | 18.9316 |
| likely_ind | 18.9304 | 18.9808 | 19.0364 | 19.0956 | 19.1582 | 19.1166 | 19.1019 | 19.103 | 18.9265 | 18.9272 | 18.9279 | 18.9292 | 18.9304 | 18.9316 |
| likely_catchwt | 0.00 | 2.98E-10 | 0.00 | 6.45E-10 | 7.43E-10 | 2.68E-07 | 3.07E-07 | 2.45E-07 | 1.83E-10 | 1.72E-10 | 1.61E-10 | 1.43E-10 | 0.00 | 1.12E-10 |
| Fpen | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| rmse | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| sigma | 0.566 | 0.595012 | 0.629 | 0.667358 | 0.710524 | 0.68153 | 0.67157 | 0.672339 | 0.563567 | 0.563968 | 0.564354 | 0.565088 | 0.566 | 0.566417 |
| **S1/S0** | 0.80 | 0.80 | 0.80 | 0.80 | 0.80 | 0.80 | 0.80 | 0.80 | **0.20** | **0.30** | **0.40** | **0.60** | **0.80** | **1.00** |
| **S0** | 215237 | 164421 | 141935 | 128870 | 120142 | 296994 | 474431 | 437114 | 685103 | 475182 | 370631 | 266613 | 215237 | 185100 |
| R0 | 302182 | 230839 | 199269 | 180927 | 168673 | 416965 | 666078 | 613687 | 961851 | 667133 | 520348 | 374311 | 302182 | 259871 |
| **steepness** | **0.25** | **0.35** | **0.45** | **0.55** | **0.65** | **0.75** | **0.85** | **0.95** | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 |
| Fmsy | 0.016 | 0.042 | 0.066 | 0.088 | 0.109 | 0.131 | 0.155 | 0.181 | 0.016 | 0.016 | 0.016 | 0.016 | 0.016 | 0.016 |
| SSBmsy | 102380 | 71907 | 57774 | 49144 | 43060 | 100107 | 150123 | 129231 | 325877 | 226026 | 176295 | 126817 | 102380 | 88045 |
| Fratio | 0.33 | 0.15 | 0.10 | 0.07 | 0.05 | 0.01 | 0.00 | 0.00 | 0.39 | 0.38 | 0.37 | 0.35 | 0.33 | 0.31 |
| SSBratio | 0.51 | 0.60 | 0.71 | 0.86 | 1.05 | 2.75 | 3.04 | 3.25 | 0.13 | 0.20 | 0.26 | 0.38 | 0.51 | 0.62 |

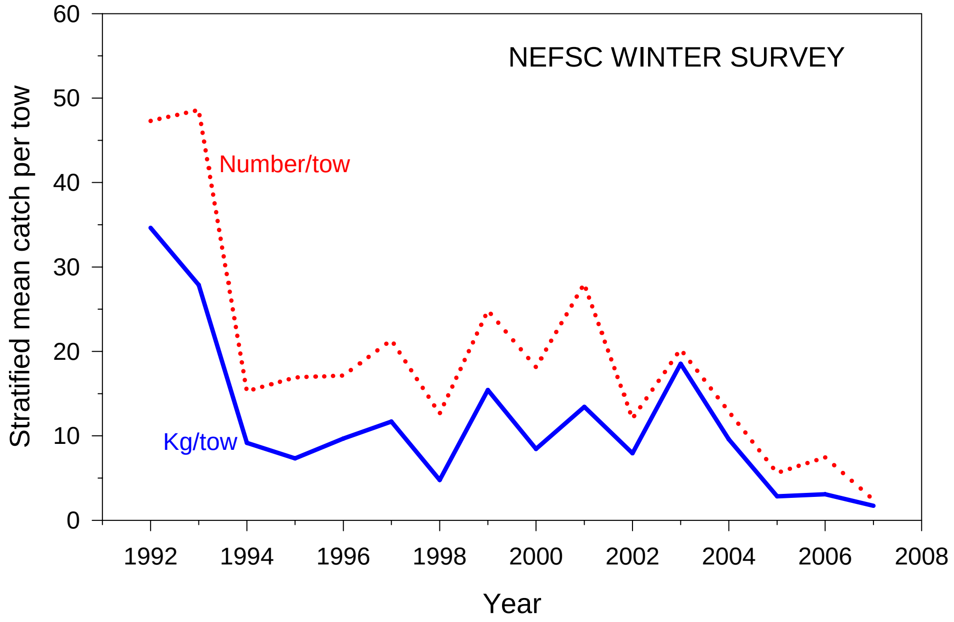
| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| obj_fun | 18.9586 | 19.041 | 19.1067 | 19.1291 | 3525.1 | 19.1402 | 19.1412 | 3490.36 | 3.01E+08 | 1.71E+08 | 85724800 | 8413490 | 18.9586 | 18.9393 |
| likely_ind | 18.9586 | 19.041 | 19.1067 | 19.1291 | 19.1375 | 19.1402 | 19.1412 | 19.1415 | 20.2771 | 20.2588 | 20.2339 | 20.0103 | 18.9586 | 18.9393 |
| likely_catchwt | 7.72E-10 | 1.05E-10 | 5.643E-11 | 4.57E-11 | 3505.96 | 3.79E-11 | 3.56E-11 | 3471.22 | 3.01E+08 | 1.71E+08 | 85723100 | 8413470 | 7.72E-10 | 8.55E-11 |
| Fpen | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 44745.3 | 22893.7 | 1595.37 | 1.3386 | 0 | 0 |
| rmse | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| sigma | 0.581939 | 0.631918 | 0.67486 | 0.69008 | 0.695939 | 0.697847 | 0.698529 | 0.698706 | 2.17506 | 2.13567 | 2.08313 | 1.66583 | 0.581939 | 0.570796 |
| **S1/S0** | 0.80 | 0.80 | 0.80 | 0.80 | 0.80 | 0.80 | 0.80 | 0.80 | **0.20** | **0.30** | **0.40** | **0.60** | **0.80** | **1.00** |
| **S0** | **200,000** | **200,000** | **200,000** | **200,000** | **200,000** | **200,000** | **200,000** | **200,000** | **200,000** | **200,000** | **200,000** | **200,000** | **200,000** | **200,000** |
| R0 | 280790 | 280790 | 280790 | 280790 | 280790 | 280790 | 280790 | 280790 | 280790 | 280790 | 280790 | 280790 | 280790 | 280790 |
| **steepness** | **0.25** | **0.35** | **0.45** | **0.55** | **0.65** | **0.75** | **0.85** | **0.95** | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 |
| Fmsy | 0.016 | 0.042 | 0.066 | 0.088 | 0.109 | 0.131 | 0.155 | 0.181 | 0.016 | 0.016 | 0.016 | 0.016 | 0.016 | 0.016 |
| SSBmsy | 95132 | 87467 | 81409 | 76269 | 71681 | 67414 | 63286 | 59129 | 95132 | 95132 | 95132 | 95132 | 95132 | 95132 |
| Fratio | 0.53 | 0.06 | 0.03 | 0.02 | 0.01 | 0.01 | 0.01 | 0.01 | 319.93 | 320.05 | 320.09 | 320.53 | 0.53 | 0.23 |
| SSBratio | 0.34 | 1.19 | 1.75 | 2.11 | 2.38 | 2.61 | 2.83 | 3.08 | 0.00 | 0.00 | 0.00 | 0.00 | 0.34 | 0.78 |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| obj_fun | 19.0478 | 19.0928 | 19.1015 | 19.1029 | 55473700 | 19.1016 | 24470 | 59.5129 | 18789000 | 18.9398 | 19.0255 | 19.0556 | 19.0478 | 2278070 |
| likely_ind | 19.0478 | 19.0928 | 19.1015 | 19.1029 | 19.0952 | 19.1016 | 19.1008 | 19.1 | 20.1336 | 18.9398 | 19.0255 | 19.0556 | 19.0478 | 19.0346 |
| likely_catchwt | 7.87E-12 | 4.79E-12 | 4.119E-12 | 3.8E-12 | 55473700 | 3.46E-12 | 24450.9 | 40.4129 | 18789000 | 1.81E-10 | 6.44E-11 | 1.59E-11 | 7.87E-12 | 2278050 |
| Fpen | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2.0263 | 0 | 0 | 0 | 0 | 0 |
| rmse | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| sigma | 0.636255 | 0.665497 | 0.67135 | 0.672252 | 0.667089 | 0.67141 | 0.670826 | 0.670305 | 1.88439 | 0.571097 | 0.622227 | 0.641219 | 0.636255 | 0.627871 |
| **S1/S0** | 0.80 | 0.80 | 0.80 | 0.80 | 0.80 | 0.80 | 0.80 | 0.80 | **0.20** | **0.30** | **0.40** | **0.60** | **0.80** | **1.00** |
| **S0** | **500,000** | **500,000** | **500,000** | **500,000** | **500,000** | **500,000** | **500,000** | **500,000** | **500,000** | **500,000** | **500,000** | **500,000** | **500,000** | **500,000** |
| R0 | 701976 | 701976 | 701976 | 701976 | 701976 | 701976 | 701976 | 701976 | 701976 | 701976 | 701976 | 701976 | 701976 | 701976 |
| **steepness** | **0.25** | **0.35** | **0.45** | **0.55** | **0.65** | **0.75** | **0.85** | **0.95** | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 |
| Fmsy | 0.016 | 0.042 | 0.066 | 0.088 | 0.109 | 0.131 | 0.155 | 0.181 | 0.016 | 0.016 | 0.016 | 0.016 | 0.016 | 0.016 |
| SSBmsy | 237831 | 218667 | 203521 | 190673 | 179203 | 168535 | 158214 | 147823 | 237831 | 237831 | 237831 | 237831 | 237831 | 237831 |
| Fratio | 0.05 | 0.01 | 0.01 | 0.01 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.27 | 0.12 | 0.06 | 0.05 | 0.04 |
| SSBratio | 1.43 | 1.95 | 2.24 | 2.46 | 2.63 | 2.84 | 3.04 | 3.27 | 0.00 | 0.26 | 0.61 | 1.10 | 1.43 | 1.68 |

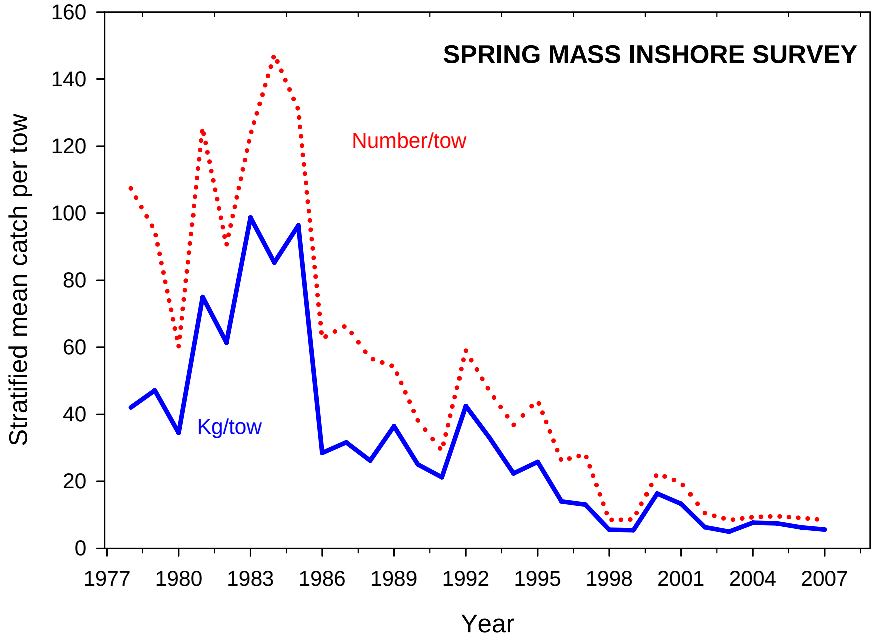
Appendix Table O10. NEFSC spring survey index(kg/tow), total catch (‘000 mt), 3yr moving average of spring survey biomass index, relative exploitation rate (catch/ 3yr average of spring survey biomass index) for Ocean pout, 1968 – 2007; preliminary 2008.

**With vessel conversion factors applied.**

| Year | NEFSC Spring Index kg/tow | Total Catch ('000, mt) | 3 year moving average (kg/tow) | Exploitation ratio (catch/ 3yr avg index) |
|---|---|---|---|---|
| 1968 | 5.446 | 16.5379 | 5.800 | 2.851 |
| 1969 | 6.154 | 30.1015 | 5.581 | 5.394 |
| 1970 | 5.143 | 9.9378 | 4.497 | 2.210 |
| 1971 | 2.195 | 7.9315 | 3.934 | 2.016 |
| 1972 | 4.463 | 4.8492 | 3.137 | 1.546 |
| 1973 | 2.753 | 6.6642 | 2.898 | 2.299 |
| 1974 | 1.479 | 4.8659 | 1.842 | 2.642 |
| 1975 | 1.293 | 0.9936 | 1.314 | 0.756 |
| 1976 | 1.170 | 1.2002 | 1.975 | 0.608 |
| 1977 | 3.461 | 1.9871 | 2.667 | 0.745 |
| 1978 | 3.371 | 2.4126 | 2.643 | 0.913 |
| 1979 | 1.096 | 2.1813 | 2.933 | 0.744 |
| 1980 | 4.333 | 2.3659 | 3.559 | 0.665 |
| 1981 | 5.247 | 2.9942 | 4.284 | 0.699 |
| 1982 | 3.273 | 4.7605 | 4.252 | 1.120 |
| 1983 | 4.236 | 4.8967 | 4.350 | 1.126 |
| 1984 | 5.540 | 5.0162 | 5.423 | 0.925 |
| 1985 | 6.494 | 4.6650 | 6.126 | 0.761 |
| 1986 | 6.345 | 4.0984 | 5.175 | 0.792 |
| 1987 | 2.686 | 4.8086 | 4.092 | 1.175 |
| 1988 | 3.244 | 4.0546 | 2.619 | 1.548 |
| 1989 | 1.926 | 8.7289 | 2.890 | 3.020 |
| 1990 | 3.501 | 10.7460 | 2.679 | 4.011 |
| 1991 | 2.610 | 6.3496 | 2.789 | 2.277 |
| 1992 | 2.257 | 1.9940 | 2.650 | 0.752 |
| 1993 | 3.084 | 1.5779 | 2.311 | 0.683 |
| 1994 | 1.593 | 1.4769 | 2.198 | 0.672 |
| 1995 | 1.916 | 0.6385 | 1.856 | 0.344 |
| 1996 | 2.058 | 0.6796 | 1.869 | 0.364 |
| 1997 | 1.632 | 0.5545 | 1.808 | 0.307 |
| 1998 | 1.733 | 0.6899 | 1.975 | 0.349 |
| 1999 | 2.561 | 0.8041 | 2.103 | 0.382 |
| 2000 | 2.016 | 0.3668 | 2.458 | 0.149 |
| 2001 | 2.798 | 0.5492 | 2.280 | 0.241 |
| 2002 | 2.025 | 0.5879 | 2.242 | 0.262 |
| 2003 | 1.903 | 0.4524 | 1.491 | 0.303 |
| 2004 | 0.546 | 0.2960 | 0.992 | 0.298 |
| 2005 | 0.526 | 0.2048 | 0.533 | 0.384 |
| 2006 | 0.526 | 0.1875 | 0.510 | 0.368 |
| 2007 | 0.477 | 0.1785 | 0.475 | 0.375 |
| 2008 | 0.424 | | | |
| mean 1968-2007 | 2.88 | | 2.88 | 1.18 |
| median 1968-2007 | 2.59 | | 2.65 | 0.75 |
| 1980-91 median | | | 4.17 | 1.12 |
| 1977-1985 median | | | 4.25 | 0.76 |



Appendix Figure O1. Trends in mean catch per tow, in numbers and weight (kg) for Ocean pout in the NEFSC winter survey, 1992 – 2007.



Appendix Figure O2. Trends in mean catch per tow, in numbers and weight (kg) for Ocean pout in the Massachusetts inshore survey,1978 – 2007.

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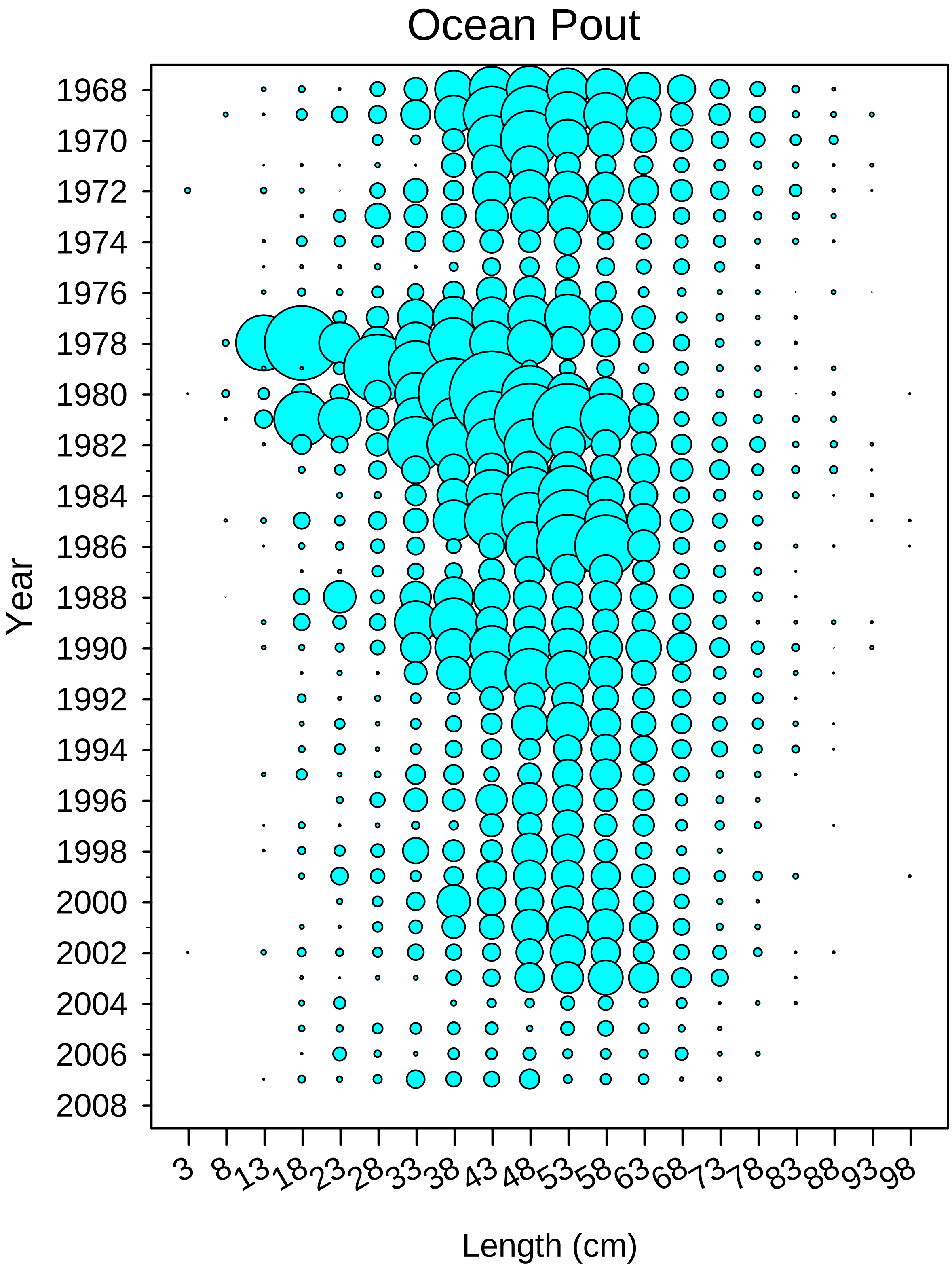
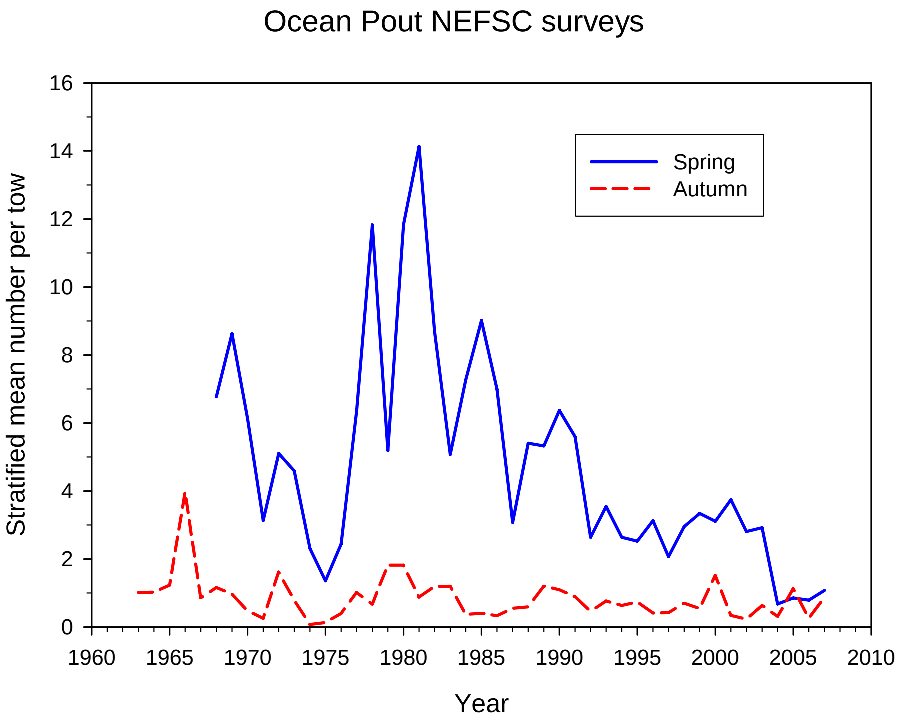
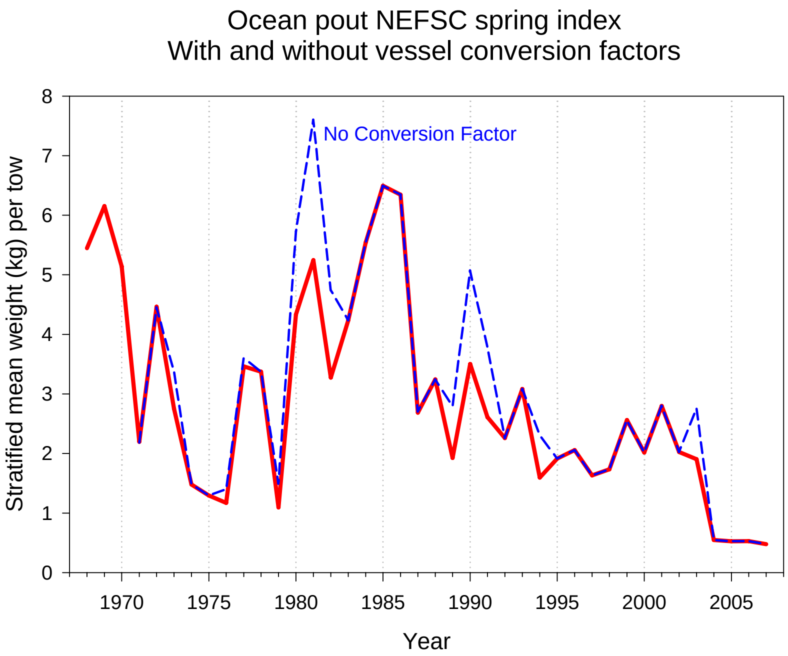


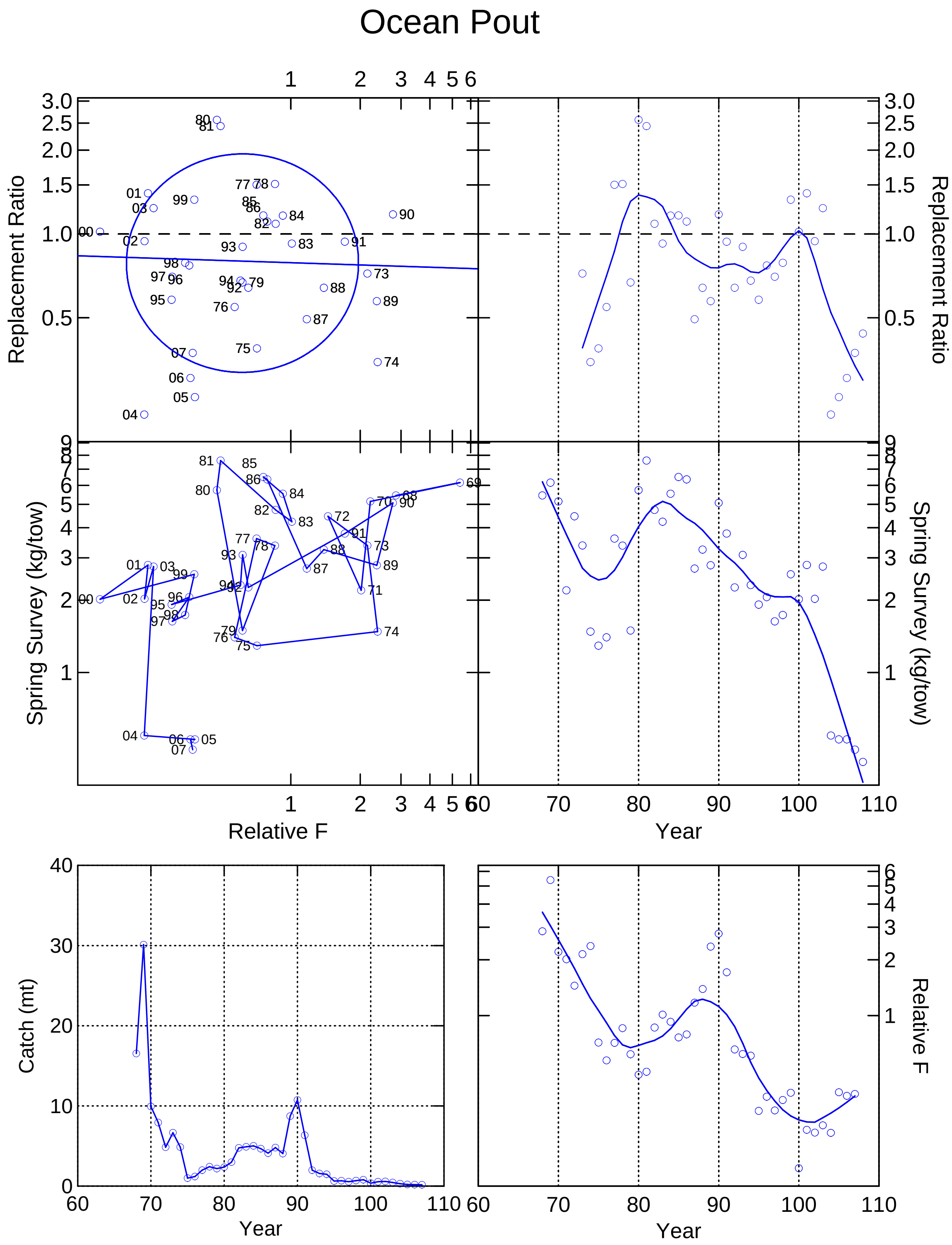
Appendix Figure O3. Stratified mean number per tow at length of Ocean pout from the NEFSC research vessel spring survey, 1968 to 2007, binned into 5 cm intervals.



Appendix Figure O4. Stratified mean number per tow of Ocean pout from NEFSC spring and autumn bottom trawl surveys, 1963 – 2007.



Appendix Figure O5. Stratified mean weight (kg) per tow of Ocean pout from NEFSC spring survey, 1968 – 2007, with and without vessel conversion factors applied.
*[ Note: R/V Delaware II underwent a refit in 1997*].



Appendix Figure O6. Trends in relative biomass, total catch, fishing mortality rate indices (catch / survey index) and replacement ratios for Ocean pout. Relative F is computed as catch in year t divided by a 3 yr average of indices in year t-1, t, and t+1.

## Appendix P. Gulf of Maine/Georges Bank windowpane flounder

by Lisa Hendrickson

This section does not have an appendix. The complete assessment is available in the Report of the 3rd Groundfish Assessment Review Meeting (GARM III), Center Reference Document 08-15.

## Appendix Q. SNE/MA Bight windowpane flounder

by Lisa Hendrickson,

This section does not have an appendix. The complete assessment is available in the Report of the 3rd Groundfish Assessment Review Meeting (GARM III), Center Reference Document 08-15.

# Appendix R.  Gulf of Maine haddock

By Michael Palmer

This section does not have an appendix.  The complete assessment is available in the Report of the 3rd Groundfish Assessment Review Meeting (GARM III), Center Reference Document 08-15.

## Appendix S. Atlantic halibut

by L Col and C Legault

This section does not have an appendix. The complete assessment is available in the Report of the 3rd Groundfish Assessment Review Meeting (GARM III), Center Reference Document 08-15.

# Report of the Groundfish Assessment Review Meeting (GARM III)

## Part 1. Data Methods

By

**Chairman: Robert O'Boyle**

**Review Panel: Victor Crecco, Lou Van-Eeckhaute, Desmond Kahn, Coby Needle, Brian Rothschild, Stephen Smith, Jon Helge Vølstad**

**Including Presentation Highlights for each Working Paper written by the lead Assessment Scientists**

**Report Date: December 27, 2007**

**Meeting Dates and Location:**
**October 29 - November 2, 2007**
**Northeast Fisheries Science Center**
**Stephen H. Clark Conference Room**
**Woods Hole, Massachusetts**

# TABLE OF CONTENTS

# SUMMARY

During 29 October – 2 November 2007, a review of the seven types of data inputs (landings, discards, tagging, fishery independent and dependent surveys, ecosystem and recreational) was undertaken for the Groundfish Assessment Review Meetings (GARM). This was the first of a four part process, with the remainder focusing on models (25 – 29 February 2008), biological reference points (28 April – 2 May 2008) and the assessments themselves (4 – 8 August 2008). The overall GARM process has been designed so that each review can inform the subsequent ones.

A considerable amount of information on the GARM data inputs was considered in the meeting time available. Consequently, the review could only focus on the most important issues and highlight work that could be undertaken by the Northeast Fisheries Science Center to address these. This report provides a synopsis of each presentation along with the associated discussion, during which a number of specific suggestions and recommendations were made to address identified issues. Following this, a panel of seven reviewers provides its perspective on the activities required to meet the objectives outlined in the meeting's terms of reference. Many of the recommendations made can be implemented in time to be included in the next GARM in February 2008. However, a number will require longer-term actions which the Northeast Fisheries Science Center is encouraged to pursue.

Overall, the meeting successfully fulfilled its terms of reference and represents an important contribution to the remainder of the GARM III process.

# INTRODUCTION

The chair (R. O'Boyle) opened the meeting by welcoming the participants (appendix 1) to the first of four GARM (Groundfish Assessment Review Meeting) reviews scheduled until August 2008. After introductions, he provided background on the GARM review, which is a peer review process developed in 2002 to provide assessments for the groundfish stocks managed under the Northeast Multispecies Fishery Management Plan. The first and second GARM reviews were held 8 – 11 October 2002 and 15 – 19 August 2005 respectively. The GARM process was initially intended to be distinct from the Northeast Stock Assessment Review Committee (SARC) process, which produces "benchmark" stock assessments. The initial purpose of the GARM was to provide assessment updates, using extant model formulations and data sources as well as to provide comments and recommendations regarding specific stock assessments and generic data collection and analysis procedures.

With this GARM III, the intent of the process has evolved. GARM III is to be the most comprehensive to date with the intent being the production of benchmark assessments and peer reviews of 19 groundfish stock assessments managed by the New England Fisheries Management Council (NEFMC). This process will take place over four meetings, with each having a different purpose:

- Data Methods (29 Oct – 2 Nov 2007) – this meeting
    - Review of the data inputs (commercial and survey) to be used in the stock assessments and the methodologies for analyzing
- Modeling (25 – 29 Feb 2008)

    - Determination of the most appropriate stock assessment methods and models for each of the 19 stocks
- Biological Reference Points (BRPs) (28 April – 2 May 2008)
    - Establishment of the BRPs for the 19 stocks
- Assessment (4 – 8 August 2008)
    - Application of the methods from the previous three meetings, along with survey and catch information through calendar year 2007, to estimate fishing mortality rates and biomass for each stock

The chair noted that the schedule has been established to allow time between meetings for scientists of the Northeast Fisheries Science Center (NEFSC) to address issues raised in each review. He noted that the GARM is a technical review of the science pertinent to assessments and would not be entertaining discussion on management issues, which is the purpose of the NEFMC. He also emphasized that the results of the meeting are confidential until its report has been released publicly.

The terms of reference (appendix 2) was then discussed. The meeting was to review the commercial and survey data that would be used in the stock assessments and identify appropriate statistical methods for analyzing those data (including bycatch and discard issues, changes in growth rates and other life history traits, issues related to merging databases, etc.). Other sources of data to be considered would be from tagging programs for cod and yellowtail flounder and from Industry-Based Surveys. Candidate sources of data relevant to ecological and ecosystem considerations would also be described. The draft agenda (appendix 3) had been structured to sequentially review the seven data types under consideration. It was noted that the agenda was exceptionally busy, with 34 working papers (appendix 4) to be considered and would be modified as needed. As it transpired, the working paper reviews were not completed until Thursday morning with the meeting adjourning noon on Friday.

The chair then introduced the GARM reviewers: Victor Crecco, Lou Van-Eeckhaute, Desmond Kahn, Coby Needle, Brian Rothschild, Stephen Smith, and Jon Helge Volstad who would be formulating the main recommendations of the meeting.

Regarding the conduct of the meeting, the chair noted that the presentation highlights and associated discussions would be recorded, the latter by the following rapporteurs:

A. Landings--Kathy Sosebee
B. Discards--Paul Nitschke
C. Tagging--Gary Shepherd
D. Surveys--Anne Richards
E. Industry Based Surveys--Lisa Hendrickson
F. Ecosystem indices--Laurel Col
G. Recreational Landings and Discards--Laurel Col

Following these comments, the meeting commenced.

The first section of this report provides the above mentioned ‘Presentations and Associated Discussion’. The presentation highlights are brief summaries provided by the authors of the working papers and do not provide many of the technical details. It is expected that the NEFSC will consider the recommendations of this report and produce working papers that are most appropriate as Center Reference documents. The discussion provides a synopsis of the main topics touched upon, as well as suggestions and recommendations, to inform the final session of the meeting in which the main conclusions and recommendations of the meeting were summarized.

The next section of the report, entitled ‘Progress towards Objectives’, provides the review panel’s recommendations and observations, structured by the meetings’ objectives as per the terms of reference. These are based upon the discussions held during the final session of the meeting and post – meeting reflections.

# PRESENTATIONS AND ASSOCIATED DISCUSSION

## COMMERCIAL LANDINGS

### Working Paper A1: Wigley S E, Hersey P, Palmer J E. 2007. A Description of the Allocation Procedure applied to the 1994 to present Commercial Landings Data.

*Presentation Highlights*

The multi-tier trip-based allocation is designed to combine each mandatory reporting dealer (Dealer) trip with a vessel trip report (VTR) trip or a group of VTR trips of similar characteristics to obtain area fished and effort associated with the Dealer trip. Although the trip-based allocation and the single species proration yield similar results with regard to stock landings (Wigley et al. 2007), the trip-based allocation is an improvement over the single-species proration because it provides area fished at a fine level of resolution (statistical area rather than stock level) for <u>all</u> species. It also estimates effort associated with these landings. The trip-based allocation represents a comprehensive approach to determining area fished and effort in Northeast region’s commercial landings in order to meet scientific and fishery management needs as well as commercial data reporting requirements to Northwest Atlantic Fisheries Organization and supports economic and ecosystems research.

The multi-tier trip-based allocation has been developed to augment commercial landings data with area fished and effort; however, trip characteristics, species landings and price information will not change. All species on a given trip/subtrip will be assigned the same area and effort. The multi-tier trip-based allocation utilizes Vessel Trip Report data that have been aggregated into four levels: Level A, Level B, Level C and Level D. At Level A, Dealer and VTR trips are matched one to one. At Levels B, C and D, VTR trips are grouped together to form a pool of trips with similar characteristics which define the stratification cell within the level of aggregation.

A Dealer trip seeks an area match at Level A, and progresses through the increasing levels of aggregated VTR data until a match occurs. Area is obtained first then effort is obtained.

For each area level and stratification cell, a discrete probability distribution function is formed representing the proportion of trips which fished in a unique statistical area. A discrete cumulative distribution is formed using the statistical area probabilities. Each unique statistical area within the VTR group will have a cumulative probability associated with it. Before the allocation begins, every Dealer trip is assigned a random number between 0 and 1. The random number is compared with the cumulative probability associated with each area. The cumulative probabilities are in ascending order; when the random number is greater than or equal to the cumulative probability value, the statistical area associated with the cumulative probability is assigned to the Dealer trip. Thus, a single area fished is assigned to a Dealer trip on a probabilistic basis by sampling (with replacement) the distribution of VTR areas within the group.

Total effort is not known in the Dealer data; each Dealer trip will be supplemented with effort (days fished and days absent) taken directly from a VTR trip or estimated from the pool of VTR trips with similar characteristics. When a match occurs at Level A, days fished and days absent are transferred to the Dealer trip only when both effort metrics have values (both must be not null). If available, the number of hauls, haul duration, crew size, gear quantity, and gear size are also transferred. If a match occurs at Level B, C or D, then an estimate of days fished (DF) per trip and an estimate of days absent (DA) per trip are assigned to the Dealer trip. Both days fished and days absent are estimated by the median of their distributions, respectively, within the cell. The median was selected as the simplest statistic of central tendency for distributions of various shapes.

The allocation assumes the follow: 1) Dealer landings are a census of total landings; 2) vessels land only once per trip; 3) each Dealer trip that enters the allocation represents one trip; and 4) VTR data set is a representative subset of the Dealer set.

The proportion of Dealer landings entering the allocation range between 19% and 32%. Between 51% and 73% of the landings that enter the allocation to find area fished match at Level A (a one to one match of Dealer and VTR trips). Total commercial landings changed very slightly (< 1 mt) due to rounding of whole species pounds on split trips. An evaluation of input data for allocation revealed the VTR subset generally reflected Dealer data. An evaluation of the random component of the allocation indicated that the random component did not contribute to a wide spread in stock landings, indicating that the random component is not a large source of stock landings variability. Although some statistical areas on the biological samples associated with allocated trips changed, the majority of samples remained unchanged.

Strengths of the trip-based allocation include: 1) provides landings at a finer temporal and spatial resolution than the single species proration; 2) is a comprehensive approach to create a master dataset to support all analyses; 3) uses the same data sources as the single-species proration; 4) the multi-tier feature of the trip-based allocation is similar to the pre-1994 data where port agents conducted interviews or used their local knowledge to determine area fished and effort; and 5) the trip-based features maintains the link to biological samples. Weaknesses of the trip-based allocation include: 1) use of VTR data (self-reported data), however, this is the only data set containing the needed information; 2) VTR compliance and data auditing could be improved; and 3) examination of effort over the entire series is needed.

### *Discussion on Working Paper A1*

There was discussion on the differences in the proportion of trips between the VTR and the dealer data particularly for invertebrate species and the large-mesh groundfish fishery. Part of the reason for this is that the not all of the lobster vessels are required to submit a VTR, and part is due to aggregation of trips in the dealer data for state landings information, resulting in a large number of single records which are actually multiple trips and/or vessels. In other words, trips may not mean the same thing in both databases.

The two algorithms used to prorate VTR data to statistical and stock area (old single-species vs new trip-based) were clarified and discussed. In the single species algorithm, proration for each species is undertaken separately (using port group, gear group, and market category, matched at permit month day, matched set by stock area, proportions applied to dealer landings). The trip-based allocation uses a similar approach but occurs at a finer scale and apportions the landings of the entire trip amongst statistical areas fished based upon a four level (A through D) allocation process. The first level (A) is considered the most detailed information which is used apportion the landings in the other levels. This allows for multi-species analyses and recreation of patterns on a consistent basis. It was noted that where latitude and longitude positional information is available, it is included in the database. The approach is meant to be similar to that of a port agent interview prior to 1994. It was noted that new and old systems produced landings allocations amongst stocks that were consistent. One of the advantages of the new system is the availability of intra-trip data on statistical area fished.

A small portion of the data is from smaller vessels that are grouped together and end up not allocated. It was clarified that the large amount of non-allocated data in Table 4 of working paper A1 are landings that did not enter the allocation process from fisheries that do not need to submit this type of logbook (i.e. surf calm, quahog, tunas) as opposed to data that required allocation.

It was noted that only one realization from the randomization simulation (different random number seed) was carried forward into the database. There is a potential for the selection of different areas assigned to Levels B, C, and D depending on the random number seed. This was tested and the distributions of the landings by stock area were generally fairly tight. The new database provides the potential to estimate the variance in the landings in the assessments due to stock area assignment.

### Working Paper A2: Wigley S E, Legault C, Brooks E, Cadrin S, Col L, Hendrickson L, Mayo R, Nitschke P, Palmer M, Sosebee K, Terceiro M. 2007. Annual Comparisons of the trip-based allocated and the single-species prorated commercial landings, biological samples and numbers of landed fish at age

*Presentation Highlights*

Annual comparisons between the data used in the GARM 2005 stock assessments and the trip-based allocated commercial data were conducted for most GARM species for 1994 to 2003. These comparisons included: annual total species landings, annual stock landings, biological samples (lengths and ages), and the resultant numbers of fish at age.

There were negligible changes in annual total species landings between current landings (CFDETS) and trip-based allocated landings (CFDETS_AA) due to rounding in the trip-based allocation. There were minor changes in annual total species landings between data used in the GARM2005/TRC2007 and CFDETS_AA due to revisions and updates of the commercial landings. For multi-stock species, some shifts in stock landings occurred, the majority of biological samples retained statistical area (and stock area), and there were generally minor changes in landings at age. Statistical area changes of biological samples for single stock species are inconsequential.

Strengths of this analysis include: 1) comprehensive examination of GARM species with multiple stocks and most GARM species with unit stocks; 2) followed the estimation process all the way through to landings at age; 3) utilized the biological samples as much as possible; 3) includes estimates of uncertainty for landings at age and 4) landings at age do not change using the trip-based allocation. Weaknesses of this analysis include: 1) focused on GARM species, but invertebrates and other species should be examined as well; 2) unfair comparisons, in some cases, due to inclusion of lengths or ages from observer or survey sources in the GARM 2 but not AA calculations, making LAA comparisons difficult and 3) did not consider alternative to trip-based allocation schemes.

*Discussion on Working Paper A2*

The NEFSC's port sampling process was discussed and many clarifications made. Differences in the landings at age (LAA) for some species using the allocated data and samples were noted. Some of these differences may be due to low sample sizes in some years, resulting in even fewer samples after the allocation. It could also be due to the augmentation of port samples with samples from the observer program in the prior assessment. There is a need to examine the impact of these differences on the relevant assessments at the next meeting.

### Working Paper A3: Nies T, Applegate A J. 2007. Accuracy of Self-Reported Fishing Locations in the New England Multispecies Trawl Fishery and

### Working Paper A5: Applegate, A.J. 2007. Using VMS data to characterize fishing activity in the US yellowtail flounder *[Limanda ferruginea (Storer 1839)]* fishery

*Presentation Highlights*

Working paper A.3 investigated the accuracy of VTR location information that is used for several purposes in fishery analyses. With respect to the GARM TOR, this information is used to allocate landings to statistical area and ultimately stock area. The key points of the presentation were:

- VTRs did not accurately report area fished for 20% - 30% of a subset of observed trawl tows
- Impact of errors depends on spatial scale used (statistical area vs. stock area)
- Errors can affect allocation of landings to stock area; this may be important for some stocks
- Errors could affect other analyses: discard estimates, effort distribution, ageing, protected species interactions. Care should be exercised when assuming that the VTR locations are accurate at spatial scales smaller than stock areas.

Working paper A5 established that VMS speed profiles can be used to reliably predict trawl fishing locations. VMS positions from a random sample of trips landing large amounts of yellowtail flounder were classified as either fishing or non-fishing positions based on speed profiles. These positions were matched to observed tow locations for those same trips. A reasonable and statistically valid association between VMS positions tagged as fishing activity and observed tows was demonstrated.

Working paper A3 matched VMS or observer data to VTR records for subsets of trawl trips for calendar years 2003, 2005, and 2005. The assignment of fishing locations as determined by VMS speed profiles or observed haul locations was compared to the assignment of fishing locations from VTRs. The differences were reported by statistical area and stock area. This evaluates the errors in the distribution of fishing effort introduced through erroneous VTR reports. For the three years examined, between 20-30 percent of observed tows examined were assigned to the incorrect statistical area by the VTR. Most of the errors are caused by vessels fishing in more that one statistical area, but reporting only one area. The presentation highlighted that there are some statistical areas where erroneous VTR reporting is more problematic (e.g. SA 526).

In an additional analysis, the catch (landings and discards) of cod, yellowtail flounder, and winter flounder on the observed trips (matched to VTRs) was allocated to statistical area and stock area by the observed area and the VTR area. This illustrated how the VTR reporting errors can affect the distribution of catch for the data set used. The results showed that for some stock/year combinations the errors were minor, but for other stock/year combinations they were substantial. In particular, SNE/MA yellowtail flounder was identified as of particular concern. In a second analysis, yellowtail flounder catch on a different subset of trips was allocated to statistical area where VMS reports most fishing activity occurred. This is compared to the allocation reported by the VTR. This analysis also suggested that the VTR may over-allocate SNE/MA yellowtail flounder. Finally, the impacts of using VTR to allocate fishing effort were shown using observed haul duration as a measure of effort. The total effort assigned to statistical areas by VTR was shown to often be in error.

Strengths of these analyses are:

- The paper used methods to verify the accuracy of VTR location information
- The methods used allow an illustration of the magnitude of the errors and possible impacts.

Weaknesses of the analyses are:

- Observer coverage was directed to special programs in 2004 and 2005. Since some of these programs limited where vessels could fish on a given trip, this may bias the results to underestimate errors introduced by VTRs. At the same time, it makes it difficult to extend the results to the fishery as a whole.
- Because of a lack of observer and VMS coverage, the analyses cannot be extended to the full catch time series.
- While the paper suggests it may be possible to develop a way to use VMS to allocate catch in the future, there is no obvious correction factor that can be applied to existing data.

### Working Paper A4: Palmer M C, Wigley S E. 2007. Validating the stock apportionment of commercial fisheries landings using positional data from Vessel Monitoring Systems (VMS)

#### *Presentation Highlights*

Vessel Monitoring System (VMS) positional data from northeast United States fisheries were used to validate the statistical area fished and stock allocation of commercial landings derived from mandatory Vessel Trip Reports (VTRs). A gear-specific speed algorithm was applied to 2004 – 2006 VMS data from the otter trawl, scallop dredge, sink gillnet and benthic longline fisheries to estimate the location of fishing activity. Estimated fishing locations were used to allocate the landings of eight federally managed species to stock areas: Atlantic cod (*Gadus morhua*), haddock (*Melanogrammus aeglefinus*), yellowtail flounder (*Limanda ferruginea*), winter flounder (*Pseudopleuronectes americanus*), windowpane flounder *(Scophthalmus aquosus*), goosefish (*Lophius americanus*), silver hake (*Merluccius bilinearis*) and red hake (*Urophycis chuss*). Haul location and catch data from the

Northeast Fisheries Observer Program (NEFOP) were used to assess the relative accuracy of both VMS and VTR allocation methods.

Overall, the mean VMS – NEFOP agreement rate was 86.4 ± 7.6 % compared to a mean VTR – NEFOP agreement rate of 58.5 ± 4.9 %. VTR's accurately record the identity of at least one of the statistical areas on a given trip, but exhibit a tendency to under-report the number of statistical areas fished when fishing occurs in multiple statistical areas. The VMS algorithm had a tendency (approx. 10 % of all trips) to overestimate the number of statistical areas fished such that when all fishing activity from a given trip occurs in a single statistical area, VTRs more accurately reflected the true fishing location. However, on trips where fishing activity occurred in multiple statistical area, the VMS algorithm showed pronounced gains (77.2 ± 11.2 % NEFOP agreement) relative to VTR reports (12.0 ± 5.9 % NEFOP agreement). The VMS method achieved distributions of stock landings closer to NEFOP estimates in 18 out of 24 instances (8 species over 3 years). The stock allocations from both the VMS and VTR-based methods were within ± 5 % for all stocks, suggesting that the impacts on total stock allocations are relatively minor. However, these small differences represent major relative differences for less abundant stocks such as southern New England/mid-Atlantic yellowtail where in 2005 the VTR-based method allocated 61.9 % more landings relative to the VMS-based method. The VMS-based method is not a replacement for the VTR-based method; however, it can, and should, be used as a tool to identify those vessels where targeted outreach activities would improve the accuracy of VTR statistical area reporting.

### *Discussion on Working Papers A3, A4 and A5*

The impact of mis-reported statistical area(s) or the reporting of a single statistical area when fishing actually occurred in multiple areas on the allocation process was discussed. The impact on smaller stocks (SNEMA yellowtail flounder) may be greater than that on larger stocks and there may be a masking of trends in the relative fishing mortality (F) for index-based stocks. This could be examined in the assessment.

The statistical area reporting practices of fishermen on a trip were discussed. There may be predictable patterns in the reporting of statistical area by fishermen that could be used in the proration algorithm.

The value of using Vessel Monitoring System (VMS) data in verifying the statistical area fished was discussed, recognizing that these data also have issues. For instance, in Europe, some boats have been observed to slow down to develop fishing time in an area. There may also be issues with misreporting due to regulations (one area having a lower quota, etc). The need to communicate with and educate fishermen who have misreported the statistical area of fishing was highlighted as a means to improve the quality of the data on statistical area fished.

There was discussion on the difference between the conclusions of the main papers. Some of these were due to the number of vessels examined in each. One paper examined a subset of vessels (offshore vessels with a large catch of groundfish) whereas the other considered a wider range of vessels. Overall though, the papers were complementary, highlighted the need for caution in interpreting the statistical area fished data, and the future potential of the VMS data to supplement and verify the statistical area fished information in the VTR database.

## Working Paper A6: Legault C, Brooks E, Seaver A. 2007. BioStat Bootstrapping for Estimating Uncertainty in Commercial Landings at Age

*Presentation Highlights*

Estimation of uncertainty for commercial landings at age is an important component for stock assessment, especially for use in forward projecting models which allow uncertainty in the catch at age. The bootstrapping process described in this working paper occurs at three levels: port samples, lengths within samples, and ages within lengths for that sample. This three tier bootstrap incorporates all levels of uncertainty in the data collection and then is treated in the same manner as the original sample to generate a bootstrap estimate of landings at age. Repeating this process many times produces distributions of landings at age which can be summarized by coefficients of variation as well as a variance-covariance matrix for landings among ages. The software is already developed and easy to use, typically taking only minutes to conduct 1000 bootstraps. An extension of the software to allow incorporation of an ageing precision matrix is in beta testing.

Results from specific application of the bootstrap method in BioStat show that uncertainty in landings at age are highest at the youngest and oldest ages and that there are often positive correlations among ages. These results showed high agreement with those of the model based estimates provided in WPA7, both in terms of the pattern of CV and the presence of positive correlations among ages, even though there are some slight differences in how the samples are expanded to the total catch. These positive correlations are not found in the typical assumption of a multinomial process for modeling error in the catch at age in forward projecting models. Preliminary exploration of using the variance-covariance matrix directly in the likelihood function of a catch at age analysis found different estimates of F than when the multinomial assumption was made.

Some additional uses of the bootstrap approach are to use the bootstrapped landings at age separately in virtual population analysis runs to produce distributions of stock and F matrices. Results can also be used to guide sampling requests and assist in determination of the plus group age. It is recommended that bootstrapping be performed regularly as part of the estimation of landings at age.

## Working Paper A7. Miller T. 2007. Model-based estimation of numbers-at-length and(or) -age for commercial landings in the Northeastern United States

*Presentation Highlights*

Model-based estimates of numbers-at-age per unit weight are multiplied by the true total weight. An implicit assumption is made that the numbers-at-age per unit weight in the larger landings are the same as that in the unsampled smaller landings. The estimates are derived with respect to model-based inference, but are also appropriate for design-based inference using a specific type of stratified multi-phase design. Model-based inferences depend on the how closely model assumptions match the reality of the data-generating mechanism (Valliant et al. 2000).

The overall model reflects measurements with multiple sources of error. For example, the estimate of total number at length $l$ for a given market category in a trip can be viewed as a measurement of the true total number at length $l$ (in the market category) with error. Furthermore, this measurement error can be estimated with the data components used to make the measurement (the number of fish sampled in the trip with length $l$ in the market category).

Similarly, the estimate of total number at length *l* at a port may be viewed as a measurement with error where the data used to make the measurement (the trip-specific total numbers at length *l*) are also measured with error and the precision of the measurements for each trip can be assumed to be different. As such, different measurement error components (trip- and port-levels) for an overall estimate (measurement) of the total numbers caught at length are produced.

*Discussion on Working Papers A6 and A7*

There was considerable discussion on the design of the NEFSC port sampling program. Questions arose on the definition of the sampling unit used. Sampling appeared clustered while the current analysis of the data assumes independence. It appeared that the current sampling procedure does not fit well into standard sampling theory. A request was made to develop a schematic of the bootstrapping sampling procedure. This was provided later in the meeting and led to the conclusion that bootstrapping below the port level was not required (see below)

It was considered that the model and design-based sampling approaches should produce similar results if both are based upon the same assumptions. The advantage of the modeling approach is that auxiliary information can be included. However, there was no discussion on what kind of auxiliary data would be appropriate.

## COMMERCIAL DISCARDS

### Working Paper B1: Blaylock J, Wigley S E. 2007. Summary of trips from the Northeast Fisheries Observer Program and Vessel Trip Report data

*Presentation Highlights*

The Northeast Fisheries Observer Program (NEFOP), which was implemented in 1989, has observed trips for a wide variety of gear types. During 1989 to 2007, the majority of NEFOP trips represent five main gear types: longline, otter trawl, shrimp trawl, sink gillnet, and scallop dredge. The number of NEFOP and Vessel Trip Report trips were summarized for 1994 to 2006 for those five gear types, stratified by area fished, mesh group, trip category and calendar quarter. Given that stock assessments need a time series of discard data, this inventory summary indicates that there are some stratification cells where there are little or no coverage. Issues of stratification, imputation and hindcasting will arise when estimating discards for stock assessments.

### Working Paper B2: Wigley SE, Palmer MC, Blaylock J, Rago P J. 2007. A Brief Description of the Discard Estimation for the National Bycatch Report and Working Paper B6: Wigley S E, Rago P J, Sosebee K A, Palka D L. 2007. The Analytic Component to the Standardized Bycatch Reporting Methodology Omnibus Amendment: Sampling Design and Estimation of Precision and Accuracy

*Presentation Highlights*

Three methods and two ratio estimators (discard weight to kept weight of all species and discard weight to days absent) were examined in the Standardized Bycatch Reporting Methodology (SBRM) analysis. This analysis used 2004 Northeast Fisheries Observer Program (NEFOP) data to estimate sample sizes needed to achieve a desired precision and to evaluate accuracy in the NEFOP data. A broad stratification of calendar quarter, region (port of departure), gear type, mesh size, access area (open, closed) and trip category (general or limited) was used. The three methods and two estimators yielded similar results; the combined ratio of discard weight to kept weight of all species was determined to be the preferred approach.

For the National Bycatch Report, the combined ratio of the discard weight to kept weight of all species was used to estimate discards in 2005 for the 33 Magnuson-Stevens Act species from 25 fleets in the Northeast Region. Similar to the SBRM analysis, this analysis used a broad stratification; however, instead of port of departure, area fished was used. In addition to estimating discards and associated precision, this analysis also validated the estimation method and underlying data by estimating landings using the Northeast Observer Program data. For many of the species and species groups, the estimated landings based on NEFOP data compared favorably to the VTR landings, with the 95% confidence interval of the estimated landings encompassing the VTR landings, confirming that the method and underlying data provide sound estimates of discards. It is important to emphasize that discard estimates and the stratification used in this analysis may not necessary correspond to the discard estimates derived for individual stock assessments.

The strengths of this analysis include: 1) a wide variety of species were examined; and 2) validation of method and underlying data was undertaken. The weaknesses of the analysis include: 1) only examined a single year; 2) estimated discards and landings at species level, not stock level; 3) used a broad stratification with many cells containing large sample sizes.

### *Discussion on Working Papers B1, B2 and B6*

The discussion raised a number of suggestions for NEFSC to pursue. The statistical methods for filling in missing data should be examined. Using nearest neighbor estimates for filling in missing years may also be appropriate. The impact of filling in missing cells or hindcasting for the results of the assessment should be investigated.

The National Bycatch report used a consistent method of estimating discards for many different species and fisheries. It was noted that a finer tuned stratification of the observer data will likely be developed in each species specific stock assessment which may result in more precise discard estimates. In addition, the use of allocated dealer data will allow for finer stratification in the discard estimates. However, the discard estimates used in the stock assessment should be on the same order of magnitude as the National Bycatch report estimates. The combined ratio method was validated by comparing estimated landings using expanded kept portion of the catch in the observer data to the actual report landing. The estimated landings appear to be in line with the reported total landings. Using kept weight of all species in the denominator of the combined ratio ensures that all the catch data were used in estimating discards.

## Working Paper B5: Legault C. 2007. Discard Estimation using Observer Data

### *Presentation Highlights*

Discards were estimated by six methods in four sample populations created using observer data. In each population, the total discards were known. Random samples of 10% of the population were selected and each of the six methods used to estimate the total discards. Bias for each method was estimated as the mean of difference between the 1000 estimates and the true value. There were two clear winners out of the six, the ratio of sums and the mean discard per trip. Both had zero bias, although individual realizations could still be relatively far away from the true value, plus/minus 50%. In contrast, the four clear losers were highly biased and almost always far away from the true value. These four poor performers were mean ratios of different types. Although only four sample populations were created, it was the use of actual observer data, with all of its inherent variability, which made this a reasonable test for the estimators and led to the poor performance of the mean ratio estimators. Use of all species kept as the denominator in the sum of ratios method appeared to produce less biased results than use of only the species of interest in the denominator.

*Discussion on Working Paper B5*

The discard simulation analysis using actual observer data showed a clear difference in the performance of the discard estimators. Discard estimators which use a mean of ratios were highly biased. Increased sampling did not make these estimates less biased. The ratio of sums (sum of discard weight over sum of kept weight) over all trips and the effort based estimator were unbiased and is the preferred ratio as there are difficulties in obtaining the total number of trips in the fishery for the effort based expansion. Although the combined ratio estimator preformed well, there was some discussion on whether landings of all species is a good surrogate for effort. The poor relationship between the discards of a species to the total landings was questioned. The simulation suggests that the estimator is invariant to the correlation between the numerator and the denominator. However, the effort based discard estimator may perform better at low sample sizes.

### Working Paper B4: Terceiro M. 2007. Comparison of commercial fishery discard estimates for SNE/MA winter flounder

*Presentation Highlights*

The National Bycatch Report's combined ratio bycatch estimation approach (NBRD2) has been applied for comparison with observer (OB) and VTR discard rate estimation methods for 1994 and later years. Discard rates by half-year were calculated for trawls and scallop dredges, and applied to the corresponding landings (winter flounder landings for the OB and VTR rates; landings of all species for the NBRD2 rates). The OB discard rate estimates were higher and more variable (with some infeasible estimates), than discard estimates from the VTR and NBRD2 methods, which were generally of about the same order of magnitude. Coefficients of Variation (CVs) for the VTR estimates have not been calculated; CVs for the NBRD2 estimates for combined trawl and scallop fisheries ranged from 118% (1994) to 11% (2005), with a median value of 28% for 1994-2006. If the VTR and NBRD2 discard estimates are examined by gear, it is apparent that the scallop dredge estimates generally make up a larger part of the NBRD2 estimate total when compared to the VTR estimates. The scallop dredge fishery lands a small amount of SNE/MA winter flounder (less than 35 mt annually) compared to the trawl fishery (1,200-4,600 mt annually), and so even though the VTR scallop dredge discard rates can be high, the VTR discard estimates (based on expansion by winter flounder landings) area relatively low. In previous assessments, neither the OB nor VTR discard rate data were considered adequate for the estimation of discards specific to the scallop dredge fishery, due to sample size and inter-annual variability of the rates.

In contrast to the VTR estimates for scallop dredge gear, the NBRD2 scallop dredge discard estimates are quite variable and can be much larger than the trawl discard estimates, in spite of a low discard rate (discard of winter flounder to total landings of all species), because of the large magnitude of total landings in the fishery (used as the expansion factor) and the sensitivity of the discard estimate calculation to small inter-annual changes in the absolute discard rate. CVs for the NBRD2 estimates for the scallop dredge fishery ranged from 75% (1997) to 15% (2005), with a median value of 42% for 1994-2006. It remains unclear if the NBRD2 scallop dredge discard estimates for SNE/MA WFL are appropriate for use in the assessment.

Wigley et al. (B2) indicated that the NBRD2 estimate of landings for winter flounder (3,186 mt) was comparable to the Dealer reported landings (3,667) for 2005, with the 95% confidence interval (2,606-3,767 mt) encompassing both the Dealer landings and the VTR reported landings (3,477).

### *Discussion on Working Paper B4*

The working paper described a real life example of estimating discards for a fishery that does not retain any catches of the discarded species. The working paper questioned how to estimate winter flounder discards in the scallop fishery. In this fishery, the combined ratio method produces very low ratios of discards to total landings but the expansion using total landing of all species was very large. The resulting discard estimates for the scallop fishery were relatively high compared to the trawl fishery discards and in years with low observer coverage, the estimates can be high and variable. The review panel suggested looking at other sources of information such as regulatory changes that could support a possible large discard event. It was noted that the trends appear to be similar among the different discard estimates from 1994 to 2003 but that there is some divergence between the trends after 2003.

## Working Paper B3: Hendrickson L, Nies T. 2007. Discard and gear escapement survival rates of some Northeast groundfish species

### *Presentation Highlights*

There are few studies that address discard and gear escape survival rates of the Northeast groundfish species that will be assessed during GARM III. No studies were identified for white hake, redfish, Ocean pout, and windowpane flounder. The working paper summarized important study design elements, factors affecting survival rates and survival rate estimates from existing studies. Most of the studies pertained to trawl gear but there were also a few longline studies for which the discard survival rates were estimated for haddock, Atlantic cod, and Atlantic halibut. Survival rates can be quite variable for the same species, gear type, and survival monitoring period because many factors affect the survivorship of discards and gear escapees. In addition, there are many important study design considerations that can affect survival rate estimates.

Survival rates are species-specific and may also be size-dependent. Some of the survival rate studies included in the review had design shortcomings such as: small sample size, lack of a control group, unrepresentative commercial fishing and handling conditions, and short holding times of caged individuals. Most of the studies did not include post-release mortality estimates attributable to avian predation, which can be a substantial source of discard mortality for some species. Therefore, it was recommended that a thorough evaluation of the adequacy of a particular study design be conducted before deciding to use the survival rate estimates in a stock assessment. Well-designed survival rate studies of Atlantic cod (longline and trawl), American plaice (trawl), and yellowtail flounder (trawl) were identified in the working paper. In general, discard survival rates were higher for flatfish (and highest for yellowtail flounder and winter flounder) than gadids and higher discard survival rates were reported for large fish compared to small fish. For example, trawl discard survival rates from one study were 0-25%, 17-37%, and 66-89% for Atlantic cod, American plaice, and yellowtail flounder, respectively. The same study estimated trawl escape survival rates for cod, American plaice and yellowtail flounder as 94-96%, 39-41%, and 68-90%, respectively. For haddock, gear escape survival rates are size-dependent with the lowest survival rates for fish < 15 cm. No precision estimates associated with survival rate estimates from any of the studies were presented. The Gulf of Maine and southern New England-Middle Atlantic winter flounder stocks are the only GARM III stocks for which a discard survival rate > 0 is used in the assessment (a value of 50% is used and is based on an average from two studies).

*Discussion on Working Paper B3*

There is limited information available on discard survival rates for GARM species in the commercial fishery. There is even less known about escapement survival. Escapement mortality is assumed to exist but is difficult to quantify. Escapement mortality estimates do not exist for GARM stocks. Gulf of Maine and Southern New England winter flounder are the only GARM stocks that assume greater than zero percent survival for commercial discards. The stress of capture or escapement can lead to higher predation mortality. However, the cod tagging study does indicate that survival in commercial gear is greater than zero. The question to the GARM was whether there is a basis to assume survival of discards greater than zero percent for a stock? It was recommended to use survival rates greater than zero percent if there are studies to support the higher survival rate estimates.

## TAGGING DATA

### Cod

### Working Paper C1: Tallack S. 2007. A description of tagging data from the Northeast Regional Cod Tagging Program (WP3A) and preliminary applications of weighting and mixing analysis (WP3C)

*Presentation Highlights*

During 2005, it was recognized that the Northeast Regional Cod Tagging Program's (NRCTP) large, quality-controlled database had the potential for real management application, particularly with regard to stock identification through estimates of mixing and growth. Between April 2003 and July 2005, over 114,000 cod were T-bar tagged on over 100 commercial and recreational vessels, during dedicated tagging trips in both US and Canadian waters. The size range of fish tagged was 29-134cm, with 41% (n=46,613) being sublegal (<53cm) at the time of release. Different tag combinations were used to enable estimates of tag shedding (n=18,305 double-tagged) and reporting rates (n=2,240 high reward releases). Tag release data is detailed, quality controlled and downloadable as an MS Access relational database (the master database is built in SQL). By October 2007, recapture information has been received by GMRI (Gulf of Maine Research Institute) for over 5% of the tagged cod releases (n>6,500).

By December 2007, release and recapture information for an additional 67,554 cod tag releases during 2000-2003 will be available. These fish represent recent cod tagging efforts undertaken by the University of New Hampshire, University of Massachusetts' School of Marine Science and Technology and Fisheries and Oceans Canada. The GMRI is currently auditing, error-checking and collating these three datasets into the same format as the larger, NRCTP dataset, ready for inclusion into the NEFSC multi-species tagging database (currently still in development). In total, 182,029 cod tag releases and >10,157 tag recaptures will be available for future movement analyses for the time period of 2000 onwards.

There are two core assumptions when defining a stock, namely that the stock is self-sustaining and that neighboring stocks exist in isolation. As the bank of recapture data has increased, a descriptive depiction of "passages of travel" for Atlantic cod in the Gulf of Maine region has become possible. These migration patterns may violate both core stock definition assumptions, as indicated through the quantification of movements using a model. Of the movements observed, some were anticipated; e.g. exchanges of fully recruited cod between the Bay of Fundy (Canada) and Georges Bank (US). However, a more surprising split in migration patterns has been observed where smaller cod appear to recruit from the Cape Cod nearshore waters and migrate either: 1) northwards into the inshore Gulf of Maine waters, or 2) eastwards out onto Georges Bank. This divergence in migration patterns is not currently accounted for in the current stock assessment models and it is recommended that cod movements and exchange rates feature in future stock assessment methods.

### Working Paper C2: Loehrke J, Cadrin S. 2007. A Review of Tagging Information for Stock Identification of Cod off New England

*Presentation Highlights*

Recent observations of cod movement across stock boundaries are generally consistent with historical tagging data as well as information from other stock identification approaches. This working paper provided an historical context in which to consider recent tagging data for spatial delineation of cod stock assessments. A review of cod stock identification approaches, focusing on tagging investigations, was presented and organized chronologically. Four conclusions were made with special consideration to transboundary movement:

1. Movement across boundaries is documented in all relevant investigations.
2. The primary direction and magnitude of movement varies between studies.
3. The current stock management boundaries are defined for operational purposes.
4. Evidence suggests that it may be appropriate to reevaluate stock boundaries, particularly in the vicinity of the Great South Channel where there is considerable mixing and growth rates are intermediate between those observed in the Gulf of Maine and Eastern Georges Bank.

### Working Paper C3: Miller A. 2007. Estimating instantaneous rates of regional migration and mortality from conventional tagging data and
### Working Paper C4: Miller A. 2007. A finite-state continuous-time approach for inferring regional migration and mortality rates from conventional and archival tagging experiments

*Presentation Highlights*

A finite-state continuous-time approach for inferring instantaneous migration and mortality rates from different types of tagging studies including tag-recovery are the subject of recent work by Miller and Andersen (in review). Here we apply the statistical method to data from tag-recovery experiments by the Gulf of Maine Research Institute (GMRI) on Atlantic cod, but expand the set of states to allow estimation of tag reporting probabilities, tag shedding rates and account for incomplete mixing of newly released individuals.

The main concern with the results so far is the unexpectedly high estimates of natural mortality. Potential causes for positive bias in natural mortality include 1) movement of fish to areas inaccessible to fishing or outside of the study area, 2) heterogeneity of size of released fish when there are differences in fishing mortality with size and 3) less than 100% reporting of high reward tags. The first potential cause is not readily dealt with using any tagging study, but the second cause could perhaps be treated by allowing fishing mortality to change with length and assuming a model for growth of tagged fish. Finally, the third cause is probably contributing substantially to the results here because tagged fish may just not be seen in large trawl catches. Non-reporting of high-reward tags does not appear to be a treatable problem, but if we can assume that this occurs equally across regions, the estimates of migration rates would be unbiased even though the natural mortality rates would be positively biased.

*Discussion on Working Papers C1, C2, C3 and C4*

It was noted that catch and effort scaling by statistical area in the cod movement paper was from NEFSC dealer data pro-rated and then combined for stock area. The selection of the cod model by Miller (C3 & C4) was not unduly influenced by the number of model parameters as it was based on a likelihood ratio test criteria and would be same choice even if AIC were used.

The suggestion was made to evaluate alternative tagging models such as the Brownie or MARK models. However, it was noted that in this situation these models may have to make some undesirable assumptions and the confounding of migration and mortality may create misleading fishing mortality estimates. A simple model of the number of recaptures divided by number of releases was also suggested.

The assumption of 100% reporting of high reward tags may not be reasonable. Lower possible rates should be considered. The majority of cod tagged were small (less than 53 cm). The model was parameterized with a constant natural mortality but it may be higher on smaller fish due to predation.

A sensitivity analysis of the Miller model was suggested. It was suggested that some rates be fixed such as exchange rates, natural mortality, reporting rate, etc. The possibility that tag return rates differ by gear type should also be investigated. In particular, differences in gear composition for the different areas may result in area - specific differences in estimates of fishing mortality. Also, if possible, the fully recruited fishing mortality using only legal size fish should be estimated. It was noted that size distribution affects probability of capture (for sensitivity issues).

The question was raised as to whether the tag return data supported the current stock definitions. The large exchange of cod between Georges and Browns Banks was noted. It is possible that permanently closed areas may have reduced tag release and recaptures (~20,000 tagged cod were released in closed areas (Cashes, CAI, CA II, WGOMCA)), because recaptures in those areas are limited to tagging trips and recreational recoveries. This may affect parameter estimates because of refuge effects. It was assumed that all fish are available and have equal probability of capture, whether tagged or untagged.

It was suggested that an analysis be conducted to examine the impact of net movements among areas. Also, it was suggested that the differences within Georges Bank be examined. If movement rates were taken at face value, would net loss be similar to having a higher natural mortality? It was noted that the results have to be conditioned on biomass by region and would be a function of the size or age of fish tagged. Incorporating additional parameters into the model to address this would be difficult but is possible.

It was concluded that the tag analysis represented a first look at sensitivity for bias. Additional work could go beyond the tag results to consider the implications of the higher natural mortality in the assessment models (e.g. VPA).

There was discussion on how much movement was needed before the current view of stock definitions was invalidated. This could be examined through the modeling presented at the meeting including expected equilibrium distributions of abundance and biomass across stocks under different migration rate scenarios and the impact of different stock boundaries on these distributions. It was unclear how much of these explorations could be done during this GARM.

## Yellowtail

### Working Paper C5: Cadrin S, Westwood A, Alade L, Moser J' Martins D. 2007. Yellowtail Flounder Tagging Data

*Presentation Highlights*

New England fishermen and staff at the Northeast Fisheries Science Center tagged over 45,000 yellowtail flounder in all three New England stock areas. The study was designed to charter commercial fishing vessels to tag yellowtail flounder with conventional disc tags and data-storage tags with the objectives of estimating movement among stocks areas and mortality within stock areas as well as providing growth observations. Preliminary results indicate frequent movements within the Cape Cod and Georges Bank stock areas with a less frequent movement among stock areas. Results are expected to provide information for yellowtail flounder stock assessments and management decisions. This report provides supporting technical information for preliminary estimates of movement and mortality to be reviewed for yellowtail flounder stock assessments (TOR C).

### Working Paper C6: Cadrin S. 2007. Movement-Mortality Analyses of Yellowtail Flounder Tagging Data

*Presentation Highlights*

The objective of this working paper was to provide updated analytical results from the cooperative yellowtail tagging study and demonstrate potential utility of the data for future stock assessments (TOR C). However, the tagging study is still in progress and these data are preliminary. More importantly, these analyses are presented to illustrate developmental methods and are not intended for stock assessment purposes. Background and introductory information about the yellowtail flounder tagging study are described in GARM Working Paper E3.

### Working Paper C7: Alade L, Cadrin S. 2007. Evaluating the Precision and Accuracy of the Yellowtail flounder Movement-Mortality Model via simulation

*Presentation Highlights*

In this study we begin to address the uncertainty of the yellowtail flounder movement-mortality model by simulating a population that emulates the yellowtail flounder population and tagging study. The results in this paper only provide a snapshot of the several possibilities for simulation and analyses. Based on the presented simulations, recapture data with coefficients of variation of 10% - 25% tend to provide the most accurate estimates of fishing mortality and movement rates. While exploratory simulations will continue to be used to determine the general properties of the model, the results in this paper should be viewed as demonstrations. Future directions involve evaluating the effect of sample size on variance estimates, simulating a design that assumes proportional releases, time varying mortality rates and stock-specific reporting rate.

### Working Paper C8: Wood A, Cadrin S. 2007. Can survival be estimated from the yellowtail tag-recapture database? A preliminary analysis.

*Presentation Highlights*

The analysis of the yellowtail data was based on the suite of Brownie models using the Mark program. Multi-period tagging models were applied. The model require a host of assumptions such as the representativeness of the tag releases, proper accounting of returns, catchability of tagged vs untagged fish, etc. Final model selection was based on an adjusted AIC value. Estimates of over-dispersion were higher than acceptable for these kinds of models. Four basic models were explored. Recaptures were fit to yearly, monthly and seasonal models. The general seasonal model likely best but still overparameterized. The model is considered preliminary and, once the models and the data are refined, the overall fit and the resulting parameter estimates will be greatly improved.

*Discussion on Working Papers C5, C6, C7 and C8*

Suggestions were made to improve the MARK model. It may be possible to limit releases to one release area and do separate MARK analyses for each stock. Other suggestions were made regarding the Cadrin model, including use of a sex disaggregated model and a model based on historical changes in regulations. Since fishing effort generally is generally related to aggregations of species, use landings instead of effort for specific auxiliary information could be considered. It was also suggested to explore alternative simple models such as the 'catch equation' method to examine natural mortality in SNE yellowtail.

The model estimated survival to be very low but with a great deal of inter-monthly variation. The mortality estimates were very high except in SNE yellowtail. The lack of tag recaptures for this stock created estimation problems in the Cadrin model. In both the MARK and Cadrin models, estimates of fishing mortality (F) were around 1.0 with natural mortality (M) around 0.2. The VPA also estimates high F which may be from high levels of discarding. There was then discussion on the level of discarding. Is SNE really a discard fishery? Discarding is high in two of the three stocks. It was suggested that with F being as high as estimated, the population couldn't persist. Recoveries in 2003 from Georges Bank, for instance, relative to the number released (an R/M or Peterson model) implied that exploitation was quite low. It was noted that R/M is commonly used for continuous fisheries, despite the intended 2-sample design of the

Peterson model and the implicit assumption of a closed population in the period between the two samples. It was mentioned that application of a Peterson model to a continuous fishery makes a logical inconsistency of recapturing tags over a period that is assumed to be closed to any losses. There could be other issues for the low exploitation in the early years (tag loss, etc.). The Miller model implies low dispersal of cod which is likely the case with yellowtail. Low dispersal rates may produce unreasonable values of the other parameters.

The low fitted reporting rate in the Cadrin model (13%) was noted. It was pointed out that even though it seems extremely low, in this fishery, there is an incentive to ignore tags (scallop fishery) and not report. It was suggested that tag returns be examined by vessel to determine the expected returns due to magnitude of vessel landings. This could also be done by fishery.

It was recommended that the Cadrin model was compared to the Miller model to examine the impact of the assumptions made in each. A suggestion was made to apply the Miller model to yellowtail but it was felt that the Miller model needed further evaluation using sensitivity analysis, although it was noted that some sensitivity analysis (sample size, etc.) was presented in the working paper. A caution was raised to avoid integrating results of tag model into VPA. The preference was to keep them independent as a means of checking conclusions. The tag models should move to integrate other information such as catch at length or catch at age. However, it was cautioned that results can be driven by the auxiliary data.

It was asked if the tag data and analyses support the current stock definitions. The reviewers concluded that nothing new resulted from this tag data, particularly boundary issues. What was known about the SNE-GB border was confirmed with tagging. Some Georges Bank fish move to Nantucket shoals seasonally. Diagonal results in the model for Cape Cod and Georges Bank are similar to tagging results from the 1940s (during WWII when F was presumably lower). This implies that the Cadrin model estimates of movement between these areas may be legitimate.

A question was asked on whether migration among stock areas can be quantified. It could but only if conditioned on a model derived F. Perhaps other methods for total mortality (survey data, etc.) would be more appropriate for use in the tag model.
Further discussion considered if it could be concluded that there was limited movement between Cape Cod, Gulf of Maine and Georges Bank. If F were high, then fish wouldn't survive long enough to migrate far. A suggestion was made to consider what process would be needed to make off-diagonals (stock movement) higher. It may be possible to use the Cadrin model to do sensitivity of this hypothesis.

The short time series of returns was thought likely to hamper analysis of mortality rates. The results may be most useful for migration and stock structure information. It was concluded that the mortality models are works in progress but not yet ready for use in assessment. It was noted that the tagging results could possibly be used as confirmatory estimates of survival in time for the final GARM meeting.

## FISHERY – INDEPENDENT SURVEYS

### Presentation: Rago P. 2007. NEFSC Bottom Trawl Surveys - Overview

*Presentation Highlights*

A brief overview of the NMFS trawl survey series was presented noting that it provided a synoptic view of the fish populations from Cape Hatteras to Scotian Shelf using a consistent stratified random design over the whole series. Of the three series, the oldest was initiated in 1963 while the newer series (winter series) was discontinued after the 2007 survey. In addition to numbers, weights and size composition for many species, ancillary data on food habits, growth and maturity are collected in addition to some basic oceanographic data (e.g., temperature, salinity).

*Discussion on Presentation*

It was noted that it was not possible to address the meeting terms of reference on fishery independent surveys (FIS) due to the lack of working papers on each issue. There are many issues to consider and it is important to prioritize work at the NEFSC to address those which are most relevant to the assessments. It was suggested that the Center hold a one to two day internal session as soon as possible to discuss FIS issues. It was suggested that the review panel provide its suggestions on the issues most pertinent to be discussed.

The choice of estimators for survey indices was discussed. With respect to delta distribution vs. zero-inflated distributions, auxiliary variables are needed to distinguish real and sampling zeroes, e.g. side scan or multi-beam sonar, bottom type or depth. Previous work suggests maximum likelihood estimates are not stable and Bayesian approaches may be best (and can incorporate the sampling scheme). Investigating estimators is a long-term research project beyond the scope of the current GARM. A quick approach to examining the usefulness of auxiliary variables would be to evaluate the gain in precision with a perfectly-known auxiliary variable. The auxiliary variable must be known everywhere to be used in this kind of analysis.

Issues with survey catchability (q) were discussed. Suggested methods for dealing with possible density-dependence in conversion coefficient estimates included (1) ignoring possible density effects when there are no estimates over a range of densities, (2) re-estimating the coefficients when density changes, (3) evaluating the empirical estimates by letting conversion coefficients be estimated as parameters in models, (4) comparing index trends over time with other ongoing surveys in same area (e.g. DFO survey on Georges Bank vs. Albatross and Bigelow) to validate trends produced with conversion coefficients, and (5) eventually considering data before and after the change in gear as separate time series.

The importance of tow duration effects was noted. For some species (strong swimmers, e.g. cod), larger individuals may be able to out-swim the net for relatively short tows. The effect may depend also on fish density or behavior pattern (schooling vs. individual swimmers); it is thought that schools are less likely to escape. NEFSC surveys for this GARM used 3.8 kt tow speed, so fish are likely to tire within the 30-minute tow time. Most studies show no difference in short vs. long tows; extensive Norwegian experiments on 15 vs 30 minute tows have shown no indication of an effect on q.

### Working Paper D1: Jacobson L, Correia S, Blaylock J. 2007. Potential environmental and spatial effects on survey data and assessments for GARM stocks

*Presentation Highlights*

The purpose of this paper was to examine environmental and spatial factors that may affect NEFSC bottom trawl survey catchability parameters and interpretation of survey trend data used in GARM stock assessments. Mechanisms that might change survey catchabilities and assessments for multiple species were of particular interest.

Results show that GARM species respond to temperature and depth in complex ways that depend on species, stock, season and fish length. Spatial distributions (latitude, longitude and depth) have changed relative to survey strata sets used in stock assessments, potentially changing survey catchability. In many cases, trends appear to be occurring still. Some stocks (e.g. GBK yellowtail flounder) have spatial distributions that shifted towards closed areas after closed area management was implemented in 1994.

Effective area swept by NEFSC bottom trawls probably changes with depth but there is little effect on trends in survey abundance, length composition or abundance at age data.

Survey catchability coefficients for young haddock, Pollock, and white hake may be affected by the presence of large numbers of recruits in strata outside of the strata sets used for assessments during some years, although more investigation is required.

Changes in mean size at age of GBK haddock appear to have changed fall survey catchability at age, but results are preliminary and more work is required.

The conclusions and recommendations in this report are intended to be robust to the underlying mechanism and would hopefully help improve GARM stock assessments under a wide range of conditions. Assessment scientists and experts should evaluate recommendations on a stock by stock basis, but alternate approaches to handling or modeling survey data may benefit GARM stock assessments. In particular, use of relatively large survey strata sets (including additional offshore and particularly inshore strata where possible) would probably make survey data trends more robust to changes in environmental and spatial factors. Consider expanding survey strata sets for age structured assessments to include additional inshore and offshore strata sampled consistently since (but not before) the first year with survey age data. Survey "holes" (years of missing data for some survey strata) should be filled using some sort of statistical model so that additional strata can be used in assessment strata sets and to facilitate interpretation. Database management software should include procedures for post-stratifying survey data by splitting large strata that overlap stock boundaries or other regions of particular interest (e.g. closed areas). Given potential changes in survey catchability at age associated with changes in size at age, it would be useful to consider stock assessment modeling approaches that use survey length composition.

### *Discussion on Working Paper D1*

During the discussion, several clarifications relating to the working paper were made, including the following: (1) catchability (q) was from N=qS where S is the survey index (as opposed to tow efficiency discussed in the overview for this session); (2) catch-weighting used number (not kg), as is done in assessments; (3) door/gear/vessel conversion coefficients were not used because the analysis was done on an annual basis; (3) changes in time of sampling among years was not accounted for; however, this is more of a problem in the early part of the time series and this analysis only used 1979-2006; (4) the analysis did not include sampling in Canadian waters.

Discussion was then pursued on each hypothesis:

### *Hypothesis 1: Shifts in distribution vs. depth and bottom temperature*

Shifts in bottom temperature may be systematic, but if size-groups react differentially due to different preferences, the pattern of shift will be complicated. Suggestions for improving the analyses included: (1) include tests for interactions (e.g. depth * temperature), (2) use a plus group for plots (e.g. age vs. depth) because sample sizes are small for older ages, (3) follow the methods of Perry and Smith (1994) to refine the analysis and construct hypothesis tests, (4) evaluate how annual random station selection may affect estimated distribution with respect to temperature and depth (e.g. if all stations fall in deep water within a stratum in a given year, this may produce a spurious year effect).

*Hypotheses 2 and 4: Distribution of GARM stocks has shifted relative to standard strata sets, possibly affecting survey catchability*

The importance of addressing these issues depends on (1) the proportion of the stock that falls within the standard strata sets. The higher the proportion within the sets, the more resilient are the estimates to a shift in distribution, (2) the stability of the proportion within the strata set over time – if the proportion is relatively constant over time, then impacts would be minor, and (3) the tradeoffs of being more or less inclusive.

Suggestions for the analysis of changes in the proportion of a stock in a standard strata set included (1) plot stock abundance vs. abundance from the whole area (proportion of stock in each stock area) to look for indications of change in q, (2) consider using different sets for different seasons because distribution of stocks may be different between seasons, (3) do not include areas in the analysis that have been excluded for biological reasons. The goal is to set up analyses that minimize the risk of measuring a different population between years. It isn't possible to have a quantitative summary of how much distribution changes over time if fish are distributed in areas that aren't sampled. Apparent (spurious) changes may be observed if the fishery is changing and causing shifts in distribution (this is not the same as a change in q).

The importance of inconsistently-sampled (and therefore ignored) strata (e.g. inshore strata) was discussed. A simple exercise to evaluate the importance of incomplete coverage would be to start with a time series from the consistent strata set (strata sampled in all years), then sequentially add strata that are sampled less frequently, ignoring holes, and look at effects on the estimates. If data are imputed for missed strata, the uncertainty in the imputations needs to be taken into account or overall uncertainty may be underestimated. Standard imputation methods exist, e.g. small area methods, model-based Bayesian approaches.

Basic biology must be considered when distribution is evaluated. The habitat where fish occur may not be where they survive well (e.g. haddock may be swept off Georges Bank rather than retained in an area favorable for survival). This is different than an environmental shift causing fish to move into a new habitat where they can now survive.

It was pointed out that other weaknesses of survey sampling may be as important as size of the strata set, e.g. rough bottom types are more poorly sampled, yet some species are primarily associated with these habitats. The list of hypotheses in the working paper did not cover all possibilities – human effects may be important, e.g. small cumulative changes in survey practice over time may have an influence that can't be quantified.

*Hypothesis 3: Changes in depth distributions causes changes in q due to area-swept-depth relations*

In addition to changes in q with wing and/or door spread, changes may come about through effects on overall net geometry, e.g. the relation between wing/door spread and headrope height.

*Hypothesis 5: Changes in mean size at length has altered age-specific q's*

Although it was asserted several times that this is the most important issue for the assessments of GARM III, it received relatively little discussion. However, it was noted that each analyst should consider the possible importance of this issue in their respective assessments. For instance, if there is a change in size at age in the population, survey results could be biased due to selectivity with size. This is an issue of particular concern for Georges Bank haddock which has recently shown large declines in size at age, where haddock at age are now the size of the previous age observed before the year 2000. It was noted that the impact on TAC advice should be examined, especially as this decline in size at age appears to be carrying through to subsequent year classes. Density-dependent effects on estimates of relative catchability at age are possible and should also be considered.

It was commented that it may not be appropriate to use average growth curves to convert selectivity-at-age to selectivity-at-length if size-at-age is shrinking over time. To help with model selection in the assessment, it would be useful to have an estimated prior for age-specific q.

## INDUSTRY-BASED SURVEYS

### Working Paper E1: Legault C, Keith C, Johnston R. 2007. Comparison of the Southern New England Yellowtail Flounder Industry Based Survey with the Northeast Fisheries Science Center Bottom Trawl Survey: Annual Trends and Distributions

*Presentation Highlights*

The comparison between the fine scale resolution of the Southern New England Yellowtail Flounder Industry-Based Survey (SNEYT IBS) and the Northeast Fisheries Science Center Bottom Trawl Survey (NEFSC BTS) clearly demonstrates the need for dense station locations to resolve fine-scale abundance issues. Once domain estimation was used to allow direct comparison between catch rates from the two surveys, the absence of yellowtail flounder in some NEFSC strata in the NEFSC BTS despite relatively high abundance found in the SNEYT IBS was a clear indication of the inability of the NEFSC BTS to measure fine-scale distributions. However, the long time series and comprehensive spatial scope of the NEFSC BTS makes it the preferred index of stock abundance over time. Trade-offs in density of stations, area coverage, and biological sampling must always be made in surveys, making some surveys better for specific topics than others. Some of the difficulties encountered in this analysis highlight the problem of cooperative research projects that are funded to collect data but are not funded to analyze the data.

### Working Paper E2: Chouinard C, Beutel D, Legault C. 2005. Consensus Report of the Technical Review of the Maine Department of Marine Resources

*Presentation Highlights*

Since the fall of 2000, an inshore trawl survey has been conducted in the spring and fall of each year in coastal waters of Maine and New Hampshire. The "Maine-New Hampshire Inshore Groundfish Trawl Survey" project has been funded by the Northeast Consortium and NOAA Fisheries, Northeast Regional Office and is led by scientists at the Maine Department of Marine

Resources. The main objective of the survey is to provide abundance indices of marine species in coastal waters that could be useful in stock assessments conducted by NOAA Northeast Fisheries Science Center. The data are also of use to the New England Fishery Management Council and the Atlantic States Marine Fisheries Commission. The presentation summarized the findings of a 2005 review panel on this survey.

As one of the major sources of information available concerning the coastal waters of the Gulf of Maine, it was imperative that all aspects of the surveys be formally assessed. The goals of the review panel required an extensive examination of survey design, data processing, and survey results to inform and improve future work and to assess the viability of using the data in the management of the resource. Overall, the survey was considered by the panel to be a valuable project with high scientific standards. It felt though the objectives of the survey needed to be clarified. As well, there was a need to adjust the design of the survey (random and fixed stations issue) to ensure achievement of the survey's objectives. Minor modifications and suggestions for improvement in survey operations, biological sampling and data collection were also suggested. The panel considered the survey to be an excellent example of a cooperative project with extensive outreach work and good data accessibility and that the data collected had a high potential for use in stock assessments, ecosystem analysis and increased understanding of coastal waters of Maine and New Hampshire. The panel made a number of recommendations for next steps and use of the data including 1) securing long-term funding, 2) implementing adjustments to sampling design, survey operations, biological sampling and data collection as soon as possible, 3) conducting small scale experiments to help resolve issues with the survey operations (e.g. towing in tide, depth-warp ratio) and a comparative fishing experiment if a second vessel becomes available, 4) detailed analysis of the data collected to date to help identify issues relating to the survey and illustrate its value and 5) developing closer contact with the NMFS stock assessment analysts who are likely to be important users of the data.

### Working Paper E3: Chouinard G, Weinberg K, McGovern J. 2006. Peer Review of Industry-Based Survey for Gulf of Maine Cod

*Presentation Highlights*

The presentation summarized the findings of an August 2006 review panel on a cod industry-based survey initially designed to examine the distribution and demographics of the Gulf of Maine cod stock. The survey design utilized a standardized grid as well as randomly selected locations provided by fishermen. An additional objective of the survey was to provide information on the age and length structure of cod within rolling closure areas. The panel undertook a comprehensive review of the technical aspects of this survey and considered that it represented an enormous amount of work for the investigators, cooperating fishermen, and the NCRPP. The care taken in the development of the survey design and gear was noted as well as the outreach program designed to keep the fishing community and general public aware of survey activity. The panel considered that the survey provides valuable information on cod in the Gulf of Maine when no other sources of data are available, particularly high resolution information on the spatial and temporal distribution, size composition, maturity and potentially age of cod which augments information from existing surveys. There is concern that the lack of sampling of cod in water deeper than 75 fathoms may not provide a complete picture of cod distribution particularly during the winter although the survey data are useful in determining the location and timing of cod in spawning condition as well as the coincidence of spawning cod with rolling closures. The panel assumed that the efficiency of the four commercial vessels providing data is the same, noting however that inter-vessel comparisons would be desirable. It considered that the data provide a qualitative spatio-temporal view for a number of parameters but further statistical analyses are required. It concluded that while it may be possible to use the data collected to derive indices of stock abundance for specific species, a significant number of issues would first need to be examined and resolved.

### Working Paper E4: Chouinard, Martin M, Sowles J. 2007. Peer Review of the Southern New England Yellowtail Industry-Based Survey

*Presentation Highlights*

The presentation summarized the findings of a February 2007 review panel on the technical aspects of the Southern New England industry-based survey for yellowtail flounder. The main objective of the survey was to assess the temporal and spatial abundance, distribution and size composition of yellowtail flounder (and associated species) within the Nantucket Lightship closed area, other proposed closed areas and adjacent areas. The survey also had a number of secondary objectives. The survey utilized a stratified random design based on strata defined by 30 minute latitude by 30 minute longitude rectangles and an equal number of fixed stations selected by the fishing industry. The panel noted the survey's high sampling intensity and the significant amount of effort by the team conducting the survey. It concluded that the survey had collected sufficient information to suggest that the Nantucket Lightship closed area does not meet the objective of protecting juvenile yellowtail. It recommended that analysis of the efficacy of the closed area be formally conducted and documented, noting that the survey dataset would be useful to identifying alternate closed areas. The panel was satisfied with the vessel selection process to minimize inter-vessel differences as well as the selection of the most appropriate trawl gear. It noted that the age samples have been very useful in complementing the age-length tables for the assessment of yellowtail flounder. However, the panel considered that the utility of the survey in tracking changes in abundance was low due to the shortness of the time series. Further, the mixed design of the survey (stratified random and fixed station) posed particular analysis difficulties, such that the survey estimates using all stations may be biased. Given the high sampling intensity, the panel felt that it should be possible to obtain unbiased indicators of the trends in yellowtail abundance by analyzing stratified random and fixed stations separately and that, if it were continued in the future, consideration should be given to using a unique sampling design, guided by the knowledge gained during the 2003-2005 surveys. As well, procedures and protocols (e.g. towing speed, guidelines for declaring null sets, swept area, fishing station standardization and analyses) need to be further documented to ensure that data are correctly interpreted and repeatable methods are used if the survey were to be resumed. It recommended that funding be made available to complete the documentation and development of metadata for this dataset to preserve its integrity and usefulness, noting the wealth of information available for analysis which would provide new knowledge on the biology of yellowtail flounder in the area. To the extent possible, it encouraged project team members, NEFSC scientists, and others to analyze these data. However, due to the single-species nature of the survey, the panel considered that the integration of this survey as it now exists with the NMFS survey, would be difficult and not cost effective. While the Southern New England industry-based survey was considered a good example of a cooperative project that provides valuable information on yellowtail flounder in the area, it, as well as other like surveys, are considered more appropriate to address short-term issues than to conduct long-term monitoring.

*Discussion on Working Papers E1, E2, E3 and E4*

Summaries of the peer-review panel reports (E.2, E.3 and E.4) were presented for each of the surveys. The surveys included a Maine/New Hampshire inshore groundfish trawl survey (spring and fall, 2000-2006), southern New England yellowtail flounder trawl survey (spring and fall, 2003-2005), and a Gulf of Maine cod trawl survey (November-June, 2003-2006). The designs of the yellowtail flounder and ME/NH surveys included stratified random sampling as well as sampling of fixed stations. The Gulf of Maine cod survey employed a fixed-station grid design. Due to the specificity of survey objectives, sampling during each survey occurred within a limited area and sometimes involved multiple vessels and gears for which conversion factors do not exist. Data from all three surveys have been audited and the yellowtail and cod survey data are available in the NEFSC research survey database. The ME/NH survey data are also available at the NEFSC but in a different format.

It was recommended that the NEFSC scientists consider using data from the three IBS surveys on a case-by-case basis. It was suggested that biological data might be the most useful data to examine for the cod and yellowtail surveys. As a result of the short time series and design issues pertaining to the yellowtail and cod surveys, these surveys were not considered useful for providing relative abundance indices. It was also noted that there is no conversion factor available for standardizing catch rates of the four vessels used to conduct the cod survey. However, the review panel suggested that the cod maturation data and size frequency data, in comparison to similar data collected during NEFSC surveys, might be useful ancillary information for the Gulf of Maine cod assessment. It was suggested that data from the yellowtail survey might be useful as a weighting factor with respect to analysis of the yellowtail flounder tagging study (C6). An attempt to use data from the yellowtail flounder survey was conducted whereby stratified mean catch per tow indices were computed and compared with those from the NEFSC research trawl surveys for a similar strata set, season, and year (E1). The review panel provided recommendations for the refining the analysis. It was concluded that such IBS surveys would be more useful in addressing management issues that require fine-scale sampling (i.e., closed area evaluations).

## ECOSYSTEM DATA

### Working Paper F1: O'Brien L, Jacobson L, Rago P J, Traver M, Col L. 2007. Trends in Mean Length and Weight at Age for Selected Groundfish Stocks.

*Presentation Highlights*

If trends in growth are significant and persistent there would be potential ramifications for stock assessments that involve stock projections or calculation of biological reference points. Randomization tests and linear regression were used to test for significant trends in mean length at age and mean weight at age for seven GARM stocks: Georges Bank (GB) cod, GB haddock, GB yellowtail flounder, Gulf of Maine (GM) cod, GM winter flounder, American plaice, and witch flounder and three other stocks: fluke (summer flounder), mackerel, and northern GB silver hake. Mean values were converted to Z-scores and presented, along with mean number per tow, as quintiles using Visual Report (NEFSC Toolbox) to display year and year class effects and possible density dependence.

No significant trends in mean length or weight at age were detected for GM cod. No significant trends in mean length at age were detected for GM winter flounder and only significantly increasing trends in mean weight at age 2 and age 3. GB yellowtail flounder showed significantly increasing trends in mean length at age for most ages and significantly increasing trend in mean weight at age 2 and age 3 only. Significantly declining trends were observed for mackerel mean weight at age but not mean length at age, whereas GB haddock showed significant trends in mean length but not mean weight at age. Silver hake showed significantly increasing trends younger ages and significantly decreasing trends in older ages for both mean length and weight at age. The remaining stocks (GB cod, American plaice, witch flounder, and fluke) generally showed significant declines in mean length and mean weight at age. These results indicate that fish condition is declining in mackerel, which may be related to competition or otherwise limiting resources. For all other stocks, mean length and weight at age generally trended together indicating that a different mechanism is influencing somatic growth. Further analyses will be conducted to explore what biological or environmental variables may be correlated with these trends.

*Discussion on Working Paper F1*

It was noted that the validity of the model assumption that somatic growth is constant over time needs to be examined since changes in growth could significantly affect spawning stock biomass and stock status determination. Persistence or transience in growth trends over time need to be determined so that an appropriate temporal interval for average growth can be made. Slower growth in young fish could also lead to higher predation, and these changes in natural mortality rates would violate the assumption of equilibrium. Changes in growth also have implications for reference points, and the causes for these changes are important to determine. If the changes are determined to be due to environmental factors, there may not be a need to change the reference points. However, if the growth changes are due to genetic shifts, then reference points should be altered accordingly. It was noted that there have been similar noticeable changes in condition factor of Canadian haddock stocks. Mackerel is the only stock that directly shows a decrease in condition for this analysis of U.S. stocks, with weight decreasing without corresponding decreases in mean length. However, decreases in length at age over time seen in many stocks could be an indirect effect of sustained poor condition.

It was discussed that non-linear relationships such as a quadratic equation should be explored to determine whether there are additional trends and to characterize these relationships. Splitting the time series further was also discussed to account for management changes such as closed areas etc. Auto-correlation of length and weight variables was raised as a concern, and it was suggested that a Durbin-Watson analysis be conducted to account for these correlations. It was also discussed that variance needs to be determined since the actual trends over time may not be significant given the confidence intervals. This could be done by bootstrapping the survey lengths and weights; however this is unrealistic given the time constraints of the GARM III. Another recommendation was to include the scale of trends in addition to the quintile divisions (e.g. range divided by the mean) since the divisions may be irrelevant if the magnitude of the change is small.

### Working Paper F2: Sutherland S J, McBride R, O'Brien L, Mayo R K, Pregracke S E. 2007. Recent Trends in Weight-at-Age of New England Flatfishes

*Presentation Highlights*

This analysis sought to determine whether recent changes have occurred in weight-at-age among nine flatfish stocks from the Northwestern Atlantic. Data from NEFSC survey cruises (1992–recent) were used to generate estimates of weight-at-age (WAA), length-at-age (WAA), and length-weight (L/W) parameters for these stocks. Trends within these measures were tested with correlation analysis by age, sex, and stock. Of the 51 tests conducted, only 2 (age-6 females for American plaice and witch flounder) showed significant ($P < 0.001$) decreases in WAA during the study period. These decreases were supported by changes in LAA and the L/W regressions as well. Sex ratios were also examined for each stock, as changes here could create an artificial change in WAA, but only summer flounder exhibited a significant correlation between the percentage of males and time ($P = 0.0001$).

*Discussion on Working Paper F2*

It was discussed that the Bonferroni correction used in this analysis is conservative, and that if a 0.1 significance level is used as in the previous study, declines in weight at age are consistent in both methods. The results of sex ratio shifts in summer flounder were discussed, which could be related to mesh size or minimum size limit changes targeting the faster growing, larger female fish. It was suggested that Murphy's change (Murphy 1952) in sex ratio method be used to determine whether there are non-linear relationships.

### Working Paper F3: Miller T, Jacobson L, O'Brien L, Legault C, Rago P J. 2007. A state-space approach for modeling maturity as a function of time and age

*Presentation Highlights*

In age-structured stock assessment models, an estimate of the vector of probabilities of maturity at age (for females in particular) is a necessary component of an estimate of spawning stock biomass. When maturity at age changes over time, it is also necessary to account for these changes. The state-space model is appealing because it directly accounts for changes in population attributes through time that are imperfectly observed from various ongoing data collection activities. More generally, the state-space model is useful for framing questions about any time series of data where the attribute of interest changes through time (Durbin and Koopman 2001). Other aspects of state-space models that are appealing from a more practical perspective include that predicted attributes at times where observations have large uncertainty due to either lower sampling or poorer information in the collected data can be improved by observations that neighbor the point in time with less uncertainty. Also, predictions can be made within the time series where observations may be missing or backward or forward in time beyond the available observations (i.e., hind- and fore-casting). As such properties are useful for projection of fish populations into the future, we propose the use of a state-space model for estimating maturity at age over time.

Given yearly estimates of any other population attributes such as mean weight at age or length at age and corresponding estimates of observation errors, the structural time series approach applied here for maturity could also be used to detect whether trends exist in these other population attributes. The structural time series approach can easily incorporate measured environmental covariates to improve predictions of the state through time and similar to GLMs the usefulness of various environmental covariates in prediction of the state can be assessed.

*Discussion on Working Paper F3*

The assumption that samples of individual fish are random was raised as a concern since the samples are clustered into tow groups. The review panel suggested using a quasi-binomial and/or generalized linear mixed effects models and coding the tows as groups to identify tow affect, however it was noted that this violation of independence applies to all methods. It was discussed that unlike previous analyses, there was no evidence for changes in maturity rates over time for Georges Bank haddock since the large confidence intervals indicate that apparent stanzas of maturity rates could simply be a random walk. Without taking into consideration the magnitude of the variability, mean maturity rates indicate stanzas of maturity patterns over time; however the model was stationary in the mean without a clear directional trend. It was questioned how large of a change would need to occur in order to acknowledge changes in maturity since it also cannot be definitively determined that there are no changes in maturity over time. Maturity rates are related to size, and previous size at age analyses could similarly have high uncertainty which would reduce evidence of trends. A further recommendation is to test the annual proportion mature instead of using the logistic relationship, and allow the model to fit the curve instead of fitting the model to an S-curve. Also, since length and weight variables are correlated, it was recommended that the age at 50% maturity be modeled over time rather than modeling the length-weight parameters.

The constant maturity rate used for forecasting projections was a concern, however since no trend was detected in the state-space model, this constant trend could be reasonable. It was noted that maturity can change with population size, and that the variability of maturity estimates have not been incorporated into spawning stock biomass. It was discussed that using a moving average of maturity rate would reduce variability, although there is no clear method for determining the appropriate bin for the moving average, and dampening the effect of the changes may overestimate or underestimate spawning stock biomass. Another approach to reducing uncertainty would be to use a length or age plus group that represents the mature fish in the stock, as used in Canadian stocks. This would incorporate the evidence that first time spawners are generally less fecund than older fish, and would eliminate the variability of the age at 50% maturity. Since this state-space model showed little trend over time, the average maturity rate over the time series could be used. However, this is not advisable since there are realized environmental and population changes over the time series which likely influence maturity. Covariates of biological and environmental variables should be incorporated to determine if trends in maturity exist.

The biological feasibility of inter-annual variation in maturity rates needs to be examined further. Knowledge of whether maturity is influenced greatest by genetics or conditions of individual fish which could exhibit considerable annual variability is important in determining realistic shifts in maturity rates. In assessments, pooling of maturity data over years is common since sample sizes are often too small to calculate annual 50% maturity rates, and the lack of pooling in the state-space model could be contributing to the high variability in the results. It was concluded that a moving window of average maturity rates should be used, and implications for using a smoothing method versus calculating maturity stanzas should be examined. Finally, it was commented that this model only examined one stock which is not necessarily representative of the other 18 GARM stocks, and that these stocks need to be examined individually.

### Working Paper F4: Legault C, Blaylock J. 2007. Analysis of Recorded Sample Weight vs Length-Weight Equation Derived Sample Weight using Commercial Port Sampling and NEFSC Survey Data

*Presentation Highlights*

Comparison of recorded sample weight with the weight predicted by a length-weight equation applied to the length frequency of the sample demonstrated changes in the population length-weight relationship over time, but not in the commercial catch generally. This apparent discrepancy could be due to a number of reasons. The survey comparisons are believed to be a representation of the population and these results agree with other working papers that fish appear to be getting slightly lighter at length in recent years. In contrast, the commercial data, which is a measure of the fishery landings, did not in general show trends in the length-weight relationship over time. There are two possible reasons for this. The commercial data could be too noisy to detect the population trends due to accumulating catch over the entire year from many gears and the use of estimated weight for the sample. Alternatively, the commercial fishery could be targeting a specific size or condition of fish. An additional analysis, not presented in the working paper, confirmed the decreasing weight at length in the survey data using individual fish weights, although the magnitude of the decline was not large relative to the variability in the observed weights at length.

*Discussion on Working Paper F4*

It was noted that the lack of trends in commercial landings despite decreasing trends in survey weights at length could be due to the uncertainty in the estimation of commercial catch weight as well as the targeting of larger fish in commercial fisheries. Analysis of individual fish weights at length from the survey data show that variability is greater than any clear trends; however this analysis is limited to data since 1992. It was suggested that linear regressions or non-parametric analyses be preformed in order to determine objective trends in weight at length over time.

### Working Paper F5: Hare J, Friedland K. 2007. Review of Environmental and Ecosystem variables relevant to assessments: *In-situ* Oceanographic Data and Remote Sensing Sea Surface Temperature and Chlorophyll Concentration

*Presentation Highlights*

The northeast U.S. continental shelf is changing (Friedland and Hare, 2007) and accounting for these changes may improve our understanding of the dynamics of fishery resources in the ecosystem. The NEFSC is currently working with a number of oceanographic data sets that describe the past and current state of the ecosystem. These data sets are separated into remotely-sensed and *in-situ* data. The remotely sensed data are derived from satellites and the NEFSC primarily is working with Level III processed-data. The *in situ* data sets are actual measurements of ocean properties and predominantly, but not exclusively, come from dedicated NEFSC monitoring activities.

The NEFSC is using these datasets to link environmental variability to ecosystem dynamics. For example, Friedland et al. (2003) estimated the distribution of winter Atlantic salmon habitat in the Labrador Sea and Denmark Strait using the OISST dataset and found that this habitat distribution was correlated with Atlantic salmon production indices. As another example, Kane (2007) linked the change in zooplankton community structure on Georges Bank to a recent shelf-wide freshening (Mountain 2004).

For the purposes of the GARM III, these environmental datasets would be included in an exploratory analysis with various stock parameters including weight-at-age. Maturity-at-age may also be included. This exploratory analysis would be an initial step in including environmental data in stock assessments. There is full recognition that mechanistic hypothesis regarding the effect of the environment on fishery population dynamics are needed, and it is hoped that the exploratory activities undertaken as part of the GARM can contribute to this broader need.

*Discussion on Working Paper F5*

Environmental data was discussed as potentially being important for assessments since changes such as melting arctic ice decreasing water temperature and salinity could cause changes in lower trophic level compositions and food availability.  Traditionally, environmental variables are not incorporated into stock assessments and would instead be addressed as independent research questions.  However, there are direct applications to assessments such as recruitment success and productivity, and there may be strong explanatory variables for recruitment other than stock size which could be incorporated as stanzas into stock assessments.  Data for environmental variables need to be made more accessible to assessment biologists and synthesized into a model in order to incorporate productivity into stock assessments.  It was concluded that changes in environmental variables indicate that the assumption of equilibrium is being violated, and that a comprehensive science plan should be made to determine which variables are important to assessments in order to prioritize facilitating the accessibility of these variables.  It was suggested that the potentially important environmental variables be incorporated into a traffic light approach be reviewed during the biological reference point meeting.

### Working Paper F6: Link J, Overholtz W J. 2007. Background Data Available for GARM3 Analyses of growth and Maturity

*Presentation Highlights*

The Northeast Fisheries Science Center of the National Marine Fisheries Service has had the Food Web Dynamics Program (FWDP) in one form or another since 1953.  The FWDP is responsible for designing the collection of, sampling, processing samples, quality control and data auditing, database management, and analyzing food habits data for the major fish species in the northwest Atlantic.  The food habits database contains more than 500,000 stomachs from over 130 predators and has more than 1,300 different prey items.  For most fish species, diet can be adequately characterized with the examination of 500 – 1000 stomachs, which is the case for the 40-50 main species.  The data have been collected quantitatively since 1973 to present (at the time of this report, 2007).  These data serve as the basis for a plethora of multi-species, single-species add-ons, and ecosystem models.  For the purposes of the GARM III, we will provide a set of food habits time series for the GARM species in appropriate strata sets, seasons, and size groupings.

## Working Paper F7: Link J S, Overholtz W J, Fogarty M, Col L, Legault C. 2007. GARM3 System Capacity Analyses

*Presentation Highlights*

There has been some concern expressed (by numerous stakeholders) whether all 19 groundfish (and more broadly, the entire fish community and even all targeted species) can have biomass simultaneously at optimal levels (e.g., $B_{MSY}$). We propose four approaches to address this question. The four proposed approaches are: 1) Converted energy budget values will be calculated to provide context, compare to other ecosystems, and be rebalanced to see if simultaneous optimal biomass is even feasible; 2) a transfer efficiency calculation will apply the overall productive capacity of the system as a limit/constraint for fish stock production at their various trophic levels; 3) an aggregate production model will be fit using ASPIC or a similar production model for all 19 groundfish and commercially targeted species as one "mega" stock and associated fishery; 4) a multi-species production simulation model will be used to bound the sensitivities of the issue.

*Discussion on Working Papers F6 and F7*

The system capacity analyses will be important during the reference point meeting in providing an ecosystem level reference to addressing the question of whether there are limitations on production for rebuilding all groundfish species simultaneously. The concern was raised that if the ecosystem results show large discrepancies from the individual stock assessments, this could cause problems with advising management and needs to be considered prior to the meeting. It was noted that the ecosystem analyses will not be made on a species-specific level, avoiding potential problems of assessing negative impacts of one species being rebuilt in relation to another species. It was noted that environmental variables such as temperature and trophic effects could cause MSY to vary, especially for stocks such as cod which are at the southern edge of their habitat range. Since this is the first time that these environmental variables have been analyzed together with single species assessments, there will be problems with modeling these combined data sets, especially where high levels of data uncertainty exist such as foreign fleet landings and commercial discards. It was noted that the time series of the analysis could be restricted to time periods with reduced uncertainty, and that scenario analyses should be done to determine the effects of varying these areas of uncertainty.

The review panel noted the magnitude of the environmental information being analyzed and the progress towards incorporating ecosystem work into assessments. However, based on these system-wide analyses, it will be difficult to address which species will not be able to reach MSY based on ecosystem interactions. It was noted that trophic interactions can be significant, as seen for inshore Southern New England stocks, and that ideally changes in M over time, as indicated by ecosystem analyses, should be incorporated into assessment models for the modeling workshop. There are several instances of stocks either being highly responsive to management measures, initially responding and then declining likely due to predation, or showing negligible response, indicating a possible regime shift due to biomass collapse or reduction of genetic variation. Even if responses to management measures occur, the predicted rebuilding time could be significantly prolonged due to ecosystem interactions. Therefore, examining these variables is important to assessing the stocks and it is recommended that ecosystem effects be analyzed on a species by species basis.

In regard to the models used for these ecosystem analyses, it was noted that models such as EcoPath and EcoNetwrk often rely on changes in transfer efficiencies to balance the models, and these metrics need to be documented and discussed. It was also noted that these types of ecosystem modeling packages often do not incorporate appropriate links between the benthos and fish populations. In these ecosystem analyses, benthos has been incorporated and there could be interactions such as the recent increase in scallops reducing available prey for larval fish. It was recommended that the system be examined at differing levels of energy allocation to the benthos.

The concern was raised that although statistical areas or survey strata sampled twice a year on groundfish surveys may be acceptable for addressing trends in adult populations, this may be too coarse of a resolution for recruitment interactions with plankton since larval fish are often only in this life stage for a short temporal period and small geographic area. It was noted that plankton samples are available six times a year with finer resolutions from GLOBEC, although there may be limited analyses of direct fish larvae prey. The review panel concluded that although these resolutions are not optimal for detailed ecosystem analyses, these concerns should not inhibit the incorporation of ecosystem changes into assessments, and forecasts could be conditioned on environmental variables. However, it was cautioned that when a model becomes overly complex, it is difficult to have confidence in the results.

The concern was raised that the GARM framework is not intended to be an ecosystem control rule amendment, however it was noted that putting constraints on harvest rates based on ecosystem interactions is not a violation of the Magnuson-Stevens Act if these constraints would reduce effort. In conclusion, the review panel suggested that sensitivity analyses be preformed, and that important trophic interactions and environmental variables be included in the assessments since they can substantially affect recruitment and MSY reference points.

## RECREATIONAL LANDINGS AND DISCARDS

### Working Paper G1: Terceiro M. 2007. Magnitude and precision of Marine Recreational Fishery Statistics Survey (MRFSS) estimates of the recreational catch of winter flounder and Atlantic cod

#### *Presentation Highlights*

For the stocks considered in the GARM, only winter flounder and Atlantic cod have significant recreational catch. The magnitude of the landings (catch types A+B1) and live discards (catch type B2) of the recreational fisheries are estimated by the National Marine Fisheries Service's Marine Recreational Fishery Statistics Survey (MRFSS). These estimates have been revised since GARM II in 2005.

The PSE (proportional standard error) of landings in numbers of winter flounder has ranged from 8.2% (1990, 1992) to 28.3% (1993) while the PSE of landings in weight has ranged from 8.2% (1992) to 27.5% (2005). The PSE of the live discards in numbers of winter flounder has ranged from 9.0% (1990) to 45.3% (1989).

The PSE of landings in numbers of Atlantic cod has ranged from 9.0% (1984, 2001, 2006) to 37.3% (1985) while the PSE of landings in weight has ranged from 10.1% (1989) to 56.2% (1985). The PSE of the live discards in numbers has ranged from 7.5% (2006) to 57.7% (1981).

*Discussion on Working Paper G1*

It was noted that length-frequencies of recreational landings are generally sparse, and that the only GARM stocks that include recreational landings in the assessment models are Gulf of Maine winter flounder, Southern New England winter flounder, and Gulf of Maine cod. These stocks all use survey based age-length keys and have to occasionally borrow length data from neighboring years. Recent declines in recreational landings for winter flounder are considered to be realistic since they correspond to reductions in commercial landings; however survey indices are also declining, indicating that reduced landings are not resulting in population increases. Similar findings were noted in the Mid-Atlantic region for several inshore species which do not have useful trawl indices but have reasonable biomass trend estimates based on recreational landings. The recent appearance of haddock in the Gulf of Maine recreational landings was discussed, and was considered to be plausible since it has been previously documented with the 1973 year class that large year classes can produce substantial recreational haddock landings.

Recreational discards were discussed, and a survival rate of 85% is used for winter flounder. Discards are not included in the Gulf of Maine cod assessment, assuming 100% survival of discards. This is probably unrealistic since it has been documented that gadoids have lower survival rates than flatfish due to their swim bladders. Cod survival rates have been estimated at 35% for longline gear and about 50% survival for commercial jigs; however these may not be comparable to recreational catch survival. Since live cod discards can reach two to three times the recreational landings, the assumption of 100% survival should be reexamined especially since discarded fish have increased as minimum sizes have increased. Allocating discards to ages is particularly difficult since there are generally no length-frequencies for recreational discards. It was noted that state divisions of marine fisheries provide estimates on discard lengths for recreational fisheries; however these estimates may not be consistent across the time series. It was suggested that commercial discard length frequencies could be used to provide a scale of discard size ranges.

The concern was raised whether MRFSS data should be used since there have been critical reviews of the data (NRC, 2006), but it was concluded that there is nothing that can be done to correct historical issues in the recreational data, and the uncertainties do not warrant exclusion of the data. It was noted that the low proportion of recreational landings compared to commercial landings in most GARM species reduces the concern of using this data set. For stocks that include recreational landings in catch at age calculations, models other than ADAPT should be considered that do not violate assumptions such as aging being measured without error. It was suggested that a meeting be conducted to focus on discards and data issues by species.

The allocation of recreational landings was discussed. Massachusetts landings were determined to be somewhat problematic for allocation since the state is a dividing region for many stocks. Since recreational landings do not include information on the capture location, assessments for the last 25 years have allocated recreational landings based on the port of landing where the samples were taken. Recreational landings are not allocated based on effort since effort estimates are not considered to be reliable and provide inconsistent landing estimates compared to total recreational landings by port. It would be beneficial to implement a standardized recreational allocation, however landings prior to 1985 would be impossible to include since site registers have changed. Site registers are lists of landing ports.

The use of party charter logbooks was discussed and it was noted that the distribution of catch could be used to validate the allocation of MRFSS data. However, the quality of the data was noted to be unreliable in that recreational logbooks are often completed on a seasonal or annual basis with only very rough estimations of area fished.

## PROGRESS TOWARDS OBJECTIVES

This section provides the review panel's response to the objectives of the GARM terms of reference. The volume of material presented and discussed at the meeting did not allow for an in-depth exploration of detailed technical aspects of the issues. The focus of the review was identification of the major issues and options for addressing these, which are reflected in this section.

### COMMERCIAL LANDINGS

### 1. Proration Methods for allocating dealer landings and port samples to Statistical and Stock Areas

#### a. *Evaluate algorithms used to estimate assignment of statistical and stock areas for dealer records, based on Vessel Trip Reports (VTR) for 1994-2006*

The current Vessel Trip Report (VTR) system has been in place since 1994, when reporting changed from a voluntary interview system to mandatory submission of trip related information (area fished, effort, gear characteristics, etc). However, before 2004, matching of VTRs with Dealer Reports, which provide landings of a trip, has not been straightforward due to the absence of a linking identifier. The latter, VTR serial number, which is available since 2004, is not yet ready to be employed in this matching but is planned for future implementation. In lieu of this, matching has been done on a single stock and species basis (the 'single species allocation system').

Wigley et. al. (A1) described a four level, trip-based hierarchical algorithm which offers a number of advantages over the single species allocation system, including comprehensive and consistent approach across all species, continuity with previous interview system, common data source for all species and finer scale of spatial resolution than currently available. Also, the new system is well documented with all allocation decisions transparent. While suffering from some of the problems present in the single species system (e.g. based on VTR self reports, compliance issues), it meets reporting needs and allows a broader range of analyses (e.g. ecosystem and economic) than currently available.

The new algorithm matched the majority of trip records at level A with decreasing degrees of matching from level B through D (where area is assigned on a probabilistic basis). Multistock species (e.g. cod, haddock, yellowtail, winter flounder and windowpane flounder) are potentially most at risk of having landings reallocated amongst stocks, this particularly due to reallocations in Statistical Areas (SA) adjoining several stocks. Overall though, the highest percent of total landings that required matching at level B, C and D was 13% and thus inter-stock reallocations were not considered significant. While there is little impact on landings allocations amongst stocks overall, there could be issues in the case of small stocks adjacent to larger ones.

The new allocation system brought attention to the accuracy of the SA information in the VTRs. Nies et. al. (A3) compared the areas fished from observer and VMS information to areas fished by large offshore groundfish trawlers, which indicated that 20 to 30 percent of observed fishing activity was assigned to the wrong statistical area. Palmer et. al. (A4) determined that when all fishing activity from a given trip occurred in a single SA, the VTRs reflected the true fishing location. However, on trips where fishing activity occurred in multiple SAs, there was significant reduction in the accuracy of the SA in the VTRs. This raised questions as to how fishermen report SAs on multi-SA trips. For instance, is there a predictable sequence to the SA reported in the VTR e.g. the first SA fished? Further research on SA reporting practices by fishermen was encouraged. It was noted that the growing use of Vessel Monitoring Systems (VMS) provides an important source of the positional information of fishing, as illustrated by Applegate and Nies' (A4) examination of fishing trip records from the yellowtail flounder fishery. While interpretation of the VMS data is still required to identify the area of fishing, these can be used to verify and supplement the VTR statistical area of fishing information. It is recognized that there remain uncertainties with the SA assignments but the current assignments are an improvement over what currently exists. It was recommended that issues with uncertain area of fishing information in the VTR can best be addressed through outreach and communication with fishermen who have low levels of reporting.

Overall, the new trip – based allocation system has a number of advantages over the single stock allocation system and is recommended for adoption. Managers will likely be interested in the impact of the new allocation system on assessments. The GARM III assessments should provide a comparison of the results using the old and new allocation system. Further, the new system affords an opportunity to investigate the impact of uncertainty in reported stock area on assessments, particularly for those small stocks in which a potential problem may exist (SNE yellowtail, Southern windowpane, Northern silver hake). The implications of the new allocation system for these resources should be investigated through a sensitivity analysis which would be included in the relevant assessments. More generally, the new system affords an opportunity to generate many different realizations of landings allocation, thus providing a consistent means of reporting stochasticity in the assessment-management cycle in the longer-term. Indeed, an appropriate ultimate goal of the allocation system may be a holistic and robust scheme that utilizes sales notes (dealer records), observer sampling, log books (VTR) and VMS records to generate probabilistic catch estimates.

### b. *Consider implications of algorithm for use of biological samples to estimate Catch At Age (CAA) by stock area*

The algorithm was designed to ensure maintenance of the link between the trip area of capture and the biological sampling information. Wigley et. al. (A2) determined that the majority of biological samples matched at level A and thus there was no change in SA designation. For the five multi-stock species (cod, haddock, yellowtail, winter flounder and windowpane, there were slight shifts in biological sample allocation to stock area but overall, significant changes to the stock landings at age were not expected.

It was noted however, that the allocation of non – GARM species, which was not investigated at the meeting, would require further investigation.

### c. *Compare results of revised algorithm with landings from GARM II*

The algorithm resulted in small changes in the overall landings reported by stock due to rounding errors. These, reported by Wigley et. al (A1), are considered minimal. Thus, the landings are unchanged relative to those used in GARM II.

### Evaluate uncertainty in CAA using information from the realized sampling design for port samples, the Age-Length Key (ALK), and overall sampling intensity

Legault et. al. (A6) and Miller (A7) explored a design (bootstrapping) and model – based approach respectively to the estimation of uncertainty in the landings at age. The bootstrapping was undertaken at three sequential levels - from port through length frequency to age within length. The model – based approach employed a correlation structure similar to that of the bootstrapping but allowed adjustment of the weighting given to each trip's sample. Both techniques produced similar results with high coefficients of variation (CVs) observed at the youngest and oldest ages. The ease of use of the bootstrapping approach was noted as an advantage. One advantage of the modeling over bootstrapping is that it allows the incorporation of auxiliary information and exploration of different assumptions to improve the estimates of uncertainty. Otherwise the approaches should provide similar results and either could be used.

A cautionary note on the bootstrap estimation procedures as currently implemented is warranted. Miller (A7) states: "Another complication is that there is a higher likelihood of sampling trips with larger landings. When this is ignored, biased prediction of numbers-at-age for the un-sampled trips will occur." As sampling generally has been a low percentage of the landings, the bias could be severe for estimates of total numbers at age and length. The bootstrap procedure assumes simple random sampling of trips within a region. A more appropriate approach would be to resample with probabilities that are modified to reflect a higher likelihood of sampling trips with larger landings. Also, it should be noted that since the sampling fractions are generally two percent or less, it is reasonable to assume sampling with replacement, thus eliminating the need for bootstrapping at the second (length samples within selected trips/market categories) and third sampling stage (subsampling of otoliths from selected lengths). Only bootstrapping at the first level only is required. The NEFSC was encouraged to undertake a comparison of bootstrapping at the first, port, level only with the results reported at this meeting to confirm this.

The above discussion highlights the importance of sampling rates at the port level and the importance of distributing sampling amongst more trips to ensure representative coverage of fishing activities. It was noted that the updated SA information in the VTR database affords an opportunity to check the sampling coverage of the spatial distribution of the catch. It was recommended that for each stock and fishery, the sampling rates be tabulated by market category and SA to guide sampling reallocation as needed and thus lead to improved estimates of the uncertainty in the landings at age. Further, it is recommended that the NEFSC explore the use of probability-based methods that are more in line with general survey practice (i.e., move away from opportunistic sampling) to safeguard against, possibly severe, biases in key estimates.

## COMMERCIAL DISCARDS

### 1. Evaluate methods for estimation of discards by stock area and measures of uncertainty

#### *a. Consider adequacy of sampling coverage by year and gear type and implications for measures of uncertainty*

Blaylock and Wigley (B1) summarized the information available from the Northeast Fisheries Observer Program (NEFOP) in relation to the VTR database for 1989 – 2007 across a range of gears and seasons. It was pointed out that the NEFOP coverage was initially oriented towards marine mammals (mandated coverage) but since 2003, has not only increased but also been more representative of the activities of five primary gear types, although there are still stock and time specific gaps (e.g. less overall coverage in the Mid-Atlantic). Wigley et. al. (B2) provided an in-depth analysis of observer coverage for 2005 which showed where coverage was good and where imputation (assumptions from sampling of adjacent cells) was required and Wigley et. al. (B6) provided background on methodologies for estimation and imputation. Overall, while it was acknowledged that the adequacy of sampling coverage has improved over time, the analysis was undertaken at a coarse level. In order to adequately judge the adequacy of sampling, an estimate of precision beyond what was presented is required.

### b. *Test and apply model-based methods for estimating discards in strata without observer coverage*

It was noted by NEFSC scientists at the review that the current practice of estimating discard rates in unsampled strata is to use data either from neighboring sample cells or from cells in which fishing activities were considered comparable to the cells in question. Decisions are made on a case by case basis. It was recommended that an analysis of the sensitivity of the derived discard rates to different sample selection assumptions be undertaken. Further, statistical techniques (e.g. Generalized Linear Models) should be applied to the data and the results compared to those of current practice, which should lead to improvements in the imputation of discard rates.

### c. *Compare and contrast alternative models for estimation of discards*

The Standardized Bycatch Reporting Methodology (Wigley et. al, 2007) documents a number of estimators of discarding and validation of the combined ratio method was provided using the 2005 observer data set by Wigley et. al. (B2). VTR data were used as a surrogate for Dealer data to expand the NEFOP discard ratios to total discards. In most cases (95%), there was good correspondence between VTR and Dealer landings, adding confidence to the use of these data, although there were patterns in the data (e.g. surf clam / quahaug, hakes) that require exploration. Overall, the technique was synoptic, reasonably well validated and exhibited little evidence of bias.

Legault (B5) provided a comprehensive simulation study to test the overall performance of a number of discard estimation techniques with respect to bias and precision. Two were clearly superior to the other four techniques: combined ratio estimator (ratio of sums) and the direct estimator, based on mean discard per trip scaled up to all trips in the simulation datasets. The latter had been advocated by McAllister (2007) for the estimation of discards, and would be the preferred approach if there is no correlation between the numerator and denominator of the estimate (i.e. no correlation between discard weight and kept weight). However, the method only provides unbiased estimates of total discard if the total number of trips is known, which in the New England groundfisheries, is often not the case. Total landings estimates are considered more reliable than those of the total number of trips. The combined ratio estimator of mean discard based on observed trips has the advantage that it can be combined with known landings data to estimate total discards. This is a pragmatic solution to data deficiencies, and appears to provide estimates with similar precision as the direct estimator. The bias in the combined ratio estimator depends on the sample size (number of observed trips) and was negligible for the data being assessed in the simulation study. It is emphasized that the unweighted mean of discard ratios should not be used to estimate total discard based on landings. As was demonstrated in simulations by Legault (B5), the total discard estimates based on applying the simple mean of discard ratios from observed trips to the landings was biased even when 99% of the trips were sampled. The reason for this is that the individual fish observed on a trip are not a random sample of fish from the total catch.

The issue then is which landings to use in the estimation of discards. Two approaches were discussed. The first was estimation of discards produced during harvest of the target species, i.e. winter flounder discards produced from landings of winter flounder. The second was estimation of discards from trips that did not land the target species, either "all" trips, or possibly a subset of trips that land species associated with discards of the target species. For example, scallop dredges can produce high discards of various flounders, including winter flounder. Ignoring these discards would produce seriously biased low estimates of discard mortality. On the other hand, weighting by total landings appears to produce unreasonably high estimates of discards in some cases when the catch of all species landed is high, as illustrated by an analysis of SNE/MA winter flounder (Terceiro, B4).

Unbiased estimates of the discard rates for the total landings are crucial to obtain unbiased total discard estimates. Thus, it is necessary to estimate discard rates for the most appropriate components of the fishery before scaling up to total landings. A biased estimator from observer trips that misses a targeted fishery, for example, can yield very biased estimates of total discard if it is applied to total landings that include the targeted fishery. The observer database should be analyzed to develop a suite of harvested species that are associated with discards of the species of interest. Discards should then be estimated based on expansion of the observed discards as a function of the landings of this suite of associated species.

*d. Consider methods to hindcast estimates of discards for years prior to start of Observer Bycatch program and*

*e. Comment on appropriateness of hindcast estimates and their implications for stock assessments*

While no formal analysis to address these objectives was presented at the meeting, NEFSC scientists reported that hindcast or historical estimates of discarding have been based upon survey data to infer discard rates and assumed percent discard of the landings. Modeling of discard rates might be possible but would require building and testing hypotheses of how fishing behavior is influenced by regulations and markets to produce discards. The NEFSC was encouraged to undertake these explorations. Another approach to estimate discards is to use growth and gear selectivity models to determine the likely discard proportion in a given year, assuming that faster-growing fish reach marketable size more rapidly and are therefore less likely to be discarded. This can be valuable, either for stocks for which discards take place but there are no discard data, or for stocks for which all fish caught of a given species and size range are discarded (in which case the discard proportion cannot be estimated). Further, while not discard estimation per se, the examination of processor records to determine the total weight and number of fish entering the plants, to the degree that this is possible for the GARM species, could be used to estimate the extent of misreporting or under-reporting and thus provide verification of the total catch on which the discards are based. Both of these approaches are considered explorations that the NEFSC is encouraged to consider in the longer term.

*f. Consider use of length samples from observer samples and "borrowing" of appropriate age-length keys from appropriate sources (eg. Research Trawl Surveys)*

There was no formal presentation to address this objective. During the discussion, it was noted that, in principle, the same methods used to estimate the landings at age could be employed to estimate the discards at age. As well, as the intent is to use estimates of the variance of the landings in the assessment models, comparable estimates of the variance of the discard at age are required. The low overall sampling rates of the discards present significant challenges which again highlight the need to use sampling and analytical approaches that address the potential biases, as noted in the landings section above.

*g. Consider measures of accuracy (bias) for discard estimates*

There are two sources of unrecorded mortality related to the fishing process: 1) discard mortality (mortality of fish caught but discarded from the catch) and 2) escapement mortality (mortality of fish caught but which escape from the gear and subsequently die. Hendrickson and Nies (B3) reviewed estimates of both types of mortality available in the literature. Some general patterns in discard mortality were evident (e.g. highest survival for bladderless fish such as flatfish, lowest for juveniles). It was noted that the current assumption for most GARM stocks is that discard mortality is 100% except for the two stocks of winter flounder where, based upon a few studies, a discard mortality of 50% is used. No specific guidance can be provided other than to state that if well designed studies of discard mortality exist, these should be used on a case by case basis. Otherwise, a discard mortality of 100% should be assumed. It is recommended that the NEFSC conduct or arrange for gear-specific discard mortality studies.

In relation to escapement mortality, it was recognized that estimates of this are very difficult to obtain and would require a sustained monitoring and research program over a number of years. Although the estimates provided in the review are illuminating, it was considered that only qualitative statements on escapement mortality could be made at this time.

## TAGGING DATA

### 1. Do results of tagging experiments support existing stock definitions for cod and yellowtail flounder?

Loehrke and Cadrin (C2) summarized the three major cod studies that have been conducted in the Gulf of Maine Area (GOMA: 4X-5Z-5Y) with the most recent in 2003 - 2005 being the most comprehensive. The analysis by Tallack (C1) of the latter tagging study in general corroborated the population movements as they are currently understood. As has been reported by earlier studies, there is a strong interaction between cod in 4X and 5Z and a less strong interaction between cod in 4X and 5Y. However, a split in migration patterns has been observed where cod less than 53 cm appear to recruit from the Cape Cod nearshore waters and migrate either: 1) northwards into the inshore Gulf of Maine waters, or 2) eastwards out onto Georges

Bank. It will be important to keep this interaction in perspective during the remainder of the GARM III process.

Cadrin et. al. (C5) reported the results of a large tagging study undertaken to describe the exchange amongst the Georges Bank and SNE yellowtail stocks. While they consider the results preliminary, they indicate high movement on Georges Bank but low movement between the Southern New England / Cape Cod and Georges Bank stocks. Overall, however, the study corroborated the location of the stock boundary between these components and the current stock structure of yellowtail in the GOMA.

It was noted that while tagging data is an important source of information to inform stock boundaries, other data such as that on growth also need to be considered.

## 2. Can migrations among stock areas be quantified?

For cod, a finite – state continuous – time (FisCot) model of migration and mortality processes in the GOMA was used to quantify cod migration rates (Miller, C3, C4). While the model could benefit from a number of improvements, it illustrated that cod migration rates could be quantified.

As noted above, the tagging data assembled by Tallack (C1) confirm apparently significant exchanges of cod among the management units in the GOMA, which are not included in current stock assessments, with a major locus of exchange occurring on the western boundary of the dividing line between 5Z and 5Y. The FisCot model computed exchange coefficients based on the current management unit definitions. It was suggested that the sensitivity of the current management unit definitions to these exchange rates be tested by simulating a movement of the western boundary. Overall, the FisCot model was seen as a valuable tool to examine the implications of management unit boundaries for the determination of key population parameters.

Cadrin (C6) also undertook modeling yellowtail tag recapture data using a formulation in which movement and mortality were considered separately. While the model showed promise, it did not adequately fit the tagging data, with significant trends in residuals in evidence. Simulations suggest that the model may not perform well when true movement rates are low, due to parameter correlations between morality and movement. It was suggested that auxiliary information, such as external estimates of fishing mortality or of movement inferred from biomass estimates from the NMFS surveys, be used to constrain model fitting.

It was concluded that while the model is a possible future application for yellowtail, the current model cannot currently provide quantified estimates of migration rates.

## 3. Develop appropriate analytical models for estimation of migration and fishing mortality

Three models were considered to estimate migration and fishing mortality rates for cod and yellowtail stocks in the GOMA, which have extensive tagging databases available. The first, used for cod, used a finite – state continuous – time process (FisCot) which allowed migration and mortality to occur simultaneously. It also incorporated double tagging information to allow estimation of tag shedding rates. The model allowed incorporation of a number of other processes (e.g. conventional and archival tags, exact time of tagging) which provides considerable flexibility in the analysis of tagging data. However, the current formulation does not include fish size or age, which would greatly enhance its utility. The model estimated high natural mortality (0.6) for all cod stocks and low fishing mortality rates, compared to the results of the relevant VPAs.

The second model, the movement – mortality model used for yellowtail, was an update of an existing formulation which modeled movement and mortality separately. It made a number of the same assumptions as the FisCot model but could not resolve model fit issues in relation to migration of yellowtail between Georges Bank and Southern New England. Thus, it was considered a preliminary formulation that required further development. An exploration of the sensitivities of this model to various assumptions on measurement and process error (Alade, C7) was instructive in identifying the model's strengths and weaknesses and guiding future work.

The third model, MARK, was also used to explore yellowtail migration and mortality processes. As with the second model, it too had difficulty fitting the yellowtail tagging data. Auxiliary data could also be useful in improving model performance. While promising, it too was considered preliminary and not yet ready for use in the assessments.

Given the difficulties that these models have encountered to date, it may instructive to model the tag-recovery data from each stock area separately to compare to the multi-stock analyses. This is the approach used in analysis of tag data from striped bass, which also uses the MARK reparameterization of the Brownie models. Also, models built on a monthly time scale may be attempting to analyze a finer timescale than these approaches were designed for, as they have been applied most commonly on an annual scale.

The tag data can also provide Petersen estimates of exploitation rate (Ricker, 1975), which can be accompanied by sensitivity analysis of violations of the assumption that all recaptured high-reward tags are reported (e.g. test effect of a 90% reporting rate of high reward tags, etc.). A number of studies can be consulted which illustrate the approach, including Crecco (2003), which is currently the primary analysis applied by the ASMFC Striped Bass Tagging Subcommittee, Kahn and Helser (2005) and Hewitt et al. (2007) for applications to blue crab, and Pollock et al. (1991) who outline the approach and provide formulae for variances. It was noted that the models presented at the meeting can be reformulated to provide Petersen estimates. Insight on the implications of assumptions can be gained by comparing the results of different model formulations, which the NEFSC is encouraged to undertake as part of its analysis of the tagging data for this GARM.

Overall, of the models presented, the FisCot model showed the most promise in modeling migration and fishing mortality rates in cod and yellowtail stocks during this GARM. The sensitivity analysis of its performance presented at the meeting was instructive in developing a more comprehensive understanding of its behavior under different assumptions and uncertainties.

## 4. Consider sources of uncertainty, particularly tag reporting rates, and commercial fishing effort

The sensitivity analysis of the FisCot model highlighted a number of sources of uncertainty that need to be kept in mind. The model indicated that fishing mortality was highly correlated with reporting rate, which was in turn linked to the assumption of a 100% return rate for high valued tags. Another model input is the assumed initial capture rate. This is a measure of the rate of return, based upon the initial aggregation of tagged fish, within one month after release. These assumptions should be verified as they may explain some of the discrepancy between the FisCot estimates of exploitation rate (5%) and those from assessment models (50%).

The model also assumes that fish of all sizes behave the same. As fishing mortality is generally relevant to mature fish, it would be useful to reformulate the model for cod of greater than 53 cm.

An unresolved issue is the seemingly high natural mortality rate (0.6) estimated by the model compared to what is used in stock assessments (0.2). It was noted that natural mortality rates in cod stocks north of 4X have been estimated to be higher than 0.2. This will require further exploration.

## 5. Consider use of tagging data to "inform" stock assessment

The FisCot model was considered as having the most potential for informing the upcoming GARM assessments. As stated above, updates for the other two models would not be available in time for the February GARM meeting but might be for that in April. If these models become available then, they could be used to corroborate the findings of the GARM rather than being inputs to the process.

It was noted at the meeting that there is a trend in fisheries population modeling to fully incorporate tagging processes within stock models. However, there is benefit to maintaining the tagging models separate from the assessment models. They provide a means to potentially estimate mortality rates independent of assumptions about the level of natural mortality required in catch-at-age models. The two modeling approaches are independent views of the same underlying processes and differences can yield insight on the veracity of the assumptions used in each. Also, the tagging data series is short and inclusion of the tagging data directly into the population model would imply a relatively low contribution to the likelihood function of the stock models.

## FISHERY – INDEPENDENT SURVEYS

There was only one paper presented to address some of the meeting objectives on fishery-independent surveys. Thus, many of the issues remain unresolved. Much of the discussion on this section referred to potential improvements that the NEFSC could consider based upon the review panel's understanding of the survey program. Reference was made to work by the March 2007 ICES Methods WG meeting, particularly on the treatment of zeros in surveys, which the NEFSC was encouraged to investigate at the working group's next meeting in April, 2008. In addition to the comments below, subsequent to the meeting during the review of this report, the review panel recommends two additional items:

- Evaluate the survey design efficiency for a number of species. This would be the first step towards deciding whether or not the design can be improved or if models with covariates are a way forward. It should be noted that some initial work on this has already been done for flounders (NRC, 2000)

- Many of the deeper survey strata are narrow and thin and may only be allocated one tow. This complicates estimates of standard errors and confidence intervals. The use of post-stratification to address this should be investigated.

It was recommended that the NEFSC conduct a one-two day focused session on fishery – independent surveys to explore survey improvements.

## 1. Consider methods for estimation of abundance indices and precision from stratified random survey designs

A complete set of estimation and analysis functions have been implemented either as part of the standard software for the survey data or in an R package (Smith, 2006) available to NEFSC scientists. This software also enables researchers to evaluate the efficiency of the stratified random design in terms of increase of precision benefits of the strata and allocation scheme for the number of tows assigned to each stratum. For instance, it was noted that while the sampling plan can be optimized for individual species being surveyed, when one considers all species together, proportional sampling has been found to be optimal. Indeed, one of the primary advantages of stratification is not only a potential reduction of variance but achievement of broad spatial coverage of the sampling. Having said this, the NEFSC was encouraged to undertake a comparison of the optimal and current sampling coverage using software that is available in the R package (Smith, 2006).

Confidence intervals for survey mean and total estimates can be calculated using the conventional normal approximation or the more robust bootstrap confidence intervals. However, there have been issues with using the bootstrap or the normal approximation when there are small sample sizes and particularly when there is only one sample as can be the case for some of the small deep water strata.

Work still needs to be done on evaluating potential gains in precision from post-stratification. There was no discussion on what would be the basis for the new stratification.

## 2. Evaluate effects of missing strata samples on estimation of spatially and temporally consistent indices of abundance and consider model based methods for imputation of missing strata

Jacobson et. al. (D1) presented six hypotheses and associated analysis to address how environment and other spatial effects may have affected the survey estimates. This working paper stated that it addressed the fishery independent surveys and ecosystem data terms of reference. However, the main emphasis of the paper was on the environmental aspects and no analysis was directed toward dealing with missing strata samples and imputation. The analyses presented were mainly graphical and exploratory in nature. If these analyses are to be developed more fully at a later time, there are established statistical methods available in the literature for analyzing associations between species and environments that should be considered. In addition, a number of these prospective methods incorporate the survey design which would address a shortcoming of the presentation, as acknowledged by the author.

The analyses were confined to the NMFS trawl survey series and the strata groups used by the stock assessment analysts for their respective stocks. Questions about the impact of not including inshore strata where for some species, juveniles may occur, were met by showing that the inshore strata from state and other surveys are included in many cases.

There was also discussion concerning the validity of the groups of strata that were used for specific species and stock. While no specific groupings were shown as being inadequate, the issue merits further investigation given the possibilities of changing distribution for some species given environmental changes. To that end, including strata now in response to changing distribution that may not have been covered every year in the past would necessitate some method of imputing past estimates for these strata. No specific methods have been used nor were any specified but the principle of including the uncertainty associated with the imputation in the estimates was acknowledged.

Potential impacts of changes in growth rates on catchability-at-age to the survey were also discussed as were possible density – dependent influences on survey catchability, both issues that require further examination.

### 3. Compare model vs design based estimators of abundance, including but not limited to geometric means, delta distribution, zero inflated Poisson, and zero-inflated negative binomial

At present, design-based estimates are being used for all GARM species. Improving the precision of design-based estimates usually involves improvements to the survey design. Given the multispecies nature of the survey, it is difficult to establish one survey design that is optimal for all the major target species of the survey.

An alternative approach for developing more precise estimates is to incorporate auxiliary covariates that are related to the distribution of specific species (e.g., depth). These types of estimates usually involve fitting a model to the data. Model-based estimates such as the Delta distribution has been used in the past for NMFS surveys. Generally, the small number of observations in each stratum has not allowed for the evaluation of the appropriateness of using the estimates defined for this distribution nor is it likely, based on theoretical work, that there will be significant gains in precision for sample sizes smaller than 30. Additionally, model-based estimates such as the Delta have not included auxiliary covariates explaining species distribution patterns.

Zero-inflated versions of the Poisson and negative binomial distribution offer the means to model the skewness noted for survey data as well as incorporate relationships with auxiliary covariates. These distributions have two kinds of zeroes, real zeroes possibly reflecting habitat where the target species is unlikely to occur and sampling zeroes as predicted by the Poisson or negative binomial distribution. Experience with these kinds of distributions is that auxiliary covariates (e.g., bottom type) are needed to differentiate between the two types of zeroes. Also, available maximum likelihood methods for estimating the parameters for the zero-inflated distributions have been found to be unstable but Bayesian MCMC approaches seem to be more useful.

The empirical likelihood approach of Chen et. al. (2004) combines design-based and model-based approaches, possibly allowing for incorporating a population model directly into the survey estimation.

There are a number of other design-based and model-based methods that allow for the incorporation of auxiliary covariates into the estimation to increase the precision but in all cases, the values for the auxiliary covariate needs to be known for the whole area and not just for where the trawl sampled. Surveys have collected auxiliary information on depth, temperature, etc. but usually at the sites where the tows were made and not over the whole survey area. Given that this kind of information is not available at this time, insights could be gained via simulation studies of the different kinds of estimates available in the literature based upon investigations of potential candidates for auxiliary covariates currently collected.

### 4. Consider implications of sampling design and age-length keys for estimation of CAA in surveys

Bootstrapping approaches were suggested by the NEFSC as being an appropriate method for characterizing uncertainty in CAA but little detail was provided. There was some discussion about making sure that the bootstrap structure replicated the sampling scheme. The review panel cannot comment further on this objective.

### 5. Consider implications of subsampling procedures for CAA and total survey effort for detection of "true" zeros and the use of multi-year ALKs. Consider implications of subsampling procedures for maturation rates, length-weight relations, and sex ratios

No projects were reported here and little was said about planned work.

### 6. Consider implications of D1-D4 for species with different catchability rates

No projects were reported here and little was said about planned work.

## INDUSTRY - BASED SURVEYS

In reviewing the industry – based surveys (IBS), the review panel noted the level of effort and funding devoted to them. Recognizing that these surveys were undertaken for specific purposes, which were generally achieved, careful consideration needs to be given about continuing these surveys to provide stock indices of abundance. The latter requires a long-term commitment to their support and it is important to evaluate whether or not this is best provided on these surveys or elsewhere in the science program in support of management.

### 1. Summarize list of IBS and cooperative research projects to date and incorporate as appropriate into the stock assessments

Industry-based surveys (IBS's) and other cooperative or collaborative resource surveys are increasingly being implemented in the US and elsewhere; an example from Europe is the Scottish Science-Industry Partnership scheme, which thus far has yielded valuable information on anglerfish and megrim around Scotland. Such surveys are generally set up to address issues that may not be answered well by traditional, long-running scientific surveys that were designed to achieve other purposes – examples of such issues might include location of spawning areas, or the stock distribution of species for which catchability in standardized survey gear is low. This implies that these projects can be of short duration. Once the objectives are successfully achieved, the project can be terminated.

Three such surveys were discussed at the meeting - the Maine-New Hampshire inshore groundfish survey (E2), the Gulf of Maine cod survey (E3), and the yellowtail flounder survey in Southern New England (E4). These had been previously peer-reviewed and it was the reports of these reviews that were presented and discussed at the meeting. Although this was informative, it meant that the meeting was unable to make recommendations on the content, veracity and utility of the surveys, only possible after extensive analysis of the survey data, including evaluations of stock coverage, consistency with other stock indicators (such as NMFS surveys), and examination of survey variability. Specifically, the review panel could not comment on the potential suitability of the surveys for the generation of abundance indices, nor on their inclusion in any subsequent stock assessment, beyond a general statement that any time-series with less than five years is generally considered too short for these purposes, as is the case with the cod and yellowtail surveys but not the case with the Maine – New Hampshire survey which has been underway since 2000.

One other issue raised by the meeting was the multi-vessel design of the three surveys. Although efforts had been taken to standardize the sampling gear configuration, the use of several different vessels with different fishing characteristics was likely to have had an effect on the relative catchabilities of different parts of the survey.

### 2. Comment on use of IBS as measures of trend, scale, and/or relevant fine-scale biological information

Legault et. al. (E1) compared the stock dynamics suggested by two candidate surveys, the Southern New England yellowtail flounder IBS and the NEFSC bottom trawl survey. While the stock trends were broadly comparable, there were considerable differences at the level of individual strata. There are a number of possible reasons for this: the vessels and gear used may have different selection characteristics, the IBS gear was a trawl specifically designed to catch flatfish and set protocols were different from those of the NMFS survey. However, the most likely explanation for the differences is the higher density of tows in the IBS, which means that it is less prone to the effects of random noise.

While unable to comment on the surveys in detail, the review panel noted the types of information that IBS's are exceptional at providing. These include fish distributions, spawning areas, age-length keys, maturity and maturation rates, and other biological characteristics on a finer scale (in many cases) than that provided by more general NMFS surveys. The review panel encourages the further development of these surveys and considers further studies on their applicability to be valuable.

## ECOSYSTEM DATA

### 1. Describe methods for detecting trends in average size, maturity and weight at length

The analyses by O'Brien et. al. (F1) and Sutherland et. al. (F2) examined temporal changes in gadoid lengths and weights at age of several GARM species. The first analysis employed a randomization test and the second a correlation analysis with Bonferroni adjustment. There was agreement in the observed trends for the flatfish stocks common to both studies. Many stocks exhibited long term declines in weights at age over time and, if persistent, have significant implications for biological reference points. Further, the analysis by Legault and Blaylock (F4) of a number of GARM species determined that the relationship between length and weight has changed in the population (fish are lighter recently) but not in the catch. While a number of suggestions were made to improve the above analyses, the broader concern remains that without hypotheses on the causes of these patterns, it will be difficult to determine how to respond to them.

In an analysis of long-term trends in maturity at age of Georges Bank haddock employing a state – space model, Miller et. al. (F3) determined that while there were patterns in the data series, these were consistent with a random walk. In order to determine whether or not there were biological or other processes causing these, it would be necessary to identify causative hypotheses (e.g. density dependent change in maturity, declining temperature) and redo the analyses using the appropriate covariates. It would be worthwhile determining whether or not the observed variation in maturation was biologically feasible. Improvements to the model to ensure that its conclusions were robust include investigating the impact of the clustered biological sampling, use of a generalized mixed effects model and use of a different functional model for the maturity ogive (e.g. Gompertz).

Given that the patterns remain unexplained, the review panel recommends the estimation of maturity at age using a multi-year smoothing average, referring to the influential biological processes of each stock when selecting the size of the window. This approach allows for slow change in the maturity at age which may be due to some as yet unknown process but also by using a smoothed average, recognizes the possibility that the observed patterns may be purely random.

## 2. Identify primary time series of extant environmental data and describe methods used to derive estimates on appropriate spatial and temporal scales

The review by Hare and Friedland (F5) of physical, chemical and biological information highlighted the availability of large amounts of data in the Gulf of Maine area that could be used to derive indices of environmental components and processes for use in the GARM stock assessments. To derive these, both temporal and spatial amalgamation is required but this is somewhat dependent upon the problem being studied. The examination of recruitment processes would require different analyses than those investigating processes, such as growth and distributional changes, occurring in the adult phase. There are a number of opportunities for inclusion of this information that would be worthwhile to pursue. Regarding recruitment, studies on the Scotian Shelf and Georges Bank have shown that haddock recruitment is influenced by phytoplankton productivity, which in turn is influenced by climate change. There is a need to explore potential environmental drivers of the observed trend in length, weight and maturity at age to resolve whether or not such trends have any biological basis. Certainly, changes in the ocean environment no doubt have an influence on the structure and function of the Gulf of Maine area ecosystem and need to be taken into account when considering stock specific reference points. There is a need to explore, on a case by case basis, how productivity might change and what adjustments to reference points would be required.

The intent by the NEFSC to include environmental processes in the GARM III is consistent with national and international efforts to more towards an ecosystem approach to fisheries (EAF). This will require the sustained effort of a coordinated science program to implement, elements of which were highlighted at the meeting. To profile these efforts with management authorities, it was suggested that the GARM III assessment report include a ‘Ecosystem Context’ section summarizing trends of a suite of pertinent environmental indicators, similar to efforts undertaken elsewhere e.g. Scotian Shelf (DFO, 2003). Further, trends in this suite could be summarized using multivariate statistical techniques which highlight the dominant changes in the ecosystem processes that have occurred. This approach might also allow identification of large scale changes, such as a regime shift from a groundfish to pelagic dominated ecosystem, which would have long term repercussions for ecosystem productivity and management.

### 3. Identify candidate measures of system-level productivity

Link and Overholtz (F6) and Link et. al. (F7) outlined a comprehensive program to integrate science on an ecosystem approach to fisheries into the GARM III. This consisted of four main elements: 1) estimation of the absolute abundance of the major species in the Gulf of Maine Area ecosystem, 2) the production potential of the fishery based on food chain processes, 3) estimates of Bmsy for exploited species (not just of GARM) in an ecosystem context and 4) modeling of the aggregate yield from the ecosystem. It is intended that the program will allow the GARM to comment on aggregate single stock yield projections in relation to overall ecosystem production and thus identify potential inconsistencies in single stock reference points with an EAF. For instance, it may be able to determine whether or not the rebuilding plans of many species are incompatible. Similar support for management decision making is already being provided to other regional councils (e.g. Pacific).

The initiative is ambitious and will require coordination of various science groups within the NEFSC prior to peer review at the April 2008 GARM. A number of the relevant datasets have never before been brought together in this manner and problems are to be expected. Indeed, each stock expert at the NEFSC is generally responsible for data collation, modeling, assessment and advice for his or her particular stock. Although this optimizes knowledge of one stock by the expert, it could hinder consideration of processes across stocks and thus calls for strong lab level coordination to fully address the ecosystem mandate of the GARM III. Notwithstanding this, the initiative was well received by the GARM and its efforts encouraged. Through it, the data needs of an EAF will be refined, including consideration of the required spatial and temporal scales of monitoring activities, uncertainties with historical fisheries statistics, and so on.

Many of the interactions amongst species occur during the early life history and are different from the processes that occur at the adult stage. As well, many of the current management issues involve the impacts of fishing on the benthic habitat. While efforts to model ecosystems have been underway for some time, the field is still relatively young and it is important not to ‘oversell’ its current capabilities. It is urged that ecosystem models be used within simulations to evaluate the relative performance of management strategies and to increase awareness and understanding of the implications of harvesting decisions.

## RECREATIONAL LANDINGS AND DISCARDS

The GARM raised a number of issues with the recreational fishery of which time at the meeting did not allow in-depth exploration. The management of recreational fisheries is growing in prominence and while GARM species are not generally implicated, it is urged that the NEFSC conduct a focused session on GARM species to explore comprehensively all recreational fishery related issues.

## 1. Retrieve relevant landings and discard information from MRFSS databases

It was noted that the Marine Recreational Fishery Statistics Survey (MRFSS) had undergone a national review (NRC, 2006) which had identified serious problems that required resolution. Given that there is a national initiative underway to redesign the system to address these concerns, the review panel did not comment on the MRFSS database.

Terceiro (G1) summarized recreational landings and discard information for cod (Georges and Gulf of Maine) and winter flounder (Gulf of Maine and Southern New England) which is available in the MRFSS database since 1981. It was noted that recreational reports on haddock have been increasing in recent years. While the winter flounder assessment appears to incorporate the recreational data in an appropriate way, the cod assessments seem to downplay such catches. While recreational catch may be a minor component, to be thorough, inclusion of recreational landings and discards is required in the catch-at-age matrix of these assessments.

It was pointed out that recreational catch per unit effort is used as important indices of abundance in other species and areas (e.g. striped bass in the Mid-Atlantic) and might be important to consider for relevant GARM species.

## 2. Report measures of uncertainty for each species

Estimates of uncertainty in the recreational catch for cod and winter flounder were reported. Concerns were raised regarding the merging of commercial and recreational landings, as the first is collected via a census while the second is based upon sampling. The major concern is not necessarily the precision of the recreational information but rather whether or not the sampling is biased. The NEFSC needs to evaluate the sampling design of the recreational fishery to determine its statistical properties.

Live discards are now significant part of the recreational catch of some GARM species. It is assumed that the survival of these discards, which are often below the minimum legal size, is 100%. Some discard mortality is to be expected, especially for species with swim bladders e.g. cod. On the other hand, discard mortality is likely not as high as in the commercial fishery. While the review panel could not recommend specific estimates of discard mortality for recreational fisheries, it felt that some level between zero and that for the commercial fishery was appropriate. The NEFSC was encouraged to consult published studies on recreational discard mortality for use in this GARM. In the longer term, the NEFSC will need to undertake field studies of recreational discard mortality.

## 3. Identify appropriate ALKs for estimation of recreational CAA

Both the Gulf of Maine cod and SNE winter flounder assessments use NMFS survey age – length keys to estimate the recreational catch at age. Recognizing that the collection of otolith material from anglers is difficult due to the need to ‘spoil’ the fish, this practice appeared appropriate but could not be fully evaluated at the GARM. It was noted that these keys should be supplemented by commercially derived aging material as appropriate (i.e. commercial aging available for size ranges in recreational fishery).

## GENERAL COMMENTS

The intent of the NEFSC to quantify the precision of each of the datasets considered at the review is laudable. While it was recognized that the combination of datasets with different sampling objectives and plans will make this task difficult, the end product will ultimately allow examination of the costs and benefits of the contribution of the various types of information to the assessment and thus to harvest advice. It will be possible to consider which data types (e.g. port sampling, observer, survey) are most critical to the assessment and what sampling rates of each of these is optimal. This will then guide the NEFSC on how best to direct the funding of these programs.

# CONCLUDING REMARKS

This report represents the review of the significant efforts of scientists at the Northeast Fisheries Science Center on the data inputs (landings, discards, tagging, fishery independent and dependent surveys, ecosystem and recreational) for the GARM III. A considerable amount of information was considered in the meeting time available and consequently the review could only focus on the most important issues and highlight work that could be undertaken to address these. Many of the recommendations made by the review panel can be implemented in time to be included in the next GARM in February 2008. However, a number will require longer-term actions which the NEFSC is encouraged to pursue. In a few cases (fishery independent surveys and ecosystem data), the NEFSC was encouraged to hold internal meetings to advance scientific investigation of the issues that were discussed.

Overall, the meeting achieved its objectives to review the data inputs for this GARM and represents an important contribution to the remainder of the GARM III process.

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# APPENDICES

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## Appendix 2. Terms of Reference

### *Purpose*

Review the commercial and survey data that will be used in the stock assessments. Identify appropriate statistical methods for analyzing those data (including bycatch and discard issues, changes in growth rates and other life history traits, issues related to merging databases, etc.). Other sources of data to be considered are tagging programs for cod and yellowtail flounder, and Industry-Based Surveys. Candidate sources of data relevant to ecological and ecosystem considerations will also be described.

Emphasis will be placed on estimating precision and bias of data and derived quantities. Measures of uncertainty will be considered with respect to their implications for use in stock assessment models.

### *Objectives*

Six (possibly 7) major sources of data will be examined:

A. Commercial Landings

1. Proration Methods for allocating dealer landings and port samples to Statistical and Stock Areas
    a. Evaluate algorithms used to estimate assignment of statistical and stock areas for dealer records, based on Vessel Trip Reports (VTR) for 1994-2006
    b. Consider implications of algorithm for use of biological samples to estimate Catch At Age (CAA) by stock area
    c. Compare results of revised algorithm with landings from GARM II
2. Evaluate uncertainty in CAA using information from the realized sampling design for port samples, the Age-Length Key (ALK), and overall sampling intensity

B. Commercial Discards

1. Evaluate methods for estimation of discards by stock area and measures of uncertainty
    a. Consider adequacy of sampling coverage by year and gear type and implications for measures of uncertainty
    b. Test and apply model-based methods for estimating discards in strata without observer coverage
    c. Compare and contrast alternative models for estimation of discards
    d. Consider methods to hindcast estimates of discards for years prior to start of Observer Bycatch program
    e. Comment on appropriateness of hindcast estimates and their implications for stock assessments
    f. Consider use of length samples from observer samples and “borrowing” of appropriate age-length keys from appropriate sources (eg. Research Trawl Surveys)
    g. Consider measures of accuracy (bias) for discard estimates

C. Tagging Data for Yellowtail Flounder, Cod, and Haddock

1. Do results of tagging experiments support existing stock definitions for cod and yellowtail flounder?
2. Can migrations among stock areas be quantified?
3. Develop appropriate analytical models for estimation of migration and fishing mortality
4. If possible, simultaneously estimate migration and fishing mortality rates for cod and yellowtail flounder from tagging data
5. Consider sources of uncertainty, particularly tag reporting rates, and commercial fishing effort
6. Consider use of tagging data to “inform” stock assessment

D. Fishery-Independent Surveys

1. Consider methods for estimation of abundance indices and precision from stratified random survey designs
2. Evaluate effects of missing strata samples on estimation of spatially and temporally consistent indices of abundance and consider model based methods for imputation of missing strata
3. Compare model vs design based estimators of abundance, including but not limited to geometric means, delta distribution, zero inflated Poisson, and zero-inflated negative binomial
4. Consider implications of sampling design and age-length keys for estimation of CAA in surveys
5. Consider implications of subsampling procedures for CAA and total survey effort for detection of “true” zeros and the use of multi-year ALKs. Consider implications of subsampling procedures for maturation rates, length-weight relations, and sex ratios
6. Consider implications of D1-D4 for species with different catchability rates

E. Industry-Based Surveys (IBS)

1. Summarize list of IBS and cooperative research projects to date and incorporate as appropriate into the stock assessments
2. Comment on use of IBS as measures of trend, scale, and/or relevant fine-scale biological information

F. Ecosystem Data for use in stock assessments

1. Describe methods for detecting trends in average size, maturity and weight at length
2. Identify primary time series of extant environmental data and describe methods used to derive estimates on appropriate spatial and temporal scales
3. Identify candidate measures of system-level productivity

## G. Recreational Landings and Discards

Comment: Recreational landing of most stocks in the GARM have been negligible historically, but risen to important fractions of total removals for some stocks, particularly cod in the Gulf of Maine. In recent years, the MRFSS data can be compared to VTR data for the commercial charter vessels.

1. Retrieve relevant landings and discard information from MRFSS databases
2. Report measures of uncertainty for each species
3. Identify appropriate ALKs for estimation of recreational CAA

## Appendix 3. Agenda

### *Monday October 29*

0900 - 0920 Welcome and Introductions
0920 - 0940 Overview of GARM and objectives of this meeting

**A. COMMERCIAL LANDINGS**

0940 - 1010 Methods for allocating landings to stock area (WP A1: Wigley)
1010 - 1040 Discussion
1040 - 1055 Break
1055 - 1105 WP A2: Wigley
1105 - 1125 Discussion
1125 - 1155 Accuracy issues VTR, VMS, Dealer data (WPs A3, A4, A5: Nies, Palmer, Nies respectively, 10 min each)
1155 - 1225 Discussion
1225 - 1325 Lunch
1325 - 1345 Commercial Landings—Estimation of total numbers landed at age and its variance Working Papers A.6, A.7 (Legault-10 min, Miller 10 min)
1345 - 1415 Discussion

**B DISCARD ESTIMATION**

1415 - 1425 Discard Estimates for National Bycatch Report (WP B1: Wigley)
1425 - 1445 Discussion
1445 - 1515 WPs B6 and B2: Wigley
1515 - 1530 Break
1530 - 1600 Discussion
1600 - 1610 WP B4: Terceiro
1610 - 1630 Discussion
1630 - 1640 WP B5: Legault
1640 - 1700 Discussion
1700 - 1710 WP B3: Hendrickson
1710 - 1720 Discussion
1720 - 1730 Wrap up and Adjourn

### *Tuesday October 30*

0900- 0915 Progress review and Order of the Day (Chair)

C. TAGGING DATA

Cod Tagging

0915 - 0935 Cod Tagging Data (WP C1: Tallack)
0935 - 0945 Cod Stock Boundaries (WP C2: Loehrke)
0945 - 1000 Cod Data Analysis (WP C1: Tallack)
1000 - 1020 Cod Modeling (WP C3: Miller & Tallack with WP C4 as background)
1020 - 1035 Break
1035 - 1115 Cod Discussion

Yellowtail Tagging

1115 - 1130 Yellowtail Tagging Data (WP C5: Cadrin et al.)

1130 - 1140 Yellowtail Movement-Mortality Analysis (WP C6: Cadrin)
1140 - 1150 Yellowtail Simulation (WP C7: Alade)
1150 - 1200 Yellowtail Mortality Analysis (WP C8: Wood)
1200 - 1230 Yellowtail Discussion
1230 - 1330 Lunch
1330 - 1430 Discard Estimation (B)follow up issues

**E. INDUSTRY-BASED SURVEYS**

1430 - 1500 Industry-based surveys (WPs E2, E3 and E4: Johnston)
1500 - 1545 Discussion
1545 - 1600 Break
1600 - 1610 Comparison of RI IBS with NEFSC survey (WP E1: Legault)
1610 - 1730 Discussion
1730 Adjourn

***Wednesday October 31***

0900 - 0930 Progress review and Order of the Day (Chair)

**D. FISHERY INDEPENDENT SURVEYS**

0930 - 0945 Fishery Independent Surveys - Overview (WP D2: Rago)
0945 - 1000 Break
1000 - 1030 Fishery Independent Surveys – WP D1: Jacobson)
1030 - 1125 Discussion

**G. RECREATIONAL LANDINGS**

1125 - 1135 Recreational Landings and Discards WP G1: Terceiro)
1135 - 1200 Discussion
1200 - 1300 Lunch

**F. ECOSYSTEMS**

1300 - 1320 Trends in biological parameters, eg. ave size, maturity, L-W etc. (WP F1: O'Brien)
1320 - 1350 Discussion
1350 - 1400 Trends in Flatfish (WP F2: Sutherland)
1400 - 1410 Discussion
1410 - 1425 State Space model for trend detection (WP F3: Miller)
1425 - 1445 Discussion
1445 - 1455 Observed vs Predicted weights (WP F4: Legault)
1455 - 1510 Discussion
1510 - 1525 Break
1525 - 1535 Review of Environmental and Ecosystem variables relevant to assessments (WP F5: (Overholtz, Friedland, Link, Hare)
1535 - 1540 Discussion
1540 - 1550 Background data relevant to food web dynamics (WP F6: Fogarty)
1550 - 1610 Discussion
1610 - 1620 Proposed analyses for Ecosystem Capacity Issues (WP F7: Fogarty)
1620 - 1630 Discussion
1630 - 1730 Review and Discussion
1730 Adjourn

**_Thursday November 1_**
0900 - 0915 Progress review and Order of the Day (Chair)
0915 - 1030 Landings Proration—Revisit/Discussion
1030 - 1045 Break
1045 - 1230 Discard Estimation—Revisit/Discussion
1230 - 1330 Lunch
1330 - 1400 Tagging Data—Revisit/Discussion
1400 - 1430 Industry Based Surveys—Revisit/Discussion
1430 - 1500 Ecosystemt Data--Revisit/Discussion
1500 - 1515 Break
1515 - 1645 Fishery Independent Surveys—Revisit/Discussion
1445 - 1530 Recreational Landings and Discards—Revisit/Discussion
1730 Adjourn

**_Friday November 2_**
0900 - 0915 Progress review and Order of the Day (Chair)
0915 - 0945 Report development
1030 - 1045 Break
1045 - 1230 Report development
1230 - 1330 Lunch
1330 - 1530 Summary and Assignments
1530 Adjourn

## Appendix 4. Working Papers

A1:. Wigley S, Hersey P, Palmer J. 2007. A Description of the Allocation Procedure applied to the 1994 to present Commercial Landings Data.

A2: Wigley S, Legault C, Brooks E, Cadrin, Col L, Hendrickson L, Mayo R, Nitschke P, Palmer M, Sosebee K, Terceiro M. 2007. Annual Comparisons of the trip-based allocated and the single-species prorated commercial landings, biological samples and numbers of landed fish at age

A3: Nies T, Applegate AJ. 2007. Accuracy of Self-Reported Fishing Locations in the New England Multispecies Trawl Fishery

A4: Palmer MC, Wigley SE. 2007. Validating the stock apportionment of commercial fisheries landings using positional data from Vessel Monitoring Systems (VMS)

A5: Applegate AJ. 2007. Using VMS data to characterize fishing activity in the US yellowtail flounder (*Limanda ferruginea)* (Storer 1839)] fishery

A6: Legault C, Brooks E, Seaver A. 2007. BioStat Bootstrapping for Estimating Uncertainty in Commercial Landings at Age

A7. Miller T. 2007. Model-based estimation of numbers-at-length and(or) -age for commercial landings in the Northeastern United States

B1: Blaylock J, Wigley SE. 2007. Summary of trips from the Northeast Fisheries Observer Program and Vessel Trip Report data

B2: Wigley SE, Palmer ME, Blaylock J, Rago PJ. 2007. A Brief Description of the Discard Estimation for the National Bycatch Report

B3: Hendrickson L, Nies T. 2007. Discard and gear escapement survival rates of some Northeast groundfish species

B4: Terceiro M. 2007. Comparison of commercial fishery discard estimates for SNE/MA winter flounder

B5: Legault C. 2007. Discard Estimation using Observer Data

B6: Wigley SE, Rago PJ, Sosebee KA, Palka DL. 2007. The Analytic Component to the Standardized Bycatch Reporting Methodology Omnibus Amendment: Sampling Design and Estimation of Precision and Accuracy

C1: Tallack S. 2007. A description of tagging data from the Northeast Regional Cod Tagging Program (3A) and preliminary applications of weighting and mixing analysis (3C)

C2: Loehrke J, Cadrin S. 2007. A Review of Tagging Information for Stock Identification of Cod off New England

C3: Miller A. 2007. Estimating instantaneous rates of regional migration and mortality from conventional tagging data

C4: Miller A. 2007. A finite-state continuous-time approach for inferring regional migration and mortality rates from conventional and archival tagging experiments

C5: Cadrin S, Westwood L, Alade J, Moser, Martins D. 2007. Yellowtail Flounder Tagging Data

C6: Cadrin S. 2007. Movement-Mortality Analyses of Yellowtail Flounder Tagging Data

C7: Alade L, Cadrin S. 2007. Evaluating the Precision and Accuracy of the Yellowtail flounder Movement-Mortality Model via simulation

C8: Wood A, Cadrin S. 2007. Can survival be estimated from the yellowtail tag-recapture database? A preliminary analysis.

D1: Jacobson LS, Correia, Blaylock J. 2007. Potential environmental and spatial effects on survey data and assessments for GARM stocks

E1: Legault C, Keith C, Johnston D. 2007. Comparison of the Southern New England Yellowtail Flounder Industry Based Survey with the Northeast Fisheries Science Center Bottom Trawl Survey: Annual Trends and Distributions

E2: Chouinard C, Beutel D, Legault C. 2005. Consensus Report of the Technical Review of the Maine Department of Marine Resources

E3: Chouinard G, Weinberg K, McGovern J. 2006. Peer Review of Industry-Based Survey for Gulf of Maine Cod

E4: Chouinard G, Martin M, Sowles J. 2007. Peer Review of the Southern New England Yellowtail Industry-Based Survey

F1: O'Brien L, Jacobson L, Rago PJ, Traver M, Col L. 2007. Trends in Mean Length and Weight at Age for Selected Groundfish Stocks.

F2: Sutherland SJ, McBride R, O'Brien L, Mayo RK, Pregracke SE. 2007. Recent Trends in Weight-at-Age of New England Flatfishes

F3: Miller T, Jacobson L, O'Brien L, Legault C, Rago PJ. 2007. A state-space approach for modeling maturity as a function of time and age

F4: Legault C, Blaylock J. 2007. Analysis of Recorded Sample Weight vs Length-Weight Equation Derived Sample Weight using Commercial Port Sampling and NEFSC Survey Data

F5: Hare J, Friedland K. 2007. Review of Environmental and Ecosystem variables relevant to assessments: *In-situ* Oceanographic Data and Remote Sensing Sea Surface Temperature and Chlorophyll Concentration

F6: Link, J, Overholtz WJ. 2007. Background Data Available for GARM3 Analyses of growth and Maturity

F7: Link JS, Overholtz WJ, Fogarty M, Col L, Legault C. 2007. GARM3 System Capacity Analyses

G1: Terceiro, M. 2007. Magnitude and precision of Marine Recreational Fishery Statistics Survey (MRFSS) estimates of the recreational catch of winter flounder and Atlantic cod

# Panel Summary Report
# of the
# Groundfish Assessment Review Meeting
# (GARM III)

## Part 2. Assessment Methodology (Models)

**By**

**Chairman: Robert O'Boyle**

**Review Panel: José De Oliveira, Stratis Gavaris, Jim Ianelli, Yan Jiao, Cynthia Jones and Paul Medley**

**Report Date: March 25, 2008**

**Meeting Dates and Location:**
**25 – 29 February 2008**
**Northeast Fisheries Science Center**
**Stephen H. Clark Conference Room**
**Woods Hole, Massachusetts**

TABLE OF CONTENTS

# SUMMARY

Models to assess the status and productivity characteristics of 19 New England groundfish stocks being considered at the 2008 Groundfish Review Assessment Meetings (GARM) were reviewed at the Northeast Fisheries Science Center in Woods Hole, Massachusetts during 25 – 29 February 2008. The review considered the applicability of a number of modeling approaches (relative trends to age and length – based models) and examined the utility of statistical catch-at-age formulations to address specific issues on each stock. The latter included the ability of these models to address observed retrospective patterns, the potential causes of which were also considered at the meeting. The review focused on the key observational error and model process assumptions for each stock to determine which class of assessment model was most appropriate to use and provided guidance on model formulations to address specific issues for each stock. The sufficiency of the assessment models to provide Biological Reference Points was also discussed as were the implications of zeros in fishery independent indices.

This was the second meeting of a four part process, with the first on data inputs (29 October – 2 November 2007) and the remaining two on biological reference points (28 April – 2 May 2008) and review of the assessments (4 – 8 August 2008). The GARM process has been designed so that each review can inform subsequent ones.

The body of this report consists of the recommendations of a seven member review panel in response to the meeting's terms of reference. The report also includes a synopsis of each of the working papers presented at the meeting along with the associated discussion, during which suggestions and recommendations were made to address identified issues. The panel considered these in drafting this report.

Overall, the meeting successfully fulfilled its terms of reference and represents an important contribution to the GARM III process.

# INTRODUCTION

This document is the summary report of the review panel (herein termed the ‘Panel’) of the Groundfish Assessment Review Meeting (GARM) on assessment methodology. The GARM is a regional scientific peer review process developed in 2002 to provide assessments for the stocks managed under the Northeast Multispecies Fishery Management Plan (Multispecies FMP). The first two GARMs took place in October 2002 (NEFSC, 2002a) and August 2005 (NEFSC, 2005) respectively. This GARM III is the most comprehensive to date, intended to provide peer reviewed assessments on 19 groundfish stocks managed by the New England Fisheries Management Council (NEFMC).

The four meetings of GARM III include:

- Data Inputs (29 Oct – 2 Nov 2007)
- Assessment Methodology (25 – 29 Feb 2008)
- Biological Reference Points (28 April – 2 May 2008)
- Assessments (4 – 8 August 2008)

The first three meetings are to establish the analytical formulations of the assessments to be used in the last meeting. The first meeting (NEFSC, 2007) focused on the data inputs (e.g. catch, sampling, surveys, etc) to be used in the assessments. The second meeting, which is the focus of this report, considered the assessment approaches to be applied to the datasets of each stock discussed at the first meeting (see Terms of Reference, appendix 1). The applicability of classes of assessment models, from relative trends to age and length-based models, was considered as well as the ability of the age-structured models to address observed retrospective patterns. Additional issues included treatment of zeros in the evaluation of fishery independent indices (e.g. surveys) and the capacity of assessment models to provide measures of stock status consistent with biological reference points (BRPs). The latter will be an important consideration for the third meeting, which will focus on the determination of the biological reference points used to guide management decision – making (see terms of reference, appendix 2).

Many of the assessments displayed similar issues, for instance the presence of retrospective patterns. The review first examined general issues applicable to all stocks by considering how these were pertinent to three case studies (Georges Bank yellowtail, white hake and Georges Bank cod). The lessons learned from these then informed discussion on the assessment model to use for each of the 19 stocks.

The meeting opened on Monday morning (see agenda, appendix 3) with an overview of the current assessment approaches and challenges facing the 19 groundfish stocks, with consideration of working papers (appendix 4) on potential factors responsible for retrospective patterns and the model implications of zeros in surveys in the afternoon. Tuesday morning was devoted to consideration of the ability of statistical catch-at-age (SCAA) models to address issues raised, particularly causes of retrospective patterns, in the Georges Bank yellowtail, white hake and Georges Bank cod assessments. Tuesday afternoon was devoted to consideration of working papers examining the presence and influence of partial recruitment assumptions on the assessments. Discussion on Wednesday further explored the issues in the assessments (retrospective patterns in Georges Bank yellowtail domed partial recruitment in Georges Bank cod and aging errors in white hake). Based on the discussions during the first three days, on Thursday and Friday morning, there was stock by stock consideration by the Panel of the most appropriate formulations to use for each assessment. Unfortunately, an update on work by the Northeast Fisheries Science Center (NEFSC) to develop ecosystem models which will inform the next meeting on biological reference points, which has been planned for Thursday, could not be presented because of time limitations, although the text of the presentation was made available to the Panel. The last part of the meeting on Friday was devoted to the Panel reviewing its conclusions and discussing report assignments. The GARM review Panel consisted of José De Oliveira, Cynthia Jones, Paul Medley, Stratis Gavaris, Jim Ianelli and Yan Jiao. The first three reviewers were assigned to the review by the national Center of Independent Experts (see statement of work for these CIE reviewers in appendix 6) while the last three were invited by the NEFSC. All were invited based upon their extensive expertise and experience with the issues considered by the meeting. The list of meeting participants is provided in appendix 5.

The presentation highlight of each working paper and the ensuing discussion as recorded by assigned rapporteurs is provided in appendix 7. These were important reference material to the Panel in drafting its report.

It is important to comment on the effectiveness of the meeting to address its terms of reference. Other than Terms of Reference 5, the panel was presented with sufficient material to address the stated terms of reference. Some clarification is required for terms of reference 5. For each of the 19 groundfish stocks, terms of reference 5 called for

> 'Assessment model that will be used to determine stock status and productivity characteristics until the next "benchmark" assessment is conducted. Where possible, apply the models to data (probably through 2006), to obtain current and historical estimates of F and B and estimates of uncertainty'

From the outset, it was apparent that in-depth review of the 19 assessments would not be possible. The approach taken at the meeting was to provide guidance on what class of model was most appropriate for each stock given the characteristics of the data (GARM III, 2007) and issues facing each assessment. Rather than focus on the software to be used, the Panel's review focused on the formulation most appropriate to take account of observational errors and model assumptions. These formulation decisions were considered more important than the choice of software because most applications have the flexibility to accommodate the formulation variants. While the details of each assessment formulation (e.g. ages to use in plus group) were not discussed, there was considerable discussion and guidance provided at the meeting that would inform some of these detailed decisions. Overall, while time was not available for in-depth review of the details of each assessment, the guidance provided by the Panel was important at this stage of development of the analyses in establishing the class of model to be used in each assessment. From this perspective, the Panel considers that important aspects of terms of reference 5 were met. If the NEFSC requires an in-depth review of the assessment formulations, this will have to undertaken later in the process.

The Panel was concerned about the limited time it had during the meeting to develop its conclusions. The Panel had planned for a full day of consideration of its report on the Friday but the meeting's agenda required the morning for completion of the discussion started on Thursday. While this requirement was understandable and perhaps unavoidable, review panels need time during meetings to consult. This needs to be factored into future GARM agendas.

Throughout the report, reference is made to a number of technical terms. The glossary provided in appendix 8 helps to clarify these terms.

# PANEL RESPONSE ON TERMS OF REFERENCE

## ToR 1. Applicability of one or more of the following modeling approaches to assess stock status (Index methods, Production Models, Age- or Length-based Models)

The Panel considers that model features required for the stocks considered in this GARM-III review must capture the underlying dynamics of populations and the key uncertainties about these and the associated data; capturing these uncertainties may require consideration of different model formulations. Models should be adequately conditioned on data so as to form the basis for the provision of advice. Appropriate consideration of uncertainty should allow risk assessment to be undertaken. Reference point generation and the ability to perform projections under alternative management options are also key features of prospective models.

A range of model classes was considered:

1. Relative trend models: These are models that consider trends in relative abundance and fishing mortality (F), and include the relative fishing mortality / replacement ratio approach of NEFSC (called "AIM"). The lack of catchability (q) estimates for this class of models limits its utility to inform management on absolute levels of allowable catch (i.e. TAC). They can however inform management on relative changes to existing TACs. Also, reference points have to be generated based upon expert judgment and on an *ad hoc* basis. There may be merit in investigating and comparing a more formal model fitting approach e.g. Glazer (2008, see next bullet), relative to the more exploratory, non-parametric approach of AIM.

2. Production models: These are essentially replacement yield models of the form: $B_{y+1}=B_y+Y^{rep}-C_y$[1], where $Y^{rep}$ can take a number of forms, including a constant ($Y^{rep}=a$; Glazer, 2008), a linear ($Y^{rep}=a+bB_y$) or a quadratic ($Y^{rep}=rB_y[1-B_y/K]$; implemented in the NEFSC software ASPIC) form. These models can be used when age data are not available but have encountered problems when there has been depletion but no recovery in the time series. Caution is needed when using constant $\mathrm{Y}^{\mathrm{rep}}$ for stocks for which there is no historical reported catch but there is evidence (e.g. anecdotal) that this could have been high or when the stock size has changed dramatically during the time period. In this situation, expert judgment may be needed to provide management with reference points based on these models.

3. Age-based models: These span the range from statistical catch-at-age to VPA-type models, and are the preferred approach when reliable age and growth data are available.

4. Length-and-age-based models: These are applied when age data are too limited to use age-based models, yet sufficient growth data (e.g. length frequency compositions) are

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[1] $\mathrm{B}_y$ = biomass in year $y$, $C_y$ = catch in year $y$ and $Y^{rep}$ is the function describing the replacement yield

available. However, it is important to evaluate stationarity when a growth model based on data from a restricted period is used.

Where data are lacking and there are conflicting hypotheses of underlying processes, the Panel noted the need to bound alternative states of nature by considering opposing extremes of plausible scenarios. Such an approach may require the consideration of multiple model formulations. If it leads to the consideration of competing models, then a risk analysis may be needed to inform decisions.

The software environment has important implications for what can be achieved. For example, a single software environment that can explore the diversity of data and assumptions is useful for comparative purposes. The use of simple models requires limited support, but also addresses a limited number of issues. On the other hand, more complex models require extensive, well-supported software (e.g. ASAP and SS2) that may limit broad access. Moderately complex approaches (e.g. ADAPT) require some support but are more widely accessible.

When moving from one class of models to another, or even from one formulation to another within the same class, it is important to document changes for fisheries managers. The Panel considers that this should be done by presenting results for the former approach (with new data), along with those for the new approach (with the same data). This allows the source of the change (whether new data or new model) to be clearly identified. It is important to provide rationale for any change in assessment models and explain differences in the results of the two approaches.

### ToR 2. For certain stocks that are aged, utility of statistical catch-at-age vs. VPA based models with respect to Retrospective patterns, Flexibility to account for alternative parameterizations, Ability to incorporate external sources of information, especially tagging and environmental data and Ability to estimate parameters incorporating prior, external information

Age structured fish population models use observations on catch-at-age to determine population abundance-at-age. It is generally necessary to incorporate ancillary information to make this determination. Most commonly, the ancillary information comprises observations on abundance indices-at-age, e.g., from surveys or fishery catch per unit effort (CPUE). The catch and index observations may be used as amount-at-age or as split components of totals and proportions-at-age. The choice will influence how the error structures are handled. Assuming natural mortality is specified, a fully and freely specified age structured fish population model requires one population abundance parameter for each year class and one fishing mortality parameter for each age and year. It is generally not possible to reliably estimate all these parameters.

Two common approaches used to reduce the number of estimated parameters are referred to as Virtual Population Analysis (VPA) and Statistical Catch-at-Age (SCAA). VPA makes the assumption that the errors in the catch-at-age are negligible relative to the errors in other observations. This assumption may be held in situations where the catch is well monitored. Though not obligatory, to further reduce the number of parameters to be estimated, VPA frequently makes the assumption that the fishing mortality on the oldest age is a specified function, e.g. average, of the fishing mortality on younger ages. SCAA, on the other hand, makes the assumption that the fishing mortality is the product of an annual fishing mortality and an age specific partial recruitment (PR). This assumption may be approximated in situations where the nature of the fishery has not changed substantially over years. Also, the SCAA dissociates the catch and index data from the model whereas in VPA, the "catch data" are bound to the algorithm for computing numbers at age. Both VPA and SCAA are approximations to the complex reality and are suitable as a basis for providing management advice.

For partial recruitment structure, index relationship to population, handling of natural mortality, and ability to incorporate 'prior' information on estimated parameters (Bayesian techniques), both VPA and SCAA are equally flexible. The principal consideration when comparing VPA and SCAA is the tradeoff between the magnitude of the error in the catch-at-age and the stability of the partial recruitment pattern over years. When the error in the catch-at-age is considered substantial, SCAA may be preferred. When the partial recruitment pattern is likely to be variable from year to year, VPA may be preferred. Often however, the results from VPA and SCAA do not differ substantially, suggesting that neither error in the catch-at-age nor departures from stable partial recruitment are critically important.

A more sophisticated variant of SCAA, referred to as semi-separable, relaxes the requirement for a stable partial recruitment pattern by allowing it to change over time. At the expense of having (usually many) more parameters, the semi-separable approach allows investigation to span the range from a VPA to a SCAA structure.

There are instances where, for some years of the analysis, the total catch is observed but the catch-at-age is unavailable. In these circumstances, only SCAA can be used to combine separate periods in the catch-at-age data. This may be of particular value for the estimation of reference points if there is an extensive initial period with total catch is observed but no catch-at-age data. Difficulties with a VPA application may also occur when errors in the catch-at-age are linked to some external or environmental observations.

An important issue in many fish stock assessments is the occurrence of retrospective patterns. These arise where the effect of removing recent data and re-running the assessment using earlier terminal years results in substantively different estimates compared to the result over the entire time period. These generally reflect incorrect model specifications or treatment of data and should be resolved. The panel reviewed results from a simulation experiment that investigated the performance of VPA and SCAA when retrospective agents were introduced and not accounted for in the model. The simulation operating model generated replicate observations which may have favored the SCAA approach because it used an underlying separable process for fishing mortality. A caveat on this is that the selectivity was length-based so the operating model was not entirely separable from an age perspective. Neither VPA nor SCAA were robust to the retrospective agents and their results displayed similar retrospective patterns. To properly address the retrospective patterns, it is necessary to know the true source, timing and magnitude of the effect (see section below on terms of reference 4). Uncertainty in point estimates should be carried forward to assist in judging the significance of the retrospective patterns. This may reveal that the estimates of uncertainty for one modeling approach contained the retrospective pattern residuals within confidence bounds more consistently than an alternate approach.

For many assessments reviewed at the meeting, the difference between results from a VPA and a SCAA approach were not the principal concern. Options for other model features had greater impact on results and deserve priority attention (see section below on terms of reference 5). The following table organizes these features and provides some guidance on the considerations for evaluation.

| **Model Feature** | **Variants**<br>(not comprehensive, reflects options considered at GARM III) | **Considerations** |
|---|---|---|
| *Structural Assumptions* | | |
| Population Model | - annual time step (no within year dynamics)<br>- homogeneous unit (no spatial sub-structure)<br>- sex aggregated<br>- sex disaggregated | - seasonal/spatial distribution of catches<br>- sexual dimorphism |
| Natural Mortality | - assumed known and constant for all ages and years<br>- age specific natural mortality | - demographics |
| Fishing Mortality | - separable as annual F and age specific PR<br>- separable as annual F and age specific PR, time block breaks/random walk<br>- separable as annual F and PR as function of age, time block breaks/random walk<br>- separable as annual F and PR as function of length<br>- calculated using catch equation, oldest age group PR estimated<br>- calculated using catch equation, oldest age group PR conditioned on younger ages | - reliability of total catch<br>- accuracy and precision of catch age composition<br>- plausibility of constant PR for years in time block<br>- support for PR pattern/assumptions |
| Index Catchability | - proportional, time invariant within block of years<br>- proportional, time block breaks | - support for change if applicable |
| Index Selectivity | - age specific, time invariant within block of years<br>- function of age, time invariant within block of years<br>- function of length, time invariant within block of years | - support for selectivity pattern |

| | | |
|---|---|---|
| *Error Assumptions* | | |
| Catch-at-age, expressed as catch numbers at age | - errors assumed negligible<br>- Errors iid after log transform<br>- Errors lognormal<br>- Errors Poisson | - residual diagnostics<br>- influential observations<br>- magnitude of mean square residuals |
| Catch-at-age, expressed as total numbers and proportions at age | - errors assumed negligible on combined (total and proportion)<br>- errors *iid* after log transform on combined<br>- errors lognormal on proportion, assumed negligible on total<br>- errors lognormal on proportion, lognormal on total<br>- errors multinomial on proportion, assumed negligible on total<br>- errors multinomial on proportion, lognormal on total<br>- errors Poisson on combined | - residual diagnostics<br>- influential observations<br>-magnitude of mean square residuals |
| Indices at Age, expressed as abundance at age | - errors *iid* after log transform<br>- errors lognormal<br>- errors Poisson | - residual diagnostics<br>- influential observations<br>-magnitude of mean square residuals |
| Indices at Age, expressed as total and proportions at age | - errors multinomial on proportion, lognormal on total | |
| Penalty/Constraint | - none<br>- recruitment conforms to Beverton-Holt form, log error, steepness<0.98<br>- recruitment conforms to a generalized Ricker form, log error<br>- first year abundance conforms to equilibrium condition<br>- on curvature of PR/catchability function<br>- von-Bertalanffy growth | - influence of constraints on estimates |
| Risk Analyses | - analytical confidence distributions<br>- bootstrap confidence distributions<br>- Bayesian posterior distributions<br>- alternative states of nature | -confidence in measures of uncertainty |

## ToR 3. Implications of zeros in the evaluation of fishery independent indices

When abundance at age estimates in NMFS surveys result in stratified mean values of zero, standard operating procedures are to treat these values as missing. This was the approach reviewed by the ICES WGMG 2007 report (ICES CM 2007/RMC:04). However in a NMFS Office of Science & Technology review in 2006, reviewers recommended an interim approach to handling these zeros as small values instead, pending further study. This problem arises when surveys used for tuning do not capture specific age classes. The presence of zeros is particularly problematic as age-stratified survey mean abundances are log-transformed before being used in VPA. Three working papers showed the results of using alternate approaches instead of changing zeros to missing. The papers explored several scenarios, including: 1) using actual values, or truncating values below a cut-off to zero and 2) treating zeros as missing, or replacing the zeros 3) an arbitrary small value, or 4) 1/6 times the smallest non-zero value. The simulations in working paper 3.1 showed that replacing zero with small values such as in scenario 3 or 4 was inappropriate because it resulted in bias. Prior to these simulations, previous studies (e.g. using g-statistic; Berry 1987) had identified a constant to replace zero based on obtaining normal skewness and kurtosis. However, any small constant is given considerable weight with a log-transform, whereas the Panel agreed that the zeros contain little information on stock size beyond abundance below some threshold. The Panel was in consensus that replacing zeros with arbitrary constants was not supportable because simulation results show that output can be biased when this is done. There was discussion as to how else to handle zeros as this poses a problem for models when abundances are low.

As an alternative to replacing zeros with an ad hoc value, the Panel discussed the potential of using other transformations beyond the log transform as a way to avoid problems with zeros. Several potential transformations of the Box-Cox type were briefly discussed, specifically the square root transform[2]. Such transformations can be used to stabilize the variance but may not always be appropriate; log transforms are from the same class of these transforms and have often been found to be suitable.

An additional approach would be to use other likelihood or quasi-likelihoods such as the Poisson or other distributions to handle zero-inflated models. Other distributions are used in modeling rare or elusive species and the Poisson has been previously used in fisheries. Multinomial (e.g. as implemented in the ASAP software), Conditional and Delta distributions have been used in other contexts and may or may not be appropriate for use when fitting populations trends from survey indices, depending on the situation. Changing to another distribution, such as the Poisson, has implications for q and variance estimation that would require further analysis and simulation. While some distributions, like the Poisson, can be fitted using iterative least squares, others, such as the negative binomial, do not have a simple relationship between the mean and variance and an additional dispersion parameter needs to be fitted as well as the mean.

The aggregation of age groups was seen to be advantageous particularly for older ages in which zero observations are more probable. One suggestion was to aggregate differently for any given year to better handle zero observations in these age groups. This has implications for the

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[2] For example, a least squares general form would be $\sum\left(\sqrt{O_i}-\sqrt{E_i}\right)^2$ preserving the linear relationship between the observed and expected variables

estimation of catchabilities at age (q) which would only be possible for consistently defined age groups over time.

The pattern of zero values is qualitatively useful in informing the assessment scientist that there may be a decline in the population or that there are issues with migration or some type of refuge, particularly as an adjunct to assessing the validity of using dome-shaped partial recruitment functions in the models. Even when data are omitted from the model fit due to the frequency of zeros, this pattern should be acknowledged and the original data presented.

The current NEFSC software which converts VPA to ASAP2 assumes a log normal likelihood for age composition data rather than a multinomial. The indices can also be entered in ASAP using the multinomial option, which could facilitate inter-model comparisons.

Altogether, the Panel considered that omitting zeros was a reasonable approach and that this was not a major issue for most assessments at this time. However, this issue could require further attention in the case of a declining sequence of biomass from surveys and would probably require identification of an alternative likelihood to the log-normal for survey data. As stated above, before being adopted, simulation should be conducted to explore the behavior of alternative formulations to address the presence of zeros in these data.

## ToR 4. Potential factors responsible for retrospective patterns

Retrospective patterns result from structural errors in the stock assessment model. Where the error is consistent through time (e.g. a misspecification of natural mortality), a retrospective pattern will not occur. It will only occur when there has been a change within the time series of observations. There are four potential causes of retrospective patterns in age structured stock assessments:

- An unrecorded change in catches
- A change in natural mortality
- A change in the abundance index catchability (q)
- A change in fishery selectivity

In all cases, either the biomass has changed (changes in natural mortality and unrecorded catch) or is perceived to have changed (changes in catchability or selectivity) in a way that cannot be explained by the catch-at-age data, and therefore is a structural error in the model. Random noise is an unlikely cause, based on simulation analyses although it was hypothesized by a Panelist that mis-specification of the likelihood function could bring about retrospective patterns through influential data points.

One mechanism identified as a possible cause for retrospective patterns is when a survey of sessile species includes an area closed to fishing. When there is effectively no movement of the population between the closed and open areas, the part of the population in the closed area becomes unavailable to fishing and relatively more abundant than the part of the population outside the closed area. This causes an overall apparent change in the survey catchabilities. However, this is unlikely to be an important factor for groundfish.

The Panel notes that it is not possible to identify the cause(s) of the retrospective pattern from model diagnostics alone. Adjusting the model assumptions (e.g. altering survey q, catches or M) to remove the pattern does not guarantee the problem has been dealt with; the model may continue to be mis-specified. It is necessary to develop testable hypotheses concerning the cause, timing and magnitude of the effect. Additional information and analyses that might assist in discriminating between hypotheses include:

- Repeating the catch-at-age analysis on a "moving window" of time series data over the full time series to identify the timing of the cause;
- Examining the model residuals for a non-stationary pattern;
- Comparing trends in commercial and survey CPUE;
- Comparing the magnitude of survey catchability estimates across species and areas;
- Comparing swept area biomass estimates from surveys with those from the assessment model.

Some solutions to retrospective patterns were considered by the Panel, which in certain circumstances, the following could resolve:

- Truncate the assessment time series to the most recent period to remove the retrospective pattern. Although the underlying problem may continue to exist, it has been dealt with in a consistent enough manner for the time series in question to inform the decision–making. The consequences of doing this on reference point determination will require attention at the next GARM meeting.
- Consider the use of robust likelihood approach, which could address the hypothesized cases where influential data points are causing the retrospective patterns (Fournier et al., 1991).

In considering the recommendations of the NEFSC report of the retrospective working group, the Panel concluded that:

- A retrospective analysis should always accompany a catch-at-age stock assessment to determine whether or not a retrospective pattern is present.
- Hypotheses that might explain the cause(s) for the retrospective pattern should be developed and form the basis for further research; these need to be communicated to decision – makers as major sources of uncertainty.
- Standardized criteria need to be developed to identify a statistically significant retrospective pattern. The statistical test presented at the meeting, based on identifying a pattern that was unlikely to be caused by random error, looked promising. The properties and power of the test should undergo further examination.
- Where there are strong grounds to reject the best single model, the alternative models (hypotheses) which explain the retrospective patterns should be used to evaluate the consequences of management decisions. The uncertainty needs to be communicated to managers and decision-makers, through decision tables and other types of risk analysis.

### ToR 5. For each stock, assessment model that will be used to determine stock status and productivity characteristics until the next "benchmark" assessment is conducted. Where possible, apply the models to data (probably through 2006), to obtain current and historical estimates of F and B and estimates of uncertainty

***General Considerations***

In this section, for each stock, the Panel provides guidance on the class of assessment model that are suitable given the nature and availability of the relevant data. Often, there was no compelling evidence to choose between a VPA and SCAA formulation. The analyses presented at the meeting using comparable VPA and SCAA formulations generally behaved similarly. In situations where the Panel considered that one formulation was more suitable, the preference is stated.

Following this, the most influential model features that need to be resolved for each stock are stated in order of priority. These are generally, but not always, intended to address retrospective patterns observed in current assessment formulations.

A number of issues arose that are relevant to all stocks and are discussed first.

*Estimation of Partial Recruitment*

The estimation of the partial recruitment pattern on the older age groups was a recurring issue in a number of the stocks. However, while dome-shaped fishery partial recruitments on the older age groups may resolve retrospective patterns, it may also lead to what was termed 'cryptic' biomass – biomass generated by the model that has not been observed in either the fishery or surveys.

The Panel considers that the burden of proof should be to convincingly demonstrate that the fish exist in the population when not observed in the fishery and surveys, even if the model fit with dome-shaped partial recruitment is better. Patterson (2002) noted for highly parameterized models, fishing mortality tended towards zero while population numbers tended towards infinity. Other solutions can only be achieved by imposing some constraints on the models e.g. constraining fishing mortality on the oldest age group in each year to a fixed proportion of an average of fishing mortality over younger ages as in ADAPT and Laurec−Shepherd methods. This is another way of saying that additional information (data and / or assumptions) external to the model is required. At the very least, the consequences of adopting a dome-shaped as opposed to a flat topped partial recruitment should be documented for consideration in the management arena. When competing hypotheses of partial recruitment are being considered, all information, including external sources of data, should be examined to inform the merits of each. For example, it may be possible to disaggregate the plus group catch to assist in hypothesis testing. Analyses of tagged fish presented at the meeting offered promise for evaluating hypotheses about partial recruitment. A number of different hypotheses emerged at the meeting that could be formally investigated which the Panel encouraged.

When considering an SCAA formulation, it is often necessary to define blocks of time during which the separable assumption is likely to be met. However, care needs to be taken on how to define the transition between blocks. Abrupt changes in estimated partial recruitment may result from large errors in the observed data. Techniques (e.g. random walks) which constrain how much partial recruitment can vary between adjacent blocks of time should be explored.

The algorithm in the software of the NEFSC used to estimate the population numbers in the plus group gives rise to inconsistencies. It assumes that the fishing mortality on the plus group is some function of the fully-recruited fishing mortality in the same year and, using the Baranov catch equation, estimates plus group abundance from the catch numbers of the plus group. This does not recognize abundance contributions of non-plus group and plus group ages from the year previous. An appropriate algorithm is provided in Anon. (2003). Differences between the two algorithms depend upon the size of the plus group as well as the assumptions made on the partial recruitment.

While the difference between the two algorithms is small when plus group catch is small, it can be important when plus group catch is large and / or when the partial recruitment is assumed to be domed.

### *Weighting of Model Components*

When fitting models to data, weighting factors are often used to emphasize or de-emphasize components, e.g. less weight given to the index for age 1 relative to others because it is considered ‘noisy’. The Panel did not extensively explore how to define weights but offers some observations, based upon discussion at the meeting.

Weighting may be internal or external. In the first case, the weights applied to the fit of each model component are based on the measure of fit of the model to the data and are iteratively updated during the estimation process. In these situations, it may be useful to define a minimum bound on the weighting (e.g. minimum variance) to ensure that no one model component draws an inordinate amount of the weighting.

External weightings may be derived from estimates of the variance in the input datasets (e.g. stratified variance in the survey dataset). In these cases, it is important to ensure that the estimate of the variance is precise enough to be useful. Small sample sizes can lead to imprecise estimates of the variance. It may be possible to generate externally derived weights based on a statistical analysis of trends in variance in the dataset (i.e. produce smoothed estimates of the variance used for weighting). This would have to be justified on a case-by-case basis. Another consideration is when the sampling variance does not fully characterize the total error, which may result in inappropriate weighting of components. This situation could be rectified by introducing an additional variance parameter to be estimated (Germont and Butterworth, 2001; Punt et al., 1997).

Ad hoc external weighting (choice of weights based upon non-statistical arguments) should be avoided. If expert judgment is required to establish external weightings, the rationale should be clearly documented and the impact of the choice should be described. Experimentation with alternative weighting may be a useful tool for exploration of the influence of components.

During the meeting, two different ways to implement external weighting were discussed. The first involved multiplying the component’s measure of model fit (least squares or likelihood) by a constant (lambda) while the second involved dividing the fit by a constant, typically a measure of the variance of the dataset under consideration. In some cases, both types of weighting were employed. The Panel considered that either approach, but not both simultaneously, is appropriate. Use of both approaches in the same model fitting process has the potential to confuse determination of what the real weighting is. It was noted that many assessment packages (e.g. ASAP, SS2) use the lambda constant to turn on (=1) or off (=0) specific components of the objective function, which is an appropriate use of the term.

### *Biological Reference Points (BRPs)*

The relative merits of estimating biological reference points internally (within the model fitting process) or externally (analyzing the assessment results to produce the BRPs) were discussed. One of the main considerations in determination of BRPs is characterization of the stock - recruitment relationship. Often the variability about this relationship is very high. Accordingly, the weighting of this component in the model fitting is low so that determining its parameters internally will not greatly influence estimation of current stock size. Its real value is in estimation of BRPs. If the same data are used, internally (assuming non-informative priors) and externally derived BRPs would be expected to be similar.

A potential advantage of estimating BRPs internally, say within an SCAA formulation, is that it allows inclusion of years in which only catch data are available. This allows consideration of years of data early in the history of exploitation of a stock which can provide a perspective of long-term productivity. This potential advantage has to be weighed against the possibility that productivity has not remained stationary over such extensive time periods.

Estimating BRPs externally is a useful way to corroborate the BPRs estimated internally using the same dataset and is encouraged by the Panel. If differences between the two approaches are encountered, these should be investigated and explained.

### *Stock-by-Stock Assessment Formulations*

The ordering of the stocks below conveys the Panel's overall sense of priority to address assessment issues. This is not the priority for undertaking the assessment which may be driven by management need. Rather, it is based on the Panel's understanding of the status of the current assessment formulation and the likelihood of improvements being made to it.

#### *Gulf of Maine Cod*

Fishery sampling and aging data are generally good. While the recreational catch contributes larger errors, on balance, the data are sufficient to employ an age – structured model assuming negligible errors in the catch-at-age.

There is only a weak retrospective pattern using the current VPA. However, there is a need to confirm the partial recruitment on ages five plus as this is particularly influential on the estimation of biological reference points and on stock status determination. The analyses presented at the meeting (working papers 2.2 and 2.3) indicated that the model fit to the data favored a domed partial recruitment. Resolution of the differences in the results with alternative partial recruitment patterns call for hypotheses on causative processes as well as external sources of information. Regarding the latter, the shape of the partial recruitment curve for the older ages could be investigated through more detailed examination of the dynamics within the plus group (age 7+) as well as analysis of the available tagging data. The consequences of either hypothesis on management advice should be explored through a risk analysis.

#### *Southern New England, Mid-Atlantic Yellowtail Flounder*

Given the good sampling rates and availability of aging information, the data are sufficient for an age-structured model. The Panel felt that negligible error in the catch-at-age could be assumed although this assumption may need to be relaxed for the recent time period.

There is a moderate retrospective pattern in the current VPA formulation that requires examination. Following the approach for the Georges Bank stock, it would be worthwhile splitting the survey time series to explore whether or not similar trends in survey catchability are present in Southern New England. If so, splitting of the survey time series could be a proxy for changes in survey catchability related to habitat use by yellowtail. Yellowtail might be occupying more preferred habitat due to environmental or other influences, causing survey catchability to increase. This hypothesis should be investigated.

The Panel noted the need to investigate long-term changes in stock productivity given the severe decline of the resource. This has implications for the determination of biological reference points. It could not comment on the details of this examination.

*Cape Cod-Gulf of Maine yellowtail flounder*

The Panel comments made for Southern New England / Mid-Atlantic yellowtail are also applicable to the Cape Cod, Gulf of Maine yellowtail stock.

*Witch Flounder*

Coefficients of variation on the landings-at-age overall are about 17%, there are no recreational catches and discards are low. The data are sufficient to use an age-structured model assuming negligible error in the catch-at-age. However, comparison with an SCAA model that allows for error in the catch-at-age may be useful in this case, following resolution of the retrospective issue.

While the current VPA formulation has been adequate in capturing the broad-scale dynamics of the stock, it has exhibited a consistent retrospective pattern that warrants exploration. The Panel could not comment on the nature of these explorations other than point out the potential sources of retrospective patterns made elsewhere in this report and the need to bring external sources of data to bear on identifying potential causative processes.

The Panel noted the desire of the NEFSC to use the ASAP software package to undertake these explorations. There are no compelling reasons not to switch from ADAPT to ASAP if this makes analyses easier.

*Redfish*

The data are sufficient for application of an age-structured model. This is important given the strong evidence for infrequent large pulses of recruitment which persist in the stock over decadal time periods. The Panel could not evaluate if error in the catch-at-age could be assumed negligible. This should be examined to determine if a SCAA approach would be more suitable.

The fishery may target abundant year-classes as they move through the stock. It will be important in the assessment to relax the separable assumption to allow for this possibility and explore if it is occurring.

In relation to biological reference points, internal estimation of the stock - recruitment relationship in a SCAA formulation will need to take account of both the stock's inherent productivity and the presence of episodic large year-classes. In relation to the former, steepness (h) can be inferred from redfish resources elsewhere (e.g. West Coast). In relation to the latter, the analysis should consider setting the assumed error around the stock - recruitment relationship ($\sigma_{R,}$) at a low constant value (e.g 0.2 or less) for years when there is limited age data (i.e. little information on year-class strength) and then to increase it to an appropriate higher constant value (e.g. 0.4 or higher) for periods when age data are more plentiful (Maunder and Deriso, 2003). The Panel considers that the sensitivity of the assessment to these stock - recruitment assumptions should be checked through comparison of the model results without them. In addition, the Panel considered that an externally-derived surplus production model should be investigated to evaluate the robustness of derived biological reference points.

### *Georges Bank – Gulf of Maine White Hake*

The differentiation between red and white hake in the commercial fishery is an issue for this stock, particularly for discards which in some years can represent 50% of the catch, much of this being less than 60cm in length. While there is no commercial aging data since 2000, length frequency sampling is available for this period. Thus the data are sufficient for an age-structured model although negligible error in the catch-at-age cannot be assumed. A model should be used that can take advantage of the age and length frequency data available (e.g. SCALE). There is a potential for sexual dimorphism to confound this attempt at modeling, which should be considered in the model formulation if possible.

The species identification problem in catch samples for lengths less than 60 cm can be examined by consideration of species composition for these fish sizes in the survey dataset, calibrating these with available observer data.

### *Georges Bank – Gulf of Maine American Plaice*

The data appear to be sufficient to undertake an age-structured model. However, the Panel could not evaluate whether or not the error in the catch-at-age could be assumed to be negligible. Since the discards are an important fraction of the catch and appear not to be well-determined, it is appropriate to assume the presence of error in the catch-at-age (e.g. SCAA).

The current VPA formulation exhibits a moderate retrospective pattern, the causes of which require examination.

There is a potential problem of conducting an assessment on the combined Georges Bank and Gulf of Maine stock subcomponents if the relative proportion of abundance of these stocks is not stable over time. The survey trends in the two areas should be examined; if they are similar, then a combined assessment of the two components should not be problematic. However, if the trends are different, there may be a need to partition the catch-at-age between the two stocks and conduct separate assessments on each assuming that there is negligible migration between the two populations.

Plaice growth rates have been observed to be different on Georges Bank and in the Gulf of Maine. This has consequences for the partial recruitment in each area. There is a need to validate the separable assumption of the SCAA when undertaking the assessment.

### *Georges Bank winter flounder*

The Panel noted the improvement in commercial age and length sampling since 2000 although gaps in these data exist in the middle of the time series (1998-99). The data are sufficient to undertake an age - structured model but error in the catch-at-age may not be negligible. Thus, the stock is a candidate for a SCAA formulation.

The Panel could not assess the overall utility of a SCAA formulation without results to examine. The Panel recommended that one model approach be chosen and if there are no problems observed then there is no need to explore an alternative approach.

The Panel noted similar issues with the other two winter flounder stocks (Gulf of Maine and Southern New England) While each has its challenges regarding data availability and other issues, the NEFSC should consider whether or not a common class of models could be applied to all three stocks. This will not only facilitate comparison of stock dynamics but also lead to new insights in each assessment.

### *Gulf of Maine Winter Flounder*

It was noted that year-classes that can be identified in the commercial and survey length compositions do not appear in the respective age composition. This may indicate smearing across year-classes in the age-length keys. As well, commercial sampling intensity has been low. Thus, while the data appear sufficient for an age-structured model, negligible error in the catch-at-age cannot be assumed. In addition, a formulation that takes advantage of the available length frequency information would be appropriate (e.g. SCALE).

The current VPA formulation exhibits a strong retrospective pattern. There was a suggestion that the causes of the retrospective might be related to sexual dimorphism, which could be investigated through a sex-separate model, although the report of the NEFSC Retrospective Working Group (working paper 4.1) indicated that a strong retrospective pattern could not be generated by sexual dimorphism alone. It will also be useful to corroborate model output by comparing fishing effort trends implied by the models with reported fishing effort.

Conflicting patterns between the recruitment and biomass time series were noted. To represent these inconsistencies in the data, a risk evaluation should be undertaken, which compares results between models weighted towards either the adult or the recruitment indices. The consequences of each weighting on harvest advice should be documented.

### *Southern New England Winter Flounder*

The data appear to be sufficient for an age-structured model and information available suggests that negligible error in the catch-at-age can be assumed.

The current VPA formulation exhibits a strong retrospective pattern but seems to be transitory as it is not evident in recent years. Some event may have occurred in the mid 1990s to cause the retrospective pattern that is no longer occurring.

The causes of the historical retrospective patterns should be explored using the current assessment formulation. A possible change in the catch-at-age around 1994 could be checked to see if the retrospective was due to a single event related to this. If the retrospective pattern does not reappear with the additional years of data to the assessment, then there is no need for further exploration. If on the other hand, it does reappear, consideration should be given to splitting the survey time series pre and post 1994. Further, as discussed in the section on terms of reference 4, a robust likelihood approach might address the retrospective pattern if some of the indices have been very influential.

### *Georges Bank – Gulf of Maine Pollock*

While there are issues with determining the age structure of the commercial catch in the Canadian and distant water fleet components in the 1960s and early 1970s, the data may be sufficient for use of an age-structured model post 1977. The Panel could not evaluate if the error in catch-at-age was negligible.

The Panel considered that the Relative Trend class of models is likely informative given the strong relationship between the relative fishing mortality and replacement yield for this resource and thus could be the basis of the 2008 assessment.

The Panel noted that suspected transboundary US / Canada migration will impact the assessment. Joint research on stock structure with the Canadian Department of Fisheries and Oceans has been proposed (TRAC, 2007).

The aging data may be informative about recruitment and could augment the Relative Trend analyses. This information should be evaluated and presented at the April GARM III review.

*Georges Bank – Gulf of Maine and Southern New England- Mid-Atlantic Windowpane Flounder*

Except for the fall 1999 NMFS survey, there is no commercial aging information for these stocks. Commercial and survey length frequency data are available that allow examination of the dynamics of recruitment and a plus group separately within an age structured model. A high percentage of the catch has been discarded, particularly since 2000 when it has been in excess of reported landings. It may not be appropriate to assume negligible errors in partitioning the recruitment and plus group, in which case SCAA would be more suitable.

While the current Relative Trends approach (AIM) appears to be adequate for the SNE-MAB stock, the Panel recommended exploring the use of SCAA in a Collie-Sissenwine formulation as the assessment model for the GOM / GB stock. There are benefits to using a common assessment framework for both stocks. Therefore, future assessments should consider a common model formulation.

*Georges Bank Yellowtail*

The data for this stock are sufficient to undertake an age - structured model assuming negligible errors in the catch-at-age.

A previous VPA formulation had exhibited a strong retrospective pattern. The Transboundary Resource Assessment Committee (TRAC, 2005) examined the causes of the retrospective pattern in detail and while not identifying the primary cause, developed an assessment formulation (termed the Major Change Model) that, through splitting the survey time series pre and post 1994 largely removed the pattern and was considered suitable as the basis for management.

There was nothing presented at this GARM III meeting which would lead to improvement of the Major Change Model and thus it should be the basis of the GARM III assessment.

Notwithstanding this, the primary cause of the retrospective pattern remains unresolved. As noted for SNE / MAB yellowtail, splitting of the survey time series could be a proxy for changes in survey catchability related to preferred habitat use by yellowtail, motivated by environmental or other influences. This hypothesis should be investigated for both stocks. If a mechanism for the apparent change in survey catchability in the mid- 1990s can be identified, this should be presented along with the current Georges Bank model.

While the partial recruitment pattern on the ages four-plus could be investigated with the Major Change Model, this issue was not identified as a concern during the TRAC benchmark review (TRAC, 2005). Model fits presented at this meeting that had not adopted the Major Change Model formulation, suggested dome partial recruitments in both the survey and commercial fishery. However, that analysis concluded that the problems indicated by the strong residual patterns, and most likely a strong retrospective pattern, should be resolved before considering the results on the partial recruitment. Further, a domed fishery partial recruitment is at odds with the results of tagging analysis presented at this meeting, which suggested no dome. There was discussion at the meeting on the potential confounding of the tagging results by other processes (e.g. gear avoidance, emigration, tag reporting rate), and although none of these appeared likely, there was insufficient time at the meeting to fully explore the alternatives. Thus, while a domed partial recruitment on the older age groups appears unlikely, further exploration of external data could be undertaken to corroborate this.

If a SCAA formulation is considered, conducting the analysis using the catch and discards by separate fleet components may improve model fits as the separable assumption is more likely to be met within these.

Finally, overall improvements in the stock assessment of yellowtail may be gained by considering all three stocks (Georges Bank, Cape Cod – Gulf of Maine and Southern New England – Mid Atlantic) as a complex with migration between components. This is not suggested for immediate exploration.

### *Georges Bank Cod*

The data are sufficient for an age-structured model in which it can be assumed that the error in the catch-at-age is negligible.

The current VPA formulation exhibits a weak to moderate retrospective pattern, the presence of which may be due to changes in the fishery partial recruitment since 1994. This may be related to major changes in management structures (e.g. closed areas, mesh size) made at the time. Model formulations that allow investigation of changes in partial recruitment, particularly with regards to the older age classes in the recent time period (post 1995) should be pursued.

### *Georges Bank Haddock*

The data are sufficient for an age-structured model which assumes negligible error in the catch-at-age. It is noted that catch-at-age data for this stock is available as a continuous time series as far back as 1930 (Clark et. al, 1982). These data should be included in the assessment.

The current VPA formulation exhibits only a weak retrospective pattern. However, recent changes in haddock size at age (declining) have implications for the assumption of stationarity of survey catchability at age and for the estimation of BRPs which will have to be addressed in any age structured model. If a SCAA formulation is considered, a number of partial recruitment blocks throughout the assessment's time period will likely be required.

Regarding biological reference points, in addition to the general comments made above, the last time that a stock – recruitment relationship was examined for this stock (NEFSC, 2002), a non-parametric form had to be used due to a lack of convexity in the relationship. This will likely persist, suggesting that the relationship might better be considered externally to the assessment model.

### *Gulf of Maine Haddock*

The data may be sufficient to undertake an age - structured model although it has not yet been processed. The Panel encourages completion of the processing of the relevant data as time is available. If this information is not processed before the next assessment is due, a Relative Trend class of models will have to be employed (e.g. AIM).

The spatial distribution of the catch and the surveys should be examined to determine whether or not the high landings and survey observations in the Great South Channel area are spill over from the Georges Bank stock. This may affect the perception of the productivity of this stock.

*Ocean pout*

Recent landings are bycatch in other fisheries. While length frequency sampling for discards has been good in recent years, there are no aging data available. Consequently, the data are not sufficient for an age-structured model.

While the current Relative Trends approach (AIM) could be used for the GARM III assessments, alternative models should be explored that both have a stronger basis in biology and more explicitly address uncertainty. These include age-structured models using life history parameters derived from literature and other external sources as well as Bayesian biomass dynamics models. The sufficiency of available age data to construct the growth relationship to support these models requires exploration.

There is only a weak relationship between Relative Fishing Mortality and Replacement Ratio, suggesting that the Relative Trends class of assessment models is not informative for reference points. It is possible that the stock's dynamics have been severely impacted by fishing historically, to the point that it may not be possible to determine the link between exploitation rate and productivity.

*Atlantic Halibut*

There is a long time series of landings data for this stock that could inform estimation of its productivity. Sampling intensity has been low and while length frequencies have been collected, there are no aging data. The data are not sufficient for an age-structured model.

The Panel suggests attempting a one parameter (for productivity) depletion analysis assuming a plausible landing level before 1893 and fit to available survey abundance trends. Notwithstanding this, 28 percent of halibut tagged in US waters are returned from the Canadian zone suggest that this stock should be assessed in collaboration with Canadian assessment scientists.

## ToR 6. Sufficiency of the assessment models to estimate measures of stock status consistent with Biological Reference Points

There are model approach implications for methods to estimate biological reference points. The Panel spent little time evaluating assessment model considerations relative to BRPs directly, although a number of issues related to this were raised throughout the meeting. Some of the key issues identified were:

- Length of time series considered (the problem of shifting baselines)
    - Assessment of stock status generally relates to the most recent time period while the estimation of BRPs requires a longer term perspective of productivity
    - Inclusion of historical catch data has implications for BRPs and long-term changes in stock structure needs to be considered
    - Temporal changes in biological parameters (e.g. recent declines in growth) need to be taken into account
    - For long catch time series (e.g., redfish) deriving an appropriate treatment for historical recruitment pattern consistent with removals is critical
- The estimation of stock - recruitment relationships internally and externally to the assessment models (see also comments on BPRs in section on terms of reference 5)

  - VPA and SCAA can estimate population stock-recruitment relationships integrated with survey and catch data and have the potential to estimate BRPs; SCAA can extend this analysis to years in the absence of a complete time series of catch-at-age data
  - It is desirable that the approach selected provides reasonably consistent estimates of BPRs (i.e., inter-assessment variability should be low)
  - Stock-recruitment assumptions are key for the estimation of biological reference points but less critical to the determination of current stock status. Also, the flexibility provided by both parametric and non-parametric estimation approaches should be considered
  - Where possible, the Panel encourages estimating BRPs both internally and externally, comparing the results and explaining differences
- The potential for ambiguity when BRPs are estimated using expert judgment (e.g. biomass reference points for stocks assessed using AIM). The Panel recommends the development of a consistent and defensible basis for estimating BRPs using the Relative Trends class of assessment model. This includes a transparent basis for estimating scale
- The extent that a stock can be considered adequately managed as a "unit" (i.e., the area is at the margins of the natural range for a stock - e.g., Atlantic halibut)
- Overall multispecies production (to be more fully addressed at the BRP GARM).
  - Technical interactions (bycatch of co-occurring species) methods need to be pursued for practical management applications

The above points need to be kept in mind when applying assessment methods for estimating BRPs.

The Panel suggested an approach for age-structured models to evaluate the impact of fishing on a stock under minimal assumptions about the underlying productivity (e.g., stock-recruitment relationships). Specifically, the historical time series of recruitment estimates from a particular assessment could be used to compute the subsequent spawning biomass levels as if no fishing had occurred. If a stock-recruitment relationship is estimated, the original recruitment estimates can be adjusted by the ratio of the expected recruitment given spawning biomass (with and without fishing) and the estimated stock-recruitment curve i.e. the recruitment under no fishing modified as:

$$R_t^{'} = \hat{R}_t \frac{f\left(S_t^{'}\right)}{f\left(\widehat{S}_t\right)}$$

where $\hat{R}_t$ is the original recruitment estimate in year *t* with $f\left(S_t^{'}\right)$ and $f\left(\widehat{S}_t\right)$ representing the stock-recruitment function given spawning biomass under no fishing and under the fishing scenario, respectively. This approach would be particularly useful where the stock-recruitment relationship is of the Ricker type, where recruitment begins to decline at higher stock biomass.

For example, application to Gulf of Maine cod using reference case estimates of recruitment, maturity and mean weights-at-age from the meeting working papers, are projected forward from age one but *without F.* Without any stock-recruitment effect, a current level of "depletion" is about 26% (figure 1). Adding an adjustment due to a stock-recruitment relationship is likely to change this pattern to some degree, particularly if a Ricker stock – recruit model is used, as noted above. This technique can be used to test both the impact of fishing and the assumptions about the stock - recruitment relationship.

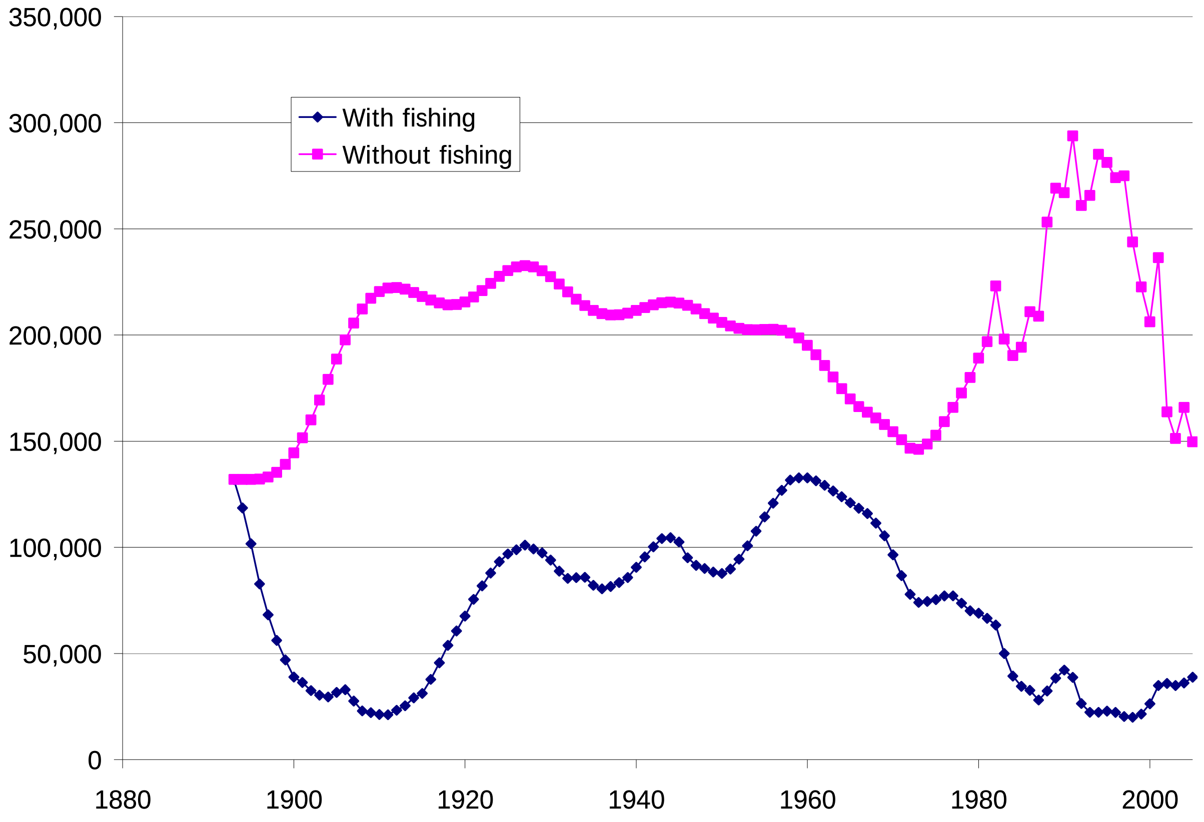

**Figure 1. Historical spawning stock biomass for Gulf of Maine cod based on the reference model (with fishing) compared to estimates assuming natural mortality of 0.2 only (without fishing)**

## CONCLUDING REMARKS

The meeting required an extensive suite of working papers prepared by scientists at the NEFSC and substantial and in-depth discussions at the meeting itself. This was a very significant workload by the Center, which the Panel acknowledges being of very high quality. The Panel would also like to acknowledge the valuable contributions at the meeting made by all participants, particularly those of Doug Butterworth and Rebecca Rademeyer, who attended on behalf of the fishing industry. Finally, the Panel would like to thank Andrea Strout of the NEFSC who assisted the chair in preparing this report. All these contributions made it possible for the GARM III 'models' review to meet its terms of reference.

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# APPENDICES

## Appendix 1. Terms of Reference for the GARM-III Models Meeting

1. For each stock, consider the applicability of one or more of the following modeling approaches to assess stock status:
   - Index methods
   - Production Models
   - Age- or Length-based Models

2. For certain stocks that are aged, compare and contrast the utility of statistical catch-at-age vs. VPA based models with respect to the following criteria:
   - Retrospective patterns
   - Flexibility to account for alternative parameterizations
   - Ability to incorporate external sources of information, especially tagging and environmental data
   - Ability to estimate parameters incorporating prior, external information.

3. Address the implications of zeros in the evaluation of fishery independent indices.

4. Examine potential factors responsible for retrospective patterns.

5. For each stock, define the assessment model that will be used to determine stock status and productivity characteristics until the next "benchmark" assessment is conducted. Where possible, apply the models to data (probably through 2006), to obtain current and historical estimates of F and B and estimates of uncertainty.

6. Evaluate the sufficiency of the assessment models to estimate measures of stock status consistent with Biological Reference Points.

## Appendix 2. Draft Terms of Reference for the GARM-III “Biological Reference Point (BRP)” Meeting (28 April – 2 May 2008)

1. For relevant stocks, determine the influence of retrospective patterns in parameter estimates (e.g., fishing mortality, biomass, and/or recruitment) from assessment models on the computation of BRPs and on specification of initial conditions for forecasting

2. Trends in Stock Productivity:

   a.) For relevant stocks, identify trends in biological parameters (i.e., life history and/or recruitment) and assess their importance for the computation of BRPs and for specification of rebuilding scenarios

   b.) If possible, summarize trends in pertinent environmental variables that might be related to the trends in those biological parameters relevant to BRPs

3. Ecosystem approaches to Gulf of Maine/Georges Bank fisheries:

   a.) Determine the production potential of the fishery based on food chain processes and estimate the aggregate yield from the ecosystem

   b.) Comment on aggregate single stock yield projections in relation to overall ecosystem production, identifying potential inconsistencies between the two approaches

4. Biological Reference Points ($B_{target}$, $B_{threshold}$, $F_{target}$, $F_{threshold}$):

   a.) For each stock, list what the current BRPs and/or BRP Proxies are (e.g., $B_{MSY}$, $B_{MAX}$, $F_{MSY}$, $F_{40\%MSP}$, historical survey catch per tow, etc.), and give their values (i.e., typically from GARM II)

   b.) For each stock, update or redefine BRPs or BRP proxies that will be used for stock status determination, and compute their expected values and precision. Note: These BRPs and their proxies must be comparable and consistent with outputs from the recommended assessment models from the GARM III “Modeling” Meeting

5. For each stock, identify appropriate models for forecasting and for evaluating rebuilding scenarios.

## Appendix 3. Draft Meeting Agenda of GARM III Models Meeting. Feb. 25-29, 2008, Stephen Clark Conference Room, NEFSC, Woods Hole, MA

***Monday February 25***

0900-0910 Welcome (Deputy Director)
0905-0910 Introductions
0910-0940 Overview of GARM and objectives of this meeting (Chair)

**TOR #1: Applicability of Models to Assess Stock Status**

0940 -1020 Overview of GARM species, data availability, assessments
*Working Paper 1.1, 1.3* - (Rago)
1020-1040 Discussion
1040-1055 Break
1055-1125 Review of modeling approaches and rationale
*Working Paper 1.2* - (Rago)
1125-1200 Discussion
1200-1300 Lunch

**TOR #4 Examine potential factors responsible for retrospective patterns.**

1300-1430 Report of Working Group on Retrospective Patterns in VPA
*Working Paper 4.1* - (Legault)
1430-1515 Discussion
1515-1530 Break

**TOR #3 Model implications of zeros in fishery independent indices.**

1530-1600 *Working Paper 3.1* - (Legault)
1600-1620 *Working Paper 3.2* - (Terceiro)
1620-1640 *Working Paper 3.3* - Report of ICES methods working group (Legault)
1640-1730 Discussion
1730-1800 Summary /Followup (Chair)
1800 Adjourn

***Tuesday February 26***

0900-0920 Progress review and Order of the Day (Chair)

**TOR #2 Compare utility of statistical catch-at-age models**

0920-0940 Overview of SCAA approaches—(Jacobson)
0940-1010 *Working Paper 2.1a* – Georges Bank Yellowtail (Jacobson )
1010-1030 Discussion
1030-1045 Break
1045-1115 *Working Paper 2.1b* - White Hake (Sosebee)
1115-1130 Discussion
1130-1200 *Working Paper 2.1c* - Georges Bank Cod (O'Brien)
1200-1230 Discussion
1230-1330 Lunch
1330-1445 *Working Papers 2.2, 2.5* - ASPM model - Georges Bank Yellowtail and Gulf of Maine Cod – (Butterworth)
1445-1530 Discussion
1530-1545 Break
1545-1600 *Supplementary paper* and discussion on domed selectivity TOR 2. (Hart/Miller)

1600-1630 *Working Paper 2.3* - Gulf of Maine Cod –ASAP model (Shepherd)
1630-1745 Discussion—GOM cod
1745-1800 Summary/Followup (Chair)
1800 Adjourn

***Wednesday February 27***
0900-0930 Progress review and Order of the Day (Chair)
**TOR #2 Compare utility of statistical catch-at-age models** (cont.)
0930-1000 *Working Paper 2.4* - Comparative Simulation Tests—Overview (Legault/Brooks)
1000-1045 *Working Paper 2.4a* – Retrospective Pattern: GB Yellowtail (Legault)
1045-1100 Break
1100-1130 Discussion—GB Yellowtail
1130-1200 *Working Paper 2.4b* – Ageing Error: White Hake (Legault/Brooks)
1200-1230 Discussion—White Hake
1230-1330 Lunch
1330-1430 *Working Paper 2.4c* - Domed Selectivity: Georges Bank Cod (Legault/Brooks)
1430-1530 Discussion—GB cod
1530-1545 Break
1545-1730 General Review—SCAA/Simulation test
1730-1800 Summary/Followup (Chair)
1800 Adjourn

***Thursday February 28***
0900-0920 Progress review and Order of the Day (Chair)
TOR #5 Recommendations on Model Selection for each stock
TOR #6 Linkage to Biological Reference Points
0920-1000 Working *Papers 5.1, 6.1* - Model Recommendations/ Selection Criteria (Rago and Population Dynamics Branch)
1000-1045 Reviews by Species
1045-1100 Break
1100-1230 Reviews by Species (cont)
1230-1330 Lunch
1330-1430 Reviews by Species (cont)
1430-1530 Ecosystem Models for Reference Points—Progress Update (Fogarty/Link/Overholtz)
1530-1730 Revisit Topics as Needed
1730-1800 Synthesis and Report Planning (Chair)
1800 Adjourn

***Friday February 29***
0900-0930 Progress review and Order of the Day (Chair)
0915-1030 Follow-up Sessions if Necessary
1030-1045 Break
1045-1230 Report development
1230-1330 Lunch
1330-1600 Summary and Assignments
1600 Adjourn

## Appendix 4. List of Working Papers for the GARM-III Assessment Methodology "Models" Meeting (25-29 Feb. 2008)

**1.1** Rago, et al. 2008. Data Summary for Nineteen Groundfish Stocks in the Northeast U.S.

**1.2** Rago, et al. 2008. Overview of Assessment Methods and Model Selection Criteria for Nineteen Groundfish Stocks in the Northeast U.S.

**M.1** Mayo R, Col L, Traver M. 2008. Data Summary of Catch and Abundance Measures. (for Working Papers 1.1 & 1.2)

**1.3** Hendrickson L, Col L. 2008. Maps Showing NEFOP Sampling Coverage and Management Areas

**2.1** Jacobson L, Legault C, O'Brien L, Sosebee K. 2008. Utility of Statistical Catch-at-age Models for Assessing Northeast Groundfish Stocks (a workshop report)

**2.2a** Butterworth DS, Rademeyer RA. 2008. Statistical Catch-at-age Analysis *vs* ADAPT-VPA: The Case of Gulf of Maine Cod

**2.2b** Rademeyer RA, Butterworth DS. 2008. Retrospective Analysis for the Gulf of Maine Cod ASPM Reference Case Assessment

**2.3** Shepherd G. 2008. Comparison of ADAPT VPA and ASAP Models for Gulf of Maine Cod

**2.4** Brooks L, Legault C, Nitschke P, O'Brien L, Sosebee K, Rago P, Seaver A. 2008. Evaluation of NMFS Toolbox Assessment Models on Simulated Groundfish Data Sets

**2.5** Butterworth DS, Rademeyer RA. 2008. Application of and Age-Structured Production Model to the Georges Bank yellowtail flounder

**3.1** Legault C, Seaver A. 2008. Simulation Studies of Issues Associated with Filling Zeros in VPA Tuning Indices

**3.2** Terceiro M. 2008. The Treatment of "Zero" Observations in the Summer Flounder ADAPT VPA Calibration

**3.3** ICES Resource Management Committee. 2007. Report of the Working Group on Methods of Fish Stock Assessment (WGMG)

**4.1** Legault C, et al. 2008. Report of the Retrospective Working Group

**5.1** Rago P, et al. 2008. Recommended Modeling Approaches by Stock
Initial Proposals for Consideration by the GARM III Review Panel

**6.1** Rago P, et al. 2008. Sufficiency of Models for Biological Reference Points

### Supplementary Papers

**TOR 1** Gulf of Maine Winter Flounder SCALE Run 2

**TOR 2** Miller T, Hart D, Cadrin S, Jacobson L, Legault C, Rago P. 2008. Analyses of Tagging Data for Evidence of Decreased Fishing Mortality for Large Yellowtail Flounder

**TOR 2** Butterworth DS, Rademeyer RA. 2008. On Drawing Inferences Concerning Trends in Selectivity with Age from Tag-Recapture Information

**TOR 2** Jacobson L. 2008. Questions about the Adjusted Lognormal Error Distribution used in Calculating Goodness of Fit for Survey and Commercial Age Composition Data in Preliminary ASPM Models.

**TOR 2** Jacobson L. 2008. Pope vs Baranov

## Appendix 5. List of Participants GARM III Models Meeting  February 25-29, 2008

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## Appendix 6. Statement of Work of Center for Independent Experts at GARM-III "Models" Meeting

### *General*

The Groundfish Assessment Review Meeting (GARM) brings together stock assessment experts to peer review work on the status of 19 important fish stocks that are managed by the New England Fishery Management Council. GARM-III takes place in 2007-2008, and it will consist of four meetings that are cumulative in nature (i.e., successive meetings incorporate methods and results that were accepted at previous GARM-III meetings). Each meeting will have a chairman as well as external panelists. A brief description and dates of the four GARM-III meetings are given below:

1. **"Data" Meeting (October 29 – November 2, 2007)**
   Review the commercial and survey data that will be used in the stock assessments. Identify appropriate statistical methods for analyzing those data (including bycatch and discard issues, changes in growth rates and other life history traits, issues related to merging databases, etc.). Other sources of data to be considered are tagging programs for cod and yellowtail flounder, and Industry-Based Surveys. Candidate sources of data relevant to ecological and ecosystem considerations will also be described.

2. **"Modeling" Meeting (Feb. 25 – 29, 2008)**
   Determine the most appropriate stock assessment methods and models for each of the 19 stocks. Perform runs of those models to obtain results (historical and current estimates of F and B) based on commercial and survey data, probably through calendar year (CY) 2006. Evaluate retrospective patterns and their importance for status determination.

3. **"Biological Reference Point (BRP)" Meeting (April 28 – May 2, 2008)**
   Update or redefine BRPs for each of the 19 stocks. Use data available through CY2006. Consider whether the BRPs are reasonable in light of results from the "Modeling" Meeting. Define the appropriate initial conditions for forecasting and rebuilding strategies, particularly with respect to trends in biological attributes, recruitment and survival rates. Comment on relevant ecosystem considerations as they relate to rebuilding strategies.

4. **GARM-III "Final" Meeting (August 4-8, 2008)**
   Use all of the methods proposed from the previous three meetings, along with survey and catch information through CY2007, to estimate fishing mortality rates and biomass for each stock. Based on procedures from the BRP Meeting, finalize the BRPs, appropriate initial conditions, and biological assumptions related to forecasts. Determine the status of each stock.

This SOW applies specifically to the GARM-III "Modeling" Meeting, which will take place at the Woods Hole Laboratory of the Northeast Fisheries Science Center (NEFSC) in Woods Hole, Massachusetts, from February 25 -29, 2008. The meeting will have a chairman (non-CIE) as well as external panelists, three of whom will be from the Center of Independent Experts (CIE).

### *Overview of CIE Peer Review Process*

The Office of Science and Technology implements measures to strengthen the National Marine Fisheries Service's (NMFS) Science Quality Assurance Program (SQAP) to ensure the best available high quality science for fisheries management. For this reason, the NMFS Office of Science and Technology coordinates and manages a contract for obtaining external expertise through the Center for Independent Experts (CIE) to conduct independent peer reviews of stock assessments and various scientific research projects. The primary objective of the CIE peer review is to provide an impartial review, evaluation, and recommendations in accordance to the Statement of Work (SoW), including the Terms of Reference (ToR) herein, to ensure the best available science is utilized for the National Marine Fisheries Service management decisions.

The NMFS Office of Science and Technology serves as the liaison with the NMFS Project Contact to establish the SoW which includes the expertise requirements, ToR, statement of tasks for the CIE reviewers, and description of deliverable milestones with dates. The CIE, comprised of a Coordination Team and Steering Committee, reviews the SoW to ensure it meets the CIE standards and selects the most qualified CIE reviewers according to the expertise requirements in the SoW. The CIE selection process also requires that CIE reviewers can conduct an impartial and unbiased peer review without the influence from government managers, the fishing industry, or any other interest group resulting in conflict of interest concerns. Each CIE reviewer is required by the CIE selection process to complete a Lack of Conflict of Interest Statement ensuring no advocacy or funding concerns exist that may adversely affect the perception of impartiality of the CIE peer review. The CIE reviewers conduct the peer review, often participating as a member in a panel review or as a desk review, in accordance with the ToR producing a CIE independent peer review report as a deliverable. The Office of Science and Technology serves as the COTR for the CIE contract with the responsibilities to review and approve the deliverables for compliance with the SoW and ToR. When the deliverables are approved by the COTR, the Office of Science and Technology has the responsibility for the distribution of the CIE reports to the Project Contact. Further details on the CIE Peer Review Process are provided at http://www.rsmas.miami.edu/groups/cie/

### *Requirements for CIE Reviewers*

Three CIE reviewers are requested to conduct an impartial and independent peer review in accordance with the Terms of Reference (ToR) herein. Each CIE reviewer's duties shall not exceed a maximum of 14 days conducting pre-review preparations with document review, participation on the SARC panel review meeting, editorial assistance for the SARC Chair, and completion of the CIE independent peer review report in accordance with the ToR and Schedule of Milestones and Deliverables. CIE reviewers shall have working knowledge and recent experience in the application of modern fishery stock assessment models. Expertise should include both the use of statistical catch-at-age and traditional VPA approaches. Experience with comparative studies of these approaches is especially valuable. Reviewers should also have experience in evaluating measures of model fit, identifiability, uncertainty, and forecasting. Some experience with groundfish (such as cod, haddock, flounder) population dynamics would be useful.

### *Specific Activities and Responsibilities*

The CIE's deliverables shall be provided according to the schedule of milestones listed on page 5. The GARM Chairman will use contributions from the CIE panelists as well as from other external panelists, to produce the GARM Panel Summary Report. In addition, each CIE panelist will write an individual independent report. These reports will provide peer-review information for a presentation to be made by NOAA Fisheries at meetings of the New England and Mid-Atlantic Fishery Management Councils in 2008. The GARM Panel Summary Report shall be an accurate and fair representation of the GARM panel viewpoint on the quality and soundness of the science, methods and data with regard to each Term of Reference (see Annex 1). The report shall also contain recommendations for improvement that might be implemented in a future GARM meeting.

### *Charge to GARM panel*

The panel is to determine and write down its viewpoint on the quality and soundness of the science, methods and data with regard to each Term of Reference (see Annex 1). Criteria to consider include whether: (1) the data are adequate and were used properly; (2) the analyses and models were appropriate and correctly accomplished; and (3) the conclusions are correct/reasonable. Where possible, the chair shall identify or facilitate agreement among the panelists regarding each Term of Reference.

During the course of the review, the panel is allowed limited flexibility to deviate from the results and recommendations of earlier GARM-III meetings. This flexibility may include minor alterations in procedures previously established at the peer review of the Data Methods Meeting in October 2007. Large scale changes, such as changing a stock definition would not be possible in view of the difficulties of implementing these changes in time available before the final GARM meeting in August 2008.

Furthermore, if the panel rejects certain assessment models, the panel should explain why those particular models are not suitable, and the panel should recommend suitable alternatives. If such alternatives cannot be identified, then the panel should indicate that the existing (status quo) models are the best available at this time.

### *Roles and responsibilities*

Prior to the meeting (GARM chair and CIE panelists)

Review the reports produced by the Working Groups, and read background reports.

During the Open meeting

(GARM chair)

Act as chairperson, where duties include control of the meeting, coordination, control, and facilitation of the presentations and discussions, and ensuring that all Terms of Reference of the GARM are reviewed and completely addressed.

During the question and answer periods, provide appropriate feedback to the assessment scientists on the sufficiency of the analyses and when possible, suggest improved approaches. It is permissible to discuss the working papers, and to request additional information to clarify or revise existing analyses, if that information can be produced rather quickly.

(CIE panelists)

For each model approach, participate in panel discussions on the quality and soundness of the science, methods and data with regard to each Term of Reference (see Annex 1).

During the question and answer periods, provide appropriate feedback to the assessment scientists on the sufficiency of the analyses. It is permissible to request additional information if it is needed to clarify or revise existing analyses, if that information can be produced rather quickly.

After the Open meeting

(GARM CIE panelists)

Each panelist shall prepare an Independent CIE Report (see Annex 2). This report should comment on the quality and soundness of the science, methods, and data with regard to each Term of Reference.

If any modeling approaches are considered inappropriate, the Independent CIE Report should include recommendations and justification for suitable alternatives. If such alternatives cannot be identified, then the report should indicate that the existing modeling approaches are the best available at this time.

During the meeting, additional questions that are not in the Terms of Reference but which are directly related to the assessments may be raised. Comments on these questions should be included in a separate section at the end of the Independent CIE Report prepared by each panelist.

If a panelist feels that his/her comments are adequately expressed in the GARM Panel Summary Report, it will not be necessary to repeat the same comments in the Independent CIE Report. In this case, the Independent CIE Report can be used to provide greater detail on specific Terms of Reference or additional questions raised during the meeting.

(GARM chair)

The GARM chair shall prepare a document summarizing the background of the work to be conducted as part of the review process, and summarizing whether the process was adequate to successfully address the Terms of Reference. If appropriate, the chair will include suggestions on how to improve the process. This document will constitute the introduction to the GARM Panel Summary Report.

(GARM chair, CIE and non-CIE panelists)

The GARM Chair will take the lead in preparing, editing, and completing the GARM Panel Summary Report, based on contributions from the external panelists (CIE and non-CIE). The panelists and the chair will discuss their views on each Term of Reference and whether their opinions can be summarized into a single conclusion for all—or only for some—of the Terms of Reference. For TORs where a consensus view can be reached, the GARM Panel Summary Report will contain a summary of such views. In cases where multiple and/or differing views exist on a given Term of Reference, the GARM Panel Summary Report will note that there was no agreement and will specify—in a summary manner—what the various opinions are and the reason(s) for the different opinions.

The chair's objective during this Summary Report development process will be to identify or facilitate the finding of an agreement, rather than forcing the panel to reach an agreement if this is not possible.

The GARM Panel Summary Report (please see Annex 3 for information on contents) should comment on the quality and soundness of the science, methods, and data with regard to each Term of Reference.

If any modeling approaches are considered inappropriate, the GARM Panel Summary Report should include recommendations and justification for suitable alternatives. If such alternatives cannot be identified, then the report should indicate that the existing modeling approaches are the best available at this time.

The contents of the draft GARM Panel Summary Report will be approved by the CIE panelists by the end of the Summary Report development process. The GARM chair will finalize all editorial and formatting changes prior to approval of the contents of the draft GARM Panel Summary Report by the CIE panelists. The GARM chair will then submit the approved GARM Panel Summary Report to the NEFSC contact (i.e., SAW Chairman).

***Schedule of Milestones and Deliverables***

The milestones and schedule are summarized in the table below. No later than March 14, 2008, the CIE panelists should submit their Independent CIE Reports to the CIE for review[3]. The Independent Reports shall be addressed to "University of Miami Independent System for Peer Review," and sent to Dr. David Sampson, via e-mail to David.Sampson@oregonstate.edu and to Mr. Manoj Shivlani via e-mail to mshivlani@rsmas.miami.edu

| **Milestone** | **Date** |
|---|---|
| Open workshop at Northeast Fisheries Science Center (NEFSC) (begin writing reports, as soon as open Workshop ends) | Feb. 25 – 29, 2008 |
| GARM Chair and CIE panelists work at the NEFSC drafting reports | Feb. 28 – 29 |
| Draft of GARM Panel Summary Report, reviewed by all CIE panelists, due to the GARM Chair ** | March 14 |
| CIE panelists submit Independent CIE Reports to CIE for approval | March 14 |
| GARM Chair sends Final GARM Panel Summary Report, approved by CIE panelists, to NEFSC contact (i.e., SAW Chairman) | March 21 |
| CIE provides reviewed Independent CIE Reports to NMFS COTR for approval | March 28 |
| COTR notifies CIE of approval of reviewed Independent CIE Reports | April 4 * |
| COTR provides final Independent CIE Reports to NEFSC contact | April 4 |

* Assuming no revisions are required of the reports.
** The GARM Panel Summary Report will not be submitted, reviewed, or approved by the CIE.

The SAW Chairman will assist the GARM chair prior to, during, and after the meeting in ensuring that documents are distributed in a timely fashion. NEFSC staff and the SAW Chairman will make the final GARM Panel Summary Report and Independent CIE Reports available to the public. Staff and the SAW Chairman will also be responsible for production and publication of the collective Working Group papers.

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[3] All reports will undergo an internal CIE review before they are considered final.

***Acceptance of Deliverables***

By 28 March 2008, CIE shall complete and submit the independent CIE peer review reports in accordance with the ToR, which shall be formatted as specified in Annex 2. Upon review and acceptance of the CIE reports by the CIE Coordination and Steering Committees, CIE shall send via e-mail the CIE reports to the COTRs (William Michaels William.Michaels@noaa.gov and Stephen K. Brown Stephen.K.Brown@noaa.gov) at the NMFS Office of Science and Technology by the date in the Schedule of Milestones and Deliverables. The COTRs will review the CIE reports to ensure compliance with the SoW and ToR herein, and have the responsibility of approval and acceptance of the deliverables. Upon notification of acceptance, CIE shall send via e-mail the final CIE report in *.PDF format to the COTRs. The COTRs at the Office of Science and Technology have the responsibility for the distribution of the final CIE reports to the Project Contacts.

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***Request for Changes***

Requests for changes shall be submitted to the Contracting Officer at least 15 working days prior to making any permanent substitutions. The Contracting Officer will notify the Contractor within 10 working days after receipt of all required information of the decision on substitutions. The contract will be modified to reflect any approved changes. The Terms of Reference (ToR) and list of pre-review documents herein may be updated without contract modification as long as the role and ability of the CIE reviewers to complete the SoW deliverable in accordance with the ToR are not adversely impacted.

## ANNEX 1: Draft Terms of Reference for the GARM-III "Models" Meeting

(Last Revised: Oct. 31, 2007; A final draft will be distributed to the Panel prior to the meeting.)

1. For each stock, consider the applicability of one or more of the following modeling approaches to assess stock status:
    - Index methods
    - Production Models
    - Age- or Length-based Models

2. For certain stocks that are aged, compare and contrast the utility of statistical catch-at-age vs. VPA based models with respect to the following criteria:
    - Retrospective patterns
    - Flexibility to account for alternative parameterizations
    - Ability to incorporate external sources of information, especially tagging and environmental data
    - Ability to estimate parameters incorporating prior, external information.

3. Address the implications of zeros in the evaluation of fishery independent indices.

4. Examine potential factors responsible for retrospective patterns.

5. For each stock, define the assessment model that will be used to determine stock status and productivity characteristics until the next "benchmark" assessment is conducted. Where possible, apply the models to data (probably through 2006), to obtain current and historical estimates of F and B and estimates of uncertainty.

6. Evaluate the sufficiency of the assessment models to estimate measures of stock status consistent with Biological Reference Points.

## ANNEX 2: Contents of GARM-III Independent CIE Reports

1. The Independent CIE Report should comment on the quality and soundness of the science, methods and data with regard to each Term of Reference. CIE panelists should consider whether the work provides a scientifically credible basis for developing fishery management advice. Scientific criteria to consider include: whether the data were adequate and used properly, the analyses and models were carried out correctly, and the conclusions are correct/reasonable.

If a panelist feels that his/her comments are adequately expressed in the GARM Panel Summary Report, it will not be necessary to repeat the same comments in the Independent CIE Report. In that case, the Independent CIE Report can be used to provide greater detail on specific Terms of Reference or additional questions raised during the meeting.

2. If any modeling approaches are considered inappropriate, the Independent CIE Report should include recommendations and justification for suitable alternatives. If such alternatives

cannot be identified, then the report should indicate that the existing modeling approaches are the best available at this time.

3. Any independent analyses conducted by the CIE panelists as part of their responsibilities under this agreement should be incorporated into their Independent CIE Reports. It would also be helpful if the details of those analyses (e.g., computer programs, spreadsheets etc.) were made available to the respective assessment scientists.

4. Additional questions that were not in the Terms of Reference but that are directly related to the assessments. This section should only be included if additional questions were raised during the GARM meeting.

## ANNEX 3: Contents of GARM-III Panel Summary Report

1. The first section the report shall consist of an introduction prepared by the GARM chair that will include the background, a review of activities and comments on the appropriateness of the process in reaching the goals of the GARM. The next section will contain comments on the quality and soundness of the science, methods and data with regard to each Term of Reference. The GARM Panel should consider whether the work provides a scientifically credible basis for developing fishery management advice. Scientific criteria to consider include: whether the data were adequate and used properly, the analyses and models were carried out correctly, and the conclusions are correct/reasonable.

If the CIE panelists, the non-CIE panelists and GARM chair do not reach an agreement on a Term of Reference, the report should explain why. It is permissible to express majority as well as minority opinions.

2. If any modeling approaches are considered inappropriate, the GARM Panel Summary Report should include recommendations and justification for suitable alternatives. If such alternatives cannot be identified, then the report should indicate that the existing modeling approaches are the best available at this time.

3. The report shall also include the bibliography of all materials provided during the meeting and any papers cited in the GARM Panel Summary Report, along with a copy of the CIE Statement of Work.

The report shall also include as a separate appendix the Terms of Reference used for the GARM Models Meeting, including any changes to the Terms of Reference or specific topics/issues directly related to the assessments and requiring Panel advice.

## Appendix 7. Presentation Highlights and Discussion

This appendix includes the presentation highlights provided by the senior author of each working paper along the rapporteur’s notes of the ensuing discussion. In regard to the latter, the emphasis was to capture the main points made. Some rapporteurs used prose while others bullet style. There was only modest editing of these during preparation of this report. Notwithstanding this, the text give a sense of the main topics discussed, areas of agreement, and areas of future work. While these were referred to by the Panel, statements in this Appendix should not be considered the final conclusions of the Panel, which are stated in the body of this report.

## Applicability of Models to Assess Stock Status

Rapporteur: Toni Chute

Working Paper 1.1: Rago P, et al. 2008. Data Summary for Nineteen Groundfish Stocks in the Northeast US

*Presentation Highlights*

The feasibility of any assessment model approach ultimately relies on the quality of underlying data. To that end this report incorporates the full set of data estimation improvements described and endorsed by the review Panel for the GARM Data Methods Meeting (October 29-November 2, 2007). The major revisions include:

- Improved methods for allocating landings to statistical area
- Revised approaches for estimation of total discards
- Improvements to software for estimation of landings at age

This document is a summary of the progress that has been made to date on the preparation of data for the Groundfish Assessment Review Meeting (GARM). The objective of this report is to provide the necessary background on the availability of data for each species, and to inform discussions on model selection. Each chapter includes a set of core tables that illustrate the available commercial landings and discards, recreational landings and discards, and survey indices. For species that are aged, additional information on biological samples and age composition is also provided. Not all of the age samples for 2007 have been processed.

Discard estimates and CVs are based on the SBRM methodology (based on a discard/kept of all species) described at the GARM Data Methods meeting in October 2007. In some instances, individual analysts varied the approach to more accurately account for known interventions that created large regulatory discards. For some species, discards were estimated using hindcast methods. A generalized database has been developed to facilitate the evaluation of alternative estimators. One of the important new aspects of this report is that measures of uncertainty in the discard totals are now estimated.

Recreational catch and landings have been revised by MRFSS and are summarized for 1981 to 2006. Compared to the more popular recreational species (e.g., striped bass) relatively few length frequency samples for groundfish are taken.

Standardized mean abundance and biomass (kg) indices are available for NEFSC spring (1968-2007), NEFSC autumn (1963-2007) and DFO spring (1986-2007) were summarized. The Massachusetts DMF spring and fall bottom trawl surveys (1982-2007) were are also included for stocks that frequent inshore waters. Numbers at age were also estimated for appropriate stocks.

The data summaries are preliminary. In particular, discard estimates may be revised as the individual analysts review the underlying data in more detail. Some of the chapters include more complete, but preliminary, investigations of model performance. Such chapters do not constitute assessments but will be used as a starting point for more comprehensive analyses.

Working Paper 1.3.Hendrickson L and L. Col. 2008. Maps Showing NEFOP Sampling Coverage and Management Areas

*Presentation Highlights*

Groundfish discards are estimated for the 2008 GARM from trips sampled by fisheries observers from the Northeast Fisheries Observer Program (NEFOP). The spatial distribution of the observed tows from these trips is shown on a series of GIS maps, by gear type during 1986-2006, in relation to statistical reporting areas and the three groundfish closure areas (CAI, CA II, and the Nantucket Lightship CA).

*Discussion on Working Papers 1.1 and 1.3*

- The important issue for this meeting is to ensure that the assessment models consider the key processes of each stock through considering changes in management and depletion over time, discards, survey variability, and so forth rather than going over all the data. Key objectives include:
  - Comprehensive evaluation of the estimation error in landings, discards, surveys, and catch-at-age.
  - Four stocks will be used as case studies to highlight major components/processes: Georges Bank yellowtail flounder, Georges Bank cod, white hake, and Gulf of Maine cod. Patterns observed for these stocks may be generalized to remaining stocks.
  - Fish sizes have been changing over time too possibly as a result of several factors including fishing, environmental changes, density dependence and natural mortality; these patterns emerge across all stocks.
- Stock structure is defined by statistical areas which are informed by both the topography of the bottom and fishing areas.
  - Not all GB stocks have the same statistical areas associated with them; some GB stocks occupy statistical areas that other GB stocks do not.
  - Stocks are determined by both natural patterns of abundance and management areas. There is some migration between stocks and tagging programs for yellowtail flounder and cod show promise for quantifying not only the rate but the fluxes among populations.
  - The GOM has colder water and is not as productive as compared to GB
  - Survey strata for fishery-independent bottom trawl surveys are chosen to approximate the statistical areas used to quantify commercial landings data. Survey strata are based on additional information including depth and bottom type.
- Distant-water fleets exploited the resources very heavily until the Magnuson act in 1976.
  - Up to 500,000 metric tons a year were removed, much of it prior to the initiation of NMFS surveys. Large reductions in biomass right around the time of the NMFS surveys began.
- The reporting of landings has changed over time
  - Pre 1994 reporting was voluntary and supplemented with interviews, now it is a mandatory logbook system.
  - There are some problems determining the allocation of landings: e.g. where the fish were caught. These problems were addressed at the GARM Data meeting. Allocation to stock areas is less problematic.
  - Dealer records have not changed much, although now they are reported electronically.

    - Observer coverage varies depending on circumstances such as a special access program and species. Overall coverage for groundfish ranges from 2 to 5%.
- Management has become more than just "a strong suggestion" and there have been some significant improvements in some species.
    - In 1994, it was planned to reduce the fishing by 50% in 5-7 years.
    - Closed areas were implemented in 1996, and rolling closures protect the stocks at certain times of year.
    - The closed area boundaries are heavily fished - 75% of haddock are caught within a few miles of the area boundaries.
- Discard estimation has been improved by stratifying the fleets and estimation by a discard to kept ratio.
    - Observer information is key
    - Hindcasting discard estimation is difficult; both observer and survey data are used.
    - With changes in management, discard patterns have changed over time.
    - The average kept weight and average trip duration seem to be the same whether an observer is on board or not.
    - The probability of capture, given the particular fleet, gear and area plus the management effects are used to estimate probable discard.
- Regarding NMFS survey sampling (over 45 years), there is evidence of abundance clustering over time (high Gini numbers).
    - The definition of the "stock area" is what is used when determining whether there is a high Gini index for a certain species, not the whole survey area.
    - In some cases, the high concentration may be due to spawning aggregations.
    - There is no evidence of bias in the survey, but the realized sampling design is not equally effective (i.e., precise) for all species.
- Number of tows within an area are used to calculate the measure of concentration (i.e. Gini index) , but some of the area within strata are not trawlable for a number of reasons
    - However, many untrawlable areas are only temporarily so.
    - Overall though, the survey coverage is generally good; there are not many holes.
    - Looking at areas of survey gear damage could point out where these untrawlable areas are.
    - Untrawled areas, if consistent over time, may not be that important.
- The definition of the plus group has changed over time due to the intensity of fishing, and changes in size of fish at age due to unknown causes.

Working Paper 1.2: Rago et al. 2008. Overview of Assessment Methods and Model Selection Criteria for Nineteen Groundfish Stocks in the Northeast US

*Presentation Highlights*

This report provides a summary of the assessment approaches that have been used to date for the 19 GARM stocks. Each section gives a brief overview of the methods that have been used to date, an evaluation of their strengths and weaknesses, and the prospects for implementing alternative approaches. This report complements the data and analyses summarized in Working Paper 1.1.

Model selection requires simultaneous consideration of multiple objectives. Alternative models should be technically superior in terms of modern statistical theory, flexibility to handle heterogeneous data and processes, stability of results, and expanded scope of inference. Alternative models must also allow for the provision of scientific advice with respect to reference points. One aspect of particular importance in the Northeast US is stock rebuilding. The model must include a forecasting component or be linked with forecasting program. This is necessary for the evaluation of alternative management strategies. Such evaluations are also required as components of the economic impacts of alternative harvest levels. Finally, coordination of assessment approaches with states and Canada is important for jointly-managed species.

This report addresses the model selection issues for 19 stocks. Each section includes a brief description and history of current approach, its key strengths and weaknesses, and the feasibility of changing assessment models. At the 2005 GARM, only one stock was assessed using a forward projecting age-structured model. For this GARM there is a general tendency to consider the application of forward projection models for several stocks including Georges Bank and Gulf of Maine cod, Georges Bank haddock, all of the yellowtail stocks, and redfish, and white hake. For other species, the current age based assessment models are performing well and may not need further exploration. Several index-based assessments (e.g., white hake, Gulf of Maine haddock) may be upgraded to age or length based models.

*Discussion on Working Paper 1.2*

- Relative F equation
    - Catch over three years is average of index of abundance
    - Relative F approach is more of a descriptive tool, not to provide an assessment number.
    - Recruitment is not taken into account when using the averaged 3 indices, allow fish a few years to be caught, but the uncertainty in the survey is why there are 3.
    - In the first and last year of a time series the relative F estimate has a different basis (n-1, or 2 if n=3). All abundances are expressed in biomass, weight per tow.
- Placement of surveys in time may affect the way the data are smoothed since the surveys are conducted at different times of the year.
    - Spatial patterns in the survey data have not affected the definition of central tendency.
    - Finer scale changes in the surveys may change the apparent pattern of the fish.
    - Does one go back and look at the survey areas where the aggregated (high GINI number) fish are found to see whether it is in a specific place. This is not an issue in design-based surveys but knowing the variation from tow to tow may be helpful for the model
- Model vs. index-based assessment
    - ability to age all the species was important
    - Some sampling years were not good so a model had to be used to cover the times of poor age data.
    - Model selection needs to be assisted by considering the summary of data is available and what the time spans and ranges of data are
- Dealer data represent a near census of reported landings and have no sampling error in terms of biomass. Allocation of landings to area and age class are subject to the veracity of the VTR data and the intensity of biological sampling. Re area allocation, are the interviews and VTR comparable?

  - The pre1994 interview program was a sampling program facilitated by expert judgment of the port agents.
  - Port agents would impute statistical area from trips, ports for unsampled trips.
  - Error in statistical area for catch is not huge, but the statistical area assignment is less certain than stock area.
- The magnitude and precision of total discards have important implications for model selection.
  - How accurate is the size frequency coming from the observers for the whole stock? Pretty good, but some of the CVs were pretty high for the catch
  - Overall, error in catch-at-age are probably small compared to the indices at age.
- What is the relative magnitude of error from all of the different data sources?
  - Stocks that have some data peculiarities are the ones that have special modeling needs
  - Are there any commonalities in the assessments that do not work? Generally for flatfish and stocks in the Gulf of Maine.
- Need to put some work into defining uncertainty in the catch (i.e., combining errors in commercial and recreational landings with imprecision of discard estimation).
- Replacement yield models
  - Considers replacement yield constant or as constant fraction of extant stock
  - Need to estimate the other parameters (catchability and population growth rate).
  - Need model to fit what is happening in the present, not what happened 20 years ago.
  - Could fit model to different periods of time (e.g. 5, 10, 15 years) in the historical dataset to examine model mis-specification
  - Paper by Glazer (2008) briefly presented and discussed

## Potential factors responsible for retrospective patterns

Rapporteur: Susan Wigley

Working Paper 4.1: Legault C et al. 2008. Report of the Retrospective Working Group

*Presentation Highlights*

This report summarizes a wide range of work related to retrospective patterns in stock assessment, culminating in conclusions and recommendations. A retrospective pattern is a systematic inconsistency among a series of estimates of population size, or related assessment variables, based on increasing periods of data (Mohn 1999). This pattern of change in estimated values can have severe consequences for management of a stock, potentially resulting in depletion of a stock even though the assessments indicate the targets are being met. Retrospective patterns have been observed in some but not all of the stocks in New England, as well as other stocks around the world. Retrospective patterns are not limited to virtual population analysis, having been observed in a wide range of models including statistical catch-at-age models. Instead retrospective patterns are an indication something is inconsistent in the data or model assumptions. However, retrospective patterns are just one diagnostic for stock assessments and lack of a retrospective pattern does not necessarily imply that all is well.

Simulation analyses have demonstrated a number of sources for retrospective patterns, including, missing catch, an increase in natural mortality rate, or a change in survey catchability. The working group examined a number of potential methods to determine the source of a retrospective pattern using simulated data, but was unable to do so. However, the working group found it does appear possible to identify the timing of an intervention which leads to the retrospective pattern in some cases. Similarly, a number of methods were examined to fix retrospective patterns. While the fixes did in fact remove the retrospective pattern, the new assessment was not always closer to the truth than the original assessment, even though the diagnostics of the new model were good. This means that caution must be exercised when applying any fix to an actual assessment to remove the retrospective pattern.

The working group recommends that stock assessment scientists always check for the presence of a retrospective pattern and that a strong retrospective pattern is grounds to reject the assessment model as an indication of stock status or the basis for management advice. The working group also recommended future research to be conducted on the topic to define objective criteria for acceptance of an assessment with retrospective patterns and to determine what type and level of adjustment in management advice is appropriate through management strategy evaluations.

*Discussion on Working Paper 4.1*

The simulations were useful in illuminating the complexity and importance of identifying the sources and timing of the retrospective patterns as well as indicating where further research could be directed. This research has a broad application because retrospective patterns can occur regardless of the analytic model and occur not only in Northwest Atlantic stock assessments but also in the Northeast Atlantic, Pacific and Southern Ocean stock assessments.

In addition to the sources of retrospective patterns examined through simulation [changes in catch, changes in natural mortality and changes in survey catchability (q)], it was noted that changes in partial recruitment could also cause retrospective patterns.

Informal meta-analyses which examined commonalities among stocks that exhibit retrospective patterns have been conducted; however, no consistent patterns among stocks have emerged with regard to source or timing. It was suggested that the meta-analysis be expanded to examine survey catchabilities among stocks and across areas.

It was also suggested that swept area values, instead of survey catchabilities, be used when investigating this source of retrospective patterns. The use of swept area values may be helpful in the interpretation of survey catchabilities because the values are cast in more realistic terms by translating the survey catchabilities into proportions that are scale-able and this may allow for easier detection of survey trends that could be at odds with the model. The expectation is that the survey values would be on the order of 1 or 2, not 10.

During the discussion, it was noted that while the timing of the change may be known, it may not be possible to determine which portion of the time series is ‘true’. It is insufficient to simply split the series to remove the retrospective pattern because while this could remove or diminish the retrospective pattern, it will not necessarily lead to true estimates. To acquire the true value of the estimates, it is necessary to know both the time of the change and the source of the change.

It was pointed out that the simulations conducted to evaluate if retrospective patterns occur by random chance used both realistic noise values (similar to values observed in Northeast stock assessments) as well as unrealistically large noise values. Regardless of the noise level, there was no evidence that retrospective patterns occur by chance alone. It was noted that additional simulation work could be expanded to include correlated noise (e.g. year effects in surveys).

During the discussion of closed areas as a source of retrospective patterns, it was noted that closed area affects could be from regulatory closed areas or from a concentration of effort in a particular area while survey indices were derived from the entire area. It was emphasized that the source of retrospective patterns created by closed areas was limited to sessile animals because the simulations revealed that the retrospective patterns diminished when movement between the closed and open areas was added into the simulations.

Since retrospective patterns arise from a change within a time series, one possible solution to remove a retrospective pattern would be to shorten the assessment time frame. It was noted that shortening the time series used in the assessment is contrary to the belief that a longer time series is preferable; however, given a retrospective pattern, a shorter time series may provide more accurate estimates of current stock status. Using moving window was also discussed as an alternative to shortening the assessment time series. A moving window may also be beneficial in identifying the timing of the change.

When a retrospective pattern occurs, what action should be taken: use another model, shorten time period, or reject the assessment? No conclusion was reached.

Alternative states of nature are analogous to calculating the confidence intervals around estimates and provide estimate bounds for managers. It was emphasized that to properly determine the alternative states of nature, many analyses would be necessary to evaluate all possible sources when the source and timing of the retrospective pattern was not known.

The panel offered the following suggestions to analysts as they prepare their assessments:

1) check for retro patterns
2) evaluate diagnostics (not only retro patterns) and
3) use other auxiliary information when possible (CPUE, landings, etc.) to identify the source(s) and timing of a change(s) within the time series.

It may be possible to account for differences created by a retrospective pattern; however, it assumes the direction of the difference is known but without the knowledge of the source, there is no mechanism to indicate where the truth lies. Caution should be used.

Management strategy evaluations (MSE) were discussed regarding their ability to appropriately determine adjustment levels when providing management advice. The MSE will be limited because they will be conditioned on a given source and timing of the cause for the retrospective pattern. The MSE would have to be cast in a risk analysis framework in order to evaluate different types of adjustments.

The panel agreed that it is important to communicate the retrospective patterns to managers due to the implications of these patterns on reference points and advice on catch and projections.

## Model implications of zeros in fishery independent indices

Rapporteur: Larry Jacobson

Working Paper 3.1: Legault, C. and A. Seaver. 2008. Simulation Studies of Issues Associated with Filling Zeros in VPA Tuning Indices

### *Presentation Highlights*

Surveys occasionally do not encounter fish of a given age in a specific year. Since age-specific survey tuning indices are usually assumed to have a lognormal error, zeros are not allowed. The NEFSC standard procedure is to treat the zeros as missing. However, during the 2006 review of the summer flounder assessment, it was claimed that this procedure introduces a bias into the assessment because no information is being presented to the model when the product of abundance and survey catchability for an age are low. No support was provided for this statement beyond this theoretical argument. An approach was recommended to fill the zeros with 1/6 of the smallest non-zero value in the series. It was claimed that this approach reduced the retrospective pattern in the assessment. This claim was later shown to be false. Many changes were made during the assessment with an end result of higher catch advice. This created a perception that filling the zeros causes higher catch advice and so it was requested that this approach be applied to the Northeast groundfish stocks as well. This working paper presents three studies demonstrating why zeros should not be filled.

The first study simply created a time series of abundance and then created deterministic indices with different detection levels for truncating low values to zero. It was shown that filling a sequence of zeros with any constant value introduces a bias by creating a flat index for these years when in fact the actual population is changing. The second study used a population simulator to create datasets for analysis by virtual population analysis under 4 scenarios: 1) all data is used, 2) tuning indices below a set value were truncated to zero and treated as missing, 3) same as case 2 except the zeros filled with a constant value of 0.01, and 4) same as case 2 except the zeros filled according to the 1/6 approach. Cases 1 and 2 had similar levels of bias while case 4 was highly biased relative to the known underlying population N and F. Case 3 had more bias than cases 1 or 2, but not as much as case 3. These simulations demonstrated no support for the claim that treating zeros as missing introduces bias and also showed that filling zeros with a constant can induce large biases. The third study (presented in the appendix) was a simple regression example to demonstrate why filling zeros with a constant can lead to bias. Random data were created and error added to "observed" values which were truncated to zero below some cut-off. When the zeros were treated as missing a regression of the log of observed and true values had a slope near one with the 90% CI of observations covering zero. When the 1/6 rule was applied, the slope of the regression was strongly bias with the 90% CI not covering zero even though it was nearly twice as large as case 1.

These studies concluded that making up data is bad. In the short term, treating zeros as missing is recommended. In the long term, a different error distribution should be found for use instead of the lognormal which allows for zero values. However, this distribution must allow for the truncation effect instead of just treating all zeros as the same value, as a square root transform would, for example.

Working Paper 3.2: Terceiro, M. 2008. The Treatment of "Zero" Observations in the Summer Flounder ADAPT VPA Calibration

*Presentation Highlights*

There is no consistent pattern in the identification of the additive constant that minimizes the absolute value of Berry's (1987) *g* statistic. There is no strong relationship between the absolute magnitude of the index values, the length of the time series, the number of zeros, the magnitude of the smallest observed value, or any of the usual statistical moments of the series (mean, maximum, non-zero minimum, CV, skewness, kurtosis), and the value of the additive constant that minimizes *g*. Further, while the "one-sixth" of the minimum observed value was identified as the "best" additive constant in 5 of the 24 (21%) cases examined, this level is not high enough to justify this approach as a reliable rule-of-thumb. In fact, the additive constant of 0.01 was identified as "best" for a higher percentage of series (6 of 24 = 25%). Given the inability to identify a constant that consistently minimizes $g$, the best rule is to maintain the current approach of making no adjustment and continue to treat "zero" observations as "missing."

Working Paper 3.3: ICES Resource Management Committee. 2007. Report of the Working Group on Methods of Fish Stock Assessments (WGMG).

*Presentation Highlights*

The ICES Working Group on Methods of Fish Stock Assessments (WGMG) met in Woods Hole 13-22 March 2007. During the meeting, a working paper was presented on the topic of zeros in tuning indices. The WGMG discussed the working paper, but did not spend any additional time on the topic. It was noted that the ICES standard approach is to treat zeros as missing values when they occur in tuning indices. The WGMG concluded that a different error structure than the typical lognormal error should be developed which allows the use of zeros. However, simulation testing is required to ensure that such an approach is robust to outliers. The delta approaches were suggested but rejected, while a quasi-likelihood function with quadratic term deserves consideration. The WGMG concluded that one should not change data to fit the model, but rather change the model to fit the data.

*Discussion on Working Papers 3.1, 3.2 and 3.3*

Comments generally supported the conclusions given in the working papers. It was noted that zeroes in fisheries are more likely a problem of truncation than a problem of true zeroes. Sub-sampling and sample size are important factors in the occurrence of zeroes because, for example, in addition to sampling relatively rare large fish in length composition data, it is necessary to sub-sample relatively rare old ones in the age-length key to observe an old fish in catch-at-age data. A zero survey observation generally means that no fish were taken in a number of tows across a number of strata. The frequency with which zeroes occur may be critical because effects of omitting zeros rarely and at "random" intervals has different consequences than omitting long strings of zero values that occur when very young or old organisms become rare for long periods of time.

It was noted that Berry's (1987) approach was designed for analysis of experimental data, rather than data used in stock assessments. Different approaches (other than logs) to transforming data may be optimal in stock assessment when zeroes are present. The possibility of using the square root transformation (which is applicable to zeroes and tends to standardize variance in lognormal data) was discussed but there was some concern about effects on the scale of the mean and variance as well as the fact that zeros would be treated the same regardless of the true level of depletion leading to their truncation. Over-dispersed Poisson or negative binomial distributions might be useful. It might be useful to vary the composition of the "plus" group for the youngest and oldest ages to eliminate zeroes at these ages. This has implications for the estimation of catchability at age which requires a consistent definition of the age group over time. These suggestions have promise but there was insufficient time to evaluate their merits prior to the GARM.

There was a suggestion to explore robust likelihood approaches to avoid excessive influence on model fitting to data affected by the presence of zeros.

## Utility of statistical catch-at-age models

Working Paper 2.1. Jacobson L, C. Legault, L. O'Brien and K. Sosebee. 2008. Utility of statistical catch-at-age models for assessing Northeast groundfish stocks: Overview (a workshop report for sections 2.1a, 2.1b, 2.1c)

Rapporteur: Tim Miller

*Presentation Highlights*

A training workshop using the SS2 (Stock Synthesis, version 2) statistical catch-at-age stock assessment model for northeast groundfish was held at the Northeast Fisheries Science Center (NEFSC) in Woods Hole, MA during 4-7 February 2005. The workshop was successful in developing potentially useful but preliminary SS2 models for three example stocks. In particular, a model for white hake was developed that spanned a period with missing fishery and survey age data. Previous attempts to assess white hake using a variety of models were problematic. Estimates from an SS2 model for Georges Bank (GB) cod appear relatively precise, presumably because of high quality of the available data. Preliminary SS2 models for GB yellowtail flounder suffered from many of the same problems as VPA models in the last assessment and a number of different model configurations were explored in SS2 that help address these problems.

Experience at the workshop with all three stocks indicates that statistical catch-at-age models are applicable and promising for northeast stocks. SS2 and VPA estimates were generally similar, particularly when configured in similar ways. As exemplified by Georges Bank cod, the data available for northeast stocks are adequate for application of statistical catch-at-age models. In fact, data available for all three example stocks were more comprehensive that the data available for many stocks where statistical catch-at-age models are used routinely. Results for white hake show that statistical catch-at-age models may be useful for stocks with missing age data or stocks currently without an analytical assessment approach. The inherent flexibility of statistical catch-at-age models may be advantageous in dealing with difficult assessment problems and complex data, although results for GB yellowtail flounder indicate that there are no "silver bullets" and that some chronic issues are likely to persist.

Participants at the workshop agreed that SS2 was substantially more difficult to apply than the traditional ADAPT VPA and that training and technical support are absolutely necessary at the outset for new users. Events elsewhere show that even experienced users require technical support and access to the software development team on an ongoing basis.

Although it has been used around the world for a large number of stocks, SS2 was developed originally for relatively slow growing, long-lived and unproductive rockfish stocks on the west coast of North America with limited data and relatively low fishing mortality rates. A number of changes were made to the program to accommodate different circumstances in the northeast. Additional work along these lines will probably be required if SS2 is used for northeast groundfish.

*Discussion on Working Paper 2.1*

A point was raised that, as with SCAA models, recruitment could be estimated freely with VPA models which supported the presenter's assertion that VPA and SCAA can both be parameterized to model the same processes. Moving to the Baranov catch equation from the

Pope approximation was discouraged unless absolutely necessary because of computation burdens especially for Bayesian inferences. Shortening the time step is an alternative to maintaining the Pope approximation but this could increase the number of selectivity parameters. There was some disagreement about whether maximum likelihood estimation of the variance of deviations around the stock recruitment relationship was possible. However, the estimation of this parameter was thought likely to be biased.

One reviewer pointed out that knowledge of the relative weighting of the age composition of the landings and surveys would be helpful in determining the respective influences on the overall objective function in a SCAA model. It was also asserted that the variance of age composition residuals should roughly match the assumed variances. However, the method of dealing with effective sample size of age composition varies among researchers and currently, there is no consensus. Along with variance assumptions for the age composition, distributional assumptions should affect the estimation of parameters in SCAA. Finally, one reviewer suggested using Bayesian approach to help in treating uncertainty in different data components.

Working Paper 2.1. Jacobson L, C. Legault, L. O'Brien and K. Sosebee. 2008. Utility of statistical catch-at-age models for assessing Northeast groundfish stocks: Section a on Georges Bank Yellowtail

Rapporteur: Tim Miller

*Discussion on Working Paper 2.1: Section a on Georges Bank Yellowtail*

There was only limited discussion on this section of the working paper as much of the time available had been devoted to the overview.

Working Paper 2.1. Jacobson L, C. Legault, L. O'Brien and K. Sosebee. 2008. Utility of statistical catch-at-age models for assessing Northeast groundfish stocks: Section b on White Hake

Rapporteur: Ralph Mayo

*Discussion on Working Paper 2.1: Section b on White Hake*

Trends in residuals from surveys suggest a change in catchability (q) around 1985. This is likely the result of the doors changes; however there are no conversion factors available from the gear comparison studies.

The fishery selectivity declines sharply after 114 cm. This is likely due to large fish inhabiting deeper water unavailable to some gear types. The drop in survey selectivity may also be due to larger fish inhabiting deeper water out of range of the survey. It is also possible that the fishery may be operating in areas outside of the area covered by the survey.

When asymptotic selectivity was imposed on the fishery, model fit was poor. Therefore, flat top selectivity is not an option conditional on the rest of the model configuration, so additional work is required on the shape of the dome or on adjusting the other parts of the model configuration.

The assessment model generates numbers at age which are then converted to number at length to derive selectivity at length. In years with length compositions but no age compositions, it is possible to use a growth model internally to convert age compositions to length compositions. This conversion can also be done externally using existing methods (e.g Kimura) using, for example, age data from adjacent years. Additional age data may be obtained from observed trips, although these otoliths have not aged.

Based on the plot of length vs. age, the variance of length at age seems large, especially for younger ages. The range of length at age represents the range from both spring and autumn surveys, leading to a wider range than if they were plotted by seasonal age.

Working Paper 2.1. Jacobson L, C. Legault, L. O'Brien and K. Sosebee. 2008. Utility of statistical catch-at-age models for assessing Northeast groundfish stocks: Section c on Georges Bank Cod

Rapporteur: Jessica Blaylock

*Discussion on Working Paper 2.1: Section c on Georges Bank Cod*

It was remarked that the VPA before this was working adequately, except that the retrospective pattern was a little high or moderate compared to other stocks.

There was discussion on the mimic-VPA model that showed a 180 degree 'flipped' pattern in all three stocks (GB Yellowtail, White Hake, and GB Cod) from the pattern exhibited by the SCAA model. However, further examination revealed that only the GB Cod exhibited this 'flipped' pattern. On this subject, it was pointed out that if the SS2 model had been parameterized to have the same biomass as the VPA, then the retrospective pattern would probably not have flipped between the two models.

On a procedural note, the Chairman reminded the panel that, for all 19 stocks, if the use of a new model is advised, it will be important to be clear about why the 'old model' is not as good as the 'new model'. Why did we change the model? What issues will be addressed better?

Concern was expressed about fitting the likelihood (fixed catch) and its influence on parameter estimation. Fixing the weighting so high (lambda = 100) has a large influence on other parameters in the model. This was done here for both runs because of the assumption the catch was known.

The panel was reminded that these were exploratory runs, but that future sensitivity runs could be done. Suggestions included allowing for a dome-shaped selectivity pattern instead of forcing a flat-topped pattern, and setting selectivity and letting catch vary.

A suggestion was made to let selectivity follow a random walk across years, in the context of parameterizing the SS2 differently to mimic the VPA better. However, caution would be necessary since a change in selectivity implies a change in q.

There was consensus that caution would be necessary if going to a full length-based versus age-based model.

Supplementary Working Paper 2.1: Jacobson L. 2008. Georges Bank Yellowtail; Questions about the adjusted lognormal error distribution used in calculating goodness of fit for survey and commercial age composition data in preliminary ASPM models

*Presentation Highlights*

The likelihood of age composition data and details of calculation are important in SCCA modeling. For example, in preliminary SS2 models for Georges Bank yellowtail flounder, results for recent years depend on whether the model solution favors (tends to fit) survey and commercial age composition data at the expense of survey trend data, or vice-versa. All approaches are approximate because the statistical distribution of age composition data is hard to specify and model misspecifications complicate the matter further. Still, it is important to understand and weight the advantages of the approach taken, particularly if it is new.

According to equation A21.9 in the working paper 2.2-a by Butterworth and Rademeyer, the negative log likelihood of survey and commercial age composition data in the preliminary ASPM for Gulf of Maine cod is:

$$-\ln\left(L^{CAA}\right)=\sum_{y}\sum_{a}\left\{\ln\left(\sigma_{com}/\sqrt{p_{y,a}}\right)+p_{y,a}\left[\ln\left(p_{y,a}\right)-\ln\left(\hat{p}_{y,a}\right)\right]^{2}/2\sigma_{comm}^{2}\right\} \quad \text{A2.19}$$

Where $p_{y,a}$ and $\hat{p}_{y,a}$ are observed and predicted proportions of the total catch age *a* during year *y*, and the standard deviation $\sigma_{comm}$ associated with the catch-at-age, which is estimated in the fitting procedure using:

$$\hat{\sigma}_{comm}=\sqrt{\sum_{y}\sum_{a}\left\{p_{y,a}\left[\ln\left(p_{y,a}\right)-\ln\left(\hat{p}_{y,a}\right)\right]^{2}\right\}/\sum_{y}\sum_{a}1} \quad \text{A2.21}$$

Thus, the log likelihood term is calculated assuming that measurement errors in catch-at-age arise from a weighed log-normal distribution. Lognormal distributions are often used for catch-at-age data and not cause for concern. However, the weighting factor (i.e. the observed proportion $p_{y,a}$) for each age is unusual and has uncertain statistical properties that should be evaluated and explained. The text following equation A2.2.1 explains "*Punt (pers. comm.) advised weighting by the observed proportions (as in equation A2.19) so that undue importance is not attached to data based upon a few samples only.*"

The following are three concerns that occur to this reviewer immediately. First, the magnitude of the proportion $p_{y,a}$ has no necessary relationship to the number of samples. A very low observed proportion would naturally occur for a rare event in any number (small or large) of samples. Secondly, this approach gives zero weight to data in age composition bins with zero observations, even though the data likely contain valid and reliable information concerning the rarity of fish of that particular age. Finally, use of the observed, rather than the predicted, proportion implies that the observed proportions are more precise as estimates of the population proportion than the predicted ones. If the observed proportions are more precise, then why bother calculating the predicted values? In any case, the observed values probably include measurement and process errors that contribute variance that is not desirable in weights.

### *Discussion on Supplementary Working Paper 2.1*

This paper was not presented to the meeting due to time constraints and thus there was no related discussion. It was however made available to meeting participants.

Working Paper 2.2a: Butterworth, D.S. and R.A. Rademeyer. 2008. Statistical Catch-at-age Analysis *vs* ADAPT-VPA: The Case of Gulf of Maine Cod

Rapporteur: Bill Overholtz

*Presentation Highlights*

The WP commences with an historical overview. In 2003, given an estimate of the spawning stock biomass ( $B^{sp}$ ) in 2001 of only 27% of the corresponding level at MSY ( $B^{sp}_{MSY}$ ) on the basis of an ADAPT-VPA assessment that used data from 1982 onwards only, the Gulf of Maine cod stock was classified as "overfished" in the context of the Magnusson-Stevens Act, and a recovery plan put in place. However, an alternative Statistical Catch-at-age (SCAA; alternatively termed Age Structured Production Model – ASPM) assessment at the time, which took account of survey data back to 1964, suggested that the stock was above $B^{sp}_{MSY}$ . An independent panel appointed as part of the process to review this and other US Northeast groundfish assessments during that year recommended further investigation of this to better understand the difference. The WP addresses and discusses this issue together with a range of other (sometimes conflicting) suggestions made during a number of reviews of the assessment of this stock over the past decade. It finds that the primary reason for the different results is that the ADAPT-VPA assessment imposed asymptotically flat selectivity-at-age in circumstances where there is strong statistical evidence for dome-shaped selectivity in the data. Making allowance for this under either assessment method reverses perceptions that recent fishing mortalities have exceeded $F_{MSY}$ , and robustly estimates $B^{sp}$ relatively close to $B^{sp}_{MSY}$ rather than below the threshold of 0.5 $B^{sp}_{MSY}$ for an "overfished" ("depleted") classification. Compared to the ADAPT-VPA approach which is limited to the period for which catch-at-age data are available, the SCAA/ASPM approach allows the longer series of research survey data available to be taken into account, thus providing a better basis to estimate management quantities linked to MSY-related targets, and doubling the related precision in some cases. Given that such targets play important roles in the implementation of the Magnusson-Stevens Act, the SCAA/ASPM approach would seem to be preferred over ADAPT-VPA for assessing this stock. The calculations conducted also point more generally to the need for care in treatment of the plus-group in analyses, as well as in use of the Beverton-Holt spawning biomass recruitment relationship which can lead to inappropriately low estimates of $B^{sp}_{MSY}$ in certain circumstances, and to the importance of using flexible parameterizations of selectivity-at-age in SCAA/ASPM assessments to avoid possibly misleading impressions of the precision with which quantities such as natural mortality $M$ can be estimated.

*Discussion on Working Paper 2.2a*

Discussions which followed are summarized in outline form below:

Statistical Distributions

- Does it matter which distributions one uses? The robustness to alternative statistical distributions can and possibly should be checked.

Ricker vs Beverton and Holt (BH) Stock - recruitment model

- Fitting problem at low stock size.
    - Limited number of observations at high stock size. Is there a decline in recruitment at high stock size? Problem arises if data suggest a negative correlation; BH cannot give a negative correlation; BH will give you a steepness of 1 in these circumstances.

    - Presented formulation provides information on pristine stock size so it helps with the issue of no data at high stock size.
    - If a prior on steepness is assumed, the data are overweighted because of neglect of correlation effects
- Has S/R data from the VPA been considered for guidance? Not yet
- Does the the ASPM have an S/R?
    - It must have since ASPM has production component built in: implies a S/R relationship
    - VPAs, however, are restricted to years with catch-at-age data.
- Parameterize the S/R directly?
    - Bayesian prior, every year there is a deviation from the mean of an S/R.
    - Intermediate world-search routine approximates randomization (random effects) (Maunder and Deriso, 2003)
    - An advantage of internal estimation is that the statistical error assumptions are internally consistent unless the S/R relation is mis-specified.
    - One aspect of mis-specification is the sigma r constraint (p. 52). Should autocorrelation be assumed in the S/R relationship? The current formulation of the model does not include autocorrelation in the residuals. Residuals from S/R are usually not randomly distributed.
- Is Rho fixed?
    - Yes run with a fixed Rho first.
    - Is there autocorrelation in the S/R data? Errors for several sources. Model cannot resolve, outliers rule the day.
    - Are S/R residuals usually autocorrelated (AC)? There is AC in the other data as well, if ignored you are overweighting. At end, this cannot be estimated, resulting confidence intervals are usually too narrow. Though there is often positive AC in residuals, attempts to estimate this in fitting sometimes introduces instability to the estimation.

GOM Cod example

- How about just running with the catches starting in 1893?
    - Was not considered practical because run times would be increase substantially. For true “virgin” biomass, it was suggested that the model would have to start 100-200 yrs earlier.
    - Looked at sensitivities for starting year, things don’t change much for management, but carrying capacity (K) change dramatically depending on starting point.
- Concern was expressed that the stock structure of cod had been compromised by excessive fishing on some components, particularly in inshore areas.
    - if true, then it is unlikely that the stock has recovered. Absence of inshore components is likely to impact BRPs.
    - What is tradeoff for including long-past history? Problem is in uncertainty. Long vs short-term uncertainty. Never know the past, but can use it, and sometimes need to use it. Starting in 1893, back to pristine in 1960, catches decreased and stock rebuilt. DeValpine and Hastings (2002) found that a Ricker model often fit better even when the BH was the true model. Highest biomass has poor recruitment. A concern if you have relatively few data points. Need a phase

    plane plot to show chronology of data? All the high stock sizes are in the 1960s when the stock was being fished down quickly.

- One model run implies that initial biomass in 1893 was at 18-30% of virgin stock size; look at sensitivity runs
    - This value is not considered important because results wash out in first 20 years
    - Most recent years are very similar in most of the sensitivity runs
    - S/R plot only shows 1963 onward, the early points may not be representative of the S/R relationship because high stocks were quickly fished down, i.e., the reproductive potential of the larger stock biomasses may not have been realized.
- Reference points: Parametric or non-parametric S/R? Parametric forms are not mandatory, perhaps this is a case for nonparametric.
    - In the absence of a hypothesized mechanism to justify the overcompensation in a Ricker model, a BH model may be more appropriate.
- Landings: Modern statistics began in the 1930s.
    - 5Y data set starts in the 1940s
    - Data collection systems are different now
    - Perhaps should examine the landings series better and consider the impact of starting other than in 1893
- Likelihood: commercial landings are dominated by ages 5, 6, and 7. The plus group begins at age 7.
    - Using a higher plus group is probably not feasible due to small sample sizes
    - Can all the ages (beyond 7+) be examined for the stock assessment? Yes, this should be looked at. Data suggests a dome for commercial PR.
- Is Pope approximation equation working here? This approximation is known to breakdown at high F.
    - Working paper used Pope because NEFSC was using it at the time
    - Only becomes a problem in 1990, and doesn't seem to present a problem here in this ASPM assessment.
- Is selectivity changing in 2003-2006, it appears so from the bubble plots? Why is selectivity in the survey, which uses a liner, lower for younger ages than the commercial selectivity?
    - The model is based on what the data suggest.
- Why is survey selectivity higher on older fish?
    - Caution needed on two counts: curves are normalized, and correspondence with the data was the primary consideration
- GOM interventions: 1976, 1994, rolling closures, gears.
    - Many different characteristics in the data
    - The ASPM approach lets the data rule the day.
- High reference points for ASPM?
    - Fully selected Fs in ASPM model, not averages over a number of ages as usually quoted for VPA. Compare apples and apples
- Long versus short time series of data
    - Long series good for BRPs, but, may be good idea to use shorter series for status determination.
    - Full time series don't include discards, haddock is a good example, many millions of young fish were discarded pre-1960s. Sensitivities to this should be explored.

- Why do outputs shift back and forth between MLE and MCMC.
    - Acknowledged that results are presented in a mixed mode, Bayesian and frequentist
    - The penalized MLE are also the Bayesian posterior modes. Other Bayesian posterior quantities were not given in every case because of the computational burden, compared to the posterior mode which is much more quickly computed.
- Sensitivity analysis: Management parameters are highly skewed, are priors overly influential?
    - Management parameters are just outputs.
    - The only priors that are informative in the ASPM are on S/R residuals. Uniform prior distributions for S, k, h are all uninformative.
    - Skewness could be real.
- Results: data pre 1982, likelihoods are different for different approaches.
    - Yes, because different data were used. Can't compare two models with different data in AIC sense.
- Clarification: Model used bounds for priors in ADMB.
- MSY calculations: Are S/R functions in R/S units? Intersection point on SR curve, comes from a per recruit perspective. Slope of the replacement line. (The equation relevant to this discussion was subsequently found to have been inadvertently omitted from an appendix in Working Paper 2.2a).
- How much does the choice of a S/R model affect the results? A number of sensitivity tests reported in the paper address this question.)
- Scaling: if you assume a Ricker with poor recruitment in early years, then scale is higher. If all due to catch, then scale is lower. Need to look at sensitivities.

Working Paper 2.3: Shepherd G. 2008. Comparison of ADAPT VPA and ASAP models for Gulf of Maine cod

Rapporteur: Bill Overholtz

*Presentation Highlights*

Gulf of Maine cod stocks were most recently assessed for GARM II using an ADAPT VPA (Mayo and Col 2006). The same input data was used in a forward projecting catch-at-age model (ASAP) (Legault and Restrepo 1998) for comparison purposes. The ASAP model was setup to evaluate five selectivity scenarios: model 1 selectivity was the average (geometric mean) from the last three years in the VPA; model 2 was a fixed equilibrium selectivity pattern used in the yield per recruit calculations; model 3 was a flat-top pattern fitted to ages 1-5 and held constant (1.0) for ages 6-7; model 4 was a fitted using a single logistic curve; and model 5 was a dome shaped selectivity pattern fitted using a double logistic model.

The ASAP model produced fishing mortality and abundance results very similar to the VPA. Among the configurations examined, the selection curve fitted with a single logistic model had the best diagnostics. However, strong retrospective patterns in the ASAP models suggests further examination is needed to determine if alternative configurations would provide a better model fit.

*Discussion on Working Paper 2.3*

- Compare retrospective pattern for various model formulations of ASAP.
    - Why are the patterns different? Abundance depends on younger ages, SSB driven by older ages.
- ASAP or other forward projecting models
    - What is the effect of choosing time blocks for selectivity?
    - Model results often sensitive to assumed timing of transitions between blocks.
    - ASAP has no dependence between time blocks. Some models introduce a random walk approach that constrains the rate of change in selectivity between adjacent time steps.
- Likelihood: double logistic had highest likelihood
    - Model 5 had the highest total log likelihood.
    - Does single selectivity pattern apply? Yes
- How many blocks in the ASAP? One block for all models. Fits to catch-at-age must be poor? Yes, but improved for later part of the time series.
- SSB? ASAP had peak in 1989, VPA acts as a smoother. Can't answer at this point. Rivard wts were used for SSB, Start up approach may account for the differences.
- What was the minimum age of the plus group in ASAP? Age 7.
- How were the means estimated for the 7+ age group? They are weighted averages based on observed values.

Working Paper 2.5: Butterworth, D.S. and R.A. Rademeyer. 2008. Application of an Age-Structured Production Model to the Georges Bank yellowtail flounder

Rapporteur: Tim Miller

*Presentation Highlights*

The WP provides the results for a Reference Case application of ASPM to the Georges Bank yellowtail flounder, together with those for three sensitivities. Strong residual patterns in the fits to survey indices of abundance, particularly to that for the Canadian DFO Spring survey, raise concerns about the compatibility of the population model and these indices. The model fits strongly favor domed over asymptotically flat selectivity. Selectivity assumptions are key to estimates of stock status, with fits to a fully flexible selectivity parameterization indicating the resource to be effectively at its MSY level $B_{MSY}^{sp}$, whereas the imposition of asymptotically flat selectivity sees the stock estimated to be below the "overfishing" threshold of 0.5 $B_{MSY}^{sp}$.

*Discussion on Working Paper 2.5*

There were only points of clarification made with discussion held off until after the follow-up dome-selectivity analysis of tagging data presented by Tim Miller.

Supplementary Working Paper TOR 2: Miller, T, D. Hart, S. Cadrin, L. Jacobson, C. Legault, and P. Rago. 2008. Analyses of tagging data for evidence of decreased fishing mortality for large yellowtail flounder

Rapporteur: Liz Brooks

*Presentation Highlights*

We performed two analyses of yellowtail tagging data from an ongoing cooperative NMFS tagging study. The first compares expected probability of recovery by age class for tagged fish based on estimates of age-specific fishing mortality by Working Paper with the observed proportions of recoveries (by sex) for different length classes (and approximate corresponding ages) in the yellowtail tagging data. In the second analysis, we fit a series of finite-state continuous-time models to the yellowtail flounder tagging data to estimate different fishing mortality parameters by length class at release while also estimating migration and natural mortality rates along with reporting probability and a scalar to adjust fishing mortality in the first month after release. None of our analyses showed evidence of decreased selectivity for large yellowtail flounder.

*Discussion on Supplementary Working Paper TOR 2*

- Presentation stated dimorphic mortality could be contributing to differential return rates between males and females
    - It was queried whether there was evidence or published results to this fact. Presenter replied that the survey has skewed sex ratio at older ages, and also pointed to tagging results (Cadrin et al) that suggest lower recovery rate of males—which could be explained by higher natural mortality on males (among other possible explanations).
- Presentation offered clarification regarding the net flux in movement (instantaneous rates) versus the realized difference in abundance between the three regions (given vastly different stock sizes in each area).
- Reviewer asked for the size bins for the 3 size classes—those values were not immediately available.
    - Motivation for specifying the break points was to examine the veracity of the dome proposed in working paper 2.5 rather than to attempt to estimate the true selectivity at size.
- Reviewer asked for clarification on the negative correlation between M and reporting rate; reviewer asked for the difference in high reward value
    - It was clarified that there was a $100 instant winner for high reward, but a regular tag got put into a once-a-year $1000 lottery.
    - A question asking for the difference in reporting rate, assuming high reward equaled 100% reporting and 60% reporting of regular tags
    - It was also stated that the overall recovery rate is 13% (presumably for all tags, both high and regular reward).
- A question was asked regarding detection probability for the tags; it was responded that the fish go through a filleting machine, and that they have gotten returns from the processors, so the tags could be missed at sea but landed fish would most likely have tags detected.
- It was asked whether they were to use this information to recommend information in assessments (regarding scale of F in assessments) or just to inform on PR.
    - Were the data meeting conclusions suggesting that these rates of Fishing Mortality were most precise and should be used to check assessment results?
    - What are we supposed to do with the different F at the end from assessment vs. the tagging data?

    - Clarification was made that the tagging data were to inform the assessment, and in particular in this case, it was informing as to partial recruitment rather than providing estimates of F.
- Regarding estimated movement (pattern and magnitude), it was noted that the high rate of perceived movement could be a result of where the fish were tagged (i.e. right on the border between SNE and GB).
- Question regarding mixing of one month only after release
    - hypothesis of fully mixed after one month had not yet been tested, but it could be tested by modeling two periods, allowing the first period to vary in length, and then determining when the mixing coefficient in the second period became statistically non-significantly different from 1.0.
- A question was asked about recoveries in closed areas? A conclusion (second bullet) was that no evidence for emigration of yellowtail to un-fished areas (however this bullet related to areas outside the three stock boundaries).
    - This bullet referred to the dome selectivity resulting from a closed area.
- Another question was asked about tag reporting in the case of discards? This would decrease the reporting rate.
    - It noted that they did receive tags from the scallop fleet, and that those recoveries were not only from observed trips.
    - Presenter also noted that only very small amounts of yellowtail flounder were retained in scallop fishery.

Supplementary Reply TOR 2: Butterworth, D.S. and R.A. Rademeyer. 2008. On Drawing Inferences Concerning Trends in Selectivity with Age from Tag-Recapture Information

Rapporteur: Liz Brooks

*Presentation Highlights*

The WP shows that the implications of dome shaped selectivity for tag recovery proportions as a function of age depend on whether the drop in selectivity at large age arises from a gear selection effect or is surrogating emigration. A simple extraction of summary statistics from tag-recapture data, including a measure of mean tag return time, is suggested to throw further light on the mechanisms actually in play for various stocks, as current high estimates of M from tagging studies may be consequences of failing to take account of emigration to outside the fishing area.

*Discussion on Supplementary Reply TOR 2*

- Presentation suggested that fish behavior, specifically swimming strength of older fish, could create a dome shape.
    - It was pointed out that if one extended the “strong swimming” argument further, one would expect eventually that selectivity of slow swimmers would continuously decrease availability of slow swimmers until you only have fast swimmers surviving.
- Presentation also suggested that emigration from the fishing grounds would make fish unavailable and could also generate a dome-shaped selectivity.
    - Reviewer asked about the fact that estimated migration rates were low (as a means of arguing against emigration masking selectivity). Presenter suggested that there could be some confounding between reporting rate and an emigration rate. There was

    - debate regarding mean time to recovery and confounding between emigration and reporting rate.
    - It was explained that this has been investigated (mean time between release and recapture) and that no age-specific differences could be found.
    - Presenter countered that mean time to recovery would also be low if emigration occurred.
- It was noted that the Miller et al. model incorporates the time specific info by modeling recaptures individually.
    - While the presenter's mathematics provides an informative check, the Miller model can incorporate these same sorts of features.
- It was interjected that these hypotheses don't sound biologically plausible for yellowtail.
    - Presenter agreed that *a priori* these hypotheses sound far more plausible for cod.
    - One still needs a hypothesis to explain the disappearance from both survey and fishery at 4-5 year olds.
    - It was suggested that a more credible explanation is a higher M on males from age 3 on.

Working Paper 2.4: Brooks, L., C. Legault, P. Nitschke, L. O'Brien, K. Sosebee. P. Rago and A. Seaver A. 2008. Evaluation of NMFS Toolbox Assessment Models on Simulated Groundfish Data Sets.

Rapporteur: Tim Miller

*Presentation Highlights*

A simulation study was performed to evaluate the performance of five NOAA Fisheries Toolbox assessment models (AIM, ASPIC, SCALE, VPA, and ASAP). Data sets corresponding to three representative groundfish stocks (Georges Bank yellowtail flounder, Georges Bank cod, and white hake) were simulated with PopSim, a simulation program in the Toolbox. For each simulated stock, a base case data set was produced as well as three data sets with a known error. There were 12 data sets in total (three stocks with four data sets each) and for each data set, 100 random realizations were generated with PopSim. Each model performed an "assessment" on the simulated datasets, and the results were compared with the "true" value (i.e., the known parameter values used to generate the data sets). Results for each model in each of the 12 cases were summarized with respect to bias and precision (CV). The base case served as a benchmark to determine how well each model could replicate the truth, and as a point of comparison for model performance on the data sets with known error. In general, no model was a clear winner in all cases. Data sets that reflected errors associated with sampling (aging error or number of length samples) were best handled by models that either did not use age (AIM) or models that incorporate error into catches (ASAP). The VPA, because it matches catch exactly, suffered the most bias and had the poorest precision in these cases. However, when the source of error introduced a "break" in the time series (as in all of the yellowtail flounder cases), none of the model configurations was robust to the effect. The "east coast" approach of tuning to age-specific survey indices appears to be robust to the shape of the selectivity function. In the case of misspecification of the fleet selectivity (assuming logistic when it is dome), both forward and backward projecting models were impacted, but the effect was only apparent at the oldest ages (as would be expected). ASPIC failed in all simulated data sets, but this was due to the nature of the simulated data (all of which were one-way trips), and not to deficiencies in the model.

*Discussion on Working Paper 2.4: Overview*

There were only a few clarifications on the generalities of the presentation before getting into the specific sections.

Working Paper 2.4: Brooks, L., C. Legault, P. Nitschke, L. O'Brien, K. Sosebee. P. Rago and A. Seaver A. 2008. Evaluation of NMFS Toolbox Assessment Models on Simulated Groundfish Data Sets. Section a on Georges Bank Yellowtail

Rapporteur: Tim Miller

*Discussion on Working Paper 2.4: Section a on Georges Bank Yellowtail*

In general, ASAP and VPA performed similarly with regard to bias and precision, but ASAP is somewhat more flexible. For Georges Bank Yellowtail, it was pointed out that other work that simulated data over longer time series showed bad fits of ASPIC as well.

One participant wondered whether the differences in the behaviors of the models was related to the weightings of different data components was the cause. It was pointed out that a simpler model like AIM would put zero weight on some data components. One panelist wondered whether changes in the signal could be picked up with the age-structured models, but the presenter pointed out that, while this is true, which data component was the cause would still be unknown. However, one reviewer pointed out that detecting these changes is more difficult with the simpler model AIM, but perhaps this could be modified to do so. It was also pointed out that the behavior of SCALE not being any better than other models was somewhat surprising since selectivity is set up as a function of length in POPSIM.

Working Paper 2.4: Brooks, L., C. Legault, P. Nitschke, L. O'Brien, K. Sosebee. P. Rago and A. Seaver A. 2008. Evaluation of NMFS Toolbox Assessment Models on Simulated Groundfish Data Sets. Section b on White Hake

Rapporteur: Ralph Mayo

*Discussion on Working Paper 2.4: Section b on White Hake*

Poor performance of AIM relative F estimates is likely to have been a re-scaling problem associated with conversion procedures used to back transform relative F to original units. Ageing error per se should not have an influence on AIM results since it uses pooled estimates of biomass.

Working Paper 2.4: Brooks, L., C. Legault, P. Nitschke, L. O'Brien, K. Sosebee. P. Rago and A. Seaver A. 2008. Evaluation of NMFS Toolbox Assessment Models on Simulated Groundfish Data Sets. Section c on Georges Bank Cod

Rapporteur: Jessica Blaylock

*Discussion on Working Paper 2.4: Section c on Georges Bank Cod*

Some clarification was provided as to the plus group in this analysis (10), in relation to the dome selectivity pattern.

There was discussion concerning why ASAP did not do better with the fleet domed PR. This was because a single logistic growth was estimated, so the flat-topped pattern was forced. This was accepted to be an important question, and that one should also look at the confidence intervals in this context.

## Recommendations on Model Selection for each stock

Working Paper 5.1: Rago P, et al. 2008. Recommended Modeling Approaches by Stock Initial Proposals for Consideration by the GARM III Review Panel.

Rapporteurs: Mike Palmer and Kathy Sosebee

*Presentation Highlights*

This Working Paper provides a review of initial recommendations of anaylsts for preferred assessment models. The appropriate assessment model for each stock is influenced by attributes of the species and their fisheries, and the ability of the model to capture the salient features of the stock dynamics. A primary consideration is the availability of age data. Before 1995 the selection of models for Northeast groundfish was less complicated because fishing mortality greatly exceeded natural mortality and incoming cohorts were quickly fished out. Various management measures reduced fishing mortality and altered the spatial pattern of fisheries. In particular, large closed areas on Georges Bank differentially affected more sedentary species which would benefit from the reductions in F afforded those fish which remained in closed areas. Increases in abundance for some stocks such as Georges Bank yellowtail flounder and haddock were dramatic. As population age structure broadened, the importance of model features such as plus groups became more important as the number of ages in the plus group increased. Model assumptions that were tenable under high F became less so with reduced F. This has motivated the exploration of a class of forward projecting models that allow greater flexibility for characterizing recent trends and extension of assessments back to periods when landings were much greater.

Individual stock dynamics were summarized with six-panel plots that illustrate the relationships among survey abundance, catches, relative F and replacement ratios. High correlations between the replacement ratio and relative F suggest that the population's rate of growth is responsive to the rate of removal. In turn this suggests that parametric models may be applicable. Disparities that arise at the end of a time series are also important and may be indicative of process changes that lead to retrospective patterns.

These recommendations herein will be reconsidered during the meeting as the results of alternative models and simulation tests are reviewed by the Review Panel.

Two appendices were included. The first examined statistical properties (mean, CV, Gini indices, and estimated design effect) of the NEFSC fishery-independent bottom trawl surveys. The second provided an overview of the AIM (An Index Method) model and an example application.

Working Paper 6.1: Rago P, et al. 2008. Sufficiency of Assessment Models to Estimate Measures of Stock Status Relevant to Biological Reference Points

*Presentation Highlights*

The definition of Biological Reference Points (BRP) for fish stock is an essential component of stock assessment. Measures of abundance and harvest rates derived from assessment models are compared to standards that constitute desirable states for each stock. These states are designed to achieve maximum sustainable yield and may include some consideration of uncertainty in estimation. For stocks that are subject to mandatory rebuilding programs, the assessment model must produce outputs that can be forecast under various harvest scenarios. This working paper summarizes the basic approaches for estimation of BRPs associated with the candidate models and highlights special considerations associated with reference point estimation.

Biological reference points can be derived as part of the model identification and estimation process. These can be called internal estimates of BRPs as they rely on specification of stock recruitment relationship within the assessment model. The derived parameters can either be used to directly define reference points or, where analytical solutions are more complicated, to parameterize simulation or forecasting models to derive BRPs and measures of uncertainty. Internal estimates are advantageous since they incorporate the full uncertainty of the model estimation. This can also be a disadvantage when the model does not fit particularly well. In these cases, the BRPs can be unstable, varying with minor changes in model configuration.

"External" estimators of BRPs use model outputs of abundance, SSB, recruits and fishing mortality as inputs to stand-alone models. In the Northeast these include stock recruitment models (SRFIT), yield per recruit models (YPR), and stochastic population projection models (AGEPRO). The SRFIT program uses AIC methods to identify appropriate models from either Beverton-Holt or Ricker stock-recruitment models with and without correlated error terms. When an acceptable model can be defined, standard approaches can be used to estimate Fmsy and Bmsy values.

If none of the parametric models are acceptable, a nonparametric method is used to estimate proxy values for Fmsy and Bmsy. These proxies are derived by combining standard yield per recruit (YPR) and SSB per recruit (SSB/R) methods with model based estimates of absolute recruitment. Model parameters can be used to define appropriate partial recruitment vectors for YPR analyses leading to estimates of Fmax. Fmax serves as a proxy for Fmsy. SSB/R estimates for F=Fmax can be multiplied by some function of the recruitment time series to obtain an estimate of SSBmsy or Bmsy. The term "some function" can imply a simple mean of the recruitment series, a measure of central tendency, or a restricted . Consideration of ecosystem conditions, trends in other populations or evidence of environmental trends can be relevant. A simplified overview of the candidate models used for estimating stock status and their relationship to biological reference points is provided.

*Discussion on Working Papers 5.1 and 6.1(stocks ordered as per working paper 6.1)*

Georges Bank Cod

The Panel recommended inclusion of historical catch (back to 1930s) and surveys (back to 1963) in the calculation of biological reference points to provide additional information on stock productivity. Presence of the retrospective pattern in the VPA suggests that after 1995, there may have been changes in the fishery selectivity. There were major changes to the management structure (closed areas, mesh size) at this time which may explain these changes. The Panel felt that model formulations should be examined which investigated changes to the selectivity curve, particularly with regards to the older age classes in the recent time period (post 1995). No preference was given to whether changes in selectivity were examined in a VPA or SCAA model.

Georges Bank Haddock

The Panel recommended including catch (landings and discards) back to 1930's referring to the VPA performed on historical data in Clark et al., 1982. It was also recommended that model formulations be explored that consider changes in selectivity over time with a particular focus on the recent time period. A recommendation was made by the Panel to explore a domed shaped selectivity pattern though the specifics were not discussed. It was pointed out that recent changes in size at age will have ramifications on the calculation of the biological reference points. There was discussion on a parametric vs. nonparametric fitting of the stock recruit relationship, noting that a non-parametric approach was chosen the last time biological reference points for this stock were discussed (NEFSC, 2002b) which suggests that this may be required again. This requires exploration.

Georges Bank (GB), Southern New England -Mid-Atlantic (SNEMA) and Cape Cod- Gulf of Maine (CCGoM) Yellowtail Flounder

The Panel did not recommend any changes to the current Major-Change Georges Bank VPA model (split survey q's). This is the same model formulation accepted during the most recent TRAC benchmark review (TRAC, 2005). The Panel supported efforts to build on the current formulation of the model to resolve observed retrospective patterns. The Panel recommended splitting the time series for the SNEMA and CCGOM stocks to resolve observed retrospective patterns in these assessments. The suggested areas of exploration included (1) investigation of spatial differences in the survey selectivity and/or environmental covariates (temperature) which may explain changes; (2) partial recruitment of the plus-age groups (particularly with regards to the uncertainty in the catch-at-age of the SNE stock); (3) using selectivity blocks; (4) changes in productivity/regimes over time (particularly with regards to severe decline of SNEMA stock). There was some concern that the Major-Change model is not based on an accepted causative process but rather based upon removal of the retrospective pattern. The Panel felt that their responsibility was to recommend which models can be used to offer sound management advice. The Panel made no recommendations on whether explorations should be performed with ASAP or ADAPT which is a software choice based upon ease of use.

Gulf of Maine Cod

The panel discussed whether there was large error in the catch-at-age (CAA). Large recreational catch may result in larger than normal error in CAA. Inclusion of discards may also increase the error due to management actions (i.e. 30 lb trip limit in 1999). However, the coefficients of variation (CVs) on ages 3-5 in the landings are less than 10% while other ages are between 20 and 30%.

There is a weak and inconsistent retrospective pattern for this stock, although the formulation of VPA tends to produce some high fishing mortality (F) on certain ages.

It may be worth changing the assumption on F at oldest age to explore dome-shaped partial recruitment. If a dome appears, a hypothesis is needed to explain the domed selectivity. It may be useful to conduct a risk analysis on the assumption of a dome when flat-topped and vice versa. It may also be useful to examine the tagging data for independent confirmation of a dome and it may be useful to extend the age composition to explore the dome hypothesis.

The Panel found no compelling reason to switch models other than extending the series of catch and survey back in time when reviewing biomass reference points. The landings data prior to the 1930s may not be useful since these data were prorated using stock splits which may or may not have been the most appropriate values. Even with VPA, stock size estimates may be hind-cast using survey data back to 1963 to develop reference points.

Formulation of stock-recruit relationship is important for reference points including whether the relationship is fit internal to the model or externally. The Ricker model provided a good fit but there are may be other issues such as the extreme peak in recruitment (1987 year class). The value for gamma ranged from 0.5 to somewhat over 1. The Panel recommended estimating reference points both externally and internally to examine if there is a difference or if either are appropriate.

### Witch Flounder

The Panel recommended exploring the reasons for the retrospective pattern that is seen in this stock. There are no compelling reasons to switch from VPA to SCAA unless this would make it easier to do the exploration.

### American Plaice

The Panel discussed the potential problem of combining the data for the Gulf of Maine and Georges Bank portions of the stock. If the relative proportion between the two areas is stable, it is not a problem to combine them. The Panel recommended examining the survey trends for the two areas separately. If the trends are similar, the assessor could continue with a single catch-at-age in either VPA or SCAA. If the trends are different, there is a need to separate the CAA into two areas. Since the discards may not be well-determined, it may be better to move to an SCAA but the separability assumption needs to be explored.

### Gulf of Maine Winter Flounder

The Panel recommended exploring the SCALE model since the year-classes which seem to track in the length composition do not appear to track in the age composition. There may be some smearing in the age-length keys. The sex ratio effect on the retrospective pattern was very slight if there were very strong differences between sexes. Something else appears to be causing the pattern. The Panel recommended examining implied fishing effort resulting from the model compared to reported effort in the area. There appear to be conflicting patterns between the recruitment time series and the biomass time series. A risk evaluation may be needed to choose between the consequences of believing one or the other.

### Southern New England Winter Flounder

The Panel recommended exploring the reason for the retrospective pattern. It appears that it may be a transient effect that may now be gone. If additional years of data do not make the retrospective pattern reappear, then nothing more is needed. If the pattern reappears, then the assessor should split the survey series at a reasonable time (e.g. 1994). It may be useful to examine if a robust likelihood might remove the retrospective pattern because some of the indices may be very influential as years in the retrospective analysis are dropped.

### Georges Bank winter flounder

The Panel recommended exploring age-based assessment with ASPIC as fall-back model. It felt that the stock is a candidate for a separable model (SCAA) due to the uncertainty in the CAA during the middle of the time series. However, without first examining results, it was not possible to assess the utility of this approach. The Panel recommended that one approach be chosen and if there are no problems observed then there is no need to explore an alternative approach.

### White Hake

The Panel recommended assessing white hake using the SCALE model. It was recognized that there exist problems differentiating between red and white hake in the commercial fishery, particularly with regards to discards. The Panel recommended that the speciation problem should be examined by using survey data to speciate small (< 60 cm) fish and calibrate these results with observer data. There is a potential for sexual dimorphism that may confound a SCALE model and this should be considered. The Panel recommended using all available information as SCALE allows tuning to age data. To ensure that a bridge exists from AIM to SCALE, the Panel recommended running SCALE on the existing data set.

### Pollock

The Panel recommended staying with AIM for the current assessment but to provide reasonable justification for selection of reference points. The Panel recommended exploring a state-space production model and examining recruitment variability. The desire for US / Canada scientific collaboration was noted, particularly on the stock assessment.

### Redfish

The Panel had questions on the current state of the fishery. It was clarified that there is currently no market. The historical market was driven by a few-centrally owned vessels and once these vessels left the fishery, they were not replaced. Current commercial groundfish gear does not catch sufficient fish to supply a market and there exists no small mesh targeted fishery. Use of an age-structured model was recommended based on strong evidence for infrequent large pulse recruitment which persists for decadal time periods. The major recommendations for model formulation were to relax separable assumptions and use a S / R steepness estimate from west coast species (e.g., Pacific ocean perch), allow $\sigma_R$ to vary (and go large), but make $\sigma_R$ small where data are uncertain. The Panel expressed a desire to see an SCAA run performed as a check of the current RED model. An additional suggestion was to investigate an externally derived surplus production model (e.g., Jacobson approach).

Ocean pout

The Panel recommended exploring other models that consider uncertainty in the relative F (e.g., Glazer, 2008) and/or better incorporate available biological information on the species life history parameters such as a Bayesian biomass dynamics model or catch-at-age model with fixed parameters. It was felt that these approaches could be useful in providing management advice. Sufficiency of available age data upon which to construct a growth relationship to support the later recommendation should be explored.

Gulf of Maine / Georges Bank (GOM/GB) and SNE / MA Windowpane Flounder

Discards are important for both stocks. The Panel recommended exploring the use of SCAA in a Collie-Sissenwine formulation as the assessment model, particularly for the GOM/GB stock as AIM is problematic. For SNE/MA windowpane flounder, AIM is an acceptable model.

Gulf of Maine Haddock

The Panel recommended exploring an age-structured model if time permits. Otherwise, AIM is acceptable. The Panel recommended exploring the spatial distribution of the catch and the surveys to determine if the high values of landings and survey catches may be spillover from the Great South Channel area. This may affect the perception of the productivity of this stock. There appears to be a difference in survey selectivity between fall and spring possibly due to large fish spawning in the spring in areas not sampled by the spring survey.

Halibut

The Panel recommended extending the model to fit to the survey trend and input of a productivity parameter and landings prior to 1893. This probably should be assessed with the Canadian coastal stock of halibut as tagging studies have shown large migrations to Canadian waters.

## Appendix 8. Glossary of Terms

| Term | Definition |
|---|---|
| Age-structured Models | Class of assessment models which incorporates age and sometimes size information into the estimation of stock status |
| Biomass Pool Models | Class of assessment model which does not consider the age structure of a stock but rather describes the relationship between its standing biomass, changes in this due to losses (natural mortality) and additions (recruitment and growth) and yield. The ASPIC software package is commonly used for these models. |
| Catchability | The parameter (q) relating an index of abundance (e.g. survey) to the stock abundance or $I = q N$. It is thus a measure of the survey's ability to sample the stock. Generally, the higher the parameter q, the more 'catchable' the fish. The catchability can be either of a group of ages or specific to a defined age e.g. survey catchability at age 5. Typically, changes in q are considered over time while changes in q over age are synonymous with selectivity (a combination of gear vulnerability and availability). |
| Relative Trends models | Class of assessment model which does not include a parameter for catchability (q) and thus only describes relative as opposed to absolute trends in stock size and fishing mortality. The terms 'index-based' and an 'index method' (AIM) have been used for these models although most assessment models use indices. |
| Partial Recruitment (PR) | The degree of availability of a stock's age or size group to fishing with one time period on a zero to one scale. Thus a PR of 1.0 for age 5 fish indicates that all age 5 fish are available to being caught – they are 'fully recruited' to the fishery. A PR of 0.5 for age 5 fish indicates that this year – class is only 'partially recruited' to the fishery as only 50% are available to being caught. PR, sometimes called selectivity, is a function of gear vulnerability and availability. |
| Plus group | Aggregation of data on year classes above a specific age into one grouping. For instance, an age five plus group indicates that the data (e.g. population or catch numbers) on all age five and older fish are aggregated into this group. |
| Retrospective Pattern | Systematic under - or over – estimation of stock related parameters (typically abundance, biomass and fishing mortality) produced by assessments as additional years of data are added. For instance, an assessment in 2003 might estimate the 2003 fishing mortality to be 0.4 while the assessment in 2008 might estimate the now historical fishing mortality to be 0.8. This under-estimation of fishing mortality by the assessment model, if systematically consistent, is termed a retrospective pattern. |
| Risk Assessment | Formal process which uses the impact of an hypothesis and the probability of this hypothesis to measure the risk of specified objectives not being met. |
| Selectivity | The degree of availability of an age or size group of fish to a survey or fishing. When scaled to the group fully selected, this and the partial recruitment are equivalent. |

| | |
|---|---|
| Selectivity blocks | Blocks of years in assessment tables in which the selectivity at age is considered to be the same for all years. Validity of the ‘Separable Assumption’ is a key feature of the sub-class of assessment models which allows error in the catch-at-age (e.g. SCAA) |
| Separable assumption | The fishing mortality on an age or size group is considered to be the product of two terms – one age and the other time (typically year) related. The fishing mortality is ‘separable’ into an age and time effect. This assumption is typically employed in the class of assessment models which allow errors in the catch-at-age (e.g. SCAA). |
| Statistical Catch-at-age (SCAA) | Assessment model which allow errors in the catch-at-age. Using values on stock abundance at some age for each year class, and fishing mortality derived from a separable assumption for specified selectivity blocks, calculates population abundance at age. Comparisons between predicted and observed catch-at-age and abundance indices are made for model fitting. ASAP and SCALE are software packages which allow exploration of this sub-class of model. |
| Stock - recruitment Relationship (S/R) | Relationship between a stock’s spawning biomass and the ensuing recruitment. Two of the most widely assumed S/R relationships are that of Beverton & Holt and Ricker. They differ in the degree of density dependence assumed occurring in the stock, with the latter having a stronger negative relationship between density dependence and stock size. |
| Virtual Population Analysis (VPA) And Cohort Analysis (CA) | Assessment models which assume negligible error in the catch-at-age. Using values on stock abundance at some age for each year class and the observed catch-at-age, calculates population abundance at age. Comparisons between predicted and observed abundance indices are made for model fitting. VPA and CA differ by the precise form of the calculating catch equation. ADAPT is a software package used to implement VPA. |

# Panel Summary Report
# of the
# Groundfish Assessment Review Meeting
# (GARM III)

## Part 3. Biological Reference Points

**By**
**Chairman: Robert O'Boyle**
**Review Panel: Michael Bell, Stratis Gavaris, Vivian Haist, Stuart Reeves and Grant Thompson**

**Including Presentation Highlights for each Working Paper written by the lead Assessment Scientists**

**Report Date: 6 June 2008**

**Meeting Dates and Location:**
**28 April – 2 May 2008**
**Northeast Fisheries Science Center**
**Stephen H. Clark Conference Room**
**Woods Hole, Massachusetts**

# TABLE OF CONTENTS

# SUMMARY

The Biological Reference Points which will be used in the assessments and rebuilding plans of 19 New England groundfish stocks being considered in the 2008 Groundfish Review Assessment Meetings (GARM) were reviewed at the Northeast Fisheries Science Center in Woods Hole, Massachusetts during 28 April – 2 May 2008. The review considered the influence of retrospective patterns in parameter estimates (e.g. fishing mortality, biomass, and/or recruitment) from assessment models on the computation of biological reference points and on the specification of initial conditions for forecasting. It also considered recent and historical trends in the productivity of each stock, including trends in pertinent environmental variables that might be related to the trends in those biological parameters relevant to the biological reference points. In relation to the latter, the review considered the overall production potential of the fishery based on food chain processes and commented on aggregate single stock yield projections in relation to overall ecosystem production. The majority of the review focused on updating or redefining the fishing mortality and biomass threshold reference points or proxies for each of the 19 stocks.

This was the third meeting of a four part process, the first being on data inputs (29 October – 2 November 2007), and the second on assessment models (25 – 29 February 2008). These three meetings will inform the review of the assessments to be undertaken during 4 – 8 August 2008. The GARM process has been designed so that each review can inform subsequent ones.

The body of this report consists of the recommendations of a six member review panel in response to the meeting's terms of reference. The report also includes a synopsis of each of the working papers presented at the meeting along with the associated discussion, during which suggestions and recommendations were made to address identified issues. The Panel considered these in drafting this report.

Overall, the meeting generally fulfilled its terms of reference and represents an important contribution to the GARM III process.

# INTRODUCTION

This document is the summary report of the review Panel (herein termed the 'Panel') of the Groundfish Assessment Review Meeting (GARM) on biological reference points (BRPs). The GARM is a regional scientific peer review process developed in 2002 to provide assessments for the stocks managed under the Northeast Multispecies Fishery Management Plan (Multispecies FMP). The first two GARMs took place in October 2002 (NEFSC, 2002a) and August 2005 (NEFSC, 2005) respectively. This GARM III is the most comprehensive to date, intended to provide peer reviewed assessments on 19 groundfish stocks managed by the New England Fisheries Management Council (NEFMC).

The four meetings of GARM III include:

- Data Inputs (29 Oct – 2 Nov 2007)
- Assessment Methodology (25 – 29 Feb 2008)
- Biological Reference Points (28 April – 2 May 2008)
- Assessments (4 – 8 August 2008)

The first three meetings are to establish the analytical formulations of the assessments to be used in the last meeting. The first meeting (NEFSC, 2007) focused on the data inputs (e.g. catch, sampling, surveys, etc) to be used in the assessments. The second meeting considered the assessment approaches to be applied to the datasets of each stock discussed at the first meeting. The third meeting, which is the focus of this report, focused on the fishing mortality and biomass biological reference points (BRPs) to be used in the assessments and rebuilding plans of the 19 GARM III stocks (see Terms of Reference, appendix 1). The meeting also considered the influence of retrospective patterns in parameter estimates from the assessment models on the computation of the BRPs and on the specification of initial conditions for forecasting. It considered recent and historical trends in the productivity of each stock, including trends in pertinent environmental variables that might be related to the trends in those biological parameters relevant to the biological reference points. In relation to the latter, the review considered the overall production potential of the fishery based on food chain processes, estimated the aggregate yield from the ecosystem and commented on aggregate single stock yield projections in relation to overall ecosystem production.

After introductions (see meeting participants, appendix 2) on Monday morning, the meeting started (see agenda, appendix 3) with an overview of the methods and estimates of the current BRPs. Stochastic simulation in rebuilding projections and the consequences of these for BRPs was then discussed. This was followed by consideration of the working papers to address terms of reference 2 (trends in stock productivity). Much of the Monday afternoon was devoted to consideration of the working papers for Terms of Reference 3 (ecosystem approaches) with the day ending with discussion on two working papers on specific aspects of Terms of Reference 4. On Tuesday morning, working papers on terms of reference 1 (influence of retrospective patterns) were first considered with the rest of the meeting until Thursday afternoon devoted to terms of reference 4 (BRPs by stock). No working papers were explicitly devoted to addressing Terms of Reference 5 (forecasting models). On Friday, the Panel held a closed session on the contents of its report. The GARM review Panel consisted of Mike Bell, Vivian Haist, Stuart Reeves, Stratis Gavaris, Grant Thompson and the chair, Robert O'Boyle. The first three reviewers were assigned to the review by the national Center of Independent Experts (see statement of work for these CIE reviewers in appendix 4) while the last three were invited by the Northeast Fisheries Science Center (NEFSC). All were invited based upon their extensive expertise and experience with the issues considered by the meeting.

The presentation highlights of each working paper (appendix 5) and the ensuing discussion as recorded by assigned rapporteurs are provided in appendix 6. These were important reference material to the Panel in drafting its report.

The focus of the meeting's review was the BRPs for each of the 19 groundfish stocks. No attempt was made to review the status of the 19 stocks, which are the terms of reference of the August GARM, although the results from models to assess status are used in models to derive BRPs. The meeting often considered a range of models and made recommendations that could result in changes to the BRPs to be considered at the August GARM review. The review focused its attention on fishing mortality and biomass MSY reference points and their proxies.

## PANEL RESPONSE ON TERMS OF REFERENCE

### ToR 1. Influence of retrospective patterns on the computation of BRPs and on specification of initial conditions for forecasting

Retrospective patterns in assessment results may be caused by an unrecorded change in catches, a change in natural mortality, a change in the abundance index catchability (q) and/or a change in fishery selectivity. To properly account for a retrospective pattern, it is necessary to know the cause. The Panel recommends that plausible hypotheses about the cause of a retrospective be investigated and an adjustment to account for the retrospective should be made if possible. There may be cases however, where an acceptable adjustment cannot be made, leaving assessment results that display retrospective patterns of a magnitude that is consequential.

There is currently no generally agreed methodological approach that can be used to develop a basis for management advice that accounts for a retrospective pattern in the assessment results. The Panel reviewed analyses that addressed only the latter aspect of terms of reference one (methods for adjusting initial conditions for forecasting when the stock assessment exhibits a retrospective pattern). Two approaches were considered

- adjust the fishing mortality (F) in the quota year by the amount of retrospective seen in the F and
- adjust the initial population to account for the retrospective pattern seen in the population numbers

The latter approach has more merit, is easily implemented and can be applicable for evaluation of rebuilding scenarios, and therefore it was favored by the Panel. While it may be imprudent to adjust for a retrospective pattern without having determined the cause(s), basing management advice on assessment results that display a retrospective pattern implicitly assumes that the terminal estimates are in error whilst the calculated values back in time are correct.

In relation to the determination of stock status, in cases where an acceptable adjustment to the assessment model cannot be made (leaving assessment results that display retrospective patterns of a magnitude that is consequential), the Panel recommends the following practice:

- adopt the default that the terminal estimates are in error whilst the calculated values back in time are correct
- check the age specific retrospective patterns to determine the age range where the magnitude is consequential
- adjust the population numbers for the terminal year of the Virtual Population Analysis (VPA) (initial year of the projection) to account for the retrospective pattern seen in the population numbers
- conduct projections using the adjusted population numbers

The burden of proof is placed on the analyst to demonstrate that an alternative practice performs better. Further, it is suggested that performance against the rebuilding trajectory be checked more frequently for stocks that display a consequential retrospective.

While there were no specific analyses on the influence of retrospective patterns in assessment results for the computation of BRPs, results were presented for several stocks using both models that displayed a retrospective and models that used ‘split’ survey indices to account for the retrospective. Most of these models used a VPA, but not all. In general, the patterns in the stock - recruitment relationships were not altered greatly by the adjustments made to account for the retrospective pattern.

Thus, in relation to the derivation of BRPs, in cases where an acceptable adjustment to the assessment model cannot be made (leaving assessment results that display retrospective patterns of a magnitude that is consequential), the Panel recommends that corrective measures do not have to be taken for the computation of BRPs.

## ToR 2. Trends in Stock Productivity

A majority of the GARM III stocks show appreciable trends in recent growth (length- and weight-at-age) and maturation, with a general trend towards reduced growth and delayed maturation. The relative influence of density-dependent and environmental factors on these life history characteristics has not been assessed; compilation of a number of environmental variables for GARM III will facilitate further work in this area, possibly with a meta-analysis approach to increase statistical power.

For most GARM III stocks, BRPs were calculated using the mean of the most recent five years for weights-at-age, partial recruitment (fishery selectivity), and maturity ogive. Where there were no long-term trends in some of these parameters (most commonly the maturity at age), the whole time series was used. These should provide the best estimates of short to medium term stock productivity, and are therefore appropriate for BRP calculations. For stocks that exhibit strong recent trends (eg. GB haddock weight-at-age) the five year averages may not be appropriate for stock projections or rebuilding scenarios. For those cases, the most recent estimates or forward projection of the trends may provide more accurate estimates of future (short-term) life history parameters.

For the GARM III stocks, the recruitment series used to calculate BRPs were selected to reflect the long-term stock productivity. A number of the stocks exhibit poor recruitment and low spawning stock abundance in recent years, and it is unclear if the reduced recruitment is caused by environmental or stock conditions. If lower recruitment is the result of a shift in environmental conditions which persists, BRPs calculated based on higher average recruitment levels may be unattainable. However, the burden of proof must lie on demonstrating that recent lower average recruitment is related to environmental changes rather than low spawning stock abundance, before adjustments are made to BRPs.

Stock projections and rebuilding scenarios should use the same recruitment assumptions as used in calculating BRPs. However, environmental or depensatory stock-recruitment effects may imply that short-term rebuilding targets are unattainable even with no or little fishing pressure.

## ToR 3. Ecosystem Approaches to Gulf of Maine / Georges Bank Fisheries

The Panel noted the following key conclusions from the five working papers presented:

*WP3.1* (worldwide cross-system comparison): "Results from this study suggest that on an ecosystem basis, current biomass management targets ($B_{MSY}$) for GARM, pelagic, and elasmobranch fishes are not unreasonable. The current targets compare favorably with the results of current and historical studies in the region and are also in general agreement with results of many studies for other worldwide ecosystems."

*WP 3.2* (energy budget contextualization): "It is unclear if $B_{MSY}$ for all species will be energy limited from a systemic perspective…. We conclude that this method and the results from it, although interesting, remain inconclusive to answer the primary question. That is, although we may have achieved balance of the network, some structural caveats and misunderstandings of this modeling package likely remain on our part."

*WP 3.3* (aggregate surplus production estimation): "Overall the results from both surplus production modeling approaches suggest that the expected aggregate yield is lower, the $B_{MSY}$ biomass is lower and the overall fishing mortality rate should be lower for the GARM stocks as a whole than is suggested from the single species results."

*WP 3.4* (aggregate and multi-species production simulation): "With respect to the main question at hand — can we have all species at $B_{MSY}$ simultaneously?— these results imply that we may not. Particularly as seen in the differential fishing scenario, it is possible to have all members of a group at or close to their K (and by extension $B_{MSY}$), but likely not all groups at that level (K or K/2) simultaneously…. Additionally, the aggregate scenarios produce more conservative results than the MS (i.e. multispecies) simulations, implying that there may be some systemic or model structural limitations in the aggregate that are more fully captured than when a more species-specific approach is employed…. The main point of this work is to emphasize the importance of including species interactions…. Often harvest was the lowest source of fish 'loss' compared to species interactions."

*WP 3.5* (fishery production potential): "If we take a mean trophic level of the catch of 3.2 and a 30% exploitation rate, then the MSY levels in the partial accounting above comprise 83% of the estimated production potential…. These estimates do not include allowance for landings of species not included in partial accounting above. Nor do they include discard levels for all species. This suggests that the available demand will be exceeded in both cases when these considerations are taken into account…. Despite the drop in primary production required over the last two decades, the concomitant drop in mean trophic level results in an overfished classification in 2005."

These observations and the discussions at the meeting led the Panel to the conclusions below relevant to Terms of Reference 3.

### a. Determine the production potential of the fishery based on food chain processes and estimate the aggregate yield from the ecosystem

The working papers provided a range of estimates of fishery production potential (MSY in kt):

| **WP (model)** | **GARM species** | **Pelagic species** | **Elasmobranchs** | **Total** |
|---|---|---|---|---|
| 3.1 | 197 | 354 | 18 | 569 |
| 3.3 (group ASPIC) | 126 | 422 | 59 | 607 |
| 3.3 (aggregated ASPIC) | n/a | n/a | n/a | 579 |
| 3.3 (multi-species) | 110-125 | 363-445 | n/a | 473-570 |
| 3.5 | n/a | n/a | n/a | 1,550-1,855 |

The Panel considers that the working papers represent a commendable effort on the part of NEFSC scientists and that the success of this effort in producing the above estimates is evidence of the utility of the methods used. However, the Panel also agrees with the caveats provided in the working papers and therefore suggests that the above estimates be viewed as preliminary, pending the results of further investigations which the authors have proposed to conduct.

### b. Comment on aggregate single stock yield projections in relation to overall ecosystem production, identifying potential inconsistencies between the two approaches

The working papers provide evidence in support of multiple, and occasionally conflicting, hypotheses regarding the relationships between estimates produced by single-species and multi-species or aggregated models. For example, WP3.1 found that estimates of $B_{MSY}$ obtained from single-species models were generally concordant with estimates obtained by cross-system comparisons; whereas WP3.2 found the results to be inconclusive; WP3.3, WP3.4, and WP3.5 found that the ecosystem is unlikely to be able to sustain all stocks at their single-species BMSY levels simultaneously. However, the authors of these working papers generally feel that "the aggregate production model results for GARM species are the elements most immediately applicable for evaluating GARM species reference points from a multispecies/ecosystem perspective". The aggregate production model for the GARM species provided in these working papers results in an aggregate $B_{MSY}$ estimate that is about one-half the value obtained by summing the estimates from species-specific production models, while the aggregate MSY is about two-thirds the value obtained by summing the estimates from species-specific production models. The aggregate $F_{MSY}$ estimate (0.17) is also indicated to be lower than most estimates from single-species models, although the comparability of FMSY values from production models and age-structured models is not clear, due to the effects of partial recruitment (selectivity) and it is based on a biomass rather than a numbers currency.

As with TOR 3a, the Panel considers that the working papers represent a commendable effort on the part of NEFSC scientists and that the success of this effort in producing the above estimates is evidence of the utility of the methods used. Most of the results seem to suggest that current estimates of $B_{MSY}$ are too high. Although the Panel believes that these results are too preliminary to implement at the present time, a precautionary approach would suggest that further research be encouraged and expedited to determine if this finding is correct. The authors have proposed to conduct such research, and the Panel endorses this proposal. In particular, the Panel suggests that future research should involve a formal Management Strategy Evaluation, including consideration of statistical uncertainty. Given that most of the working papers seem to indicate that the sum of single-species $B_{MSY}$ levels cannot be sustained, and given that most of the GARM III stocks are currently somewhat below $B_{MSY}$, another aspect of the question meriting further investigation concerns the mechanism(s) by which the ecosystem was able to support pre-overexploitation levels of biomass for the GARM III stocks in the first place.

## ToR 4. Biological Reference Points by Stock

### General Considerations

#### *Overfishing and Overfished Biological Reference Points*

For the management of the GARM III stocks, status determination with respect to overfishing and overfished is evaluated using $F_{MSY}$ or its proxy and $B_{MSY}$ or its proxy respectively. If a stock is determined to be overfished, a rebuilding fishing mortality (F) must be specified that achieves a 50% chance or greater that spawning stock biomass (SSB) will exceed $B_{MSY}$ in the prescribed time frame. Fishing at $F_{MSY}$ will not necessarily result in a 50% chance that equilibrium SSB will exceed $B_{MSY}$ if the error distributions for stochastic processes are not symmetric. This observation has led to a perceived inconsistency. This perceived inconsistency was addressed in the working papers by adopting a particular estimator of $B_{MSY}$ based on stochastic long-term projections with the recruitment stream feeding into the projection empirically by resampling from all or a subset of the observed recruitments, or parametrically by putting lognormal error on the predicted recruitment at $F_{MSY}$. This procedure (herein termed 'stochastic projection') was used for determining the biomass reference points of the 19 GARM III stocks under review. The estimator of $B_{MSY}$ adopted in the working papers was the median long-term SSB obtained when the stock is fished at the deterministic estimate of $F_{MSY}$. In some cases, the resulting estimates of $B_{MSY}$ were greater than the deterministic estimate of $B_{MSY}$, by varying amounts, while in others, the resulting estimate of $B_{MSY}$ was less than the deterministic estimate. While addressing the perceived inconsistency, the Panel notes the following complications with the procedure:

- Federal Guidelines for National Standard 1 under the Magnuson-Stevens Fishery Conservation and Management Act (Restrepo et al., 1998) explicitly define $F_{MSY}$ as the constant F that maximizes long-term average (not median) yield and $B_{MSY}$ as the long-term average (not median) stock size when the stock is fished at $F_{MSY}$. While the Guidelines allow for the use of proxies in cases where information is insufficient to estimate the quantities contained in the definitions directly, the Panel wondered whether changing the biomass BRPs from "average" to "median" might pose a difficulty in terms of compliance, given that estimation of the average does not require any more information than estimation of the median.

- The stochastic projection may place high reliance on the dispersion of an empirical cumulative frequency distribution that is based on few observations. Characterizing dispersion is generally more demanding than characterizing central tendency. For the parametric approach, it is necessary to assume a distributional form for the errors, typically lognormal, and the results are sensitive to the reliability of the estimate of the variance for this distribution. This complicates interpretation of the $B_{MSY}$ proxy and may be contentious.
- When no parametric model of the stock-recruitment relationship is considered suitable for BRP estimation (as was the case for all or nearly all of the GARM III stocks reviewed), mean SSB is straightforward to compute, being simply the product of average recruitment and SSB/R. Moreover, in the case where the recruitment distribution is lognormal, the ratio between stochastic $B_{MSY}$ and deterministic $B_{MSY}$ is straightforward, being exp ($\sigma^2/2$). Computation of median SSB, on the other hand, requires stochastic projection as described in working paper 4.2 (AGEPRO), and there is no simple formula for the ratio between stochastic $B_{MSY}$ and deterministic $B_{MSY}$.

The Panel noted that, when no estimate of the stock-recruitment relationship is available and the recruitment distribution is lognormal, simulations indicate that the median SSB is typically very close to, albeit less than, the mean SSB. This suggests that the estimates of $B_{MSY}$ provided herein are, for the most part, likely to be close to the estimates that would have been obtained had the mean been used rather than the median.

The Panel therefore decided to accept the estimates of $B_{MSY}$ provided by the stochastic projections, but suggested that the NEFSC consider the following alternatives when preparing the final assessments:

- Estimate $B_{MSY}$ by the mean rather than the median; and
- In cases where an estimate of the stock-recruitment relationship is available, estimate $F_{MSY}$ by maximizing the long-term average yield rather than the long-term deterministic yield.

### *The Spawning Stock Biomass – Recruitment Relationship and Estimation of BRPs*

The specification of $F_{MSY}$ and $B_{MSY}$ relies on a stock recruitment relationship. In making recommendations for reference points of $F_{MSY}$ or its proxy and $B_{MSY}$ or its proxy, the Panel adopted the following procedure as the default:

- If the recruitment and spawning stock biomass derived from the assessments are informative about a relationship, the Panel recommended use of the stock-recruitment relationship to compute $F_{MSY}$ and $B_{MSY}$ using the parametric projection approach (herein termed the 'parametric' approach)

- If the recruitment and spawning stock biomass derived from the assessments are not informative about a relationship, the Panel recommended use of $F_{40\%MSP}$ as a proxy for $F_{MSY}$ (NEFSC, 2002) and a $B_{MSY}$ proxy computed using the stochastic projection approach (herein termed the 'non-parametric' approach)

The burden of proof was placed on the analyst to demonstrate that an alternative approach to that used by the Panel is more appropriate. Unfortunately, the recruitment and spawning stock biomass derived from most assessments did not display compelling support for any particular functional form of stock recruitment relationship and parameters are generally poorly determined. Therefore, the non-parametric approach was generally adopted. This required inspection of the stock – recruitment relationship to choose the stream of recruitment for the stochastic projection. Specifically, it required a decision on whether or not there was a spawning stock biomass (herein termed 'breakpoint') below which recruitment would be diminished. It also required determination of whether or not exceptionally large year-classes occurred which were unrelated to the size of the spawning stock biomass. In these cases, recruitment may be due to some other, perhaps environmental, process. To choose the recruitment stream for the non-parametric stochastic projections, the Panel initially visually inspected the stock – recruitment relationship to determine the breakpoint SSB and then undertook a more objective scan of the recruitment time series to identify the break point as that which minimized the residual variance after taking mean values either side of this break point ('razor analysis'). The latter resulted in some changes to the breakpoints identified through visual inspection.

On a related note, addressed previously in association with ToR 2, long-term productivity changes stimulated by broader ecosystem changes can influence the relationship between recruitment and spawning stock size. When the Panel considered the recruitment time series to use in the estimation of the BRPs, its choices were more related to data and model estimation issues than potential long-term changes in ecosystem and stock productivity. While the Panel admitted that changes may have occurred, firm evidence was required to suggest that BRPs have changed due to environmental factors rather than fishing impacts. If this could be demonstrated in the future, down- weighting of historical information in the estimation of the BRPs to better reflect productivity conditions both current and in the period of rebuilding would be appropriate.

### *Overview of Stock-by-Stock Biological Reference Points*

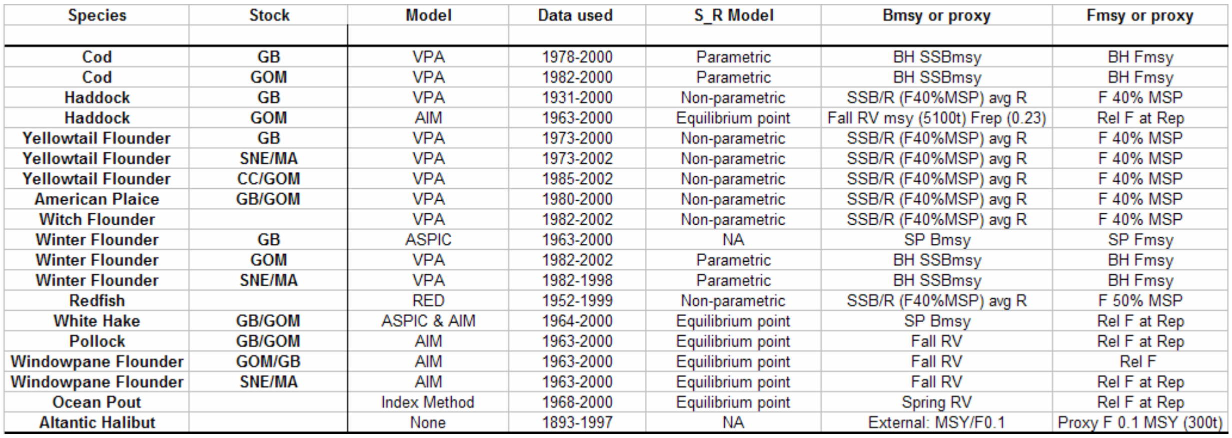
The models, data and analytical approaches used to estimate the current BRPs are provided in Table 1. Many of these were developed in reviews held in 1998 (NEFMC, 1998) and 2002 (NEFSC, 2002). Two things become evident in comparison with the models, data and approaches used to update the BRPs at this meeting. First, while some of the stocks originally had BRPs based upon index approaches (e.g. Gulf of Maine haddock), many of these are now based upon age-structured models. This was not possible in all cases (e.g. windowpane and Ocean pout) due to data and/or modeling constraints. Second, the data sets for some of the stocks were extended considerably back in time (1913 for redfish and 1893 for Atlantic halibut). Regarding the model of the stock-recruitment (S-R) relationship, as noted above, the Panel adopted a non-parametric approach for many of the stocks. Only in one case was a parametric approach taken (halibut). The non-parametric derived BRPs were generally based upon a fishing mortality at 40%MSP (except for redfish) which provided spawning stock biomass per recruit (SSB/R) and in turn, with the chosen recruitment time series (indicated for each stock below), provided the biomass target ($B_{MSY}$) and yield (MSY) reference points. For the index-based stocks, generally the Relative F - Replacement relationship was inspected for statistical significance and if deemed useful, the biomass reference point proxy was based on survey kg/tow for a period of time when the Replacement Ratio was equal or greater than one. The details on the process of identifying BRPs for these data-poor stocks can be found in the respective working papers of the meeting.

Table 2 provides a comparison of the current with the new BRPs developed at this meeting. Note that the biomass reference points are estimated using the stochastic projection approach noted above. On first glance, it will appear that many of the newly estimated biomass reference points are lower and the fishing mortality reference points higher. Unfortunately, one cannot make a direct one-to-one comparison between the old and new BRPs due to changes in weights and partial recruitment at age. If through a combination of low growth rates and management regulations, the fishery has increasingly exploited older individuals, one would expect, based upon yield per recruit considerations that the fishing mortality reference point would increase. The Panel noted that the communication of the GARM III BRPs by the NEFSC to managers and industry will require careful comparison of these with the current BRPs to ensure that the true nature and reasons for the changes are apparent.

Tables 1 and 2 refer only to the fishing mortality and biomass MSY reference points.

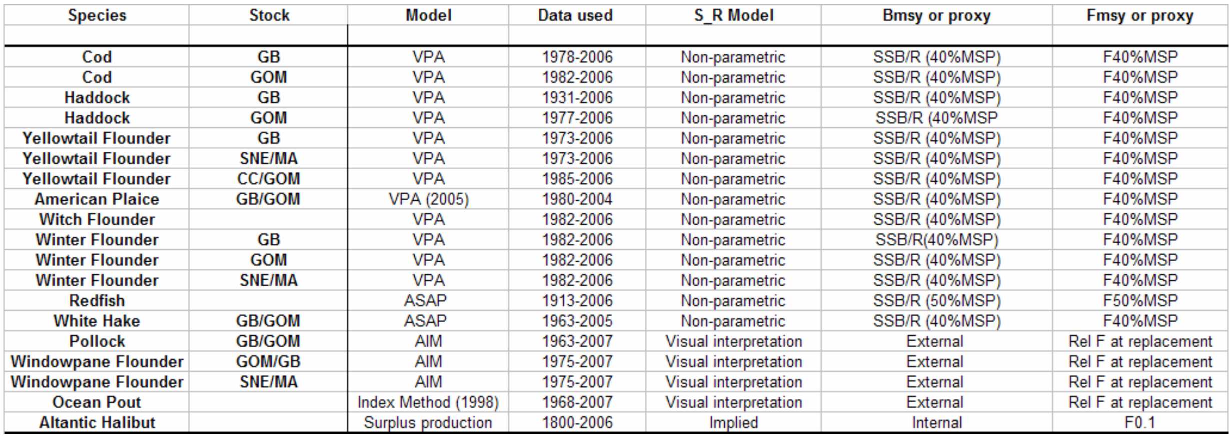
Table 1. Models, data and approaches used to estimate biological reference points both current and developed at the GARM III 'BRP' review; stock units are as per text and biomass units are in metric tons

## A. Current



| Species | Stock | Model | Data used | S_R Model | Bmsy or proxy | Fmsy or proxy |
|---|---|---|---|---|---|---|
| **Cod** | **GB** | VPA | 1978-2000 | Parametric | BH SSBmsy | BH Fmsy |
| **Cod** | **GOM** | VPA | 1982-2000 | Parametric | BH SSBmsy | BH Fmsy |
| **Haddock** | **GB** | VPA | 1931-2000 | Non-parametric | SSB/R (F40%MSP) avg R | F 40% MSP |
| **Haddock** | **GOM** | AIM | 1963-2000 | Equilibrium point | Fall RV msy (5100t) Frep (0.23) | Rel F at Rep |
| **Yellowtail Flounder** | **GB** | VPA | 1973-2000 | Non-parametric | SSB/R (F40%MSP) avg R | F 40% MSP |
| **Yellowtail Flounder** | **SNE/MA** | VPA | 1973-2002 | Non-parametric | SSB/R (F40%MSP) avg R | F 40% MSP |
| **Yellowtail Flounder** | **CC/GOM** | VPA | 1985-2002 | Non-parametric | SSB/R (F40%MSP) avg R | F 40% MSP |
| **American Plaice** | **GB/GOM** | VPA | 1980-2000 | Non-parametric | SSB/R (F40%MSP) avg R | F 40% MSP |
| **Witch Flounder** | | VPA | 1982-2002 | Non-parametric | SSB/R (F40%MSP) avg R | F 40% MSP |
| **Winter Flounder** | **GB** | ASPIC | 1963-2000 | NA | SP Bmsy | SP Fmsy |
| **Winter Flounder** | **GOM** | VPA | 1982-2002 | Parametric | BH SSBmsy | BH Fmsy |
| **Winter Flounder** | **SNE/MA** | VPA | 1982-1998 | Parametric | BH SSBmsy | BH Fmsy |
| **Redfish** | | RED | 1952-1999 | Non-parametric | SSB/R (F40%MSP) avg R | F 50% MSP |
| **White Hake** | **GB/GOM** | ASPIC & AIM | 1964-2000 | Equilibrium point | SP Bmsy | Rel F at Rep |
| **Pollock** | **GB/GOM** | AIM | 1963-2000 | Equilibrium point | Fall RV | Rel F at Rep |
| **Windowpane Flounder** | **GOM/GB** | AIM | 1963-2000 | Equilibrium point | Fall RV | Rel F |
| **Windowpane Flounder** | **SNE/MA** | AIM | 1963-2000 | Equilibrium point | Fall RV | Rel F at Rep |
| **Ocean Pout** | | Index Method | 1968-2000 | Equilibrium point | Spring RV | Rel F at Rep |
| **Altantic Halibut** | | None | 1893-1997 | NA | External: MSY/F0.1 | Proxy F 0.1 MSY (300t) |

## B. GARM III



| Species | Stock | Model | Data used | S_R Model | Bmsy or proxy | Fmsy or proxy |
|---|---|---|---|---|---|---|
| **Cod** | **GB** | VPA | 1978-2006 | Non-parametric | SSB/R (40%MSP) | F40%MSP |
| **Cod** | **GOM** | VPA | 1982-2006 | Non-parametric | SSB/R (40%MSP) | F40%MSP |
| **Haddock** | **GB** | VPA | 1931-2006 | Non-parametric | SSB/R (40%MSP) | F40%MSP |
| **Haddock** | **GOM** | VPA | 1977-2006 | Non-parametric | SSB/R (40%MSP | F40%MSP |
| **Yellowtail Flounder** | **GB** | VPA | 1973-2006 | Non-parametric | SSB/R (40%MSP) | F40%MSP |
| **Yellowtail Flounder** | **SNE/MA** | VPA | 1973-2006 | Non-parametric | SSB/R (40%MSP) | F40%MSP |
| **Yellowtail Flounder** | **CC/GOM** | VPA | 1985-2006 | Non-parametric | SSB/R (40%MSP) | F40%MSP |
| **American Plaice** | **GB/GOM** | VPA (2005) | 1980-2004 | Non-parametric | SSB/R (40%MSP) | F40%MSP |
| **Witch Flounder** | | VPA | 1982-2006 | Non-parametric | SSB/R (40%MSP) | F40%MSP |
| **Winter Flounder** | **GB** | VPA | 1982-2006 | Non-parametric | SSB/R(40%MSP) | F40%MSP |
| **Winter Flounder** | **GOM** | VPA | 1982-2006 | Non-parametric | SSB/R (40%MSP) | F40%MSP |
| **Winter Flounder** | **SNE/MA** | VPA | 1982-2006 | Non-parametric | SSB/R (40%MSP) | F40%MSP |
| **Redfish** | | ASAP | 1913-2006 | Non-parametric | SSB/R (50%MSP) | F50%MSP |
| **White Hake** | **GB/GOM** | ASAP | 1963-2005 | Non-parametric | SSB/R (40%MSP) | F40%MSP |
| **Pollock** | **GB/GOM** | AIM | 1963-2007 | Visual interpretation | External | Rel F at replacement |
| **Windowpane Flounder** | **GOM/GB** | AIM | 1975-2007 | Visual interpretation | External | Rel F at replacement |
| **Windowpane Flounder** | **SNE/MA** | AIM | 1975-2007 | Visual interpretation | External | Rel F at replacement |
| **Ocean Pout** | | Index Method (1998) | 1968-2007 | Visual interpretation | External | Rel F at replacement |
| **Altantic Halibut** | | Surplus production | 1800-2006 | Implied | Internal | F0.1 |

Table 2. Fishing mortality and biomass biological reference points both current and developed at the GARM III 'BRP' review; stock units are as per text and biomass units are in metric tons; c/i refers to index-based method (catch / index)

A. Current

| Species | Stock | Model | Bmsy or proxy | Fmsy or proxy | MSY |
|---|---|---|---|---|---|
| Cod | GB | VPA | 216,800 | 0.18 | 35,200 |
| Cod | GOM | VPA | 82,800 | 0.23 | 16,600 |
| Haddock | GB | VPA | 250,300 | 0.26 | 52,900 |
| Haddock | GOM | Landings & Survey | 22.17 kg/tow | 0.23c/i | 5,100 |
| Yellowtail Flounder | GB | VPA | 58,800 | 0.25 | 12,900 |
| Yellowtail Flounder | SNE/MA | VPA | 69,500 | 0.26 | 14,200 |
| Yellowtail Flounder | CC/GOM | VPA | 12,600 | 0.17 | 2,300 |
| American Plaice | GB/GOM | VPA | 28,600 | 0.17 | 4,900 |
| Witch Flounder |  | VPA | 25,250 | 0.23 | 4,375 |
| Winter Flounder | GB | ASPIC | 9,400 | 0.32 | 3,000 |
| Winter Flounder | GOM | VPA | 4,100 | 0.43 | 1,500 |
| Winter Flounder | SNE/MA | VPA | 30,100 | 0.32 | 10,600 |
| Redfish |  | RED | 236,700 | 0.04 | 8,200 |
| White Hake | GB/GOM | AIM | 14,700 | 0.29 | 4,200 |
| Pollock | GB/GOM | AIM | 3 kg/tow | 5.88 c/i | 17,600 |
| Windowpane Flounder | GOM/GB | AIM | 0.94 kg/tow | 1.11 c/i | 1,000 |
| Windowpane Flounder | SNE/MA | AIM | 0.92 kg/tow | 0.98 c/i | 900 |
| Ocean Pout |  | Index Method | 4.9 kg/tow | 0.31 c/i | 1,500 |
| Altantic Halibut |  | None | 5,400 | 0.06 | 300 |

B. GARM III

| Species | Stock | Model | Bmsy or proxy | Fmsy or proxy | MSY |
|---|---|---|---|---|---|
| Cod | GB | VPA | 143,343 | 0.25 | 30,220 |
| Cod | GOM | VPA | 71,150 | 0.23 | 14,936 |
| Haddock | GB | VPA | 164,300 | 0.34 | 35,000 |
| Haddock | GOM | VPA | 5,995 | 0.45 | 1,360 |
| Yellowtail Flounder | GB | VPA | 46,000 | 0.25 | 10,000 |
| Yellowtail Flounder | SNE/MA | VPA | 27,600 | 0.26 | 6,300 |
| Yellowtail Flounder | CC/GOM | VPA | 8,310 | 0.24 | 1,820 |
| American Plaice | GB/GOM | VPA (2005) | 20,828 | 0.18 | 4,317 |
| Witch Flounder |  | VPA | 10,863 | 0.22 | 2,195 |
| Winter Flounder | GB | VPA | 15,500 | 0.25 | 3,400 |
| Winter Flounder | GOM | VPA | 3,557 | 0.27 | 854 |
| Winter Flounder | SNE/MA | VPA | 37,608 | 0.26 | 9,658 |
| Redfish |  | ASAP | 239,309 | 0.04 | 8,951 |
| White Hake | GB/GOM | ASAP | 56,500 | 0.21 | 7,000 |
| Pollock | GB/GOM | AIM | 2.00 kg/tow | 5.76 c/i | 11,516 |
| Windowpane Flounder | GOM/GB | AIM | 1.14 kg/tow | 0.62 c/i | 700 |
| Windowpane Flounder | SNE/MA | AIM | 0.33 kg/tow | 1.53 c/i | 500 |
| Ocean Pout |  | Index Method (1998) | 4.94 kg/tow | 0.76 c/i | 3,754 |
| Altantic Halibut |  | Surplus Production | 70,000 | 0.04 | 2,800 |

## Stock-by-Stock Biological Reference Points

### *Georges Bank (GB) Cod*

The current BRPs are based upon a VPA conducted upon the 1978 – 2000 dataset. In the GARM III 'models' review (NEFSC, 2008), it was noted that the data were sufficient for an age-structured model which assumed negligible error in the catch-at-age. A weak retrospective pattern was present.

A range of models on which to base updated BRPs was considered at this review. Given a more pronounced retrospective pattern in the ASAP, the VPA on the 1978 – 2006 dataset (with a mid-1990s split in the times series of all survey tuning indices) was selected as the most appropriate model for BRP estimation.

The revised $F_{MSY}$ (0.25) for Georges Bank cod was based on the fishing mortality (F) that produced 40% of the unfished level of spawning biomass per recruit (herein termed $F_{40\%MSP}$). The yield/SSB per recruit calculations used mean weights, maturities and partial recruitment at age during 2002-2006. There are no obvious recent trends in these parameters. The revised $B_{MSY}$ (143,343 t) was derived using $F_{40\%MSP}$ together with a stochastic projection (AGEPRO) drawing from the cumulative frequency distribution of all recruitments produced by spawning stock biomasses of 50,000 t or greater. This sub-set of the recruitments was used to reflect the higher productivity apparent at larger stock sizes observed earlier in the time series. The 50,000 t breakpoint was confirmed as that which minimized the residual variance after taking mean values either side of it ('razor' analysis). The resulting revised MSY for the stock is 30,220 t.

While the stock assessment on which these reference points are based has not yet been fully reviewed (and it will be updated with recent data in August), it indicates that recent SSB has been at a low level. This is likely to continue to result in low recruitment unless the stock can be rebuilt to a higher and more productive level. The rebuilding deadline for this stock (2026) reflects the recent low productivity of the stock.

### *Gulf of Maine (GOM) Cod*

The current BRPs for Gulf of Maine cod are based upon a VPA using 1982 – 2000 data. The revised BRPs are based on $F_{40\%MSP}$ using the entire recruitment series (1982-2006) from a VPA. The VPA exhibits a weak retrospective pattern with no systematic trends that would cause concern for stock projections or rebuilding scenarios. The revised $F_{MSY}$ and $B_{MSY}$ proxies are 0.23 and 71,150 t respectively. The associated MSY is 14,936 t.

While the Panel considers the new VPA as an adequate basis for the determination of stock status and BRP revision, it noted the need to confirm the partial recruitment on ages five and older as this is particularly influential on the estimation of biological reference points and on stock status determination. An alternative BRP analysis of the Gulf of Maine cod data, using a statistical catch-age model variant (an Age-Structured Production Model - ASPM) and a longer catch series (1893-2006) provided support for the assumption of domed selectivity at age for both the survey and the commercial fishery. Alternatively, when a higher natural mortality rate was assumed (M=0.3), model fits were statistically equivalent for the asymptotically flat and domed survey selectivity assumptions. Both the alternative natural mortality rate and alternative selectivity assumptions will effect BRP calculations and estimates of current status relative to the BRPs.

Tagging analyses were conducted to attempt to distinguish between the domed and flat-top selectivity assumptions. A tagging model that partitioned tagged fish into three length categories and estimated length-specific natural mortality rates, fishing mortality rates, and movement rates was fitted to Atlantic cod tag release-recovery data. Results from this analysis were inconclusive in terms of distinguishing between the two selectivity assumptions because parameters of the tagging model are confounded (e.g. low tag recoveries in a size group can be explained by higher natural mortality rates, fish moving to an area with lower exploitation rates, or lower tag reporting rates). An integrated approach, incorporating the tag release and recovery data with the catch-at-age analysis, may allow resolution of the model selection question. It was noted that the tagging analysis suggests a higher natural mortality rate. Model selection criteria of ASPM model runs accepted larger values of natural mortality with flat – top selectivity. However, the higher natural mortality estimates from the tagging analysis could be aliasing for lower reporting rates or higher tag-induced mortality.

On balance, reiterating the conclusions of NEFSC (2008), the Panel felt a flat-top partial recruitment assumption should be the default unless there is compelling evidence that older fish are not caught by the fishery. Further, a flat-top survey catchability at age is preferred unless there is a plausible explanation for older fish to avoid the survey gear or to have emigrated out of the survey area. The VPA model was fit to a limited range of fishery catch ages and survey ages (ages 2 to 6). For the August 2008 assessment, analyses with data extended to include older ages should be investigated to evaluate their utility to better determine the partial recruitment on older ages. Additionally, VPA explorations should examine a higher natural mortality assumption. Other natural mortality assumptions that could be explored include higher rates for older ages or density dependent mortality such that mortality rates are higher in years (such as recently) with low stock abundance.

### *Georges Bank (GB) Haddock*

The current BRPs are based upon a VPA conducted upon the 1931 – 2000 dataset, which was updated to 2006 for this review. In the GARM III ‘models’ review (NEFSC, 2008), it was noted that the data were sufficient for an age-structured model which assumed negligible error in the catch-at-age. A weak retrospective pattern was indicated as being present with one of the key concerns being recent changes in haddock size at age (declining). Further, difficulties with using a parametric stock – recruitment relationship (NEFSC, 2002) were noted with exploration of a non-parametric form likely required.

Based upon analyses presented at this meeting, the 1931 – 2006 VPA was considered an adequate basis on which to base BRPs. However, inspection of the stock-recruitment relationship confirmed, as noted by NEFSC (2008), that BRPs should be estimated using a non-parametric approach. Thus the $F_{MSY}$ proxy was established as F40%MSP (0.34), taking into account recent declines in weights at age and partial recruitment. In relation to the latter, the Panel noted that when exceptionally large year – classes have previously moved through this stock (e.g. 1963 and 2003 year-classes), weights at age have declined and subsequently increased. It is thus possible that the current changes in weights at age and partial recruitment are transitory due to the size of the 2003 year-class.

The $B_{MSY}$ proxy was based upon a stochastic projection (AGEPRO) at F 40%MSP and the expected distribution of recruitment at the biomass proxy. Inspection of the long time series of spawning stock biomass and recruitment indicated that the stock generally experiences moderate but highly variable sized year-classes at SSBs greater than 75,000 t. Below this, the probability of small year – classes appears to increase. Thus, the BRPs are based upon year-class sizes observed at greater than 75,000 t SSB.

The other important feature of recruitment into this stock is the appearance from time to time of exceptionally large year-classes (e.g. 1963 and 2003). These dominate productivity of the resource for a number of years after they enter the fishery. However, they do not appear to be related to the size of the spawning biomass. It is possible that a number of linked environmental factors are responsible for these exceptional year-classes. The Panel noted the 'mixed recruitment' nature of this stock and determined that for the estimation of BRPs, that the 1963 and 2003 year-classes should not be included in the analysis. This assumes a long-term sustained level of stock productivity without the necessity of relying upon the incidence of exceptionally large year-classes. When the latter occur, they can be taken advantage of on a yield per recruit basis.

Thus, the $B_{MSY}$ proxy using recruitment where spawning stock biomass exceeded the 75,000 t breakpoint but excluding the 1963 and 2003 year-classes was 164,300 t with an associated MSY of 35,000 t.

*Gulf of Maine (GOM) Haddock*

The current BRPs for this stock are based on an index-based (AIM) assessment of the 1963 – 2000 dataset. While the GARM III 'models' review (NEFSC, 2008) considered this approach an adequate basis for revised BRPs, it encouraged efforts to process data sufficient for an age-structured approach. This work was done for this review and new BRPs for the stock are based on a VPA using catch-at-age data for 1977-2006. Unlike the AIM assessment, the VPA takes account of the decreased weight-at-age seen in recent years.

The VPA indicates SSB supported by a few strong cohorts. A strong residual pattern is seen in the fit of a Beverton-Holt stock-recruitment relationship with the resulting parametric $F_{MSY}$ being very high. Therefore, a non-parametric approach to estimating BRPs was adopted. The $B_{MSY}$ proxy (5995 t) was chosen as the median of stochastic projected (AGEPRO) SSB values after 50 years of fishing at $F_{40\%MSP}$ (0.45). Recruitment values were drawn from a sample including estimates hindcast back to 1962 using age one abundance indices from the NEFSC fall survey but excluding the exceptionally strong 1962 year-class and recruitment estimates associated with SSB less than 3,000 t (breakpoint based on 1986-1996 SSBs). The associated MSY is 1,360 t.

The Panel noted that the high value of $F_{40\%MSP}$ is contingent on the partial recruitment pattern in the most recent five years. The gear used by the commercial fishery changed in 2002 from 6 inch diamond mesh (which is still used in the Georges Bank fishery) to 6.5 inch square mesh, which resulted in greater escapement of mature haddock. Haddock taken by the recreational fishery, which accounts for an increased proportion of landings in recent years, are also relatively large. The selectivity change estimated by the VPA and incorporated in the BRP analyses, reflects substantial escapement of mature fish. This implies that the spawning biomass at $F_{40\%MSP}$ is composed of very young fish. It was noted that the current analysis indicates that Gulf of Maine haddock have lower weights at age than the Georges Bank stock. As well, the age at 50% maturity was also lower for Gulf of Maine as compared to Georges Bank haddock.

Comparisons with the Georges Bank haddock stock suggest that current productivity of the Gulf of Maine stock may have changed. Estimates of SSB for the two haddock stocks shows that, since 1988, the Gulf of Maine haddock SSB has been a lower proportion of Georges Bank SSB than during the years prior to 1988. It is also important to note that the perception that the Gulf of Maine stock is currently rebuilt may depend heavily on the contribution of the strong 1998 year-class.

*Georges Bank (GB) Yellowtail Flounder*

Current BRPs for this stock are based upon a VPA using 1973 – 2000 information. New BRPs for this stock are based on an update of the so-called 'Major Change' VPA (TRAC, 2005). In this assessment, the survey series are split between 1994 and 1995, which results in reduced retrospective patterns in biomass and fishing mortality estimates compared to the base VPA with no split. Except for minor changes to the catch-at-age data (principally discards), the assessment is an update of that applied in 2005. Data for 1973 to 2006 were included in the assessment, and recruitment estimates were hindcast back to 1963 based on regression of VPA estimates on the NEFSC Fall survey index at age one.

Initial exploration of potential BRPs used geometric means of the upper range of hindcast estimates to derive priors for unfished recruitment in fitting Beverton-Holt stock-recruitment curves. Values of $F_{MSY}$ based on these curves were much higher than $F_{40\%MSP}$. Given the extrapolation of the stock-recruitment curve well beyond the range of observed SSB, the Panel preferred to use a non-parametric approach to setting BRPs. Recruitment estimates for SSB greater than 5,000 t (breakpoint), including the hindcast values, were considered representative of productivity at higher stock levels. The $B_{MSY}$ proxy (46,000 t) was chosen as the median of stochastic projected (AGEPRO) SSB values after fishing for 50 years at $F_{40\%MSP}$ of 0.25. The associated MSY is 10,000 t.

The BRPs depend on the hindcast recruitment estimates to provide insight into productivity at higher stock levels than are observed during the time-series of the VPA. It was suggested that inverse variance weighting could be used in the estimation of mean recruitment based on hindcasting. More fundamentally and as time permits, the Panel recommends that the hindcast recruitments be projected forward to assess whether they are consistent with the recorded catches. It would not be possible to fully validate the hindcast estimates, but catch should at least indicate the minimum recruitment levels required to support them. Further, the Panel recommends that the relationship of hindcasted recruitment with SSB be explored to check whether the non-parametric approach to estimating BRPs has fully represented the potential for increased productivity at higher stock levels.

The biological basis for the Major Change model is not yet understood. The Panel commented that caution is required in treating converged VPA estimates as an absolute criterion of reality – removal of retrospective pattern does not guarantee that the assessment results are more correct. However, the Major Change model provides the soundest available foundation on which to base management advice. The BRPs for this stock are not dependent on the presence or absence of retrospective pattern, since the estimated stock-recruitment relationship is very similar between the Major Change and the base VPA. Nevertheless, further long-term research is advisable into the basis for retrospective pattern and its removal.

*Southern New England –Mid Atlantic (SNE/MA) Yellowtail Flounder*

Current BRPs for this stock are based upon a VPA using 1973 – 2002 data. New BRPs for this stock are also based on a VPA. This differs from the previous assessment principally in the change of plus-group definition from age 7+ to age 6+ and in minor changes in the catch-at-age data. Data for 1973 - 2006 were included in the assessment, and recruitment estimates were hindcast back to 1963 based on the relationship between VPA estimates and NEFSC Fall survey indices at age one.

The parametric stock-recruitment relationship based on the VPA results is very uncertain and highly influential on the BRP estimates. BRPs were thus based upon a non-parametric approach using VPA recruitment estimates for SSB greater than 5,000 t (breakpoint). The $B_{MSY}$ proxy (27,600 t) was chosen as the median of the stochastic projected (AGEPRO) SSB values after fishing for 50 years at $F_{40\%MSP}$ (0.26). Hindcast estimates were not included in the recruitment sample for projection. They extended well above the range of 'observed' recruitments and may not be representative of current stock productivity. The associated MSY is 6,300 t.

The Southern New England – Mid-Atlantic yellowtail flounder stock is at the southern end of the range for the species, where it may be more subject to environmental changes affecting productivity and other biological characteristics. Given the sustained low level of recruitment experienced by the stock since the early 1990s, it may not be possible to rebuild to the predicted $B_{MSY}$ level under current conditions.

### *Cape Cod – Gulf of Maine (CC/GOM) Yellowtail Flounder*

The Cape Cod – Gulf of Maine yellowtail flounder stock is the smallest of the three GARM stocks of this species. Current BRPs are based upon a VPA using 1985 – 2002 data. New BRPs for this stock are also based on a VPA. This differs from the previous assessment principally in the change of plus-group definition from age 5+ to age 6+, in minor changes in the catch-at-age data and in the addition of two new survey series from the Maine-New Hampshire inshore survey. Data for 1985 - 2006 were included in the assessment, and recruitment estimates were hindcast back to 1977 based on the relationship between VPA estimates and NEFSC Fall survey indices at age one. This approach was consistent with that used for Georges Bank yellowtail. Sampling limitations (related to inshore strata) prevented extending the hindcasting series back to 1963.

As with the other yellowtail stocks, the parametric stock-recruitment relationship based on the VPA results is very uncertain and highly influential on the BRP estimates. Parametric estimates of $F_{MSY}$ based on a Beverton-Holt stock – recruitment relationship are very high. The Panel preferred $F_{40\%MSP}$ as a proxy for $F_{MSY}$. The revised BRPs are based on a non-parametric approach, using the full time series of recruitment estimates, including the hindcasted values. Reduced recruitment at low SSB were not evident from a stock-recruitment relationship, and the hindcasted recruitments were all within the range of values estimated by the VPA. The $B_{MSY}$ proxy (8,310 t) was chosen as the median of the stochastic projected (AGEPRO) SSB values after fishing for 50 years at $F_{40\%MSP}$ (0.24). The associated MSY is 1,820 t.

Unlike Georges Bank yellowtail flounder, the hindcast recruitment estimates were within the range of 'observed' values and hence did not provide a perspective on stock productivity at SSB levels higher than those estimated for the VPA time period. In this sense, the hindcast estimates were less informative for derivation of BRPs. Nevertheless, as recommended for the Georges Bank stock, it would be worthwhile to assess as time permits, whether the hindcast recruitments are consistent with the recorded catches.

### *Georges Bank – Gulf of Maine (GB/GOM) American Plaice*

The last assessment for the plaice stock was undertaken in 2005 on the 1980 – 2004 dataset. Due to data availability issues, this analysis could not be updated in time for this review. In lieu of this, an updated $F_{MSY}$ proxy ($F_{40\%MSP}$) of 0.18 was derived using partial recruitment estimates from the 2005 VPA and weights at age from NMFS spring surveys averaged over

2003-2007. Since 2002, there have been increases in fishery mesh sizes which are likely to change the partial recruitment and thus the BRPs.

Recruitment from the full time series of the VPA was used along with the $F_{MSY}$ proxy in a stochastic projection (AGEPRO) to provide an updated $B_{MSY}$ proxy of 20,828 t and an MSY of 4,317 t.

These BRPs should be considered provisional as the assessment and thus BRPs will be updated at the August GARM III review.

*Witch Flounder*

The current BRPs for the witch flounder stock were derived from the results of a VPA for 1982 – 2002 using a non-parametric approach for the stock – recruitment relationship. The BRPs derived at this review were also based upon a VPA using the 1982 – 2006 dataset and modified to address a retrospective pattern as noted at the GARM III ‘ models’ review. The latter could not comment on the nature of the retrospective pattern other than point out that it could be due to potential sources indicated elsewhere in its report (NEFSC, 2008). The NEFSC undertook explorations of the source of the retrospective but could not identify a specific cause. It was noted that a number of management measures came into effect in the mid-1990s that could be implicated. Notwithstanding this, as has been done for a number of other GARM III stocks, the survey time series was split for the VPA calibration which appeared to largely address the retrospective pattern, caused by an as yet unknown process. This is a discussion for the August GARM III review as the modification is influential on the determination of stock status and the rebuilding schedule, but not the derivation of BRPs.

The non-parametric approach to determination of BRPs was continued at this review due to the observed negative relationship between recruitment and spawning stock biomass.

Thus the $B_{MSY}$ proxy of 10,863 t for this stock was derived using a $F_{MSY}$ proxy of F 40% MSP (0.22) and the recruitment from the full VPA time series (1982-2006) in a stochastic projection (AGEPRO). The resulting MSY is 2,195 t.

*Georges Bank (GB) Winter Flounder*

Current BRPs for the Georges Bank winter flounder stock are based upon a surplus production model (ASPIC) using 1963 – 2000 data. The GARM III ‘models’ review noted that this stock is a candidate for an age-structured analysis and consequently a VPA for 1982 – 2006 was undertaken for this meeting. It exhibited well-behaved retrospective and residual patterns and was considered a suitable basis for the derivation of BRPs.

When examining the Beverton and Holt stock-recruitment relationship using data from the VPA, it was noted that the fit was highly dependent upon the assumed level of asymptotic recruitment ($R_0$). The Panel considered that the data were not informative of the form of the relationship between recruitment and spawning stock biomass and chose a non-parametric approach as the basis for the BRPs.

The $F_{MSY}$ proxy ($F_{40\%MSP}$) of 0.25 was derived using the partial recruitment and weights at age from the most recent five years of the VPA. As observed in other GARM III stocks, observed weights at age have declined recently which will impact the partial recruitment. Using a non-parametric approach, recruitment estimates from the full time series of the VPA were used in a stochastic projection (AGEPRO) to provide a $B_{MSY}$ proxy of 15,500 t and an MSY of 3400 t.

*Gulf of Maine (GOM) Winter Flounder*

The Gulf of Maine winter flounder stock is the smallest of the three GARM stocks of this species. Current BRPs for this stock are based upon a VPA using 1982 – 2002 data. The revised BRPs presented here are based on a VPA with survey series split between 1993 and 1994. Splitting the survey series served to diminish the severe retrospective pattern seen in an unsplit VPA, although some bias remains in the recruitment estimates (less so in the most recent years). The VPA was applied to re-estimated catch-at-age data for 1982-2006.

A non-parametric approach was adopted for deriving revised BRPs. The $B_{MSY}$ proxy (3557 t) was chosen as the median of stochastic projected (AGEPRO) SSB values after 50 years of fishing at $F_{40\%MSP}$ (0.27). Recruitment from the full time-series of estimates from VPA was used in the projections. The associated MSY is 854 t.

There is considerable uncertainty associated with this assessment and the resulting BRP estimates. Conflicting trends between relatively stable recruitment indices and declining catches and the failure to track year-classes in the catch and survey age compositions lead to a lack of confidence in the results. In particular, the appropriate level for the biomass reference point is doubtful because of uncertainty about the level of average recruitment. The VPA indicated a steeper decline in recruitment than indicated by alternative models (i.e. SCALE), although there was broad congruence between the different assessments in the upper limits of recruitment. Based on the VPA and SCALE models, it is possible to state that $B_{MSY}$ should be at least 3,000 t, but it is unclear how much larger than this would be appropriate. The assessment difficulties were not resolved by attempting SCALE assessments which incorporated differences in growth and natural mortality between males and females. The Panel recommends further exploration of the SCALE assessment approach as time permits.

Notwithstanding the problems encountered, the updated VPA was considered to be the best available basis for developing BRPs. An important outcome is that the new assessment indicates a stock that is less resilient to exploitation than appeared from the previous assessment.

*Southern New England – Mid Atlantic (SNE/MA) Winter Flounder*

The current BRPs for this stock are based upon a 1982 – 1998 VPA which provided recruitment and spawning stock biomass for an externally estimated Beverton and Holt stock – recruitment relationship. The GARM III 'models' review, while noting that an age-structured model was appropriate as a basis for determination of stock status and derivation of BRPs, could not assess the overall utility of which modeling approach to use and encouraged model explorations to address the severe retrospective pattern that has been observed.

The VPA formulation presented at this meeting used a split survey time series (pre and post 1994), which appears to have reduced the retrospective problem. It is emphasized that while this modification to the VPA addresses the retrospective pattern, the underlying causes are still unknown. This split VPA was thus accepted as the basis of BRP calculations.

After examination of the stock – recruitment relationship using data from the VPA, the Panel determined that a non-parametric approach should be used to estimate BRPs. Thus, the $F_{MSY}$ proxy of 0.26 was determined using 40% MSP considerations, with $B_{MSY}$ (37608 t) then derived using a stochastic projection (AGEPRO) with recruitment estimates of all year- classes produced at spawning stock biomasses of 6000t (breakpoint) or greater. This sub-set of the recruitments was chosen to reflect the higher productivity apparent at larger stock sizes observed earlier in the time series. The break point identified as that which minimized the residual variance after taking mean values either side of the break point (the "razor" analysis). The associated MSY with these BRPs is 9658 t.

It is notable that the recruitment time series for this stock shows similarities with other flatfish stocks in the area, for example in relation to the period of high recruitment in the early 1980s. While recent productivity appears to have been much lower, it should not be overlooked that the stock is apparently being subjected to fully recruited fishing mortalities between 0.8 and 1.

*Redfish*

Current BRPs for the redfish stock are based upon a statistical catch at age model specifically developed for this resource ('RED'). The review of GARM III assessment models (NEFSC, 2008) supported use of an age-structured approach to modeling, particularly given the strong evidence for infrequent large pulses of recruitment which persist in the stock over decadal time periods.

The model adopted for the estimation of BRPs for the redfish stock was based on a new age-structured approach (ASAP), using a longer time series of landings data (1913 - 2006), and revised weights and maturities at age. In relation to the former, weights at age now are considerably larger than estimated previously.

Panel discussion focused on the choice of natural mortality (M) and the selection of recruitments to be used to determine $B_{MSY}$. With regard to the former, there were some concerns that the assumed M of 0.05 was low compared to estimates used for other redfish stocks. This value should be corroborated with supporting data if possible for the August 2008 review. With regards to recruitment, the model was apparently able to explain the high catches early in the time series; however the estimates prior to 1969 were largely determined by the Beverton and Holt stock – recruitment relationship assumed in the model. For the stochastic projections, the Panel chose to use recruitment estimates from the model for 1969 onwards (period for which age composition data of landings and / or survey data are available) in a non-parametric determination of BRPs.

This stock exhibits low productivity, which is reflected in the $F_{MSY}$ (0.04 based on the F producing 50% of unfished SPR as opposed to the 40% used on other GARM III stocks). The $B_{MSY}$ from the stochastic projections (AGEPRO) is 239,309 t while the associated MSY is 8951 t.

*Georges Bank – Gulf of Maine (GB/GOM) White Hake*

Current BRPs for this stock were derived upon an index-based analysis (AIM) of catch and survey data from 1964 – 2000.

Stock reconstructions using ASAP were conducted using both a short (1963 - 2005) and a long (1893 - 2005) catch time series. Tight priors were placed on the survey catchability (*q*) parameter to resolve issues with a historical retrospective pattern; however this created unreasonable patterns in the survey residuals. Suggestions for developing the model further for future assessments include: initialize the population (ie. 1893) assuming fishing mortality has been constant, and explore sensitivity to the assumed value; fix recruitment residuals for cohorts which are not represented in the age-composition data at zero (but, bias-corrected) unless doing a Bayesian analysis; no prior on the survey *q*, unless doing a Bayesian analysis; fit the catch data exactly (either a high weighting on catch fits or explicit solution of the catch equations); and examine uncertainty in the catch due to red / white hake misidentification through sensitivity analysis. Development of the long-term statistical catch age analysis is encouraged; resulting estimates of $R_0$ (virgin recruitment) should allow estimation of parametric stock-recruitment relationships. These explorations should be undertaken as time permits.

Notwithstanding concerns with the $q$ prior, survey residual patterns, and the use of a pooled age-length key for estimating 2001-2006 age compositions, the short time-series ASAP analysis was considered appropriate for calculating BRPs. Certainly, the use of an analytical assessment model for estimating BRPs is considered an important step forward for this stock. A relatively strong and systematic retrospective pattern, particularly in SSB estimates, should have minimal impact on BRP estimates although it could result in appreciable bias in stock projections. A model formulation assuming different pre- and post-1994 survey catchabilities should be investigated for the August GARM review in relation to resolving the retrospective pattern.

The revised BRPs are based on a non-parametric approach using $F_{40\%MSP}$ with recruitment estimates from a statistical catch-age analysis (ASAP) of 1963-2005 catch, survey, and age-composition data. All recruitment estimates produced by SSB greater than or equal to 10,000 t (breakpoint) were included in the BRP calculations. The $F_{MSY}$ and $B_{MSY}$ proxies were 0.21 and 56,500 t respectively with an associated MSY of 7,000 t.

*Georges Bank – Gulf of Maine (GB/GOM) Pollock*

The current BRPs for Pollock are based upon an index-based (AIM) analysis of the 1963 – 2000 dataset. NESFC (2008) considered that this 'relative trend' class of models is likely informative given the strong relationship between the relative fishing mortality and replacement yield for this resource and thus could be the basis of the 2008 assessment and revised BRPs. Thus, new BRPs for the stock are based on an updated AIM analysis. The main change from the previous analysis is the inclusion of recreational landings in the catch time-series. NEFSC fall survey data for 1963-2007 were included in the analysis.

The $F_{MSY}$ proxy (5.76 catch / fall survey index) was derived as the Relative F corresponding to a Replacement Ratio of 1, estimated from the Replacement R - Relative F relationship. The $B_{MSY}$ proxy (2.0 kg / tow in the fall survey) was selected by visual interpretation of the survey time-series in comparison with relative F estimates. This resulted in a decreased value compared with the current proxy in order to resolve a mis-match between the landings data and the relative F estimates. During the 1980s and early 1990s, landings close to the old MSY were associated with relative F values in excess of the $F_{MSY}$ proxy. This mis-match was resolved by adjustment of the $B_{MSY}$ proxy downward to ensure that landings below the new (lower) MSY (11, 516 t estimated as product of $F_{MSY}$ and $B_{MSY}$ proxies) coincided with Relative F estimates below the $F_{MSY}$ proxy.

One inconsistency in the survey data remains. Biomass indices have generally increased since the early 1990s but this coincides with a period when fish older than age 8 were generally absent from the survey catches. This raises questions about the availability to the survey gear of this highly mobile species. Concerns were also raised about the high Replacement Ratios at low relative F values implied by the Relative F – Replacement Ratio model for deriving the $F_{MSY}$ proxy. Suggestions were made for alternative model formulations (e.g. log-linear with priors on $a$ or logistic). However, AIM is used to deduce when Relative F is too high, not for establishing $B_{MSY}$, and $a$ and $b$ can be viewed as nuisance parameters in this context. As time permits, if the alternative formulations can be fit, the parameter estimates might be useful for validating the chosen value of $B_{MSY}$ and put the biomass reference points in the same context from which the F index reference points were derived.

*Georges Bank – Gulf of Maine (GB/GOM) Windowpane Flounder*

The current BRPs for this stock are based upon an index-based (AIM) analysis conducted in 2005 (NEFSC, 2005). The GARM III 'models' review (NEFSC, 2008) considered that this approach would be adequate for assessment and BRP derivation. An age-based assessment for this stock is not possible as there is no age composition data available from either the research surveys or fishery samples.

Commercial landings data are available for 1975 – 2006. Catches ranged between about 3700 and 2000 t during 1985 – 1991 but since 1994, catch has been primarily bycatch in other targeted fisheries. Since 2000, most of the catch has been comprised of discards, these being about 10 - 20 times the landings.

The 2005 AIM analysis was updated with the most recent survey information. Biomass indices from the 1975 – 2006 NMFS fall survey were used due to the lack of significant relationships between Relative F and Replacement Ratios for the other surveys considered. The Relative F (catch / fall survey biomass index) increased during 1977 – 1991, then declined through 2002 but then increased during 2002 – 2006. Replacement Ratios were near to or greater than 1.0 during 1995 – 2001 then declined to below one thereafter. A marginally significant Relative F – Replacement Ratio relationship indicated that the stock can replace itself at a Relative F of 0.62 which was thus chosen as the $F_{MSY}$ proxy.

To determine the biomass BRPs, the trends in catch and fall survey biomass indices were examined during the period when the discards were most precisely estimated (1989 – 2006). The stock appeared to be able to sustain a median catch of 700t during 1995 – 2001 as Replacement Ratios were near or above 1.0 during this period and thus this was chosen as the MSY proxy. Division of the MSY proxy by the $F_{MSY}$ proxy of 0.62 provided a $B_{MSY}$ proxy of 1.14 kg / tow in the NMFS fall survey.

It is important to note that whereas the current BRPs were stated in terms of landings, the updated BRPs are stated in terms of landings plus discards.

*Southern New England – Mid Atlantic (SNE/MA) Windowpane Flounder*

The current BRPs for this stock are based upon a surplus production model (ASPIC). The GARM III 'models' review (NEFSC, 2008) considered that there were benefits to using a common approach for both windowpane stocks and that an index – based method (AIM) would be adequate for assessment and BRP derivation. An age-based assessment for this stock is not possible as there is no age composition data available from either the research surveys or fishery samples.

Commercial landings data are available for 1975 – 2006. Catches have been primarily discards, which were highest during 1982 – 1991, ranging between 3600 – 5400 t annually, and then declining to a time series low in 2001 before gradually increasing thereafter. In recent years, discards have been about 7 – 8 times the landings.

The AIM analysis used biomass indices from the 1975 – 2006 NMFS fall survey. Survey indices from previous assessments were computed based upon data from only the offshore sampling strata. As the inshore strata comprise a substantial portion of the total windowpane habitat, these were included in the current analysis.

The Relative F (catch / fall survey biomass index) increased during 1980 – 1990, then declined through 2001 with a slight increase thereafter. Replacement Ratios were near to or greater than 1.0 during 1995 – 2001 then rapidly declined and have been below 1.0 since 2004. Replacement Ratios suggest that the stock was able to replace itself during 1980 – 82 but has not been able to replace itself for extended periods since then. A significant Relative F – Replacement Ratio relationship indicated that the stock can replace itself at a Relative F of 1.53 which was thus chosen as the $F_{MSY}$ proxy.

To determine the biomass BRPs, the trends in catch and fall survey biomass indices were examined during the period when the discards were most precisely estimated (1989 – 2006). The stock appeared to be able to sustain a median catch of 500t during 1995 – 2001 as Replacement Ratios were near or above 1.0 during this period and thus this was chosen as the MSY proxy. Division of the MSY proxy by the $F_{MSY}$ proxy provided a $B_{MSY}$ proxy of 0.33 kg / tow in the NMFS fall survey.

It is important to note that whereas the current BRPs were stated in terms of landings, the updated BRPs are stated in terms of landings plus discards. Also, the previous BRPs were estimated using fall survey data from only the offshore sampling strata. The updated BRPs are more reflective of the stock as they are based upon an analysis using survey indices from the entire habitat of windowpane flounder.

### *Ocean pout*

Existing BPRs, based on the AIM method, were updated using a new catch time series that now includes discard estimates.

An AIM analysis was conducted using 1968-2006 catch and survey data, however the relationship between Relative F and Replacement Ratio was not significant thereby invalidating the assumptions underlying the use of AIM for calculating BRPs. The lack of a significant relationship between Relative F and Replacement Ratio is largely attributed to the four most recent Relative F estimates, which are among the lowest in the time series, yet the trend in the survey abundance index (used for the Replacement Ratio) continues downward. For this reason the AIM analysis was not updated, however previous BRPs were adjusted to account for discards as well as the landings estimates.

The Ocean pout fishery is essentially a discard fishery and catches are at historical low levels. The survey abundance index declined dramatically in 2004 and is currently at a historical low level. This suggests that Ocean pout may be in a depensatory state where the stock cannot rebuild to BRPs even in the absence of removals.

Thus the revised $F_{MSY}$ and $B_{MSY}$ proxies are 0.76 (catch / survey index) and 4.94 kg / tow respectively while the MSY is 3754 t.

### *Atlantic Halibut*

As was pointed out at the GARM III 'models' review, the tagging data for this stock showed a relatively high proportion of recoveries from Canadian waters, suggesting that the stock boundaries should be reviewed and that this might be better treated as a trans-boundary issue.

The current BRPs for this stock are based upon an index-based approach. NEFSC (2008) suggested attempting a one parameter depletion analysis for the determination of stock status and revision of the BRPs. A replacement yield model (which is a form of surplus production model) was developed and reviewed at this meeting and while it had issues to be resolved (e.g. how high catches are dealt with early in the time series and with the estimation of catches during 1800-1900), it was considered informative for BRP determination.

A yield per recruit analysis using updated biological information was used to estimate F0.1 = 0.04 as a proxy for $F_{MSY}$. $B_{MSY}$ (70,000 t) was then derived using the replacement yield model assuming r = 2 * $F_{MSY}$ (as implied by the Schaefer production model) and M = 0.06. The associated MSY is 2800 t. The Panel considered that the estimate of natural mortality (0.06), while consistent with the maximum age observed in the data, is low compared to other halibut stocks (e.g. typically in the order of 0.14 – 0.15), and should be reviewed in time for the August 2008 review in the light of information from Pacific Halibut and Atlantic Halibut stocks in, for instance, West Greenland and Canadian Atlantic waters. Consideration of the estimate of natural mortality and revisions to the replacement yield model will have implications for the BPRs which will need to be considered at the August GARM III review.

### ToR 5. Appropriate models for forecasting and for evaluating rebuilding scenarios

Other than comment in working paper 4.2 on the need to consider using different recruitment scenarios for short and long-term projections, no analyses were tabled that explicitly addressed ToR 5. There was also some limited discussion about the need to consider different weights at age and fishery selectivity to be used in short term versus medium to longer term projections. The Panel suggests that in developing rebuilding scenarios, careful consideration be given to consistent use of the stream of recruitments used in those scenarios with those used in this review to derive the BRPs. There is limited experience with potential difficulties that may be encountered when imputing a 'sharp breakpoint' between two recruitment stanzas rather than a 'smooth' transition of recruitment from low biomass to higher biomass, and warrants some caution when interpreting rebuilding projections.

## CONCLUDING REMARKS

The meeting required an extensive suite of working papers prepared by scientists at the NEFSC and substantial and in-depth discussions at the meeting itself. This was a very substantial workload for the Center, which the Panel acknowledges being of very high quality. The Panel would also like to acknowledge the valuable contributions at the meeting made by all participants, particularly that of Doug Butterworth, who attended on behalf of the fishing industry. Finally, the Panel would like to again thank Andrea Strout of the NEFSC who assisted the chair in preparing this report. All these contributions made it possible for the GARM III 'BRPs' review to generally meet its terms of reference.

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# APPENDICES

## Appendix 1. Terms of Reference

1. For relevant stocks, determine the influence of retrospective patterns in parameter estimates (e.g., fishing mortality, biomass, and/or recruitment) from assessment models on the computation of BRPs and on specification of initial conditions for forecasting.

2. Trends in Stock Productivity:

   a.) For relevant stocks, identify trends in biological parameters (i.e., life history and/or recruitment) and assess their importance for the computation of BRPs and for specification of rebuilding scenarios;

   b.) If possible, summarize trends in pertinent environmental variables that might be related to the trends in those biological parameters relevant to BRPs.

3. Ecosystem approaches to Gulf of Maine/Georges Bank fisheries:

   a.) Determine the production potential of the fishery based on food chain processes and estimate the aggregate yield from the ecosystem;

   b.) Comment on aggregate single stock yield projections in relation to overall ecosystem production, identifying potential inconsistencies between the two approaches.

4. Biological Reference Points ($B_{target}$, $B_{threshold}$, $F_{target}$, $F_{threshold}$):

   a.) For each stock, list what the current BRPs and/or BRP Proxies are (e.g., $B_{MSY}$, $B_{MAX}$, $F_{MSY}$, $F_{40\%MSP}$, historical survey catch per tow, etc.), and give their values (i.e., typically from GARM II);

   b.) For each stock, update or redefine BRPs or BRP proxies that will be used for stock status determination, and compute their expected values and precision. Note: These BRPs and their proxies must be comparable and consistent with outputs from the recommended assessment models from the GARM III "Modeling" Meeting.

5. For each stock, identify appropriate models for forecasting and for evaluating rebuilding scenarios.

## Appendix 2. List of Participants

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## Appendix 3. Agenda

| ***Date /Day*** | ***Start*** | ***End*** | ***Duration (min)*** | ***Topic*** | ***Presenter*** |
|---|---|---|---|---|---|
| 28-Apr | 9:00 | 9:10 | 10 | Introduction | |
| 1 | 9:10 | 9:30 | 20 | Overview of GARM and objectives of this meeting | Chair |
| | | | | **TOR #4 Biological Reference Points: a. Current values and proxies** | |
| 1 | 9:30 | 9:45 | 15 | *Working Paper 4.1* Overview of current BRPs methods and estimates | Rago |
| 1 | 9:45 | 10:00 | 15 | Discussion | |
| 1 | 10:00 | 10:30 | 30 | *Working Paper 4.2* Setting SSBmsy via Stochastic Simulation Ensures Consistency with Rebuilding Projections. Chris Legault | Legault |
| 1 | 10:30 | 10:45 | 15 | Break | |
| 1 | 10:45 | 11:00 | 15 | Discussion | |
| | | | | **TOR #2: Trends in Stock Productivity** | |
| 1 | 11:00 | 11:45 | 45 | WP 2.1 Trends in Average length, weight and maturity at age for relevant stocks and trends in environmental variables. | *O'Brien* |
| 1 | 11:45 | 12:00 | 15 | Discussion | |
| 1 | 12:00 | 12:15 | 15 | WP 2.2 Implications of biological trends for estimation of biological reference points and rebuilding schedules. | *Rago et al* |
| 1 | 12:15 | 12:30 | 15 | Discussion | |
| 1 | 12:30 | 13:30 | 60 | Lunch | |
| | | | | **TOR #3 Ecosystem Approaches to Gulf of Maine/Georges Bank Fisheries** | |
| 1 | 13:30 | 13:50 | 20 | *WP 3.1* US Northeast Shelf LME Biomass, target biological reference points for fish and worldwide cross-system comparisons. Overholtz, Link, Fogarty, Col, Legault. | Overholtz |
| 1 | 13:50 | 14:00 | 10 | Discussion | |
| 1 | 14:00 | 14:20 | 20 | WP 3.2 Energy Budget contextualization of fish biomasses at B_MSY | Link |
| 1 | 14:20 | 14:30 | 10 | Discussion | |

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|---|---|---|---|---|---|
| 1 | 14:30 | 14:50 | 20 | WP 3.3 Estimates of aggregate surplus production for the GARM and other stock groups for the US Northeast Shelf LME. Overholtz, Fogarty, Link, Legault, Col. | Overholtz |
| 1 | 14:50 | 15:00 | 10 | Discussion |  |
| 1 | 15:00 | 15:15 | 15 | Break |  |
| 1 | 15:15 | 15:35 | 20 | WP 3.4 An Aggregate and MS Production Model: A Simulator Tool | Link |
| 1 | 15:35 | 15:45 | 10 | Discussion |  |
| 1 | 15:45 | 16:10 | 25 | WP 3.5 Fishery Production Potential | Fogarty |
| 1 | 16:10 | 17:00 | 50 | Discussion—WP 3.6 Synthesis: Implications for single species reference points | Link/Fogarty |
|  |  |  |  | **TOR #4 Biological Reference Points:** |  |
| 1 | 17:00 | 17:15 | 15 | WP 4.3. Sensitivity of the Long-term Observation-error Survey Series (LOSS) model to variable stock-recruit steepness and stock depletion inputs: A test case using Gulf of Maine haddock (Palmer and Legault). | Palmer/Legault |
| 1 | 17:15 | 17:25 | 10 | Discussion |  |
| 1 | 17:25 | 17:40 | 15 | Supplementary Paper WP 4.7 Size-specific tag recovery rates of cod and implications for estimation of fishing mortality in analytical models. Miller and Hart | Miller/Hart |
| 1 | 17:40 | 17:50 | 10 | Discussion |  |
| 1 | 17:50 | 18:00 | 10 | Summary/Followup (Chair) |  |

| ***Date /Day*** | ***Start*** | ***End*** | ***Duration (min)*** | ***Topic*** | ***Presenter*** |
|---|---|---|---|---|---|
| 29-Apr | ***9:00*** | 9:15 | 15 | Progress review and Order of the Day (Chair) | Chair |
|  |  |  |  | **TOR #1 Influence of retrospective patterns on parameter estimates and specification of initial conditions for forecasting.** |  |
| 2 | 9:15 | 9:35 | 20 | *WP 1.1* Specifying Initial Conditions for Forecasting When Retrospective Pattern is Present. | Legault/ Terceiro |
| 2 | 9:35 | 9:50 | 15 | Discussion |  |
| 2 | 9:50 | 10:10 | 20 | *WP 1.2.* A simulation study to evaluate estimation of biological reference points from VPA and ASAP. | Brooks/ Legault/ Seaver |

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|---|---|---|---|---|---|
| 2 | 10:10 | 10:25 | 15 | Discussion |  |
| 2 | 10:25 | 10:40 | 15 | Break |  |
|  |  |  |  | **TOR #4 Biological Reference Points: b. Update by stock** |  |
| 2 | 10:40 | 11:25 | 45 | WP 4.A Georges Bank Cod | O'Brien |
| 2 | 11:25 | 11:55 | 30 | Discussion |  |
| 2 | 11:55 | 12:55 | 60 | Lunch |  |
| 2 | 12:55 | 13:40 | 45 | WP 4.F Gulf of Maine Cod | Mayo |
| 2 | 13:40 | 14:05 | 25 | Discussion |  |
| 2 | 14:05 | 14:30 | 25 | WP 4.F.1 Gulf of Maine Cod | Butterworth |
|  | 14:30 | 14:40 | 10 | Discussion |  |
| 2 | 14:40 | 15:30 | 50 | WP4.B. Georges Bank Haddock | Brooks |
| 2 | 15:30 | 15:55 | 25 | Discussion |  |
| 2 | 15:55 | 16:10 | 15 | Break |  |
| 2 | 16:10 | 17:05 | 55 | WPs 4.C. Georges Bank + 4.D. Southern New England + 4.E Cape Cod-Gulf of Maine yellowtail flounder | Legault |
| 2 | 17:05 | 17:50 | 45 | Discussion |  |
| 2 | 17:50 | 18:00 | 10 | Summary/Followup | Chair |
|  |  |  |  |  |  |
| ***Date /Day*** | ***Start*** | ***End*** | ***Duration (min)*** | ***Topic*** | ***Presenter*** |
| 30-Apr | ***9:00*** | 9:15 | 15 | Progress review and Order of the Day (Chair) | Chair |
| 3 | 9:15 | 10:00 | 45 | WP 4.N. Gulf of Maine/ Georges Bank Acadian Redfish | Miller |
| 3 | 10:00 | 10:15 | 15 | Discussion |  |
| 3 | 10:15 | 11:00 | 45 | 4.K. Georges Bank winter flounder | Hendrickson |
| 3 | 11:00 | 11:15 | 15 | Break |  |
| 3 | 11:15 | 11:30 | 15 | Discussion |  |
| 3 | 11:30 | 12:30 | 60 | *WP* 4.I. Gulf of Maine Winter Flounder | Nitschke |
| 3 | 12:30 | 12:45 | 15 | Discussion |  |
| 3 | 12:45 | 13:45 | 60 | Lunch |  |
| 3 | 13:45 | 14:30 | 45 | WP 4.J. Southern New England Winter flounder | Terceiro |
| 3 | 14:30 | 14:45 | 15 | Discussion |  |
| 3 | 14:45 | 15:30 | 45 | *WP* 4.G. Witch Flounder | Wigley |
| 3 | 15:30 | 15:45 | 15 | Discussion |  |
| 3 | 15:45 | 16:00 | 15 | Break |  |
| 3 | 16:00 | 16:45 | 45 | 4.H. Gulf of Maine/Georges Bank American Plaice | O'Brien |
| 3 | 16:45 | 17:00 | 15 | Discussion |  |
| 3 | 17:00 | 17:30 | 30 | *WP* 4.M. Georges Bank/Gulf of Maine Pollock | Mayo |

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|---|---|---|---|---|---|
| 3 | 17:30 | 17:45 | 15 | Discussion |  |
| 3 | 17:45 | 18:00 | 15 | Summary/Followup | Chair |
|  |  |  |  |  |  |
|  | 19:30 | 22:30 |  | Social/Dinner --British Beer Company, Falmouth Heights |  |
|  |  |  |  |  |  |
| ***Date /Day*** | ***Start*** | ***End*** | ***Duration (min)*** | ***Topic*** | ***Presenter*** |
| 1-May | ***9:00*** | 9:15 | 15 | Progress review and Order of the Day | Chair |
| 4 | 9:15 | 10:05 | 50 | *WP* 4.L. White Hake | Sosebee |
| 4 | 10:05 | 10:20 | 15 | Discussion |  |
| 4 | 10:20 | 10:35 | 15 | Break |  |
|  | 10:35 | 10:55 | 20 | WP.4.L.1 White Hake alt | Butterworth |
|  | 10:55 | 11:05 | 10 | Discussion |  |
| 4 | 11:05 | 12:00 | 55 | *WP* 4.R. Gulf of Maine Haddock | Palmer |
| 4 | 12:00 | 12:15 | 15 | Discussion |  |
| 4 | 12:15 | 13:15 | 60 | Lunch |  |
| 4 | 13:15 | 13:35 | 20 | *WP* 4.O. Ocean pout | Wigley |
| 4 | 13:35 | 13:45 | 10 | Discussion |  |
| 4 | 13:45 | 14:05 | 20 | WP 4.P. Gulf of Maine/Georges Bank Windowpane Flounder | Hendrickson |
| 4 | 14:05 | 14:15 | 10 | Discussion |  |
| 4 | 14:15 | 14:35 | 20 | *WP* 4.Q. Southern New England – Mid-Atlantic Windowpane | Hendrickson |
| 4 | 14:35 | 14:45 | 10 | Discussion |  |
| 4 | 14:45 | 15:05 | 20 | *WP* 4.S. Atlantic Halibut | Col |
| 4 | 15:05 | 15:15 | 10 | Discussion |  |
| 4 | 15:15 | 15:30 | 15 | Break |  |
| 4 | 15:30 | 17:50 | 140 | Review/Revisions/Follow-up | TBD |
| 4 | 17:50 | 18:00 | 10 | Summary/Followup (Chair) | Chair |
|  |  |  |  |  |  |
| 2-May | ***9:00*** | 9:30 | 30 | Progress review and Order of the Day | Chair |
| 5 | 9:30 | 10:30 | 60 | Review of Outstanding Issues as necessary | TBD |
| 5 | 10:30 | 10:45 | 15 | Break |  |
| 5 | 10:45 | 12:00 | 75 | Report Development [CLOSED] |  |
| 5 | 12:00 | 13:00 | 60 | Lunch |  |
| 5 | 13:00 | 16:00 | 180 | Report Development, Summary and Assignments [CLOSED] |  |
| 5 | 16:00 | 16:00 | 0 | Adjourn |  |

## Appendix 4. Statement of Work of CIE Reviewers

### General

The Groundfish Assessment Review Meeting (GARM) brings together stock assessment experts to peer review work on the status of 19 important fish stocks that are managed by the New England Fishery Management Council. GARM-III takes place in 2007-2008, and it will consist of four meetings that are cumulative in nature (i.e., successive meetings incorporate methods and results that were accepted at previous GARM-III meetings). Each meeting will have a chair as well as external panelists. A brief description and dates of the four GARM-III meetings are given below:

4. “Data Methods” Meeting (October 29 – November 2, 2007)
Review the commercial and survey data that will be used in the stock assessments. Identify appropriate statistical methods for analyzing those data (including bycatch and discard issues, changes in growth rates and other life history traits, issues related to merging databases, etc.). Other sources of data to be considered are tagging programs for cod and yellowtail flounder, and Industry-Based Surveys. Candidate sources of data relevant to ecological and ecosystem considerations will also be described.

5. “Modeling” Meeting (February 25 – 29, 2008)
Determine the most appropriate stock assessment methods and models for each of the 19 stocks. Perform runs of those models to obtain results (historical and current estimates of F and B) based on commercial and survey data, probably through calendar year (CY) 2006. The runs of the models will be used to evaluate diagnostics of model fit and appropriateness, including retrospective analyses.

6. “Biological Reference Point (BRP)” Meeting (April 28 – May 2, 2008)
Update or redefine BRPs for each of the 19 stocks. Use data available through CY2006. Consider whether the BRPs are reasonable in light of results from the “Modeling” Meeting. Define the appropriate initial conditions for forecasting and rebuilding strategies, particularly with respect to trends in biological attributes, recruitment and survival rates. Comment on relevant ecosystem considerations as they relate to rebuilding strategies.

4. GARM-III “Final” Meeting (August 4 - 8, 2008)
Use all of the methods proposed from the previous three meetings, along with survey and catch information through CY2007, to estimate historical and current fishing mortality rates and biomass for each stock. Based on procedures from the BRP Meeting, finalize the BRPs, appropriate initial conditions, and biological assumptions related to forecasts. Determine the status of each stock.

This SOW applies specifically to the GARM-III “Biological Reference Point (BRP)” Meeting, which will take place at the Woods Hole Laboratory of the Northeast Fisheries Science Center (NEFSC) in Woods Hole, Massachusetts, from April 28 – May 2, 2008. The meeting will have a chairman (non-CIE) as well as external panelists, three of whom will be from the Center of Independent Experts (CIE).

## Overview of CIE Peer Review Process

The Office of Science and Technology implements measures to strengthen the National Marine Fisheries Service's (NMFS) Science Quality Assurance Program (SQAP) to ensure the best available high quality science for fisheries management. For this reason, the NMFS Office of Science and Technology coordinates and manages a contract for obtaining external expertise through the Center for Independent Experts (CIE) to conduct independent peer reviews of stock assessments and various scientific research projects. The primary objective of the CIE peer review is to provide an impartial review, evaluation, and recommendations in accordance to the Statement of Work (SoW), including the Terms of Reference (ToR) herein, to ensure the best available science is utilized for the National Marine Fisheries Service management decisions.

The NMFS Office of Science and Technology serves as the liaison with the NMFS Project Contact to establish the SoW which includes the expertise requirements, ToR, statement of tasks for the CIE reviewers, and description of deliverable milestones with dates. The CIE, comprised of a Coordination Team and Steering Committee, reviews the SoW to ensure it meets the CIE standards and selects the most qualified CIE reviewers according to the expertise requirements in the SoW. The CIE selection process also requires that CIE reviewers can conduct an impartial and unbiased peer review without the influence from government managers, the fishing industry, or any other interest group resulting in conflict of interest concerns. Each CIE reviewer is required by the CIE selection process to complete a Lack of Conflict of Interest Statement ensuring no advocacy or funding concerns exist that may adversely affect the perception of impartiality of the CIE peer review. The CIE reviewers conduct the peer review, often participating as a member in a panel review or as a desk review, in accordance with the ToR producing a CIE independent peer review report as a deliverable. The Office of Science and Technology serves as the COTR for the CIE contract with the responsibilities to review and approve the deliverables for compliance with the SoW and ToR. When the deliverables are approved by the COTR, the Office of Science and Technology has the responsibility for the distribution of the CIE reports to the Project Contact.

## Requirements for CIE Reviewers

Three CIE reviewers are requested to conduct an impartial and independent peer review in accordance with the Terms of Reference (ToR) herein. Each CIE reviewer's duties shall not exceed a maximum of 14 days conducting pre-review preparations with document review, participation on the GARM panel review meeting, editorial assistance to the GARM Chair, and completion of the CIE independent peer review report in accordance with the ToR and Schedule of Milestones and Deliverables. CIE reviewers shall have working knowledge and recent experience in the application of modern fishery stock assessment models. Reviewers should have experience in development of biological reference points that includes an appreciation for the varying quality and quantity of data available to support estimation for individual fish species living within the ecosystem. Expertise should include statistical catch-at-age, traditional VPA approaches, and index-based methods. Desirable background includes life-history theory, risk analyses, stock-forecasting methodology, and ecosystem fisheries ecology. Some experience with groundfish (such as cod, haddock, flounder) population dynamics would be useful.

## Specific Activities and Responsibilities

The CIE's deliverables shall be provided according to the schedule of milestones listed on page 6. The GARM Chair will use contributions from the CIE panelists as well as from other external panelists, to produce the GARM Panel Summary Report. In addition, each CIE panelist will write an individual independent report. These reports will provide peer-review information for a presentation to be made by NOAA Fisheries at meetings of the New England and Mid-Atlantic Fishery Management Councils in 2008. The GARM Panel Summary Report shall be an accurate and fair representation of the GARM panel viewpoint on the quality and soundness of the science, methods and results with regard to each Term of Reference (see Annex 1). The report shall also contain recommendations for improvement that might be implemented in a future GARM meeting.

## Charge to GARM panel

The panel is to determine and write down its viewpoint on the quality and soundness of the science, methods and results with regard to each Term of Reference (see Annex 1). Criteria to consider include whether: (1) the data are adequate and were used properly; (2) the analyses and models were appropriate and correctly accomplished; and (3) the conclusions are correct/reasonable. Where possible, the chair shall identify or facilitate agreement among the panelists regarding each Term of Reference.

During the course of the review, the panel is allowed limited flexibility to deviate from the results and recommendations of earlier GARM-III meetings. This flexibility may include only minor alterations in procedures previously established at the peer review of the "Data Methods" Meeting in October 2007 and the "Modeling" Meeting in February 2008. Large scale changes, such as changing a stock definition would not be possible in view of the difficulties of implementing these changes in time available before the final GARM meeting in August 2008.

Furthermore, if the panel rejects certain assessment models or Biological Reference Points (BRP), the panel should explain why they are not suitable, and the panel should recommend suitable alternatives. If such alternatives cannot be identified, then the panel should indicate that the existing (status quo) models and/or BRPs are the best available at this time.

## Roles and responsibilities

### (1) Prior to the meeting

(GARM Chair and CIE panelists)

Review the reports produced by the Working Groups, and read background reports.

### (2) During the Open meeting

(GARM Chair)

Act as chairperson, where duties include control of the meeting, coordination, facilitation of the presentations and discussions, and ensuring that all Terms of Reference of the GARM are reviewed and completely addressed.

During the question and answer periods, provide appropriate feedback to the assessment scientists on the sufficiency of the analyses and when possible, suggest improved approaches. It is permissible to discuss the working papers, and to request additional information to clarify or revise existing analyses, if that information can be produced rather quickly.

(CIE panelists)

Participate in panel discussions on the quality and soundness of the science, methods and results with regard to each Term of Reference (see Annex 1).

During the question and answer periods, provide appropriate feedback to the assessment scientists on the sufficiency of the analyses. It is permissible to request additional information if it is needed to clarify or revise existing analyses, if that information can be produced rather quickly.

### (3) After the Open meeting

(GARM Chair, CIE and non-CIE panelists)

The GARM Chair will lead preparing, editing, and completing the GARM Panel Summary Report, based on contributions from the panelists (CIE and non-CIE). This report (see Annex 3 for information on contents) is to comment on the quality and soundness of the science, methods, and results with regard to each Term of Reference. If any modeling approaches and/or BRPs are considered inappropriate, the GARM Panel Summary Report should include recommendations and justification for suitable alternatives. If such alternatives cannot be identified, then the report should indicate that the existing modeling approaches and/or BRPs are the best available at this time.

The panelists and the chair will discuss whether their views on each Term of Reference can be summarized into a consensus conclusion. In cases where multiple, differing views exist on a given Term of Reference, the GARM Panel Summary Report will note that there was no consensus and will summarize the various opinions and the reason(s) for these.

(GARM Chair)

The Chair's role during GARM Panel Summary Report development will be to facilitate rather than to force consensus from the panel.

The GARM Chair shall prepare the introduction to the GARM Panel Summary Report, summarizing the background of the work to be conducted as part of the review process, and whether the process was adequate to successfully address the Terms of Reference.

As appropriate, the chair will include suggestions (in an Appendix) on how to improve the process.

The GARM chair will finalize all editorial and formatting changes of the draft GARM Panel Summary Report prior to its final approval by all panelists. The GARM chair will then submit the approved GARM Panel Summary Report to the NEFSC contact (i.e., SAW Chair).

(GARM CIE panelists)
Each CIE panelist shall prepare a CIE independent peer review report (see Annex 2). This report should comment on the quality and soundness of the science, methods, and results with regard to each Term of Reference.

If any modeling approaches and/or BRPs are considered inappropriate, the CIE independent peer review report should include recommendations and justification for suitable alternatives. If such alternatives cannot be identified, then the report should indicate that the existing modeling approaches and/or BRPs are the best available at this time.

During the meeting, questions which are not in the Terms of Reference but are directly related to the meeting may have been raised. Questions not explicitly referenced in the TOR but relevant to its intent can be documented and addressed.

## Schedule of Milestones and Deliverables

The milestones and schedule are summarized in the table below. No later than May 16, 2008, the CIE panelists should submit their CIE independent peer review reports to the CIE for review[4]. The CIE reports shall be sent to "University of Miami Independent System for Peer Review," and sent to Dr. David Sampson, via e-mail to David.Sampson@oregonstate.edu and to Mr. Manoj Shivlani via e-mail to mshivlani@ntvifederal.com

| **Milestone** | **Date** |
|---|---|
| Open workshop at Northeast Fisheries Science Center (NEFSC) (report writing begins as soon as open Workshop ends) | April 28 – May 2, 2008 |
| GARM Chair and CIE panelists work at the NEFSC drafting reports. Report writing starts during the meeting. Panelists leave meeting with at least the summary bullets. | May 1 - 2 |
| Draft of GARM Panel Summary Report, reviewed by all panelists, due to the GARM Chair ** | May 16 |
| CIE panelists submit CIE independent peer review reports to CIE for approval | May 16 |
| GARM Chair sends Final GARM Panel Summary Report, approved by CIE panelists, to NEFSC contact (i.e., SAW Chairman) | May 23 |

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[4] All reports will undergo an internal CIE review before they are considered final.

|  |  |
|---|---|
| CIE provides reviewed CIE independent peer review reports to NMFS COTR for approval | May 30 |
| COTR notifies CIE of approval of CIE independent peer review reports | June 6 * |
| COTR provides final CIE independent peer review reports to NEFSC contact | June 6 |

* Assuming no revisions are required of the reports.

** The GARM Panel Summary Report will not be submitted, reviewed, or approved by the CIE.

The SAW Chairman will assist the GARM chairman prior to, during, and after the meeting in ensuring that documents are distributed in a timely fashion. NEFSC staff and the SAW Chairman will make the final GARM Panel Summary Report and CIE independent peer review reports available to the public. Staff and the SAW Chairman will also be responsible for production and dissemination of the collective Working Group papers.

## Acceptance of Deliverables

Upon review and acceptance of the CIE reports by the CIE Coordination and Steering Committees, CIE shall send via e-mail the CIE reports to the COTRs (William Michaels William.Michaels@noaa.gov and Stephen K. Brown Stephen.K.Brown@noaa.gov) at the NMFS Office of Science and Technology by the date in the Schedule of Milestones and Deliverables. The COTRs will review the CIE reports to ensure compliance with the SoW and ToR herein, and have the responsibility of approval and acceptance of the deliverables. Upon notification of acceptance, CIE shall send via e-mail the final CIE report in *.PDF format to the COTRs. The COTRs at the Office of Science and Technology have the responsibility for the distribution of the final CIE reports to the Project Contacts.

## Key Personnel

Contracting Officer's Technical Representative (COTR):

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## Request for Changes

Requests for changes shall be submitted to the Contracting Officer at least 15 working days prior to making any permanent substitutions. The Contracting Officer will notify the Contractor within 10 working days after receipt of all required information of the decision on substitutions. The contract will be modified to reflect any approved changes. The Terms of Reference (ToR) and list of pre-review documents herein may be updated without contract modification as long as the role and ability of the CIE reviewers to complete the SoW deliverable in accordance with the ToR are not adversely impacted.

## ANNEX 1: Draft Terms of Reference for the GARM-III “Biological Reference Point (BRP)” Meeting *(Last Revised: 1/11/08; A final draft will be distributed to the Panel prior to the meeting.)*

1. For relevant stocks, determine the influence of retrospective patterns in parameter estimates (e.g., fishing mortality, biomass, and/or recruitment) from assessment models on the computation of BRPs and on specification of initial conditions for forecasting.

2. Trends in Stock Productivity:
   a.) For relevant stocks, identify trends in biological parameters (i.e., life history and/or recruitment) and assess their importance for the computation of BRPs and for specification of rebuilding scenarios;

   b.) If possible, summarize trends in pertinent environmental variables that might be related to the trends in those biological parameters relevant to BRPs.

3. Ecosystem approaches to Gulf of Maine/Georges Bank fisheries:
   a.) Determine the production potential of the fishery based on food chain processes and estimate the aggregate yield from the ecosystem;

   b.) Comment on aggregate single stock yield projections in relation to overall ecosystem production, identifying potential inconsistencies between the two approaches.

4. Biological Reference Points ($B_{target}$, $B_{threshold}$, $F_{target}$, $F_{threshold}$):
   a.) For each stock, list what the <u>current</u> BRPs and/or BRP Proxies are (e.g., $B_{MSY}$, $B_{MAX}$, $F_{MSY}$, $F_{40\%MSP}$, historical survey catch per tow, etc.), and give their values (i.e., typically from GARM II);

   b.) For each stock, update or redefine BRPs or BRP proxies that will be used for stock status determination, and compute their expected values and precision. Note: These BRPs and their proxies must be comparable and consistent with outputs from the recommended assessment models from the GARM III “Modeling” Meeting.

5. For each stock, identify appropriate models for forecasting and for evaluating rebuilding scenarios.

## ANNEX 2: Contents of GARM-III CIE independent peer review report

1. The Independent CIE Report should comment on the quality and soundness of the science, methods and results with regard to each Term of Reference. CIE panelists should consider whether the work provides a scientifically credible basis for developing fishery management advice. Scientific criteria to consider include: whether the data were adequate and used properly, the analyses and models were carried out correctly, and the conclusions are correct/reasonable.

2. If any modeling approaches and/or BRPs are considered inappropriate, the Independent CIE Report should include recommendations and justification for suitable alternatives. If such

alternatives cannot be identified, then the report should indicate that the existing modeling approaches and/or BRPs are the best available at this time.

3. Any independent analyses conducted by the CIE panelists as part of their responsibilities under this agreement should be incorporated into their Independent CIE Reports. It would also be helpful if the details of those analyses (e.g., computer programs, spreadsheets etc.) were made available to the respective assessment scientists.

4. Additional questions that were not in the Terms of Reference but that are directly related to the meeting can be addressed. This section need only be included if additional questions were raised during the GARM meeting.

## ANNEX 3: Contents of GARM-III Panel Summary Report

1. The first section the report shall consist of an introduction prepared by the GARM chair that will include the background, a review of activities and comments on the appropriateness of the process in reaching the goals of the GARM. The next section will contain comments on the quality and soundness of the science, methods and results with regard to each Term of Reference. The GARM Panel should consider whether the work provides a scientifically credible basis for developing fishery management advice. Scientific criteria to consider include: whether the data were adequate and used properly, the analyses and models were carried out correctly, and the conclusions are correct/reasonable.

If the CIE panelists, the non-CIE panelists and GARM chair do not reach an agreement on a Term of Reference, the report should explain why. It is permissible to express majority as well as minority opinions.

2. If any modeling approaches and/or BRPs are considered inappropriate, the GARM Panel Summary Report should include recommendations and justification for suitable alternatives. If such alternatives cannot be identified, then the report should indicate that the existing modeling approaches and/or BRPs are the best available at this time.

3. The report shall also include: a.) the bibliography of all materials provided during the meeting and any papers cited in the GARM Panel Summary Report; and separate appendices with b.) a copy of the CIE Statement of Work; c.) the assessment with the Terms of Reference used for the GARM BRP Meeting, including any changes to the Terms of Reference or specific topics/issues directly related to the assessments and requiring Panel advice; d.) a list of participants; e.) the meeting agenda, f.) a list of working papers; and g.) Presentation Highlights and Meeting Discussion Summary for each working paper. The Highlights and Discussion Summary are to be written by the assessment scientists and rapporteurs, respectively, with editing and oversight by the GARM Chairman.

## Appendix 5. List of Working Papers

1.1 Legault C, Terceiro M. Specifying Initial Conditions for Forecasting When Retrospective Pattern is Present.

1.2 Legault C, Seaver A, Brooks L. A Simulation Study to Evaluate Estimation of Biological Reference Points from VPA and ASAP.

2.1 O’Brien L. Trends in Average Length, Weight and Maturity at Age for Relevant Stocks.

2.2 Rago et al. Implications of Biological Trends for Estimation of Biological Reference Points and Rebuilding Schedules.

3.1 Overholtz W, Link J, Fogarty M, Col L, Legault C. US Northeast Shelf LME Biomass, Target Biological Reference Points for Fish and Worldwide Cross-System Comparisons.

3.2 Link J, Overholtz W, Legault C, Col L, Fogarty M. Energy Budget Contextualization of Fish Biomasses at B_MSY

3.3 Overholtz W, Fogarty M, Link J, Legault, Col L. Estimates of Aggregate Surplus Production for the GARM and Other Stock Groups for the US Northeast Shelf LME.

3.4 Link J, Gamble R, Overholtz W, Legault C, Col L, Fogarty M. An Aggregate and MS Production Model: A Simulator Tool

3.5 . Fogarty M, Overholtz WJ, Link J. Fishery Production Potential of the Northeast Continental Shelf of the United States.

3.6 Link et al. Synthesis of Ecosystem Considerations.

4.1 Rago et al. Overview of Current BRPs Methods and Estimates.

4.2 Legault C. Setting SSBmsy via Stochastic Simulation Ensures Consistency with Rebuilding Projections.

4.3 Palmer M, Legault C. Sensitivity of the Long-term Observation-error Survey Series (LOSS) Model to Variable Stock-Recruit Steepness and Stock Depletion Inputs: A Test Case using Gulf of Maine haddock

4.4. Palmer M. (Supplementary Paper): A Method to Apportion Landings with Unknown Area, Month and Unspecified Market Categories Among Landings with Similar Region and Fleet Characteristics

4.5. Palmer M, Wigley S, O'Brien L, Mayo R, Rago P. (Supplementary Paper): A Description of Discard Estimation Methods Where Observer Coverage is Unavailable

4.6 Legault C, Palmer M, Wigley S (Supplementary Paper): Uncertainty in Landings Allocation Algorithm at Stock Level is Insignificant.

4.7 Miller T, Hart D. (Supplementary Paper): Analysis of Tagging Data for Evidence of Decreased Fishing Mortality for Large Gulf of Maine Cod.

4.8 Butterworth D, Rademeyer R. (Supplementary Paper): Implications of Tagging Analyses for the Shape of Selectivity at Age of GoM cod.

4.8a Butterworth D. (Supplementary Paper). Further Runs of ASPM/SCAA for GoM cod

4.A. Georges Bank Cod . O'Brien L.
4.B. Georges Bank Haddock. Brooks L.
4.C Georges Bank yellowtail flounder. Legault C
4.D Southern New England-Mid Atlantic yellowtail flounder. Legault C, Cadrin S.
4.E Cape Cod-Gulf of Maine yellowtail flounder. Legault C, Cadrin S, King J, Sherman S.
4.F. Gulf of Maine Cod. Mayo R
4.F.1 Gulf of Maine Cod, Butterworth D
4.F.1a Gulf of Maine Cod Addendum, Butterworth D, Rademeyer R
4.G. Witch Flounder. Wigley S
4.H. Gulf of Maine/Georges Bank American Plaice. O'Brien L
4.I. Gulf of Maine Winter Flounder. Nitschke P
4.J. Southern New England Winter flounder. Terceiro M
4.K. Georges Bank winter flounder. Hendrickson L
4.L. White Hake. Sosebee K
4.L.1 White Hake, Butterworth D
4.M. Georges Bank/Gulf of Maine Pollock. Mayo R
4.N. Gulf of Maine/ Georges Bank Acadian Redfish. Miller T
4.O. Ocean pout . Wigley S
4.P. Gulf of Maine/Georges Bank Windowpane Flounder. Hendrickson L
4.Q. Southern New England – Mid-Atlantic Windowpane Flounder . Hendrickson L
4.R. Gulf of Maine Haddock. Palmer M
4.S. Atlantic Halibut. Col L

WP 5.1. Rago P, Brodziak R. (Supplementary Paper): Overview of age-based projection model (AgePro) for reference point estimation and scenario analyses.

## Appendix 6. Presentation Highlights and Discussion

This appendix includes the presentation highlights provided by the senior author of each working paper along the rapporteur's notes of the ensuing discussion. In regard to the latter, the emphasis was to capture the main points made. There was only modest editing of these during preparation of this report. Notwithstanding this, the text gives a sense of the main topics discussed, areas of agreement, and areas of future work. While these were referred to by the Panel, statements in this Appendix should not be considered the final conclusions of the Panel, which are stated in the body of this report.

## ToR 1. Influence of Retrospective Patterns

Working Paper 1.1: Legault, C. and M. Terceiro. Specifying Initial Conditions for Forecasting when Retrospective Pattern Present

Rapporteur: Tim Miller

*Presentation Highlights*

There is currently no generally agreed methodological approach to adjusting projections to account for retrospective patterns in the stock assessment. This paper presents three alternative approaches and compares the resulting time series of spawning stock biomass, landings, and fishing mortality rate based on a summer flounder-like stock assessment. The three adjustments for retrospective patterns all reduce landings in the quota setting year, but the magnitude of the reduction is quite variable and the implications for future years in the projections are quite different. Adjusting the fishing mortality rate in the quota setting year is not recommended in the context of rebuilding programs because the future catches are greater than the unadjusted projections. Adjusting all ages in the starting population creates the largest decrease in projected catch, but typically cannot be justified based on the patterns observed at age. Making adjustments to the starting population based on the age specific retrospective patterns produces the most consistent approach, although the overall impact is relatively minor. A number of technical questions remain regarding exactly how to compute the retrospective adjustments at age. Management strategy evaluation work is required in the future to determine if any adjustment method performs better than the others.

*Discussion*

The chair and the presenter agreed that the methodology is not yet ready for the formal assessment process. A reviewer noted that perhaps retrospective patterns could be obtained when model misspecification is consistent over time, but it was not the case in the scenarios explored here. The presenter suggested that age-specific adjustments to initial population numbers at age is the best approach for dealing with retrospective patterns when they exist, but it may not always help and the question of what magnitude of a retrospective pattern warrants adjustment still remains. There was a proposal to assess the aggregate biomass for retrospective patterns and if one was suspected, look at age-specific patterns. Determining a default adjustment procedure was proposed as an important first step in using the methodology for formal stock assessment. In the near term, while the best adjustment procedure is still being determined, the chair thought (and others agreed) that it important to caution the Council that the results of any adjustment procedure are not robust and use the results with that in mind. Further work that will help determine best adjustment methodology includes simulation. However, it will be important to constrain the set of scenarios for simulation to include the only the most problematic GARM stocks.

Working Paper 1.2: Liz Brooks, C. Legault, A. Seaver. A simulation study to evaluate estimation of BRPs from VPA & ASAP

Rapporteur: Tim Miller

*Presentation Highlights*

A simulation study was performed to evaluate two NOAA Fisheries Toolbox assessment models (VPA and ASAP) with respect to their ability to estimate biological reference points (BRPs) and the parameters of a stock recruit function. Data sets with different lengths of time, three different levels of recruitment variability (0%, 20%, and 80% CV), and two levels of steepness (h=0.60, 0.88) were simulated with PopSim, a simulation program in the Toolbox. Each simulated dataset was fit in the VPA and in ASAP. The estimated time series of spawning biomass and recruits from each model were passed to SRFIT, another Toolbox program, to estimate the stock recruit function and the corresponding BRPs. These externally estimated reference point values were compared to the true values to determine bias and precision. In addition, the internally estimated BRPs from ASAP were compared to the true values.

Between externally estimated BRPs from VPA and ASAP runs on the same data sets, the bias in estimates of the stock-recruit parameters was similar, but slightly less for ASAP, which carried through to less bias in the BRPs. Comparing internally versus externally estimated stock-recruit parameters for ASAP, the external estimates of $R_0$ were generally less precise, but slightly less biased for CV=0% and CV=20%. However, the bias in external estimates was quite severe when CV=80%. This may relate to misspecification in the default level of recruitment variability assumed in ASAP and SRFit; it would require further detailed tuning to evaluate the impact of that model setting. When the ASAP model was applied to data from three different time periods with different amounts of data in each period, we found that the model performance was improved by extending the series as far back as there were indices (1963), but extending back to 1935 when only total catch was available produced no gain and oftentimes exacerbated the bias. For the VPA model runs using catch at age data that started in 1977 or in 1995, the shorter time series (only 12 years of data) did a very poor job of estimating unexploited levels of recruitment. This could be due to the length of the time series, or to the limited amount of contrast in stock size (the depletion level in SSB was pretty flat over that time period, ranging from 6% to 16%). Although there is not time to fully evaluate these hypotheses, based on the cases explored in this simulation, we conclude that short time series from an overfished stock are likely to produce informative time series of SSB and recruitment from which to estimate BRPs.

In all comparisons, the pattern of bias and precision in steepness carried through to the bias and precision of $F_{MSY}$ while unexploited recruitment ($R_0$) largely determined the bias and precision in MSY and $SSB_{MSY}$.

*Discussion*

The inability to better estimate reference points with longer time series in some cases was unexpected by several people. The chair raised a concern that there was a stock-recruit curve assumed for the simulations, but that VPA does not assume one. Some simulations where a "random" stock-recruit relationship is assumed would provide interesting results. However, the expected fact that short time series did not provide reliable estimation of reference points was thought to be an important result of this study and the chair thought that, in these cases, incorporating other information from related stocks in a statistically rigorous way would be a good option.

## ToR 2. Trends in Stock Productivity

Working Paper 2.1 Part II. O' Loretta O'Brien, Michele Traver, Jessica Blaylock, Betty Holmes, Jiashen Tang, Liz Brooks, Laurel Col, Mike Fogarty, Kevin Friedland, Larry Jacobson, Joe Kane, Jason Link, and Paul Rago. Trends in Average Length and Weight, and Proportion Mature at Age for Relevant Stocks and Trends in Environmental Variables

Rapporteur: Jessica Blaylock

*Presentation Highlights*

This paper presents the results of several approaches aimed at detecting trends in length, weight, and maturity for twenty groundfish stocks.

Z-score analyses combined with a Loess smooth fit of the NEFSC Survey stratified mean lengths and mean weights at age indicate that six stocks show no particular trend in either mean length or mean weight in more recent years, while two stocks show an increasing trend, and the remaining twelve stocks show a decline in length and mean weight at age in recent years. Female maturity ogives estimated with data smoothed with 3- or 5-year moving average show no trend for 8 stocks, an increasing trend for 11 stocks, and decreasing trends for 2 stocks.

Quintile Plots (Visual Report) show three different patterns across the stocks: 1) faster growth during periods of low density and slower growth during periods of high density, suggesting density dependence in some stocks such as GB Haddock; 2) reverse non-density dependent growth, as in GB Cod; and 3) a mix of patterns 1 & 2, as in GB Yellowtail. A reordering of these plots showed that juveniles and adults are trending together, and that mean weight seems to be declining more in Gadids than in Flatfish in recent years.

Analysis of environmental data, such as the Northwest Atlantic Oscillation (NAO), sea surface temperature, and primary productivity, shows an earlier period of low anomalies, low temperatures and low productivity, followed by a more recent trend to positive anomalies, higher temperatures, and high productivity.

Finally, copepod and zooplankton abundance data exhibit a distinct pattern of negative anomalies prior to 1989, and generally positive values in the following years. Food habits data showed no strong trends.

*Discussion*

Panelists questioned the implications of these trends for the determination and use of Biological Reference Points (BRPs). This brought the use of a three to five year average for mean weights for BRP determination back into question. This issue had been widely discussed during the GARM III 'Data Inputs' review, but the results of WP 2.1 might influence the decision to use a short-term versus a long-term approach concerning BRPs. In other words, should one incorporate recent trends in long-term projections using a three to five year average or use the time series average instead? There was also some concern about potentially incorporating trends for which the exact cause is unknown. This discussion is continued in the review of Working Paper 2.2.

It was observed that most trends seem to be year effects rather than cohort effects. This is expected since these trends are assumed to be linked to environmental patterns affecting all ages, so we would not expect to see cohort effects.

In response to the suggestion to look at other sources of data in addition to the survey data, the presenter reminded the Panel that it was the observation of decreased catch weights that was the initial reason for undertaking this analysis. Survey data was therefore analyzed to determine if the trends also occurred at the population level.

Finally, there was some concern about the significance of changes in the parameters, given that no error bars were presented. There is some question about whether conclusion on trends would be different if we had error bars, and whether recent values are truly significantly different than previous ones. The presenter asserted that the time-series trend was shown to be significant for ten of the stocks in a previous analysis using randomization tests, and that the calculation of confidence intervals cannot be easily incorporated into computations at this time.

Working Paper 2.2: Rago et al. Implications of biological trends for estimation of biological reference points and rebuilding schedules

Rapporteur: Jessica Blaylock

*Presentation Highlights*

This paper evaluates the potential effects changes in life history parameters can have on Biological Reference Point (BRP) estimation and rebuilding strategies. Determination of size at age, maturity and survival has a direct influence on fisheries management since these measures reflect stock productivity and are used to determine BRPs, which are the basis for defining rebuilding plans. Changes in life history parameters have been observed for numerous stocks in the region (Working Paper 2.1), but the exact cause of these changes is not always clear. Mis-estimation of these parameters can have serious consequences, as illustrated by the Pacific Halibut and GB Haddock stocks.

It is thus critical to estimate correct values for life history parameters, both for long-term goals such as efficient management and successful rebuilding, but also in relation to the more immediate decisions that have to be made concerning BRP estimation.

*Discussion*

Much of the discussion reconsidered the decision to use the 5-year moving average for weight, length and maturity in relation to Biological Reference Point (BRP) estimation. When this decision was made at the GARM III ‘Data Inputs’ review, it was agreed that this approach would be suitable for most stocks. In the current meeting, Working Paper 2.1 showed trends in life history that differed across stocks, suggesting a different approach to each stock might be preferable. Despite this, and because it is not clear how sensitive the BRPs are to the observed trends, the Panel cautioned that the 5-year average approach should still be used unless analysts have compelling reasons not to do so. Consensus was reached to use the 5-year moving window approach as a default for BRP estimation, while staying open to specific case-by-case deviations from this method. This is especially valid because some stocks do not seem to be recovering (i.e. Cod), and many of the stocks are on the southern edge of their distribution, where they are expected to be most influenced by changes such as climactic and environmental variations. Whatever the final decision is concerning BRP estimation, the chosen approach will have to be clearly explained to management bodies.

These conclusions led to questions about implications for forecasting as mentioned in Term of Reference 1, especially relative to ‘specification of initial conditions’. While using a 5-year period average seemed acceptable for SSB, there was agreement that TACs would need a different forecasting approach that would take any trend into account.

A few other topics also required brief clarification: 1) density dependence is currently not built into any of the forecasting tools, and 2) the number of years to be used for recruitment is determined on a case-by-case basis.

## ToR 3. Ecosystem Approaches to Gulf of Maine / Georges Bank Fisheries

Working Paper 3.1: W.J. Overholtz, J.S. Link, M. Fogarty, L. Col, and C. Legault. US Northeast Shelf LME Total Fish Biomass, Target Biological Reference Points for Fish and Worldwide Cross System Comparisons.

Rapporteur: Tony Chute

### *Presentation Highlights*

The total target biomass for the US Northeast Shelf ecosystem is 6.1 million mt, 67% demersal species and 33% pelagic species. The GARM stocks, commercial pelagic fishes, and elasmobranchs have similar $B_{MSY}$ biomass targets at 5.78, 5.24, and 4.69 t/km2, respectively. The LME biomass targets for pelagic and demersal fishes are similar in scale to biomass estimates from previous studies of the region. The total $B_{MSY}$ target biomasses for the Northeast LME for demersal and pelagic fish resources are similar to the current Northeast LME biomass and similar to the average biomass of many other temperate marine systems. The target biomass for the Northeast LME is below the average for the nine other temperate marine systems (24.485 versus 32.763 t/km2). The target biomass for the demersal component is moderately higher than the average for the demersal group from nine other systems, while the target pelagic biomass is well below the average for pelagic fish from these systems.

### Conclusions

On an ecosystem basis, current biomass management targets (Bmsys) for GARM, pelagic, and elasmobranch fishes are reasonable. The current targets compare favorably with the results of current and historical studies in the region and are also in general agreement with results of many studies for other worldwide ecosystems.

### *Discussion*

The carrying capacity of the system is supposedly only 70% of the summed $B_{MSY}$ of all the species (GARM spp, pelagics, elasmobranchs). A 2-tier system where the individual MSYs as well as the carrying capacity of the system should be adopted. The fish don’t need to just feed each other; their populations need to be able to withstand human removals. We will look at the whole Northeast shelf ecosystem and the MSYs of managed species based on single species models, an energy budget, and surplus production models.

One of the presenters noted that they looked at the current biomass and target BRPs for individual fish species from the Northeast shelf ecosystem, summed them up and converted to biomass per unit area for comparison with other systems around the world. They collected all the $B_{MSY}$ and current biomass information available for the 19 GARM species, pelagics and some elasmobranchs. Species which had a kg/tow proxy for a BRP used that information and swept area biomass to calculate current biomass and a $B_{MSY}$. The ratio of current biomass to $B_{MSY}$ was then calculated. Biomass of squid, sand lance, mesopelagics, anadromous fish etc was also added. It was estimated using ECOPATH that 12 tons per km2 of demersals were currently in the system, and the target biomass is 16 tons. For pelagics, the current biomass is 11.4 tons and the target biomass is 8.4. When compared to other LMEs, the biomass per unit area fell within reasonable bounds.

It was acknowledged that the entire shelf ecosystem was used for analysis when some fish species inhabited only part of it. Sub-areas were considered too small for comparison with other ecosystems. Migration out of the system was accounted for. The ratio of pelagics to demersals was similar to that found in other systems. When biomass and kg/tow of some species were known, they were used to estimate a catchability value which was useful for the species that only had kg/tow information. The Northeast shelf system was not obviously similar to any of the other systems used for comparison.

Working Paper 3.2: J.S. Link, W.J. Overholtz, C. Legault, L. Col, M.J. Fogarty. Energy budget contextualization for fish biomasses at Bmsy.

Rapporteur: Tony Chute

*Presentation Highlights (from slides presented to meeting)*

Model Structure
- EMAX for four NEUS regions combined into one total
- Areal weighted for B, P/B and C/B
- Common diet with all nodes (group of species) from SNE
- Summed for fisheries and bycatch
- Used mass-balance equations
    - C = P + R + E

Model applications
- Current biomass combined for all four NEUS regions
- Then balanced: used as baseline
- Main objective was to ascertain effects of having fish nodes at Bmsy

Model scenarios
- BMSY for eight fish groups
- All pelagics B doubled from BMSY values
- All pelagics B halved from BMSY values
- All demersals B halved from BMSY values
- Rebalanced each scenario
    - Compared difference from input & difference from current baseline
    - Locked P/B, C/B ratios
    - Changes demersals: perturbed & rebalanced
    - Compared rebalanced scenarios to current baseline

Results

- Bmsy: had to up small pelagics & down demersals to make model work
- Double pelagics
- Half pelagics
- Half demersals
- Flow to detritus tracked
- Cybernetic metrics summarized

Summary

- Overall, results inconclusive given multiple caveats of network model
- Recall, just equilibrium rebalancing; doesn't account for responses in F
- Fish components of the system could be increased relative to current biomass levels
- Overall, scenarios had minimal change relative to balanced baseline
- Unclear if BMSY for all species is energy limited from a systemic perspective
- However, rebalancing relative to input levels suggests may not be able to have all fish spp at BMSY due to flow constraints
- All scenarios were balanced largely predicated upon a higher small pelagic-comm biomass and a lower demersal-omniv. and pisc. Biomass

*Discussion*

The presenters used the EMAX model to make an energy budget for the Northeast shelf ecosystem. The system was four sub-regions, and nodes within each sub-region. For the diet portion of the model, the Southern New England diet web was used, because it contained the most nodes. The model is an equilibrium model and accounted for fish entering and leaving nodes, and used biomass, consumption per unit biomass and production per unit biomass. Model runs were started with target biomass of each species in the nodes, then the model ran with double the pelagics, half the pelagics, and half the demersals (perturbing the system). C/B and P/B were fixed but diets could change. Results were shown as percentage or number increase or decrease in various species groups. At target biomasses, the model reduced demersal benthivores and increased small pelagics; at double the pelagics, the model increases the demersals, but halve the pelagics and the model wants to increase them and reduce the demersals, and if the demersals are halved, the pelagics increase by a large amount. The different scenarios delivered similar results with the exception of the double pelagics. A large proportion of pelagics increases the "flow to detritus" in the model. No fishing mortality was included in the model. It was not clear whether the system itself put any constraints in the Bmsys.

"Pedigrees" were given to each node depending on the confidence level they inspired before the model was run, and some parameters were more flexible, like diets and species composition. Life history parameters can be added into the model, such as larger fish becoming more prevalent as species recover. Small pelagics were always increased in each run of the model, but they are currently over Bmsy. They may have an impact on the recovery of the GARM species and that point needs to be raised.

Working Paper 3.3: W.J. Overholtz, M. Fogarty, J.S. Link, C. Legault, and L. Col. Estimates of aggregate surplus production for the GARM and other stocks groups for the US Northeast Shelf LME.

Rapporteur: Tony Chute

*Presentation Highlights*

Overall, the results from both surplus production modeling approaches suggest that the expected aggregate yield is lower, the Bmsy biomass is lower and the overall fishing mortality rate should be lower for the GARM III stocks as a whole than is suggested from the single species results. The expected yield for the pelagic complex is similar or slightly higher, the Bmsy biomass is higher, and the overall fishing mortality rate is lower than suggested from the single species target results. This suggests the need for an overall 2nd layer of consideration for the GARM III stocks as a whole, and managing the pelagic stocks at a higher level of biomass than suggested by the single species results.

*Discussion*

Aggregate (summed) surplus production was estimated for all stock groups using the ASPIC model which uses landings and survey indices as input data. Methods like this have also been used in the Gulf of Alaska and the Bering Sea ecosystems. Each group, GARM spp, pelagics and elasmobranchs, had its own parameters developed initially by using sensitivity analysis. Sometimes survey data was lacking, but again those species with a kg/tow proxy were given a q based on swept area biomass. Final ASPIC results indicated a fairly low aggregate Fmsy of 0.11, and a high Bmsy for the group. It looked like a better recovery for all species with the addition of the pelagic group. The results of a 1998 study which calculated individual species MSY and Bmsy were summed and compared to the ASPIC results and were found to be different.

To attempt to take into account environmental variables, another model was used with SST, SST range, CO2 and bottom temperature as input (positive, negative or neutral). CO2 showed a significant result indicating a higher F and lower MSY, but most did not seem to affect the model appreciably. A higher Bmsy for pelagics and a lower F for all spp was shown to be best for recovery.

It might be possible to come up with a value for natural mortality (M) using this type of model. It is important to look at the residual patterns before bootstrapping. The aggregate Fmsy takes the different species in different nodes into account, sometimes it is easier to think of it as “fishing effort”. The output changes when the B1/K goes from 0.5 to 0.6 in table 7, and that may be evidence of some sort of “wall” in the model. All zooplankton and phytoplankton is being eaten in the model. Some models make the plankton more dynamic. There are many analyses that can be done with this model, including adding up “known” MSYs from an age-structured models and seeing how ASPIC output compares. For the purpose of this analysis, the species needed to be summed for comparison with other studies.

Working Paper 3.4: J.S. Link, R. Gamble, W.J. Overholtz, C. Legault, L. Col, M.J. Fogarty. An Aggregate and MS Production Model: A Simulator Tool

Rapporteur: Larry Jacobson

*Presentation Highlights*

A logistic model was augmented to include ecosystem effects on a fish organized into three guilds (GARM species, small pelagic species and elasmobranch guilds). The model included fishing, predation, inter- and intra-guild competition. Model parameters were from single species stock assessments (e.g. Fmsy and Bmsy), food habits data and other sources. The model was used to simulate biomass dynamics of guilds and individual species under various assumptions under various levels of fishing, competition and predation. The main purpose was to examine how fishing, predation and competition affect carrying capacity and stock rebuilding plans for simulated GARM stocks individually, as guilds and in aggregate.

Long term projections for aggregate biomass showed four main patterns. First, all groups had approximately equal carrying capacity with GARM species dominating slightly in simulations with no fishing and no species interactions. Second, harvesting impacted the pelagics and elasmobranchs more than GARM species guild. Third, species interactions impacted pelagics the most (as would be expected due to predation). Finally, with no harvest or interactions, the system produced a total biomass close to system carrying capacity. As either interactions or harvest intensified, aggregate carrying capacity was reduced. With both factors occurring, carrying capacity was reduced by approximately one-half.

There were five main patterns in multispecies simulation results. First, with no harvest or interactions, most species achieved the carrying capacity levels expected based on assumed parameter estimates and carrying capacity for the entire system was high. Second when species interactions are turned on, not all species reached their expected carrying capacities and many species approached carrying capacity much more slowly than expected. Third, reductions in carrying capacity due to harvesting were smaller than reductions due to species interactions. Fourth, with harvest and species interactions, carrying capacity and stock biomass was substantially lower for all species, guilds and the ecosystem as a whole than in the absence of these factors.

### *Discussion*

Discussants generally agreed with the overall results indicating reduction in carrying capacity due to species interactions and their potential importance. However, no procedures for adjusting actual reference points used by managers were presented.

Several members of the audience pointed out that production parameter estimates from single species assessments implicitly include “average” predation and species interaction effects during years included in the model. It was argued that model presented as parameterized had heuristic value but should not be used for management purposes as parameterized because species interaction effects were “double counted”. The authors agreed with the point but indicated that the intent was heuristic, the model was preliminary and similar overall results would be obtained using adjusted parameters.

Working Paper 3.5: Fogarty, M., W. Overholtz and J. Link. Fishery Production Potential on the Northeast Continental Shelf of the United States

Rapporteur: Larry Jacobson

### *Presentation Highlights*

The Northeast Continental Shelf of the United States has undergone dramatic shifts in species composition of harvested fish populations over the last five decades. We have documented a steady decline in the mean trophic level of the catch since 1960 with a current dominance by low trophic level invertebrates and small pelagic fishes. At the height of the distant water fleet fishery, an estimated 35% of the primary productivity was required to account for the observed commercial landings. Currently, approximately 10% of the primary production is appropriated to account for the observed catch (landings plus discards). Under our best current estimates of primary production, mean trophic level of the catch, transfer efficiencies, consideration of total removals (landings and discard) from the system at MSY levels, it appears that important constraints on available energy must be considered in setting harvest policies at an ecosystem level. Further consideration of food requirements for threatened species and apex predators under rebuilding strategies highlights the potential constraints on available energy to meet overall ecosystem management objectives. This perspective of necessarily involves consideration of possible tradeoffs among harvesting of GARM species and other system components. Application of an ecosystem overfishing criterion based on the primary production required to account for observed catch levels and the mean trophic level of the catch, the Northeast Continental Shelf is classified as overfished at the ecosystem level. If changes in system productivity states resulting in lower growth rates for GARM and other species are confirmed, the ecological transfer efficiencies for these components will shift to lower levels and the estimated fishery production potential will be correspondingly lower, exacerbating the constraints on the system removals.

### *Discussion*

This working paper compared preliminary estimates of total MSY for GARM species from preliminary stock assessments to updated estimates of potential production based on primary production and trophic structure assumptions. Trends in relative amounts of primary production associated with catches of various species were calculated also. Consumptive demands of fish (including GARM species), marine mammals, turtles, birds and protected species were included in calculations.

Results indicate that 7.2% of total primary production was required to support the commercial fishery during 2005. Including discard estimates and recreational catch, 9.55% of total primary production was required. In contrast, almost 35% of total primary production was required during peak years of exploitation by the distant water fleets. The estimated mean trophic level at MSY for all species represented by stock assessments during 2005 was 3.1. Based on a recently published classification system that uses percent of total primary production and mean trophic level, ecosystem overfishing occurred on the northeast shelf during 2005.

Results were sensitive to relatively uncertain assumptions about mean trophic levels. Based on one plausible estimate of mean trophic level, MSY for finfish and invertebrates is 1.29 million t or about 83% of the estimated primary production potential. If discards and incidental losses were included, then primary production required to support the fishery might be near or exceed 100% of the total available. Thus, results suggest that production potential may be a limiting factor in achieving MSY biomass levels for all fisheries simultaneously. It may be important to considering this possibility in formulating harvest policies for GARM and other northeast stocks.

Members of the audience seemed to recognize potential limits on stock biomass and fishery productivity due to limits on available primary production. After discussion, however, the Panel decided that the paper did not propose any particular immediate adjustment to harvest recommendations for GARM species during the current management cycle.

Working Paper 3.6: Link JS et al: Implications for Single Species Reference Points

Rapporteur: Larry Jacobson

*Presentation Highlights*

Proposed Ecosystem Terms of Reference Updates

1) Simulation studies to examine the performance of the aggregate model when applied to data generated using full age-structured models for an assemblage of species.
2) If the simulations in (a) confirm the utility of the aggregate model, we will compare our final results with results of single species production model analyses using the same estimation methods.
3) We will compare results from production models (both aggregate and single species) with the final results from GARM analyses of BRPs to determine overall applicability of the production models.
4) If we find convincing evidence that the aggregate case remains appreciably lower than the sum of the single species levels, we will examine possible ways of integrating the multispecies perspective with the individual species reference points in a simulation exercise.
5) We will update and refine the broader ecosystem analyses to provide an overall context for the GARM analyses. These will be used in a qualitative way.

*Discussion*

No working paper was presented under this agenda item. Instead, the previous working papers were discussed.

Several lines of evidence in WP3.5 and WP3.6 indicate that the ecosystem may not be able to support Bmsy levels for all managed stocks simultaneously, particularly if consumption by large marine mammals increases and considering discard.

## ToR 4. Biological Reference Points by Stock

Working Paper 4.1. Rago, P. Overview of Current Biological Reference Point Methods and Estimates for Multispecies Groundfish in the Northeast US

Rapporteur: Elizabeth Brooks

*Presentation Highlights*

This report provides a summary of current Biological Reference Points (BRP) for the 19 GARM III stocks and background on their methods of estimation. The definition of BRPs is an essential component of stock assessment. Measures of abundance and harvest rates derived from assessment models are compared to standards that constitute desirable states for each stock. These states are based on the concept of maximum sustainable yield. When sufficient information is available, BRPs can be based on fishing mortality and biomass values that produce maximum sustainable yield. In other instances, the BRPs are based on a proxy value that should approximate the fishing morality rates and biomass levels associated with maximum sustainable yield. The range of approaches reflects the range of available data types and quantity, and historical exploitation patterns.

Biological reference points for the GARM III stocks can be classified into three groups: “parametric”, “nonparametric”, and “index”. Parametric BRPs are derived from specification of an explicit functional relationship between recruitment and stock size. “Internal” parametric estimates are derived as part of the model identification and estimation process (GB winter flounder (fl.), surplus production model). “External” parametric estimators of BRPs use model outputs of abundance, SSB, recruits and fishing mortality as inputs to stand alone models such as SRFIT (GB cod, GOM cod, GOM winter fl., and SNE winter fl.). If parametric models (internal or external) are not acceptable, a “nonparametric” method is used to derive proxy values for Fmsy and Bmsy (GB haddock, GB yellowtail fl., SNE yellowtail fl., CC/GOM yellowtail fl., Amer. Plaice, witch fl., and redfish). These proxies are derived by combining standard yield per recruit (YPR) and SSB per recruit (SSB/R) methods with model-based estimates of absolute recruitment. Model parameters can be used to define appropriate partial recruitment vectors for YPR analyses leading to estimates of proxy estimates of Fmsy. SSB/R estimates for proxy Fmsy values can be multiplied by some function of the recruitment time series to obtain an estimate of SSBmsy or Bmsy.

Index methods the GARM III stocks this approach is formalized as the AIM model in the NOAA Fisheries Toolbox. This empirical approach finds a reference point for relative F where the population replaces itself (Pollock, northern windowpane fl., southern windowpane fl., Ocean pout, GOM haddock, and white hake). A major limitation of the AIM model is that the relative biomass target must be externally supplied. For a number of stocks even the index methods fail to provide precise quantitative guidance. For these stocks proxy reference points were deduced by examining historical landings, relevant aspects of the fisheries, and behavior of surveys (halibut).

*Discussion*

Clarification was requested as to whether rebuilding requirements were separate or distinct from specifying BRPs. It was noted that care is needed in how one re-samples recruitment into the future. Clarification was also requested as to what determines the decision for when to reject the fit of a stock-recruit model. The approach was outlined in Brodziak and Legault (2005). Typically, it takes into account multiple models, looking at the degree of fit for all models, variances, etc. The rules within parametric world look at AIC, but making the jump from saying “no parametric model fits are acceptable” to move to a non-parametric approach is not well-defined. One typically looks at diagnostics such as patterns in residuals. A panelist noted that one might also want to look at the level of SSB contrast (observations between $SSB_{MSY}$ and $SSB_0$. This was acknowledged by the presenter, but emphasized that one doesn’t always have (rarely has) that type of contrast.

The meaning of $B_{threshold}$ was unfamiliar to some of the panelists, who questioned what happened when a resource goes to that threshold. It was clarified that $B_{threshold}$ is the point below which management action is triggered and a rebuilding plan is established. The equivalent threshold for fishing mortality is $F_{threshold} = F_{MSY}$.

A panelist suggested that it would be good to get clarity on terminology, targets, threshold, limits, Fmax, $F_{40\%MSP}$, etc. We need to think about the different types of proxies, justification and implication of when a proxy is chosen.

Working Paper 4.2. Legault, C. Setting SSBmsy via Stochastic Simulation Ensures Consistency with Rebuilding Projections

Rapporteur: Elizabeth Brooks

*Presentation Highlights*

Current approaches to setting biological reference points and conducting projections contain an inconsistency. Specifically, fishing at the Fmsy rate for many generations does not produce the SSBmsy with 50% probability. This inconsistency arises whether a parametric or empirical approach is used due to the variance in projected recruitment causing the stock to be more or less productive than assumed in the deterministic calculations of the reference points. The proposed solution is to utilize the available projection software to make the SSBmsy value an emergent property of fishing at Fmsy for many generations. This approach ensures consistency between the reference points and the projections used to determine fishing levels necessary to rebuild overfished stocks to the SSBmsy level. This paper provides a demonstration of large the inconsistency can be in a typical situation and discusses a number of related issues including an extension of this approach to solve for Fmsy, the standard approach to deal with lognormal error distributions, historical significance of this inconsistency, biologic and fishery vectors used in the calculations, and Fmsy relative to its proxies.

*Discussion*

A panelist was concerned that you end up having a different definition for Bmsy if your rebuilding target were 50% or 75%. Bmsy should be independent of your rebuilding target. The speaker clarified that 50% would still be the Bmsy target, but management could shoot for a different rebuilding target. The speaker was not proposing that we change the 50% target; the management choice of a rebuilding percentile is an independent choice.

Regarding projecting to get the median, a panelist asked if this is a switch to use the median vs. the mean. If you are happy to go with the average F, then you can use bias correction, so it seems the difference is whether we accept median or mean. The panelists' inclination is to stick with the mean, only because you don't have to do the simulations and therefore your results would be invariant to simulation trials. It is quicker and easier. The speaker responded that the issue is that in the deterministic calculation, you can solve for the values, but the implied precision is unreal. For mean vs. median, because we are working in a probabilistic situation, and because there is talk of moving to alternative percentiles, we need a method that is consistent with that. It works in the parametric case, but not so easy for the empirical approach. The projections accept two parameters for the stock recruitment function, and you assume (fix) some level of variability about that. This approach takes into account whatever level of uncertainty is specified.

A panelist questioned the decision to not do same thing for Fmsy as is being proposed for Bmsy. The speaker responded that when we do the empirical approach, we have a different model to derive Fmsy. The panelist rejoined that it seems like you have an F that you would get for a different model. The speaker responded that the tradeoff is you have to look at variability in yield from year to year.

There was a fair amount of discussion regarding the mean versus the median for reference points. The main point of debate was that the median is a management decision, whereas the mean is an expectation or maximum likelihood result. Choosing the median is just another way of defining an SSB reference point, but it doesn't correspond to the population dynamics implied SSBmsy. The speaker responded that this is a proposed proxy. It is an easy fix to ensure that you meet your rebuilding target.

A member of the audience strongly supported the proposed projection approach. He pointed out that you have a process that has an inconsistency, and this method solves the inconsistency. A nightmare of added complexity could ensue if one were to carry this any further; what is needed is a robust proxy rather than something perfect. One shouldn't get carried away with the mass at age, and say you'll work with it over the short term horizon. It is not worth nitpicking every year. The proposed approach is viable and consistent. It was pointed out, however, that there are two things to take care of in this proposed approach. 1) the issue of what is in and what is not in when you consider recruitments (ex: for haddock, is it a mixture distribution or a single distribution; considering a single distribution you get an unbelievable distribution); 2) given the different results for fitted S-R vs. proxy, you've got to look at some measure of precision of that estimate (the proxy); you will likely see that there is a wide range that may be in a more reasonable range. The speaker responded to the first point by saying that with the exceptionally large year-classes for haddock, even if one sets the bar high by including them, you still have consistency—even if it is unrealistic.

A panelist asked if, when going through stocks later, would the expected value for SSBmsy from deterministic as well as AGEPRO estimates be presented, just so that the Panel understands the magnitude of the adjustment. The speaker replied that for some that would be the case, but probably not for all. The SRFit values probably exist for most, so it is a matter of compiling those. The panelist followed up, saying that it is important for the Panel to see the estimates so that they can understand the adjustment, and to understand what is causing the size of the adjustment; it becomes a point of whether you believe the estimate of sigma for recruitment deviations.

The Panel decided to accept the approach in principle, but to look at results on a case by case basis to see if it makes sense.

Working Paper 4.3: Michael Palmer and Chris Legault. Sensitivity of the Long-term Observation-error Survey Series (LOSS) model to variable stock-recruit steepness and stock depletion inputs: A test case using Gulf of Maine haddock

Rapporteur: Gary Shephard

### *Presentation Highlights*

The GARM III 'models' review Panel recommended that for stocks currently using the Relative Trend class of models "alternative models should be explored that both have a stronger basis in biology and more explicitly address uncertainty". Specifically, age-structured models were recommended that incorporate life history parameters and which allowed direct estimates of biological reference points; e.g., age-structured production model. Biological reference points for the Gulf of Maine haddock stock have been determined using An Index Method (AIM) since 2002. This model is assumed to be informative given the strong relationship between the relative fishing mortality and replacement yield for this resource. Because of this strong relationship, the Gulf of Maine haddock stock is good candidate to assess the performance of age-structured production models on northeast United States groundfish stocks.

The application of a specific age-structured production model, the Long-term Observation-error Survey Series (LOSS), to the Gulf of Maine haddock stock is examined. Despite a clear minimum value of the objective function, none of the LOSS model runs are statistically different from one another with values of the objective function ranging from 21.795 to 22.517. However, there are large differences in the implications between the runs for stock status determination. Given the inability to determine a "best" model formulation and the wide ranging implications on stock status, the LOSS model is not a good candidate with which to determine biological reference points for Gulf of Maine haddock.

*Discussion*

The intent was to examine the use of an alternative model for Gulf of Maine haddock assessment. It was concluded that there was no clear best model based on the objective function and there were implications in the biological reference point in choosing the wrong model.

The Panel suggested the development of a model incorporating process error. In addition, a follow-up model was suggested using an informed prior such as the use of age one estimates. However, since the log-likelihood did not provide adequate contrast, incorporation of process error could have a big influence on the outcome. Use of some catch at age information would constrain the process error. The approach has worked for some species but inevitably poor data creates poor results without any information as a prior. A more extensive modeling exercise has been undertaken in the GoM haddock assessment.

Working Paper 4.7: D. Hart and T. Miller. Analyses of tagging data for evidence of decreased fishing mortality for large Gulf of Maine Cod, Gadus morhua

Rapporteur: Gary Shephard

*Presentation Highlights*

Two complimentary analyses of Atlantic cod tagging data from a tagging study carried out by the Gulf of Maine Research Institute were performed using the methodology we employed previously for yellowtail flounder at the previous Groundfish Assessment Review Data Meeting. The first compares expected probability of recovery by age class for tagged fish based on estimates of age-specific fishing mortality by Butterworth and Rademeyer (2008) and a standard VPA with the observed proportions of recoveries for different length classes (and approximate corresponding ages) in the Atlantic cod tagging data. The second analysis fits a finite-state continuous-time model to the Atlantic cod tagging data to estimate different fishing mortality parameters within the Gulf of Maine, Georges Bank and Canadian 4X stock areas for fish in three size classes ($\leq 60$, $> 60$ and $\leq 85$, $>85$) at release. Maximum likelihood estimates of instantaneous migration, natural mortality and tag-shedding rates, tag reporting probability and a non-mixing scalar to adjust fishing mortality in the first month after release are also provided by the second analysis. Although the latter parameters are not the focus here, it is desirable to "control" for different migration between and mortality rates within regions when estimating these size-specific fishing mortality rates. Neither of the analyses we undertook showed evidence (statistical or otherwise) that larger (older) Atlantic cod are subjected to lower fishing mortality in the Gulf of Maine than smaller (younger) Atlantic cod. Ideally, we would like to consider a model for the tagging data that allows fishing mortality to change over the life history of a given fish as it grows larger and older, because fish that are small at release will experience different fishing intensities as it grows. However, the use of size at release should provide results that are a good approximation.

*Discussion*

Tag results from a cod tagging program in the Gulf of Maine were presented. The Panel questioned if the high reward tags were randomly assigned among all sizes. The model produced variable M by size and it was suggested a constant M model may influence the results as the higher M may confound the dome question. However in the largest size class the M was fairly uniform compared to the next smaller size category and was unlikely creating any undue influence. The high reward reporting rate remained an issue in that a higher reporting rate by size could camouflage any dome selectivity pattern. Perhaps further examination of high reward reporting rates would be helpful. Some modifications to the Miller model were suggested, such as constant M, but time constraints did not permit new runs.

Working Paper 4.8 (Supplementary Paper): Butterworth, D. Implications of Tagging Analyses for the Shape of Selectivity at Age for Gulf of Maine cod

Rapporteur: Gary Shephard

*Presentation Highlights*

WP 4.8 (Supplementary) discussed alternative possible interpretations of the results of the tag-recapture data for cod provided in Hart and Miller (GARM-III BRP TOR 4.7). Building on the basic framework underlying estimation from such data previously presented in Butterworth and Rademeyer (Supplement 2 to GARM-III TOR 2), it was shown that the high estimates of M in the Hart and Miller analyses could reflect either higher natural mortality than 0.2, or permanent emigration of portions of the population, given that the other interpretation of a tag-induced additional mortality rate of 0.8 for older animals seemed unrealistically large. Thus the tag-recapture results were open to interpretation as a validation of permanent emigration (which would be reflected as an apparent decline in selectivity at large ages), or of higher natural mortality. A further possibility was that there is either large immediate mortality of tagged cod, or under-reporting of high reward tags, which would lead to increased estimates of F and decreased ones of M. Specifications for a suggested further run of the Hart and Miller analysis were put forward, anticipating that the results would show whether the requisite decrease in M could be obtained without increasing F to an extent that would render it incompatible with the assessment. Suggestions were made of approaches to independently test hypotheses that would lead to domed shaped selectivity. Specifically the possibility of older stronger swimming cod being able to escape capture by trawl nets could be examined by mounting cameras on nets, and of older cod preferentially inhabiting untrawlable rocky ground by placement of longlines in such areas.

WP 4.8a presented the results of runs of the ASPM (SCAA) assessments for Gulf of Maine cod presented in WP 4.F.1 adjusted to commence in 1964 as requested during discussions, and covering values of M=0.3 as well as the conventional M=0.2 for both Ricker and Beverton-Holt stock recruitment relationships, and for both estimated and flat selectivity at large ages. Notable results were clear preferences in likelihood terms of Ricker over Beverton-Holt relationships, and of M=0.3 over M=0.2. For M=0.3 and the Ricker relationship, extension from flat to dome shaped survey selectivity was not justified in terms of AIC. Thus a change from

M=0.2 to M=0.3 would seem to provide a way forward towards satisfying the requirement for assessment models to fit proportion at age data at large ages without at the same time having to postulate decreasing selectivity at these ages. However there remained a number of aspects of these analyses that needed to be investigated further, including alternative formulations of the stock-recruitment relationship which might have implications for values estimated for the spawning stock biomass at MSY.

*Discussion*

The discussion turned to an alternative interpretation of the tagging model results. The suggestion was made that a permanent emigration to parts unknown would account for a dome shaped selectivity pattern in GoM cod. The chair remarked that the saturation of the area with fishing effort made it improbable that a refuge for large fish existed within the confines of the Gulf of Maine. Also a high reward reporting rate less than 100% was suggested as a factor influencing M and consequently the selectivity pattern in the Miller model. The alternative Butterworth model implied that the Miller model had likely over estimated M. It was noted that M in the Miller model is actually a combination of all factors that could result in tag not being recovered.

The issue of dome shaped selectivity was further discussed. Gear avoidance was proposed as a possible mechanism. However the mixture of gear types in the fishery would make that mechanism less likely. The survey gear could have a dome if fish were concentrated in unfishable habitat or the survey changed over time. It was pointed out that the change in age distribution over the survey time series suggested that excessive fishing mortality on large cod was a more plausible explanation. The issue of dome shaped selectivity was not resolved and participants waited the next iteration of this discussion.

Working Paper 4.A: O’Brien L. Georges Bank Cod

Rapporteur: Sue Wigley

*Presentation Highlights*

Georges Bank Atlantic cod is a transboundary stock that is harvested by both US and Canadian fishing fleets. The stock includes landings from statistical areas 521-522, 525-526, 561-562, 551-552, 537-539 and south. GB cod range in depth from 32 m to 226 m, occupying cool, shallow water in the spring and warmer, deep water in the autumn.

A VPA model formulation was accepted as the final assessment for GB cod (O’Brien et al., 2006) at the GARM-II meeting (NEFSC, 2005). The biological reference points (BRPs) were developed based on landings only from the 2001 assessment (O’Brien and Munroe, 2001), using a Beverton-Holt stock-recruit relationship with an assumed prior for the unfished recruitment as (NEFSC, 2002):

$F_{MSY}$ = 0.175,
MSY = 35,200 t and
$SSB_{MSY}$ = 217,000 t.

At the GARM III BRP meeting, a VPA formulation was accepted as a preliminary assessment model and a non-parametric YPR analysis was chosen for estimation of BRPs.

These estimates are provisional and may change after the GARM III Assessment Meeting in August 2008:

$F_{MSY}$ = 0.25,
MSY = 30,220 t and
$SSB_{MSY}$ = 143,343 t.

The current April 2008 VPA formulation includes landings, commercial discards, and recreational catch in the catch at age as recommended by the GARM II Panel (NEFSC, 2005) for the period 1978-2006. The NEFSC spring and autumn, and DFO spring survey abundance indices are used to calibrate the VPA. A three-year moving average was used to estimate the proportion mature at age. An ASAP model formulation was also run but not used for estimation of BRPs. In the YPR analysis, VPA results were used to derive a five year average, 2002-2006, for the PR, stock weights, catch weights, and proportion mature at age.

The provisional BRPs from the current YPR are higher for $F_{MSY}$, slightly lower for MSY, and lower for $SSB_{MSY}$ compared to the previous BRPs. This is due in part to a change from a parametric to a non-parametric model for estimation of the BRPs. The lower values are also due to a change in the partial recruitment vector with GB cod becoming fully recruited at age 5 instead of age 4 as seen in previous assessments. In addition, the mean weights at age have declined in recent years, and there is an updated maturity ogive.

### *Discussion*

An updated assessment that included landings, commercial discards, and recreational catch through 2006 was presented. Based on GARM ‘models’ review advice, two models (VPA and ASAP) were used to assess this stock. Results from the two models were similar with relatively small percent differences in F and SSB between the VPA and ASAP formulations. ASAP estimates of Age 1 recruitment of the 2003 and 2005 year classes are about 35% less than VPA estimates. Regarding the ASAP model, a point of clarification was made; the ASAP formulation did account for changes in mean weights at age, however it did not account for changes in selectivity. Given a more pronounced retrospective pattern in the ASAP, the VPA (with split in all survey tuning indices) was selected as the most appropriate model for biological reference point estimation and that best model for stock status determination would occur at a later meeting.

There has been a shift in fully recruited fishing mortality from age 4 to age 5. The Panel noted that the revised biological reference points (BRPs) are not comparable to current BRPs due to this shift in selectivity as well as the addition of discards in the catch-at-age and the declining trends in mean weights that have occurred in age 5-8 yr old fish in recent years.

The Panel commented that recruitment has been low for the past 15 years, biomass has been low, and fishing mortality has been high for this stock. SSBmsy estimates for all models are outside the range of the time series observations. The BRPs may not be met given current conditions.

The Panel discussed the large differences between the parametric (Beverton-Holt S-Rfit) and the non-parametric (YPR) approach to derive SSBmsy (274,211 t and 93,995 t, respectively). The Panel suggested a closer examination of the stock-recruit relationship, specifically: 1) examine recruitment when SSB is greater than 40,000 t; 2) compare the stock spawning biomass and recruitment derived from the ASAP and VPA models, 3) use ASAP formulation with a selectivity block at 1999 to account for the change in mesh size regulations, and 4) examine the impact of trimming the recruitment series based on residual variances.

The requested analyses were conducted during the meeting. A non-parametric approach using values of recruitment (14 values) when SSB was greater than 50,000 t was presented. Recruitment from SSB greater than 50,000 t was determined to be the best cut-point based on a 'razor' analysis, i.e. total variance of recruitment is estimated as a function of cut points on SSB where the preferred SSB cut point corresponds to the lowest variance in recruitment.

It was noted that the current BRP established in 2002 used a prior on recruitment of 23 million fish. The first B-H model BRPs presented was based on the upper 90% of recruitment (29 million fish) whereas the revised recruitment prior of 21 million fish is based on the 50,000 t SSB cut-point. The use of hindcasted values would have resulted in higher values for the prior on recruitment. The Panel expressed concern regarding the use of the ASAP re-run to derive BRPs due to the wide range of SSBmsy and MSY that results between the deterministic and the stochastic analyses. Because the results depended upon the prior and sigma used, the issue could not be resolved.

For this stock, the Panel agreed that the revised BRPs should be based on the projection results of the non-parametric approach (YPR) where $F_{40\%MSP}$ = Fmsy = 0.25, SSBmsy = 143,343 t, MSY = 30,220 t using an empirical cdf of recruitment associated with SSB greater than 50,000 t. These reference points are provisional and may change at the August 2008 GARM.

Working Paper 4.B: Brooks L. Georges Bank Haddock

*Presentation Highlights*

The Georges Bank stock of haddock (*Melanogrammus aegelfinus*) is found in the waters of Georges Bank at depths of 40 to 150 m. The stock spans NEFSC statistical areas 521, 522, 525, 526, 537, 538, 539, 551, 552, 561, 562. The stock was last assessed at GARM-II in 2004 using an ADAPT VPA model. The reference points were derived from the working group on biological reference points (NEFSC 2002), where $F_{40\%MSP}$ served as a proxy for $F_{MSY}$, and SSB/R and YPR were scaled by the average recruitment level for years where SSB>75,000 t, excluding the 1963 year class. The GARM-III agreed that an ADAPT VPA (v2.7.7) was the preferred assessment model. Model inputs included new estimates of discard at age for years 1989-2006, following the method of observed ratio of discarded haddock to kept of all species (approved method from GARM III 'models' review). Landings at age were re-estimated for years 1989-2006 using the landings allocation methodology agreed to at the GARM III 'data input' review. One further difference between the GARM-III and GARM-II formulation is that the GARM-III VPA used a single maturity ogive for all years, whereas the GARM-II assessment used time-varying stanzas of maturity. The reference points for GARM-III were calculated according to the AGEPRO projection methodology accepted at the GARM-III reference point meeting. Bootstrapped numbers at age for the terminal year were projected for 100 years at $F_{40\%MSP}$ (a proxy for $F_{MSY}$) using AGEPRO and taking the median value of SSB and yield at equilibrium. An average of the last five years of selectivity and weight at age were used, and the selectivity was forced to be flat topped by scaling such that the fully selected age and all older ages had a selectivity value of 1.0. Projected recruitment was resampled from the cdf of recruitment values that corresponded to years where SSB greater than 75,000 t, excluding the 1963 and 2003 year classes. The recruitment values came from applying the accepted VPA framework to data that extended back to 1931. The BRPs for GARM-III were:

$F_{MSY}$=$F_{40\%MSP}$=0.34, $SSB_{MSY}$=164,300 t, and MSY=35,000 t. The rate for $F_{MSY}$ is higher than that from GARM-II because the partial recruitment has shifted towards older ages, in part because of smaller fish length at age. The values for $SSB_{MSY}$ and MSY are lower than values from GARM-II because fish weigh less at age now than in 2000 (the last year of data used to calculate existing reference points). These BRP values are provisional and may change at the final GARM-III meeting.

*Discussion*

It was noted that this assessment differs from previous analyses by the inclusion of revised discards, and maturity ogives. The addition of the revised discards back to 1989 resulted in a slight increase in the estimated stock sizes.

It was suggested that one should look for year effects and age effects in the bootstrapped survey indices. Because the parametric fit to the Beverton-Holt S/R function did not provide reasonable results, the AGEPRO approach was attempted, resampling the CDF of recruitment. This also produced an unreasonable outcome. The default was to use SSB/R multiplied by average recruitment. The average used excluded the large 1963 and 2003 year classes. This generated considerable discussion, with Panel members on both sides of the issue. It was seen to be acceptable if only one of these appeared. But now that the 2003 year class has appeared at the similar magnitude as 1963, it is possible that these may appear again. These year classes were included in the CDF used by AGEPRO, but not when calculating the average recruitment for the SSB/R analysis. There will be a lesser effect on the median compared to the mean.

The question of density-dependent effects on weights at age was raised. Are these effects transient meaning that the stock may return to earlier conditions and a longer period to average the mean weights at age may be more appropriate. For this meeting the “true” values were presumed to be bounded by those used in the 2002 BRP meeting and GARM III.

For the ASAP run, considerable effort was placed on matching the catch at age a closely as possible. This was achieved by inserting a series of selectivity blocks. Based on this, it appears that selectivity has changed over time, especially in recent years. This led to a question on the basis of using a 5 year recent average instead of the most recent few years. It was suggested that changes in the partial recruitment may occur as the 2003 year class passes through the fishery. In general, selection of a partial recruitment pattern should take into account the same considerations as changes in growth.

There were many reasons such as autocorrelation for rejecting the deterministic stock-recruit fit in addition to the residual pattern. It was noted that autocorrelation is present in many groundfish stocks.

The calculation of SSBmsy using the SSB/R approach is deterministic, and was used as a fallback approach. One of the consequences of lower partial recruitment and mean weights at age is higher F 40% MSP that says fish harder. Concern was raised that there will be an increase in exploitation as the change in partial recruitment will affect the TAC. Average recruitment was calculated using estimated recruits produced by SSB levels greater than the median SSB as was done by the 2002 BRP Working Group.

A discussion ensued on whether to use median SSB as the breakpoint at the present meeting, or whether the transition from the lower recruitment stanza to the higher one occurs at another SSB level. The s/r plot should be examined to look for the SSB breakpoint. It was concluded that 75,000 t of SSB may still be a valid value for use as the transition point.

A lengthy discussion took place regarding three assumptions related to this approach: 1) whether to remove the 2 largest year-classes (1963 and 2003), 2) whether to use an arbitrary eyeball approach to determine the transition point, and 3) how to incorporate stochasticity.

On point 1, the Panel agreed that it is appropriate to remove these 2 very large year classes. This is equivalent to managing for a lower distribution of recruitment and take advantage of a bonanza when it occurs. It may be possible to test to see when we are at the transition point.

On point 2, it was suggested that the 75,000 t breakpoint is arbitrary. There may be an objective way to find the breakpoint, such as the breakpoint that provides the best AIC. Use a 3 parameter step function, including the value to the left, the one to the right and the change point. Actually, choice of 75,000 t is not arbitrary as it was based on odds ratios.

On point 3, it was suggested that instead of taking the average, one can bootstrap the distribution of recruitment in calculating the median. Using this approach may not be consistent with the AGEPRO approach. AGEPRO allows for 2-stage re-sampling and can be tried here.

The Panel questioned the type of reference point that is required for this almost rebuilt stock. There is a need to capture stochasticity and maintain consistency and not alter the measure of central tendency. The median Bmsy is the median value of the biomass that provides MSY at Fmsy rather than the expected value (the mean). This does depend on the underlying distribution.

Finally the Panel concluded that The VPA model 3 is the most appropriate. The Panel also supported exclusion of the 2 very large year classes, and to use the 75,000 mt SSB breakpoint.

Working Papers 4.C, D & E: Legault C et al.: Georges Bank, Southern New England/Mid Atlantic, Cape Cod/Gulf of Maine Yellowtail Flounder

Rapporteur: Lisa Hendrickson

*Presentation Highlights Georges Bank*

Georges Bank yellowtail flounder are generally found in depths between 40 and 70 m. The biological reference points in GARM-II were derived from a VPA as Fmsy = 0.25, SSBmsy = 58,800 t, and MSY = 12,900 t. The biological reference points in GARM-III were derived from a VPA as Fmsy = 0.25, SSBmsy = 46,000 t, and MSY = 10,000 t. These updated values are provisional and may change at the final GARM-III meeting. The updated values assume $F_{40\%MSP}$ as a proxy for Fmsy and recruitments associated with SSB values greater than 5,000 t including hindcast recruitments. The updated VPA has catch information for years 1973 to 2006 and the hindcast values are for years 1963-1972. All hindcast values are assumed to have SSB above 5,000 t. Changes to the data include revisions to the US commercial landings due to the new trip-based allocation scheme and revisions to the US commercial discards due to the application of the SBRM approach. The NEFSC Spring and Fall surveys along with the DFO survey were used as age-specific tuning indices and the NEFSC scallop survey provided an age-1 index of abundance as well. The changes in biological reference points are relatively minor and reflect mainly changes in estimated recruitments due to the change from the “Base Case” VPA to the “Major Change” VPA and the retrospective pattern observed in the “Base Case” VPA.

*Discussion Georges Bank*

Parametric (assumed Beverton-Holt S-R relationship) and empirical (YPR and SSB/R model) approaches were utilized to estimate biological reference points (BRPs) for the “base case” VPA run (strong retrospective pattern) versus the “major change” run (survey series split between 1994 and 1995 resulting in improved retrospective pattern, this is the model used for management purposes). The Panel noted that the BRPs were similar for input data from both the “major change” model and the “base case” model. The Panel discussed the Beverton-Holt (B-H) stock-recruitment model formulations at length and noted that the inclusion of an $R_0$ prior resulted in lower $F_{MSY}$ and higher $SSB_{MSY}$ estimates than those estimated without an $R_0$ prior and that the estimated steepness parameters were high (0.79-0.86). As a result, the Panel recommended acceptance of the empirical BRP estimate of $F_{40\%MSP}$ and $SSB_{MSY}$, but was concerned about the effects of the inclusion of the less-precise estimates of hindcast recruitment (1963-1972) and the inclusion of all of the SSB values. Consequently, the Panel requested and reviewed a per-recruit model run with an SSB cut point of 5,000 t and inclusion of all hindcast recruitment estimates (SSB values were assumed to be greater than 5,000 t), in order to increase the likelihood of high recruitment in the future. There was some concern about the fact that catches were high during the period for which recruitment was hindcast (1963-1972) and therefore the R and SSBmsy may be underestimated. Conversely, the large extrapolation in the hindcast calculations caused concern that these values may be too high. It was suggested that the hindcast recruitment values and associated catches during the period be used to solve for F for confirmation that the hindcast values are reasonable.

The Panel accepted the empirical reference point estimates that incorporated data from the “major change” VPA model ($F_{40\%MSP}$ = 0.25, as an $F_{MSY}$ proxy, and $SSB_{MSY}$ = 46,000 t). The associated MSY value is 10,000 t.

*Presentation Highlights SNEMA*

Southern New England-Mid Atlantic yellowtail flounder are generally found in depths between 40 and 70 m. The biological reference points in GARM-II were derived from a VPA as Fmsy = 0.26, SSBmsy = 69,500 t, and MSY = 14,200 t. The biological reference points in GARM III were derived from a VPA as Fmsy = 0.26, SSBmsy = 27,600 t, and MSY = 6,300 t. These updated values are provisional and may change at the final GARM III meeting. The updated values assume $F_{40\%MSP}$ as a proxy for Fmsy and recruitments associated with SSB values greater than 5,000 t but does not include hindcast recruitments. The updated VPA has catch information for years 1973 to 2006. The new VPA uses ages 1-6+ while the previous VPA used ages 1-7+. The new VPA does not exhibit a retrospective pattern while the previous one did. Changes to the data include revisions to the commercial landings due to the new trip-based allocation scheme and revisions to the commercial discards due to the application of the SBRM approach. The NEFSC Winter, Spring and Fall surveys were used as age-specific tuning indices. The changes in biological reference points are relatively large and reflect mainly changes in recruitments used in the calculations. Only VPA estimated recruitments are used in the updated biological reference points while the GARM II values used hindcast recruitments as well. This change is due to the continued low recruitment in recent years potentially indicating a change in stock productivity.

*Discussion SNEMA*

Similar to the GB stock, Panel members recommended acceptance of the empirical BRP estimates based on input data from the VPA model but were concerned about the effect of including the two largest hindcast recruitment values and all of the SSB values in the estimation. Survey indices suggest that the stock has been much less productive since the early 1990s, and because the stock is at the southern limit of its range, sustainability may be affected by changes in environmental conditions. As a result, the Panel reviewed two additional model runs that included an SSB cut point of 5,000 t and either the exclusion or inclusion of the hindcast recruitment values for 1963-1972.

The Panel accepted the empirical reference point estimates that incorporated data from the final VPA model run ($F_{40\%MSP}$ = 0.26, as an $F_{MSY}$ proxy, and an $SSB_{MSY}$ estimate of 27,600 t). The associated MSY value is 6,300 t.

*Presentation Highlights Cape Cod-Gulf of Maine*

Cape Cod-Gulf of Maine yellowtail flounder are generally found in depths between 40 and 70 m. The biological reference points in GARM-II were derived from a VPA as Fmsy = 0.17, SSBmsy = 12,600 t, and MSY = 2,300 t. The biological reference points in GARM-III were derived from a VPA as Fmsy = 0.24, SSBmsy = 8,300 t, and MSY = 1,800 t. These updated values are provisional and may change at the final GARM-III meeting. The updated values assume $F_{40\%MSP}$ as a proxy for Fmsy and both VPA and hindcast recruitments. The updated VPA has catch information for years 1985 to 2006 and the hindcast values are for years 1977-1984. The new VPA uses ages 1-6+ while the previous VPA used ages 1-5+. The new VPA does not exhibit a retrospective pattern while the previous one did. Changes to the data include revisions to the US commercial landings due to the new trip-based allocation scheme and revisions to the US commercial discards due to the application of the SBRM approach as well as the addition of two new survey series: the Maine-New Hampshire Inshore Trawl Survey Spring and Fall series. The NEFSC Spring and Fall surveys and Massachusetts Spring and Fall surveys, along with the ME-NH surveys, were used as age-specific tuning indices. The changes in biological reference points are relatively minor and reflect mainly changes in estimated partial recruitment (for Fmsy) and recruitments (SSBmsy and MSY) due to the change from the age 5+ VPA to the age 6+ VPA using the new data.

*Discussion Cape Cod-Gulf of Maine*

A $R_0$ prior was required to estimate the steepness parameter for the B-H curve, otherwise steepness was estimated as 1.0 and very high estimates of $F_{MSY}$, equal to $F_{max}$, were obtained. However, even with the incorporation of a prior, high steepness estimates (0.949 and 0.954, respectively) were obtained for models that used VPA and ASAP input data. As a result, the Panel recommended acceptance of the empirical BRP estimates based on input data from the VPA model. However, the Panel had concerns about the effects of the inclusion of hindcast recruitment values and all of the SSB data on the BRP estimates. Therefore, the Panel requested and reviewed an additional model run that included hindcast recruitment estimates for 1977-1984. There was no obvious breakpoint present in the SSB data series, so the entire series was used in the final model run.

The Panel accepted the results of the empirical approach which resulted in an $F_{40\%MSP}$ estimate of 0.24 (= $F_{MSY}$ proxy) and $SSB_{MSY}$ estimate of 8,300 t. The associated MSY value is 1,800 t.

Working Paper 4.F: Mayo R. Gulf of Maine Cod

Rapporteur: Sue Wigley

*Presentation Highlights*

Atlantic cod (*Gadus morhua*) inhabiting the waters of the Gulf of Maine are found at most depths ranging from the shallow parts of the western Gulf of Maine out to depths down to 300+ m. The stock comprises NEFSC statistical areas 511-515. The stock was last assessed at GARM II in 2004 using a VPA model. The existing reference points at that time were: Fmsy = 0.23, SSBmsy = 82, 830 t, and MSY = 16,600 t. The GARM III agreed assessment is a VPA model using the same formulation as at GARM II. The reference points based on results of this assessment are: $F_{40\%MSP}$ proxy Fmsy = 0.23, SSBmsy = 71,150 t and MSY = 14,936 t. The GARM III assessment includes catch data through 2006 and survey data through spring 2007. The catch data have been revised since the GARM II assessment, including: revised catch by stock based on the allocation scheme agreed at the October 2007 GARM III Data Meeting, revised catch at age from 1994 forward, revised recreational estimates from 1982 forward, and revised Massachusetts DMF survey indices from 1982 forward. These data changes were minor and did not contribute to any substantial differences in the assessment. The biological reference points estimated at the GARM III Biological Reference Point Meeting are similar to those in place at GARMII. Fmsy is the same, and SSBmsy is about 14% lower and MSY is about 10% lower than the existing reference points. The revised reference points were based on a period of lower partial recruitment and average weights at age than the existing reference points.

*Discussion*

VPA and ASAP models were presented with updated information through 2006 (WP 4.F). The VPA analyses included a BASE run that used the same formulation as in previous assessments and a SPLIT run that used survey tuning indices that were split between 1994 and 1995. Retrospective patterns were not present in either the BASE or the SPLIT VPA formulations. An alternative forward-projecting model (ASAP) was also performed to investigate the fishery selectivity pattern. A single logistic selectivity pattern and a double logistic pattern for two time periods were explored. Results indicated a similar fully recruited F in most years; however estimates of F from ASAP were lower than from the VPA. Retrospective patterns of F were considerably different between the two ASAP formulations. The Panel agreed with the conclusion of the GARM III 'models' Panel that the catch at age data are sufficient to employ an age – structured model assuming negligible errors in the catch-at-age, thus, the VPA base assessment was preferred model for estimation of biological reference points.

Discussion focused on the magnitude of the hindcast recruitment from the S-R model; the Panel noted that the mean of the hindcast recruitment was approximately twice the mean of the non-hindcast recruitment. The Panel noted that high recruitment occurred at high biomass. Given the low current biomass, the Panel commented that it appeared unlikely that stock re-building could be achieved by 2014.

Additional discussion focused on the flat-top partial recruitment vector used in the VPA, lack of older fish in the population and the previously high fishing mortality on this stock. This topic was also discussed during the cod tagging analysis (WP 4.7) that indicated no evidence of a decline in the return rates for older fish compared to younger fish in the population.

Working Paper 4.F.1: Butterworth D. Gulf of Maine Cod

Rapporteur: Sue Wigley

*Presentation Highlights*

WP 4.F.1 (plus Addendum) updated the ASPM (SCAA) assessments for Gulf of Maine cod presented in Butterworth and Rademeyer (GARM III Working paper 2.2a) through the addition of data for two more years, with the plus group extended from age 7 to age 8 on AIC grounds. Based largely on AIC considerations (though for technical reasons these are admittedly approximately calculated), the best assessment selected was that with a Ricker stock recruitment function and dome shaped selectivity. Amongst a number of sensitivity tests, an early gear change, use of the Baranov form rather than Pope's approximation, and commencing the assessment in different years (all prior to abundance index data becoming available) did not lead to any differences of note in estimates of key quantities. A simulation study showed the ASPM estimator to introduce only a slight bias towards a domed shape when the underlying reality exhibits asymptotically flat selectivities. Assessment variants which force flat selectivity in NEFSC surveys and the commercial fishery at large ages were not simply less preferred, but indeed strongly rejected under the AIC model selection criterion (e. g. relative AIC-weights of less than 10-13 for the standard M=0.2 specification). Such variants are not compatible with the low proportions of older cod in surveys and commercial catches – a feature for which cogent explanation needs to be offered before they might be accepted as providing a reliable basis for assessment. The greater rate of decline of commercial selectivity for old cod compared to that for the NEFSC surveys provides indirect confirmation of some dome effect, though further evidence from other sources would be desirable. The assessment could hardly distinguish different values of M, though increasing M above 0.2 suggested a lesser downward selectivity slope at large ages and a better resource status. Search over a range of stock recruitment relationships suggested the Ricker form to be preferred, though without completely eliminating the Beverton-Holt form in AIC terms. Reference point estimates for each of these forms were put forward. Under the best ASPM assessment, the stock was estimated to be at present at some 80% of its MSY level in terms of spawning biomass, with most assessment variants suggesting somewhat higher levels than this.

The Alt-VPA methodology of Butterworth and Rademeyer (GARM III Working paper 2.2a) was applied to these updated data for the period 1982-2006 for which catch-at-age data are available. The fits of the models showed a preference for domed over asymptotically flat selectivity. However, the narrow range of estimates of Bsp values virtually precludes fits of different stock-recruitment curves from being able to distinguish between options as different as Ricker and Beverton-Holt (from which also very different estimates of Reference Points follow). Because of the clearly high variance that would accompany Reference Points inferred from this VPA analysis, they were not advanced, with a preference for approaches that can accommodate a wider range of data and hence achieve reasonable precision being expressed.

*Discussion*

An alternative assessment (SCAA/ASPM; WP4.F.1) was also presented where sensitivity to natural mortality, stock-recruitment and selectivity was explored. From this study, change in survey gear, the starting year, and the catch equation used (Pope vs. Baranov) had little effect on biological reference points. However, natural mortality did have an impact on BRPs. It was noted that there is a confounding relationship between M, selectivity, and the stock-recruitment relationship (either Ricker or Beverton-Holt). Additional analyses would be needed to isolate each of the three factors. Given the tagging (WP 4.7) result discussions, arguments were made (and counters to these also offered) that there is no evidence of older fish in the population as suggested by this alternative SCAA/ASPM assessment.

The discussion of the alternative SCAA/ASPM assessment focused on the years used in the assessment, the selectivity pattern, and natural mortality. It was pointed out that it is inappropriate to use landings data prior to 1963. While total species landings may be accurate prior to 1963, stock landings were derived via ad-hoc methods and thus the quality of the stock landings is different pre- and post-1963. The long history of cod fishing in New England indicates that 'pristine' conditions were not present in 1956 as suggested. Additionally, there is no survey data available to calibrate the model prior to 1963. WP 4.F.1 had shown that key results were not sensitive to whether the analysis commenced in 1960 rather than 1893. It was recommended that data from 1963 onward should be used.

The Panel pointed out that the alternative SCAA/ASPM analysis and the VPA analysis used a different time period as well as different age groups. The two assessments were not comparable due to the input differences.

Subsequent SCAA/ASPM analyses (WP4.8.a) were conducted during the meeting and presented where the time period of the alternative assessment was limited to 1964 onward and the implication of M=0.2 and M=0.3 were explored. Results indicated when M=0.3, statistical model selection criteria admitted the choice of a model with flat-topped survey selectivity, though for the case of a Ricker (and not a Beverton-Holt) stock recruitment relationship.

The Panel noted that the alternative SCAA/ASPM assessment is useful for exploring the interdependency of M, selectivity, and stock–recruitment; however, the unsolved issue of input data comparability remains. Without resolution of the above issue, there must be strong evidence to move away from the current approach (VPA analyses).

The Panel agreed that the choice of S-R model (Ricker or Beverton-Holt) could not be resolved at this meeting, and they recommended an empirical, non-parametric approach be used for biological reference points. The Panel suggested further examination of older age groups in the VPA assessment (beyond the current 7+ age groups); however the Panel recognized that there may be limitations in the survey data that may prevent extending to older age groups. The Panel also suggested extending the VPA time period back to 1963, if possible.

The Panel agreed that there was enough information to provide preliminary estimates of BPRs based on the VPA assessment. The Panel felt a flat-top partial recruitment assumption should be the default unless there is compelling evidence that older fish are not caught by the fishery. Further, a flat-top survey catchability at age is preferred unless there is a plausible explanation for older fish to avoid the survey gear or to have emigrated out of the survey area. The Panel also agreed that the all recruitment values from the time series (1982 -2006) should be used. The revised reference points are: SSBmsy = 71,150 t, $F_{40\%MSP}$=Fmsy=0.23 and MSY = 14,936 t. These revised reference points are provisional and may change at the August 2008 GARM.

Working Paper 4.G: Wigley S. Witch Flounder
Rapporteur: Laurel Col

*Presentation Highlights*

Witch flounder are common throughout the Gulf of Maine and in deeper areas on and adjacent to Georges Bank and along the shelf edge as far south as Cape Hatteras; witch flounder are assessed as a unit stock. During the SAW/SARC 37 (NEFSC 2003), a VPA assessment was conducted. The current biological reference points were estimated for witch flounder using yield and spawning stock biomass per recruit analyses (Thompson and Bell 1934) and the arithmetic mean of the VPA Age 3 recruitment (NEFSC 2003). The current biological reference points from that analysis are: SSBmsy = 25,248 t; Fmsy = $F_{40\%MSP}$= 0.23; and MSY = 4,375 t.

To update the biological reference points, two VPA formulations were performed for witch flounder: a BASE run and SPLIT run where survey tuning indices were split into two series between 1994 and 1995. The retrospective patterns observed in previous assessments persist in the BASE run while the retrospective patterns diminish in the SPLIT run. The VPA SPLIT run is selected as the preferred run for estimation of biological reference points.

Based on yield per recruit analyses using the 5-year (2002-2006) averages for partial recruitment, stock weights, catch weights and the 2005 maturity vector (2003-2007 pooled maturity data), the revised Fmsy = $F_{40\%MSP}$ = 0.22. Based on the long-term (100 year) stochastic projection, revised SSBmsy is 10,863 t and revised MSY is 2,195 t. The stochastic projection used the same partial recruitment vector, mean weight at age and maturity vectors used in the yield per recruit analysis. A constant F scenario was used (F = Fmsy = 0.22). Estimates of age 3 recruitment used in the projection was derived by re-sampling the cumulative density function based on the empirical observations during 1982 to 2006 (1979 to 2003 year classes) from the VPA SPLIT RUN. Fishing mortality was apportioned among landings and discards based on the proportions observed during 2002 – 2006. The proportions of F and M which occurs before spawning equals 0.1667 (March 1); M = 0.15. The revised SSBmsy and MSY values are lower than the current reference point values; this is attributed to the lower estimates of recruitment from the VPA SPLIT run, as well as the lower yield and SSB per recruit estimates. The revised reference points are provisional and may change at the August 2008 GARM.

*Discussion*

The Panel recommended the non-parametric (empirical) approach to determine biological reference points given the negative the stock-recruitment relationship for this species. This method was consistent with the previous biological reference point evaluation in 2002. For this stock, the Panel agreed that the VPA split formulation was the preferred model to use for the estimation of biological reference points given the diminished retrospective pattern. The underlying mechanism for splitting the time series in 1994 was questioned and it was commented that this time period was concurrent with several major changes in management regulations. By splitting the time series to address the retrospective pattern, it was felt that biological reference point estimation and associated management advice would be sounder. The best model for stock status will be determined at a later meeting. For witch flounder, the Panel agreed that the revised BRPs should be based on a non-parametric approach where $F_{40\%MSP}$ = Fmsy = 0.22, SSBmsy = 10,863 t and MSY = 2,195mt using all recruitment values.

Working Paper 4.H: O'Brien L. Georges Bank/ Gulf of Maine American Plaice
Rapporteur: Anne Richards

*Presentation Highlights*

American plaice is distributed along the Northwest Atlantic continental shelf from southern Labrador to Rhode Island in relatively deep waters (Collette and Klein-MacPhee 2002). Off the U.S. coast, American plaice are managed as a single stock in the Gulf of Maine-Georges Bank region where the greatest commercial concentrations exist between 90 and 182 m (50 and 100 fathoms).

A VPA model formulation was accepted as the final assessment for American plaice at the GARM II meeting (O'Brien et al. 2005, NEFSC, 2005). The biological reference points (BRPs) were developed with a non-parametric YPR analysis (NEFSC 2002) using mean recruitment associated with all SSB estimates from the 2000 assessment (O'Brien and Esteves, 2000):

$F_{MSY} = 0.17$,
MSY = 4,900 t and
$SSB_{MSY} = 28,600$ t.

At the GARM III BRP meeting, an update VPA formulation was not presented, however, the YPR analysis was updated using a 3 year average (2002-2004) of partial recruitment, stock weights, catch weights, and maturity at age from the most recent assessment (O'Brien *et al.* 2005). The YPR was then updated further by using research survey mean weights at age averaged over 2003-2007 for stock weights, spawning stock weights, and proportion mature at age. This updated non-parametric YPR analysis was chosen for interim estimation of BRPs. The following estimates are provisional and will change once the final assessment is conducted and presented at the GARM III Assessment Meeting in August 2008:

$F_{MSY} = 0.18$,
MSY = 4,317 t and
$SSB_{MSY} = 20,828$ t.

The provisional BRPs from the above YPR analysis are higher for $F_{MSY}$, slightly lower for MSY, and lower for $SSB_{MSY}$ compared to the previous BRPs. The lower $SSB_{MSY}$ is due to a change in the partial recruitment vector and a decline in the population mean weights at age in recent years.

*Discussion*

The American Plaice assessment was not completely updated because the data were not available with sufficient time before this meeting; however, the partial update presented takes account of recent changes in mean weight at age which is a primary determinant for reference points. The results therefore indicate a likely direction for change in the BRPs, but there will be further changes in the estimated BRPs when the full assessment is completed for the August 2008 GARM meeting.

Working Paper 4.I: Nitschke P. Gulf of Maine Winter Flounder

Rapporteur: Kathy Sosebee

*Presentation Highlights*

The Gulf of Maine winter flounder assessment suffers from poor sampling of the landings by market category. A substantial overlap in lengths among market categories did help justify the pooling used to estimate the catch at length and age. The VPA model exhibited a severe retrospective pattern in F, SSB, and recruitment. Splitting of the surveys did improve the retrospective pattern but a lack of fit to the age 1 and 2 recruitment indices was still present. A forward projecting model (SCALE) that tunes to indices at age for the younger ages and length data for the older/larger fish was also examined. Winter flounder exhibits sexually dimorphic growth and males appear to have higher natural mortality than females. Sex specific growth and natural mortality were modeled within the Scale model. The alternative forward projecting Scale model failed to reconcile the conflicting trends between the age 1 and 2 recruitment indices with the declining trend in catch and the adult indices. Lower weights on the recruitment indices and a low penalty on recruitment variation allowed the Scale model to produce a declining trend in recruitment in order for the model to fit to the catch. The scale model has a retrospective pattern similar to the VPA and the splitting of the surveys also improved the retrospective pattern. Parametric stock recruit reference points were not used for either model due to the uncertainty in the estimated recruitment. The entire time series of recruitment (1982-2006) was used to estimate empirical biological reference points. The Scale model estimated a higher $F_{msy}$ proxy ($F_{40\%MSP}$ = 0.44) than the VPA ($F_{40\%MSP}$ = 0.27) due to the difference in the estimated selectivity. However the estimated $SSB_{msy}$ values were similar between the two models (VPA = 3,557 t, Scale = 3,138 t).

*Discussion*

Several models were attempted for this stock. The VPA which did not have a strong retrospective pattern in 2002 now has a severe pattern. Recruitment and adult biomass trends are not the same. Both the VPA and Scale models have poor fits to the age 1 and 2 recruitment indices. The proposed model is SCALE with split survey series and with recruitment not emphasized. Diagnostics may not indicate SCALE to be a better model.

SCALE captures more biologically (sexually dimorphic growth and differential M) than does the VPA. A model which assumes error in the catch may be more appropriate for this stock which has limited sampling of the landings. SCALE is sensitive to weighting on recruits and the current model has low weight on recruits. The Panel felt that a stock-recruitment curve may not be applicable for this stock even though the SR points appear to be similar between models. The Panel discussed examining catchability from the other stocks of winter flounder but it was noted that growth rates and mesh sizes are different between areas which would make selectivity different. The Panel did not feel confident in the recruitment values. At this time, it is recommended to use the value of $F_{40\%MSP}$=0.27 from the VPA run for the fishing mortality reference point and that the Bmsy proxy is unlikely to be lower than 3000 t. A preliminary SSBmsy reference point could be set at 3557 t with and MSY of 854 t.

Working Paper 4.J: Terceiro M. Southern New England Winter Flounder

Rapporteur: Larry Alade

*Presentation Highlights*

The GARM III 'models' Panel reviewed the 2005 GARM3 VPA and a version of the assessment implemented in ASAP v2.0.9, which both exhibited a strong retrospective pattern in the late 1990s and into 2001. The Panel advised that model results should be checked for the retrospective pattern when the 2005-2006 catch data were added and that if pattern reappeared, then "consideration should be given to splitting the survey time series pre and post 1994." Splitting the survey series used in calibration acts as a proxy for fishery and biological factors that could have changed in the mid-1990s, resulting in the observed retrospective pattern. Fishery catches were updated through 2006 and survey indices through 2007 to create the GARM III BASE case VPA. The BASE run continued to exhibit a strong retrospective pattern, although it was less severe in recent years than in the 2005 GARM II assessment. Given the persistence of the retrospective pattern in the BASE configuration, survey series were split as per the GARM III 'models' Panel recommendation. Under this SPLIT run configuration, the retrospective pattern was significantly reduced, no appreciable problems in residual patterns developed as a result of splitting the survey series, and the precision of the terminal year estimates was comparable to the BASE run estimates. The SPLIT configuration was selected as the preferred run for the basis of reference point calculations and stock status determination. The Southern New England/Mid-Atlantic (SNE/MA) winter flounder stock complex is overfished and overfishing is occurring. Fishing mortality (F) in 2006 was estimated to be 1.02 (exploitation rate = 59%), about three times $F_{MSY} = 0.34$. There is an 80% chance that the F in 2006 was between 0.87 and 1.20. SSB in 2006 was estimated to be 2,544 t, about 7% of $SSB_{MSY}$ = 35,240 t. There is an 80% probability that SSB in 2006 was between 2,306 t and 2,860 t. The 2005 year class is estimated to be among the smallest on record, at only 5.6 million fish.

*Discussion*

The report summarizes a proposed revision of the reference points for the Southern New England Winter flounder assessment based on an ADAPT VPA (TOR 4). The Panel points out that the retrospective pattern continues to be problematic and agree that the split series configuration appears to address the retrospective problem, but the underlying causes are still unknown. The Panel also identifies that the weight at age and maturity at age have been relatively stable as this implies that biological conditions have not changed much. However, the Panel raises concerns about the recruitment time series as they believe that that the $R_0$ may not be characteristic of the virgin recruitment and may only correspond to the time periods when the stock was exploited. This also led to discussions about the use of priors in the S-R fit as to whether it is informative or not in determining the reference points. The Panel came to consensus with the following recommendations: (a) Move forward with the VPA split series configuration as the basis of the assessment , (b) adopt the non-parametric empirical approach using $F_{40\%MSP}$ as a proxy for $F_{MSY}$ as the basis for the BRPs (c) Calculate the deterministic equivalent of the AGEPRO stochastic projections in determining $SSB_{MSY}$ (d) Coupled with recommendation (b), use a "breakpoint" approach to determine average recruitment above 6000 for SSB in the non-parametric empirical approach (i.e., the top eight estimated recruitments).

Working Paper 4.K: Hendrickson L. Georges Bank winter flounder

Rapporteur: Kathy Sosebee

*Presentation Highlights*

Winter flounder is a shallow-water species. The Georges Bank stock was assessed at GARM II using a surplus production model (ASPIC) for the period 1963-2004. The current biological reference points were estimated internally from the same model and are: $F_{MSY} = 0.32$ and $B_{MSY}$ = 9,400 t. The GARM III assessment was conducted utilizing an age-based Virtual Population Analysis (VPA) for the period 1982-2006. The provisional reference point estimates from the VPA model are: $F_{MSY}$ proxy ($F_{40\%MSP}$) = 0.25 and $SSB_{MSY}$ = 15,500 t. The VPA model included: an initial estimate of discards-at-age; landings-at-age for U.S. and Canadian landings; and all ages from the NEFSC spring (1982-2006), and fall surveys (1981-2005, lagged forward one year and age), and the Canada spring surveys (1987-2006). The difference between the current reference point estimates and the provisional estimates are, in part, due to the two different types of models. In addition, different data sets were utilized in each model.

*Discussion*

It was noted that the projected non-parametric gave a lower value for SSBMSY and MSY although others were higher. The Panel questioned the use of a tight prior on R0 suggesting that using a different prior may give a different answer. An alternative would be to use a prior on steepness obtained from the literature for similar stocks. For SNE-MA winter flounder the BRP Working Group tested all options and models and decided to use the prior on R0 instead of steepness. It may be useful to check if past survey and recruitment were not higher. The Panel recommended using the empirical approach with recruitment values sampled from 1982-2005.

Working Paper 4.L: Sosebee K. Georges Bank/Gulf of Maine White Hake

Rapporteur: Michael Palmer

*Presentation Highlights*

An assessment was conducted for Gulf of Maine-Georges Bank white hake using ASAP, a forward projecting age-structured model. Two variations of the model were explored, one with a long (1893-2006) time series of catch data and the other with a shorter (1963-2006) time series. Both models showed the same trend in spawning stock biomass, fishing mortality, and recruitment over the similar time frame. The reference points were derived using both Beverton-Holt stock-recruit curve fits and empirical yield-per-recruit estimation. The value for SSBmsy ranged from 35,900 t to 83,800 t depending on the assumptions. A value of 56,500 t was chosen for the reference point with a value of 0.21 for Fmsy proxy and 7,000 t for MSY.

Working Paper 4.L.1: Butterworth D. Georges Bank/Gulf of Maine White Hake

Rapporteur: Michael Palmer

*Presentation Highlights*

WP 4.L.1 applied the ASPM (SCAA) methodology presented in Butterworth and Rademeyer (GARM III Working paper 2.2a), with an adjustment to be able to incorporate data on proportions at length, to white hake. In a preliminary and (for reasons of time) restricted analysis, four scenarios were considered for the period from 1963 when abundance indices first become available. These reflected the assumptions that spawning biomass in 1963 was at 25% and 50% of its pristine level, and that the catch of hake of length less than 60 cm was either all white hake or all red hake, with the latter assumption leading to somewhat more optimistic appraisals of the current status of white hake. Model fits to survey index trends were broadly reasonable; though there were some difficulties with proportions at length data which would likely be better addressed in future analyses by adopting a length-specific rather than an age-specific selectivity framework. All four scenarios considered suggested an increase in spawning biomass over the last decade, and that the current fishing mortality is less than FMSY. Nevertheless the preliminary nature of all results was stressed, particularly as time had thus far allowed for only a very limited number of variants of the assessment to be investigated. A set of reference point values ranges across the four scenarios considered was presented on an indicative rather than a definitive basis.

*Discussion on working papers 4.L and 4.L.1*

The Panel expressed concern with the ASAP fits of the survey indices and the use of prior distributions for the survey catchabilities (q). In general the Panel commended the ASAP attempt, but suggested additional formulations be investigated as time permits to include splitting the survey time series and removal of the prior distributions for q's. The Panel expressed concerns with calculating biological reference points (BRP) using the long time series of recruitment (pre-1963). Their concern was based on the uncertainty of these data. The uncertainty was related to the fact that historical recruitment was estimated internally within the ASAP model based on historical landings which may suffer from the same speciation problems that plague the current landings time series. It was clarified that since the historical fishery was a hook and line fishery it is unlikely that an appreciable proportion of the landings comprised red hake. The Panel recommended that BRPs be calculated using recruitment estimates from 1963 and onward, but felt that these BRPs should include a disclaimer that BRPs may change if historical productivity is later determined to have been higher than observed during the time series from 1963. The Panel supported empirical estimates of BRPs (including use of $F_{40\%MSP}$) due to concern with the reliability of stock recruit fits. It was recommended that recruitment resulting from SSB greater than 10,000 t be used to derive $B_{MSY}$ and MSY. If time permitted use of a variance minimizer approach ('razor' analysis) was suggested to provide a more objective measure of the SSB threshold.

Working Paper 4.M: Mayo R. Georges Bank/Gulf of Maine Pollock

Rapporteur: Anne Richards

*Presentation Highlights*

Pollock (*Pollachius virens*) in habiting the waters of the Gulf of Maine and Georges Bank are found at most depths ranging from the shallow parts of the western Gulf of Maine out to depths down to 300+ m. The stock comprises NEFSC statistical areas 511-616, although most of the fishery occurs in the Gulf of Maine. The stock was last assessed at GARM II in 2004 using an AIM model. The existing reference points at that time were: Fmsy proxy (Relative F) = 5.88, Bmsy proxy = 3.00 kg/tow (NEFSC autumn RV survey, and MSY = 17,640 t. The GARM III agreed assessment is an AIM model using a similar formulation as at GARM II. The reference points based on results of this assessment are: Fmsy proxy = 0.5.758 (Relative F), Bmsy proxy = 2.00 kg/tow (NEFSC autumn RV survey) and MSY = 11,516 t. The GARM III assessment includes commercial and recreational landings data and autumn RV survey data through 2006. The recreational landings data have been revised since the GARM II assessment. These data changes were minor and did not contribute to any substantial differences in the assessment. The biomass reference points estimated at the GARM III Biological Reference Point Meeting are substantially different from those in place at GARM II. The Fmsy proxy is almost the same, but the Bmsy proxy is about 33% lower than the existing Bmsy reference points. Because the Fmsy proxy has not changed appreciably, this results in a similar reduction in the MSY proxy.

*Discussion*

BRPs were estimated using the status quo method and with two changes: (1) inclusion of recreational landings in the catch time series, and (2) using an assumed Bmsy proxy of 2 kg/tow (vs. 3 kg/tow in the status quo method).

The Panel had no objections to adding recreational landings to the catch series.

The choice of Bmsy proxy is subjective and the revision was based on examination of trends in replacement ratios and survey biomass. When replacement ratios were below 1 (stock not replacing itself), survey biomass indices were generally below 2 kg/tow. The Panel agreed that Bmsy proxy=2 kg/tow is more internally consistent, and approved using this in place of the status quo Bmsy proxy (=3 kg/tow).

The survey shows strong year effects and cohorts can not be tracked, probably because of variability in migratory patterns and thus availability to the survey. However, a clear pattern is the lack of fish older than age 8 since the early 1990s, similar to many other GARM species; this information does not enter into evaluation of stock status with the present method.

Concerns were raised over the high implied population growth rate from the AIM model and suggestions made for alternative formulations for the relationship between replacement ratio and relative F (e.g. log-linear with priors on *a* or logistic). However, AIM is used to deduce when relative F is too high, not for establishing Bmsy, and *a* and *b* can be viewed as nuisance parameters in this context. A suggestion was made that if the alternative formulations can be fit, the parameter estimates might be useful for defending the chosen value of Bmsy and would put the biomass reference points in the same context from which the F index reference points were derived.

Working Paper 4.N: Miller T. Georges Bank/Gulf of Maine Acadian Redfish

Rapporteur: Elizabeth Brooks

*Presentation Highlights*

The Panel at the GARM III 'models' review was concerned with the problematic estimation of biomass levels prior to the substantial landings starting 1936 using RED and STATCAM. The reviewers suggested implementing a Beverton-Holt stock-recruitment relationship with a steepness as estimated for Pacific Ocean Perch and assume low coefficient of variation (CV, approximately 0.2) of log recruitment residuals in years where age samples is not available and high CV (approximately 0.4) of log recruitment residuals where age samples are available. The reviewers were also interested in relaxing the constant selectivity assumption (i.e., the separability assumption).

In the revised assessment, we have used ASAP (ASAP 2008) as the assessment model because it is also a statistical catch-at-age model and it has options for assuming a Beverton-Holt stock-recruitment relationship. We fit three ASAP models assuming the suggested CVs for log recruitment residuals (0.2 and 0.4, alternative 1) assuming more drastic differences in the CVs for periods with and without age sampling (0.1 without age samples and 0.8 with age samples, alternative 2) and assuming the same CVs as alternative 2 except with a 5 year linear ramp from 0.1 in 1964 to 0.8 in 1969 (alternative 3). In addition, we revised the maturity at age, weight at age and assumed CVs for survey biomass indices and we included discards with landings for total catch estimates between 1989 and 2006 with corresponding CVs provided by variance estimates for the annual discards. The CVs for the biomass indices were estimates provided by the sampling design used in the fall and spring bottom trawl surveys when available. In years where design-based CV estimates were not possible, we assumed CV = 0.3. Further assumptions in the ASAP models were intended to mimic those used previously in STATCAM and RED models where possible. However, we have not attempted to relax the constant selectivity assumption in this assessment because the time span over which age composition data are available from landings (1969-1985) is short relative to the entire time span of landings (1913-2006) and as such there is no ability to estimate different selectivity patterns in the periods prior to and after age observations from landings.

The spawning biomass estimates in the initial period (1913 to 1934) provided by the ASAP alternatives are all greater than those provided by the STATCAM alternatives. Furthermore, the magnitude of the infrequent large recruitment estimates is generally less using the ASAP models. Overall, the diagnostics of the three ASAP alternatives were similar and estimation of initial stock biomass was better behaved than any of the STATCAM alternatives. However, we propose ASAP alternative 3 as the best of the alternative assessment models at this time because the standardized recruitment residuals were best behaved.

We used AGEPRO (AGEPRO 2005) to determine median $SB_{MSY}$ under two alternative scenarios. In the first scenario, we assumed recruitment events are related to spawning biomass in the same manner as the ASAP alternative 3 with 0.8 CV for the residuals (Beverton-Holt spawner-recruit relationship) and the stock is fished at $F_{MSY}$ with fishery age-specific selectivity as estimated from that model. In the second scenario, we assumed recruitment is a random draw from the 94 recruitment estimates provided by ASAP alternative 3 and the stock is fished at $F_{50\%MSP}$ (0.03780) as determined from the revised weight at age and maturity at age and fishery age-specific selectivity as estimated from ASAP alternative 3. For both projection scenarios, we used 100 draws of numbers at age vectors in 2007 from the posterior distribution provided by ASAP alternative 3 and we projected 300 years forward with 100 simulations per numbers at age vector.

The median $SB_{MSY}$ as estimated using AGEPRO, using the first scenario with a Beverton-Holt spawner-recruit function is approximately 353,040mt and the MSY estimate is approximately 13,660 t whereas the median spawning biomass using the 94 estimated recruitments from ASAP and $F_{50\%MSP}$ is approximately 261,280 t ($Yield_{50\%MSP}$ estimate is 9,780mt). Both of these $SB_{MSY}$ estimates are greater than the NEFSC (2002) estimate.

*Discussion*

A panelist asked about the stock recruit plots for the different CV cases, because he thought he'd see red points above and below the predicted line for CV=20%, but they were all above the line. Another panelist said that the problem with those points is that because there is no age information for those points, they go to the curve. The way you fit the model, prior to data kicking in your estimates are lower. The expected value during that period is lower during that period than after, because of the lognormal distribution. But this influences the shape of the S-R curve and estimates of $B_0$. In a Bayesian analysis, you'd want the CV constant over time.

A panelist suggested that he thought the point was to find the recruitment that explains the amount of catch removed during that early period. Given that selectivity is constant, ASAP is filling in the recruitment to generate the observed catch.

A member of the audience pointed out that there is a self-consistency problem, but in a frequentist framework, you'd want to make it the S-R curve deterministic prior to some period, then add the bias correction to it. What has happened is the model has had difficulty at the transition point between the CV periods. But, the other question is how strictly you want to interpret them.

The panelists had trouble reading and interpreting the plots of fits to age composition. One panelist thought they were residuals, rather than observed versus predicted. One panelist voiced a preference for bubble plots of observed and another bubble plot of residuals. It was also noted that strong year classes appeared on the diagonal of the age composition plots.

A panelist asked what was the effect of changing the weights at age on the model results. Another panelist asked for clarification, regarding MSP relative to SSB/R and SPR? It was clarified by a NEFSC employee that MSP is % of spawning potential relative to F=0.

A panelist asked what is the F reference. It was noted that the S-R curve was not believed, so an SPR was defaulted to, and because redfish was long lived, they use 50% instead of 40% SPR.

A panelist suggested that he was not sure this model will work for assessing status, but that it may be ok to average over it in a YPR calculation. The value added to what is shown here is that we've shown that catches prior to age composition data have come from average recruitment rather than earlier models that suggested one strong 'bonanza' year-class. It was noted that the previous STATCAM applications to this stock used a single selectivity.

A member of the audience questioned why M=0.05? He suspected that the results will be highly dependent on that assumption (this is whale like). For the distribution of ages, he would not have thought that M was as low as .05. He pointed out that in Figure N20, bottom right, there is a clear temporal pattern in residuals, and that you can reduce that autocorrelation in recruitment residuals with a higher M.

A NEFSC employee pointed out that the value of M is consistent to redfish stocks around the world.

Both an audience member and a Panel member pointed out that weight at age plot shows older fish. One way to support the use of M=0.05 would be to show the age or length data that has been collected to help corroborate that you have such a low M.

A member of the audience asked if he heard correctly that the model didn't show any evidence of a change in selectivity. It was clarified that what he heard was that the residual fits were not bad. The same individual asked if that weren't troubling given the management history. It was clarified by a NEFSC employee that the fishery always used a small mesh; when the mesh changed in 1994, the fishery effectively closed. Therefore, the single selectivity assumption is probably justified.

A panelist commented on the modeling approach, and referenced Fig N10, which shows the pattern of residuals in fit to total catch. The panelists comment is that you should try to fit total catch quite exactly, even when there is uncertainty. The rationale is that you can't expect a model like this to pick up where in catch series the errors should be. It is disturbing to see this residual pattern. This suggestion is just a general approach to modeling. Another panelist asked what this general approach was based on. The first panelist responded, again, that it is unlikely that the data can inform where the errors in catch are or aren't. In the face of uncertain removals, you're better off running models with different assumed levels of removals (as sensitivity cases), and in each of those runs, fit to those removals exactly.

The meeting chair asked if there was sufficient support for the BRPs. A panelist questioned the middle one case (with CV=0.8 fixed) given that in the model fitting exercise the analyst had split the CV. Another panelist was comfortable with the model fit and internally estimated S-R function, because it doesn't require very different recruitment levels than what we've observed. But this is not to say that the panelist was comfortable with the exact S-R function, because the form is largely influenced on predicted recruitments which are based on data from where we have no age comp.

A discussion ensued as to whether predicted recruitment for years where there was no age composition should be included in the projections that sample from the recruitment cdf. Many panelists agreed that it did not make sense to sample from those years without age composition data, and that they should be dropped in making projections to get the reference points. Because those points are basically on the predicted S-R function, which was rejected as a basis for deriving reference points, then those points shouldn't be included; including them is giving an artificially tight central tendency.

Further discussion centered on trying to reconcile the difference in the BRP table of results between the far left and the far right columns. Several assignments were requested of the analyst.

1. take arithmetic average of top of recruitments associated with the top 25% of SSB values, and scale reference points by this.
2. use this same series of recruitments in the AGEPRO approach
3. bring info forward to corroborate lower M.

Working Paper 4.O: Wigley S. Ocean pout

Rapporteur: Laurel Col

*Presentation Highlights*

Ocean pout is assessed as a unit stock from Gulf of Maine/Cape Cod Bay south to Delaware. An index assessment was presented. Landings, survey indices and exploitation ratios remain at, or near, record low levels and the annual estimates of discards exceeds the landings. Although exploitation has been low, stock size has not increased. The stock appears to be in a depensatory state. Discards are estimated to be an important component of catch and may be sufficiently high to hinder recovery of the stock.

For Ocean pout, the replacement ratio and relative F analyses, as well as age-structured biomass dynamics model analyses, were not informative upon which to base Bmsy, Fmsy, and MSY. Thus, biological reference point proxies for Ocean pout remain based upon research vessel survey biomass trends and exploitation.

The current biological reference points were determined by the Overfishing Definition Panel in 1998. The Bmsy proxy is the median NEFSC spring survey biomass (4.9 kg/tow) during 1980-1991. The MSY is 1,500 t, chosen by visual inspection of landings. The Fmsy proxy is 0.31 (4.9/1.500).

The revised biological reference points are updated using total catch (landings and discards). The Bmsy proxy is the median NEFSC spring survey biomass (4.94 kg/tow) during 1977-1985; the Fmsy proxy is the median exploitation ratio (0.76) during 1977-1985. The 1977-1985 time period corresponds to the time when the replacement ratio was above 1 and biomass increased. Based on these revised proxies, MSY is estimated to be 3,754 t (4.94 * 0.76 * 1000). Differences between current and revised reference points are due to the inclusion of discards in the total catch. The revised biological reference points are provisional and may change at the August 2008 GARM.

*Discussion*

The Panel expressed concern with the method for determining the biological reference points since AIM showed that the relationship between relative F and the replacement ratio was uninformative. The Panel commented that the time period used to determine MSY, the time when replacement ratio greater than 1, could have encompassed a strong year class.

It was discussed that when the current reference points were determined in 1998, there appeared to be a relationship between biomass and relative F. The 2002 re-evaluation of the reference points defaulted to the 1998 values since the recent data were not informative to update the biological reference points. The Panel discussed that the available data remains generally uninformative for providing updated reference points; however, defaulting to the 1998 reference points is not advisable since discards are important and were not included in 1998 reference point determinations. The Panel therefore concluded that using the method of estimating MSY based on a stable period where replacement ratio was greater than 1 should be applied to the new catch data, since this method is consistent with 1998 reference point determinations. The revised reference points are MSY = 3,754 t, $SSB_{MSY}$ proxy = 4.94 kg/tow, and $F_{MSY} = 0.76$. The Panel further stated that caution should be taken in interpreting the reference points since the recent depensation would likely inhibit rebuilding. It was commented that the stock may not be able to increase even in the absence of fishing.

Working Paper 4.P: Hendrickson. Georges Bank/Gulf of Maine Windowpane Flounder
Rapporteur: Toni Chute

*Presentation Highlights*

Windowpane flounder is a shallow-water species. The Gulf of Maine-Georges Bank stock was assessed at GARM II using an index-based method for the period 1963-2004. The current biological reference points are: $F_{MSY}$ proxy = 1.11 and $B_{MSY}$ = 0.94 kg per tow. The $F_{MSY}$ proxy was based on an assumed MSY proxy of 1,000 t and the median of the fall survey biomass index during 1975-1987. The GARM III assessment was conducted utilizing an index-based model called AIM for the period 1975-2006. The provisional reference point estimates are: $F_{MSY}$ proxy (relative F) = 0.62 and $B_{MSY}$ proxy = 1.14 kg per tow. Input data to the AIM model consisted of: initial estimates of discards; landings; and the NEFSC fall survey biomass indices. The provisional $F_{MSY}$ proxy was estimated from the AIM model and represents the relative fishing mortality rate (catch / fall survey biomass index) at which the stock can replace itself. The MSY proxy (= 700 t), assumed as the median catch during a period of time when the stock was replacing itself (1995-2001), was divided by the $F_{MSY}$ proxy to compute the $B_{MSY}$ proxy. The current reference point estimates cannot be compared with the provisional estimates because different survey strata sets were used and the provisional reference point estimates include discards.

*Discussion*

The population is assessed as two different stocks, northern (GOM/GB) and southern (SNE/MAB). The AIM model was used to estimate the relative F (catch/survey biomass index) at which the population would be stable. Inputs to the AIM model are catch and survey biomass indices.

GOM-GB

For the northern stock, catches and NEFSC fall survey biomass indices were used in the final AIM model run. Biomass indices from the spring NEFSC, Canadian, MA, NJ, and Long Island Sound surveys and the fall MA, NJ, and Long Island Sound surveys were not included in the final model run because the regression of relative Fs against stock replacement ratios was not significant at the p = 0.1 level. Since 1994, catches have been mostly bycatch, and since 2000, consisted of 10-20 times the landings. It is important to note that the previous reference point estimates included only landings and that the revised estimates include discards as well as landings. Since 2004, there has been an increase in pre-recruit abundance in the NEFSC fall surveys.

AIM results indicate the stock can replace itself at a relative F of 0.62. This was considered an Fmsy proxy. During 1995 and 2001, the replacement ratio was greater than or near one which infers that the catch was sustainable during that time period. Therefore, the median catch during 1995-2001 (700 t) was considered as MSY and a BMSY proxy was computed as 1.14 kg per tow. These reference points were selected by the Panel over the BMSY proxy estimate representing the median biomass index because of the greater precision of the discard estimates after 1988. It was also noted that replacement ratios suggest that the stock could not replace itself when a directed fishery occurred during the early part of the time series. The extent of discarding indicates that there is currently no market for GOM-GB windowpane flounder. It was speculated that the AIM regression may have been determined as significant as a result of a few data points.

Working paper 4.Q: Hendrickson L. Southern New England Windowpane Flounder

Rapporteur: Toni Chute

*Presentation Highlights*

Windowpane flounder is a shallow-water species. The Southern New England-Middle Atlantic Bight stock was assessed at GARM II using an index-based model (AIM) for the period 1963-2004. The current biological reference points are: $F_{MSY}$ proxy = 0.98 and $B_{MSY}$ = 0.92 kg per tow. The $F_{MSY}$ proxy was based on an MSY estimate of 900 t from an ASPIC surplus production model for the period 1963-1996. The GARM III assessment was conducted utilizing an index-based model called AIM for the period 1975-2006. The provisional reference point estimates are: $F_{MSY}$ proxy (relative F) = 1.53 and $B_{MSY}$ proxy = 0.33 kg per tow. Input data to the AIM model consisted of: initial estimates of discards; landings; and the NEFSC fall survey biomass indices. The provisional $F_{MSY}$ proxy was estimated from the AIM model and represents the relative fishing mortality rate (catch / fall survey biomass index) at which the stock can replace itself. The MSY proxy (= 500 t), assumed as the median catch during a period of time when the stock was replacing itself (1995-2001), was divided by the $F_{MSY}$ proxy to compute the $B_{MSY}$ proxy. The current reference point estimates cannot be compared with the provisional estimates because different survey strata sets were used and the provisional reference point estimates include discards.

*Discussion*

Catches for the southern stock are driven by discards and the survey indices have been at very low levels for the past two decades. The same methods and the same time period of sustainable fishing (1995-2001) used for the northern stock, based on stock-specific trends in replacement ratios, were used to estimate BRPs. It was noted that the southern stock has not shown a positive response to management actions in the past two decades and that replacement ratios suggest that the stock could not sustain itself when the directed fishery occurred. The revised BRP estimates are substantially different from the current BRPs but the two sets are not comparable because of differences in the methods and data used to compute each set of BRPs. The revised BRPs include initial discard estimates and discards are the predominant catch component. Also, the previous BRPs were based on an ASPIC surplus production model which did not contain survey indices covering the entire habitat of windowpane flounder (inshore strata were not included). As a result, the two sets of BRPs are not comparable. It was noted that recent fishing in sea scallop closed areas may also be impacting the stock. The question was asked about what would happen if the stock, at this point mostly discards, crept back above Bmsy and this was interpreted as a signal that a directed fishery would be sustainable? The Panel noted that caution must be taken here because the market for windowpane flounder may change in the future.

Working paper 4.R: Palmer M. Gulf of Maine Haddock

Rapporteur: Ralph Mayo

*Presentation Highlights*

The Gulf of Maine haddock stock is defined by the United States statistical areas 511 through 515, corresponding to the Northwest Atlantic Fisheries Organization area 5Y. Haddock in this region range in depth from 20 m to 380 m, but are more common at depths ranging from 45 m to 135 m. This stock was last assessed in 2005 at the Groundfish Assessment Review Meeting (GARM) II using biological reference points determined using the method, An Index Method (AIM). The corresponding biological reference points were $F_{MSY[proxy]} = 0.23$, $B_{MSY[proxy]} = 11.09$ kg/tow, and $MSY_{[proxy]} = 5{,}100$ t. These biological reference points (BRPs) and the associated assessment included only commercial landings in the estimates of fishery removals.

Reference points have been recalculated for GARM III using the results from an ADAPT virtual population analysis (VPA) run for the years 1977 to 2006. The VPA included commercial landings at age, commercial discards at age and recreational landings at age and was tuned to both the spring and autumn Northeast Fisheries Science Center bottom trawl survey indices of abundance. Both empirical and deterministic BRPs were calculated, however the deterministic estimates were determined to be unreliable because of the poor fit of the stock-recruit function. AgePro projections were used to determine the BRPs associated with a constant harvest of $F_{40\%MSP} = 0.454$ using the cumulative distribution function (CDF) of age-1 recruitment from 1963 to 2006. The 1962 “bonanza” year class was removed from the recruitment time series as well as those year classes corresponding to spawning stock biomass less than 3,000 t (1986 to 1996). The five year averages (2002 to 2006) of partial recruitment, stock weights, catch weights and spawning stock weights, the 1977 to 2006 average female maturity at age and an assumed constant natural mortality of 0.2 were used as input vectors in the AgePro projections. The resultant BRPs were $SSB_{MSY} = 5{,}995$ t and MSY = 1,360 t; however, these are considered provisional and subject to change at the final GARM III meeting.

The updated BRPs for this stock were appreciably different from those previously calculated using the AIM method. This is not unexpected given that these updates were determined using the results from an age-based model. The estimated $F_{40\%MSP}$ was higher than that estimated for Georges Bank haddock. This difference is likely due to the lower partial recruitment at age relative to the Georges Bank stock resulting from a higher proportion of the fishery removals made up of the recreational hook and line fishery and larger trawl mesh sizes used in the Gulf of Maine commercial fishery.

*Discussion*

The VPA exhibits a weak retrospective pattern, but was considered to be a reliable basis for calculating biological reference points. The Panel focused first on the estimate of the Fmsy proxy ($F_{40\%MSP}$). The estimate was considerably higher than the estimate for Georges Bank haddock.

Several factors were discussed as possible reasons for this difference. Fishery selectivity is delayed on this stock compared to the Georges Bank stock. This is due to lower mean weights at age and the larger mesh used by fishermen in the Gulf of Maine. Since 2002, these fishermen use 6.5 inch square mesh to target flatfish, resulting in greater escapement of roundfish compared to the 6 inch diamond mesh used on Georges Bank.

This supports the observation that larger haddock are taken in the Gulf of Maine compared to Georges Bank. The recreational fishery accounts for a large proportion of the landings in recent years and these fish are also relatively large. There was an abrupt drop in F in 2002, especially at age 2 when the mesh went to 6.5 inch square. The VPA appears to be picking this up. It was also noted that the $F_{40\%MSP}$ is contingent on continued use of the 6.5 inch square mesh. The delayed partial recruitment also indicates that stock is able to spawn at least once before they are selected.

A multiplicative model was used to explain age and year effects on the partial recruitment matrix. Younger ages in recent years show lower partial recruitment compared to earlier years. Largest differences occur in the most recent years.

Spring survey weights at age are similar to the RIVARD stock weights used in the SSB/R. There was a very large decline in survey weights at age in recent yrs, about½ of earlier weights. This argues for a lower Bmsy than the existing value from the AIM analysis. The Bmsy from the AIM model was based on an average from a period of heavy exploitation during the 1950s and 1960s when landings were very high.
Replacement ratios were never above 1.0 when the catch was above 2,000 t.

There was consensus that there is a need to explain the factors that account for the lower partial recruitment and mean weights resulting in the higher $F_{40\%MSP}$.

Four recruitment options were reviewed, including hindcasting to 1963, and dropping 3 large year classes. The SSBmsy estimates show that the stock is rebuilt and F is low, a reversal from the last assessment. The Panel felt that it is difficult to accept that stock is above SSBmsy compared to 1970s. A larger SSBmsy estimate is more appropriate because the recent biomass increase is based on 1 year class (1998), not a rebuilt stock.

The Panel focused on current stock productivity. High historical landings imply that the stock was more productive during the 1950s. Is productivity lower now? SSB in the 1970s is a product of good recruitment of 1975 year class and recent SSB is a product of the 1998 year class. It was felt that the fishery is not maximizing yield per recruit with the use of the larger mesh. We may be underestimating the overall productivity by focusing on recent recruitment. Since recruitment dynamics in the Gulf of Maine is similar to Georges Bank, it could be that current productivity is underestimated by half if productivity is similar to what we saw for Georges Bank during the 1930-1950s.

The Panel ultimately agreed to accept $F_{40\%MSP}$ as the Fmsy proxy and to use the recruitment option, hindcast back to 1963, and remove just the highest year class (1962) and other recruitment data when SSB was less than 3000 t. The Panel also recommended that recruitment patterns on Georges Bank be compared to Gulf of Maine to see if Gulf of Maine recruitment can be hindcast back to the 1930s.

Should a Fmsy proxy higher than $F_{40\%MSP}$ be used because of reduced productivity? This issue should be examined in the future.

Working Paper 4.S: Col L. Atlantic Halibut

Rapporteur: Larry Alade

*Presentation Highlights*

Previously an index-based method was used to assess Atlantic halibut, where the 5-year moving average of the swept-area biomass was compared to biomass reference points ($B_{threshold}$ = 2,700 t and $B_{MSY}$ = 5,400 t). The previous reference points were determined based on a MSY of 300 t, estimated from the landings time series, and yield per recruit and biomass per recruit analyses using growth curve and length-weight equations from published literature. Although reliable fishing mortality estimates were not available using the index-based method, previous reference points were given as $F_{0.1}$ = 0.06 and $F_{target}$ = 0.04. Index-based reference points were updated using a length-weight relationship from NEFSC spring and autumn surveys, and von Bertalanffy growth parameters and maturity at age estimates from recent studies in the Gulf of Maine region. Revised biomass reference points were slightly higher, with $B_{threshold}$ = 3,200 t and $B_{MSY}$ = 6,400 t, and revised overfishing reference points were slightly lower, with $F_{0.1}$ = 0.04 and $F_{target}$ = 0.02.

An alternative replacement yield model was performed for Atlantic halibut, incorporating the time series of commercial catch. US discards were estimated using the Standardized Bycatch Reporting Methodology combined ration estimation. Due to low observed encounter rates of halibut and the implementation of the Atlantic halibut regulations in 1999, an average discard ratio from 1989 to 1998 was applied to the 1893-1998 landings and an average discard ratio from 1999-2006 was applied to the landings in those years. The resulting average US discards were added to the total landings, and a linear increase in catch was assumed from 1800-1892 to approximate the entire time series of Atlantic halibut catch in the Gulf of Maine-Georges Bank region. Simulations of varying carrying capacities and intrinsic growth rates were performed, and the model with the best fit was determined using a negative log-likelihood function. The resulting biomass in 2006 was estimated to be 21,000 t, well below the model estimated biomass reference points of $B_{threshold}$ = 75,000 t and $B_{MSY}$ = 150,000 t. Unlike the index-based method, current fishing mortality is estimable using the replacement yield model, and the 2006 estimated F of 0.0022 was below the $F_{MSY}$ estimate of 0.003.

*Discussion*

This paper summarizes a proposed revision of the references points for the Atlantic Halibut assessment based on an Index based approach (old and revised approach) and an alternative replacement yield model for TOR 4. The Panel initially expressed concern with moving forward using the replacement yield model because the model was highly sensitive to priors on K and r. The Panel recommends using the updated life history parameters for the Gulf of Maine region for the YPR model, and that M should be consistent with published estimates from other halibut stocks. The Panel also recommended fixing r in the replacement yield model as two times the $F_{0.1}$ (proxy for $F_{MSY}$ ) from the YPR model. The Panel recommended using a parabolic function as basis for landings from 1800-1893, and using the replacement yield model to estimate $B_{MSY}$, $B_{threshold}$, current biomass and current F. A partial re-run of the replacement yield model was conducted by the analyst based on some of the recommendations made by the Panel to provide a tentative place-holder for BRP estimates. The current parameterization of the re-run included a new intrinsic growth rate value, twice the $F_{0.1}$ as a proxy for $F_{MSY}$ (r = 0.08) which yielded a $B_{MSY}$ = 70,000 t, an $F_{MSY}$ = 0.04 and MSY = 2800 t. The analyst noted that further analyses that will include a change in M for the YPR analyses and the incorporation of a parabolic function for the Pre-1893 landings will have implications on these BRP estimates and therefore subjected to revisions before the August meeting.

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